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Market Analysis and Business Plan for Residential Energy Efficiency Services

Development of a Business Plan based on a B2C model for Energy Efficiency Management (EEM) companies targeting Residential consumers

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Abstract

The aim of this study is to develop a market analysis for the energy efficiency residential sector and to propose a business plan for the company *Enerbyte, Smart Energy Solutions* to move from a B2B to a B2C business model. The work is divided in four main blocks: First, the need of the market has been identified together with a general description of the residential consumer. Moreover, an introduction to the energy retail market with some important influencers such as smart meters and prosumers is presented. Second, an overview of the company is provided in order to present the actual market of *Enerbyte* and the product delivered. Then, a competitor analysis has been developed with the objective to analyse the products offered by the companies serving residential consumers with energy efficiency solutions. Additionally, a comparison between B2B and B2C companies is presented in order to identify the main differences between them. Finally, a business plan has been proposed based on a B2C model. A strategic decision has been made to focus the business model on a niche market composed by prosumers and the most appropriate geographical markets have been identified considering several parameters such as number of prosumers and smart meters data access.

Keywords

Energy Efficiency, Residential consumers, Prosumers, Smart meters, B2B, B2C

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I. Market opportunity

The Internet of Things (IoT) has emerged from the management of Big Data and is revolutionizing technology offering constantly new applications in all fields for the benefit of society. Consequently, the energy retail market together with the residential market is not an exception. They are suffering from many changes that are rethinking the way companies look at the energy market and its players. As stated in [1], the IoT is revolutionizing the retail industry offering new opportunities in three main areas: customer experience, the supply chain and new revenue streams.

1. Description of the problem

As it has been stated before, to analyse energy related services for the residential users, it is important to focus on the specifications of the two markets involved: the energy retail market and the residential market. Therefore, it is significant identify and understand the pain that is suffering each one in order to recognize reconciliatory solutions.

a) Energy retail market

The energy retail market is one key figure within the energy market value chain. It is the one intended to commercialize the energy produced. For example, in the electricity market, retailers purchase energy to generators in the wholesale market, and afterwards it is supplied to residential consumers through the retail market. In other words, it acts as a "bridge" between end-users and energy producers.

Figure 1 presents a scheme of the traditional electricity value chain together with the so-called emerging electricity value chain. It can be observed the appearance of flow of information through the energy value chain that can be delivered by the energy retail figure. This bidirectional flow of information allows introducing the concept of smart grid.

The pain addressed to utilities is suitable for the traditional scheme. However, it is important to say that in the emerging value chain, new figures will appear that will require new business opportunities. A clear example of this fact is the incorporation of prosumers into the energy value chain. Prosumers are an evolution of the conventional consumers who decide to install micro generation sources at home. As a result, many services can be born from the interaction between prosumers and utilities for the benefit of both figures.

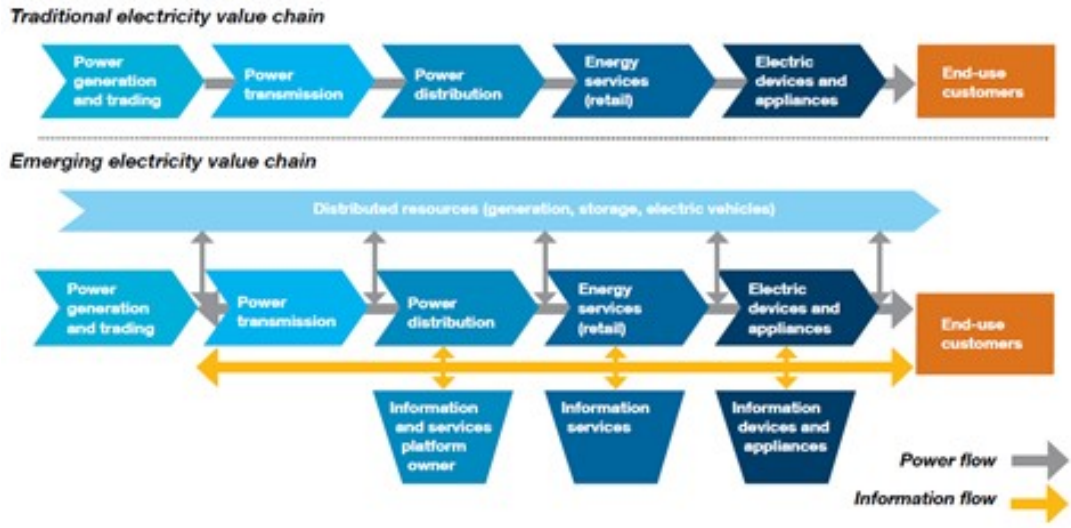


Figure 1. Traditional and emerging electricity value chain [2]

The figure of the energy retailer is very different varying across countries. Depending on the legislation of each country, the electricity retail market behaves more like a monopolistic market rather than a liberalized one. Consequently, the level of competition between retailers is divers in each country and this fact affects directly residential end-users and how to address their problems (see Figure 2). In those countries with more competence and thus, a high switching rate between retailers, customer engagement tools are a priority for utilities. However, in countries where the market share is divided between a few companies, utilities do not suffer from this pain and their concern to maintain engaged customers is lower. In other words, the level of market liberalization is a good measurement of utilities pain and therefore, it is a key issue to consider when developing the business plan to enter a market.

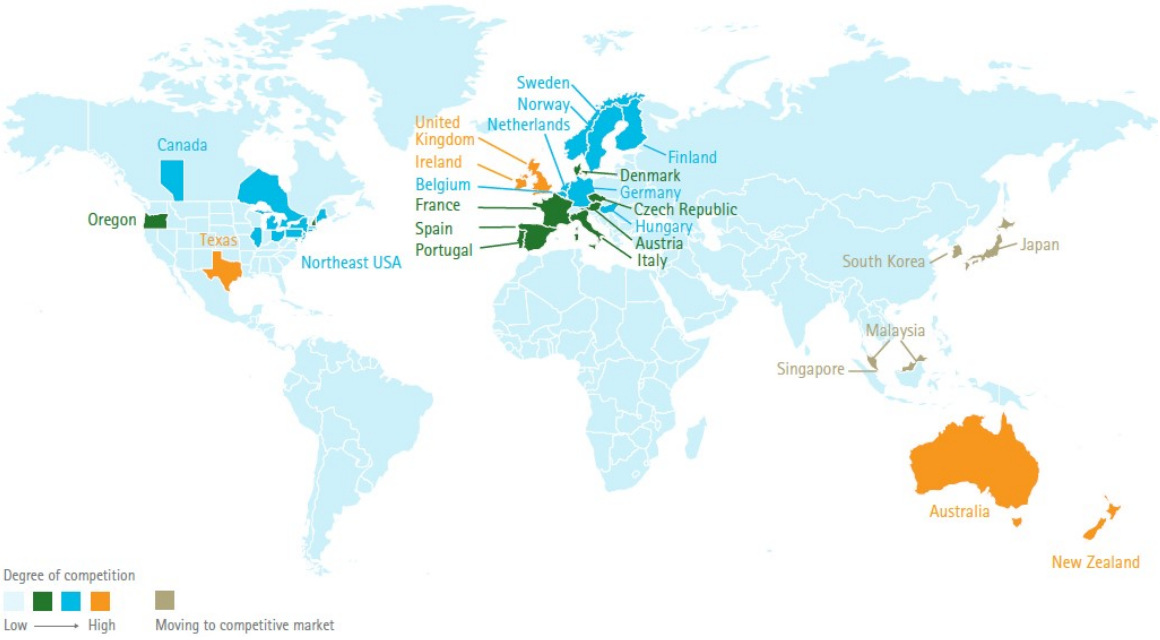


Figure 2. State of global retail competitive electricity markets [3]

To sum up, low customer engagement is a generalized problem in the utilities world. As it is stated in Figure 3, only 27% of users trust on their utilities or energy providers. However, it is also important to say that they are still better positioned compared to alternatives such as governmental organizations or home service providers.

Figure 3. Consumer trust on possible energy providers [3]

b) Residential market

Houses and apartments are starting to become more automated and residential users appreciate the possibility to monitor all types of energy consumption, remotely control appliances and at the same time, increase their home security. In other words, homes are transforming into 'smart homes' and the residential user profile has changed becoming more demanding of these type of services. However, it is important to highlight that the speed at which homes are converting into smart homes is not as fast as the theory had expected when the technology appeared. The technology is ready to enter residential homes, but there are some downsides that slow its penetration. As stated in [4], *"smart homes are a natural extension of current electronic, information and communication technologies. (…) However, the last 20 years of development have failed to achieve anticipated results. Demand has been slack, and the supply of smart home technologies is too low".* Moreover, one of the challenges identified by [4] is that *"user habits and intentions should be studied in more detail and respected whenever possible"*.

Besides this, society is giving more importance on controlling and being aware of the data they generate. This mind change is due to, from one side, privacy issues and from the other side, because we know we could get a profit from it. A clear example of it is the deployment of smart meters that monitor hourly electricity consumption: residential users are willing to

control their hourly electricity consumption in order to identify their own consumption habits and be aware of their potential economic savings.

Nevertheless, one should not forget that one of the main concerns of society is the privacy of personal data and consequently, residential users may be reticent to provide data if the communication is not addressed in the most convenient, clear and transparent way.

With the aim to adapt and advance the previously cited changes, the EU is working on the road to promote a New Deal for Energy Consumers [5]. This process is divided in three main goals: first, deliver better information in order to save more kWh and thus, save more €. Second, offer a wider choice of action for consumers to participate and take advantage of the energy market. Third, assure a high level of consumer protection. In relation to this policy, Figure 4 presents a poster being distributed by the European Commission that summarizes how consumers will benefit from the future electricity market.

Figure 4. Poster from EU to inform consumers on how they can benefit from the future electricity market

2. Residential consumer description

Residential consumer had been presented briefly in the previous block. Nevertheless, the following point is intended to be a more detailed description about how they act, which types of consumers can be distinguished, which are the best communication tools, what influence has the level of digitalization, etc.

a) Type of consumers

It is commonly agreed the importance of segmentation in order to deliver effective energy efficiency messages. *"We concluded that messaging to consumers in a way that includes an emotional appeal to the priorities of each of the five segments is a key success factor for increasing the adoption of energy-efficiency programs"* is an affirmation included in a report from McKinsey&Company [6] making reference to the five types of consumers they discovered previously. Clustering is the best way to identify which are the potential consumers for specific campaigns and personalization is the most effective approach to assure that consumers will receive the information through a pleasant and enjoyable experience.

A simple approach to consumer segmentation is done by identifying common load profiles. Taking into account the time of the day with highest energy consumption, one can deliver energy savings tips more relevant to consumers. This methodology has been used by Opower [7]. In this case, they analysed energy consumption data from 812.000 utility customers in US and through advanced clustering techniques, they identified five different patterns (see Figure 5). The identification of these archetypes is a very powerful source of information to be used in new business opportunities for utilities and their customers. For example, demand response events can be focalized for those customers with high energy consumption during peak demand periods.

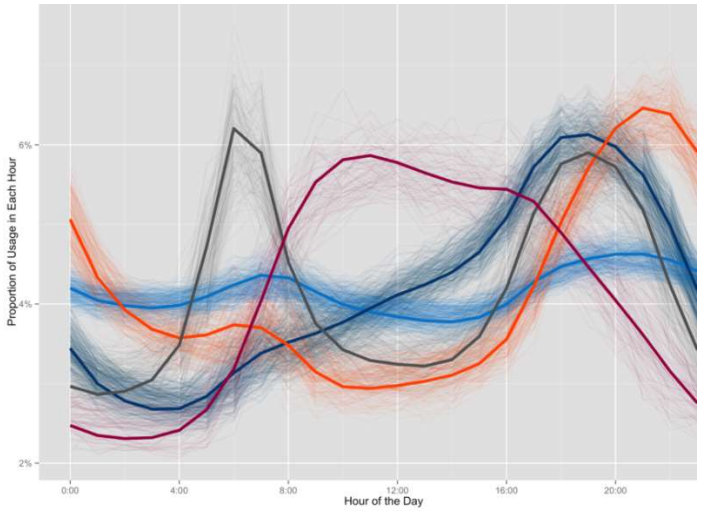
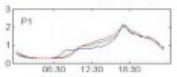
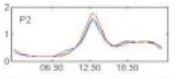
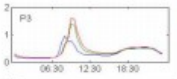
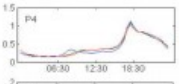
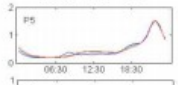
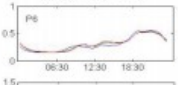
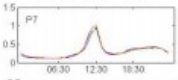
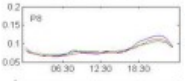
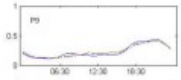
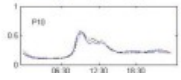


Figure 5. Load curves from 1000 customers [7]

The same approach has been used in [8] to identify profile groups through their electricity load curve. In this academic thesis, the author recognized ten different profiles each one with specific characteristics presented in Table 1**¡Error! No se encuentra el origen de la referencia.**.

Table 1. Electricity load profiles and main characteristics [8]

Profile Number	Profile Shape (kW)	Main Characteristic	Secondary Characteristic (if any)
Profile 1		Large evening peak	Small morning peak
Profile 2		Large lunchtime peak	Small evening peak
Profile 3		Large morning peak	Small evening peak
Profile 4		Evening peak	Small morning peak
Profile 5		Late evening peak	Small demand across the day
Profile 6		Small average load profile across the day	
Profile 7		Late morning peak	Small evening peak
Profile 8		Very small average load profile across the day	
Profile 9		Small late evening peak	
Profile 10		Small late morning peak	

Besides this, the segmentation of consumers can also be done through a more sociological approach. This is the case of Enerbyte Smart Energy Solutions SL that developed a sociological research based on 400 phone calls survey [9]. Sociological research is a methodology followed by sociologist to study society and social behaviour. As a result, they identified three main groups of consumers presented in Figure 6.

Environmentalist Savers is willing to save energy for economic and environmental reasons, accepting some loss of comfort. **Comfort-Oriented Indifferent** represents the less motivated profile in terms of money savings and environment. Therefore, they are not accepting to lose any level of comfort. **Environmental Investor** is the most sensible for the environment and is willing to make large investments to achieve energy savings goals. A more detailed analysis of each group is presented in [9].

Be able to identify these groups of consumers, help utilities to understand their customers, and allow them to provide personalized energy saving services and promote targeted marketing campaigns. A good approach to identify these groups is by looking at some parameters such as power contracted or annual consumption divided by number of people.

Figure 6. Cluster analysis developed by Enerbyte Smart Energy Solutions SL [9]

Furthermore, McKinsey&Company presented a report in which they segmented US consumers into five groups based on their attitude and behaviour. Figure 7 presents these five clusters with its associated level of energy-saving behaviour.

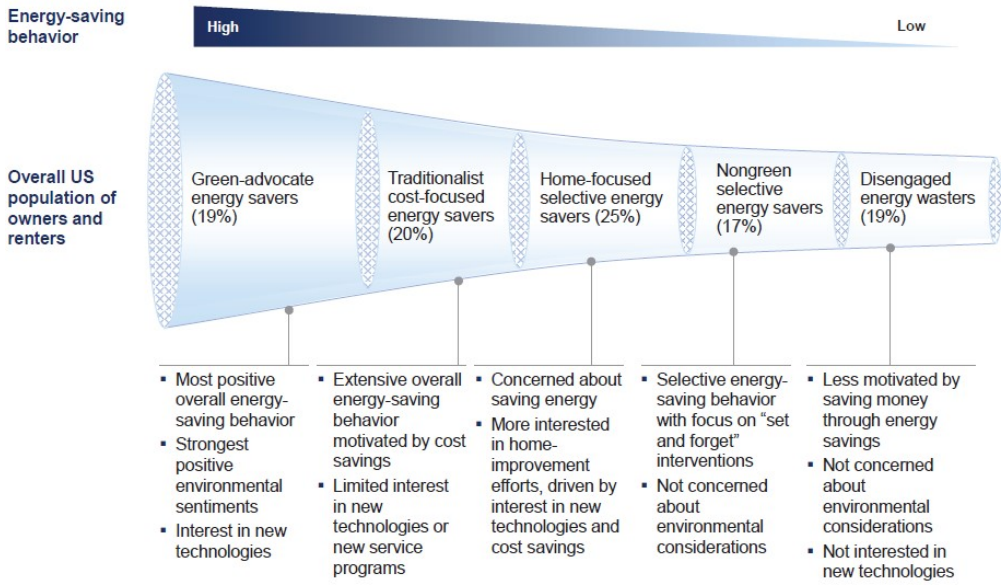


Figure 7. Five US customer segments based on attitudes and behaviours [6]

b) Communication strategies

The way to communicate and interact with energy consumers is crucial to engage them and keep improving their energy efficiency behaviour. Communication messages can be designed using different motivational tools. As it has seen before, personalization is decisive to effectively transmit messages to consumers. However, some approaches had identified

several general motivational experiments: challenging consumers to save money, challenging them to save the planet, tell them to be a good citizen or to do better than their neighbours.

As it is defended in [10], the most stimulant energy conservation approach is by using normative information that compares people between them. Literally, *"normative information spurred people to conserve more energy than any of the standard appeals that are often used to stimulate energy conservation, such as protecting the environment, being socially responsible, or even saving money"*. This conclusion was the result of a research study developed to detect the influence of normative social messages in consumer's energy conservations behaviour. The first part of the study was based on a survey to 810 households in California, whereas the second part consisted on a field experiment that confirmed the theoretical results. In the experiment, households received four types of messages (Economic, Environment, Societal Benefits and Social Norms) while their electricity consumption was being measured. After one month, they observed that those households having received social norm messages were the ones consuming less energy. An example of these messages is presented in Table 2.

Table 2. Sample intervention messages used in the second part of the study [10]

SOCIETAL BENEFITS
Social Responsibility: Do Your Part to Conserve Energy for Future Generations. Summer is here and we need to work together to conserve energy. How can you conserve energy for future generations? By using fans instead of air conditioning! Why? According to researchers at Cal State San Marcos, you can reduce your monthly demand for electricity by 29% using fans instead of air conditioning to keep cool this summer! Using fans instead of air conditioning—The Socially Responsible Choice.
SAVE MONEY
Self-Interest: Save Money by Conserving Energy. Summer is here and the time is right for saving money on your home energy bill. How can you save money this summer? By using fans instead of air conditioning! Why? According to researchers at Cal State San Marcos, you could save up to $54 per month by using fans instead of air conditioning to keep cool in the summer.
SAVE THE PLANET

Environmental Protection: Protect the Environment by Conserving Energy. Summer is here and the time is right for reducing greenhouse gases. How can you protect the environment this summer? By using fans instead of air conditioning! Why? According to researchers at Cal State San Marcos, you can prevent the release of up to 262 lbs of greenhouse gases per month by using fans instead of air conditioning to keep cool this summer! Using fans instead of air conditioning—The Environmental Choice.
SOCIAL NORMS
Descriptive Norm: Join Your Neighbors in Conserving Energy. Summer is here and most people in your community are finding ways to conserve energy at home. How are San Marcos residents like you conserving this summer? By using fans instead of air conditioning! Why? In a recent survey of households in your community, researchers at Cal State San Marcos found that 77% of San Marcos residents often use fans instead of air conditioning to keep cool in the summer. Using fans instead of air conditioning—Your Community's Popular Choice!

Besides this, the effect of different types of feedback has been identified in [11]. It is important to consider that this information can be delivered to the consumer before or after his consumption occurs having different impact. As it can be extracted from Figure 8, energy savings vary for each type of feedback, being "direct" or real time feedback the one with the highest scope of energy savings.

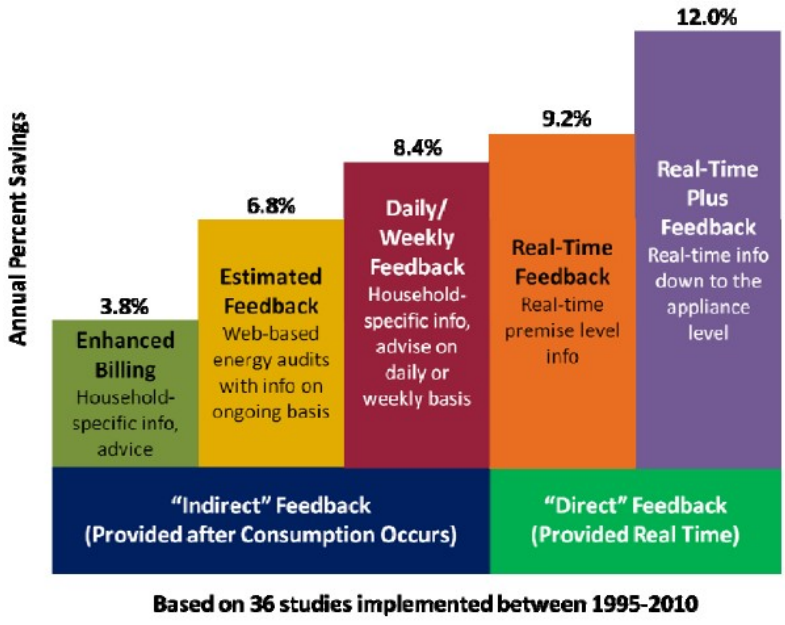


Figure 8. Average household electricity savings (4-12%) by different feedback types [11]

To sum up, the differences between types of feedback affect directly to the final impact on the consumer's energy savings. The highest energy savings are achieved by using daily/weekly and real-time feedback. However, authors in [11] cited that these estimates are based on small size samples and thus, more studies are needed to confirm these conclusions.

Furthermore, other researches [12] distinguished that "indirect" types of feedback are more effective when considering changes that imply high investment. For example, these types of feedback provide more understandable insights on the effect of changing the space heating system or to purchase a high consumption appliance. Besides this, "direct" types of feedback are more difficult to provide and have a higher impact when connecting energy savings to smaller consumptions such as lighting or TV media.

c) Five Universal Truths

This section is based on a white paper from Opower [13]. In this case, the authors researched and surveyed across 12 countries (US, Canada, UK, Spain, France, Germany, Sweden, China, Japan, Indonesia, Australia and New Zealand) in order to discover five requirements from utility customers that are almost universal despite geography, culture or regulation differences. The five universal truths found are resumed in Figure 9.

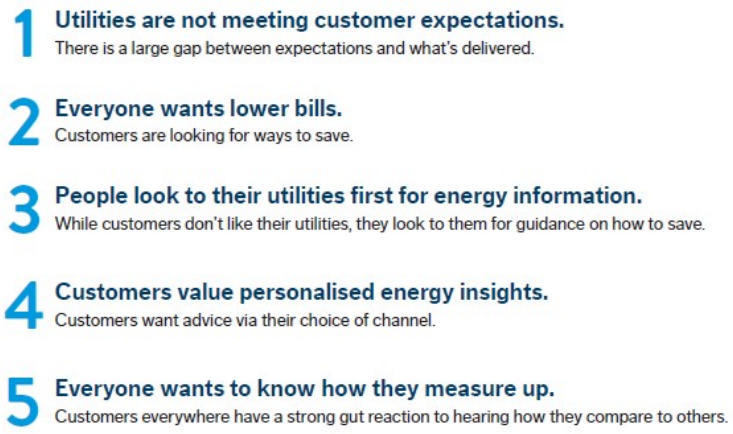


Figure 9. Five universal truths [13]

Utilities are not meeting customer expectations: Despite this fact could differ between liberalized or non-competitive markets (see *Energy retail market* in page 7), they found out that in general customers expect more added value services from their utilities. However, the expectation level varies slightly between continents.

Everyone wants lower bills: People want to save energy and thus, save money at the end of the year. Surprisingly, this fact occurs regardless the cost of electricity. In [13], they present a correlation graph between the electricity price and the consumer satisfaction of each country in order to observe if any relationship existed. The graph demonstrated that there is no relationship between the cost of electricity and the customer satisfaction.

People look to their utilities first for energy information: When they asked customers about which institution was they preferred to receive energy related services, the most common answer was the utility company. Despite the fact that customer satisfaction levels are low, utilities are still well positioned as the favourite energy provider for current consumers.

Consumers value personalised energy insights: As commented in *Type of consumers* in page 11, personalized information is key to increase customer engagement and keep their attention in the long-run. This study demonstrated that this fact occurs all over the world.

Everyone wants to know how they measure up: This point is referring to the study in [10] that defended the effectivity of normative social comparison between consumers in front of economic, environmental or society goals.

3. Energy retail market

a) Market description

This section is intended to describe how energy is supplied to residential homes and to introduce the stakeholders involved in the electricity value chain in order to understand their roles and the energy retail market operation.

Figure 10 shows a simple scheme of the whole process to transport electricity from the power plants to residential homes.

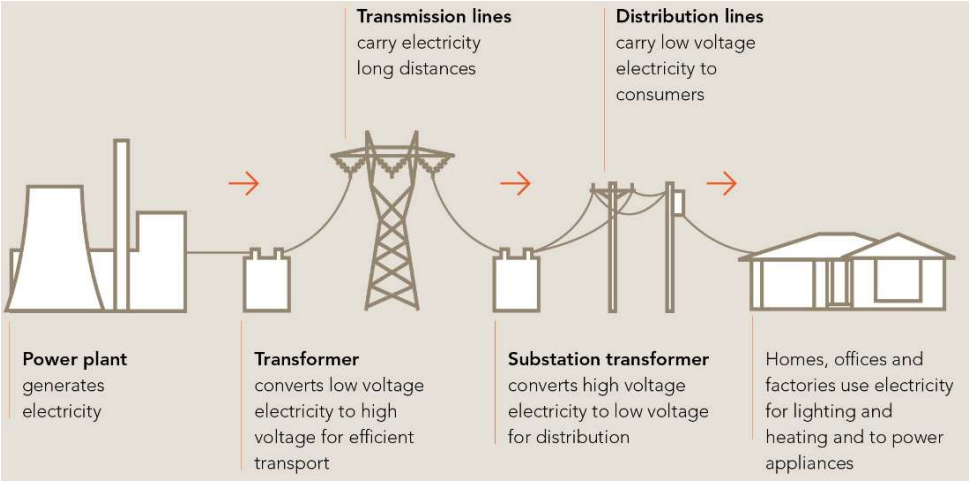


Figure 10. Transport of electricity [14]

Electricity is produced in power plants that can fuel using different energy sources (coal, gas, nuclear, hydro, wind, solar, etc.). Companies managing power plants are commonly referred as **Generators**. After the electricity is produced, it is immediately transported. At this stage, all the electricity coming from different energy sources is merged in the same transmission lines. To decrease losses during the transportation, electricity is converted to high voltage. The management of high voltage transmission lines is done by the **Transmission System Operator (TSO)**. Finally, to distribute the electricity among end consumers, the voltage is decreased and electricity is distributed through the distribution lines. This part of the system is managed by the **Distribution System Operator (DSO)**. However, the electricity is not delivered to consumers directly. The figure that sells the electricity to end consumers is the **Retailer** which has previously bought the electricity from the pool market.

Furthermore, there are two more important figures involved in the energy value chain. On the one hand, there is the **System Operator** which is an independent stakeholder with the objective to assure an efficient management of the system. His main duty is to balance the production with the demand. On the other hand, **Regulators** should also be considered because of its influence. This is the figure that sets the regulatory framework. Figure 11 illustrates the position that each figure occupies in the energy value chain.

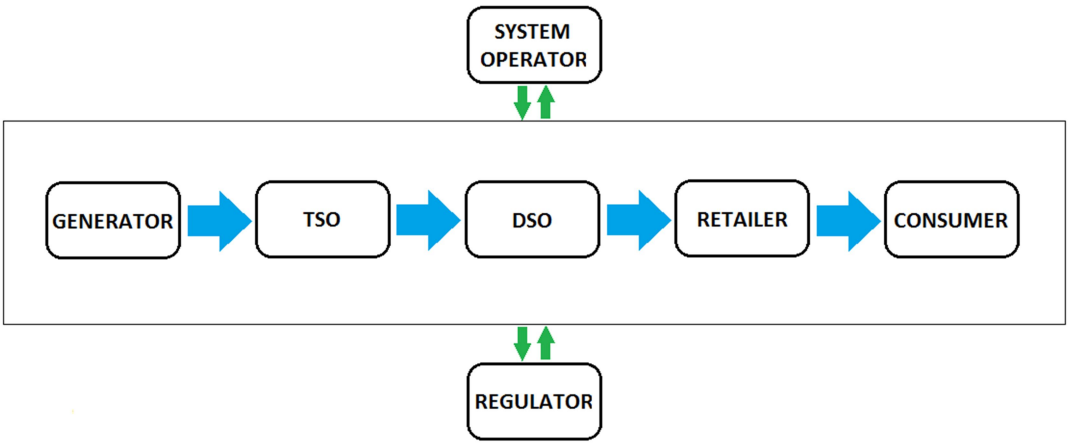


Figure 11. Figures that influence the traditional energy value chain

In general, the scheme in Figure 11 can be applied to all electricity retail and gas markets across Europe. However, each country has his singularities and there exists important differences in the legislation of each market that affect significantly the possibilities of emerging business around it.

Such differences could be the degree of liberalization of the market, the competitiveness within each stakeholder, the role of the market operator or the bargaining power of regulators. Depending on these parameters, the pain suffered by each figure is different and the businesses emerged from it are viable or not.

For example, on the one hand, a potential business could be to provide a solution to DSO's (or even to the System Operator) in order to allow them managing more efficiently the grid. However, to make this business viable, DSO's should have some motivations to manage the grid more efficiently. These motivations could be caused by several facts: DSO's needs to increase the capacity of the grid or regulators are incentivising grid efficiency with economic penalizations. If none of these problems exist, a business addressed to DSO's would not be viable. On the other hand, the will of retailers to invest in customer engagement solutions is directly linked to the fear they are facing for losing customers. This fact depends a lot on the competitiveness of the retail market.

b) Smart meters [15]

A smart meter is an electronic device that measures energy consumption (electricity, gas or water) in intervals of hours or minutes. The data collected by smart meters is transmitted to utilities for billing purposes. However, the possibilities offered by the evolution of smart meters are wider and they can be applied for many purposes.

For example, the communication between smart meters and central systems has suffered significant improvements. Nowadays, it is commonly referred as Advanced Metering Infrastructure (AMI) which means that the smart meters are able to communicate in a two-way

channel between the central system and the smart meter. Earlier smart meters were only able to send information in one way, which was referred to Automated Meter Readings (AMR).

Regarding the type of energy source, there are different types of smart meters: for monitoring electricity, gas and water. In each case, the smart meter is different and the actual level of implementation is also different. In parallel, the type of technology may also differ between same energy measures smart meters.

