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Marketing and communications channels for diffusion of electricity smart meters in Portugal

Yash Chawla[a], Anna Kowalska-Pyzalska[a,*], Paulo Duarte Silveira[b]

[a] Wroclaw University of Science and Technology, Department of Operations Research and Business Intelligence, Wroclaw, Poland
[b] Instituo Politcnico de Setbal, College of Business and Administration, Department of Marketing and Logistics, Setbal, Portugal

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ABSTRACT

National roll-outs of electricity smart meters (ESM) have been undertaken in most of the European countries. The exchange of traditional meters into smart ones is a part of power system transmission into so called smart grids. In these smart grids, the communication and sharing of information happens in real-time and all market players, such as energy suppliers, sellers and consumers, play an important role. As the literature reveals, the successful deployment of ESM requires consumers' awareness and engagement. That is why, within this paper, we investigate the impact of consumers' knowledge on what ESM is, as well as the role of marketing platforms: both traditional (i.e. TV or radio) and modern ones (i.e. social media) in ESM diffusion. Based on the on-line survey conducted in Portugal (N = 518), we provide some policy and practical recommendations for energy companies and local authorities regarding the effective usage of marketing platforms and content.

1. Introduction

The recent industrial revolution, Industry 4.0, has led to the introduction of smart technologies in various fields of our lives. It is also present in the energy sector, where, for several years, practitioners and researchers have been investigating various intelligent technologies in the generation, distribution and consumption of energy. They aim to combine modern advanced communication and information technologies to enhance and optimize the interaction between all players of the electricity market: producers, suppliers, sellers, and consumers. In coming times, electricity will become a technology that is visible and would require attention and decision-making from the consumers (Kowalski and Matusiak, 2019). This new approach, called smart grid (SG), includes the broad implementation of electricity smart meters (ESM), which are electronic devices that enable automatic collection of consumers' energy consumption data and share this information with the electricity supplier for monitoring and billing purposes, as well as with the consumers themselves. This demand side response management can help in energy saving (Soroczyński and Szkutnik, 2015).

The broad implementation of ESM in Europe is induced among others by the EU directives concerning common rules for the internal market for electricity and gas (2009/72/EC and 2009/73/EC) and the EU directive on energy efficiency (2012/27/EC). These regulations require EU Member States to ensure the implementation of ESM in order to enable active participation of consumers in the energy market. According to Biresselioglu et al. (2018, 2017), ESM would allow consumers to take advantage of the benefits of the progressive digitalisation of the energy market via several different functionalities. For example, consumers would be able to access dynamic electricity tariffs, such as real-time tariffs, which belong to one of the most important demand side

* Corresponding author.
E-mail addresses: yash.chawla@pwr.edu.pl (Y. Chawla), anna.kowalska-pyzalska@pwr.edu.pl (A. Kowalska-Pyzalska), paulo.silveira@esce.ips.pt (P.D. Silveira).

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management/ demand response tools (DSM/DR).

The regulatory decision regarding ESM implementation is done on a national level based on the assessment of long-term costs and benefits. If the assessment is positive, then at least 80% of households should be equipped with smart metering systems by 2020 (Crispim et al., 2014). It is predicted that smart metering and smart grid roll-outs can reduce emissions in the EU and annual household energy consumption by even 9%.[1] Although an ESM roll-out has indisputable advantages, its implementation is in different stages, depending on the location (Zhou and Brown, 2017; Avancini et al., 2019). Whereas, in many of the European countries, such as Denmark, Sweden, Finland, Estonia or Spain, the ESM roll-out is already finalized, and in countries such as Norway, Italy or UK, it is at an advanced stage (Sovacool et al., 2017; Zhou and Brown, 2017), other countries, such as Germany, the Czech Republic, Greece and Ireland, represent a lower commitment level towards ESM deployment (European Commission DG Energy, 2018). In those countries, the governments have usually not formally decided to have a national ESM roll-out, mainly because of negative results of cost-benefit analysis (CBA). According to the Agency for the Cooperation of Energy Regulators (ACER), in late 2018, only 37% of EU consumers were equipped with ESM, which is a very weak result.

Portugal belongs to the group of countries, where a nationwide roll-out of ESM has been recently approved by the government, but the Portuguese government has not decided to take any formal commitment for the target to reach in terms of smart metering deployment (European Commission DG Energy, 2018). Currently, only one third of Portuguese citizens are equipped with ESM. At the same time, there are many pilot projects underway across the country. The implementation of those projects, together with the recent energy market liberalization, has increased the awareness level of the consumers and their attention to energy savings (Ghazvini et al., 2019). Joao Torres – the CEO of EDP Distribution, the main distribution system operator in Portugal, clearly stated in January 2019 that: "*(electricity)* smart metering is really important because it is the first step to get consumer engagement".[2] Taking all of that into consideration, it can be projected that the Portuguese power system is going to experience great changes in the coming years because of its further digitalisation. It may also have a significant influence on the consumers' electricity consumption unless they stay uninterested and disengaged.

The current digitalisation of the Portuguese power system was one of the reasons that prompted us to carry out this study in Portugal. Moreover, there is a gap observed in the literature about marketing tools used for the diffusion of information and awareness regarding ESM, especially among social media users. As already revealed in similar studies conducted in Poland (Chawla and Kowalska-Pyzalska, 2019), in India (Chawla et al., 2020), or in Indonesia (Chawla et al., 2019), social media are often neither used to promote energy efficiency among consumers nor are used to explain the benefits of the smart grid approach to the power system. Secondly, there is a lack of effective communication between electricity distribution companies and their customers in terms of sharing the information about the advantages and opportunities connected with ESM roll-outs.

In order to enhance the ESM deployment, some regulatory support is needed. But this is not enough. The society will benefit from this enrollment, only if consumers learn how to use the information provided by ESM. In particular, how to monitor energy consumption based on the information provided by the enabling technology, such as smart metering information systems (platforms) or in–home displays (Kowalska-Pyzalska and Byrka, 2019; Foulds et al., 2017; Ma et al., 2018; Schleich et al., 2017). The first step in this process is connected with the increase of consumers' awareness and engagement regarding energy efficiency issues (Verbong et al., 2013; Ellabban and Abu-Rub, 2016; Burchell et al., 2016; Akroush et al., 2019; Gans et al., 2013). Within our survey we want to explore how to reach the residential consumers, represented by the social media users, to raise consumers' awareness of ESM. We focus on social media users, who, according to the literature (Droge et al., 2010; Kumar Verma et al., 2017; Barrios-O'Neill and Schuitema, 2016; Bentoa et al., 2018) are a social group, which is perceived to be more open-minded towards innovations and IT-based solutions than the rest of the society. Further, we believe that reasonable usage of traditional and modern communication channels and marketing platforms could be very useful in ESM promotion and diffusion in the energy market. Hence, the aim of this paper is threefold. First, we want to investigate the attitudes, preferences and fears among social media users towards ESM. Second, we want to verify which socio-economic and attitudinal variables influence the knowledge about ESM. Third, we want to explore the communication channels, marketing platforms and content that could be used by the energy companies and the government to enhance the outcomes of ESM roll-outs. The survey is based on the example of Portugal – the country where the ESM is not finalized yet and still needs initiative to ensure the effective transition of the power system into the smart grid.

This paper contributes, not only to the scientific literature through the findings and analysis of this study, but it also offers practical recommendations regarding marketing platforms and content, which can be useful for energy companies and local authorities for the facilitation of ESM diffusion in Portugal and in the other countries.

The structure of the article is as follows. In Section 2, the ESM deployment, in terms of political will and consumers' engagement, with respect to the Portuguese energy market, is elaborated. Next, in Section 3 we discuss the marketing trends in the context of the energy market in general and ESM diffusion in particular. In Section 4, the results of the study are presented and discussed. This Section contains the methods of data collection, framework of the survey, and the analysis of the data. Finally, in Section 5 we provide a broad discussion and elaborate on the marketing platforms and their content dividing them into traditional platforms and those based on social media. The conclusions of this study are followed by the limitations and the future scope.

[1] https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters/overview (accessed September, 6th 2019).

[2] for more details seehttps://www.euractiv.com/section/energy/news/smart-meter-woes-hold-back-digitalisation-of-eu-power-sector (accessed September, 10th 2019).

