



Original research article

The rejection of innovations? Rethinking technology diffusion and the non-use of smart energy services in Finland



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ARTICLE INFO

Keywords:

Smart energy services
Technology diffusion
Non-use

ABSTRACT

Energy markets are in a state of considerable transformation. As a result of new smart energy technologies, novel services can now be offered to customers. The adoption of innovations is often conceptualized in terms of technology diffusion, the success or failure of the new technology depending on how it is able to move across a market. It is taken as given that novel technologies diffuse from innovators to the mass market – a transfer in which non-use is thought to disappear over time. The article challenges the received approach to non-use, building on a typology by Satchell and Dourish, who suggest that non-use is more than lagging adoption: it can also manifest as active resistance, disenchantment, disenfranchisement, disinterest and displacement. The article draws on a survey carried out in Finland in 2013. We proceed from examining the non-adoption of smart energy services to analysing the attitudes linked to the many types of non-use. Thereafter, we will consider forms of non-use that are closely linked to assets and housing. We find that in the case of smart energy services the most important dimensions of non-use are disinterest and disenchantment, alongside lagging adoption. Moreover, disenfranchisement also has a role in explaining non-use.

1. Introduction

The European energy system is facing several simultaneous challenges: the need to reduce carbon dioxide emissions, increase the share of renewables and reduce total energy demand. One of the responses of information and communication technologies (ICTs) to these challenges and opportunities is the development of the smart grid [1–3]. Another response is a change in the role of energy companies, reflected, for example, in energy service obligations and the Energy Efficiency Directive [4]. The need to reduce energy demand and challenge for energy companies to reformulate new products and services are often seen as intertwined [5]. Also the emergence of active energy consumers is presented as an evolutionary process in which the improved information provided by, for example, informative energy bills and smart meters supports the change [6].

Current research on the diffusion of innovations and consumer interest in novel technologies is generally more concerned with the use of these technologies [7,8] than with their non-use. Based on Rogers' canonical diffusion of innovations framework [9], efforts to promote smart energy services are thought to require enhanced consumer segmentation [3], as the evolutionary process begins with *early adopters* [9,10], who are a critical first market for the development and diffusion of new services. There is an emerging body of literature on the

motivations and experiences of pioneering consumers, which offers valuable insights into the development of smart energy services [11–17]. However, focusing solely on the adoption of innovations and early use can lead to a partial understanding of how innovation diffuses through markets [18]. Studying non-use can provide insight into future market evolutions and the proportion of consumers who could become active players in the energy market if their initial motivation for non-use were better understood.

During the present upheaval in the energy markets, consumers are expected to play an active role in adopting novel smart energy services, with sophisticated equipment and services reducing energy demand, shifting consumption away from peak periods and producing and potentially storing electricity at or near home [19]. Nevertheless, recent research has challenged optimistic expectations that consumers will embrace smart energy technologies [20], suggesting there is a pressing need to better understand non-adopters and non-users. Indeed, understanding why certain people choose not to use smart energy services can provide important information for service providers and policy makers.

Alongside the smart energy hype, there is growing unease about consumer reactions to the smart grid rollout and the changing energy market [3], highlighting concerns about privacy [21], as well as issues of control, security and cost [22]. Innovation diffusion in the energy

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market has been the focus of a wide range of studies, including analyses of high-profile controversies [23,24], desk-based, expert-based and stakeholder studies of consumer concerns [21,22] and qualitative research addressing the potential effects of smart meters [25,26]. Nonetheless, relatively little is known about consumers who are reluctant to adopt smart energy services: are they merely sceptical, uninterested or uneducated? Conversely, are they actively opposed to some aspects of smart services, such as technology, energy companies or external intrusion into their households?

In this article, we study the non-adoption of smart energy services by focusing on the group of *non-users*, a consumer segment reluctant to adopt new technology. In Rogers' innovation diffusion theory [9], late adopters are termed laggards, whereas non-users are excluded from the theory altogether. Our starting point is that non-use is not merely delayed uptake or the passive absence of use; instead, it is a choice with many dimensions and motivations. In the analysis, we apply a conceptual framework of the reasons and motivations of non-use [27–30] to empirical data on the adoption of smart energy services.

The objective of this paper is to examine the non-use of smart energy services and its relationship to consumer attitudes, social background and housing conditions. The article builds on [Energy Efficiency in Finland] survey data collected in 2013 on the attitudes of Finnish consumers to energy and technology and ultimately their interest in smart energy services. Finland makes an interesting country case, as it is one of the leading countries in renewable energy and energy efficiency with aggressive climate and energy policies [31]. The smart meter roll-out in Finland has been the most advanced in Europe, with 100% of households with smart meters installed by 2015, which has enabled the offering of smart energy services in the market early as compared to most European countries. Therefore, four years after the data collection, the data still offers an interesting viewpoint to the manifestation of non-use in early stages of the smart energy service market. Besides, Finland represents a country where cold climate and high heating needs lead to high energy consumption and dependency. This implies an interest towards novel services enabling energy efficiency as well as home electricity generation. Moreover, there is a general interest among the population towards novel technology such as ICT solutions [see Ref. [32]], but at the time of the survey new energy services had not yet managed to intrigue many users.

