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Social acceptance of renewable energy technologies for buildings in the Helsinki Metropolitan Area of Finland

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ABSTRACT

The application of renewable energy technologies (RETs) in the residential building sector requires acceptance of technical solutions by key stakeholders, such as building owners, real-estate developers, and energy providers. The objective of this study is to identify the current status of public perceptions of RETs that are available in the Finnish market and associated influencing factors, such as perceived reliability, investment cost, payback time, and national incentives. A web-based questionnaire was disseminated to the general public in the Helsinki Metropolitan Area ($n = 246$). Social perceptions of building-integrated RETs were evaluated through integration of survey data and Stochastic Multicriteria Acceptability Analysis (SMAA), which was applied to analyse the robustness of the survey results. The SMAA demonstrated that Finnish residents exhibit broad acceptance of multiple options, rather than preference for a single RET. Solar technologies and ground source heat pumps were the most preferred options and evaluated as very reliable, whereas wind-based technologies and combined heat and power were ranked as the least popular. In general, respondents indicated a strong willingness to financially invest in RETs as a means to reduce their carbon footprint and preferred tax deductions as an incentive to invest in RETs.

1. Introduction

Finland provides 36.8% of total energy demand through renewable energy sources (Fig. 1), ranking near the top among European Union (EU) Member States. In accordance with the EU 2020 target, Finland aims to raise the share of renewable energy to 38% by 2020 [1,2].

Improving the energy performance of both existing and future building stock has become essential to achieve EU climate and energy objectives. These targets are focused on public transport and building sectors, where the potential for energy savings is the greatest [3,4]. The EU has also set an ambitious target to increase the number of 'nearly Zero Energy Buildings' (nZEBs). Acknowledging the variations in building culture and climate throughout Europe, the European Building Legislation (EPBD) does not prescribe a uniform approach to nZEBs [5]. The current 'National Plan of Finland' [6] also intends to increase the number of nZEBs, but does not give detailed specifications. Nonetheless, definitions of nearly zero energy construction and associated specifications are underway.

Since 1983, the Ministry of the Environment in Finland (in Finnish: Ympäristöministeriö) has been responsible for leading national efforts on energy efficiency of buildings [7]. Directive 2002/91/EC of the European Parliament and of the Council on the Energy Performance of Buildings was issued on 16 December 2002, from which amendments were applied to both existing and new buildings [8]. During the past decade, numerous incremental improvements have been made in the National Building Code of Finland to set minimum levels of energy efficiency for new buildings [9].

The Helsinki City Council approved a new energy policy

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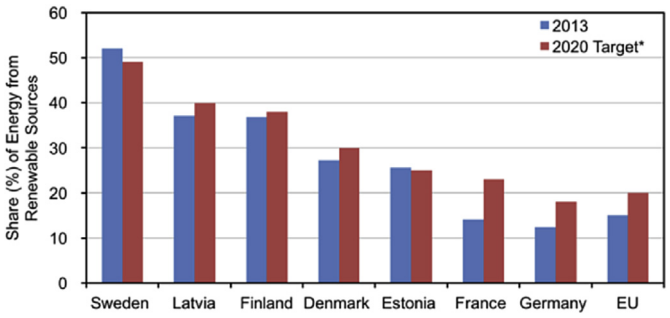

Fig. 1. Share of renewable energy in the final consumption of energy in selected EU Member States as a percentage [1].

guideline in 2008 which specifies increasing the share of renewable energy from 4% to 20% by 2020 [10]. This commitment by the City Council is intended to cover all energy use in areas which fall under its jurisdiction (e.g. building sector). An important part of this commitment is to activate citizens to get involved in reducing their GHG emissions and developing measures for reduction [11].

Building owners and users represent the most critical stakeholders in determining the share of energy efficiency and renewable energy technology (RET) potential for buildings as renovations are made at their cost [12]. There are several barriers which may prevent an individual from seeking an environmentally friendly home, including: cost effectiveness of the investment, lack of attractive products and services, limited knowledge, priority for comfort, and other non-energy aspects [13–15]. A study on the acceptability of nZEB renovation strategies in Norway [13] found that social and economic factors, such as initial cost, payback time, and return on investment, could significantly affect the selection of the renovation option by the home owner.