2. ESM deployment in Europe: literature review

Smart and green technologies are becoming increasingly popular all over the world. There are many reasons that induce the broader and faster diffusion of those goods in the energy markets. Let us just mention the urgent need of societal and energy transitions of the power systems from the traditional ones – based on fossil fuels with passive consumers into the smart grids, where modern information and communication technologies play a great role in sharing the information in real-time between all market players: energy producers, sellers, distributors and end-users, that is, consumers. Nowadays, consumers are encouraged to play an active role in the energy market. Within the smart or micro grid approach, consumers may become producers of electricity and heat, by installing their own energy generators in their households. The introduction of electrical smart meters, combined with other enabling technologies, such as DSM/DR tools or smart metering information platforms (SMP), give consumers the access and better control over their energy consumption (Kowalska-Pyzalska, 2019; Chawla and Kowalska-Pyzalska, 2019; Biresselioglu et al., 2018; Bellido et al., 2018).

Without any doubt, many of the EU countries are world leaders in the diffusion of those innovative, smart and green technologies in the energy markets. There are many initiatives, such as the European Electricity Grid Initiative (EEGI) and European Strategic Energy Technology Plan (SETplan), that encourage the sustainable transition of the power systems in terms of its economic, ecological, technical, and social aspects in the coming decades (Biresselioglu et al., 2018).

The literature broadly emphasizes that implementation of the smart grid approach is, not only a matter of modernization and digitalization of the electricity grid, but firstly it requires some new business models and practices and some appropriate legal regulations that would enable and motivate some behavioral change on the consumers end and, hence, would lead to social acceptance of this revolution (Chawla and Kowalska-Pyzalska, 2019; Kowalska-Pyzalska, 2018; Biresselioglu et al., 2018).

Currently, one of the main reasons for the slow ESM diffusion is the consumers' reluctance and lack of engagement, but also the lack of legal regulations and arrangements provided by the national authorities. As emphasized by the CEO of the Portuguese EDP – Joao Torres, although *reminding that consumer empowerment and dynamic pricing of electricity were among the key objectives of EU clean energy laws adopted in 2018, the speed of ESM deployment is too slow*. ESM and dynamic electricity tariffs are very important for households as they enable consumers to take active control over their electricity consumption. The advantages of smart metering for the future use of DSM/DR tools, such as for example dynamic tariffs are emphasized in the literature, see for example (Doostizadeh and Ghasemi, 2012; Aghaei and Alizadeh, 2013). Although there are countries in the EU that have already finalized their ESM roll-out[3], in many of the EU countries, the billing is still done on quarterly or even yearly forecasts rather than on the basis of real electricity consumption. Installation of ESM would allow consumers better control over their electricity bills and could encourage them to monitor and save on energy consumption (Kowalska-Pyzalska and Byrka, 2019). According to ACER, many of the consumers are still very sceptical and reluctant to adopting ESM. For example, in some of the French cities, the residents may legally refuse entry to the installations teams of the local distribution system operator. There are still EU countries, including Germany, Croatia, Cyprus, the Czech Republic, Greece and Ireland, where the national governments are sceptical about ESM deployment.

The European Commission does not encourage the reluctant countries to change their minds and decide for ESM enrollment by means of some additional measures or regulations, even if their decline will not allow to achieve some ambitious goals regarding increases in energy efficiency. At the same time, the European electricity industry is in favor of further digitalisation as they observe great benefits due to smart metering. According to Eurelectric, by 2030, more than half of all electricity in Europe is expected to come from renewable energy, including solar PV systems installed on people's rooftops. More than 40 million electric cars are also expected to appear on the European roads by that date, according to EU estimates. Meanwhile, the number of electric heat pumps, batteries and other grid-connected smart devices are expected to rise steeply. It is predicted that all this equipment will require smart meters to function properly.[4] It must be, however, underlined that the digitalisation and rapid increase of grid-connected smart devices is not enough to provide sustainable development of the power system. Without regulatory support, ensuring interoperability of ESM systems and their concentration on the end-users of electricity and connectivity with other consumer energy management systems, the diffusion of ESM will not be effective and successful (Bellido et al., 2018; Biresselioglu et al., 2018; Zhou and Brown, 2017; Avancini et al., 2019; Nizetic et al., 2019; Park et al., 2018).

2.1. ESM in Portuguese energy market

The Portuguese energy market has been recently liberalized and, since 2017, residential consumers may choose the energy company from which they buy electricity (Ghazvini et al., 2019; Miguel et al., 2018). Currently there are two main national legislation regulating electricity and gas smart metering deployment in Portugal: 'Decreto-Lei n° 215-A/2012' (October 8) and 'Decreto-Lei n° 231/2012' (October 26), and 'Portaria n° 231/2013' (July 22). A few years ago Portugal belonged to the EU countries which have not decided in favour of a large-scale ESM roll-out and 80% target penetration rate by 2020, as recommended by the European Commission (Lopes et al., 2016). One of the main reasons why Portugal did not want to join the European smart meters deployment,

[3] Sweden is the uncontested EU leader in smart metering penetration (100%), followed by Finland (99%), Estonia (98.2%), Spain (91.7%) and Denmark (80%).

[4] https://www.euractiv.com/section/energy/news/smart-meter-woes-hold-back-digitalisation-of-eu-power-sector (accessed, September, 10th 2019).

was the fact that the initial cost-benefit analysis (CBA) in 2013 has resulted as non-conclusive[5]. A few years later, in 2018, the CBA results changed into positive giving a green light for ESM deployment (European Commission DG Energy, 2018). In particular the estimated normalised costs per a smart metering point were equal to 333.30 Euro/meter in 2018 (versus 99 Euro/meter in 2013) and normalised benefits 466.70 Euro/meter (versus 202 Euro/meter in 2013).

Currently Portugal, together with Latvia and Slovenia belong to the group of countries that have not decided for taking any formal commitment for the target to reach in terms of smart metering deployment. As the final report about Smart Metering Deployment among EU-28 Member States summarizes (European Commission DG Energy, 2018), in case of Portugal, *a simultaneous decrease in costs and increase in benefits has triggered a wave of new commitment for smart metering, even though the full roll out will require more than the business as usual to be completed within the next 10 years.* The approximate ESM penetration in Portugal has already reached around 25%, in comparison to 10% in 2017 (European Commission DG Energy, 2018). If such a fast rate of change continues, Portugal will be able to achieve even 80% rate of ESM penetration in 2022–2023 (European Commission DG Energy, 2018).

Portugal can show off with its several pilot programs that have already been carried out in various Portuguese regions and cities. One of the most well-known large-scale smart grids projects is called InovGrid. It has been run by EDP – Portuguese transmission and distribution system operator. This is a very broad project which includes several issues, such as: support of dispersed generation, on-demand management, customer self-service, renewable energy sources, electric vehicles, cyber security, data privacy and others. Additionally, as a part of the project, in a small Portuguese city Évora in 2009, approximately 35,000 ESM were installed. Since then, this number was expected to climb to six million by the end of 2019[6]. Today, InovGrid is delivering impressive results, including improved energy efficiency with significant consumption reductions, faster response times and improved service quality, increased knowledge of customer and grid behaviors, and easier integration of renewable energy sources and other emerging technologies. Its scale and success led to its selection by the European Union Commission and Eurelectric as a leading smart grids reference project in Europe.

Energy box is an example of another, recently conducted, project developing a demand responsive energy management system to be used to control, manage and optimize smart grid technologies and home electricity use[7]. Both innovative projects share the knowledge about smart grids and smart metering among consumers.

