Business Models for Smart Homes

Janina Florenţa Popeangă

***Abstract*—** The rising concerns over the climate challenge have led to an increased ambition for finding innovative solutions that can decrease energy demand and CO_2 emissions and at the same time stimulate economic growth. To achieve these objectives, smart metering technology is proposed as a smart home solution that will help consumers to be better informed about their energy consumption and hopefully they will become more interested in changing their behavior. But human reaction and interaction with this technology can be surprising, considering the potential rebound effect.

This study presents the business models that exist today among smart home players and proposes a new one adapted to legislation and market needs from Romania.

Also, giving the fact that every sustainable business model for smart homes must incorporate rebound effects, this study aims to identify the most significant ones and analyze effective methods of minimizing these rebound effects in order to reach the maximum potential of smart metering technology.

***Keywords*—**Business Model, Smart Metering Technology, Energy Efficiency, Rebound Effects

I. Introduction

A smart home is a home that is equipped with highly advanced automatic systems that enable occupants to remotely control or program most of the automated devices installed in the house and also provide them monitoring and management functions.

In this research, smart homes will be explored with focus on smart metering. Systems developed for entertainment, security, medical and other types of care will not be taken into consideration.

Smart metering of energy means a measuring device with support systems and infrastructure for metered data transfer and management, which records energy consumption in time, periodically or upon request, in a more detailed way than conventional and transfers the data recorded to the supplier for monitoring and billing.

Analyzing several smart meter business models, resulted that most of them do not take into consideration the rebound effect nor solutions for minimize or eliminate them. Identifying the value proposition was the main element examined when analyzing and evaluating business models.

Romanian consumers are not only skeptical, but also unaware of technological improvements that are available on the international market.

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At this stage of the smart home market creation, the business model is essential. So, in the next sections of this paper a business model adapted to legislation and market needs from Romania is proposed.

II. Context Setting

The European Union has established ambitious objectives for energy and climate change, including 20-20-20 energy targets by 2020: to reduce greenhouse gas emissions by 20% compared to 1990, to lower energy consumption by 20% through increased energy efficiency, to cover 20% of energy consumption from renewable sources.

Romania, as one of the 11 Member States which have assumed before the European Commission national targets more ambitious than the European level (20%), is only 0.1% of fulfilling the goal of using renewable energy and 24% of domestic consumption to be produced from these sources by 2020.

On the other hand, Romania consumes 2.5 times more energy per unit of Gross Domestic Product (GDP) compared to the EU average and in the long term could save 5 to 7 billion euros, if we apply energy efficiency measures, which would amount to an increase of 4-6% of GDP, without additional energy consumption. [1]

Romania's objective is to make energy efficiency savings of 9% by 2016, thereby contributing to the overall objective set at EU level.

During the Summit from October 2014, the EU countries fell agree on new targets on energy efficiency by at least 27% reduction by 2030. European Commission proposed a target of 30% in the official communiqué for Energy Efficiency.

Simply eliminating energy waste, without lowering the level of perceived comfort, we can reduce total energy consumption in buildings by 40-50%, more than the European average (30%). [2]

A. Smart Home Market Opportunity

In 2009, the European Parliament approved the EU Third Energy Package, so it is expected that by 2020, 80% of electricity consumers in each EU Member State to have smart meters installed, where the cost benefit analysis shows that implementation is feasible.

According to Berg Insight research firm, 602.7 million smart meters will be installed worldwide by 2016. [3]

Rates of penetration of smart meters should arrive until 2016 to 50% in Europe and US, and 75% in Asia. By 2020 it is expected that the penetration rate in most developed

countries to be 100%, with multiple processes running in India and developed countries in South America.

According to a 2014 European Commission report, 200 million smart meters for electricity and 45 million for gas will be rolled out in the EU by 2020. This represents a potential investment of €45 billion.

Providing all consumers detailed information about their energy use can significantly reduce total energy consumption by up to 5-20%. [4]

The installation of smart meters will enable them to adapt their energy consumption, reducing peak consumption, CO_2 emissions, technological and commercial losses.

On the other hand, it is absolutely necessary to use smart meters in order to track energy consumption and the time when it was recorded, so companies can bill correctly in accordance with the tariff plans for households, set by the National Energy Regulatory. [5]

These tariffs are fixed depending on the season and time zones, but because reading electricity meters is made traditionally, such tariff plans cannot be implemented for households and so they cannot be invoiced correctly, depending on their profile.