There are only a few scientific studies presenting the key factors which influence societal acceptance of renewable energy-based heating and cooling technologies in the Nordic region. The objective of this study is to identify the current status of public perceptions of RETs currently available in the Finnish market and associated influencing factors, such as perceived reliability of RETs, investment cost, payback time, national incentives, and housing type. The RETs referred to in this study can be defined as a mechanism to generate renewable energy to either support net energy need in a building or to produce surplus energy to be stored or exported to the grid. A web based questionnaire was disseminated and received 248 respondents with a 21% response rate. Selected results of the survey study were analysed with Stochastic Multicriteria Acceptability Analysis (SMAA) to identify preference rankings of different RETs in the Helsinki Metropolitan Area (henceforth referred to as Helsinki) and to identify the associated uncertainty of the rankings. The results will support policy makers, technology providers, stakeholders in the energy and building sector, and building engineers to enable development and adoption of RETs for residential buildings, including nZEBs, in urban centres of Finland.

1.1. Attitudes and perceptions towards renewable energy in Finland

The attitudes of the Finnish public towards different energy sources were investigated in an EU study (as presented in Fig. 2). In general, the public is in support of renewable energy sources [16]. Additionally, the Finnish Energy Industries have conducted annual surveys on the energy attitudes of the Finnish public since 1983 [17]. In 2006, 86% of the respondents agreed and 4% disagreed with the statement that climate change is a real and extremely serious threat that requires immediate actions. By 2014, only 75% agreed, which could mean that people are becoming immune to hearing about climate change. However, the climate change hypothesis is largely accepted by the residents of Finland.

A recent study found that residents in countries that express more environmental concerns related to energy use (e.g. Denmark, Finland, and Sweden) are also less optimistic about advancements in technology solving environmental problems in the future [12]. Another survey indicated that residents of Finland expect the public sector to be the forerunner for renewable energy production [18]. At the same time, one of the conclusions of a survey study conducted in 2007 was that Finnish residents believe their own individual consumer choices can be extremely significant in making a difference in the energy sector [19]. Our study focuses on specific RETs which have an established market in Finland and can be implemented in a nZEB or an environmentally-friendly home.

1.2. Incentives to promote RETs and energy efficiency in Finland

Often in environmental law, incentives are divided into tax-based, economic, volunteer-based, or eco-labeling. Finland has primarily used tax incentives to promote wind energy and other renewable electricity until 2010. Finland had no obligations or binding recommendations for power companies to promote energy production from renewable energy sources [20]. Economic incentives were lacking to encourage wood pellet use for thermal energy production. Recently, Finland's energy taxation and subsidies have been developed to promote GHG reduction, energy efficiency, and the use of renewable energy. In order to promote electricity generation based on renewable sources, Finland introduced a feed-in tariff system operating on market terms partially replacing the tax subsidies and some of the investment subsidies for electricity generation. In 2010, the feed-in tariff system entered into force offering electricity users to pay the difference between the market price and the feed-in tariff if the market price is below the agreed feed-in tariff [21]. The feed-in tariff system developed mainly to promote electricity production from wind power and biogas, however, it also involved other renewable sources.

Beside the above incentives, building regulations were developed in 2010, requiring additional energy efficiency measures, such as additional insulation and tighter building envelope, to be applied in new construction. Recently, regulations and guidelines codes for Indoor Climate and Ventilation of Buildings (Building Code D2), Energy Management in Buildings (Building Code D3), and Calculation of Power and Energy Needs for Heating of Buildings (Building Code D5) were revised and reformed and have been under force from July 2012.

For buildings requiring renovation, energy subsidies for the improvement of energy efficiency and changes in heating systems were granted for residential buildings, mainly for apartment blocks and terraced houses. Refurbishments of energy systems in detached houses became eligible for improved domestic help credits. Moreover, grants for energy improvements in detached houses were used as a supplementary aid for low-income households.

In Finland (2006), renovation investment was estimated to be roughly half of the total construction investment. Residential buildings account for half of the renovation activities and their share is expected to increase as the stock built in 1960–1970 will soon come to an age requiring renovation. The renovation investments for 2006–2015 are estimated to be around €1800 million per year. Due to subsidies and ownership structures, renovation activities in the rental sector are likely to be higher than in the owner-occupied sector [22].