3. Marketing in the context of energy market

Marketing any product or service presents a number of challenges, especially in the current era, where going digital is the new normal. More and more businesses prefer digital marketing, especially social media, in place of traditional marketing, such as direct sales, TV, radio, mail, print advertisements in newspapers or magazines, and printed materials like billboards, posters, catalogs or brochures (Das and Lall, 2016). Globally digital media has emerged as a cost effective medium which caters to the marketing and strategy of firms, especially in terms of engaging customers, building and managing customer relations and communication in a wide variety of fields (Filo et al., 2015; Saxena and Khanna, 2013). It provides a two-way or multi-way communication channel, as compared to only one way communication through the traditional marketing channels (Hanna et al., 2011; Abidin et al., 2010), which enables businesses to listen to consumers. Digital media also plays a very important role for increasing customer awareness and knowledge. They are used to share customer experience, to get to know their preferences and to accept certain products or services (Duffett, 2015). Understanding consumer expectations and preferences helps businesses to adopt appropriate strategies to enhance the diffusion of products or services in the market (Fiore et al., 2017). The majority of the studies in the literature state that digital media, especially social media, increases the impact and prevalence of word of mouth as compared to traditional mediums (Alalwan et al., 2017). This is due to the ease with which the consumers are able to share their own pleasant or unpleasant experiences, thoughts, as well as recommendations about brands, products or services to a large number of users on social media platforms (Leong et al., 2019; Hudson et al., 2016; Priyanka, 2013). This results in higher involvement of the customer in the market. Although digital media is highly effective, specialists suggest that businesses should not abandon traditional methods and to try to blend digital and traditional channels to reach their customers (Todor, 2016).

For energy markets, the importance of marketing and understanding the prospective consumer for diffusion of new technologies, as well as sustainable development, was highlighted by the researchers since the later part of the 20th century (Nakarado, 1996). This is even more important because of the changing dynamics of the electricity market (Parag and Sovacool, 2016) with the integration of Internet of Things (IoT). In energy markets, a social marketing mix of both traditional and digital media is prevalent (Sheau-Ting et al., 2013), with more focus on the traditional marketing tools. Although, in recent years, more energy companies have started increasing their presence on digital media, especially social media, in order to increase their reach to the consumers, but still it has not reached the critical masses. Barrios-O'Neill and Schuitema (2016) found that using strategic social marketing mix through diverse, networked platforms, which is meaningful in the contemporary social and technological context, is most likely to influence consumer behaviours. Engaging the customers also increases their awareness about new technologies, which has a significant effect on consumers' purchase intentions towards more energy efficient devices (Akroush et al., 2019; Heikkinen et al., 2012). This type of interaction and consumer engagement is likely to become an integral part of future energy delivery systems, due to which digital

[5] According to EUs' Joint Research Centre in 2017 in seven countries (Belgium, Czech Republic, Germany, Latvia, Lithuania, Portugal and Slovakia), the CBAs for large-scale roll-out by 2020 were negative or inconclusive.

[6] for more details seehttps://www.iea-isgan.org/cee-case09-portugal/ (accessed 7th July 2019)

[7] for more details seehttps://www.uc.pt/en/org/inescc/Projects/projects/Energy_Box (accessed 23rd August 2019)

marketing in the energy sector becomes an important area of investigation (Barrios-O'Neill and Schuitema, 2016).

There have been a few studies regarding marketing strategies and tools for the energy sector. Bogdal (2013) studied communication management in the public sector for energy markets, where he highlighted the need for updating strategies and tools used for diffusing information to the consumers. Streimikiene and Vveinhardt (2015) found that a community based marketing approach is effective for saving energy and one of the hurdles for energy saving includes a lack of information with the consumers. Hille et al. (2019) studied various programs aimed towards promoting electricity saving and proposed that the marketing and communication programs should be tailored for specific target groups. Gong et al. (2019) explored various marketing strategies adopted by the energy companies and concluded that there is a need for energy companies to put more effort in marketing as well as to broaden the communication channels. To cater to these challenges discovered by the researchers, the understanding of various consumer preferences and habits would prove to be beneficial in devising an effective marketing strategy and content.

3.1. Marketing tools used by Portuguese energy suppliers in ESM roll-out

The marketing tools used in the energy market can be discussed with the example of the ESM roll-out in Portugal. As already mentioned, the ESM roll-out has been conducted by the Portuguese main distribution system operator – EDP. The company had highlighted the importance of the role of customer engagement on energy efficiency and its impact on the value of a pilot project, Inovgrid, conducted in Evora, Portugal[8]. EDP has used a mix of initiatives for raising awareness about this project. First of all, they reached out to key stakeholders and groups of customers through activities like the Inovcity showroom, the Energy Bus, the organization of conferences and events, articles in the local press, several public sessions and so on. However, these initiatives had covered only a part of the population.

Before making the upgrade to ESM in each household, EDP notifies the customer through a letter. Fig. 1 shows the example of a letter sent by the energy supplier – EDP to the Portuguese customer.[9]

Although EDP gives detailed information on their website about smart meters and smart grids, the letter does not mention these terminologies. It consists of a simple notification of upgrading the electric meter to a more technologically advanced one. It lacks the primary information, such as the terminologies, and it does not explain the benefits and opportunities available via ESM. The letter does not answer any of the following questions: What is a difference between a smart and traditional electricity meter? How is the smart meter more technologically advanced? Is the implementation of ESM obligatory? Who pays for it? Is the cost of replacement borne by the company or is there government funding? What is the timeline for the change of the meters? Will the installation of ESM have any effect on the current billing methods? Will ESM have any effect one's privacy and safety of the personal data? Hence, only the consumers who made an effort to log on to EDP's website to get more information, would have acquainted themselves with ESM. For the rest, it would be business as usual. By means of this study, we want to highlight consumer preferences for receiving such information and also the preferred communication channels in Portugal, which would be a strong basis for the government or energy companies to prepare their marketing content, as well as to choose the proper communication channels.

4. Study, results and discussion

4.1. Data collection and the sample

An empirical quantitative study was conducted to gather primary data, via a self-administrated online questionnaire directed to a target population of individuals living in Portugal in May–June 2019 (regardless of their nationality), responsible or co-responsible for the household energy decisions. Two sampling techniques were used in sequenced phases. First, a convenience sample was selected and contacted. Respondents were recruited via social media general posts (via Facebook and Linkedin) and private messages (via Linkedin and WhatsApp), as well as direct email messages. During the second phase, snowball sampling was used, requiring the respondents of the first phase to forward the study invitation. The techniques used to recruit the respondents didn't allow us to control the type of people who responded to the questionnaire. We were able to verify that the respondents belonged to our target audience, social media users in Portugal above the age of 18, based on their responses to usage of social media channels and age variables. The user sessions on the web page that hosted the questionnaire was tracked by Google Analytics (GA), to know the response rate. This did not affect the anonymity of the respondents, as the IP addresses of the respondents were not available to the authors through GA. 932 user sessions were recorded during the period of dissemination of the questionnaire, resulting in 518 valid records being collected. The average time spent by users who submitted the completed questionnaire was 5 min and 37 s.

4.2. Framework of the survey

The questionnaire was divided into two parts: the first part being dedicated to all respondents and second directed only to those respondents who knew what electricity smart meter was ("Yes" to question K1). In the first part, all of the respondents were asked

[8] for details seehttps://www.iea-isgan.org/cee-case09-portugal/

[9] Originally, the letter was in the Portuguese language, which has been translated into English for representation, ensuring the contents and meaning remains the same. Apart from the website address, all the contact information has been made anonymous to conserve the privacy of the user.

Subject: Replacement of the electricity meter

Dear Customer,
EDP Distribuição will perform the replacement of your electricity meter.
In the context of its functions of managing the electricity distribution network, EDP Distribuição -being represented by an identified technician - will soon replace your meter with a new and technologically more evolved equipment.

This action covers customers of all electricity supplying companies and you will not incur in any costs.

For the visit of our technician to succeed, and for future contacts, it is important that the elements we have are up to date.
Tel. xxx
E-mail: xxx

Call us through the 808 100 100 (working days from 8h-22h-local call cost) and:
- update your contacts If any changes have occurred;
- clarify your doubts;
- schedule the technician visit to your installation, if the counter is not accessible.

Learn more at www.edpdistribuição.pt
With my compliments,
xxx

Fig. 1. The example of the content of the letter sent by the energy provider to the customer.

about their demographic attributes, such as gender, age and household's income (D1–D10). Then, they were asked about their belongings (B1–B6), social media platforms used by them on a regular basis (S01–S08) and the most common sources through which they get information about electricity and the energy market (S1–S14). They were also asked about their consumers' preferences (P1–P6) and concerns (F1, F4). They were inquired about the potential usage of renewable energy sources in their households (R1) and whether they monitor their energy usage (A1). Finally their willingness to install ESM under various conditions ($De_1 - De_8$, except De_5) were investigated.