In general, smart meters transmit data through a Local Area Network (LAN) to a data collector. The frequency of such transmission depends on the use of the data and it covers between 15 minutes to one day. Afterwards, data is transmitted through a Wide Area Network (WAN) to the utility central system. Furthermore, there are different types of technologies: Radio Frequency (RF) and Power Line Carrier (PLC). The selection of each technology is done considering several parameters such as the existing infrastructure, technical requirements or the advantages of each technology.

As stated before, smart meters can be used for the benefit of utilities, but also for consumers. On the one hand, utilities and system operators (DSO's and TSO's) can use the information to manage the grid system more effectively. The main example of such applications is the use of smart meters in demand response programs. On the other hand, consumers can also take advantage of smart meters information. For example, consumers can allow third parties specialized in energy efficiency to access to their consumption data in order to receive recommendations on how to save energy.

As a result, smart meters are a critical issue in Energy Efficiency Management (EEM) solutions. Consequently, to start a business within the energy efficiency residential market, it is very important to know the level of smart meters deployment in each country and the exact process to access to the data generated.

In the next lines, an introduction of smart meters data access for third parties in Europe will be presented inspired on the information extracted from the research study [16].

The implementation of smart meters is in relation with the European energy objectives by 2020. EU energy objectives for 2020 are divided in three actions: to decrease 20% CO2 emissions compared to 1990, to attain 20% of renewable energy use and to increase 20% energy efficiency compared to baseline scenarios. As a result, the residential market represents one of the approaches to achieve these challenges.

On the road to increase energy efficiency in residential homes, the European commission has established the objective to replace 80% of electricity meters by 2020. This change is expected to reduce emissions and home energy consumptions by approximately 9%. In 2014, the commission reported about the current state of accomplishment and they provided several significant numbers [17]:

- By 2020, it is expected that 72% of European consumers will have installed an electricity smart meter and 40% a gas smart meter.
- This represents 200 million of electricity smart meters and 45 million of gas smart meters.
- The cost of installing a smart meter is between 200€ and 250€. The potential savings provided by smart meters are, on average, 309€ for electricity and 160€ for gas. The average of energy saving is around 3%.

Besides this, to achieve European goals, each country has a different legislation in the field and the objectives vary across countries. Consequently, it is important to analyse country by country which is the level of smart meters roll out and the use that can be done with the data generated by them.

Regarding the percentage of smart meters rollout, Figure 12 illustrates the objectives established by each country. Furthermore, as a percentage can provide a confusing idea on the size of each market, it has been plotted as well the absolute number of smart meters to be installed.

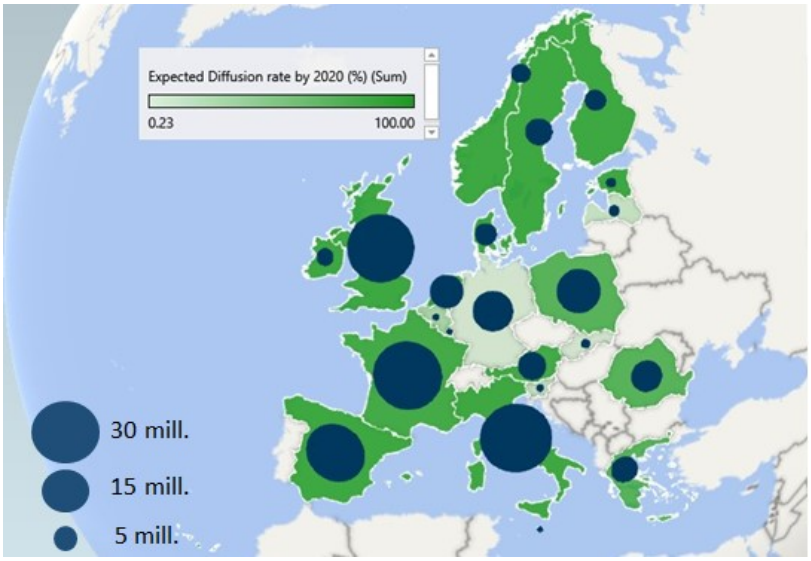


Figure 12. Target on smart meters deployment by 2020 [16]

Besides this, the difficulties to access smart meters data may be the main problem for companies willing to explode that information in some countries. In general, the directives are on the road to facilitate access of third parties in order to enhance functionalities for the benefit of consumers. However, as stated before, the legislation across countries is very different. Figure 13 identifies the possibilities of access to smart meter data by third parties.

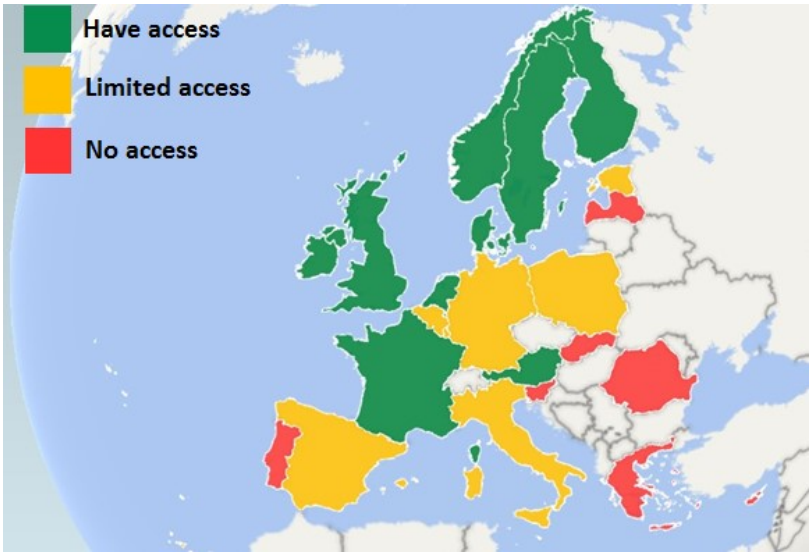


Figure 13. Third party data access [16]

The information presented in Figure 12 and Figure 13 give an insight of which European markets are more interested to start a business based on the data generated from smart meters. By comparing the biggest markets with the ones with data access, one can obtain the most suitable ones.

Finally, after selecting some candidates, it is also important to consider the process to access that data because it varies in each country. For example, a significant difference results from the location where third parties have to extract the data from. This can be managed through the utility web portal or through a central data hub. The importance of such difference is that each option affects directly the design of the business model. If the utility is not involved in the process of accessing data, companies can consider designing their business around a B2C model. However, this option is more complicated in those situations where it is indispensable to partnership with utilities to have access to smart meters data.

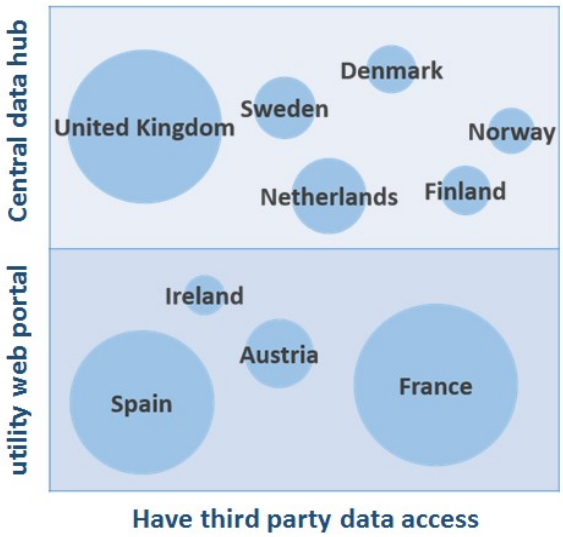


Figure 14. Difference on where to extract smart meters data from [16]

c) New players: Prosumers

The electricity market has suffered several changes in the recent years and it is still in a constant evolution. A clear innovation within the energy market is defined by the emergence of a new figure: the prosumers. The identification of such community is done because they are players operating both in the demand side and in the production side.

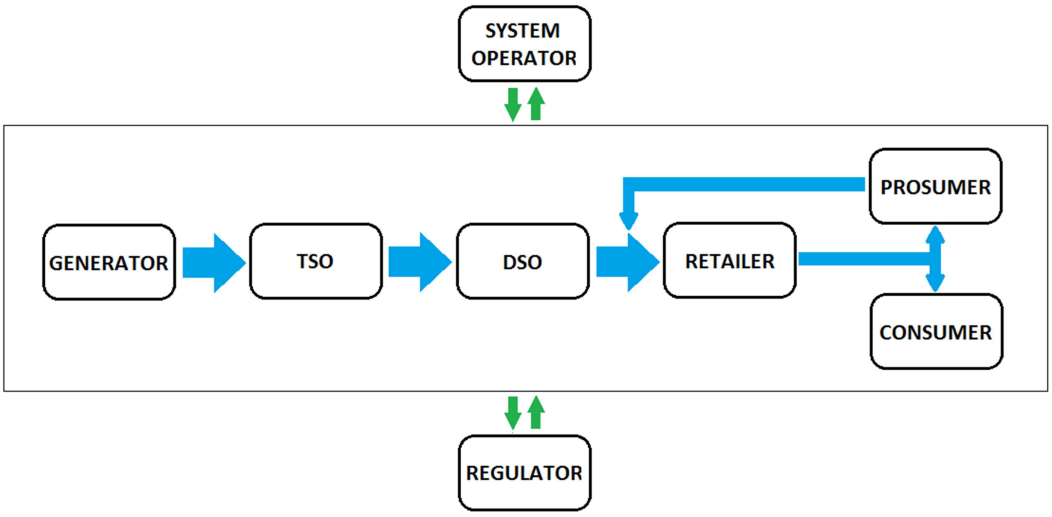


Figure 15. The emergence of Prosumers in the energy value chain

Figure 15 illustrates what is the position of prosumers into the energy value chain when they act as producers and consumers. However, it is important to distinguish two different types of prosumers: prosumers connected to the grid (Figure 15) and prosumers off-grid. The second type of prosumers is not connected to the grid and thus, they cannot inject electricity. Consequently, they use batteries to support their remote system: store the excess of energy produced when the demand is low and consume energy when the production is low. This type of prosumers is more common in countries with low electrification rates, where distributed energy systems are the only mean to access electricity. Nevertheless, this study focus on the type of prosumers illustrated in Figure 15 because it is the most common in developed countries.

The growth of the community of prosumers is an opportunity for emerging business around energy management. Prosumers represent a new figure to address energy management tools with singular characteristics and special requirements. As a result, one of the many features analysed in the block *Ecosystem* (*Competitor Analysis*) will be the presence of services specifically designed for prosumers.

Prosumers are not difficult to identify, but capturing them is a big challenge. Several prosumers characteristics have been identified in [18]:

- Prosumers are early adopters of technologies.
- The salary of prosumers is 15% higher.

- Prosumers use solutions to keep in touch with family and friends such as social networking.
- Prosumers are interested in entertainment.
- Prosumers want to be connected and serviced always and everywhere.
- Despite being technology lovers, they appreciate simplicity in solutions.
- Prosumers are mainly smartphone users, but they also use frequently tablets and laptops.

Besides this, it is also important to mention the importance of smart meters in prosumer services. As stated in [19], an adequate metering data provided by smart meters with an interval reading of one hour or less is the key to create the most suitable business environment for companies to offer services to prosumers.

The prosumer segment may be still small, but what makes it interesting is its expected continuous growth for the future (see Figure 21). In 2008, the research study [18] affirmed that prosumers represented 4.5% of the total population in USA, which signified 14 million. Moreover, they declared that a similar percentage of prosumers can be estimated globally in developed countries.

In parallel, study [20] displays the rapid growth of solar PV market with an estimation about the percentage of residential sector.

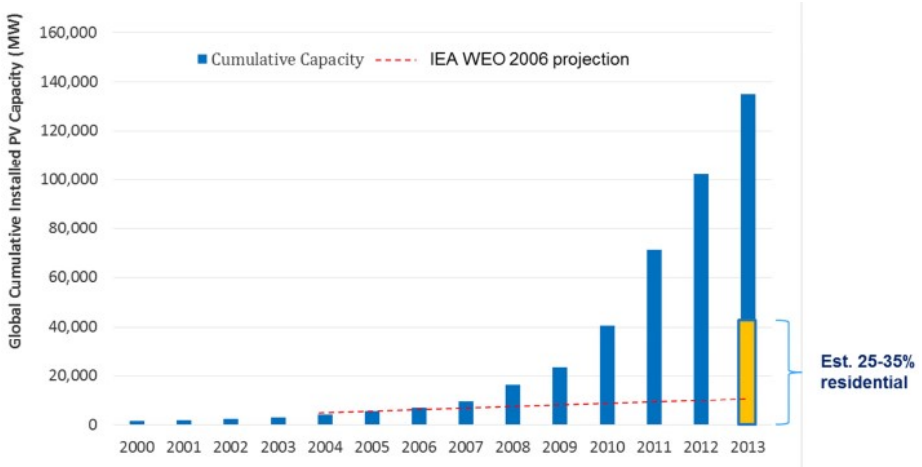


Figure 16. Evolution of cumulative PV capacity and estimated residential share for 2013 [20]

These values are based on data from the PV market in Europe, North America and Asia. The information has been gathered considering different sectors or the system sizes. The aim of such study is to demonstrate that residential systems represent an important share of the global PV market. However, authors in [20] comment that more research should be done in order to obtain more accurate estimations.

Previous information from [18] and [20] offer an initial approach to the market size of prosumers; however, this study aims to provide a more detailed estimation about the size of the market in Europe.

Figure 17 presents the increase of PV capacity in the European countries since 2000. This is a first approach to the size of the market in each country. However, the values presented here correspond to all the sectors where PV systems are installed: ground mounded, industrial, commercial and residential.

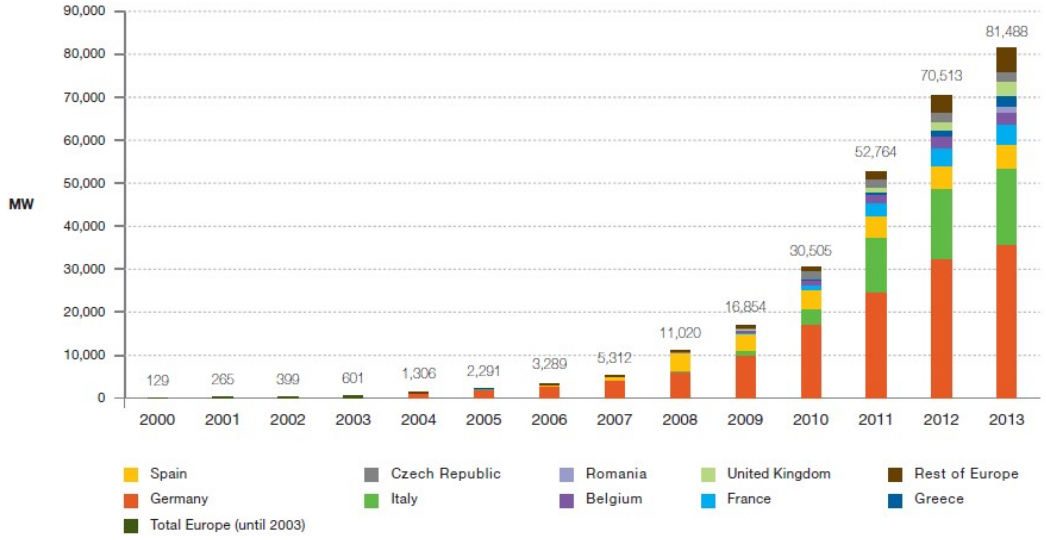


Figure 17. Evolution of PV installed capacity in Europe [21]

Consequently, it is important to know the percentage composed by the residential sector which is included in Figure 18 and Figure 19. Figure 18 presents the percentage at European level and it is interesting to observe the changes between 2012 and 2013. The residential sector has been increased by 1 point of percentage. Moreover, to evaluate the size of each European country, the PV cumulative market segmentation is presented in Figure 19 for 2013. Then, by bringing together Figure 17 and Figure 19, one can estimate the concrete size of the PV residential market in 2013.

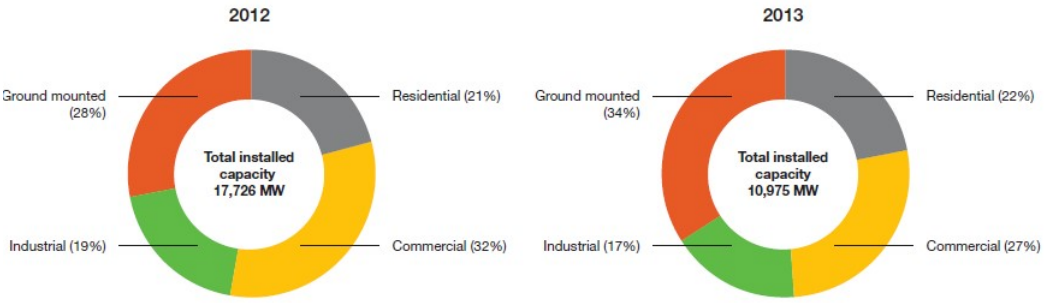


Figure 18. Evolution of PV market segmentation in Europe between 2012 and 2013 [21]

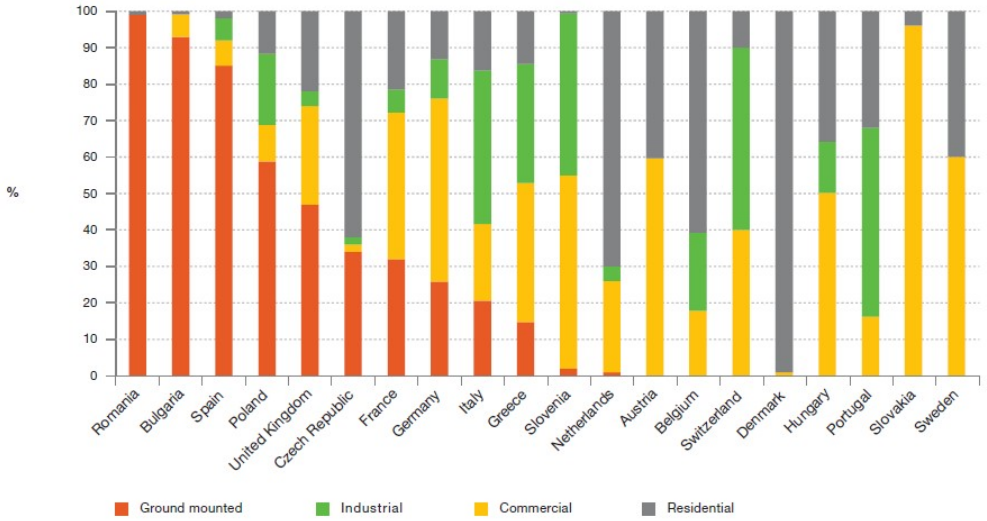


Figure 19. PV cumulative market segmentation by country in 2013 [21]

Moreover, Figure 20 shows which were the countries with a higher increase of prosumers during 2013.

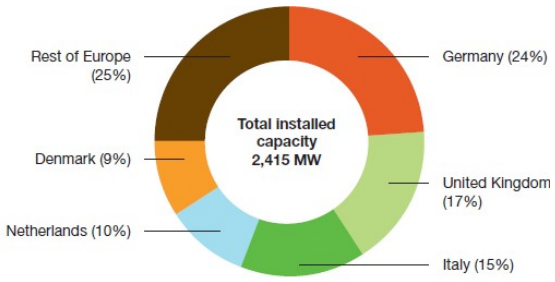


Figure 20. Top five European Residential PV markets in 2013 [21]

Besides this, other factors need to be considered when estimating the size of the prosumer market. For example, it is important to consider the prosumer legislation of each market in order to forecast the rate of growth of the market. Figure 21 demonstrates that all scenarios agree on a general growth of the PV market in the coming years. However, the information provided is at European level and it may vary considerably across countries. Consequently, it is very important to know the political support to solar energy in each country. For example, in those countries where the support to PV is low or inexistent, the market is not expected to suffer an immediate growth (see Table 4).

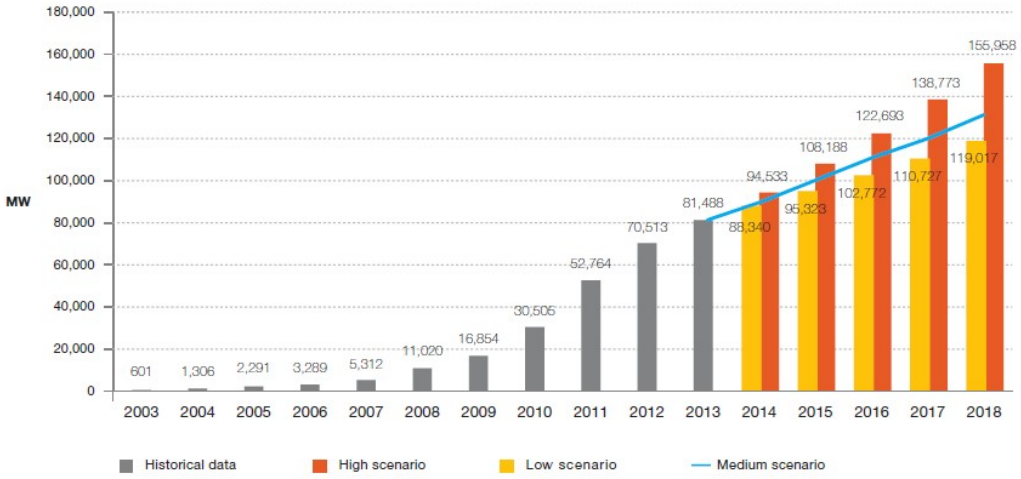


Figure 21. European PV market capacity forecasts [21]

Finally, the information presented here is expressed in terms of power capacity. However, it may be more interesting to express the size of the market with number of prosumers in order to know, to how many users energy management tools could be addressed. The capacity of grid connected PV residential systems vary from 2 to 10 kWp. Then, one can divide the PV power installed in residential sector by 10 kWp in order to obtain the estimation of the minimum number of prosumers in each European market. Results are presented in Table 3.

Table 3. Number of prosumers estimation in 2013

	PV cumulative capacity 2013	Residential segment 2013	PV Residential capacity 2013	Minimum number of prosumers
Austria	613	40%	245.2	24520
Belgium	2983	60%	1789.8	178980
Bulgaria	1020	2%	20.4	2040
Czech R.	2175	62%	1348.5	134850
Denmark	548	98%	537.04	53704
France	4673	22%	1028.06	102806
Germany	35715	14%	5000.1	500010
Greece	2579	14%	361.06	36106
Hungary	22	36%	7.92	792
Italy	17928	16%	2868.48	286848
Netherlands	665	70%	465.5	46550
Poland	7	12%	0.84	84
Portugal	278	32%	88.96	8896
Romania	1151	2%	23.02	2302
Slovakia	524	4%	20.96	2096
Slovenia	212	1%	2.12	212
Spain	5340	2%	106.8	10680
Sweden	40	40%	16	1600
UK	3375	22%	742.5	74250

Table 4. Political support prospects for PV in Europe [22]

Austria	
Belgium	
Bulgaria	
Croatia	
Czech Republic	
Denmark	
France	
Germany	
Greece	
Italy	
Malta	
Netherlands	
Poland	
Portugal	
Romania	
Slovakia	
Spain	
Switzerland	
Turkey	
United Kingdom	

II. Company presentation

This study has been developed as the MSc thesis of the author and in accordance with the company *Enerbyte, Smart Energy Solutions SL*. Consequently, this block of the project is intended to introduce the solution offered by *Enerbyte* and the markets where the product is currently being applied.

1. Description of the product

Enerbyte presents his product as a Virtual Energy Advisor and compares it with a GPS for energy efficiency. The software developed is designed to collect hourly consumption data from smart meters and deliver personalized energy savings tips. Moreover, the input data is also enriched by the information that users want to introduce about their home.

The business model is based on delivering the service to residential customers through utilities or smart cities.

Figure 22. Product presentation of Enerbyte

The service informs the residential consumer about his energy efficiency level compared to his neighbours. Moreover, it uses gamification strategies such as gratification badges or efficiency rankings in order to engage the users into the platform. Hourly electricity prices are also included in the platform and recommendations about the cheapest time periods for turning on appliances are provided.

An important characteristic of the solution proposed by Enerbyte is the incorporation of a community within the platform. This tool allows users to interact and share questions and answers. Moreover, it can be used to promote the community achievement of social trends

(for example, reducing energy poverty in the community). More specific features regarding the product of Enerbyte are considered in the comparison with other competitors (see section *2.Market segmentation* in the Annex).

2. Current market presence

Enerbyte is involved in several projects mainly in the country of Spain, but also in other European countries (see Figure 23). Most of its customers are smart cities; however, it is also collaborating with one utility.

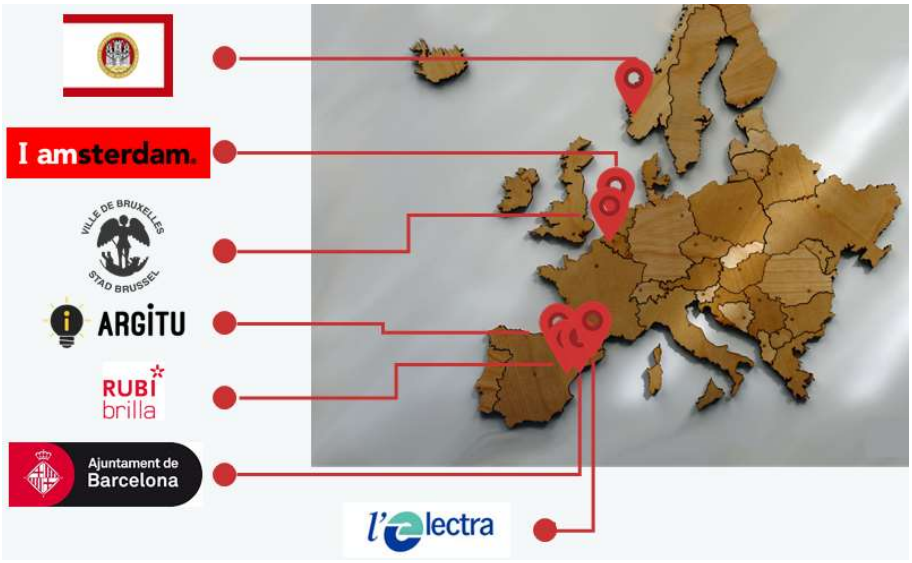


Figure 23. Current projects of Enerbyte in Europe

The market presence of Enerbyte is dominated mainly by the Spanish market despite the non-favourable conditions of the Spanish energy market for starting businesses around energy services for the residential sector. As a result, the vision of the company is at European level because other markets are more suitable for this type of solutions. Consequently, Enerbyte has been selected by the EU to replicate his experience with smart cities in Spain to other European cities: Brussels (Belgium), Amsterdam (Netherlands) and Bergen (Norway).

The roadmap of Enerbyte in terms of number of users is presented in Figure 24. It has started in 2014 with a pilot project of 100 households in the city of Rubí and it is expected to achieve the value of 1 million of users by 2017.

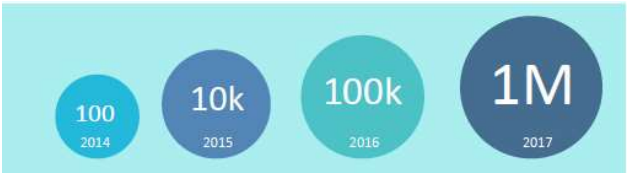


Figure 24. Roadmap of Enerbyte

III. Ecosystem

The aim of this section is to analyse in deep most of the companies offering energy management services to residential users. Some of the companies presented in this study provide energy management solutions to residential consumers as one of their main products; while some other companies have a residential energy management solution as their main product. This is an example of the wide variety of companies that will be presented in this analysis.

The objectives of such analysis is to understand how are the energy efficiency solutions performing in the residential market, what are the main differences between Business to Business (B2B) and Business to Customer (B2C) solutions and where are the biggest potential business opportunities.

1. Competitor Analysis

The competitor analysis presented in this section is based on 40 companies from around 14 countries across the world. The list of companies is available on the Annex (*List of companies* in page 85). The competitor analysis will be developed around the characteristics of their product and the type of business. Furthermore, it is important to highlight that the research has been based on the information available in their official websites or in LinkedIn and in some articles from scientific journals.

a) Description of the parameters

The first parametrization is done regarding the channel used to reach the end users (residential consumer). There are two main choices: B2C or B2B. Furthermore, within B2B solutions there are several options depending on which business is served.

B2C: Residential consumers can contract directly the services and products provided by these companies.

B2B: Companies offering their solution to other business companies.

- **Utility:** Companies offering their solution to utilities as an added value service for their customers.
- **Institutions/Smart Cities:** Companies offering their solution to public institutions, city councils, municipalities, etc.
- **Communities/SME's:** Companies offering their solution to small and medium enterprises (SME's) or community buildings.

Regarding the product, channels to communicate with consumers and its features of each solution have been identified. Moreover, the analysis also considered the possibility to

monitor gas and water consumption (apart from electricity), the necessity of installing additional hardware and also the process to obtain the data.

Channels

- **Smartphone app:** Energy management platform available to be used through a mobile app.
- **Web portal:** Energy management platform available from the computer in a website.
- **Newsletter/Reports:** Frequent reports that summarize the consumer performance. These can be paper reports or emails and the frequency of delivering such information is varied.

Features

- **Comparison:** Comparison tools are available for the consumer. It is important to distinguish between different levels or quality of comparison.
- **Community:** The platform allows consumers to share their achievements with the community or to interact with other users.
- **Gamification/Rewards:** The solution includes the organization of friendly competitions that can be rewarded with virtual points or badges.
- **Prosumer:** The possibility to monitor energy production from microgeneration sources.
- **Temperature:** Monitoring of the home temperature is included on the platform. In most of the cases, this is linked to the availability of smart thermostats.
- **Remote control:** The platform allows consumers to remotely control heating, appliances or lighting.
- **Notifications:** Possibility to send notifications to consumer for alert purposes, irregularities or events organizations.
- **Marketplace:** A marketplace is incorporated within the platform. This can include energy related products or not.
- **Demand response:** The platform allows consumers to participate in demand response programs to save energy during peak demand events.
- **Disaggregation:** The solution uses algorithms to identify the pattern consumption of some appliances.

Electricity: The solution includes monitoring of electricity consumption.

Gas: The solution includes monitoring of gas consumption.

Water: The solution includes monitoring of water consumption.

Hardware based: The solution uses some type of hardware product to deliver energy management tools.

Type of data

- **Smart meter:** Consumption data is obtained from smart meters
- **Submetering:** Consumption data is obtained thanks to the installation of a gate connected to the home electric box.
- **Billing:** The only consumption data available is the one presented in the bill.

b) Analysis procedure

Each company analysed has been located in all the parameters previously mentioned in order to be able to extract conclusions when looking at the complete analysis. However, the author would like to state that in some cases it was difficult to locate companies in specific parameters due to lack or not clear enough information. For this reason, it is possible that some discrepancies appear between other similar studies.

