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Smart Home Market Study for Iberdrola

Drivers, State of the Art, Benchmarking, Business Models and Proposals

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Abstract

Iberdrola is well-positioned to embrace the growth of the Smart Home market, which is expected to reach 16.1% of Spanish households by 2021. This paper examines the main factors, technologies, main players, start-ups, and current business models in the Smart Home market with a focus on the energy management area which most interests the Spanish utility. The paper highlights the drivers for customers and Iberdrola, studies the market forecasts, compares different solution providers in a benchmarking study and presents the different business approaches the market players are taking. Finally, the paper offers four different positioning proposals for Iberdrola. These proposals use an incremental approach and build on already running projects in Hardware retail, Service-tariffs and Data including Smart Electric Vehicle charging stations, Disaggregation using the data from the Spanish households' Smartmeters, Smart Solar for neighbour communities and Demand Response using HVAC systems from office buildings.

Keywords: Smart Home, Iberdrola, Market Study, Benchmarking, Proposals

Portuguese Abstract

Iberdrola está bem posicionada para abraçar o crescimento do mercado das Smart Homes, que espera alcançar o 16.1% das casas espanholas antes de 2021. Este documento examina os principais fatores, tecnologias, players, start-ups e modelos do negocio atuais no mercado da Smart Home com foco na area de Energy Management que é o mais interessante para a empresa elétrica espanhola. O documento destaca os principais fatores para clientes e para Iberdrola, estuda as previsões do mercado, compara diferentes soluções em um estudo de benchmarking e mostra as diferentes modelos de negócio que os players do mercado estão a tomar. Finalmente, o artigo oferece quatro propostas de posicionamento diferentes para a Iberdrola. Essas propostas usam uma abordagem incremental e baseiam-se em projetos já executados em varejo de hardware, tarifas de serviço e dados, incluindo estações de carregamento de veículos elétricos inteligentes, desagregação dos Smartmeters das famílias espanholas, o Smart Solar para comunidades dos vizinhos e a Resposta de Demanda usando sistemas HVAC dos prédios de escritórios.

Palavras-chave: Smart Home, Iberdrola, Estudo de mercado, Propostas

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Abbreviations

IT – Information and Technology

IoT – Internet of Things

IDC – International Data Corporation

DIY – Do it yourself

CES – Consumer Electronics Show

M2M – Machine to Machine

CNMC - National Commission Markets and Competition

EV – Electric Vehicle

HVAC – Heat, Ventilation and Air Conditioning

PV – Photovoltaic

SHEM - Smart Home Energy Management

DSR – Demand Side Management

DR – Demand Response

IFTTT - If This Then That

IEEE - Institute of Electrical and Electronics Engineers

RESSs - Residential Battery Storage Systems

BOE – Boletín Oficial del Estado

AC – Air Conditioning

RTO – Regional Transmission Organization

ISO – Independent System Operator

BYOD – Bring Your Own Device

BYOT – Bring Your Own Thermostat

OG&E – Oklahoma Gas and Electricity

SCE – Southern California Edison

SMUD – Sacramento Municipal Utility District

TOU – Time Of Use

CPP – Critical Peak Pricing

TSO – Transmission System Operator

BG – British Gas

SSE - Scottish and Southern Energy

HAN – Home Area Network

TDC - Danish telecommunications company

TIM – Italian Telecom

AMI – Advance Metering Infrastructure

ADMS – Advance Distribution Management Systems

DRAS – Demans Response Automation Server

EVSE – Electric Vehicle Service Equipment

REE – Red Eléctrica Española

1 Introduction

The automated home of the future is becoming a reality. The Smart Home market is growing in numbers of products, sales and services. The expected revenues by 2022 vary from \$50 to \$150 Billion depending on the source. IT companies, insurance companies, utilities, telecoms, security companies, consumers and Iberdrola know it and are investing in the potential behind this market trend.

The Internet of Things and Smart Homes, although they are still in their early stage, are taking lot of interest from leading technology companies around the world specially in the US and Europe. The first devices that were “smart” in the home were the phones or the vacuum cleaners, but nowadays the range of devices is huge and still growing. There is a set of devices for each front of the home and research forecasts from different companies agree Smart Homes are gaining traction. Moreover, during the next 5 years this market is expected to grow very rapidly. “Gartner Research forecasts approximately 20.8 billion IoT enabled devices, while IDC projects a \$1.7 trillion global IoT market” (PWC, 2017).