In the second part of the questionnaire, the respondents who declared to know what ESM was, were additionally asked about their information sources for ESM (I1, I2, I31–I45), preferences regarding the government's role in ESM roll out (G1–G3), concerns about ESM (F2, F3), social influence in the context of ESM (W1), knowledge whether they already have ESM installed or/and their willingness to have it installed in the future (K2–K4, X1), and, finally, their willingness to install ESM if they had to pay for it (De_5).

The variables included in the survey were motivated by the literature and similar studies regarding consumers' acceptance and preferences towards ESM and other enabling technologies (see, for example (Gerpott and Paukert, 2013; Krishnamutri et al., 2012; Kowalska-Pyzalska and Byrka, 2019; Chawla and Kowalska-Pyzalska, 2019; Kahma and Matschoss, 2017; Paetz et al., 2012)). According to the literature, apart from social and economic attributes, consumers' knowledge, awareness and preferences, as well as social influence, may play a role in ESM diffusion. Fig. 2 presents the survey's framework. The definitions of the variables and their coding are described in Table A.2.

4.3. Initial analysis of the data set, preferences, attitudes and fears regarding ESM

The demographic variables are presented in Table 1. The majority of respondents were male, middle-aged, married, with a bachelor degree completed, working in the private sector and living in a small or a big city. Our data can be considered as representative, as the demographics are similar to that of the social media users in Portugal,[10] which were the target participants in this study. Moreover, 65% of Portuguese population is active on social media, as of 2019. Hence the data is also representative for majority of Portuguese population in general. Most of the respondents possessed some basic smart devices, such as a smart TV (64%) or other home appliances connected to Internet (70%). 97.7% of respondents had a wi-fi/ Internet connection at home. Around 40% of respondents declared to monitor their energy consumption. Only 12.5% had some renewable energy sources installed at their household.

The distribution of the respondents' preferences (P1–P6) and concerns related to data privacy (F1) and potential stress caused by fluctuations of electricity prices (F4) are presented in the Fig. 3. Generally, respondents would have liked to know how to use

[10] for more details see:https://datareportal.com/reports/digital-2019-portugal.

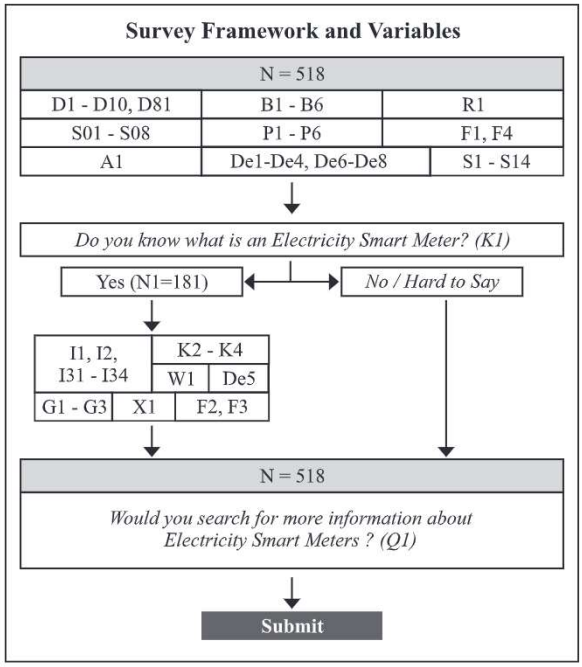

Fig. 2. The framework of the survey (N = 518).

electricity in a more efficient way. The majority of them (85%) would have liked to have real time information about their energy consumption. They believed that having access to such information would allow them to reduce their energy consumption. More than 70% of the respondents would have liked to have the possibility to control their electricity supply through mobile applications. 73.2% were interested in having a dynamic electricity tariff (e.g. real-time tariff) which would allow them to shift the demand when the electricity is cheaper.

4.4. Logit model of having knowledge about ESM

To evaluate the impact of the socio-economic and attitudinal variables on the knowledge what ESM is (K1), a binary logistic regression model has been used. For this reason a binary variable Y_i is constructed, which takes two values: $Y_i = 1$ when an i-th individual reports to have knowledge what ESM is (K1 = 1; N1 = 181) and $Y_i = 0$ when a respondent does not know (K1 = 0; N2 = 205) or is not sure what ESM is (K1 = 0.5; N3 = 128)[11] The logistic regression model enables to condition the probability of having knowledge what ESM is on a set of exogenous variables. The model is aimed to reveal and estimate, which variables have an impact of having knowledge of ESM, which in turn may be significant for deciding about marketing tools and communication channels by the energy companies. A probability of having knowledge about ESM, is assumed to depend on a set of variables, X_i, which includes a constant, demographics (D1-D10), belongings (B1-B6, R1), social media platforms (S01-S08), sources of information about the electricity market (S1-S14), energy monitoring behavior (A1), preferences and fears towards ESM (P1-P6, F1, F4) and willingness to install ESM under various conditions ($D_e1 - D_e8$, excluding D_e5). The model takes the following form:

$$Prob(Y_i = 1) = \frac{e^{x_i\beta}}{(1 + e^{x_i\beta})} \tag{1}$$

where β is a vector of the model coefficients.

In order to limit the number of the insignificant variables, we have used the stepwise selection method, as in the works of (Ntanos et al., 2018; Kowalska-Pyzalska, 2019). Table 2 presents the final model with its coefficients, their standard deviations and marginal effects. The latter can be used to approximate the change in probability of having knowledge what ESM is by an increase of the corresponding variable by one. The final model prediction accuracy is quite high, as even 72% of the respondents were correctly classified by the model in terms of having or not having knowledge about ESM. The model Log-likelihood ratio equals 590.01, Nagelkerke R square: 0.17, and Chi-square 66.81(9) with p = 0.000, indicating that the model is well specified.

In the final model all the remaining explanatory variables: gender (D1), age (D2), education (D4), type of residence (D9), as well as information about the electricity market directly from the energy companies (S11), monitoring of energy usage (A1) and the desire

[11] The total number of N1 + N2 + N3 = 514, as 4 responses were unclear and were not included in the further analysis.

Table 1
Frequencies of the demographic variables (D1-D10), N = 518.

Variable	Frequency
Gender (D1)	female 47.9%
	male 52.1%
Age (D2)	18–25 years old 11.5%
	26–35 years old 19.8%
	36–45 years old 37.8%
	46–55 years old 24.0%
	over 56 years old 7.3%
Martial status (D3)	single 32.2%
	married 52.2%
	divorced/separated 8.8 %
	in a relationship 6.4%
	widowed 0.4%
Education (D4)	no formal education 0.4%
	high school pass 6.6%
	bachelor completed 64.4%
	masters completed 18.2%
	PhD completed 10.4%
Occupation/ Employment (D5)	private sector 61.6%
	public sector 21.7%
	student in college/ university 4.4%
	others 12.3%
Household's income (in Euro per month) (D6)	less than 830 3.9%
	831 to 1125 7.3%
	1126–1580 11.8%
	1581 to 2290 13.1%
	2291 to 2700 7.5%
	2701 to 3300 13.3%
	3301 to 4165 13.7%
	4166 to 6156 12.4%
	more than 6166 11.9%
	prefer not to say 5%
Electricity bill (in Euro per month) (D7)	0 to 25 7.1%
	26 to 50 29.7%
	51 to 76 30.5%
	75 to 100 18.1%
	more than 100 11.6%
	prefer not to say 3.0%
Household size (D8)	M = 2.75, SD = 1.29 (where the integer number indicates the number of family members)
Number of children (D81)	M = 1.01, SD = 1.05 (where the integer number indicates the number of family members)
Type of a house (D9)	apartment/ flat (in a 4 stored building) 37.3%
	apartment/ flat (in a more than 4 stored building) 34.2%
	house (only ground floor) 6.9%
	house (ground and upper floor) 21.6%
Place of a living (D10)	village 22.6%
	city 75.1%
	others 2.3%

to get more information about one's electricity use (P1) and to have dynamic electricity tariff (P6), as well as the willingness to install ESM if a representative of the energy company provides information about the advantages of ESM (D_e4) are statistically significant. The results indicate that the male respondents, living rather in apartments or flats than in houses, are more probable to have knowledge what ESM is. Also the increase of age (by one category e.g. from 18–25 years old to 26–35 years old) and the increase of education, leaving all the other explanatory variables unchanged, increases the probability of having knowledge a lot. Knowledge about ESM is also positively influenced by regular monitoring of energy and collecting the information about electricity market from the energy company. The probability of having knowledge increases also significantly if the representative of the energy supplier would visit the respondent and present the benefits of having ESM. Finally, the probability of having knowledge is positively influenced by the desire to learn more about the one's electricity consumption and the willingness to have dynamic electricity tariffs which may lead to decrease of energy consumption.