As can be seen in page 86 (2.Market segmentation), those companies matching the specifications defined previously; have the box fulfilled in green. Otherwise, the box is painted in red. However, some of the contain text in order to clarify and give more information when is needed.

Furthermore, an analysis using data from LinkedIn has been done in order to observe common patterns within the companies offering energy management services.

c) Market segmentation

The first segmentation done in order to proceed with the analysis has been between B2B companies, B2C companies and utilities offering their own solution.

From the 40 solutions analysed; 20 correspond to B2B companies, 14 to B2C companies and 6 to utilities (see Market segmentation in page 86).

d) Market findings

Regarding the data available on LinkedIn, several findings have been extracted. On the one hand, when plotting the year of foundation of each company into a one-dimensioned temporary graph (see Figure 25), it can be observed that most of the companies were created during the last 10 years. As a result, it can be concluded that most of competitors within this business are start-ups working to achieve a dominant position in the market.

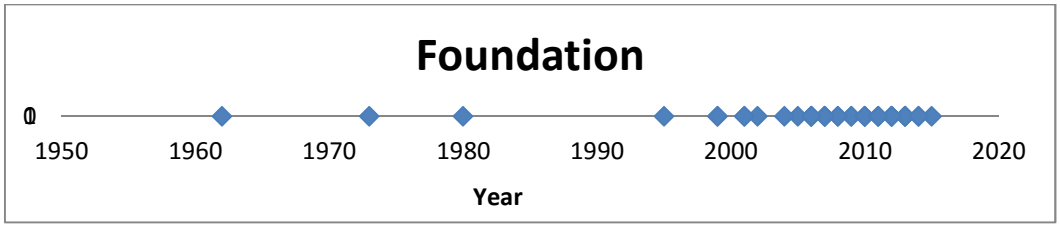


Figure 25. Year of foundation (Data: List of companies in p. 85)

Figure 26 gives a more detailed insight on the number of companies founded during the last 10 years.

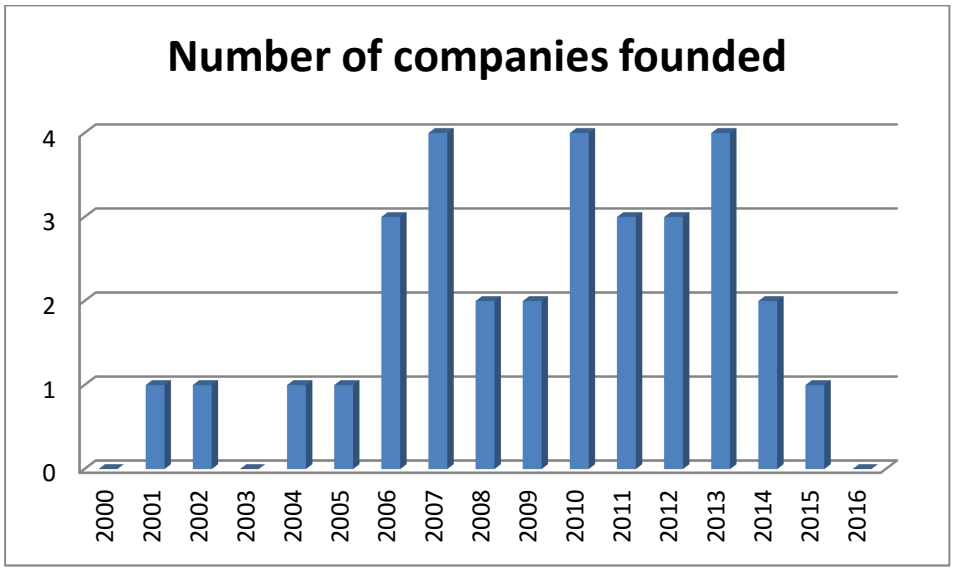


Figure 26. Number of companies founded since year 2000 (Data: List of companies in p. 85)

This fact is coherent taking into account the characteristics of the type of service provided. Businesses created around energy management are one of the applications appeared from Big Data world and therefore, all the solutions are innovative. *Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate* [23].

To confirm these conclusions, it has been plotted the size of each company in terms of number of employees (see Figure 27). As it was expected, most of the companies are in the category of 11-50 employees. Moreover, the second position is occupied by companies with 1-10 employees. This fact demonstrates that the companies in the market are mostly start-ups or SME's (Small and Medium Enterprises) because the market is new and fresh. Furthermore, the fact that the dominant category is 11-50 employees together with the early year of foundation shows that most of the companies have been successful and thus, the energy management market continues to offer high potential opportunities.

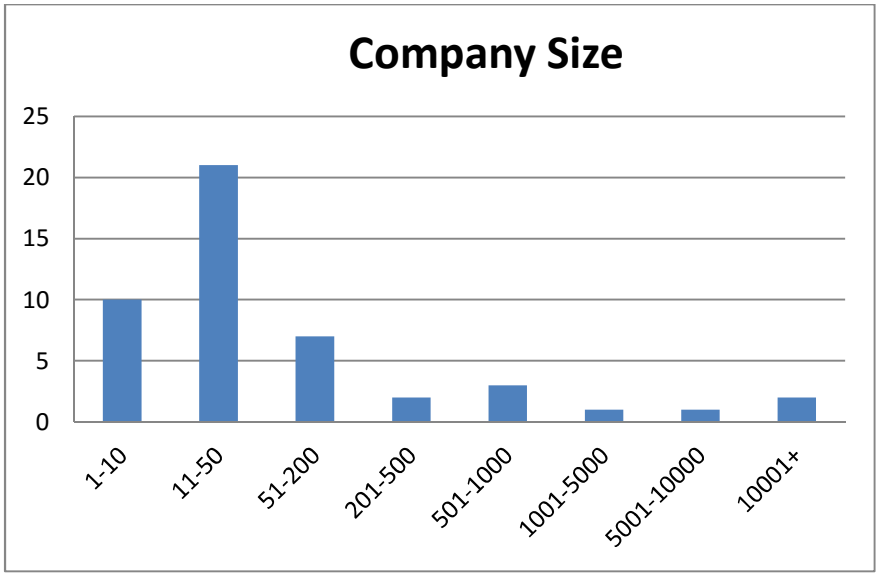


Figure 27. Number of employees (Data: List of companies in p. 85)

e) Summary of Market findings

This section summarizes the main conclusions from the previous analysis based on LinkedIn data.

- The majority of companies offering Energy Management services for residential were founded during the last 10 years.
- This fact is explained by the emergence of Big Data in the same years and the wide range of applications.
- The most common size of companies is 11-50 employees and the second most common is 1-10 employees.
- This fact demonstrates that the market is growing and it contains potential opportunities for businesses to be explored.

2. Results

a) Comparison between B2C and B2B

The data collected regarding the product offered by each company has been used to understand the main differences between those companies addressing directly to residential consumers (B2C) and those companies that use other business to serve their customers (B2B). The most relevant findings from this analysis are resumed in the following lines.

As can be seen in Figure 28, **mobile apps** are used by all the companies analysed. Therefore, it can be concluded that they are considered today one of the most effective channels to interact with users. At the same time, **web based** platforms are offered together with mobile apps in the majority of the cases. Related to these findings, the following

affirmations are made by a Navigant Research [24]: *"The energy app market is still emerging, but the early movers have deployed apps that provide consumption information and suggest steps that customers can take to be more efficient. (…) The number of apps is growing, and customers now expect them to be readily available-either from a mobile device or online through a PC or laptop"*.

As a conclusion, it is widely agreed that mobile apps are a very effective way to communicate with energy consumers. However, as the market is still in its early stage, the effectiveness of the content included into the app needs to be proved. Both mobile apps and web portals are commonly used to communicate with users, but another research could be done considering which content should be introduced in each platform.

Besides this, Figure 28 shows that **newsletters** are more commonly used in B2B companies rather than B2C companies. Newsletters are considered weekly or monthly Home Energy Reports (HER) that summarize the consumer performance during the last period of time and in some cases, these reports are provided together with the energy bill. This fact may be the cause of such difference between B2B and B2C.

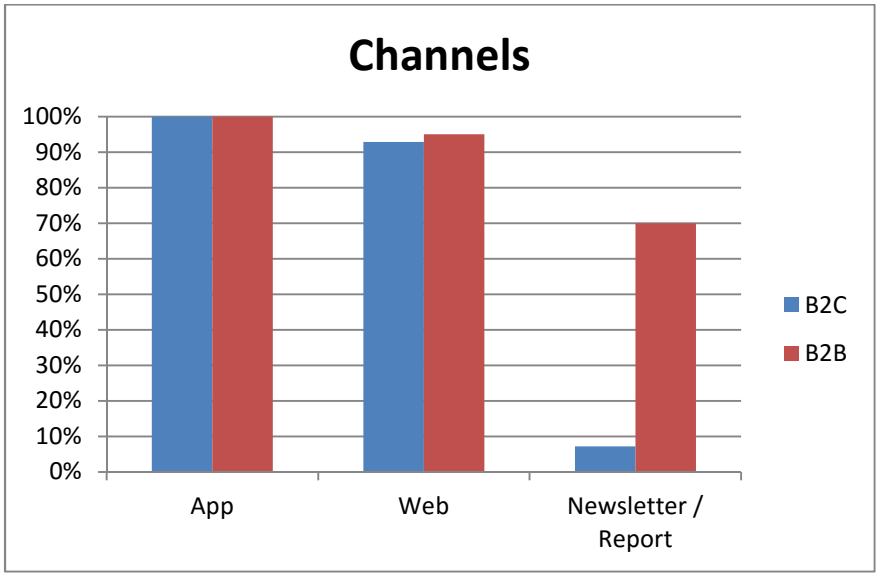


Figure 28. Channels used to communicate with consumers (Data: List of companies in p. 85)

The same experiment has been done by comparing the features included in the product, and the results are presented in Figure 29.

First, it can be observed three features that are more commonly offered by B2B companies: **comparison tools between consumers**, **rewarded friendly competitions** and **notifications sending** are more frequent in those companies reaching end consumers through other businesses. This fact can be explained because B2B solutions are more focused on the customer engagement side of the solution as the core business is to provide an added-value service to utilities, smart cities or communities. In general, B2C companies

are not so intensive in customer engagement. Comparison between consumers is a feature provided as a result of behavioural science studies. Friendly competitions are usually organized to program demand response events and therefore, it may exist some link between these two parameters. The same occurs for notifications sending which are frequently used to advice consumers about peak demand events and competitions dates.

It is important to highlight that **demand response programs** are only offered in B2B companies. This is mainly due to the fact that this solution corresponds to demand side management (DSM) tools. DSM is a methodology used by utilities to decrease energy demand during peak hours and therefore, increase the efficiency of the system. This allows them to avoid the installation of new power plants. Instead of adding more power generation capacity to reach the peak demand, utilities encourage their customers to reduce their consumption during these time periods. (See [25] for more information about DSM)

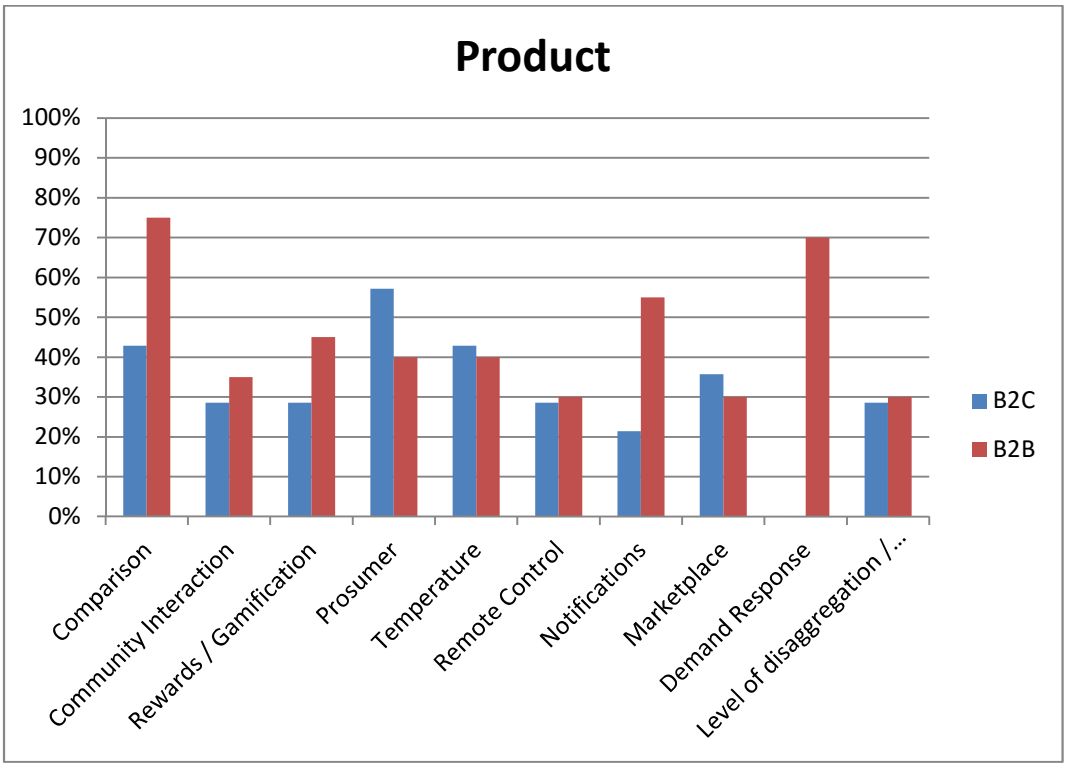


Figure 29. Main features of the energy management product (Data: List of companies in p. 85)

Besides this, it is also important to highlight that B2C companies are more used to incorporate services for **prosumers** into their solutions. This is a good approach for B2C companies to differentiate because the figure of prosumers is usually seen as a threat for utilities. Nevertheless, this observation may differ across different countries and it is expected to change in the future. Utilities will start to change their business model in order to adapt to an inevitable future distributed energy system and consequently, they will ask to incorporate prosumer tools into their customer engagement platforms [26].

There are several ways to **obtain consumption data** needed to offer such services. These different methods also distinguish between B2B and B2C companies as it is shown in Figure 30.

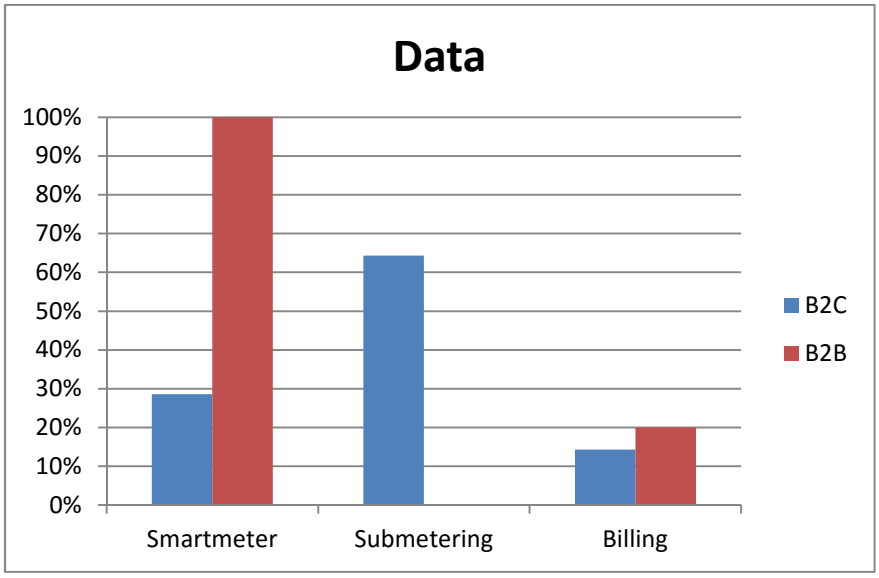


Figure 30. Source of consumption data (Data: List of companies in p. 85)

It is comprehensible that B2B companies use data from smart meters to offer their services because in most of the cases, utilities are the owners or the installers of the smart meters and they manage the data. Consequently, they can allow other companies to use that data in order to generate a customer engagement solution for them. Nevertheless, there are some countries where the legislation regarding the access to data from smart meters is more advantageous for consumers. In those countries where consumers have access to their consumption and have control of the data generated, they can allow external companies to use their data to provide energy management services. In these cases, a B2B model is not required to reach end users and B2C companies can contact directly residential consumers. For this reason, in Figure 30 there is a small percentage of B2C companies using smart meter data.

In the cases where no smart meters are installed or when the accessibility to smart meters data is not possible, submetering devices can be used to obtain consumption data. These devices are installed into the home electric boxes and, in most of the cases; they are connected via Wi-Fi. The accuracy measure of such devices is lower than smart meters and they require maintaining the modem always on. Reference [15] is a study by an independent testing group that revealed that 99.91 percent of smart meters are accurate within 0.5 percent. Besides, in [27] is presented the technical sheet of a submetering device from a specialized electrical company. In this data sheet, the accuracy measurement is 2 percent. However, as shown in Figure 30, at present it is the most common solution for B2C companies to obtain consumption data directly.

Consequently, B2C companies are more used to include hardware in their energy management services as presented in Figure 31.

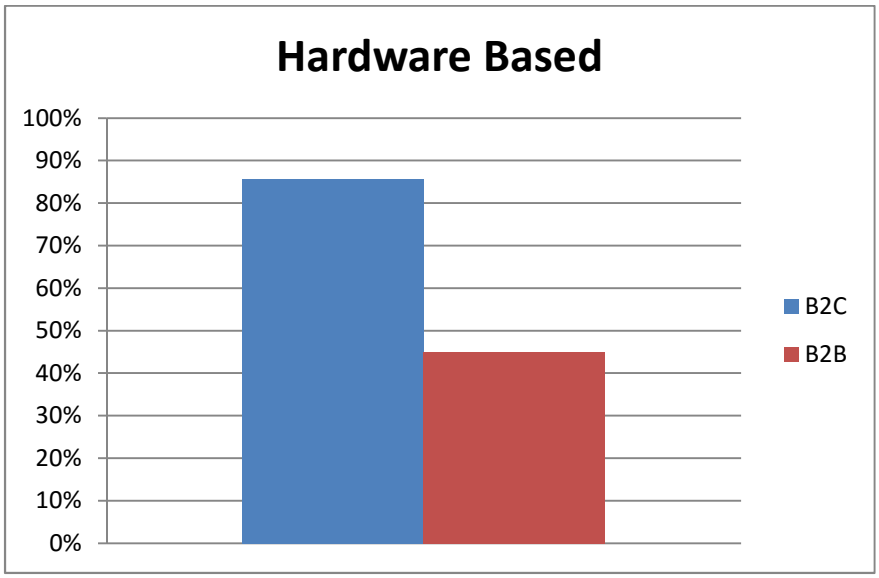


Figure 31. Companies including hardware in their solution (Data: List of companies in p. 85)

This reality can be seen as a drawback for B2C companies in front of B2B, and it explains why most of the companies within this market are using a B2B model. There are several studies that highlight the difficulty of hardware devices to penetrate into residential homes due to the high investment cost associated with it and the short beneficial effects. For example, in a UK newspaper article [28] it is said that *only a tiny minority of consumers have invested in the Internet of Things (IoT) technology, partly due to its high cost*. This article is based on a research survey from Deloitte [29] of 49,000 respondents across 30 countries. Furthermore, some real non-successful experiences also demonstrate the difficulties of introducing smart hardware into residential homes. Big utilities such as *Gas Natural Fenosa* or *Iberdrola* have launch their own solutions based on installing hardware, and they had not been successful to sell to their own customers so far.

b) B2B companies

To analyse the characteristics of B2B companies offering Energy Management services for residential consumers, it has been identified the markets each company is focusing.

As presented in Figure 32, there are some companies completely focused on utilities. These companies are specialized on offering energy management platforms to increase customer engagement of utilities. In this case, this is the main and unique product of the company and therefore, they design the service considering 100% utility purposes. Slogans from *Opower*, "*Elevate your customer experience*", or *Onzo*, "*The customer in focus*", demonstrate which the main mission of these companies is.

The utility approach is the most shared and until now, it is the most successful one. Nevertheless, there are some companies that are innovating on the conventional business model. For example, some B2B companies are providing Energy Management solutions to residential consumers through smart cities and community buildings apart from utilities. This is the case of *Enerbyte* which is providing a service platform to reduce energy consumption of households in Barcelona [30]. Furthermore, B2B companies offering solutions for community buildings have been located in this same category. These are the cases of *Tendril* or *Bee Group (CIMNE)* that provide solutions for building managers apart from utilities.

Some companies have been located in the line dividing two segments because they could be fitted in both of them. However, the approaches of each company use to be different. For example, *Ijenko* is providing solutions for utilities, telecommunication companies and smart cities. Besides, *SilverSpring* is helping utilities and smart cities to modernize their infrastructure.

Finally, there are some companies like *Grid4C* and *C3 IoT* that work with all the stakeholders within the energy value chain and therefore, customer engagement solutions for utilities are only one of their extensive range of products or services.

Figure 32. Market focused by B2B companies (Data: List of companies in p. 85)

The next step is to classify each of the companies located in the "Utility only" sector considering the penetration level of hardware into their solutions. Four levels have been identified:

- **Free of Hardware:** companies offering an energy management platform to save energy without the need of any hardware installation.
- **Energy Bridge/Hub** (see Figure 33)**:** a device usually called "Energy Bridge" that is connected to the smart meter is needed.

- **Energy Bridge + Smart Thermostat:** when the solution also incorporates the installation of a smart thermostat.
- **Smart home:** when many hardware devices can be installed such as smart plugs, remote control devices, etc.

As can be seen in Figure 34, most of the companies are positioned in the sector “Free of hardware”. This evidence is reasonable taking into account that until now, the incorporation of hardware has been seen as a drawback for this type of solutions. Residential consumers are reticent to invest in hardware to monitor their house and therefore, companies opt to forget about hardware based solutions.

Nevertheless, the fact that the majority of companies are located in the same corner can also be seen as an overcrowded market. Consequently, there are some companies trying to innovate on their solutions. For example, *Bidgely* and *Watty* offer the possibility to install an “Energy Bridge” to the smart meter in order to obtain more frequent data and be able to deliver more accurate information. The installation of such device allows these companies to differentiate themselves with the competence by delivering insights on disaggregation appliance consumption. Bidgely is located in the line dividing two sections because the “Energy Bridge” is not indispensable for their solution.

Figure 33. Example of "Energy Bridges"

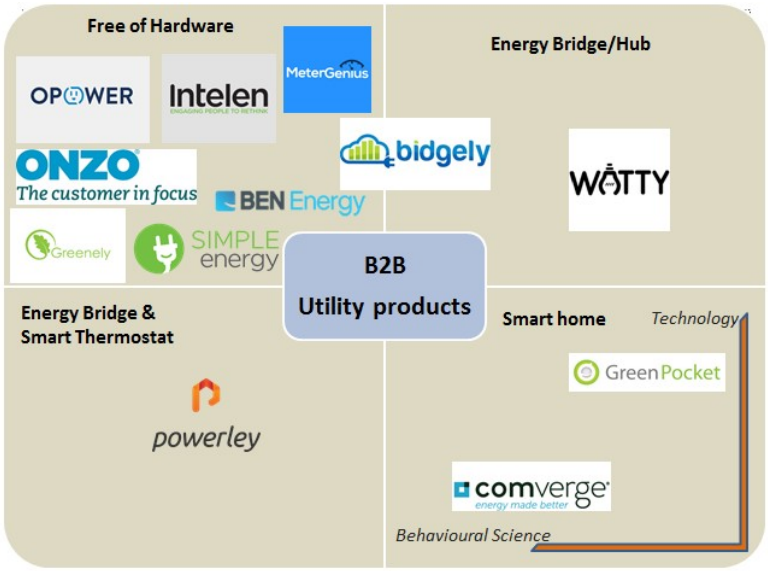


Figure 34. Penetration of hardware in "Utility only" B2B companies (Data: List of companies in p. 85)

The case of *Powerley* is particularly significant because they are the only company in Figure 34 including a smart thermostat into their solution for utilities, together with the previously called “Energy Bridge”. Finally, *Comverge* and *Green Pocket* offer several devices for the complete monitoring and control of the home. In the future, when the concept of “Smart Home” is more integrated in the society, these companies may enjoy of a dominant position.

In addition, those companies competing in the “Free of Hardware” corner have been compared in Table 5.

Table 5. Features of "Free of Hardware" and "100% Utility faced" companies (Data: *List of companies* in p. 85)

	OPOWER	Intelen	ONZO	MeterGenius	bidgely	Greenely	SIMPLE energy	BEN Energy
Comparison	✓	✓	✓	✗	✓	✓	✓	✗
Community	✗	✗	✗	✗	✓	✓	✓	✓
Gamification Rewards	✓	✓	✗	✓	✗	✓	✓	✓
Prosumer	✗	✗	✗	✗	✓	✗	✗	✗
Gas/Heating	✓	✗	✓	✓	✗	✗	✗	✗
Disaggregation	✗	✓	✓	✗	✓	✗	✗	✗
Marketplace	✓	✓	✗	✓	✗	✗	✓	✗

Regarding the inclusion of **Comparison** tools, one can conclude that this feature is commonly shared by the majority of the companies and therefore, it is important information to include in the platform. Companies will not differentiate with their competitors by including such service; however, the quality of the comparison may be the best way to attain a strong position in this feature.

There are different levels of comparison details and the information can be provided in several ways. The most common one is by comparing the user with all neighbours and with efficient neighbours. In addition, the definition of neighbours may differ depending on the company. Next sentence is an example of how *Opower* informs about whom are you being compared with.

"Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,023 sq ft) and have both electricity and natural gas service."

Besides this, other companies like *Bidgely* or *Enerbyte* provide a ranking positioning (see Figure 35).

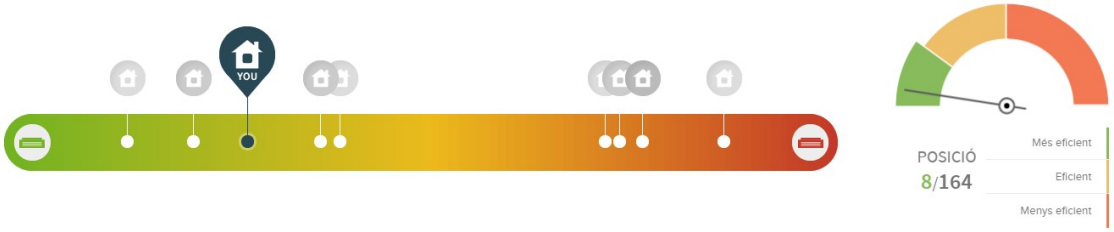


Figure 35. Example of Ranking Positioning as Comparison tool (Companies: *Bidgely* and *Enerbyte*)

The quality of information perceived by the user is higher when he/she can observe his consumption number and the average consumption of compared figures. This insight is missing on rankings, however, they are the most visual and rapid way to inform the consumer about his/her performance.

The same happens with **Community** offerings. There are several types of features which have been considered community services in this study. On the one hand, community tools from *Bidgely* and *Greenely* are the possibility to share personal information through social networks such as Facebook or Twitter. On the other hand, *Simple Energy* and *BEN Energy* organize friendly competitions between users within their communities allowing users to have a slight contact with others and therefore, building a community.

Despite these cases, there is a lot of potential improvement in such community tools. *Enerbyte* is a clear example on how to innovate this type of solutions by providing their customers (utilities or smart cities) with a community network within their platform. Such community allows customers to get in touch whenever they desire with residential consumers. Moreover, consumers can also communicate with other consumers in order to solve and debate on energy related issues.

Gamification and **Rewards** are widely used by the majority of companies. These tools are an effective way to interact with consumers in a friendly environment in order to improve the relationship with them. Users can be compensated with virtual reward points for good behaviours in relation with the functioning of the platform. For example, consumers can receive virtual points for fulfilling as much information as possible regarding the characteristics of their home, or for recommending the platform to other consumers. Furthermore, demand response events can also be rewarded with virtual points for each kWh saved (Figure 36).

Previously mentioned virtual points are commonly linked to the presence of a **Marketplace** inside the platform. This fact is explained because the marketplace is an adequate place to exchange virtual points with all type of products. Consequently, the majority of companies offering rewards for their consumers also incorporate a marketplace where they can purchase products with virtual points. Examples of these products are very varied: from energy related products such as efficient appliances, to entertainment products like cinema tickets (Figure 36).

Figure 36. Example of virtual points in DR programs and Marketplace (Companies: *MeterGenius* and *Intelen*)

Regarding **Prosumer** services, Table 5 proves that these types of services are not yet a priority to be included in energy management services. However, this fact can be seen as a weakness of such solutions and consequently, it can be one of the best ways to differentiate with competitors and gain a dominant position among the prosumers world. Furthermore, this thought will be reaffirmed in the future taking into account the expected increase of prosumers in detriment of conventional consumers.

Energy management solutions are mainly based on electricity monitoring. However, some solutions also include services regarding **Gas/Heating**. Being able to gather more types of energy consumption (electricity, gas and water) in one platform is an advantage very appreciated by consumers. Nevertheless, this is not widely implemented yet in the majority of companies and therefore, being able to offer such service provides with a high-valuable advantageous position.

There are several reasons that explain why not all energy consumptions services are offered together. On the one hand, there are some technical barriers regarding the implementations

of energy smart meters. Gas and water smart meters are not so largely installed as electricity smart meters. The following statement has been made related to the deployment of electricity and gas smart meters [31].

"According to our estimates, the roll-out commitments amount to an investment of around €45 billion for the installation by 2020 of close to 200 million smart meters for electricity (representing approximately 72% of all European consumers) and 45 million meters (around 40% of consumers) for gas. (…) This also indicates that the business case for rolling out smart metering is not yet overwhelming throughout Europe, and this is something more of a challenge in the case of gas."

On the other hand, it is important to remember that only B2B companies are being considered in this section and utilities are the most usual customer. Therefore, the types of energy consumption included by each solution will depend on the energy supplied by the utility. Some of the biggest utilities offer electricity, gas and water into their energy services. However, this fact is not widely extended and those utilities supplying merely electricity are not interested in including gas and water consumption into their solution. Consequently, as this requirement is more a concern from the point of view of the consumer, it is expected to be more present in B2C companies.

Finally, the level of consumption detail has been compared among solutions. **Disaggregation** allows companies to deliver high value information at appliance level (diagnostics, recommendations, targeted marketing, etc.). Providing this detail of information enables consumers reaching higher percentage of energy savings (see Figure 37). This fact is important to highlight because sometimes the energy savings achieved with conventional energy management tools are very low in terms of money saved. Therefore, being able to increases the amount of energy saved is very well received by consumers.

Figure 37 is inspired on Figure 8 but in this case, it is including a new bar located in the right side. Figure 8 is based on a research study previously mentioned [11]. The new update is included in a new study [32] focused on the effects of disaggregation. The incorporation of the right-most bar wants to illustrate how the energy services associated to disaggregation can achieve higher electricity savings.