Iberdrola must use the new digital and IoT trends to create new business models. Different trends such as (Elizald & Goertz, 2016) device mesh, ambient user experience, information of everything, machine learning, Apps, service architecture and IoT platforms offer opportunities for new digital business models which Iberdrola can take advantage of.

In this paper, the aim is to provide the Iberdrola’s Ventura Capital Department with a clear overview of the Smart Home growing market the utility is facing. In order to do that, Smart Home drivers, market structure and the state of the art were presented. Moreover, a benchmarking was performed to study different business models used by potential Iberdrola’s Smart Home competitors and study which are the business approaches Iberdrola needs to take to become a Smart Home market player.

What is an Smart Home?

An Smart home consist in a dwelling which is equipped by different IoT products, network connected products for controlling different aspects of the home. Lighting, temperature, security, entertainment or energy consumption are some of the aspects which can be controlled thanks to phones, computers or different systems to in order to created a more liveable, controlled, efficient or sustainable home.

Any device, object or product connected to the internet, which can be monitored or controlled remotely is a Smart Home device. Different devices within a home become a Smart Home ecosystem. It must be considered that these systems should be a complement to a good bioclimatic architecture in new buildings, that user manual controls must not be forgotten and that durability of the systems is important when taking about sustainability.

Iberdrola

Iberdrola is a Spanish energy utility which has become the first energy utility in market capitalization in Spain and the third in the world. Since 2002 Iberdrola has a clear focus on Innovation and Clean-Tech, trying to go ahead the energy transition and the global warming challenges. The Venture Capital department of Iberdrola uses PERSEO Programme to fund new technologies and disruptive businesses to ensure the sustainability of the energy model.

PERSEO was created in 2008 and it has invested €50M in start-ups developing new energy business models around the world. Through this programme, Iberdrola offer its investment, its expertise, its clients (32million) and its capacity generation (45GW) to the entrepreneurs; helping them to build development and improve dynamism of the innovative businesses in the energy sector.

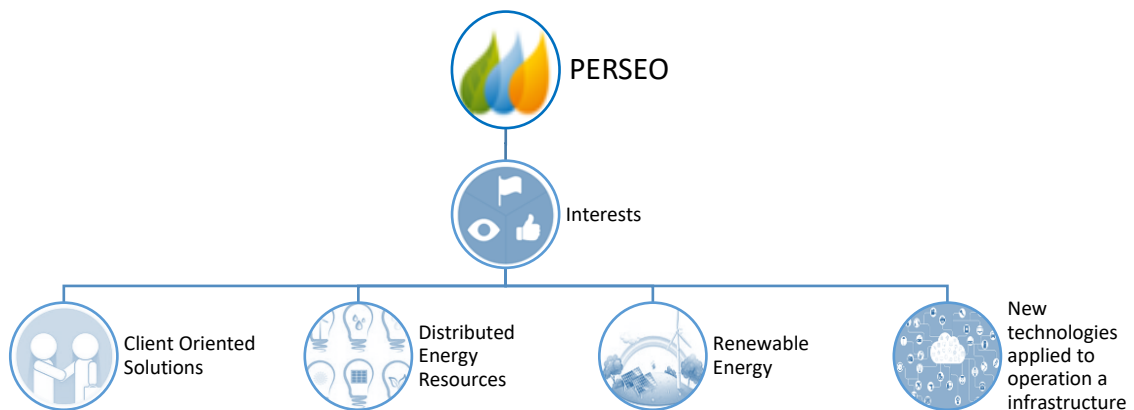


Figure 1. PERSEO. Areas of interest.

Iberdrola's interest towards innovation bring Smart Home technology into their scope. Both, the expected growth of the technology and its potential influence in a market like the energy market, make Iberdrola study potential positioning proposals within the Smart Home.

1.1 Approach for Innovation

Iberdrola wants to be a pioneer for energy innovation. The idea of disruptive trends and technologies help it to be one of the leader utilities in Southern Europe. Facing any business opportunity using the right approach is as important as localize those opportunities. The future digital business models (Elizald & Goertz, 2016) utilities might face require an Iberdrola approach with three main steps:

- Exploration. Research and discover new potential business models from upcoming and future trends.
- Rationalization. Understand the opportunity for Iberdrola, study it the real impacts that the technology will have in the company.
- Delivery. Create the plans and create products and services.



Figure 2. Exploration, Rationalization and Delivery. (Elizald & Goertz, 2016)

This paper will represent the Exploration of the Smart Home technology for later rationalize and deliver the ideas in the upcoming years.

2 Smart Homes Drivers

The Smart Home technology does not only benefit technology providers. Iberdrola and its customers can take advantage of this technology and produce a mutually beneficial relationship. The different drivers for using Smart Home technology for customers and Iberdrola are studied in this chapter.