TABLE I
DAY AND NIGHT ZONES

Time of day	Time of night
7:00 AM – 10:00 PM	10:00 PM – 07:00 AM and from Friday 10:00 PM until Monday 07:00 AM

TABLE II
PEAK HOURS

Season	Peak area
1 April – 30 September	08:00 AM – 09:00 AM
1 October – 31 March	08:00 AM – 10:00 AM 07:00 PM – 10:00 PM
Season	**Off-peak area**
1 April – 30 September	12:00 PM – 08:00 AM 09:00 PM – 12:00 PM and from Friday 09:00 PM until Monday 08:00 AM.
1 October – 31 March	12:00 PM – 08:00 AM 10:00 PM – 12:00 PM and from Friday 10:00 PM until Monday 08:00 AM.
Season	**Normal area**
1 April – 30 September	09:00 AM – 09:00 PM
1 October – 31 March	10:00 AM – 07:00 PM

B. Smart Home Market Challenges

Given the fact that Romania currently lacks this technology, the main competitors remain global developers like:

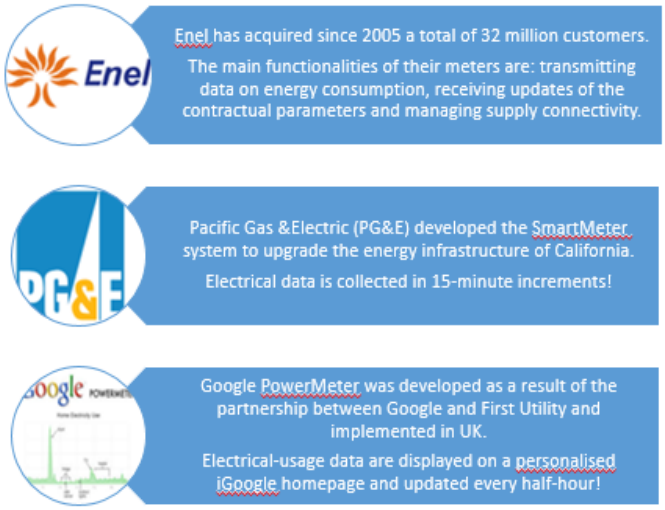

Fig. 1 Main competitors

Furthermore, Enel unveiled during the seminar "Focus on Energy" organized by Business Review, plans to implement smart metering technology for the Romanian market. The project consists in replacing traditional meters with 2.6 million smart metering systems.

There are several high potential risks that can hamper the introduction of smart metering:

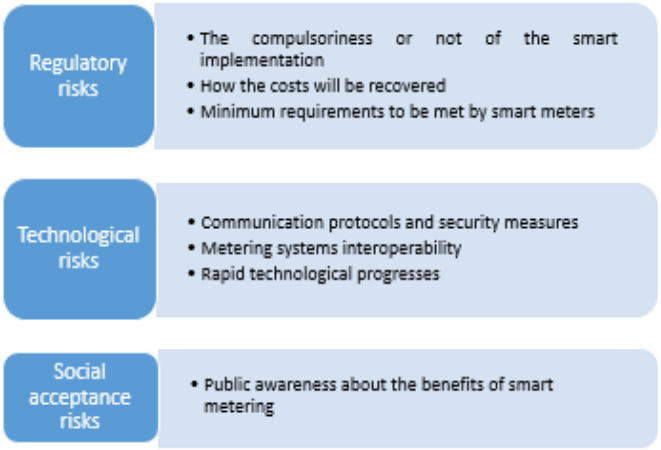

Fig. 2 Potential risks

The compulsoriness or not of the smart implementation should be regulated before starting investment and also, in order to avoid possible speculations should be established from the very beginning the minimum requirements to be met by smart meters and how the costs will be recovered (through network rates or economic-financial incentives).

For consumers, a major issue is the potential cost of a smart meter and how they will be asked to meet those costs. They have to understand the services and sustainable advantages of the smart technologies and justify investments.

Technological risks are related to the communication protocols and security measures, errors that can occur at the level of the new systems because several incompatibilities between their components and the fast technological progresses.

Also, consumers may be unaware of smart metering initiative or they may be concerned about privacy of data, possible increases of their bills or possible health problems caused by the communication technology.

In order to protect consumers' personal data, the European Commission recommends several data protection and privacy provisions and sets rules on who can access personal data and under what circumstances.

Following the survey conducted in March 2015, in Bucharest, I've obtained the following results regarding consumers' fears about smart metering:

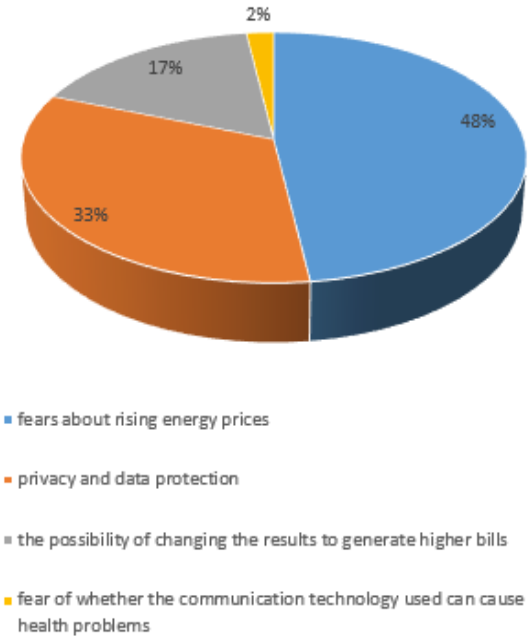

Fig. 3 Consumers' fear regarding smarts metering

Another challenge is the type of feedback they prefer:

- 48% - direct feedback through in-home displays
- 35% - direct feedback through phone applications
- 12% - direct feedback through web applications
- 5% - indirect feedback through detailed bill

III. Value Proposition

In order to compete with global providers, this solution offers more useful functionalities in order to respond to consumers' needs and most important all data are updated in real-time.

The smart system for monitoring and managing energy consumption:

- Tracks real-time electricity consumption indicators
- Stores measured data for various periods of time (preferably hourly)
- Allows access to data from both consumers and suppliers or their agents and offers the following functionalities:

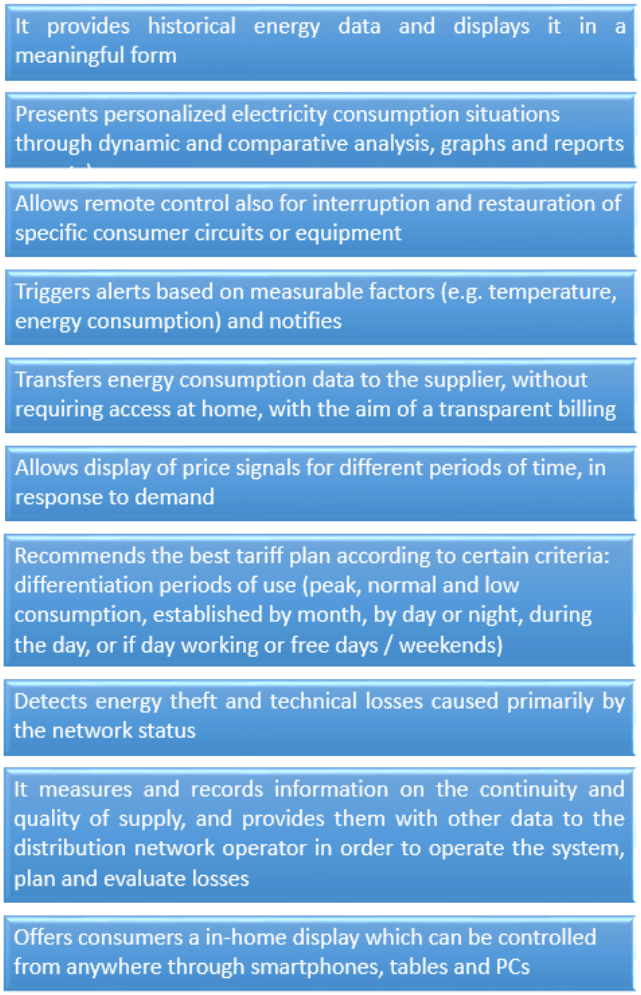

Fig. 4 – Smart metering functionalities

IV. Consumers And The Potential Rebound Effect

Smart homes solutions are intended to the following types of consumers:

- Non-residential (stadium, hospitals, hotels, restaurants, commercial and office buildings etc.)
- Residential homes

In this study, smart houses will be defined as residential homes, not institutional or commercial buildings. It is expected that smart metering will help consumers to be better informed about their consumption and hopefully they will become more proactive.

A rebound effect is defined as the change in energy demand caused by changes in consumer behavior. Even if the technology itself is more energy efficient and we would expect a decrease in energy usage, consumers' behavior can reduce the overall efficiency of this solution through new usage areas.

In most cases, the overall energy consumption is higher after this technology was introduces than before.

The rebound effect is a well-known situation in energy economics where consumers are aiming to maximize their economic profit or personal level of comfort.

There were identified different types of rebound effects.