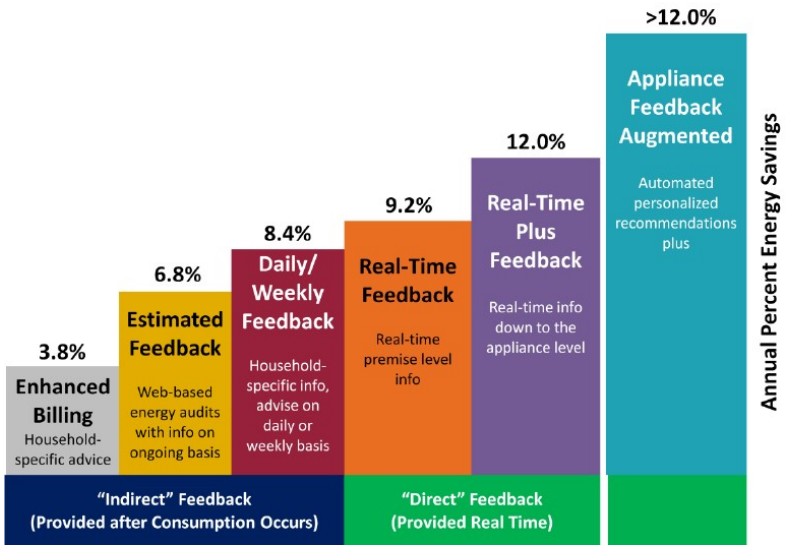


Figure 37. Percentage of residential savings depending on the type of feedback provided [32]

As a result, some companies make the decision to invest strongly in R&D tasks to develop disaggregation algorithms and be able to offer such services. Nevertheless, this is not widely implemented in all the solutions in the market yet (only 30% from Figure 29) and consequently, achieving rapidly this capacity may provide a competitive advantage.

For further information regarding the product or business of each company, see the section *Companies brief presentation* on the Annex (page 1).

c) B2C companies

A similar procedure has been followed to analyse B2C companies. In this case, 14 companies have been compared (see B2C companies in *Market segmentation*, page 86).

The first distinction is focused on the diversity of each company business. Despite the fact that their core business is based on a B2C model, some companies use in parallel previously mentioned B2B channels to reach residential consumers. Figure 38 presents five B2C companies that have some relationship with B2B channels.

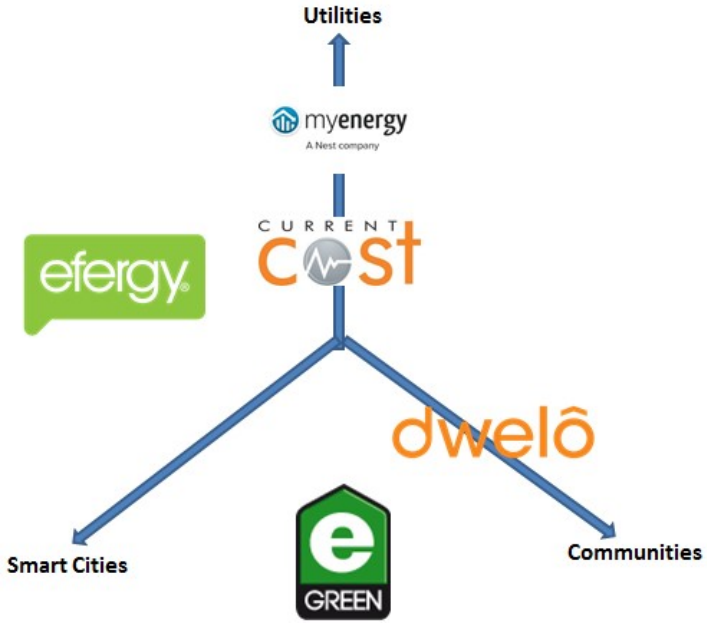


Figure 38. B2C companies using in parallel B2B channels (Data: *List of companies* in p. 85)

In the website of *MyEnergy,* the following message is referred to utilities: *"We're probably already helping some of your customers save energy, but if we work together, we can help you meet and exceed your energy efficiency goals"*.

CurrentCost is also working with utilities. In this case, the company offers a large range of energy related hardware products that can be purchased directly or through their utility partner website.

Efergy is located in the zone between Utilities and Smart Cities because their solutions are also offered to utilities in the case they want to implement their own solution with external products. Furthermore, *Efergy* had also participated in public projects for specific cities (Queensland, Sabadell and Donostia).

Egreen has firmed a contract with the city council of Paris to provide their energy management tool to the citizens of Paris. In parallel, they are also offering their solution to community buildings.

Finally, *Dwelo* identifies two main types of customers: residents and building managers.

The second part of the analysis follows a procedure similar to the one from the previous section. Figure 39 proposes a characterisation about the degree of hardware penetration of each company for delivering energy management services. It is a first approach to provide an idea on where most of the companies are located nowadays. Thus, an additional more detailed examination will be done later. The following list defines the characteristics of each corner in Figure 39.

- **Free of Hardware:** companies offering an energy management platform to save energy without the need of any hardware installation.
- **Submetering:** a device is needed to collect the electricity consumption data. In most of the cases, it is connected to the home electric box, but devices connected to the smart meter are also considered.
- **Submetering + Other devices:** apart from the submetering device, other devices are offered to complement the solution such as IHD's, Smart thermostats or Smart Plugs.
- **Smart home:** when the service offered is a compact solution including security measures, light controlling, heating, etc.

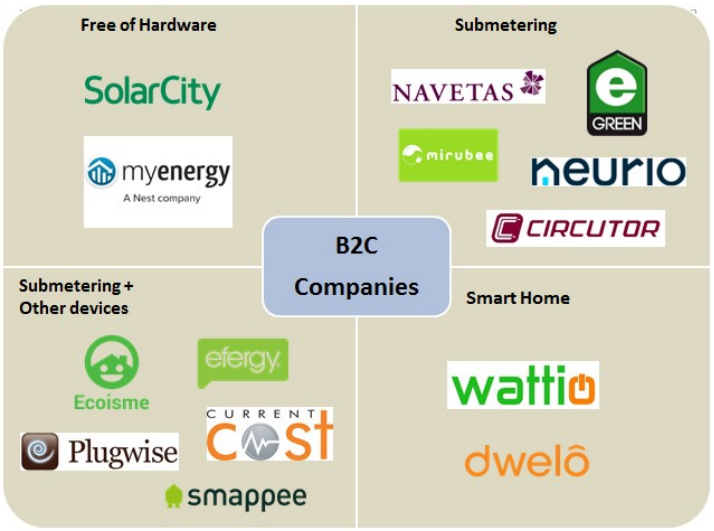


Figure 39. Penetration of hardware devices into B2C solutions (Data: *List of companies* in p. 85)

The first conclusion that can be extracted from Figure 39 is that in this case, the majority of the companies are located within the third sections including hardware (12 out of 14 companies). In other words, one can affirm that B2C companies incorporate hardware to collect consumption data into their energy management solutions. This evidence is explained by the strong difficulties to access electricity consumption data from smart meters without the mediation of utilities. As it has been stated before, the trouble of such process depends a lot on the legislation of each country. Consequently, Figure 39 demonstrates that at present, B2C companies are using submetering devices to monitor consumption as they do not access directly smart meters data.

Nevertheless, it is important to highlight that some companies in Figure 39 connect the submetering device to the smart meter. It is the case of *Plugwise* and *CurrentCost*. *Plugwise* is a company from Netherlands which is a country with a favourable legislation regarding the data management of smart meters. In this case, third parties are allowed to access electricity consumption data and consequently, the smart meters installed in Netherlands are prepared to be easily connected with external monitoring devices. This fact is important to be considered because in some countries, the access to smart meters data is blocked due to technical reasons regarding the type of smart meter installed. For example, *Plugwise*

submetering device requires to be connected with the smart meter through a P1 port which is not available in all types of smart meters. Figure 40 presents different types of submetering devices: up-left and right are examples of submetering devices connected to smart meters through LED impulse or P1 ports. Down-left is an example of a submetering device installed directly to the electrical box and connected via Wi-Fi.

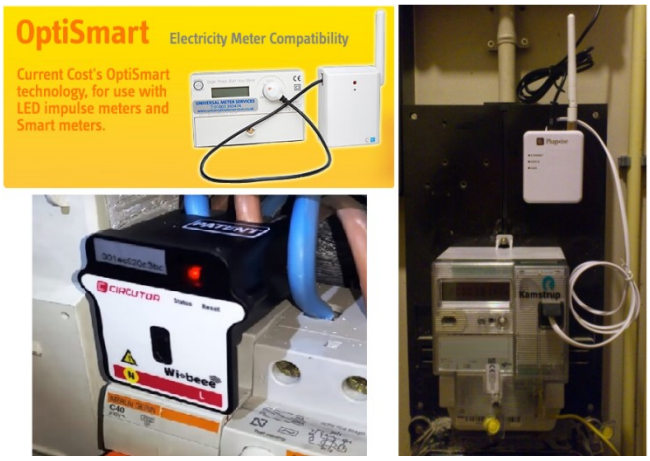


Figure 40. Example of submetering devices (Companies: *CurrentCost*, *Plugwise* and *Circutor*)

The difference between up-right corner (**Submetering**) and down-left (**Submetering + Other devices**) corner is the availability to install extra hardware devices into the solution offered such as IHD's, smart thermostats or smart plugs. The companies within the **Submetering** corner only incorporate monitoring of electricity consumption into their solution. However, companies located in **Submetering + Other devices**, offer other features apart from the basic electricity monitoring consumption (see Figure 41).

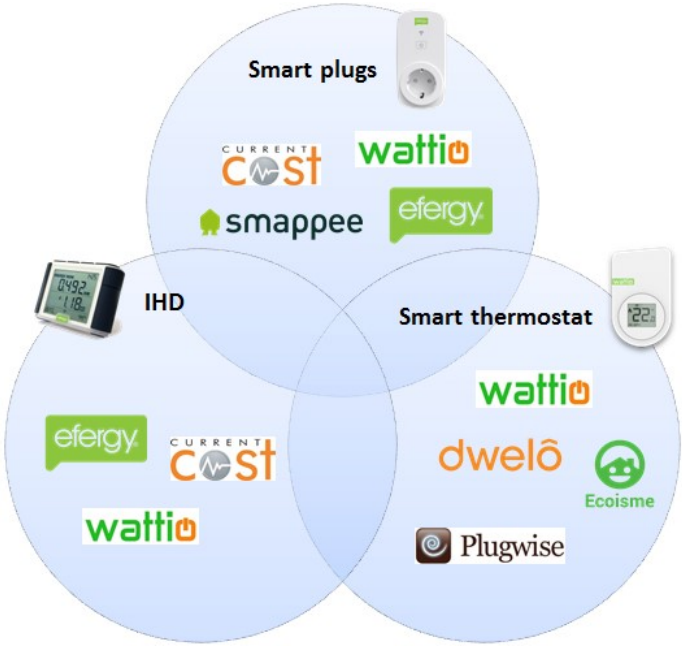


Figure 41. Companies including Smart plugs, IHD's and Smart thermostats into their solutions

It is also important to distinguish the cases of *Neurio*, *Ecoisme* and *Smappee* because their submetering device is able to collect consumption data at high frequency. The aim of such device is to obtain data accurate enough to be used in disaggregation algorithms. It is important to highlight that the frequency of the data is critical in order to apply effectively for disaggregation purposes. As stated in [32], *"improved data frequency increases both the number of appliances recognized, and the accuracy with which they are detected, by providing more detailed appliance signatures"*. Furthermore, a table summarizing the appliances identified for six levels of frequency is presented in page 17 from the same study [32].

Figure 42 presents the so-called submetering devices from *Smappee* and *Ecoisme* and shows how they are connected to the electric box.

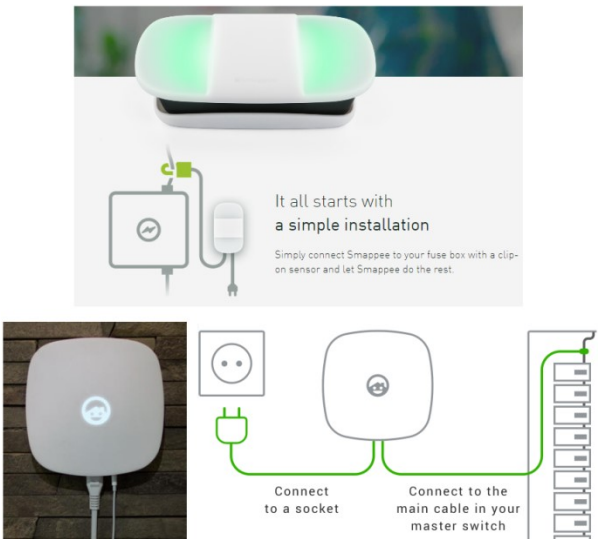


Figure 42. Example of Energy Monitors and connection scheme (Companies: *Smappee* and *Ecoisme*)

Regarding the **Smart Home** corner, *Wattio* and *Dwelo* are distinguished because the solution they offer is not only focused on energy efficiency services and it gathers three main areas: security, heating and comfort. Moreover, *Dwelo* is not including any monitoring of electricity into their solution, but the author considered adequate to include it in the analysis because it is covering a very similar demand from the residential sector.

Finally, it is important to highlight that only two companies are located in the section **Free of Hardware**. As stated before, this fact is caused by the difficulty to access smart meter data without the mediation of utilities. In addition, being located in this corner could be seen as privileged competitive position in the sector. In other words, **Free of Hardware** corner does not represent how nowadays, the majority of B2C companies are making business out of EEM services, but it can be seen as a good strategy to differentiate from competitors. Moreover, one should take into account that *SolarCity* and *MyEnergy* are companies based on USA which is a country where the legislation regarding smart meters data access is more suitable from the consumer side. Article [33] was written in 2010 to inform that the state of

California had ordered utilities to deliver consumer data. The following statement is made in the article: *"The U.S. House of Representatives is debating whether to require utilities to give real-time energy consumption data to consumers and companies like (…) that want to build services around this data"*.

To understand in more detail what are the features included in B2C solutions and identify the most important characteristics and the main deficiencies, a detailed comparison table between B2C companies is presented in Table 6.

Table 6. Main features included in B2C EEM solutions (Data: *List of companies* in p. 85)

The first observation done is regarding **Comparison** tools. In this case, such tool is not as extendedly included as it was in B2B "Free of Hardware" companies. Therefore, one can conclude that B2C companies do not make so much emphasis on this type of services. As a result, providing with accurate comparison tools could be a good strategy for B2C companies to acquire a dominant position in the market. This finding may be validated taking into account that half of the companies in Table 6 are already opting for such services.

Building a **Community** around EEM services is not widely implemented in B2C solutions. Therefore, offering this tool can be seen as an attractive strategy to differentiate from competitors. However, it is important to say that communities around B2C solutions are different and more difficult to be scaled than B2B. Whereas in B2B solutions, the community is already formed around each utility or smart city, B2C companies have to focus the community around their platform because it is the only common aspect shared between their users. In addition to this, in B2B cases, community tools are seen by utilities or smart cities as a new channel to communicate with consumers. This interest is not shared in B2C companies and as a result, community tools may not be a priority feature for their products.

In relation to this lack of necessity in B2C solutions to interact with the user compared to B2B, **Gamification** and **Rewards** are also not widely implemented in the majority of companies. It is important to remember from the analysis of B2B companies which are the motivations around this service. On the one hand, virtual reward points can be used to recompense consumers for each kWh saved during demand response events organized by the utility. This event does not take place in B2C solutions as utilities are not involved. On the other hand, virtual points can also be used to recompense for having an active user behaviour inside the platform (fulfil optional information, recommend the platform, etc.). In this case, B2C solutions may be more concerned about the number of users they have, and consequently, they are interested in rewarding active users as a good strategy to not lose number of users.

A **Marketplace** is included in some B2C solutions. The presence of it in B2C solutions can be a good way to diversify the revenue streams of the company. Furthermore, in the prior analysis about B2B companies, it has been observed a link between virtual point rewards and the presence of a marketplace in order to exchange the virtual points gained by the users. Nevertheless, this link is not observed in Table 6. As a result, this can be a good strategy for a B2C company to differentiate from competitors. The incorporation of a marketplace can provide new revenue streams and, at the same time, it could be an effective manner to engage their users if the marketplace is linked to the rewarding virtual points.

Regarding **Prosumer** services, this is a feature considered by the majority of B2C companies and it is the main difference with B2B solutions. This evidence is understandable taking into account the increase number of prosumers among consumers. Moreover, some of these prosumers are disconnected from the electric grid or do not have a paying relationship with any utility. As a result, the best way to reach them is through a B2C channel. In other words, not considering prosumer tools is an important disadvantage in B2C solutions.

The addition of other consumptions such as **Gas/Heating** (or Water) related services are considerably incorporated in B2C solutions. In this case, the type of energy monitored is not dependent on the product offered by utilities and therefore, it is expected that B2C companies make more emphasis on offering the three types of energy consumptions in one platform (electricity, gas and water). Gathering all consumptions in one platform is very attractive from the point of view of residential consumers. Therefore, being able to offer such diversity of services could be seen as an excellent strategy to attract consumers.

Finally, the level of consumption has been compared by differentiating those solutions offering **Disaggregation** information. The conclusion extracted from Table 6 is that this service is not widely implemented yet (only 29% from Figure 29), despite the fact that many studies defend its significant influence for achieving higher energy savings [32]. However, being able to deliver such information depends a lot on research work that is being done at present. As a result, an increase of companies delivering this service is expected in the future and, therefore, it may be important to acquire a strong position in such ability.

For further information regarding the product or business of each company, see the section *Companies brief presentation* on the Annex (page 1).

d) Utilities

6 utilities are presented here as they offer they own EEM solution to their own residential customers or even in some cases, to the general audience. These examples represent cases where utilities decided to offer EEM services without including third parties specialists. In general, EEM solutions designed by a utility have resulted in a successful experience until the moment. Consequently, it has been analysed the competitiveness of such solutions comparing the same parameters from the previous sections in order to understand the causes. Moreover, the features included in their solutions are usually influenced by the geographic location. Therefore, Figure 43 shows the market where they are serving: *Factor Energia* in Spain, *Enel* in Italy, *British Gas* in UK, *Elenia* in Finland, and both *Eneco* and *Green Choice* in Netherlands.

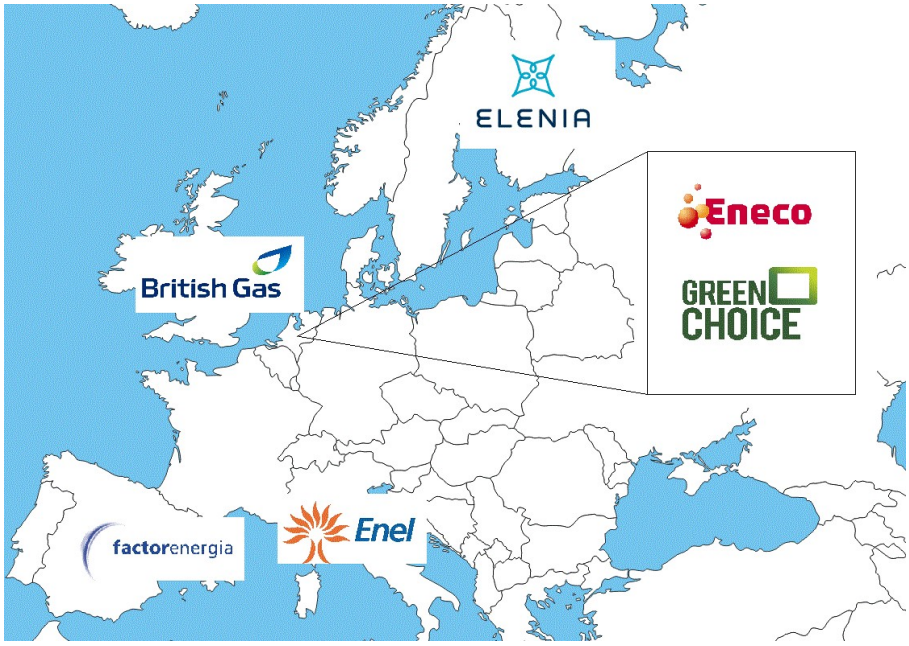


Figure 43. Location of utilities analysed across Europe (Spain, Italy, UK, Netherlands and Finland)

Regarding the **Comparison** tools, no new insight is extracted from Table 7**¡Error! No se encuentra el origen de la referencia.**. However, if compared to the analysis of B2B companies, it is surprising that 3 out of 6 utilities are not including such service (in *B2B companies*, 8 out of 9 companies are offering comparison tools). This deficiency may be one of the causes for low success.

Table 7. Features included in EEM utilities own made solutions (Data: *List of companies* in p. 85)

There are some parameters that illustrate very clear the main weaknesses of such solutions and explain the main causes of failings. First, any of the companies presented in Table 7 include **Community** platform within their solutions. As stated before, this parameter together with **Gamification Rewards** are features to enhance customer engagement into the platform. Without including such tools, companies are taking the risk that their users do not stay active within the platform. It is important to give them reasons to regularly log in into the platform.

Regarding the **Marketplace** parameter, any of the solutions include such service. This is another example that demonstrates utilities have not yet recognize the new roles they can play within the emerging energy market. Utilities have been always focused on exclusively selling energy and now they have to rethink their strategy and offer added value services to engage their customers and not lose market share. Including a marketplace with energy related products is an example of a new service they can provide.

The **Prosumer** case is a clear example about the influence of the geographical situation. The companies including this service are *Eneco* and *Green Choice* from Netherlands, and *Enel* from Italy. Both countries have favourable legislations to incentivize micro generation with photovoltaic panels. As a result, the percentage of prosumers in the energy market is considerable and it is important for them to receive this service.

Including **Gas/Heating** depends on the energy sources provided by each utility. As it is expected, those utilities supplying gas are offering gas monitoring consumption services into their EEM solutions.

Furthermore, *Eneco* and *British Gas* offer heating services into their platform. This fact is in accordance with the incorporation of **Hardware** into their solutions. Both companies offer a

complete package of hardware with a smart thermostat to remotely control the heating system (see Figure 44). Apart from the smart thermostat, in the case of *Eneco*, the package also includes devices that connect with the electricity and gas smart meter. Regarding the hardware included in the solution from *Enel*, it consists on a device to connect with the electricity smart meter and with the solar photovoltaic panels if they exist (one device for each).

Figure 44. EEM hardware solutions by *Eneco* and *British Gas* respectively

Finally, **Disaggregation** information is not included in any of these solutions. This fact is expected as it is a very specialized parameter omitted in the typical NDA of utilities.

For further information regarding the product from each of the previous utilities, see the section *Companies brief presentation* on the Annex (page 1).

e) Conclusions

This section is intended to summarize the principal findings from the market research developed previously.

About the differences between B2B and B2C companies, the following points can be pointed out:

- Mobile apps are used by all the companies offering this type of services.
- Web based platforms are also used by a high majority of companies to deliver information to the user.
- Mobile and Web platforms are both commonly chose as the best way to interact with residential consumers. However, the content to be included in each of them may be different.
- Weekly or monthly newsletters are more generally provided by B2B companies. In some cases, such reports are included together with energy bills.
- Comparisons with neighbours or community users are more commonly provided by B2B companies instead of B2C.

- Rewarded friendly competitions are more frequently organized by B2B companies instead of B2C. Such competitions used to be linked with demand response programs.
- Notifications to alert for exceptional high consumption periods or to advice for coming events (demand response programs, competitions, etc.) are more used in B2B companies instead of B2C.
- Solutions for Prosumers are more likely to be included by B2C companies due to the lack of interest from utilities to incorporate such solutions. However, this is intended to change in the future.
- B2B companies are more likely to use data from smart meters to offer their services because they work together with utilities.
- B2C companies without access to smart meters data, use data from submetering devices installed in the electrical box.
- As a result of previous two points, B2C companies are more likely to include hardware to their solutions.
- The use and access to smart meters data is very dependent on the availability of smart meters and on the legislation of each country.

About B2B companies:

- Three B2B approaches have been identified: 100% utility, smart cities and communities, and other industry.
- The utility approach is the most shared in B2B companies and the most successful one until the moment. However, because of the high competition some companies are approaching new markets such as smart cities or community buildings.
- Four levels of hardware penetration have been identified for those B2B companies 100% utility faced: Free of hardware, Energy Bridge/Hub, Energy Bridge + Smart thermostat and Smart home.
- Most of the companies are located in the section Free of Hardware. The incorporation of hardware is seen as a drawback for this type of solutions.
- The concept of “Energy Bridge” is introduced. The main characteristic is that it allows delivering disaggregation information.
- Companies located in the Smart Home section are expected to enjoy of a dominant position in the future when the concept of “smart home” is extended.
- The main features from the platforms of those B2B companies located in Free of Hardware have been compared and analysed.
- Comparison tools are widely implemented in the market. However, the quality of the comparison may become a crucial aspect.
- There are different types of community concepts. On the one hand, some companies allow sharing information through social networks. On the other hand, some companies allow interaction between users within the scope of friendly competitions

organized by them. There is a high degree of potential improvement in this feature (*Enerbyte* is an example).

- Gamification and rewards are widely used. This is a very effective way to interact with users in a friendly environment.
- The presence of a marketplace is usually linked to virtual reward points. It represents an adequate place to exchange such rewards.
- The marketplace can provide a new revenue stream for interested companies.
- Prosumer services are not yet a priority in B2B solutions. This fact demonstrates that, in general, utilities have not yet integrated such possibilities into their business model. However, this service can have a strong influence in the future as the number of prosumers is expected to grow.
- Including gas and heating services depend on the energy sources provided by the utility.
- The degree of implementation of gas smart meters is not as extend as electricity smart meters.
- Being able to deliver disaggregation information requires investing in R&D tasks. This service is not widely implemented in the market. However, it may represent a competitive advantage in the future.

About B2C companies:

- Some B2C companies have diversified their channels towards B2B channels in order to reach residential consumers. Three channels have been identified: utilities, smart cities and communities.
- An analysis on the degree of hardware penetration has been done. The following levels have been identified: free of hardware, submetering, submetering + other devices and smart home.
- The principal finding is that the majority of B2C companies incorporated hardware into their solutions. This fact is due to difficulties in having access to smart meters data.
- B2C companies use submetering devices connected to the home electric box in order to monitor electricity consumption. Other typical hardware devices are: IHD's, smart thermostats and smart plugs.
- Some submetering devices are specially designed to be able to collect more accurate data at higher frequencies in order to provide disaggregation information.
- Some solutions gather many diversified areas which define the concept of smart home: security, heating and lighting.
- B2C companies that do not incorporate hardware in their EEM solutions are not a reference nowadays. Nevertheless, not including hardware depends a lot on the difficulties to access smart meters data. Having this ability will provide a very advantageous position in front of competitors, mostly in terms of price.

- Comparison tools are not widely implemented in B2C solutions. As a result, enjoying of a strong ability regarding this feature is a good strategy to be distinguished in the B2C market.
- Community tools are not widely implemented in B2C solutions. Communities in this market are more difficult to be built because they do not enjoy of a high amount of initial users (like in B2B solutions).
- Communication with users may lose importance in B2C solutions compared to B2B (the core idea of B2B is undoubtedly to engage customers).
- Gamification and Rewards are not widely implemented in B2C solutions. This fact may be due to the usual link of virtual rewards with demand response programs which are only interested by utilities.
- Nevertheless, including such services may be seen by B2C companies as a strategy to keep the users active within the platform.
- A marketplace can be a suitable new revenue stream for B2C solutions.
- The link between marketplace and reward points is not observed in this case.
- The incorporation of a marketplace together with gamification and reward points are services not widely implemented in B2C companies, but with a lot of potential.
- Prosumer services are generally implemented in B2C solutions. This is the main difference with B2B companies.
- Not including prosumer tools in B2C solutions is an important disadvantage in front of competitors.
- Gathering several energy consumptions in one platform is very attractive for residential consumers.
- Offer such diversity of services is a very effective strategy to attract new users.
- Disaggregation is not still here. However, the increase of savings provided by this ability may represent a common service in the future.

About Utilities:

- In general, these types of solutions have resulted in unsuccessful experiences due to several reasons.
- Comparison tools are not broadly implemented as in B2B solutions where utilities are also involved. This deficiency may be one of the causes.
- Community services and gamification rewards are not present in any solution. This fact clearly states a lack of customer understanding.
- None of the solutions presented include a marketplace. This fact is another example that utilities had not yet understand the new roles they can play within the energy market.
- Prosumer tools are an example of how features are influenced by the geographical location. Utilities offering such services are located in countries with favourable micro generation legislations.

- Including other energy consumptions apart from electricity depends on the type of energy supplied by the utility.
- Some utilities offer a package of hardware into their solutions consisting on smart thermostats and devices to monitor consumption.
- Disaggregation is not present in any solution. This is expected because such specialized ability is not in utilities typical NDA.

3. Unsuccessful experiences

There are some companies not presented in the previous study because they have failed and abandoned their solution to provide energy efficiency services to residential consumers. Nevertheless, despite not existing anymore, some of those cases are still of interest nowadays because of its influence. This is the case of *Google* and *Microsoft*.

The presence of two very big players in the energy efficiency residential market advocated to a monopolistic market with a high level of entry barriers for small competitors. Moreover, both players are technology specialized and the reference in their fields. As a result, it is not expected that emerging companies can compete in terms of technology with them. Besides this, the fact that two big companies do not succeed in entering that market may be understood as a lack of market potential. This is the impression presented in [34]: *How to succeed in energy management where Google and Microsoft failed*.

a) PowerMeter from Google

PowerMeter was a software developed by Google to allow consumers monitoring their home electricity consumption. The platform was designed to work with smart meters in order to provide real time electricity consumption. The aim of such project was to raise awareness among residential consumers and make users more energy efficient. Moreover, the initiative was leaded by the philanthropic arm from Google [35].

The service was available since October 2009 until September 2011. The reason they gave for shutting down the platform was that they did not succeed on scaling up as fast as they expected. Nevertheless, it is important to highlight the influence of the initiative in the sector. As it has been stated in the closing announcement [36]: "*Since our launch, there's been more attention brought to the issue of giving consumers access to their energy data and we're excited that PowerMeter has helped demonstrate the importance of access to energy information"*.

PowerMeter has not succeeded in reaching a high percentage of users. However, there is no doubt that it has been a significant breakthrough for the market as a high number of emerging new players appeared afterwards.

However, it is important to analyse which were the reasons why Google did not succeeded in achievement enough users. Five reasons are presented in [37]:

First, Google PowerMeter was introduced in a too early stage. In 2009, consumers were still unaware of the technologies available and the possibilities they had by monitoring their electricity consumption. In addition to this, the level of deployment of smart meters was not sufficient to rely on them.