2.1 For customers

There are different motivations for transforming a home into a Smart Home: energy efficiency, security, control, comfort, safety or connectivity are some of the things a Smart Home devices can do for their users.

The US represents the cradle of the Smart Home market, “One in four US internet users have a Smart Home device” according to PWC research (PWC, 2017). US smart home market has overcome the “Early bird” consumers stage and it is facing the “mass market”. Strategic Analytics details that there is an increasing Smart Home products purchases despite the fact a truly seamless and interconnected home is still an utopia because of the number of different products, protocols and working procedures among all the Smart Home products. Nevertheless, consumers have different reasons to upgrade their homes. The most common drivers for consumers purchasing Smart Home products are:

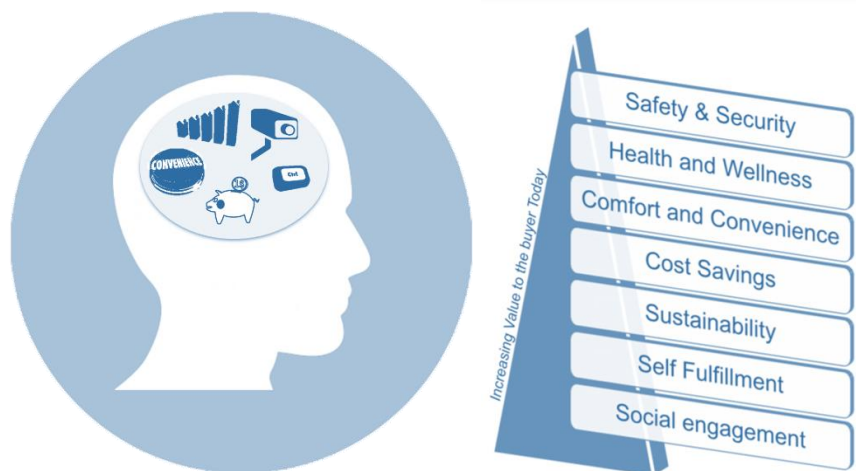


Figure 3. Consumer drivers. Partially sourced (Strategic Analytics, 2017)

- Savings. Energy Efficiency, energy independence and cost reductions.
- Safety. Increase home’s security, monitor the home, health and keep peace of mind.
- Convenience and make life easier.
- Control. Increase controllability of home functions.

- Other reasons: Increase customization, sustainability, reduce stress, health, accessibility, increase the value of the home, self-fulfillment, social engagement.

However, according to surveys carried out by the Consumer Intelligent Series of PWC, the main reasons that the owners of Smart Home devices give when they ask them why they bought smart home products are different.

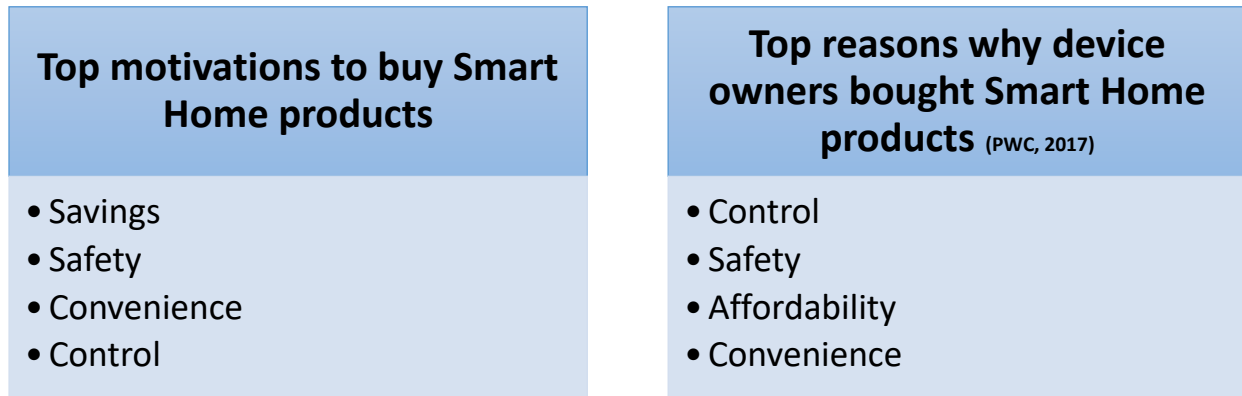


Figure 4. Comparison reasons to buy Smart Home devices.

Moreover, some device manufactures have used market niches (such a kid devices, pet controllers¹...) as a way to get into the Smart Home business.