4.5. Marketing platforms and content

To share the information about electricity in general, and smart metering or DSM/DR tools in particular, energy suppliers need to use some marketing platforms. In our study, we examined not only traditional marketing platforms, such as TV or radio (S1–S3/

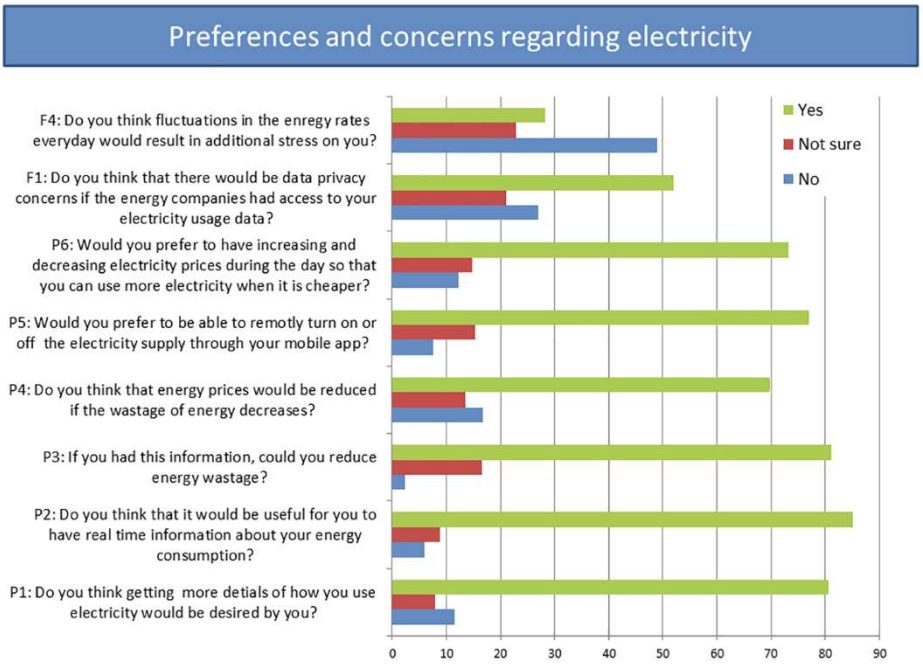

Fig. 3. Preferences and concerns regarding electricity (N = 518).

Table 2
The final logistic regression model for the estimation of Y_i.

	Coefficient (β)		Standard error		Marginal effects	
const	−0	174	0	634	0	840
D1	−0	793* * *	0	206	−0	453
D2	0	253**	0	098	1	288
D4	0	281*	0	136	1	324
D9	−0	197*	0	091	0	821
S11	0	555**	0	210	1	742
A1	0	445**	0	206	1	560
P1	0	881**	0	307	0	415
P6	0	728**	0	294	0	483
D_e4	0	906**	0	317	2	475

Note: The statistical significance of the results is coded as follows: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$ (two-tailed test).

I31–I33), but also social media, such as Facebook or LinkedIn (variables S5–S10/I35–I40), social influence (S4/ I34), information from energy companies and official governmental portals (S11–S12/ I41–I42), workshops and seminars (S13/ I43), and telephone or text messages (S14/ I44). First, we examined how often those platforms were used (see Figs. 4 and 5).

The upper panel of Fig. 4 compares the distribution of the usage of social media platforms in a daily routine between those respondents who declared being familiar with ESM (K1 = 1; N = 181) with those who do not know or are not sure what ESM is (K1 = 0 and K = 0.5, N = 333). In both groups most of the respondents admitted to using social media platforms regularly, such as: Facebook, Facebook Messenger, LinkedIn, WhatsApp and Instagram. Youtube, Twitter and SnapChat were used more rarely.

In order to illustrate the impact of communication channels on consumers' knowledge about ESM, we have also compared the sources of information about electricity market (S1–S14) dependent on the knowledge what ESM is (K1), see bottom panel of Fig. 4. The analysis shows that respondents who declared to know what ESM is, collect information about electricity market mostly from traditional sources of information, such as: TV news, radio, newspaper, but also from their social network and Facebook. This group of respondents collect information also directly from energy companies and from official government web-pages. At the same time the respondents who are not familiar with ESM also possess information mostly from TV news, and then radio, newspaper, from their

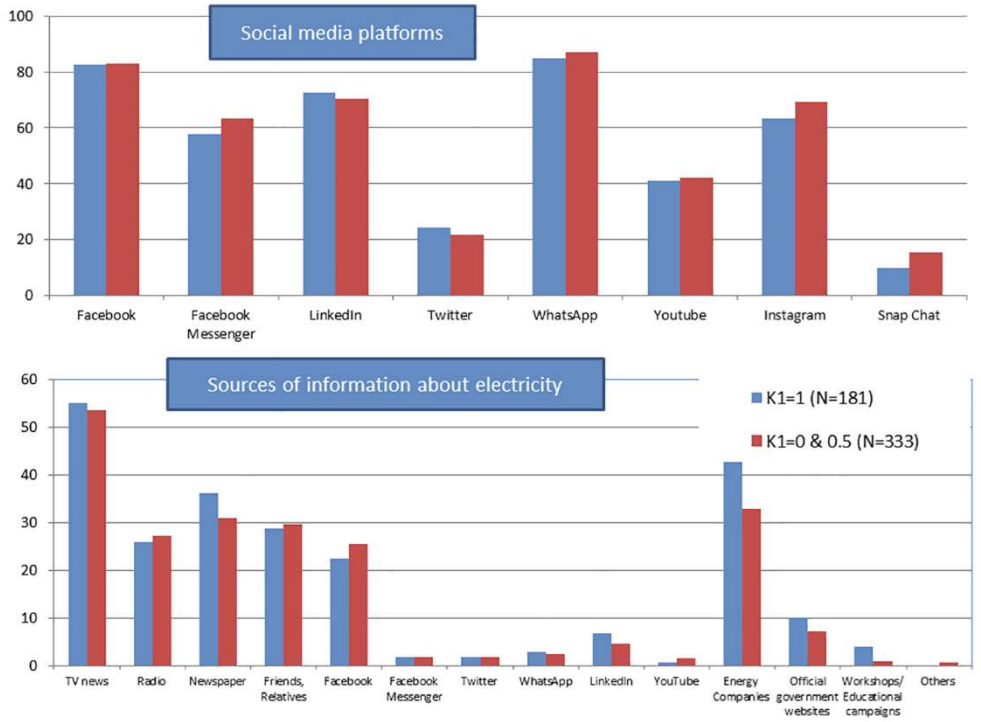

Fig. 4. Upper panel: Usage of various social media platforms S01-S08 (N = 514). Bottom panel: Sources of information regarding electricity S1–S14 dependent on the knowledge what ESM is (K1).

