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The citizens' role in energy smart city development

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Abstract

The purpose of the paper was to investigate citizens' experiences and feedback related to strategies and products targeting energy savings and emission reduction in Sweden. Survey results presented in this paper showed that consumers did not make use of the advantages of the smart meters and that tailored feedback is necessary to help them save electricity. Moreover, despite the high satisfaction levels among electric vehicles owners, additional improvements (e.g. reliable charging infrastructure) and information are needed to attract potential owners. Effective information dissemination is thus a crucial part of increasing urban sustainability.

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1. Introduction

With a continuously increasing world population and with cities responsible for approximately two thirds of the global primary energy consumption with 86% of the energy demand being supplied by fossil fuels [1], most efforts are currently focusing on increasing urban sustainability and efficiency. Smart city initiatives around the world are aiming at fulfilling the citizens' needs and demands while reducing the impact on the environment. The energy used by the residential sector, especially in the developed countries, is becoming one of the most significant contributors to the countries' energy balances with forecasts showing that over 40% of the total yearly consumption will come from this sector [2]. Moreover,

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it is estimated that approximately 77% of the global transport oil demand in 2010 was on account of road transport, and it is expected that by 2050 the global energy demand will double or triple and oil and gas supplies are unlikely to meet the demand, making the transport sector an important issue to address [3,4].

The European Union (EU) has been strongly involved in providing support for the Member countries helping them increase their energy efficiency and reduce emissions. On the end-user side for instance, from 2015 new energy efficiency measures have been set to help consumers save up to 45€/year: energy labels for cooking appliances, automatic standby for coffee machines and network equipment, and energy labels for online sales [5]. Significant efforts have been put towards increasing the use of electric vehicles (EVs), due to their “tank-to-wheels” efficiency being a factor of about 3 higher than internal combustion engine vehicles, and also for being a more sustainable solution ensuring the security of energy supply and a broader use of emission-free energy source, thus helping the EU reach its CO₂ emission targets [6]. The EU provides additionally funding to carry out research, and for adoption of different practices and technologies in the related energy topics. As an example, the “Planning for Energy Efficient Cities” (PLEEC) project, where Sweden together with 17 partners from 13 cities combine their expertise to help 6 small-medium sized cities create and implement energy efficient action plans (including urban planning, citizens’ behavior, and technology adoption), part of the results being presented in this paper. Within the EU, Sweden was in 2014 the country with the highest number of “Smart Cities”, as indicated in the “Mapping Smart Cities in the EU” report [7], making the country of special interest for the analysis. This paper aims at answering the research question related to the smart meters benefits for the end-users and the experience of current EV owners – results that can be used for further improving the way new technologies and solutions are implemented by the cities. The paper presents survey results from the implementation of solutions and initiatives in Sweden targeting domestic energy consumption reduction, consumers’ behavior and experience from private electric vehicle use.

2. Materials and methods

The results presented in this paper are based on strategies and initiatives carried out in Sweden related (but not limited) to the PLEEC project targeting energy savings and use of electric vehicles. A questionnaire and a web-based survey were used to collect information about the consumers experience, characteristics and preferences regarding use of electric vehicles and use of smart electricity meters. The obtained response rates were 64% for the EV survey and 56% for the smart meters users.

The online survey was distributed to customers of Mälarenergi, a city-owned power and district heating provider, located in the city of Västerås, Sweden. The link with the online survey was provided on the company’s website as well as with the free magazine sent out to all their customers.

The questionnaire, on the other hand, was sent out to all EV private owners in Sweden; the addresses being provided by the Swedish Transport Administration.

3. Results and discussion

3.1. Household electricity consumption

Sweden counts with the second lowest carbon-intense economy among OECD countries despite a relatively high per-capita energy use [8]. According the Swedish 2020 climate goals, the country has to reach an overall reduction in greenhouse gas emissions by 40%, increase energy efficiency by 20% and reach 50% share of renewable energy in the final energy use [9]. Sweden became in 2009 the pioneer in

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