Affordability appears as one of the key reasons the customers choose to purchase Smart devices. If one every four Americans own a smart device that means 75% percent of the population do not buy Smart devices for a reason. Companies in the Smart Home market must look at these reasons as challenges to overcome. Affordability, not fully understood benefits or problems of performance of the devices are some of them.

Inhibitors

First, the prices of Smart devices are still high for hesitant consumers and for those who do not know what the devices are going to give to their lives. The price of a Smart Hub (to control other devices in the home) is between €100 and €200 depending on the brand, he very popular Philips Hue light bulbs are around €60 per unit and a Nest Cam to keep an eye to a room in your home (kids monitoring) is €200. These range prices put affordability as one of the main inhibitors for some consumers who want to purchase smart home products.²

¹ Last year, the Energy Saving Trust published findings that showed worried pet owners spend an extra £78 million a year on energy to give their pets comfort.

² 64% of people between 18-34 years old say Affordability is the main reason why they do not purchase Smart Home products. (PWC, 2017)

Secondly, some people are more skeptical when they spend their money on Smart Home products and do not think or understand what are the benefits those products might bring to their lives. This is the reason why some people still do not spend the money in Smart Thermostat in Northern countries when it is proven that there is a recovery of the investment within 5 years. Moreover, everyday there are more and more devices for the home and in some cases people does not feel their need.

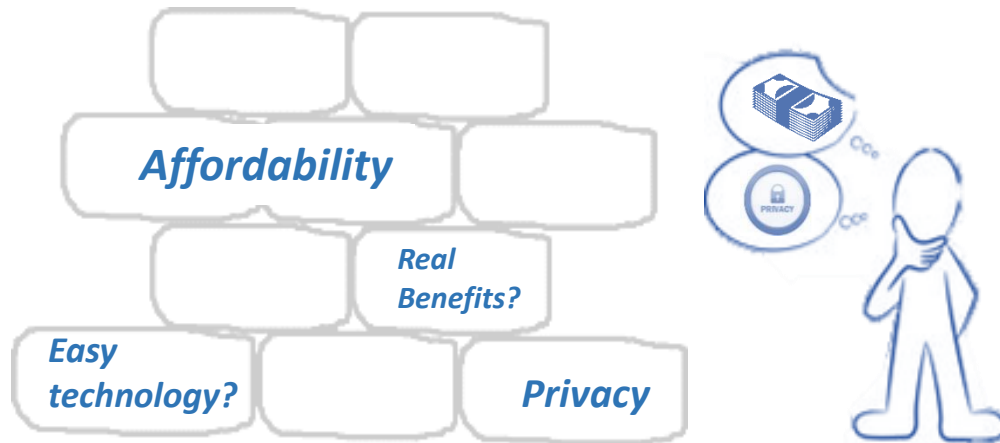


Figure 5. Market inhibitors for Smart Home consumers.

The third main inhibitor of people purchasing connected devices are the different connections they have. In theory, all the devices could be connected and controlled from the smartphone with the right hub, but the different protocols, apps and architectures make the use of the devices become not comfortable for every user. "To date, one of the largest barriers to realizing the benefits of comprehensive smart home program offerings has been market confusion." (Snell, 2017)

Moreover, although is not the main concern, the idea of having the home hacked is a constant worry for some consumers. Some companies face this problem with extra security measures, Apple, with its approach, only opens its platform to devices that fulfill some standards and after Apple specialists have analysed personally the product.

Consumers segmentation in Western Europe

According to Brian Bowen (Bowen, 2017) utilities must use the customer segments, just like big digital players like Netflix or Amazon, for their digital interaction with customers and e-commerce. Address the right person during the only 13 minutes electricity US customers³ take every year as an average interacting with their energy provider (Accenture, 2016) must be allow Iberdrola to engage that customer and the customer build a satisfactory relationship and experience with the company.