Second, Google PowerMeter was offered through an opt-in (only sent if the user wants it) program instead of opt-out (sent unless the user specially refuses it). As it is defended in [37], opt-out programs are more effective in early stages. This fact is related to the business model selected. Opt-out programs are viable if the business model is based on a B2B model like for example, the successful case of Opower.

Third, as Google PowerMeter position was seen as a threat by utilities because of their relationship with their customers. Google represented a big player entering the energy market with a considerable better position than utilities in the relation with consumers. However, the success of the platform was depending on smart meters and utilities were the ones that had to install them. As a result, Google needed to partnership with utilities in order to access smart meter data.

Fourth, Google PowerMeter should have considered offering such service without the need of utilities partnership. Using a completely B2C business model would allowed them to not depend on utilities. However, to be able to do so they needed to access data from the online utilities account after the consumer permission.

Last, but not the least, Google is not an energy company. Energy is not in his business DNA and this fact may provide a wrong vision to design the best business model for an energy management service. In addition, Google is a technological company and one of the reasons of his failure was to design a solution too much focused on technology and forgetting the social part.

Despite the previous points, Google did not abandon completely the energy market sector. Three years after closing PowerMeter, in January 2014, Google acquired Nest Labs, a home automation self-learning thermostat also involved in energy management services around electricity consumption. This case is presented in the next section.

b) MyEnergy from Nest Labs

MyEnergy is already considered in the previous analysis about *B2C companies* because the platform has been closed while this study was being developed. However, as the service was shuttered down in March 2016, it was considered also appropriated to include the case of MyEnergy in this section.

The case of MyEnergy is related with one of the reasons of Google PowerMeter failure. Specifically, the fourth cause states the possibility to access homes electricity consumption data only with the permission of consumers and therefore without the need of a partnership with utilities. This idea has been applied by MyEnergy (formerly called Earth Aid).

MyEnergy was a start-up founded in 2007 with the aim to develop a software platform that provides energy efficiency recommendations around electricity consumption in order to save energy. During some years, the company was called Earth Aid and they developed algorithms to collect and analyse electricity consumption data in order to be able to deliver recommendations. It is important to highlight that this solution did not require the involvement of utilities because they accessed consumption data with the permission of consumers through the online utility account [38].

In May 2013, Nest Labs acquired MyEnergy in order to offer their customers with more services around home energy consumption. Nevertheless, three years later, in March 2016, Nest closed the service and MyEnergy disappeared [39].

It is not clear if Nest did not succeed in scaling up the service and if the reasons were similar to those of Google PowerMeter. However, the cause they gave is that now they do not need consumers to provide them with their login information into the utility online account, because they developed an API that allows to consumers to authorize their utility to share data with Nest.

Furthermore, the close of MyEnergy services is seen as a movement by Nest from a B2C model to a more focused B2B vision. The following message was included in the closing announcement message: *"Even though we're shutting down MyEnergy, Nest now has a simple way for energy companies to connect to your Nest Account. As energy providers join, you'll be able to see all the energy you use in your monthly Home Report."*

In other words, this decision can represent a future move from a B2C model to a B2B with utilities as the best channel to reach residential consumers.

c) Hohm from Microsoft

The history of Microsoft Hohm has some similarities with Google PowerMeter. Hohm was an online platform that monitored home electricity and gas consumption in order to deliver energy saving recommendations to residential consumers. Moreover, the initial idea was to include also water consumption in the future in order to gather all the types of home energy consumption [40].

The service was launched in 2009 as a beta product and closed in May 2011, two years later. The operational period of time was similar to Google PowerMeter, and the main reason they gave for shuttering down the service was the same. The number of users was not growing as fast as they expected and they decided to start thinking on a new product or solution that

attracts and adapts more rapidly the residential energy efficiency market. Company words were: *"The feedback from customers and partners has remained encouraging throughout Microsoft Hohm's beta period. However, due to the slow overall market adoption of the service, we are instead focusing our efforts on products and solutions more capable of supporting long-standing growth within this evolving market."* [41]

Finally, it is important to say that in 2010 Microsoft Hohm incorporated a kit package of hardware into his solution through the collaboration with a specialized company. The product was an IHD called “PowerCost Monitor” and the price was $249 [42].

IV. Business plan

1. Introduction

The main disadvantage of B2C companies in front of B2B companies is the difficulty to reach a high number of users. Using a B2B business model allows companies to achieve a high volume of users when acquiring a new customer. In the case of the residential energy efficiency sector, the most common partnership is done with utilities in order to have direct access to their customers.

Besides this, B2C models have also been used in the energy efficiency residential sector. However, as it has been commented previously, some of these cases have also finally considered B2B channels in parallel (see Figure 38 in page 47). Moreover, significant past experiences from big players such as Google or Microsoft, have not been successful in their goal to scale up their solutions.

These cases demonstrate that B2C companies have not yet found the right business model to succeed in the energy efficiency residential market, where B2B solutions are the dominant. Consequently, it is important to analyse several factors. For example, which could be the errors done by big players and the weaknesses of actual B2C solutions? What can be learnt and adaptable from successful B2B companies?

When Google and Microsoft turned off their energy efficiency services, they justified the closing by not being able to scale up the business as fast as they had previously expected. Despite the fact that the expected rate of growth might be too high in both cases, the difficulty for B2C companies in scaling up the number of users is a common problem. As a result, two visions can be considered taking into account that the biggest actual challenge for B2C companies is to scale up in number of users.

On the one hand, continuing with the same objective of scaling up the business, the immediate strategy could be to rethink the features included in the product in order to be more attractive for users or to consider new innovative channels to reach the users.

On the other hand, another strategy could be based on the acceptance that B2C solutions in the residential energy efficiency market cannot reach a high volume of energy consumers when targeting the broad market and therefore, it is more appropriate to segment the market and focus on smaller, but more profitable groups.

2. Strategic position

Figure 45 presents four generic competitive positions that can be applied to all types of businesses. In the case of the residential energy efficiency market, the majority of the

companies are located in the superior part of the graph, because they are facing the broad market. However, it is interesting to locate the two previous visions on how to succeed with a B2C model in order to understand what could be the possible moves. The two visions are:

- **Vision 1**: increase the number of users in the broad market by rethinking the features of the product in order to be more attractive or consider new channels.
- **Vision 2**: segment the market and focus on smaller, but more profitable groups.

Therefore, on the one hand vision 1 could be associated with the **Differentiation** corner. Include unique features in the platform or improve the quality of existing ones in order to attract more users by differentiating from competitors. In parallel, innovate on the type of channels to meet residential consumers. Several approaches such as create brand through advertising, develop innovative capabilities or invest in R&D are suggested in [43] to achieve this position.

On the other hand, vision 2 would be located in the **Niche** corner. A niche strategy is based on generating rents from higher consumer willingness to pay by targeting a small premium segment of the market. In this case, the approaches proposed in [43] are to gain knowledge and expertise in specific fields, and to build brand loyalty.

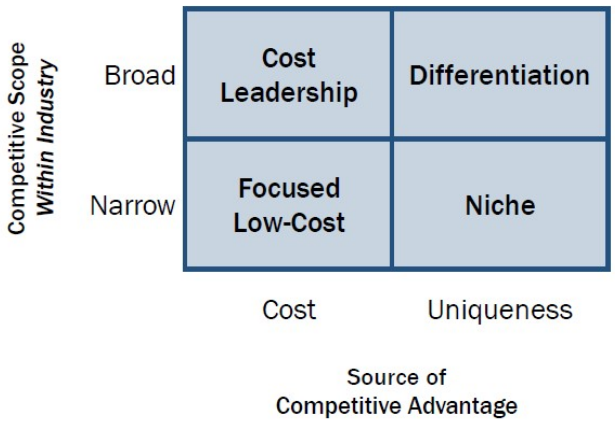


Figure 45. Generic competitive positions [43]

Considering the previous aspects from each strategy option, the move to a Niche market (vision 2) has been selected due to several reasons:

- On the one hand, the Differentiation corner implies a higher investment because the marketing tasks become very significant. The biggest problem when focusing the broad residential market in a B2C model is the difficulty to get known across residential consumers and consequently, it is needed to put most of the efforts in marketing and advertising campaigns. Despite the fact that, in immature markets, small companies can take advantage of big players marketing, there is still a considerable marketing cost needed to differentiate from competitors.

- Even that this type of market is not mature yet, the cost associated with these promotions is considered high for start-up companies. In addition, the low state of maturity is a drawback to develop new features, because companies would never know how the market would receive their innovations.
- On the other hand, selecting a specific group in the broad market provides more control and knowledge on their requirements. Thus, features are more effectively designed.
- The need of marketing efforts to differentiate from competitors is lower in this case, because competition is not significant.
- Moreover, moving to a Niche market is seen as more disruptive move within the residential energy efficiency market. However, in this case, the targeted premium group becomes very important for the success of the business and therefore, it is crucial to select the most appropriate group or groups.

As a result, it has been decided to focus the product specifically on the market composed by prosumers for three main reasons:

- Prosumers are more technology users than conventional consumers [18]. Residential energy efficiency solutions are completely technology focus and therefore, prosumers are more attracted by these solutions.
- Their salaries are 15% higher and their willingness to pay is also higher [18].
- The prosumer market has increased rapidly in the last years and it is expected to follow the same track in the future.

3. Market value

From Table 3 in page 27, the total minimum number of prosumers in Europe at the end of 2013 was about 1.467.326 residential solar systems. This value is calculated considering a common size for residential systems of 10 kWp. However, the real average size of these systems is lower than 10 kWp and bigger than 2 kWp. Consequently, a size of 2 kWp can be used to estimate the maximum number of prosumers. Then, a range comprising the number of prosumers in Europe is obtained.

The maximum number of prosumers in 2013 was 7.336.630 residential solar systems. Moreover, considering the estimated rate of growth forecast for PV capacity in Europe (see Figure 21, page 27), one can estimate the increase of number of prosumers. It is considered that the percentage of residential PV in the complete PV capacity will not be increased neither decreased in the following years. The residential segment has developed more rapidly than the other segments in some countries such as Belgium, Denmark, UK or Greece. However, at European level the residential segment had only increased 1 point of percentage between 2012 and 2013 [21].

Then, the same rate of growth for residential sector and the whole PV capacity has been used to forecast the number of prosumers in the coming years. Figure 46 presents the results considering the average between minimum and maximum number of prosumers in 2013.

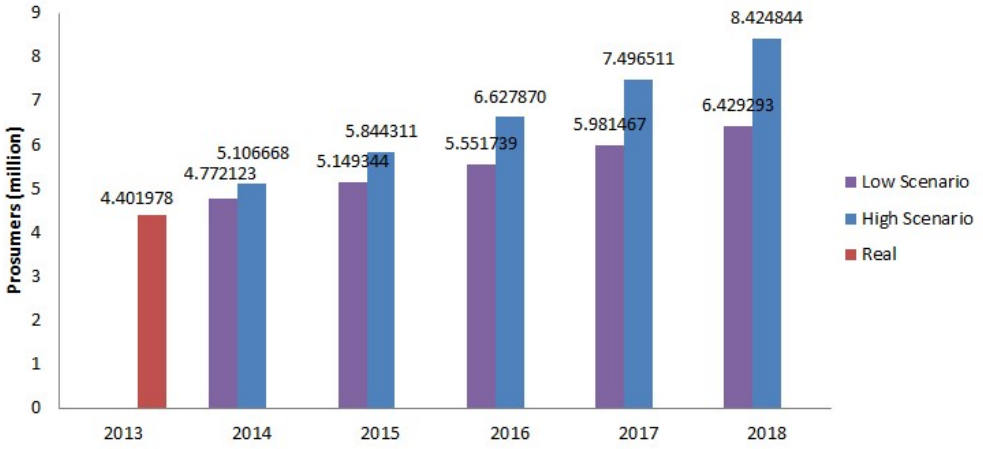


Figure 46. Number of prosumers evolution in Europe until 2018

To estimate the value of the market in monetary terms, it is needed to quantify the money associated with the value delivered to the customer. This estimation is difficult to quantify in general terms, because there are many parameters than influence on it.

The value that can be delivered to prosumers varies from one country to another. For example, in those countries where prosumers are allowed to inject and sell the excess of energy into the grid, they can benefit of energy management tools in order to choose whether to inject the excess into the grid or into a personal battery pack. There are some initiatives that facilitate consumers and generators to buy and sell energy respectively. This is the case of the platform named *Piclo* from the UK start-up *OpenUtility* [44]. In these cases, the potential economic savings would be higher than in those countries where prosumers cannot sell the excess of energy into the grid.

However, it has been concluded that, in general, prosumers can benefit more than conventional consumers of energy efficiency management services. The main argument to support the previous affirmation is that all the services that can be delivered to conventional consumers can also benefit prosumers. Consequently, to estimate the value of the market in monetary terms, it has been considered that each prosumer would assume a monthly minimum cost of 1.25 €. This is the price presented in [45] that utilities are paying to *MeterGenius*.

Considering this price, the graph in Figure 47 is built in order to show the total value of the market and its expected growth until 2018.

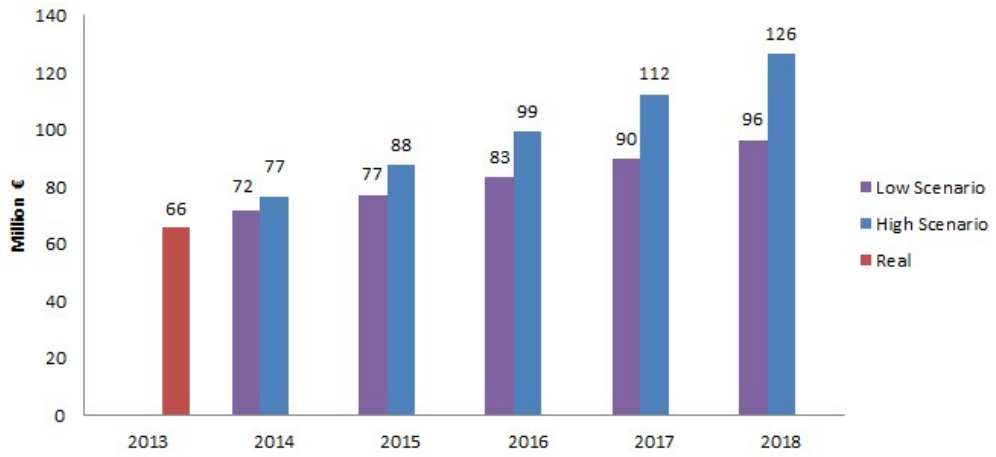


Figure 47. Economic value of the prosumer market until 2018

Figure 47 demonstrates again the high potential of the market for energy efficiency companies if they succeed in reaching a sufficient percentage of the segmented group of prosumers.

Furthermore, it is important to highlight that the Average Revenue per User (ARPU) and the Customer Acquisition Cost (CAC) are very difficult to quantify in such innovative market.

On the one hand, a minimum monthly fee has been considered (1.25€/month) in the previous calculations. This price corresponds to the amount of money the utilities are considering to pay for each of their customers. As a result, it is important to take into account that a high volume of users is considered in this case. Consequently, it is expected that a higher revenue could be assumed by the customer in a B2C model. For example, the energy retail company *Lucera* [46] is delivering energy efficiency services for a price of 3.9€/month. Moreover, in the statistics presented in [47], the average revenue per user for the energy management segment of the smart home is expected to reach 189 US$ annually by 2020. This value is only considering the services delivered and not the hardware cost, but the concept of smart home gathers many services apart from energy efficiency such as remote controlling or security.

Finally, considering that the type of customer selected here has more capacity of purchase (salaries of prosumers 15% higher) than conventional consumers, a higher price could be offered.

On the other hand, the acquisition cost of a prosumer should also be considered. As it is stated in [48], a large number of start-ups succeed in solving the product/market fit problem but fail for not lowering enough the customer acquisition cost (CAC). There are not clear findings on the exact CAC for residential energy efficiency services in a B2C model; however, some reference values suggest a cost of 100$ per user.

4. Selection of the geographical market

Next step is to analyse the most suitable countries for delivering energy management services taking into account the previous decisions. Several considerations can be applied to select the best country to enter.

On the one hand, as it has been explained previously, the availability of smart meters and the process to access their consumption data is critical. Using consumption data from smart meters is the key to not incorporate any hardware device in the solution proposed.

On the other hand, the number of prosumers is something to consider when selecting the best market to enter, because the product offered is targeted to them. Moreover, the competitiveness of the retail market and the legislation for solar energy should also be considered because both parameters effect on the willingness of society to become prosumers.

To quantify the best markets, a value matrix has been built with the following parameters and delivering marks from 0 to 3 to each field. In addition, each parameter has been pondered depending on the importance given to it. Finally, the results have been presented in a scale from 0 to 10. The criteria followed in each parameter are explained in the following points.

- **Number of smart meters**: ~30million (3), ~15million (2), ~5million (1). See Figure 12 in page 21.
- **Smart meters data access**: limited access (1), have access from utility web portal (2), have access from central data hub (3). See Figure 13 and Figure 14 in page 22.
- **Number of prosumers** (See Figure 48): more than 250.000 (3), between 100.000 and 250.000 (2), between 40.000 and 250.000 (1), less than 40.000 (0).
- **Percentage of prosumers in the country** (See Figure 49): more than 0.8% (3), between 0.2% and 0.8% (2), between 0.1% and 0.2% (1), less than 0.1% (0).
- **Legislation on solar energy:** sunny (3), sunny and cloudy (2), rainy (1). See Table 4 in page 28.
- **Competitiveness of the retail market:** high (3), medium (2), medium-low (1), low (0). See Figure 2 in page 8.

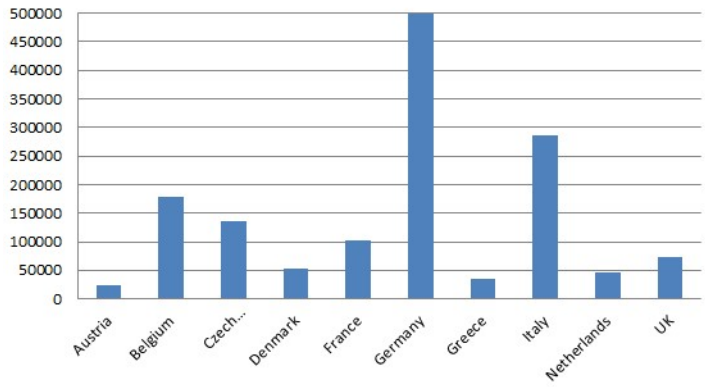


Figure 48. Top ten countries on number of prosumers in 2013 (minimum values)

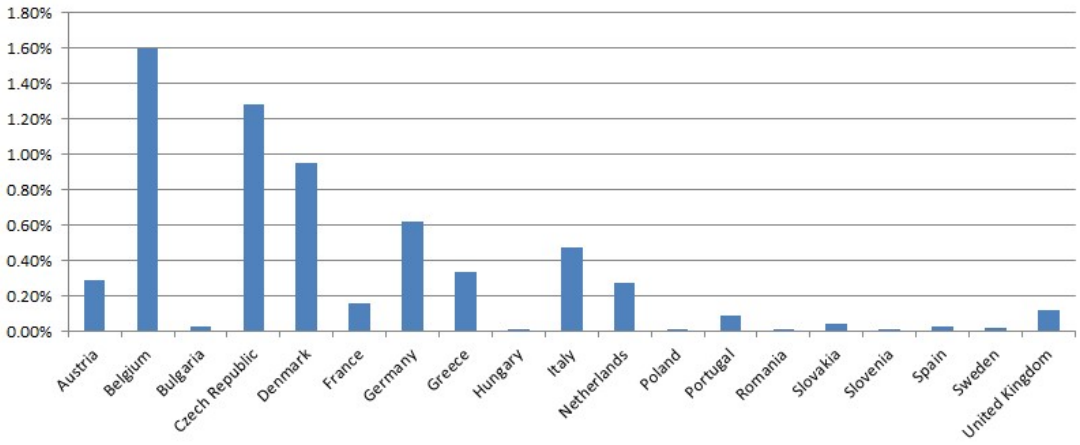


Figure 49. Percentage of prosumers in the population for 2013 (considering minimum values)

The adjudicated values are presented in Table 8.

Table 8. Matrix Value to select the best geographical market

	Number of smart meters	SM Data access	Number of prosumers	% of Prosumers	Solar Policy	Retail compet.
UK	3	3	1	1	3	3
Sweden	1	3	0	0	0	2
Netherlands	2	3	1	2	3	2
Germany	2	1	3	2	2	2
France	3	2	2	1	2	1
Denmark	1	3	1	3	3	2
Finland	1	3	0	0	0	2
Spain	3	2	0	0	0	1
Italy	3	1	3	2	2	1
Belgium	0	1	2	3	2	2
Ponderation	2	3	2	2	3	1

Finally, the results have been scaled to the range 0-10 and are presented in Table 9 with an additional graphic interpretation in Figure 50.

Table 9. Results obtained from the matrix value

	RESULTS	
	Not pondered	Pondered
UK	10.0	10.0
Netherlands	9.3	9.7
Denmark	9.3	9.7
Italy	8.6	8.4
Germany	8.6	8.1
France	7.9	8.1
Belgium	7.1	6.8
Sweden	4.3	4.2
Finland	4.3	4.2
Spain	4.3	4.2

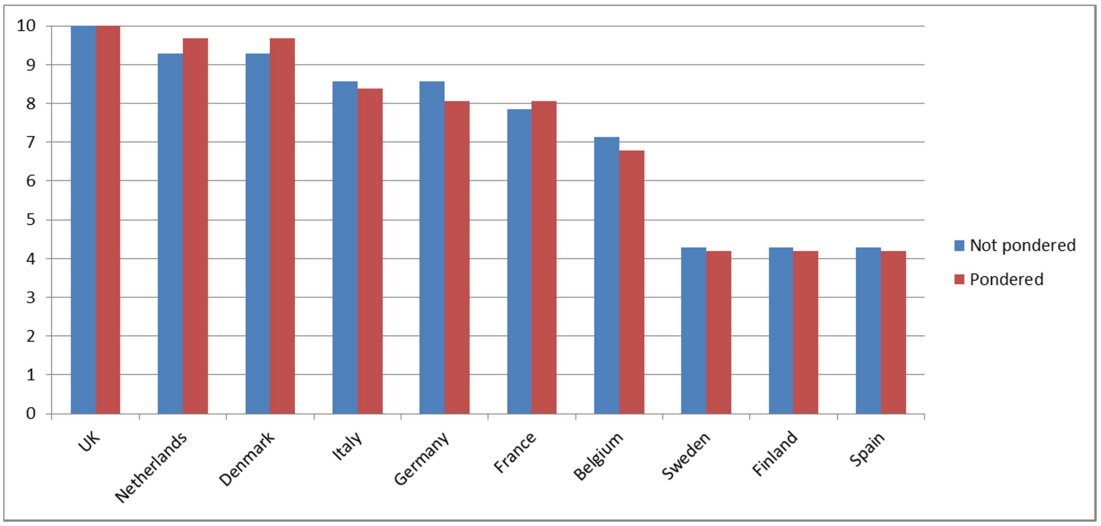


Figure 50. Graphic results of the matrix value

Several conclusions can be inferred from the previous results. The countries of Sweden, Finland and Spain can be discarded today mainly because their low number of prosumers. Therefore, the remaining countries (UK, Netherlands, Germany, France, Denmark, Italy and Belgium) should be considered because their punctuation is equal or higher than 7. In other words, any of these markets would be appropriate to enter with an energy management solution for prosumers. Furthermore, there are only three countries with an excellent punctuation (higher than 9): UK, Netherlands and Denmark.

Therefore, the most effective market to start a business around residential energy efficiency services for prosumers should be one of these three countries.

5. Product description

The aim of this section is to describe the product and the features to be included in an energy management solution specifically designed for prosumers in a B2C model.

The general philosophy followed here is based on the idea of providing an energy efficiency management solution as a social entertainment tool. Offering this type of services from a more technological point of view is considered as the main drawback for scaling up the business and reaching a high number of users.

The first decision to be made is regarding the penetration of hardware. In this case, it has been concluded that the best strategy is to **not include any type of hardware** in the solution proposed for two main reasons.

On the one hand, it has been always in the core business idea of Enerbyte to not include any type of hardware in their solution because it always requires an investment cost difficult to be accepted by the residential sector. Therefore, it has been considered important to keep the same philosophy in a B2C model.

The presence of hardware could be offered through a marketplace as an option for the users associated with added value or premium services. However, it is crucial that the central solution provides services around consumption data from smart meters and does not turn around hardware capabilities.

On the other hand, being located in the corner “Free of Hardware” (see Figure 39 in page 48), it has been considered a strategic decision that provides a significant competitive advantage with competitors. As it is presented in Figure 39, the majority of B2C companies are incorporating hardware into their solutions. As a result, being able to offer energy efficiency services without the need of installing hardware provides a big competitive advantage. Furthermore, Figure 34 in page 42 shows where B2B companies are located considering the penetration of hardware. In this case, the majority of the companies and the most successful ones are in the section “Free of Hardware”. This fact demonstrates that offering services only by using smart meters data is crucial to success in the residential energy efficiency services market.

Regarding the features to be included in the solution, several conclusions have been extracted from the market analysis in block *III. Ecosystem* (page 31). These are summarized following.

Comparison

Comparison tools are a feature offered by almost all B2B companies and not so widely implemented in B2C solutions (50% of the B2C companies). Consequently, it has been considered that comparison tools should be included in the solution because their presence in

B2B solutions demonstrate its importance and moreover, it could be seen as a distinction with competitors in the B2C market.

Nevertheless, different types of comparison services have been identified. As a result, it has been recognized that the quality, the level of detail from such comparison tools or the way to present the information can also provide a competitive advantage with similar products.

Users perceive more value when they are compared with similar user profiles rather than general users. To be able to deliver such accurate comparisons, the user should have the possibility to introduce information data about his consumer profile.

Community

Regarding the presence of a community into the platform, this has been considered a very important feature to be included because of its big potential. This feature is not widely implemented in B2B neither in B2C companies and therefore, it may provide a valuable competitive advantage.

Moreover, the most common community services being offered are based on the possibility to share information or achievements through external social networks such as Facebook or Twitter.

Enerbyte is already offering a community that enables communication between users as one of the features in his energy efficiency solution. In this case, the community allows its users to share doubts, ask questions and give recommendations to other users always within the scope of the platform. Moreover, the community includes a Pear to Pear (P2P) communication allowing users to recommend and validate the activities of other users. This approach is the main differentiation of Enerbyte with the rest of competitors because the community offered is unique for this type of solutions. Consequently, it is important to keep and continuously improve this feature as it provides the main competitive advantage of the company.

Moreover, the possibility to interact with other users in a community environment is seen as a strong feature to offer an energy management solution from the social point of view. For example, Enerbyte's community enables to organize community activity goals such as to achieve energy savings in exchange to cover energy poverty.

Gamification/Rewards

Gamification is considered key for providing entertainment and keeps the user active. It is important to focus gamification from the social point of view. A clear example of it is the organization of friendly competitions to reach community energy savings. For motivating users to participate in such activities, social collective goals can be presented.

Besides this, the way to recompense good user behaviour is also very important. Users can be recompensed for succeeding in challenges or just by participating actively in activities. The rewards suggested are virtual points, badges or public recognitions.

As it is stated in [49], carefully planning is crucial to design a successful game. It is important to define in detail the target audience and what it is expected from them. Moreover, the parameters to analyse their performance should be previously defined.

Marketplace

The presence of a marketplace is a great opportunity to enable the exchange of virtual points with products. This provides a motivation for users to gain points through gamification activities and it is expected that the link between gamification and marketplace may become the success of both features.

Furthermore, it is important to highlight that the presence of a marketplace is something already proved in a successful mode by other sectors such as banking. Moreover, it provides a new revenue stream for the company getting a commission for each purchase.

Two main types of services have been distinguished to be included in the marketplace. On the one hand, energy related products and entertainment products have to be included. On the other hand, other services informing and comparing the available pricelists of energy supplies can be offered.

Gas/Water consumption

Regarding the introduction of other energy consumptions a part from electricity, it is considered more necessary in B2C solutions rather than B2B. From B2B companies analysis, it has been concluded that offering other energy consumptions depend on the energy supplied by the utility. In the case of B2C solutions, offering a compact solution that gathers all the energy consumptions may be a determinant requirement by the customers. There is no doubt that this requirement will be demanded by the broad market in B2C solutions. If only the prosumers segment is considered, this diversity may lose importance because the main characteristic of prosumers is that they are producers of electricity. However, such feature is expected to enrich considerably the platform and to attract new users.

Disaggregation

Disaggregation capabilities allow delivering a big range of new services around the consumption of appliances and enables high energy savings. As a result, it is considered to gain more importance in the future and that more companies are able to deliver such services. Consequently, it is important to be considered in all types of solutions. Moreover, this feature could be offered as a premium service because of the added value that can be provided from it.

Besides this, it has been detected that, at present, the majority of disaggregation solutions require the installation of some hardware in order to collect more accurate (frequent) data from smart meters.

In order to obtain more revenue streams, it should be considered the possibility that some of the features are offered in a premium version depending on the associated value from each of them. This view will be extended in section *6. Business Model Canvas.*

Prosumers

All the features presented above can also be applied for B2C solutions targeting the broad market. In addition, some features will be specifically for prosumers. The main one is the *monitoring of electricity production* which is enabled by collecting the data from smart meters. This is already a common feature in the majority of residential PV systems. However, the available solutions only provide monitoring and, in this case, the significant values will be delivered from it.

Furthermore, another crucial feature specific for prosumers has been identified that enables to deliver many services out of it: *forecast of energy production*. The estimation of the electricity produced by solar panels can be obtained by applying weather conditions, physical models or neural networks [50] [51]. This service can be provided by third parties specialized on renewable energy forecasting and incorporated in the platform in order to permit user visualizing energy consumption, production and forecast at the same time. However, what is innovative from this solution will be the **artificial intelligence** provided from the previous data in order to change the energy management rules in advance and decrease even more energy consumption.

With this information, many services specific for prosumers can be delivered. For example, for those prosumers having batteries they can receive information to manage efficiently the charging and discharging cycles of the batteries. They can receive the best times whether to inject excess electricity into the grid or into their batteries. The same is applied for those prosumers having electric cars with electrical chargers at home. In this case, they can know the best time to charge their vehicle looking for lower prices in the energy market.

In addition, it is important to highlight that the previous prosumer measures represent big economic savings for the user. Consequently, it is expected that prosumers are willing to pay more for this type of services.

6. Business Model Canvas

Finally, a Business Model Canvas can be built considering all the information presented previously. Next paragraphs present each of the sections to be included in a Business Model Canvas and they are summarized in Table 11.