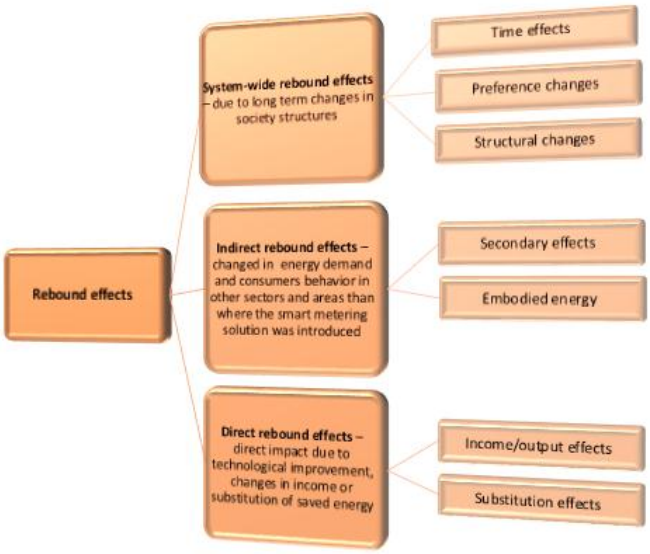

Fig. 5 Rebound effects

To obtain significant energy efficiency, we should maximize the resulting energy, saved after the sum of negative rebound effects has reduced the energy efficiency increased from the technological improvements. This means that we should minimize rebound effects, if we cannot eliminate them.

For example, higher production output is caused by reduced energy prices, while higher incomes determine higher consumption. A positive measure would be to invest the increased income in new energy efficiency measures.

Or, if a consumer has more free time as a result of energy efficient technologies, he may choose to do high carbon and energy demand activities, but with special programs he will learn to be more aware of his behavior impact and will choose low carbon and low or no energy demand, like reading or walks in the park.

In order to avoid negative reactions from consumers, the following steps should be followed before and after initiating the smart metering penetration on the Romanian market.

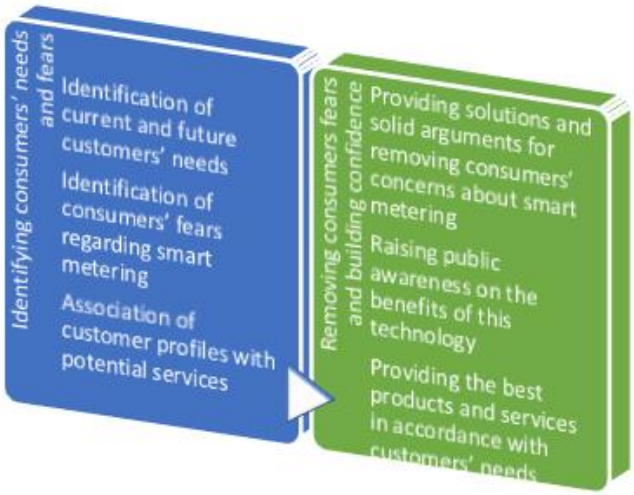

Fig. 6 Steps to avoid negative reactions from consumers

V. Value Capture

Other stakeholders in the system are:

- Regulatory Authority for Energy
- Utility service providers
- Product standards

Also, the solution will be presented to real estate developers in order to equip new homes with smart technology.

As the current system to monitor electricity consumption in Romania is characterized by the physical reading of traditional meters and recording the consumption indexes on paper, the introduction of smart meters can signify a pressure for regulators to lower cost through reducing losses and costs of meter reading.

A reduction of 3,825% of electricity consumption, compared to a reference where there are not smart meters installed, can be achieved gradually over time, as far as gradual installation of smart meters continues. Considering the 3.825% reduction of electricity consumption, the value saved until 2022, when full implementation of the smart meters will be completed, will be 3.4 TWh (and 826,000 MWh per year on average after 2022). This amount is recorded based on consumption of 18.85 million MWh/year in 2011 and taking into account all the assumptions included in the cost benefit analysis, i.e. 1.6% increase in consumption and a total of 2, 1% reduction as a result of minimizing trade losses. [6]

After a detailed and objective analysis there were found some ways forward to maximize strengths and market opportunities (strategic control):

- obtaining patents for innovative solutions, always one step ahead of technological progress
- customer satisfaction by offering products and services adapted to their needs
- future alliances with government initiatives

VI. Conclusions

The current system for monitoring electricity consumption in Romania is characterized by physical reading of the traditional meters, recording consumption on paper and finally transfer data on electronic spreadsheets. This naive procedure has to be changed and, at this stage, designing the business model for introducing smart metering on the market is essential.

Smart metering offers numerous benefits, the most important being a greater awareness of energy consumption from users. The installation of smart meters will enable them to adapt their energy consumption, reducing peak consumption, CO_2 emissions, technological and commercial losses.

Acknowledgment

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Janina Popeangă graduated in 2010 the Faculty of Cybernetics, Statistics and Economic Informatics, Economic Informatics specialization. The title of her Bachelor's thesis is "Distributed Databases". In 2012, she graduated the Databases for Business Support master program with the thesis "Monitoring and management of electric power consumption using sensorial data". Janina's interests are broadly in the fields of databases and distributed systems. Since 2012 she is a Ph.D. Student in the Doctoral School of Bucharest Academy of Economic Studies. Her research focuses on real-time database systems, business intelligence analytics, sensor data management, smart grid and renewable energy.