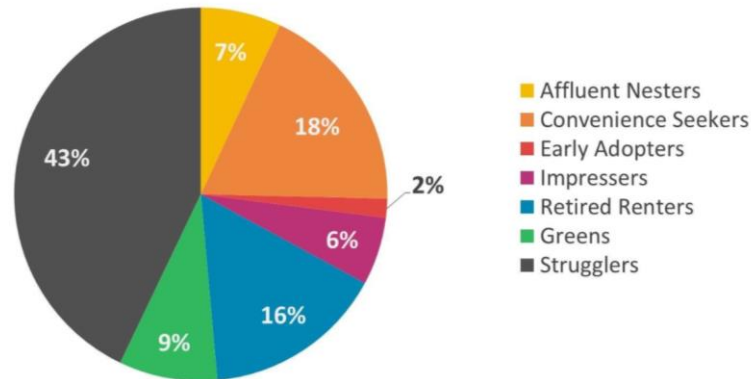


Figure 6. Smart Home customer segmentation in the market place Western Europe. (Strategic Analytics, 2017)

There are many studies on customer's segmentation for Smart Home companies. The Strategy Analytics report, following a Latent Class Analysis methodology (instead of the age and demographic group methodology followed by other papers like the PWC (PWC, 2017)) found seven different market segmentations. In their study, the biggest group were the strugglers⁴. They have no interest on environment nor technology nor utilities, making them very challenging to reach. Some could say that this percentage could be up to 60%, since it is the number of households in the UK who had never switch providers since the market was liberalized in the 90s (Ofgen, 2015). Retired renters is the second group most challenging to sell to, but it might be sensitive to products or programs helping to reduce pollution or global warming.

The second largest group, the Convenience seekers, "could be attracted by service providers who focus on the convenience of smart home products and de-emphasize the technology" (PR Newswire, 2017). Strategic Analytics set Impressers and Affluent Nesters as a "prime target" since they are ready buy latest technologies, but different

³ Only the states with competitive markets have been taken into account in order to simulate the liberalized market in which Iberdrola works.

⁴ "Strugglers" or people not interested on Smart Homes represent close to a 50% of the population according to many reports, including "Smart home, seamless life Unlocking a culture of convenience" from PWC and "Smart Home Marketing strategies for Western Europe" from Strategy Analytics.

approaches should be taken with these two groups since the Impressesers are much more concern about the environment than the Affluent nester, who prefer convenience. (Strategic Analytics, 2017).

Other segments, like Greens or Early adopters would be willing to pay more for eco-friendly or for new technology. These are more likely to become prosumers, installing their own Solar panels or even taking use of batteries in some cases. Smart Homes represent an opportunity for Iberdrola to connect to these prosumers, facilitating their power installations and helping Iberdrola to maintain a balance on the grid.

Iberdrola must focus in 4 main groups to address:

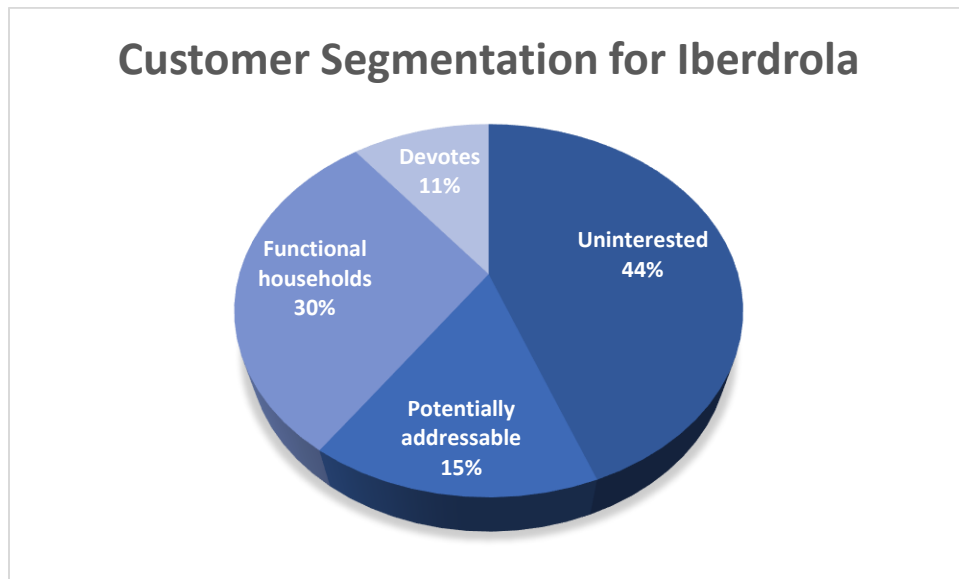


Figure 7. Customer Segmentation for Iberdrola.

The different segments are

- Uninterested. Hard to reach, do not care about energy consumption. High prices of electricity could be a reason for them to purchase Smart Home devices.
- Potential customers. Not worried about price, nor technology. They will not go to Iberdrola nor search for products, but could be addressed if they find something else further than their own benefit.
- Functional Households. These customers will purchase Smart Home technologies if they get benefits from any side: energy/money savings, convenience, increase the value or the image of their homes...
- Devotes. Easy to address, people very interested on the idea of Energy Efficiency or Early adopters who want to have the latest technology.