Customer Segments

The solution is aiming to serve residential consumers that can consume and produce electricity at their home. This group is a segmentation of the broad residential market and they are commonly referred as prosumers.

The customer is concerned about being energy efficient in order to save energy and to save money. Moreover, he/she wants to share achievements and knowledge with similar users.

Value Propositions

The solution offers artificial intelligence services from monitoring the home electricity consumption and production. Examples of such services are: best times of consumption, best times of battery charging, best times of grid injection, comparison with similar users, channels to communicate and interact with the community of users.

Moreover, the platform includes a marketplace where users can access to many different types of products (from entertainment to energy related products).

Channels

As it is stated in [18] the channels to reach prosumers are varied but they have to be analysed carefully. For example, prosumers rarely see television ads because they prefer to record their favourite shows according to [18]. In this case, they identified three types: traditional consumer channels (advertising or direct mail), non-traditional channels (online) and B2B channels.

Besides this, Figure 38 in page 47 presented B2C companies already using B2B channels to reach residential consumers. These channels are through utilities, smart cities or communities.

With the previous knowledge, the best channels to reach prosumers have been identified:

- All types of online advertising are effective because prosumers are high technology users. This channel will represent the main Customer Acquisition Cost (CAC).
- Some utilities are starting to offer solar packages for electricity self-generation. Recommending our solution to these new prosumers is an effective channel and well-receive by utilities. Therefore, this channel will not increase the CAC.
-

- PV Systems suppliers.
- Enerbyte is already working with smart cities in a B2B model. However, smart cities or public institutions willing to promote energy efficiency can become a good channel to reach prosumers. This channel will not increase the CAC because smart cities will be equally interested.
- Pear to Pear (P2P) recommendation. It is expected that contented users will recommend the product to new prosumers and they will be virtually rewarded for such favourable activity.

Customer Relationships

The relationship with the customer segment should be completely digitalized, because it is the most usual way to communicate. However, it is important to remember that despite they are technology lovers they also appreciated simplicity in their solutions.

Therefore, the communication with the customer can be done through email or through the community provided by the platform.

Revenue Streams

The revenue streams proposed are divided in two:

- Monthly payments for joining the platform and having access to energy efficiency services. Furthermore, premium versions with an extra fee will also be considered for some features. The features proposed for the premium version are those associated with big economic savings: disaggregation services and electricity production forecasting.
- Commissions from the marketplace: purchase of energy related or entertainment products and a commission for new energy supply contracts done through the marketplace. In parallel, commissions for each click should be considered.

Publicity in the platform is not included because it is considered an important drawback to engage prosumers.

Another alternative of revenue streams is the exploitation of the data generated by the platform. In this case, the revenue streams should be completely based on it and users would have access to energy efficiency services for free in order to reach a high amount of them. Nevertheless, this option has been discarded because the privacy is considered one of the main concerns of the customer segment. Therefore, despite the fact that the exploitation of the data could be done in a secure and private way, this could become a barrier for users to join the platform.

Key Activities

Two crucial activities have been identified.

- First, regarding the product. The solution is considered Software as a Service (SaaS) and consequently, the software development is one of the main activities. It is vital that the technology works always well and is presented in a simple way. The software development should be covered by an expert developer team. Furthermore, it is important that the team is supported by another group specialized on behavioural science. This complement will assure to keep the platform simple for the user and will design the features to be included in the platform.
- Second, considerable efforts should be dedicated to commercial tasks to meet new users. In order to get known among the prosumers segment, the company should be have presence in congresses, conferences, blogs, websites, all related with distributed energy producers.

Key Resources

On the one hand, the developer team is considered a key resource in order to build the adequate product. On the other hand, as it has been stated previously, the access to smart meters data is crucial to be able to deliver energy efficiency services without incorporating hardware. As a result, smart meters data is also considered the key resource.

Key Partners

Key partners will vary across different countries. The most important ones are related to the crucial challenge previously mentioned: the access to smart meters data. Depending on the legislation of each country, the data generated by smart meters is stored differently and managed by different public or private companies. All the figures involved in the process to access smart meters data should be identified for each country and therefore, they are considered key partners for delivering the service.

For example, Table 10 provides some specific characteristics regarding the smart meters data access in the three countries selected in point *4. Selection of the geographical market* (page 68). Information presented in Table 10 is extracted from [16].

In the case of UK, to access the central hub where the data is stored, third parties need to become a Data Communications Company (DCC). However, the process to become a DCC has been very criticized because it is a long and bureaucratic process for small companies.

In the case of Denmark, to have access to the data hub, companies need to fulfil some conditions. For instance, they need to be registered in Denmark.

Finally, in the case of Netherlands, there are some public agencies such as *Milleau Centraal* that gather all the Energy Services Companies (ESCOs) in a common website in order to allow residential consumers to choose their most appropriate product.

Table 10. Information about smart meters data access [16]

Country	Data Management Responsible	Frequency of meter readings	Max. access delay
UK	DCCs	10s real-time / 30min remote	1 day
Denmark	TSO	15min	1-2 days
Netherlands	DSOs	10s real-time / 15min remote	1 day

Moreover, official prosumers groups (institutions, magazines, congresses, etc.) are considered key partners because it is crucial to be present in all the activities organized by them in order to get known among the prosumers community.

Cost Structure

The cost structure is composed by the salaries required to build the necessary team and the expenses associated with the channels used (online advertising and B2B channels). In some cases, a fee will need to be paid to utilities and public institutions for having access to their customers.

Table 11. Generic Business Model Canvas for a B2C solution in the Residential Energy Efficiency Market

<table>
<tr>
<td rowspan="2">Key Partners
- Stakeholders involved in the process to access smart meters data
- Prosumers official groups</td>
<td>Key Activities
- Software development and maintenance
- Product design
- Commercial tasks</td>
<td rowspan="2">Value Propositions
Energy Efficiency services from the monitoring of electricity consumption and production</td>
<td>Customer Relationships
- Digital:
• Email
• Community</td>
<td rowspan="2">Customer Segments
Prosumers willing to become more energy efficient and receive benefits from it</td>
</tr>
<tr>
<td>Key Resources
- Team
- Smart meters data</td>
<td>Channels
- Online advertising
- B2B channels:
• Utilities
• Public institutions
• PV Suppliers
- Users recommendation</td>
</tr>
<tr>
<td colspan="3">Cost Structure
- Team salary
- Costs associated with channels</td>
<td colspan="2">Revenue Streams
- Monthly payments for joining the platform
- Premium version with added value services
- Marketplace (purchase/contracts)</td>
</tr>
</table>

V. References

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VI. Annex

1. List of companies

Enerbyte	http://www.enerbyte.com/
Opower	https://opower.com/
C3 IoT	http://c3iot.com/products/
SilverSpring	http://www.silverspringnet.com/
Comverge	http://www.comverge.com/
Bidgely	http://www.bidgely.com/
Grid4C	http://www.grid4c.com/products
Powerley	http://www.powerley.com/
MeterGenius	https://metergenius.com/
CIMNE Bee Group	http://www.beegroup-cimne.com/solutions/
Greenely	https://greenely.com/
Plugwise	https://www.plugwise.com/
Toon	https://www.eneco.nl/toon-thermostaat/
Green Choice	https://www.greenchoice.nl/app/
Green Pocket	http://www.greenpocket.de/en/
Mirubee	http://www.mirubee.com/
Wattio	https://wattio.com/en/
Circutor	http://circutor.es/es
Intelen	http://intelen.com/us/
Watty	http://watty.io/
British Gas	https://www.britishgas.co.uk/smarter-living.html
Factor Energia	http://www.factorsmarthome.com/
Fifth Play	http://www.fifthplay.com/
Onzo	http://www.onzo.com/
Ijenko	http://www.ijenko.com/
Efergy	http://efergy.com/
Smappee	http://www.smappee.com/be_en/energy-monitor
Navetas	http://www.navetas.com/
Ecoisme	https://ecois.me/en/
Neurio	http://neur.io/
Simple Energy	http://simpleenergy.com/
Egreen	http://www.egreen.fr/
MyEnergy	http://www.myenergy.com/
Currentcost	http://www.currentcost.com/
Dwelo	http://dwelo.com/
BEN Energy	https://www.ben-energy.com/
SolarCity	http://www.solarcity.com/residential/mysolarcity
Elenia Oy	http://www.elenia.fi/
Enel	http://www.ilevia.com/products/enel-smart-info/
Tendril	https://www.tendrilinc.com/
Rocket home	http://www.rockethome.de/en

2. Market segmentation

3. Product and Business Analysis

	Product												
	Channels			Features									
	App	*Web*	*Newsletter / Report*	*Comparison*	*Community Interaction*	*Rewards / Gamification*	*Prosumer*	*Temperature*	Remote Control	Notifications	Marketplace	Demand Response
Enerbyte				Ranking		Not now		Not now		Not now	Not now	
Opower								Thermostat		Bill advisor		
C3 IoT												
Silver Spring							CustomerIQ Solar	Thermostat				
Comverge								Thermostat	Control switches (HW)			Leader
Bidgely					Share in FB					Reminders, Events,...		
Grid4C										Alerts, irregularities		
Powerley								Thermostat		Alerts, DR Events...		
MeterGenius										Reminders...?		Not sure
CIMNE Bee Group												
Greenly					*Share FB*							
Plugwise								Anna/Coolding	Anna/Coolding			
Toon								Thermostat	Boiler	Smoke detector YES		
Green Choice App												
Green Pocket			Newsletter		*Share FB*			Smart Home YES...				
Mirubee												
Wattio								Thermostat	Smart plugs...	Alerts	their own products	
Circutor. Wibeee							If it's in the PV panel...					
Intelen										Events, Alerts		
Watty			Monthly report							Alerts		
British Gas								Thermostat	Hardware...			
Factor Energia												
Fifth play					Messages					Alerting		Not clear
Onzo			if asked...			Goals&Challenges		if asked...		Personalized		
Ijenko						Points (lack info)			Telcos...	lack info	Integration	
Efergy												
Smapee								Gas&Water...	Smart Plugs		but Awards...	
Navetas			Weekly			Budgets...					Tariff tracker	
Ecoisme				Facebook	Facebook			if integration smart devices...		Personalized	Integration	
Neurio				Ranking				maybe Third party integrations...		Excess		
Simple Energy			Weekly / timely ba	Similar Home	Competitions	Badges		Outdoor		Personalized		
Egreen				Anonymus	Not sure...							
MyEnergy	Not sure			Key	Facebook, Google							
Currentcost				Depends on the software chose				IHD's		Online Shope of their HW		
Dwelo		Managers						Thermostat		Alerts? Maybe Yes...		
BEN Energy			Email, Sms	No INFO	Rally	Rally				No INFO	No INFO	No INFO
SolarCity		Not sure		Not cited	SolarCity story	Ambassador						
Elenia Oy	Mukana	Minun Sivuni										
Enel												
Tendril			Home Energy Report		Facebook, Twitter			With connected home devices				
Rocket Home											Demand Side manage	

	BtoC	BtoB			Electricity	Gas	Water	HW based	*Level of disaggregation / Individual Monitoring*	Data		
		Utility	*Institutions / Smart*	*Communities / SME's*						Smartmeter	Submetering	Billing
Enerbyte									Only statistical			
Opower												
C3 IoT												
Silver Spring			?						Load dissagregations apps from partners			
Comverge						?			but, if HW...			
Bidgely								Bridge				
Grid4C												
Powerley								Bridge /Thermostat				
MeterGenius												
CIMNE Bee Group			?	?								
Greenly									Not yet			
Plugwise												
Toon		Eneco...										
Green Choice App		Green Choice...										
Green Pocket									Smart home YES...			
Mirubee												
Wattio									Smart plugs YES...			
Circutor. Wibeee												
Intelen										NO imprescindible		
Watty								Bridge		Bridge		
British Gas							hot water...		Hardware...			
Factor Energia												
Fifth play	not sure..		see "Nuvonet"			Not sure if already there			Smart plugs YES...			
Onzo												
Ijenko		Telcos also...				?		gateway + outsource	Smart devices YES...			
Efergy			Sabadell i +			TBC			Smart sockets YES...			
Smapee												
Navetas								Bridge		Bridge. m3	Bridge. kWh	
Ecoisme									Spectrum Analysis!			
Neurio									Premium version			
Simple Energy									Not cited			
Egreen			Paris	Buildings				Gaz,eau,electricité				
MyEnergy										No need		
Currentcost		online shop							Smart sockets YES...	Bridge	Bridge	
Dwelo				Property managers								
BEN Energy						No INFO			No INFO			
SolarCity									Energy usage analysis (installation)	Not cited		
Elenia Oy						Not sure				Not cited		
Enel										Bridge		
Tendril				Real State...?					Energy Calculator / Statistical	Is not required		
Rocket Home		Telcos also.	Not sure					Segurament...				

4. Analysis based on LinkedIn

	LinkedIn				
	Industry	**Size**	**Followers**	**Headquarters**	**Founded**
Enerbyte	Information Technology & Services	1-10	128	Spain	2012
Opower	Computer Software	501-1000	17200	USA	2007
C3 IoT	Computer Software	51-200	3460	USA	2009
Silver Spring	Computer Networking	501-1000	9891	USA	2002
Comverge	Oil&Energy	201-500	1846	USA	1980
Bidgely	Computer Software	51-200	5248	USA	2010
Grid4C	Information Technology & Services	11-50	26	USA	2013
Powerley	Information Technology & Services	1-10	40	USA	2015
MeterGenius	Utilities	1-10	36	?	2013
CIMNE Bee Group	Renewables&Environment	11-50	38	Spain	2001
Greenly	Environmental Services	1-10	211	Sweden	2014
Plugwise	Renewables&Environment	11-50	494	Netherlands	2006
Toon	Renewables&Environment	5001-10000	22086	Netherlands	1995
Green Choice App	Renewables&Environment	51-200	1627	Netherlands	2001
Green Pocket	Computer Software	11-50	83	Germany	2009
Mirubee	Information Technology & Services	1-10	61	Spain	2011
Wattio	Consumer Electronics	11-50	371	Spain	2010
Circutor. Wibeee	Industrial Automation	501-1000	2258	Spain	1973
Intelen	Information Technology & Services	11-50	1715	USA	2011
Watty	Information Technology & Services	11-50	203	Sweden	2013
British Gas Energy Efficiency	Renewables&Environment	51-200	1175	UK	1999
Factor Energia	Renewables&Environment	51-200	691	Spain	1999
Fifth play	Information Technology & Services	11-50	617	Belgium	2007
Onzo	Utilities	11-50	700	UK	2007
Ijenko	Computer Software	11-50	261	France	2008
Efergy	Electrical/Electronic Manufacturing	11-50	403	UK	2006
Smapee	Information Technology & Services	11-50	477	Belgium	2012
Navetas	Renewables&Environment	11-50	204	UK	2008
Ecoisme	Renewables&Environment	11-50	87	Poland	2013
Neurio Tech.	Consumer Electronics	11-50	457	Canada	2005
Simple Energy	Computer Software	51-200	1191	USA	2010
Egreen	Environmental Services	1-10	84	France	2012
Rocket Home	Computer Software	11-50	78	Germany	2010
MyEnergy	Internet	11-50	168	USA	2007
Enel	Utilities	10001+	87781	Italy	1962
Elenia Oy	Oil&Energy	201-500	726	Finland	2012
Currentcost	Electrical/Electronic Manufacturing	1-10	59	UK	2006
SolarCity	Renewables&Environment	10001+	79562	USA	2006
BEN Energy	Information Technology & Services	11-50	17	Switzerland	2011
Dwelo	Computer Software	1-10	55	USA ?	2014
Tendril	Computer Software	51-200	2555	USA	2004

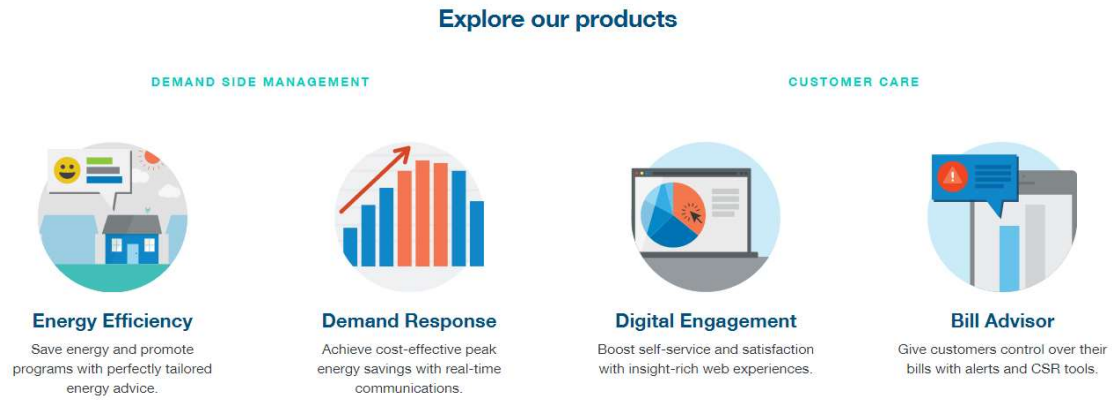
5. Companies brief presentation

Opower

Opower is the leading company of the residential energy efficiency sector mainly due to its high amount of final customers. It is a Software as a Service (SaaS) company providing customer engagement software to more than 95 utilities in 9 countries, which represents an scope of more than 50M final customers. Some fact that demonstrates its high influence in the sector is for instance, its dominating position in US market (37% of US households).

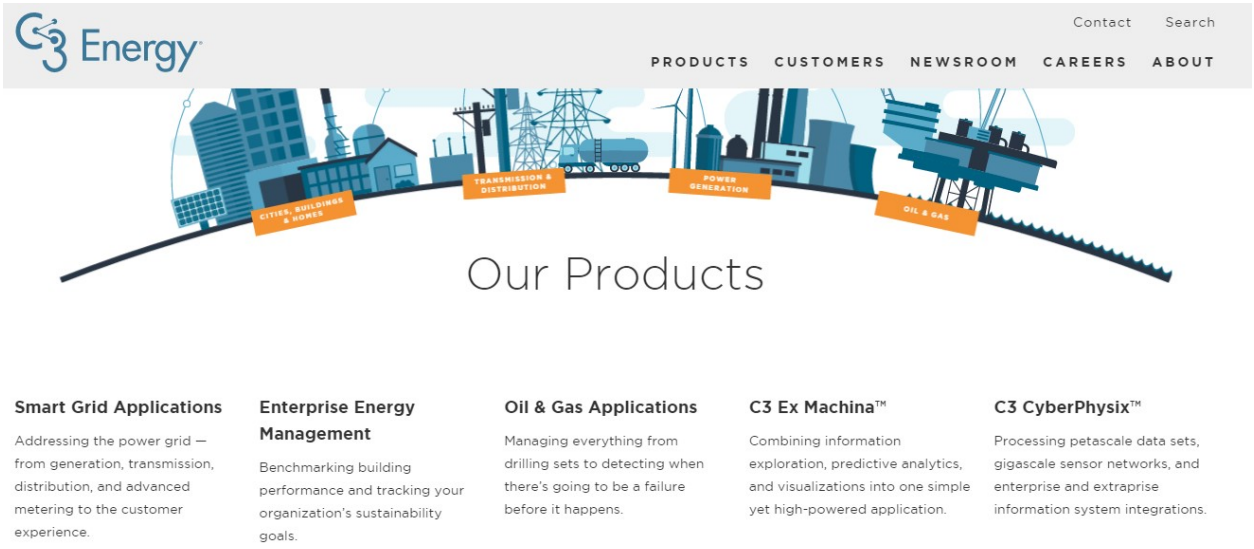
Opower define his product as a "customer engagement platform tailor-made for utilities". It uses smart meters data to inform customers about their energy consumption (including Electricity and Gas). This interaction with the customer is done through several channels: a mobile app, a web portal and the Home Energy Report (HER) which provides a comparison of energy use with neighbours in order to challenge the customer to a more energy efficient behaviour. *As many studies defend, social norms have demonstrated to be the most effective way to have an impact on customer energetic behaviour, whereas economic, environmental and community incentives have lower or no impact*. Other significant features from Opower's software are: reward programs, online billing, utility notifications (for instance, high bill alerts) and targeted recommendations. Furthermore, the platform is completely white-labelled in order to brand the web portal and mobile app with each utility branding.

The product is presented in two different sides. On the one hand, it is a demand side management tool for utilities as it offers energy efficiency advice and demand response peak events. On the other hand, utilities also benefit from its customer care side based on digital engagement and bill advisor that increases the customer satisfaction and its loyalty.



C3 Energy

C3 Energy defines themselves as a company transforming the energy value chain by delivering “The internet of energy”. In fact, the variety of their products is very wide within the energy value chain. For instance, they give advice in the oil and gas industry, help organizations to achieve their sustainable goals and provide complex software to analyse and process data.



The Smart Grid applications segment is divided in two sections: one dedicated to the building and running processes regarding the advanced metering system and another tool named *C3 Customer Engagement Application*. This last instrument aims to offer a new customer engagement tool for utilities to interact with their customers.

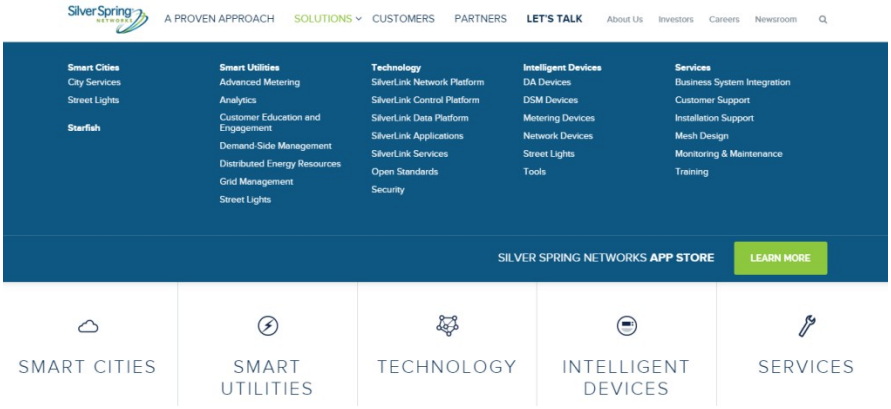
Focusing on C3 Customer Engagement platform, it differentiates three types of customers: residential, commercial business and industrial enterprise.

The channels used to interact with the customer are through web portal, mobile app, mails and reports. Moreover, the features offered are for instance, a comparison of energy consumption with an average efficient home or business and the possibility to earn rewards. Finally, the platform is also available to be branded by the utility itself and it gives advice both on electricity and gas consumption.

Silver Spring Network

Silver Spring Network is a provider of smart grid products. Similar to C3 Energy, its product range is very wide and they offer many types of services. For instance, they differentiate between five types of business focus: smart cities, smart utilities, technology, intelligent devices and services.

In the smart cities section, Silver Spring Network provides guidance to cities in their challenges to modernize the infrastructure in the way to become a smart city. This is done for instance by adding new applications such as lighting/parking/traffic monitoring or including advanced meters for electricity, gas and water.



Regarding smart utilities, Silver Spring Network offers a customer engagement platform together with other services. However, this software does not compete in the broad open market, because it is only available for those utilities using their smart meters. It is important to highlight that Silver Spring Network is also a hardware based company selling intelligent devices such as smart meters, thermostats, In Home Displays (IHD) or Electrical Vehicle (EV) chargers.

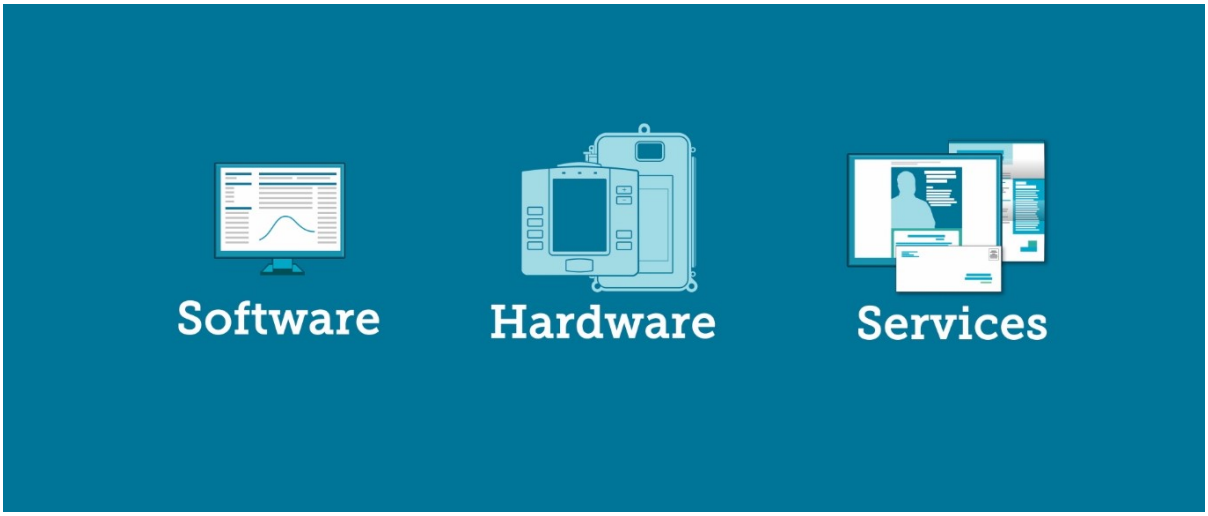
Its customer engagement platform for utilities is called *CustomerIQ* and it is a tool for residential, commercial and industrial customers to manage better their energy consumption by providing recommendations and bill projections through a web portal, a mobile app or weekly email reports. The platform is highly configurable and the dashboard is also highly configurable allowing utilities to introduce their own branding. Moreover, as the result of several partners' agreements, it includes load disaggregation applications. Besides this, Silver Spring Network also provides Demand Response (DR) technology for utilities.

Finally, *SilverLink* is an app store of industry-leading applications built by Silver Spring and other partners from different sectors (advanced metering, demand-side management, distribution automation, smart cities and software). For instance, Bidgely is one of their software partners. Within this app store, they also offer *CustomerIQ Solar* which is a tool that utilities can offer to their customers with a prosumer profile in order to maintain their customer relationship.

Comverge

Comverge is a company that provides hardware, software and services to utilities related with demand management programs. In addition, it is considered the leading company in the Demand Response (DR) industry and they serve over 500 utilities.

The hardware provided by Comverge goes from smart thermostats to remote control systems. *IntelliSOURCE* is the software platform offered which integrates demand response, energy efficiency and customer engagement tools. The platform is accessible from laptops, tablets and smartphones, but it was designed to be used from a mobile device. It provides normative comparisons with other users participating in the same utility program and gives personalized tips. Furthermore, it can be also connected to smart thermostats from Comverge or third-party suppliers, in order to control and configure the home temperature remotely. Finally, the platform is also integrated with demand response programs allowing utilities to manage peak load events.



Bidgely

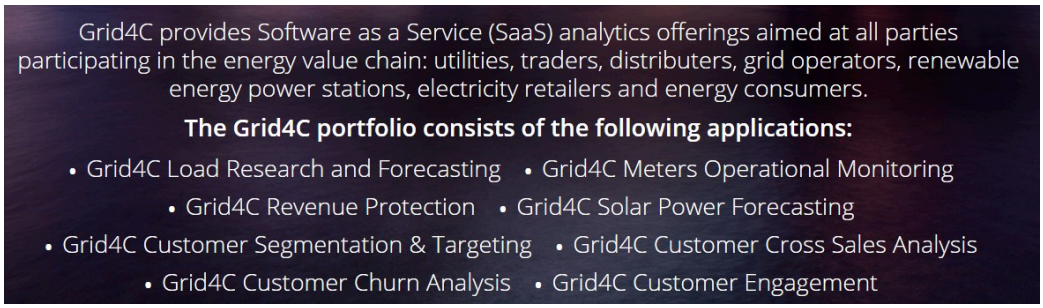
Bidgely is presented as “your personal energy advisor”. It provides individually energy efficiency advice, neighbourhood comparison tools, appliance itemization and solar disaggregation. All these features are presented in a web portal or a mobile app, and the user is also able to share its successes through Facebook, Twitter and other communities. Despite they offer this service to end users passing through utilities, the platform can be found either from Bidgely directly or the utility branding. Therefore, in this case the utility may offer an energy efficient service as an outsource service under Bidgely’s branding.

Bidgely’s technology is based on disaggregation appliances, which enables to provide information on how individual appliances impact the bill. However, to have a more precise real-time energy tracking of individual appliances, they also developed a hardware named *HomeBeat Energy Monitor* that works as a bridge between the smart meter and the home router internet. The cost of such device is 35$ which is much more economically accessible than others smart thermostats.

Grid4C

Grid4C is a smart grid predictive analytics company focused on all the actors within the energy value chain. They provide software to analyse data collected from smart meters and consequently, provide forecasts, energy efficiency and customer engagements solutions.

The variety of their products is wide as they are offered specifically for each participant within the value chain: utilities, distributors, retailers and energy consumers.



From the previous products, *Grid4C Customer Engagement* is a software platform focused on final energy consumers. The input information comes from pricing, customer data and smart meters data. As a result, it offers energy efficiency solutions that are translated into economic profit for energy consumers and customer engagement for utilities.

The software is available both in web portal and app. Some of its significant features are: non-intrusive detection of app's, demand response optimizations and customer segmentation. This allows providing personalized messages to inform about irregularities or give recommendations.

Powerley

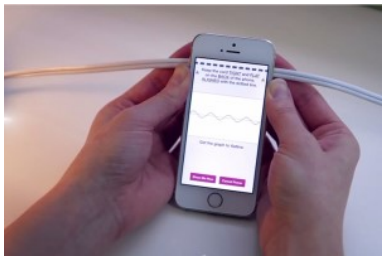
Powerley is a new venture created from the collaboration of two companies: Vectorform which is a software developer and the utility DTE Energy.

They define themselves as the only utility-designed home energy management solution in the market. Therefore, its solution is centred on the utility and is completely branded with the utility brand ("delivering a unique experience to each utility").

Moreover, apart from the software, the complete package solution also includes two branded hardware: first, an energy 'bridge' that works as a gateway device connected with the smart meter in order to receive more frequent information from it and that can be also connected to other external devices. This device can be connected with the majority of home solutions and therefore, it allows to remotely control thermostats, lights, etc. from the smartphone. Second, a smart thermostat that controls the home temperature remotely and is connected to the previously called energy 'bridge' is also included on the package. The cost of such devices depends on how much each utility wants to charge. In the case of DTE Energy, it is offered to their customers for free.

The platform provides real time consumption information, appliance level disaggregation and energy efficiency recommendations from self-learning and personalization method. Moreover, it also offers a collaborative system for peak demand response events. This system encourages customers to participate in community events and enables utilities to better manage their targeted savings.