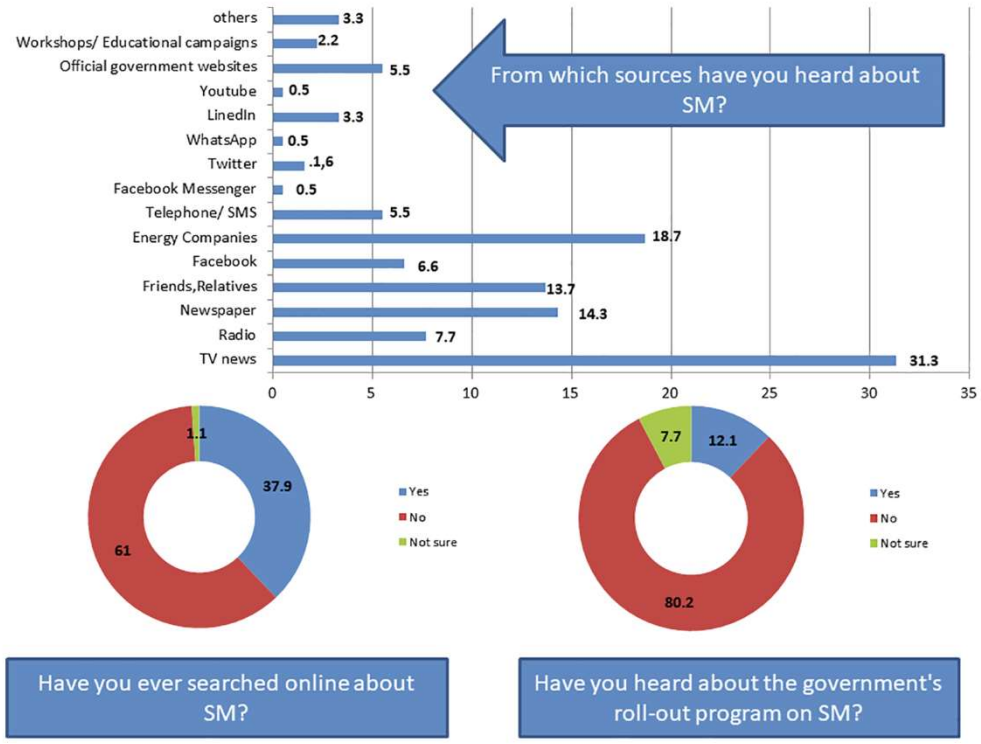

Fig. 5. Sources if information regarding electricity smart meters (N1 = 181).

peers and Facebook and directly from the energy companies. Generally, we have not observed large differences between both groups of respondents in terms of their communication channels.

Among respondents who declared to have knowledge what ESM is, we have also verified which sources of information are used to find some information about ESM. As presented in Fig. 5 mostly TV news, energy companies, and then newspaper feeds and social network belong to the main sources of such information. Further, as the diagrams in the bottom panel of the Fig. 5 present, only around 40% of the respondents had ever searched online for ESM. Even less respondents (only 12%) had heard about the government's program of ESM enrollment in Portugal.

Then, we tested the hypotheses about the relation between marketing platform and various parameters by means of student's t-tests for independent samples and different variances. In particular, we checked whether there was any statistically significant relation (positive or negative) between the marketing platforms and: the consumers preferences (P1–P6), fears and concerns (F1–F4), attitudes towards the role of the government in ESM roll-out (G1–G3), consumers' willingness to install ESM under various conditions ($D_e1 - D_e8$), monitoring of energy consumption (A1) and possession of renewable energy sources in one's household (R1), as well as possessing knowledge about ESM, and having ESM or willingness to have ESM in the future (K1–K4).

First, the test was used to identify variables with significant negative correlations, which indicated the scope for improving promotions on respective communication channels. For example, a significant negative correlation between Facebook (a communication channel) and renewable energy installation at household, would indicate that there is scope to promote renewable energy among Facebook users. Thereafter, the test was used to identify variables with positive correlations, which indicated that the communication channel is performing well. For example, a significant positive correlation between TV news (a communication channel) and renewable energy installation at household, would indicate that TV news is currently effective in promoting renewable energy among TV news audience.

Analysis reveals that the importance of using conventional marketing channels for the energy markets is still quite high. Communications through energy companies, official government websites and educational programs or workshops are still the most common sources through which the users have been receiving information regarding the electricity policies and developments, as well as ESM. For social media platforms, it is very evident that there is large scope of improvement. Social media platforms are proving to be effective in terms of propagating the diffusion of new innovation (Leong et al., 2019; Hudson et al., 2016; Priyanka, 2013), but analysis in this study showed that people, who were aware about ESM, claimed to have negligible information on social media. In contrast, the same users reveled high preference towards using various social media platforms. Based on the results, in Tables A.3, A.4 and A.5, detailed recommendations have been drawn and discussed in the subSection 5.2.

5. Conclusions and recommendations

The analysis provided in this paper confirms that electricity is an abstract commodity for most people who do not usually engage much in energy conservation unless they are motivated by financial, environmental, or social incentives. In terms of ESM roll-outs, the literature, as well as our study, clearly indicates that social aspects cannot be neglected in the process of launching new technologies because societal resistance may slow down or even stop the deployment of the novel technology (see, for example (Zhou and Brown, 2017; Kowalska-Pyzalska et al., 2014; Biresselioglu et al., 2018)). Knowledge of what ESM is, increases the probability of willingness to have such equipment in one's household and reduces the level of uncertainty regarding the potential advantages and disadvantages of ESM. We found that, in terms of having awareness about ESM in Portugal, only about 35% of the respondents knew what an ESM was, which is very low score. On the other hand over 62.5% of the respondents were interested for getting more information regarding ESM, including 19% respondents who knew what an ESM was. Thus energy companies must take more efforts to reach out to the consumers and make them aware regarding ESM and its details.

Analysis of the attitudes, preferences and fears, revealed that consumers prefer to have facilities that an ESM could provide. They would like to get more detailed and real time information about electricity consumption, would like to be able to remotely control their electricity supply, are positive towards fluctuating tariff and express confidence that they would be able to act more efficiently by making more informed decisions with access to such information. Privacy concerns were found to be an important issue, but over 61% of total respondents and 42.8% respondents who expressed privacy concerns were willing to accept ESM despite possibilities of energy companies having access to energy usage data. One of the reasons for this is the fact that the respondents are social media users, who are more aware about the data privacy issues as compared to non-users of social media. Moreover, interacting with ESM through in-home displays or a mobile application would be more or less similar to interacting with peers on social media. Hence these users are more willing towards acceptance of smart meters. Social influence is also expected to have an impact on the willingness to accept ESM. In the context of this study, social influence has an emphasized effect because of the power possessed by social media users to influence other social media users, which form even 65% of Portuguese population.

5.1. Impact of knowledge

Knowledge about ESM was found to be higher among consumers who were interested or were keen to engage with the details of their energy consumption, where as there were no factors indicating interest from passive consumers to engage. This conclusion was

drawn based on the significant variables such as attitude of regularly monitoring energy consumption, preference to have dynamic tariff for electricity throughout the day, and desire to know get more details about electricity consumption. These factors combined with the statistically significant source of information as energy companies, shows the effect of the passive marketing of ESM by the energy companies. The example of the letter received by one of the co-authors, shown in Fig. 1, is an evidence of energy companies' passiveness. The letter doesn't even refer to the phrase "smart meter" or "electricity smart meter" but just calls it "new and technologically more evolved meter". Although the options, to get more information regarding the upgrade for instance learning more through the website, talking to the company representative to clarify doubt or scheduling a technician visit and so on are given in the letter, only the interested consumers would engage in this scenario. This is consistent with our findings regarding the factors influencing knowledge among consumers. More attractive content with upfront explanation of benefits, and use of wider variety of communication channels should be the way forward. Due to the peculiar nature of the energy markets, a marketing mix of various types of content, as well as conventional channels and social media platforms, would be effective. Based on the analysis of the various sources of information indicated by the respondents in this study and their responses to other variables we drawn out recommendations of marketing content that can be used by the energy companies on various channels. Even though the study was conducted among social media users, the importance of using conventional marketing channels for the energy markets was still found to be high.

5.2. Recommendations for marketing content on various communication channels for raising awareness of ESM in Portugal

Below we present the recommendation for marketing content, first through the conventional platforms, such as TV news or radio, and second through social media, such as Facebook or Twitter. Our recommendations can be useful not only for the energy companies who want to find an effective way to reach out the target consumer segment, but also for the national and local authorities interested in rising consumers' awareness and engagement towards energy efficiency issues.