Iberdrola must develop a Smart Home approach to address all the different customer groups at some level, since even the Uninterested (more skeptical about the Smart Home development) represent a potential market opportunity. Moreover, the percentage of population interested on the latest technology keeps growing, since more “connected” customers are getting into the market (mainly led by younger generations). Baschnonga researchs proved that in 3 years (from 2013 to 2016) the interest on the latest technology increased from 30% to 34% of the population⁵ and according to Morgan Stanley report 2015: “63% of respondents are interested in using a smart system which monitors and controls gas and electricity consumption.”

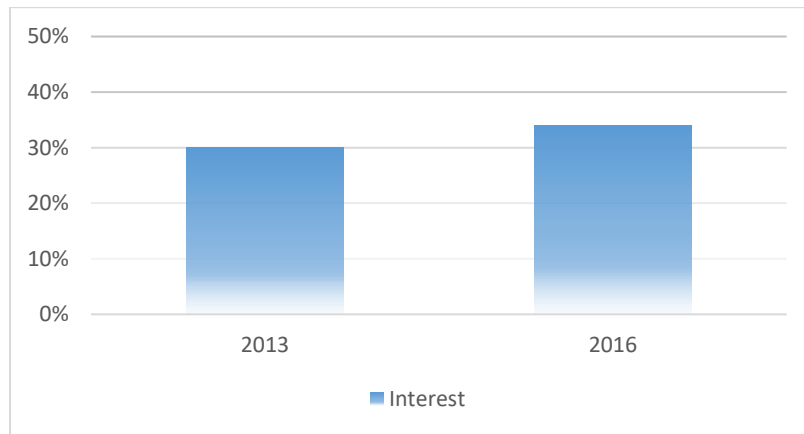


Figure 8. Interest on latest technologies. (Baschnonga, 2016)

⁵ 2,500 households were surveyed. (Baschnonga, 2016)

2.2 For Iberdrola

Companies in different markets are planning to develop strategies on the Smart Home field. Utilities, Security providers, telecom companies and even part of the insurance industry are looking at Smart Homes as a way to replace loses or find new revenues. But for a company like Iberdrola, what are the benefits of entering the Smart Home market?

Total household's energy consumption has decreased in the European Union since its peak of 3,700TWh during 2010 (850TWh out of those were electricity). During the same year, Spain reached its maximum power consumption with 750TWh of energy and 350TWh of electricity. Improvements on devices or heating and cooling systems and the deployment of some solar PV installations for households are some of the reasons of this decreasing power consumption since 2010 (EUROSTAT, 2017). The reduction of energy consumption, might bring losses on revenues for electricity providers, who compete in a liberalized market where their product (a commodity) is impossible to differentiate. Retailing, selling, or managing Smart Home products, which might increase this household's energy efficiency, appears as a way to find new revenues streams to compensate the reduction of the power consumption (many utilities offer already different installation and maintenance programs for households as a way to diversify revenues).

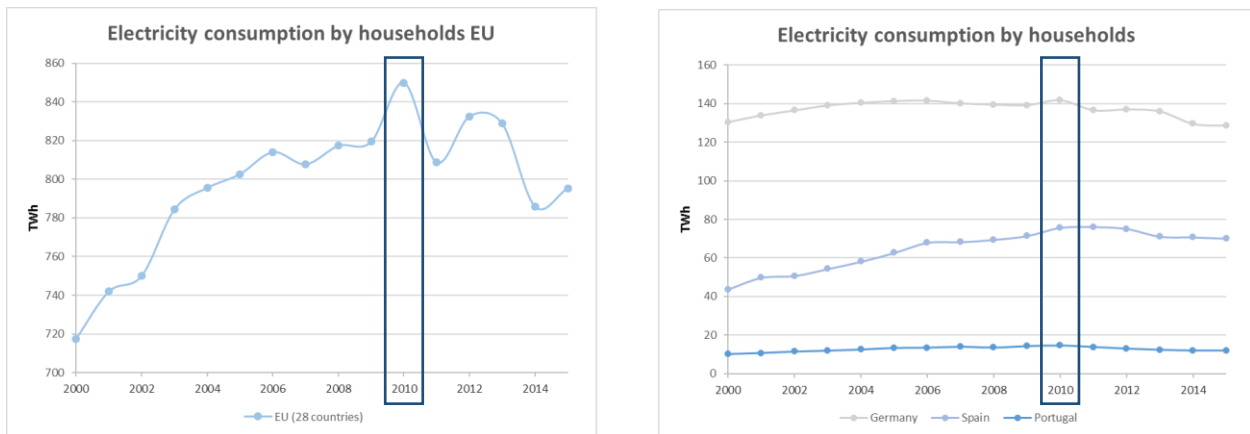


Figure 9. Electricity consumption by households in the European Union. Data source: Eurostat.