Finally, a very innovative feature of the app is the so-called *PowerScan* tool which reads the magnetic field created by a power cable and provides the power consumed and the cost associated with it of any device only by using an iPhone.

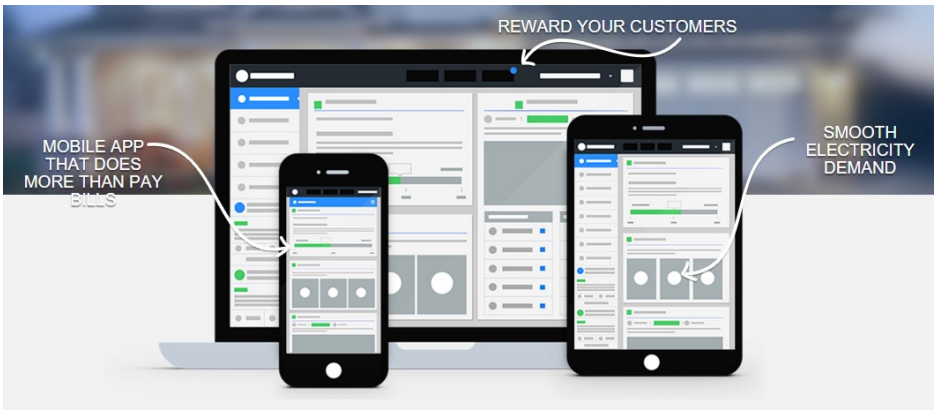


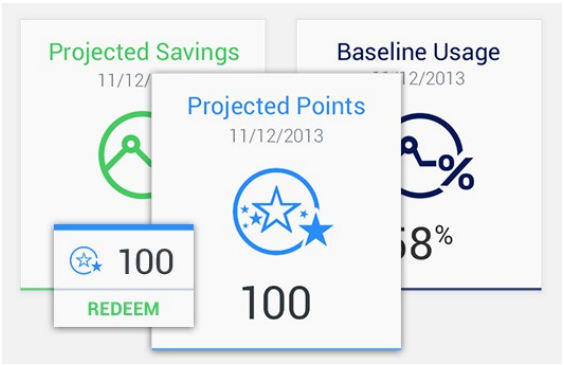
MeterGenius

MeterGenius offers to utilities a self-branded customer platform for energy management. The platform is available on web portal and mobile or tablet app. It gives general suggestions and recommendations on how to save energy and become more energy efficiency. Moreover, it can be connected to outsource devices such as thermostats from external providers.

Special focus is made on gamification. In order to motivate customers, they offer reward points to stimulate good energy behaviours, engage customers into the platform and create loyalty with the utility brand.

They differentiate themselves from other products (like OPower) by delivering a persistent-engagement platform because their customers continue to see the results due to their gamification programs. However, they claim that in other platforms the customer only sees the results at the beginning and afterwards he or she declines.

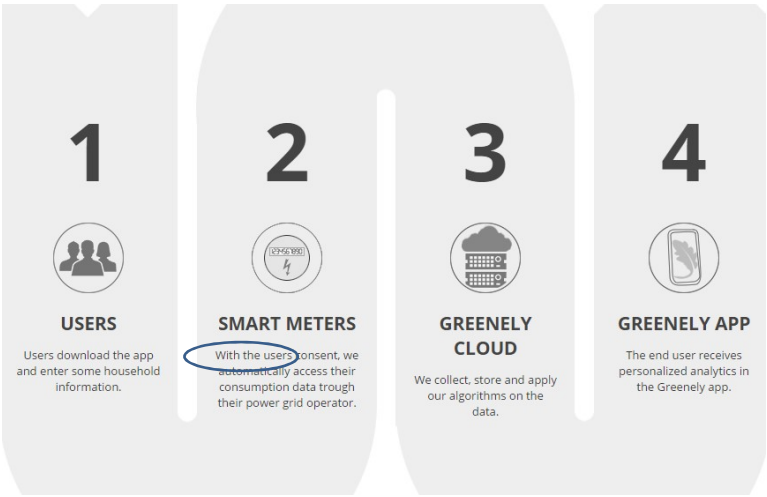


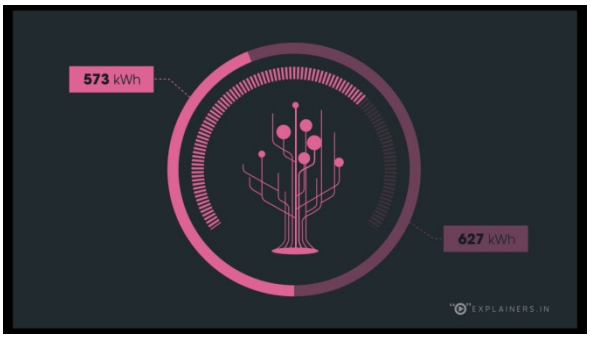


Greenely

Greenely is a start-up from Sweden focused to help customer in decreasing their energy consumption by offering a platform that stimulates their energy behaviour. The software is available through utilities and therefore, it is also a customer engagement solution and a way to decrease peak costs for them.

The software is presented in an app and a web portal. To stimulate good energy performance, gamification is one of their key features together with comparison tools and community building. To visualize the energy consumption, the platform includes the design of a tree which is directly influenced by the level of consumption.





Plugwise

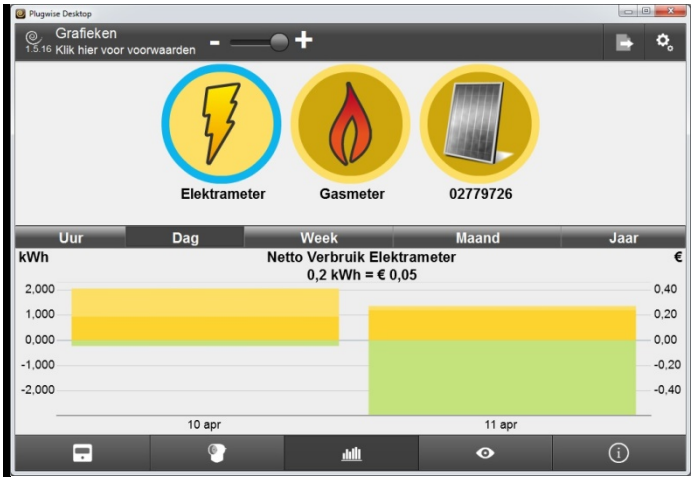
Plugwise is a Dutch company offering different hardware based products related with wireless energy management and control systems in order to increase energy efficiency in private households and business organizations.

One of their popular devices is *Smile P1* which connects the smart meter with the smartphone or tablet via wireless. The connection is done through a P1 port and therefore, it is required that the smart meter has this output source.

It works as a gateway of consumption data both for electricity and gas. The app is mainly informative presenting hourly, daily, monthly and yearly data. The app is also available for prosumers allowing them to measure both production and consumption.

The product including the hardware and software is available at a price of 99€.

Other products from *Plugwise* are Anna and *Coolding*. The first one is a smart thermostat that allows the user to control and schedule home temperature from his smartphone and it costs 249€. The second one is an infrared device to remotely control the HVAC from the smartphone or tablet which costs 149€.

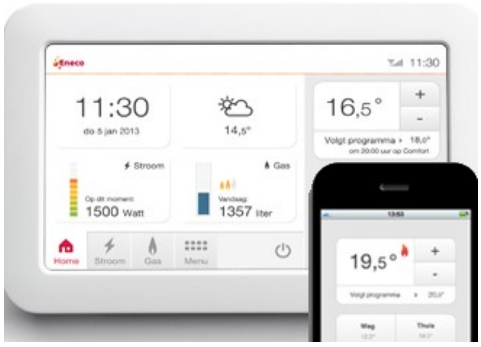


Eneco

Eneco is a Dutch utility company offering *Toon*, an energy efficiency product that consists on a smart thermostat connected to smart meters. The package is composed by several elements as is connected via wireless to the boiler, the electricity and gas smart meters.

It provides information on how much electricity and gas is being consumed at any time and by day, week, month or year. Besides this, if desired it also offers some tips on how to save energy and is able to control remotely the boiler.

The product is also available for non-utility customers. However, the cost of it varies: for Eneco's customers, the installation is for free and they charge 3.5€ per month in the bill. For non-customers, they have to pay the installation cost (75€) and a monthly fee of 4.95€.



Green choice

Green choice is a renewable Dutch utility that provides electricity and gas. They have their own platform to provide an energy efficiency service to their customers. The software offered to their customers is a very simple app that provides daily, monthly and yearly consumption information.

The app does not offer real time consumption and the smallest time lapse is daily consumption. However, it offers a comparison with other similar households and provides some tips on how to save energy.

Download the new app Greenchoice

The app will get you as a customer of Green Choice insight into your consumption and you can arrange a lot of energy business itself. Simple, anytime, anywhere:

- ✓ Submit meter readings in your cupboard
- ✓ Check your energy consumption and grid per year, month, week and day
- ✓ View or change your monthly installment amount
- ✓ Compare your consumption with the rest of the Netherlands or similar households
- ✓ Use our saving tips to save energy

Bee Group

Bee Group is the energy efficiency department of the International Centre for Numerical Methods in Engineering (CIMNE). The company offers solutions to households, utilities, community buildings and cities, all related to provide tips and recommendations for a more efficient use of energy.

For the consumer side, they offer *ControlaEnergia* which is an app that provides graphs on your historic consumption, gives recommendations and compares with other users. Also, it includes some gamification tips to enhance the user engagement on the app. For instance, it awards the user with points for different reasons such as daily access or input information. It is important to highlight that the user has to enter his consumption data and is able to enter as much data as desired.

Besides this, the same software together with extra services related to data analytics is offered to utilities as a customer engagement tool. In this case, the software uses the data provided by the utility smart meters.

Green Pocket

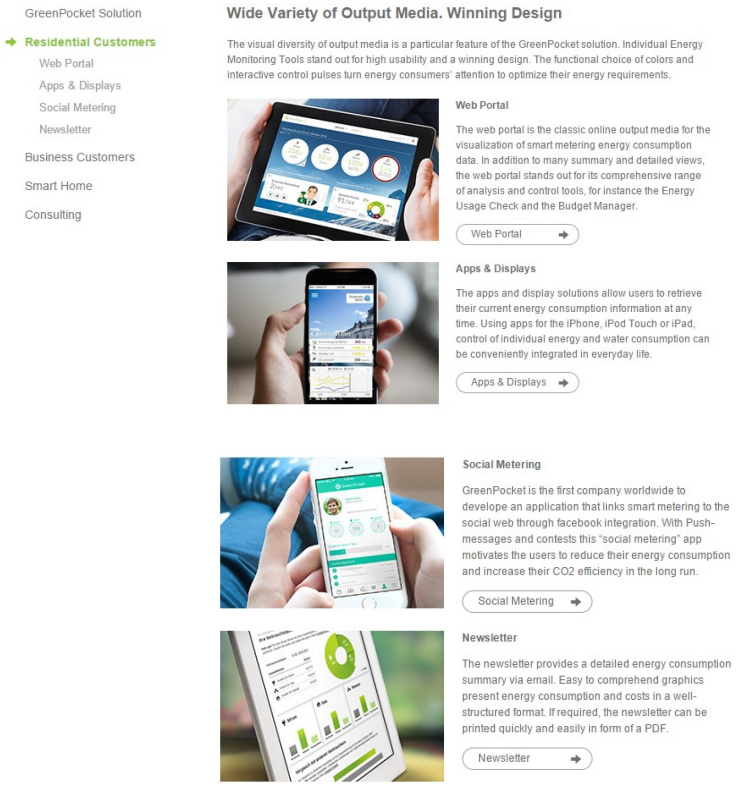
Green Pocket is a software specialist based on Germany that provides energy and water management solutions to large and small utilities for residential and business customers.

The channels used within the residential product are: web portal, smartphone app and newsletter. Consumption data is obtained from smart meters, but the software is also able to connect with other hardware that allows offering extra smart home tools. Besides this, social metering is a key feature of the software: it allows posting the user's achievements on Facebook, challenging your friends and wining badges for personal successes. Furthermore, it is also possible to visualize the energy produced if the customer works as a prosumer.

The software for business customers is similar, but more focused on the management side of time and resources.

In addition, Green Pocket is spreading its product by offering also smart home software. This tool includes remote control of appliances and lighting, and can be connected to many types of hardware (control devices, sensors, etc).

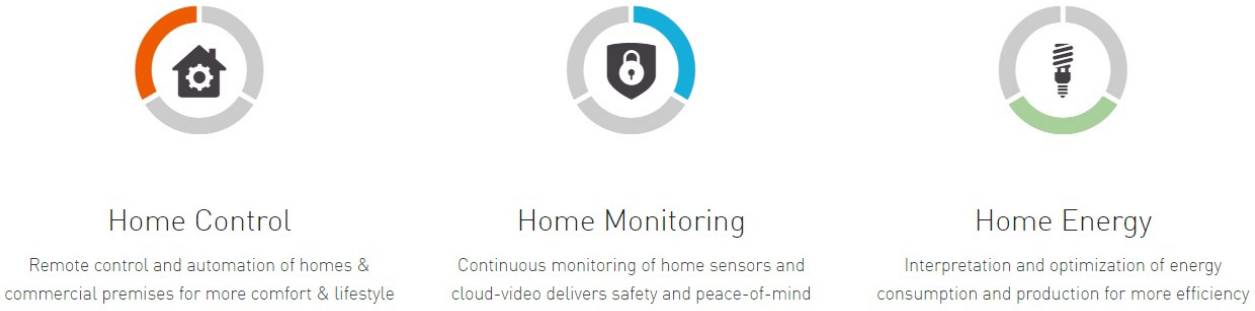
Finally, the company also offers consulting services for those interested in entering the smart home market. They provide different types of help such as market research or hardware acknowledgement as a result of their experience.



Rocket Home

Rocket Home is a German company offering multiple products in a centralized way. All the applications and features are connected in a unique device in order to provide “a complete solution for connected homes”. The fields covered are: home control, home monitoring and home energy.

Their solution is provided with an open software platform called *HomeRUN intelligence cloud*. The platform is white-label in order to allow branding on it and highly customizable. Their customers are mainly utilities and telecommunication companies.

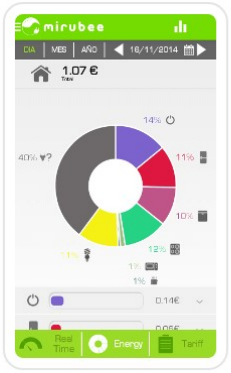


Mirubee

Mirubee is a start-up from Wayra (Telefonica accelerator) that offers an energy efficiency solution in a BtoC (Business to Customer) business model. It is important to highlight that this solution does not use the data from smart meters and requires installing a device into the home's electrical panel. This device, *Mirubox*, sends continuously the consumption data via Wi-Fi and its price is 119.50€.

The channels used are smartphone app and web portal. It provides tips on the best electric tariff for the customer based on his/her past consumption. The most important feature is its ability to disaggregate consumption data through *Inspectee* technology.

Consumo en tiempo real



Energía consumida por electrodoméstico

Registro de consumos máximos para el ajuste de la potencia de tu contrato

Recomendaciones personalizadas de tarifas de electricidad

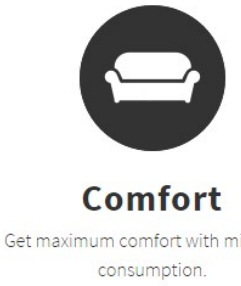
Wattio

Wattio is a company providing home control solutions for comfort, energy efficiency and security services. They offer different types of devices such as smart thermostats, smart plugs, security cameras, etc.

For each demand, they offer several packages composed by different devices. For instance, to save electricity, they offer a package composed by a smart plug and an electricity monitor. Both devices are connected to the software provided by Wattio.

The software gives insights on your electricity consumption and provides information on your consumption habits. Moreover, it also provides a comparison with other homes and sends alarm when something unusual happens in the consumption.

The price of a package composed by a smart thermostat, a smart plug, an energy monitor and a home automation centre is 299.90€.



Comfort

Get maximum comfort with minimum consumption.

Energy Efficiency

Control your electricity expenses and recover your investment quickly.

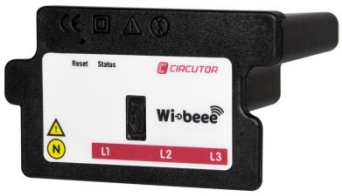
Security

Receive alerts should some something unexpected occur in your home.

Circutor

Circutor is a company with more than 40 years of experience on designing and manufacturing hardware devices for energy efficiency services such as monitoring, measurement, control, protection, etc.

One of their innovative devices is *Wibeee* which is a consumption analyser. The device is inserted into the electrical panel and connected to a Wi-Fi connection in order to collect electrical data. The market price of the device is 173€.



The interaction with the user is done with an app also developed by Circutor. The software allows the user to access to his/her consumption data in real time by using a smartphone, a tablet or a computer. The platform provides instantaneous power consumption and allows exporting the data generated to an Excel sheet. Moreover, it also provides instantaneous values for other variables such as active power, reactive power, intensity, voltage, and frequency, etc. The data is collected into the platform in order to observe and compare the evolution of electricity consumption.

Intelen

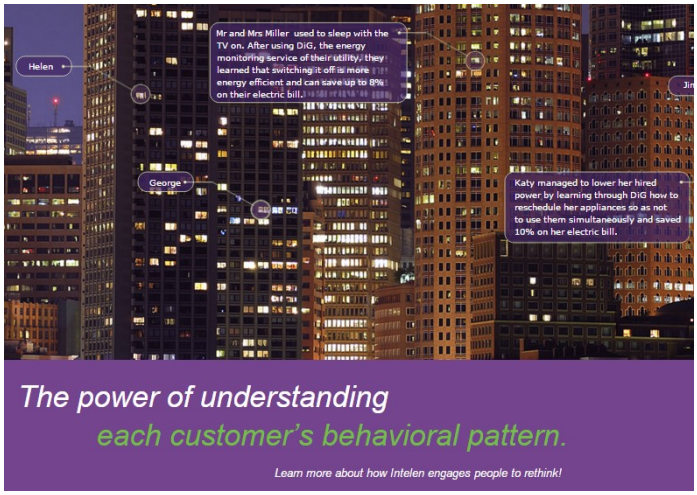
Intelen is a USA start-up company that provides a customer engagement platform for utility customers both businesses and residential. The company puts all the efforts on providing the most completely personalized service. Understanding each customer's behavioural pattern is the key success to offer services that "Engage people to rethink".

The solution proposed, presented under the name of *DiG Energy*, is white-labelled in order to include utility brands and has many different features that can vary depending on the willingness of each energy provider.

Features are comprised in 4 main sections: DiG Energy, DiG Engagement, DiG Marketplace and DiG Consulting/Analytics. DiG Energy provides tools to monitor daily energy consumption and its associated cost through different functionalities such as peer comparison, peak demand monitoring, energy disaggregation, personalized notifications and bills prediction. DiG Engagement provides educational tools to empower behavioural changes in the users in order to retain them as long as possible and attract new customers. They provide personalized services in order to satisfy customer's needs through gamification tools. At the same time, users are challenged in order to understand the benefits of their achievements. DiG Marketplace is also related with the gamification tools. It is a place that can be used for the utility as a way to increase the revenues, and with the introduction of virtual coins, it offers the user an extra gamified experience to recompense his/her energy savings efforts. Finally, DiG Consulting/Analytics is a service resulting from the acknowledgement on understanding every user's routine. This tool is offered to utilities in order to be able to segment more accurately the market and prepare more customized marketing campaigns.

Intelen

ENGAGING PEOPLE TO RETH!NK



Watty

Watty is a start-up from Sweden focused on disaggregation technologies. Using just one measurement source and applying it to their machine learning algorithms, they are able to diagnose the appliances energy usage. To do so, their solution requires of a low-cost hardware that obtains the data from the smart meter. Moreover, it also compares the appliances with alternatives in the market.

The solution is mainly designed for utility companies to increase their customer engagement. However, they also offer his software to solar providers and connected homes companies. In these cases, they allow to use and integrate with their software.

Alert Me

AlertMe is a UK company offering hardware and software in order to enable household users to monitor and control their energy consumption. Through disaggregation algorithms, they provide energy savings recommendations.

Hardware devices are based on a home hub that can be connected via wireless to other AlertMe devices and third party devices.

The software platform is based on three main products: *SmartEnergy* for electricity monitoring, *SmartHeating* for remote heating control and *SmartMonitoring* for home monitoring.

It has been acquired by British Gas and the original website is no longer available. (65m$)

British Gas

British Gas is the largest UK energy company. They supply gas, electricity, boilers and home services. In 2015, they acquired the company AlertMe in order to offer an energy saving service directly to their customers.

The company offers for free to their customers the installation of a smart meter that monitors at real time the electricity and gas consumption. The smart meter together with the platform *My Energy* enables the user to visualize his/her daily, weekly, monthly and yearly energy consumption, and compares it with past values and other customers. Moreover, the platform also provides some general energy saving tips.

Besides this, they also offer *Hive*, a smart thermostat to control and monitor heating. The thermostat is provided in a package with two more devices that enable to connect to the boiler and the wireless router. It is important to highlight that there is no need to be British Gas customer to be able to purchase this product. The price of the complete kit is 249$.

A wireless thermostat

Beautiful design. Clever control. The new Hive thermostat lets you easily control your heating at home.

A hub

Plugs into your broadband router so your thermostat connects to the internet. (We'll set it up for you in the installation.)

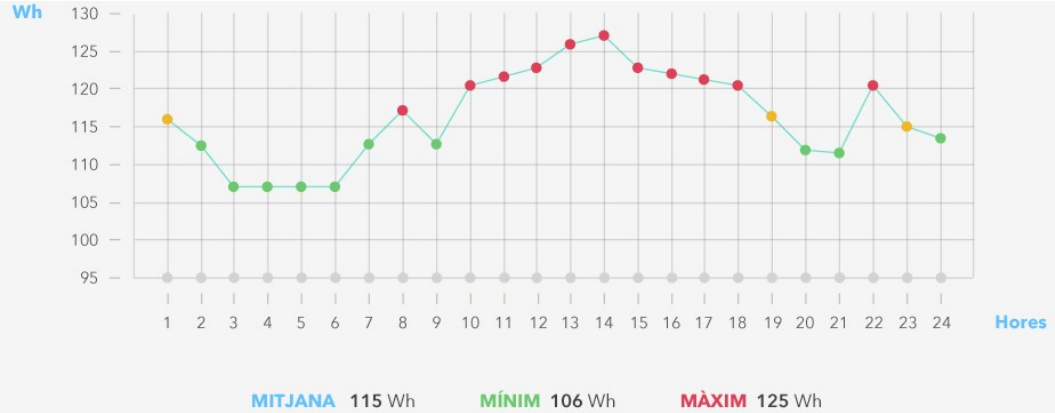
A receiver

Lets your thermostat and boiler talk to each other. It's usually fitted near your boiler, so you'll barely notice it.

Factor Energia

Factor Energia is an electricity retailer offering a new energy efficiency service to his customers. The service is accessible from an app named *Factor SmartHome* and it is focused on the economic savings through a responsible energy use.

The main characteristic of the platform is the ability to present the hourly price of electricity and give recommendations on the best time for using common appliances such as washing machines. Besides this, the platform also offers the possibility to compare with other consumers. If the user includes information about his/her home, the platform is also able to provide personalized energy saving tips depending on geographic situation, number of people, heating/cooling system, etc.



Fifthplay

Fifthplay is a Belgium company delivering smart home solutions for increasing comfort and save energy. They work together with utilities, telecommunication companies and others.

The product range is wide and they offer mainly many different hardware smart devices and software connected to them. The products are assembled in several packages for specific purposes. For example, they offer packages for schools and universities, for software developers and for utilities.

Using the software from a web portal or through the app, the user can control smart plugs, set the temperature of the thermostat and compare the consumption of each device.

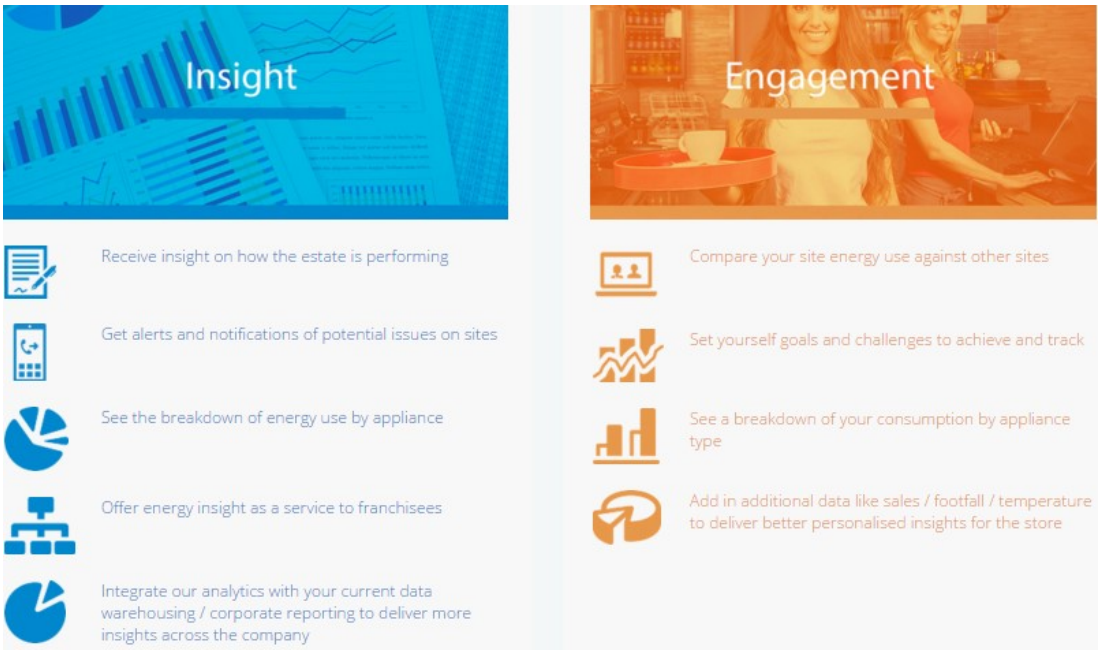
Smart cities are also one of their customers. In this case, they offer a specialized solution for them called *Nuvonet* that offers a smart community platform built by blocks that are chose specifically for each type of community.

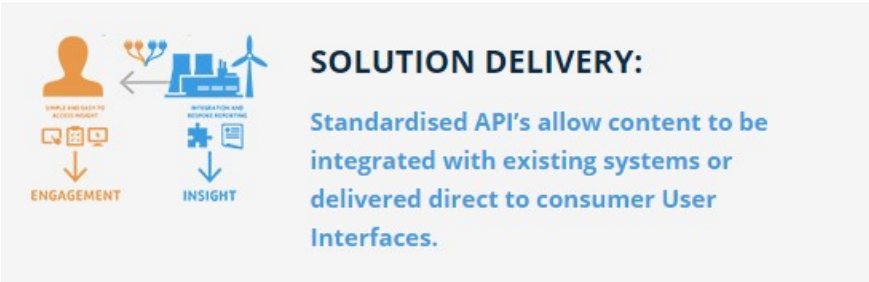
Onzo

Onzo is a company focused on analysing big data in order to provide customized solutions to utilities for customer engagement services. They emphasize on their ability to develop complete customized tools for specific uses depending on each utility need. Moreover, the platform offered is completely white-labelled in order to personalize the communication between the customer and the utility.

In other words, they analyse big data from the utility to transform and deliver valuable information that benefits both user and utilities. The data received from the utility comes from electricity and gas meters.

They are already working with the utility Green Choice and with Silver Spring Networks.



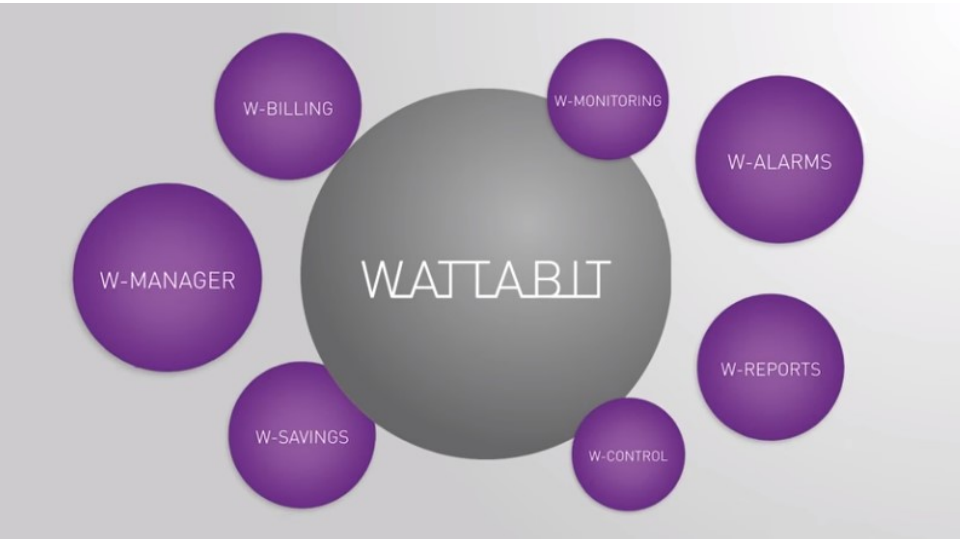


Wattabit

Wattabit is a Software as a Service (SaaS) company providing a platform to monitor and remotely control energy consumption such as electricity, gas and water.

The company does not take park on the Hardware development, but it enables the connection and communication with any hardware. The software is focused to small business and companies. Moreover, it is also provided to Energy Service companies as a tool to offer their services.

The basic features included on the platform are presented in the image below. Personalized reports, remote control, billing information and detection of extra payment, real time monitoring, etc.



Ijenko

Ijenko is a French company that provides a platform to enhance consumers experience across different IoT environments. The platform offers what they called the Internet of Energy (IoE) which consists on developing services and linking smart energy devices in order to provide a collaborative tool between Ijenko's customers and residential consumers.

Ijenko's customers are divided in four figures: utilities, telcos, consumer electronic (CE) groups and smart cities. They enable utilities to engage their customers by providing tools to save energy and demand response programs. Telcos can use the platform to offer added-value services such as security, home automation and smart heating services in order to differentiate. CE companies collaborate with Ijenko to design and develop smart home devices. At the same time, they can use the platform as a bridge to enter new markets from the IoT. Finally, smart cities can take advantage of its platform to deploy integrated energy management systems.

The Ijenko Home Energy Management Solution have different features: *Energy efficiency* tips such as total consumption, appliances consumption, savings and comparisons. Other features are: *Smart heating*, *Demand response*, *Electric Vehicles charging*, *PV production*.

The platform is accessible through many APIs which allow customer to create their own end-user experiences.