5.2.1. Marketing through conventional platforms

- **TV News**: It was found to be the most popular channel as the source of information for electricity policies in general and ESM in particular. Based on the analysis, content showing benefits about energy consumption monitoring, effects on electricity prices, link of ESM to renewable energy systems, safety in terms of health as well as privacy, return on investment (ROI) or cost effectiveness of ESM and increased savings, would attract the consumer who prefer this platform.
- **Radio**: It was found to be among the top platforms through which information regarding electricity policies in general was received, but in particular for ESM, it was rated relatively lower. On radio, content addressing no stress or decrease in stress due to the use of ESM, benefits towards monitoring consumption, effects on savings & billing, safety in terms of health and accuracy of measurements would prove to be beneficial. There was quite a high significance of social influence for this platform, which would indicate that campaigns through radio would be more effective if people with high social influence were active participants of the campaign.
- **Newspaper**: It was among the top platforms both, in terms of information regarding electricity policies in general and ESM in particular. Effective content for newspaper, including the ones for TV news, in addition to the ones that stress on benefits, such as remote access of electricity data or devices and government plans or policies, would prove to be effective.
- **Friends, Colleagues and Relatives**: Word of mouth was one the most influential mediums for the adoption of new technology, but its propagation is now more dependent on digital media (Alalwan et al., 2017). Through the analysis, it was observed that consumers are more prone to discuss the monitoring of energy consumption, effects on health & personal information and their tendency to protest against ESM being made mandatory. To have positive outcomes through this platform, ensuring the availability of this information through the rest of the platforms would be required.
- **Energy Companies**: It is the second most common source of information for electricity policies, as well as ESM. The effect of information from energy companies would be highly actionable as they are the direct sellers and their openness towards making consumers aware, by providing information about the benefits and options, would have a convincing effect on the consumers. They need to put extra effort to provide, not just notifications, as we observed with the EDP letter in this study (please see Fig. 1), but more detailed information through conventional channels. In the context of content, reminding assurances for the consumers and involving them through feedback, would attract more consumers to adopt new technologies offered by the energy companies. There is also a need make the consumers aware about the availability of personalized information, through the website, mobile application or in-home displays, as well as making the same available to them. Increasingface-to-face interactions with company representatives will also be an important trigger for the acceptance of ESM.
- **Workshops Educational Programs**: This was one of the least common sources of information for electricity policies, as well as ESM, mentioned by the respondents. One of the reasons for this was possibly the lack of suitable number of such programs to reach to the masses or lack of proper content delivery (Hess, 2014), which was not in the scope of this research. Based on the analysis in this study, we can recommend that content, such as benefits of ESM in reducing energy wastage, its effect on cost & billing, addressing health and privacy concerns and cost effectiveness or ROI of ESM, would make such programs more effective. These

programs were also linked to increasing social influence and interaction between friends, relatives and colleagues, which have been found to be important for increasing the diffusion of ESM.

- **Official Government Websites**: Detailed information about various aspects of electricity in general and ESM in particular are available on these websites, but difficult to find. These websites need to be updated, so as to enable the consumers to find the information they are seeking more conveniently and also addressing the preferences, fears and decision making factors of the consumers addressed in this whole sub-Section 5.2.1.
- **Telephone/ SMS**: This platform was found to be in the bottom half in terms of a significant source of information about electricity in general and ESM in particular. This platform was well suited for notifications, updates with web-links and interactions with representatives of energy companies. Content for marketing through this platform would include areas in all other conventional platforms mentioned in the points prior to this and, additionally, the availability of redressing to consumer queries as well as complaints.

5.2.2. Marketing through social media

- **Facebook**: It is the world's largest social network, with over 2 billion users, but among the respondents in this study, it was second most preferred platform. It was also not indicated as a source through which the respondents received information regarding electricity or ESM. Promoting content, such as availability of remote access of electricity usage and control through ESM, cost effectiveness of ESM and effectiveness in terms of reducing wastage of electricity, would be effective.
- **Facebook Messenger and WhatsApp**: Both these platforms had similar functions and the same parent company. WhatsApp was the most popular social network being used by the respondents of this study but majority the of the respondents indicated that they did not receive information regarding ESM through these two platforms. The significance of social influence for making a decision regarding the installation of ESM was high amongst these users, which indicated that, on receiving information regarding ESM through WhatsApp or Facebook Messenger, the users were more likely to take positive steps towards the installation of ESM. The users of these platforms preferred to have information regarding electricity consumption, wanted to reduce energy wastage, wished to have remote access to devices and cared about information privacy and the effects on health. Marketing content addressing these themes would be appealing to the users on these platforms.
- **LinkedIn**: It was the most popular social media platform among the respondents for getting the source of information regarding electricity in general and ESM in particular. In addition to the content recommended for Facebook, elaborating government plans and policies would be useful. LinkedIn also had a high social influence significance, which suggested that these consumers would be able to gather influence among their peers. Hence, increasing the output manifolds.
- **Twitter**: Twitter played an important role to empower people for partaking in sharing what continues to happen around the world. It was shown to be quite useful for the diffusion of innovation, due to its hashtag function (Chang, 2010). From our analysis, content related to savings, due to the installation of ESM, would be effective in attracting consumers. Respondents, who preferred Twitter as one of the communication platforms, were also the ones who expressed interest in installing ESM. Hence, the use of Twitter would amplify the outcomes of the marketing campaign.
- **YouTube**: It is another social media platform which was quite commonly preferred by the respondents, but they indicated not receiving information regarding electricity in general and ESM in particular through it. These users showed interest towards monitoring energy consumption, reducing energy wastage, receiving updates regarding electricity pricing and cared about savings and health effects. Content regarding these topics would attract these users towards the acceptance of ESM.
- **Instagram**: This photo sharing platform was the 4th most popular among the respondents in this study. The preference and interests of users were similar to that of Facebook, therefore, it can be suggested that the content recommended for Facebook would also be suitable for Instagram.
- **SnapChat**: This is a very peculiar platform, and was found to be the least popular among the respondents in this study. Although the statistical significance of SnapChat was quite high with some variables, which can be see in Table A.5, the number of users were too low to recommend enacting separate efforts for marketing on this platform. Content created for Facebook Messenger and WhatsApp would be suitable for this platform at large, if this was included in the marketing strategy.

Managers should interpret these recommendation in conjunction with the impact of knowledge and also the goals they wish to achieve. The recommendations describe the content material and content type (images, videos, text, web links and so on) based on the properties of the communication channel. Particular care should be taken while using the same content type for the same content material to ensure that intensity of marketing is not too high. We also recommend that managers use social media measures, already available in the literature (for example see: Chodak et al. (2019, 2020)), to plan and measure the effectiveness of their campaigns.

6. Limitations and future scope of research

This study has limitations that point to future works and research avenues. The sample analyzed introduces limitations, due to the geographical context and to the non-random sampling methods used. Therefore, it is recommended to replicate the study in different samples. This study also opens new horizons for research, such as analyzing the particular effectiveness of each of the marketing platforms for smart meter diffusion.

Acknowledgments

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Appendix A

Tables A.2–A.5.

Table A.2
Definitions of the variables, coding and description (N = 518).

Variable Group A	Code *(Variables of Phase 1)*	Description
Demographics	D1–D10, D81	
Gender	D1	2 categories (nominal)
Age	D2	6 categories (ordinal)
Relationship status	D3	5 categories (nominal)
Highest Educational Qualification	D4	6 categories (ordinal)
Occupation/Employment	D5	6 categories (nominal)
Monthly Household Income (in Euro per month)	D6	13 categories (ordinal)
Range of electricity bill (in TL per month)	D7	6 categories (ordinal)
Total members in the household	D8	6 categories (ordinal)
Number of children	D81	5 categories (ordinal)
Type of house	D9	4 categories (nominal)
Area of living	D10	4 categories (ordinal)
Belongings of smart devices & personal assets)	**B1–B6**	
House	B1	(1) yes / (0.5) no, but I plan to buy it within one year/ (0) no, and I do not plan to buy it.
Flat or Apartment	B2	
Laptop or Desktop	B3	
Wifi / Internet connection at home	B4	
Smart TV	B5	
Other home appliances that can connect to the internet	B6	
You regularly monitor energy usage in household	**A1**	(1) yes / (0.5) hard to say / (0) no
Any renewable energy sources installed at the household	**R1**	(1) yes / (0.5) hard to say / (0) no
Social media platforms commonly used	**S01–S08**	
Facebook	S01	(1) yes/ (0) no
Facebook Messenger	S02	
LinkedIn	S02	
Twitter	S03	
WhatsApp	S04	
Youtube	S05	
Instagram	S02	
Snap Chat	S02	
Source of information regarding electricity (prices, new offers, etc.)	**S1–S14**	**(1) Yes / (0) No** *(Note: variables are listed in the table notes)*
Preferences regarding ESMplatforms	**P1–P6**	
Getting more details on electricity usage is desirable	P1	(1) yes / (0.5) hard to say / (0) no
Getting real time information of electricity usage would be useful	P2	
You can reduce energy wastage if you had real time information of electricity usage	P3	
Energy prices would be reduced if waster of energy decreases	P4	
Prefer to be able to remotely turn on or off the electricity supply	P5	
Prefer to have fluctuating unit rates of electricity usage	P6	
Willingness to install SM	$D_e1 - D_e4$, $D_e6 - D_e8$	