Moreover, these new potential revenue streams might complement the low margins the utilities obtain in a liberalized market by supplying electricity at the same time as diversifies risks and reduces their dependency on changing policies or political intervention.

Customers engagement could be another potential benefit for Iberdrola. More and more electricity markets are being liberalized in the past years (Spanish Market introduce the Pool in 1998), the number of energy suppliers increase and customers' loyalty become more valuable. According to the Council of European Energy Regulators, only during 2014, 12% of Spanish households change their electricity provider. Smart products, such as Smartmeters,

could help utilities to engage with customers (offering saving tips, selling them additional products which make their life easier) and reduce customer's dissatisfaction (e.g. taking more precise readings from the Smartmeters). At the same time, Iberdrola's brand image can be improved, which even more important in competitive markets. Moreover, Park Associates places utilities as the second most trust Home Monitoring Service provider only behind Security systems Companies Appendix 9.2.

Load control, management and data acquisition could be improved by getting customers connected through their homes. Their connection make easier for them to understand consumption patterns, thus, save energy during peak times (when the electricity is more expensive) or shift loads to other times of the day (this could be done by the consumer or in some cases even by the utility).

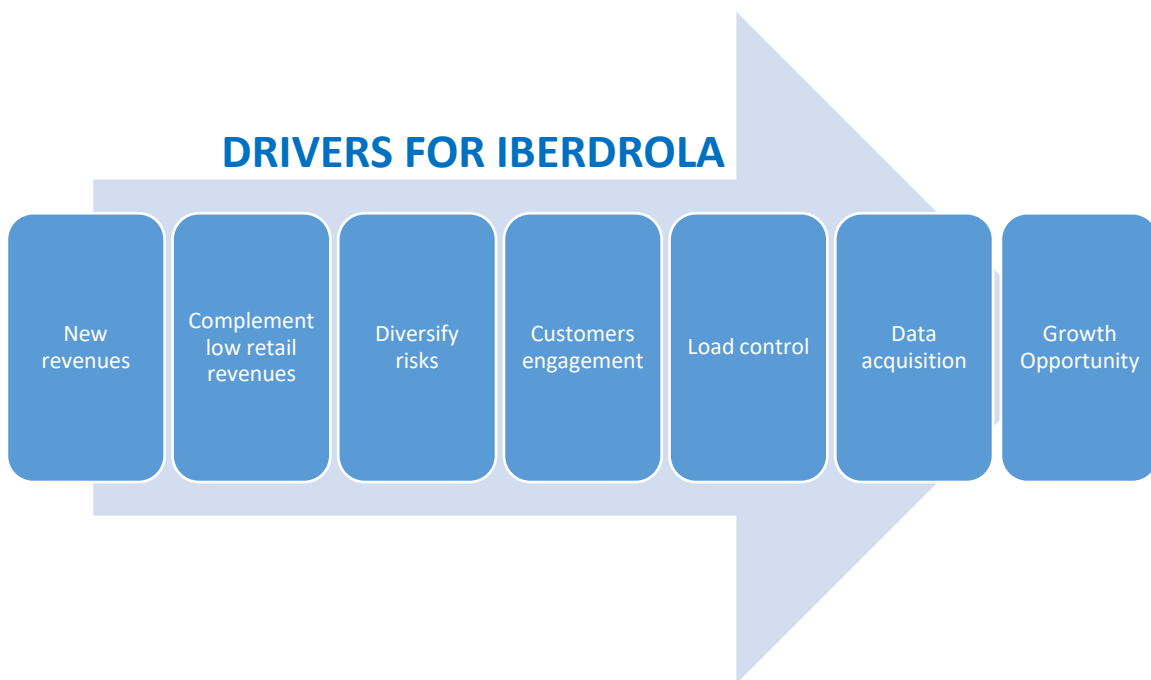


Figure 10. Smart Home drivers for Iberdrola.