This article addresses two questions. First, what non-use is in the area of smart energy services. Here, we examine consumer attitudes and apply Satchell and Dourish's non-use typology [27]. Second, we ask which background features (sociodemographic background, assets and housing) relate to non-use. Based on our findings, we contemplate how the markets should regard non-use and what the results might mean for smart energy service policies and for the restructuring, facilitated by the rollout of smart metering, of the electricity market.

2. Non-use and the adoption of smart energy services

According to Everett M. Rogers [9], the success or failure of new technology depends on its ability to move across a market characterized by qualitatively different customer segments. *Diffusion* is thus defined as the spread of innovation through a market and *innovation diffusion* as the process of market penetration by new products and services, which is driven, with or without consumers' explicit knowledge, by social influences [33]. Customer segments differ in terms of their relationship with technology, their need for recommendations and their use of communication channels, which are all factors that cause these segments to respond to marketing in a specific way. Research has uncovered individual differences in inherent inclinations to resist new ideas as well as products [34], which may manifest as late- or non-adoption of innovations [30]. Looking at laggards, the last adoption segment in Rogers' theory [9], as the sole group where non-adoption is embodied ignores the fact that non-use can be something other than delayed consumption: it can be a deliberate choice, and it can be caused

Table 1
Forms of non-use.

Form of non-use	Definition
Lagging adoption	Temporary non-use that will disappear over time.
Active resistance	A steadfast refusal to adopt technology because of concerns over privacy, lack of time, preference for other forms of technology or varied moral considerations.
Disenchantment	Non-use explained by reluctant or partial use of technology often explained by nostalgic reasons.
Disenfranchisement	Non-use explained by lack of physical or cognitive availability.
Displacement	Non-use explained by having someone else in the household or nearby adopt the innovation.
Disinterest	Non-use explained by lack of interest in or ignorance of new technology.

by exterior factors (see, for example, Wyatt et al.'s critique of the concept of laggardness in the digital divide debate [35]).

The non-use typologies employed in previous non-use studies offer an apt solution for conceptualizing non-use in the case of energy markets. These studies suggest that non-use can be motivated by myriad factors, some of them associated with resources, some with attitudes and some with a consumer's level of knowledge.

In their account of the forms of non-use, Satchell and Dourish [27] suggest that non-use can manifest in six forms (Table 1).

The first form, lagging adoption is simply defined as a temporary condition where some consumers have yet to adopt a particular innovation. Consequently, it is difficult to study the segment with cross-sectional data, and it remains largely undefined in research. The second form of non-use is active resistance, a considered and steadfast refusal to adopt a technology [see also Refs. [30,32]]. Potential reasons for active resistance can be seen in concerns over privacy, lack of time and preference for alternative modalities of engagement, or in a plethora of other potential factors, ranging from ideas of corporate responsibility to educational, environmental and health considerations. The third form of non-use, disenchantment, stands for reluctant or partial use of technology, which is often intertwined with nostalgic wistfulness. The fourth form is disenfranchisement, which is linked to the physical and cognitive availability of new products. The fifth form of non-use is displacement, which suggests that the adoption of services can be done by someone else. The sixth form of non-use is simply called disinterest – an apathetic attitude towards embracing new technologies. The consumer data used in the present study allow for the examination, at least to some extent, of all the six types of non-use.

The most challenging task in studying non-use is the investigation of active resistance, a particular effort to resist new technology [27]. Here, we understand active resistance as opposing certain concrete consumer choices. In the survey, questions on the adoption of smart energy services included the answer option "I do not want this service under any circumstances". In addition, however, active resistance can be seen in a number of attitudinal questions. Concern over autonomy is an integral part of the technology experience [36]; resistance can spring from a fear that dependence on technology might leave consumers with less choice and freedom (e.g. [37,38]). In Satchell and Dourish's non-use typology [27], the writers posit that the reasons for active resistance of HCI (Human-Computer Interaction) lie in concerns over privacy and consumer autonomy and also in educational, environmental and health considerations. In the case of smart energy services, consumers often express concerns about losing control over their electricity usage and violation of their privacy through audits and surveillance [39]. New innovations can also raise concerns about their environmental effects. This type of resistance also manifests as lack of trust in the chain of actors providing the innovation [37], which, in the case of the smart grid and smart meters, is well-documented. Consumers tend to be sceptical of energy companies' willingness to actually reduce their customers' energy consumption (see Ref. [40]). Several authors suggest

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