(*continued on next page*)

Table A.2 (*continued*)

Variable Group A	Code *(Variables of Phase 1)*	Description
Demographics	D1–D10, D81	
Willing if ESMcould help save money	D_e1	(1) yes / (0.5) hard to say / (0) no
Willing if ESMcould help save money, but possible have adverse effect on health	D_e2	
Willing if ESMcould have save money, but energy companies would have access to electricity usage data	D_e3	
Willing if company representative visits home and explain all details	D_e4	
Willing to install if upgrade to ESMis free	D_e6	
Willing to install if one of the friends / relatives/ neighbours recommends it	D_e7	
Willing to install if one of the friends / relatives / neighbours installs ESM at their house	D_e8	
Concerns about ESMusage	**F1,F4**	
Data privacy concerns	F1	(1) yes / (0.5) hard to say / (0) no
Fluctuations in unit rate of electricity would cause additional stress	F4	
Willingness to search or collect more information regarding SM	**Q1**	**(1) yes / (0.5) hard to say / (0) no**
Group B *(Conditional Variable for Phase 2)*		
Knows what is a ESM	K1	(1) yes / (0.5) hard to say / (0) no
Group B *(Variables of Phase 2 – For K1 = 1)*		
Knowledge about SM	**K2–K4**	
Has ESMinstalled at home	K2	((1) yes / (0.5) hard to say / (0) no
In process of installing ESMat home	K3	
Plans to install ESM at home	K4	
Source of information regarding SM	**I1, I2, I31–I44**	
Search online about ESM	I1	(1) yes / (0.5) hard to say / (0) no
Hear about Government's ESM rollout programme	I2	
Other sources *(variables are listed in the table notes)*	I31–I44	(1) Yes / (0) No
Social influence	**W1**	**(1) yes / (0.5) hard to say / (0) no**
Willing to install ESM even if payment is required for upgrade	D_e5	**(1) yes / (0.5) hard to say / (0) no**
Preferences regarding the role of the government in ESM enrollment	**G1-G3**	
Government should make it mandatory for all to have ESM	G1	(1) yes / (0.5) hard to say / (0) no
Government should give an option to decline installation of ESM	G2	
Would protest if government makes it mandatory to install ESM	G3	
Concerns about ESM usage	**F2,F3**	
Billing through ESM could be inaccurate	F2	(1) yes / (0.5) hard to say / (0) no
ESM could have adverse effects on health	F3	
Willingness to have one's home to be equipped with ESM	**X1**	**(1) yes / (0.5) hard to say / (0) no**

Note: TV News (S1, I31); Radio (S2, I32); Newspaper (S32, I33); Friends, relatives, colleagues (S4, I34); Facebook (S5, I35); Facebook Messenger (S6, I36); Twitter (S7, I37); WhatsApp (S8, I38); LinkedIn (S9, I39); YouTube (S10 I40); Energy Companies (S11, I41); Official government websites (S12, I42); Workshops / educational campaigns (S13, I43); Telephone / SMS (S14, I44).

Table A.3
Student's t-test for correlation significance between the information sources for ESM and chosen variables.

	I31	I32	I33	I34	I35	I37	I39	I41	I42	I43	I44
A1	-2.066*	-2.229*	-1.783*					-1.859*			
R1										-2.402*	
P1						-8.306***			2.065*	-8.315***	
P2						-6.81***	-6.825***			-6.815***	
P3						-7.732***				-7.739***	
P4					2.3*			-1.704*			
P5						-7.961***	-7.985***			-7.969***	
P6	-2.226*					-8.769***		-1.926*			
F1				2.706**						-12.02***	
F2											6.252***
F4		-2.017*						2.704**			
G1				-2.097*			-2.034*				
G2										-7.854***	
G3	-2.282*	-2.824**	-4.433***		-2.183*						
DE1						-4.994***		-2.733**		-4.996***	
DE2	-2.458**		-1.746*								3.739***
DE3	-2.849**								2.236*		
DE4						-14.675***			1.995*		
DE5			-2.078*								
DE6	-1.666*										
DE7										-14.828***	
DE8						-8.076***	-8.101***			-8.084***	
K3									-1.846*		2.486**
K4					1.772*	-18.104***					
X1	-2.887**					-10.818***			2.086*	-10.837***	

Table A.4
Student's t-tests for correlation significance between the sources of information about electricity and chosen variables.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
A1			-2.055*								-2.93**	-1.715*		
R1	-2.167*							-1.883*		8.62***				
P1					-2.808**			-11.225***			-1.766*	2.218*		-11.195***
P2						-9.516***				-9.511***			-9.517***	-9.504***
P3						-11.006***			-2.233*			2.605**		-10.988***
P4						-15.053***							-2.029*	-15.007***
P5			2.176*					-12.465***	-2.994**		2.695**	1.71*		-12.425***
P6										-13.8***				-13.78***
F1				-2.555**	-2.193*									
F2	-2.262*	2.263*			-1.94*						-1.76*			
F4								-1.812*						14.255***
G1									-3.083**					
G2			-1.74*					-7.861***	-2.016*		-2.376**			
G3			-2.436**	-2.128*								-3.413**		
DE1	2.801**	2.121*	1.967*			-6.759***	-6.759***	-6.762***		-6.758***	2.291*			
DE2	-1.773*			-3.143***	-2.303*			-2.281*	-1.934*		1.789*			6.307***
DE3				1.684*							2.455**	1.732*		
DE4						-2.643*			-1.728*				-2.036*	
DE5									-1.984*			-2.218*		
DE6		1.906*									1.737*			
DE7		3.885***	2.117*			2.12*						2.059*		
DE8										-13.731***				
K1											-2.662**		-2.3*	16.716***
K2		2.235*								-1.996***				
K3												-2.055*	-2.034*	
K4				1.729*		-18.104***								
X1						-10.818***			-2.018*					

Table A.5
Student's t-tests for correlation significance between social media platforms being used by consumers and chosen variables.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
A1			-2.055*								-2.93**	-1.715*		
R1	-2.167*							-1.883*		8.62***				
P1					-2.808**			-11.225***			-1.766*	2.218*		-11.195***
P2						-9.516***				-9.511***			-9.517***	-9.504***
P3						-11.006***			-2.233*			2.605**		-10.988***
P4						-15.053***							-2.029*	-15.007***
P5			2.176*					-12.465***	-2.994**		2.695**	1.71*		-12.425***
P6										-13.8***				-13.78***
F1				-2.555**	-2.193*									
F2	-2.262*	2.263*			-1.94*						-1.76*			
F4								-1.812*						14.255***
G1									-3.083**					
G2			-1.74*					-7.861***	-2.016*		-2.376**			
G3			-2.436**	-2.128*								-3.413**		
DE1	2.801**	2.121*	1.967*			-6.759***	-6.759***	-6.762***		-6.758***	2.291*			
DE2	-1.773*			-3.143***	-2.303*			-2.281*	-1.934*		1.789*			6.307***
DE3				1.684*							2.455**	1.732*		
DE4						-2.643*			-1.728*				-2.036*	
DE5									-1.984*			-2.218*		
DE6		1.906*									1.737*			
DE7		3.885***	2.117*			2.12*						2.059*		
DE8										-13.731***				
K1											-2.662**		-2.3*	16.716***
K2		2.235*								-1.996***				
K3												-2.055*	-2.034*	
K4				1.729*		-18.104***								
X1						-10.818***			-2.018*					

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