Efergy

Efergy was founded in 2005 with the central mission to help people save energy, money and the environment by providing online energy monitors and In-home displays. Their systems give an insight on how much energy is being consumed in real time and the cost associated with it. It also shows historical information.

Their monitoring solutions are available both for end users (homes and small businesses) and utilities. Moreover, they participated in public projects for specific cities (for example Queensland, Sabadell and Donostia).

Besides this, Efergy also collaborates with some utilities to develop smart meters by providing PLC gateways and Zigbee enabled monitors.

They are constantly developing new smart home products to keep on the road of the connected home.

They offer different package products with kits specialized for each application and customer.

Smappee

Smappee offers a solution to monitor the home electricity consumption. They present the product as “the world’s smartest home energy monitor”.

The solution is based on an Energy Monitor that has to be connected to the home’s fuse box. This monitor is connected through the Wi-Fi to their own software accessible from a smartphone and web portal. They provide appliance level consumption due to their knowledge on disaggregation algorithms.

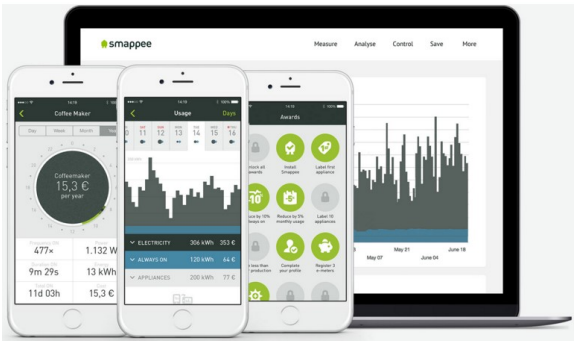
Besides this, they also offer smart home products. Specifically, Smart Plugs are provided to control remotely selected appliances or lighting.

Moreover, the software presents an Awards section that rewards good user’s behaviours such as completing your profile, reduce consumption, label appliances, etc.

The product can be found directly for the end-user and is presented in packages. For instance, the most common product including the Energy Monitor and a Smart Plug, costs 199,00€.

They also offer a version named Pro which is focused on bringing energy monitoring and control to SME’s.

Finally, as their newest product, Smappee has also developed hardware to monitor gas and water consumption. All the hardware offered is connected and is presented together in the same software.



Navetas

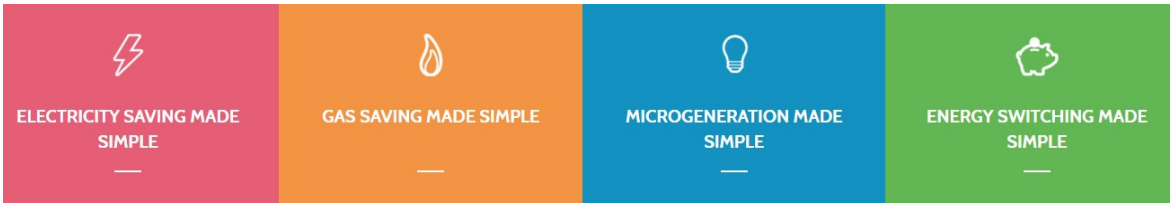
Navetas is a UK company delivering services for the smart home. The services are cloud-based energy monitoring and smart data analytics.

They have a product called *Loop* that works as a personal energy assistant. It consists on a platform that monitors electricity and gas, gives real-time advice and is accessible from your phone, table or computer. Moreover, starting on 2016, it also monitors Micro-generation.

The platform offers real-time monitoring of consumption in terms of energy and cost. It also presents spends on the last day, week, month and year. Gas and electricity are presented together in order to observe the importance of each one.

Moreover, it offers tools such as comparison with similar users and budget challenges proposed by the user: the platform only explains what the current state of accomplishment is and summarizes the previous budgets.

Finally, an important and distinctive tool within the platform is the access to the best deals based on your consumption and the possibility to switch easily from your energy provider. This service is similar to a marketplace of energy providers and is offered through a partnership with *uSwitch.com* which is the #1 energy switching service in the UK.



Ecoisme

Ecoisme is a Polish company that developed a solution to “save energy in an easy way”. The solution is hardware based and includes a sensor connected to the home electric box that tracks the energy consumption. This measurement is synchronised with a platform that provides recommendations and alerts in order to save energy.

The two principal characteristics of this solution is the ability to detect appliances through disaggregation algorithms and the personalized tips. **It is important to highlight that they used power analysis and spectrum analysis to detect devices. This is a very precise tool that requires high frequency measurement hardware.**

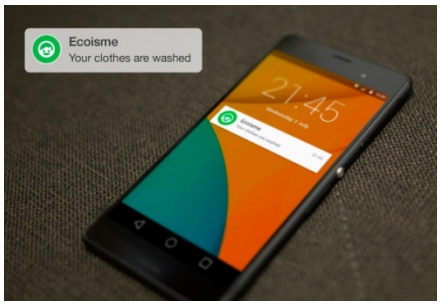
Moreover, the platform can be also integrated to out-source smart devices. Besides this, it is also connected to social network such as Facebook in order to compare with your friends.

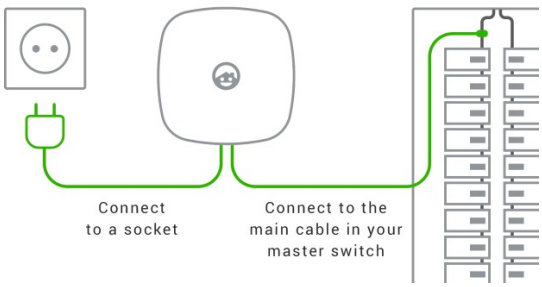
The solution automatically detects the most common appliances. However, the user can also provide some detailed information about them in order to get more precise feedback.

The personalized tips are based on detection of high energy consumption. For instance, with this system, the software can detect if the user forgot to close the fridge or if the iron is turned on for too long. Furthermore, other recommendations regarding the best time to charge the car or to run the washing machine are available.

Finally, the platform also monitors micro-generation in case the user has solar panels or some other micro generation at home.

The project was financed via crowdfunding and the campaign end by June 2015 raising the amount of 67.000$. The product is intended to be available in the market in April 2016, but the price is not presented yet.





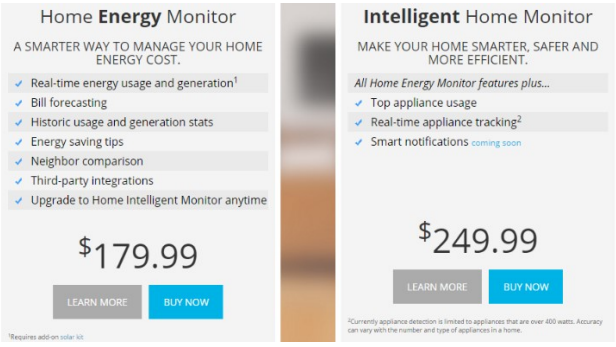
Neurio

Neurio is a company from Canada offering a solution for residential users to save energy and thus, save money.

Their solution is hardware based and consists on installing a measurement device into the electric box. This device is connected through the Wi-Fi to a software platform that monitors the home electricity consumption. Therefore, the platform presents the real-time power consumption of the house and other features such as historic data, ranking comparison with neighbours, bill forecasting and energy saving tips. Moreover, the platform is also able to monitor solar generation in the case it exists.

The product is presented in two versions named *Home Energy Monitor* and *Intelligent Energy Monitor*. The difference between them are the features included, being the second one the premium version. Consequently, Intelligent Energy Monitor offers appliance level consumption and it is able to detect several appliances. Moreover, to have more precise insights, the user can input information regarding his appliances. To do this, the platform includes the "training" mode which is designed specifically to detect appliances.

Finally, the solution also sends personalized notifications to alert of forecasted excess consumption in order to prevent the user.



Simple Energy

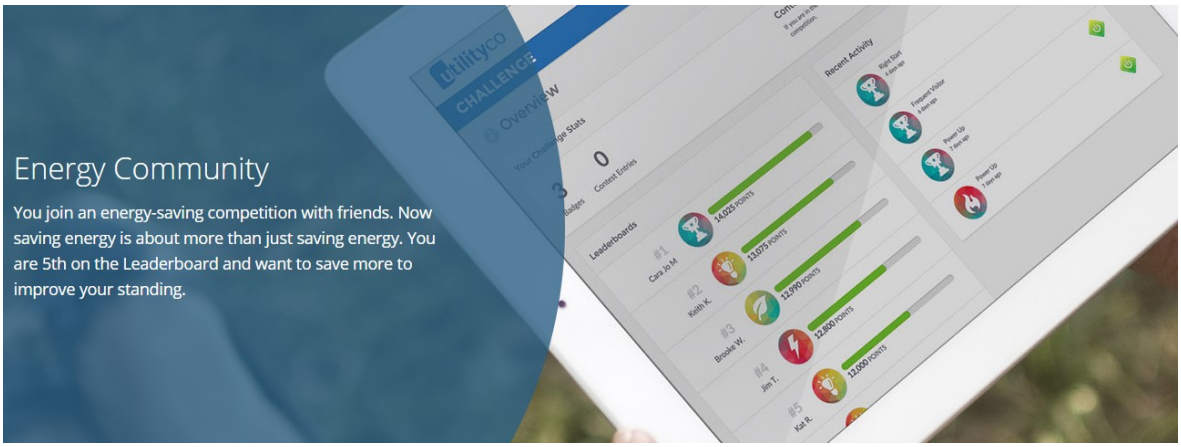
Simple Energy is a customer engagement company for utilities with the aim to change people's mind on energy. Their goal is to "inspire customers to take action". Their solution offers a range of experiences to engage people and is designed taking into account that different people respond to different things. Consequently, they put a lot of emphasis to send personalized messages to every customer. To receive more precise and personalized tips, the user is able to introduce characteristics of its home using an intuitive survey.

Moreover, the platform also provides comparison with similar houses. It shows the consumption of those houses similar to yours. Furthermore, several tools are used to motivate users. For instance, good behaviours are rewarded, goals are proposed and testimonial stories from other users are shown in order to inspire people to act.

It is important to highlight one of the innovative tools included: community energy saving competitions. This type of competitions is organized during peak energy times and is rewarded with badges or virtual points. Moreover, this tool is their way to build a community because every user participates to achieve a common goal and it compares between users by showing the contribution of each participant. Therefore, the platform also offers a demand side management for utilities in order to allow their users to participate in demand response programs.

Besides this, the platform is also connected to a marketplace branded by the utility that allows customers to take wise decisions when purchasing new energy related products. Some products can be purchased using virtual points or badges.

Finally, the platform is white-labelled and each utility is able to brand the platform and integrate with the utility's current website.



eGreen

eGreen is a French start-up that helps to reduce water consumption and energy consumption both in electricity and gas. To achieve this goal, it monitors water, electricity, gas and indoor temperature. However, it is important to highlight that users without access to monitoring can join the platform as well. In this case, the user introduces manually the consumption of his electric, gas or water meter regularly.

The monitor these consumptions, an online shop is available to purchase monitoring devices. These devices are installed into the electric box or the gas/water meters and connected via wireless to eGreen's platform. At the moment, eGreen offers devices to measure electricity consumption, but other external companies can also offer other devices that can be synchronized to eGreen platform.

eGreen's platform shows the consumption of water, gas and electricity in an hourly time base. Consumptions is presented in kWh consumed, € costed or CO2 emitted. Moreover, it also offers a comparison with anonymous neighbours. It is important to say that within this comparison the user can observe the number of habitants or the house surface in each household in order to have a more effective comparison. Besides this, the platform also provides energy efficiency recommendations and it can be used as a tool to organized friendly competitions. The messages presented or general with the common link to be sustainable, ecological or energy efficiency related.

The product is generally offered to end users. However, it is also available for enterprises and community buildings. Moreover, eGreen has been selected as one of the five start-ups included in a project called *DataCity*. In this case, the services from eGreen will be offered to the citizens of Paris.

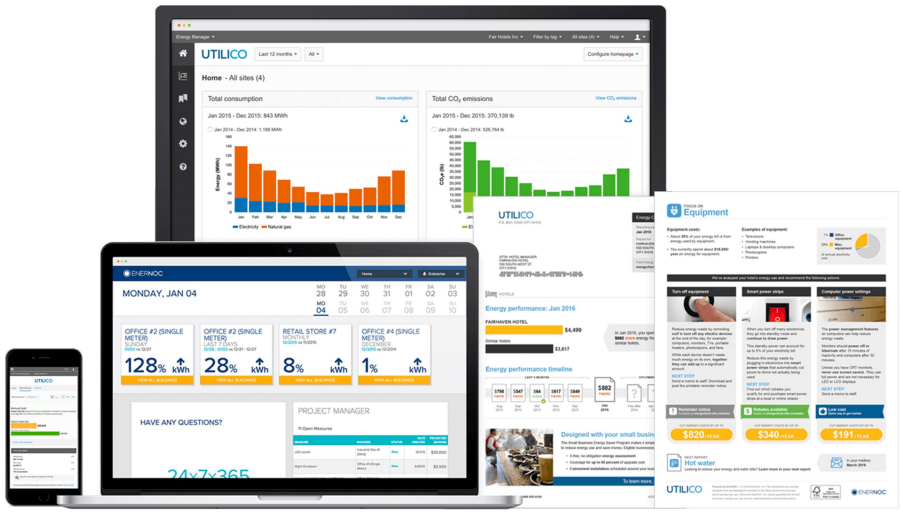
Enernoc

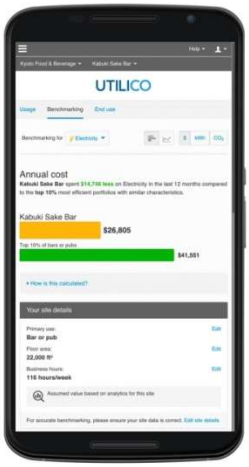
Enernoc define himself as “the world leader in energy intelligence software”. They identify two main customers: business and utilities. For business they offer analytics solutions to control their energy costs and for utilities, they provide solutions to enhance the relationship with their customers.

Their solution compares electricity consumption between neighbours for residential and SME’s. It also sends energy efficiency recommendation messages.

It enables also to organize demand response events in order to increase customer engagement and improve demand-side management.

Enernoc’s solution is specialized on utilities business customers rather than residential.



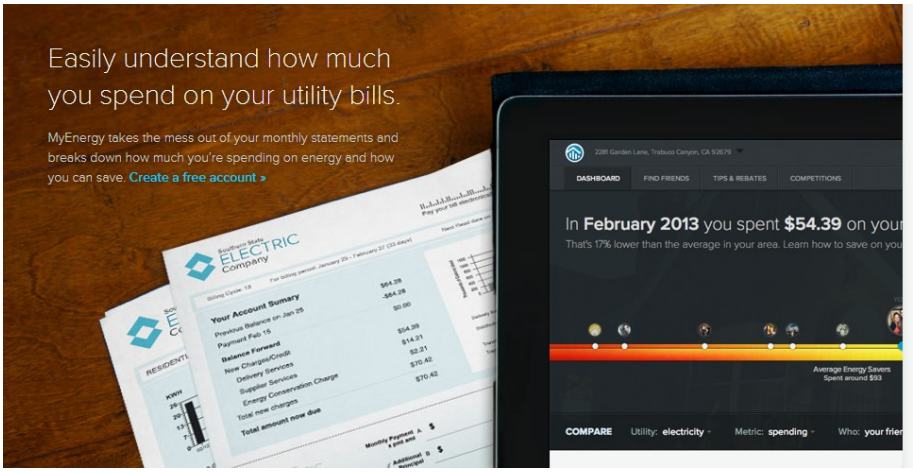


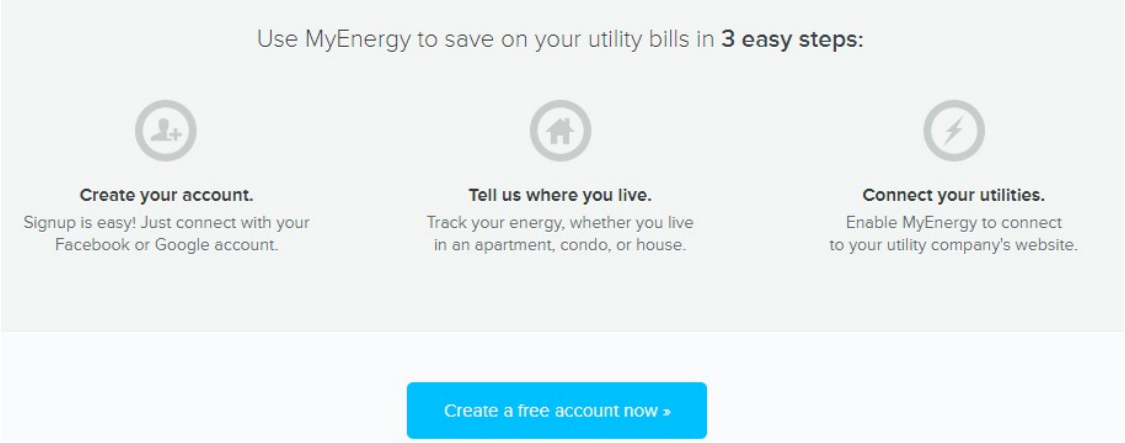
My Energy

My Energy is an online service company that had been acquired by Nest in 2013. The company itself provides a platform that gathers all your utility bills in one common place. Therefore, it is a way for residential users to collect electricity, gas and water bills in a same place. Moreover, the platform is connected to Facebook or Google social network in order to create a community and compare with your friends. At the same time, by introducing his address, the user is also compared to their neighbours.

The platform is offered directly to residential users in US. However, utilities can also participate on it and use the platform as a customer engagement solution and meet their energy efficiency goals.

Energy savings challenges are organized through the platform allowing its users to participate on them and earn rewards for good energy behaviours. These reward points can be used later in a marketplace offered as a result of the collaboration with other businesses. Energy savings can be achieved thanks to the “tips to save on your energy bill” presented in the platform.





Current Cost

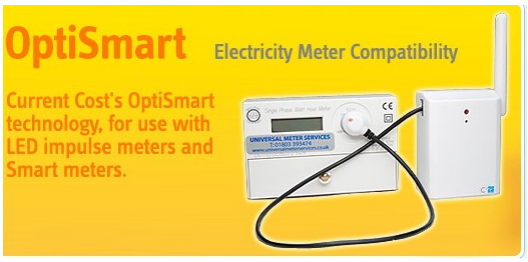
Current Cost is a UK company that produces devices to monitor electricity (recently, gas also) consumption. Their solution is hardware based and they offer different devices to track energy. Besides this, they also offer some software to show the data collected from their software online. Moreover, they allow other parties or individuals to develop software to be used with their devices and these options are included in their website.

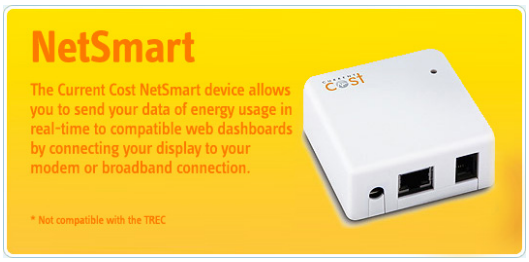
Their main product is an IHD device that works as an Energy Monitor that track the energy consumption in real-time. There are several models: the simplest one only presents real-time consumption and associated cost, and the new generation models also offer appliance monitoring. This is not based on disaggregation models, but it shows how your consumption is expended during the day in order to identify if you are leaving some appliance on.

In addition, to connect IHD's to software, it is needed to purchase another device (NetSmart) that works as a bridge between them. This hardware product has been also developed by Current Cost. Finally, there is another energy bridge that is connected directly to the smart meters and obtains energy consumption data from it. However, this product is also compatible with some types of smart meters that are presented in their website.

Finally, they recently developed a product that is connected to gas smart meters and therefore, it also monitors gas consumption. The information is gathered also into their online dashboard. They have two models depending on the smart meter type.

Current Cost's products can be found directly in their online shop and through some utilities that include their products in their personalized online marketplace.





Dwelo

Dwelo is a start-up company created in 2014 with the aim to transform apartments into smart homes. Their solution is offered to two types of customers: residential and apartment managers.

The product can be divided in three main areas, all gathered in a common mobile app. The first service is focused on *Convenience* and it consists on enabling the user to control the lighting from the smartphone. Second, it is also a *Security* service allowing the user to lock and unlock door from the phone. Finally, the third area is focused on *Efficiency* and it consists on controlling the home's temperature through a smart thermostat.

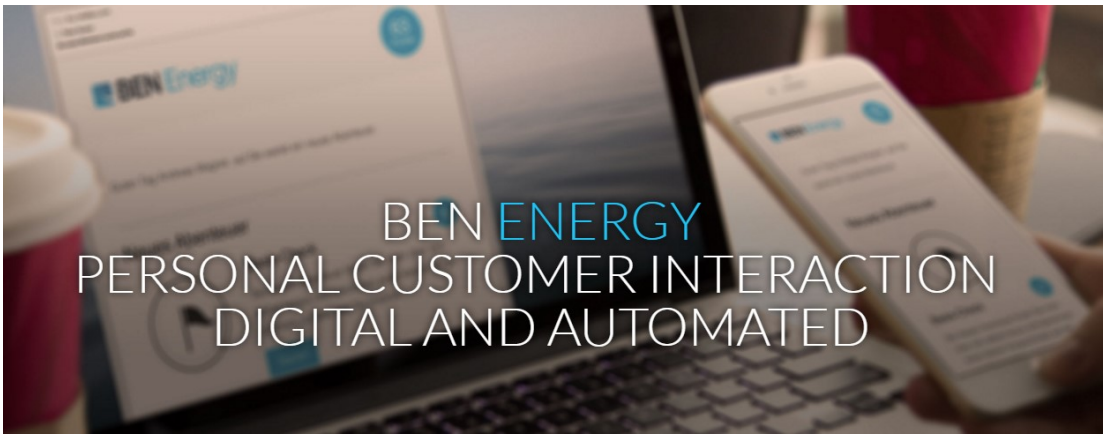
The product is offered directly to residential users or home apartment managers. In this case, managers can control all their properties with a central platform accessible from the smartphone or in the website.

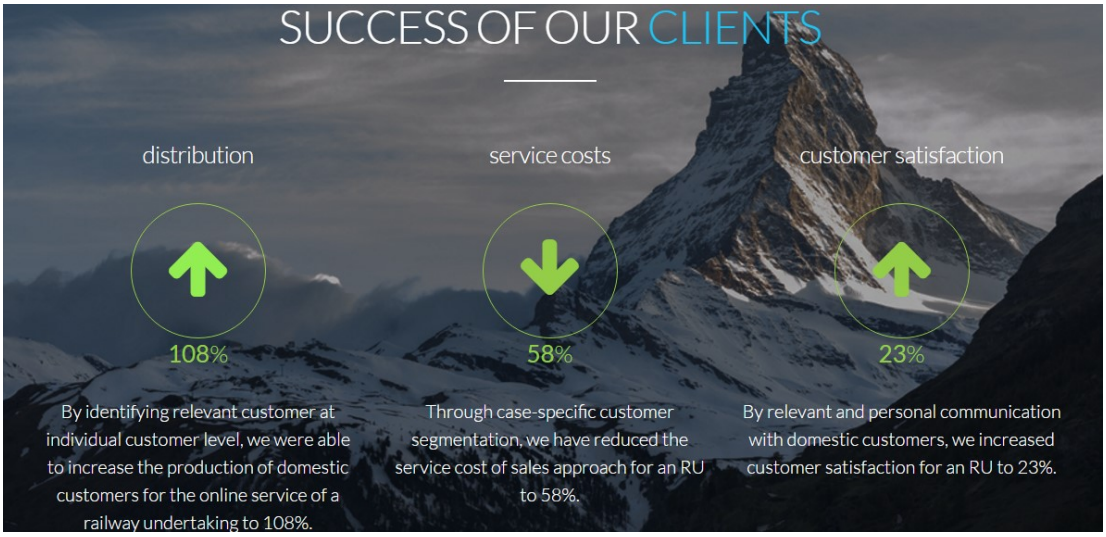
BEN Energy

BEN Energy is a SaaS (Software as a Service) company with the aim to change how people interact with their energy. The software is based on data analytics and behavioural science algorithms in order to offer the end-user an energy experience that engages utility companies with residential users.

There is not much information regarding the characteristics and features included in their platform. Nevertheless, it is intended to be highly customizable for the utility and the communication with the user is done in a personalized manner through mobile, web, email or sms. In addition, it can be integrated with the utility service portal and the service can be delivered to users with and without smart meters.

They are already offering different types of end-customer relationship solutions through their services to 28 utilities.



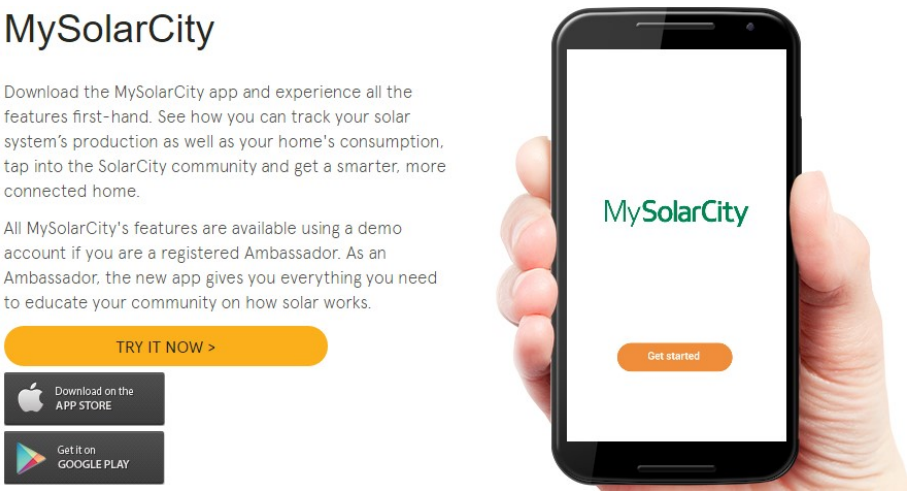


SolarCity

SolarCity is the leader company in photovoltaic solar systems for residential homes, businesses and governments. They provide full services: design, financing, installation and monitoring.

They have recently developed a mobile app called *MySolarCity* which allows users to monitor their energy consumption and solar production. Consumption and generation data is presented in real-time mode, but also historic daily, monthly and yearly data is presented. Apart from it, the platform also includes extra features such as information regarding where the user can save more energy in his home, a map that shows the location of other users within the community and the possibility to earn reward points and money when recommending to new customers. Furthermore, it also enables users to share their experience through a social media tool called SolarCity story.

This service is only delivered to those customers that installed a special device in their electric panels during the installation phase. This process requires having access into the wires coming from the grid that can be physically limited in some cases.



Elenia

Elenia is a Finish electricity and heating utility that already had developed a smart electricity grid by integrating power distribution and data systems. Consequently, their customers can access online to their real-time electricity consumption on a month, daily and hourly basis.

This information is provided through a mobile app and a web portal.

Enel & Ilevia

Enel is the biggest Italian company within the energy market and Ilevia is a company dedicated to develop software and hardware to automate homes and buildings. As a result of their collaboration, they have developed a product called *Enel Smart Info* which consists on a smart device connected to a socket that connects with Enel's smart meters and thus, monitors electricity usage.

The information is presented through an app and web portal and it also shows historical data. Moreover, it also monitors generation from solar panels if existing.

It is important to highlight the easy way of installing such device and that it is only compatible with Enel's smart meters.

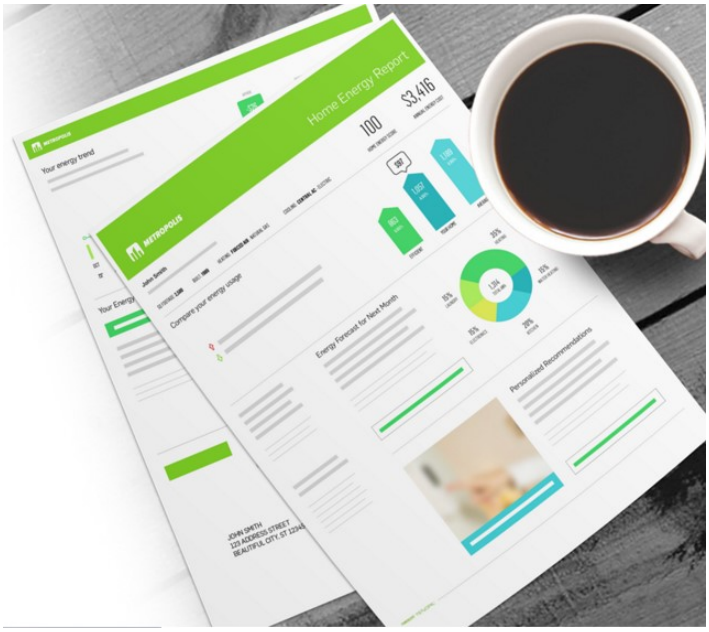
Tendril

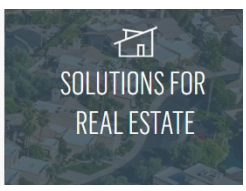
Tendril is a US company offering a cloud-based platform for utilities to deliver customer engagement solutions.

The solution is based on what they called *Tendril's Energy Intelligence* which consists on understanding and simulating how people worldwide consume energy. They also use data analytics to analyse how structural data of the house (size, insulation, thermal capacity, and a long etc) and how weather conditions affect energy consumption. Besides their knowledge on the home, they also analyse behaviours on the home and how people engage with energy services. They emphasize on the unique way of user's relationship with energy habits and consequently, the importance of personalizing communication with them. Furthermore, no smart data is required to offer his solution.

Features included in the platform are: real-time energy consumption, neighbourhood comparisons and energy efficient personalized tips. The app can also be synchronised and control remotely connected home devices. Moreover, it allows also to participate in Demand Response programs organized by the utility and the user can share his achievements through social media such as Facebook, Twitter and email.

Finally, they identified three types of customers: Utilities & Retailers, Solar providers and Real Estate professionals.





EcoFactor

EcoFactor applies advanced analytics to connected home devices. Their application automatically manages thermostats and air conditioners allowing end users to reduce their energy bill.

The platform is based on three main fields: Proactive Energy Efficiency recommendations, optimized Demand Response events and HVAC Performance Monitoring.

Their solution is offered through different channels: Utilities, Home Service Providers and Energy Retailers. All designed to reach end consumers.

They emphasize on providing solutions that avoid the user to be constantly monitoring and adjusting their thermostat. Their algorithms learn by themselves and adjust automatically. It also prevents from DR events by cooling the home before a DR event starts. Finally, it detects problems on the HVAC system that may affect the energy efficiency of the equipment.

The platform can be integrated to existing interfaces through an API allowing customers to brand their unique consumer experience.