Moreover, it is a rare growth opportunity, "This is obvious, but it needs saying. The forecast growth and size of the smart home market is something that utilities simply cannot ignore. Growth opportunities such as this are few and far between in their world. Furthermore, utilities, particularly integrated players, have seen other parts of their business, such as generation, worn down by political intervention, overcapacity and the expansion of disruptive renewable energy technologies. Utilities were generally slow to react to the explosive growth of renewables in some markets and they are understandably keen to be on the front foot with this latest industry development." (Steele, et al., 2017). This is a worldwide opportunity, being even greater in Europe, where the Smart Home market is less settle than in the US, and specially in countries like Spain, France, Netherlands, etc. in which there are not clear market

leaders shaping the market. However, strong American and European companies (Nest, Hive...) will move to other markets so this situation might change. Iberdrola customers' bases are a strength position; they count with customers and technical reputation.

Iberdrola must step strongly and wisely into the market, otherwise it might be left behind and without opportunities to compete. Since competition is heating up and American companies look for revenues in Europe.

The Smartmeter deployment by 2019 in Spain, or in England by 2020, represents a unique opportunity for energy companies to engage customers and transform their business into a more digital managed one. Thus, using the smart home technology deployment as a milestone to develop other branches of the business, as integrated solar, EV charging stations or simply improving customer's relationship. "Utilities are well-placed to support a broader set of consumer needs by expanding beyond energy devices into other categories." (Ozler, et al., 2017)

Inhibitors

The number of companies finding interested on the Smart Home market is growing. Companies from different markets (ITs, Telecoms, Utilities...) are going to blend into one. This represents an increase of competition in a market in which connecting to customers will be a key point. Iberdrola will have to compete with the big IT companies as well as with start-ups from different sector who see in Smart Homes an opportunity.

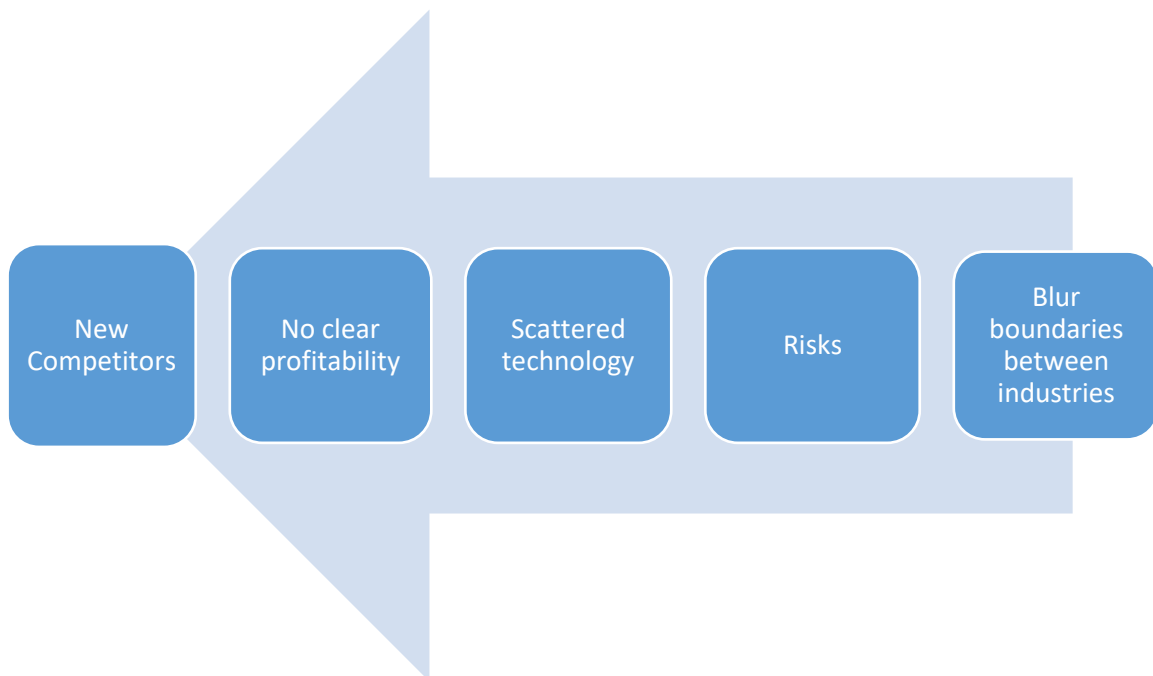


Figure 11. Market inhibitors for iberdrola.

According to Mark Brinda, Jolyon Dove and Stu Levy “The future of energy-related services as part of the smart and connected home market is still being defined. Even in markets like the US, where many nonenergy players have begun offering energy management as part of a bundle of connected home products and services, it is not clear that the energy portion of these bundles will yield sustainable, long-term profits.” (Mark Brinda, 2014). The investment necessary to develop a Smart Home business must be differentiable and take in advantage all the knowledge Iberdrola offers to create long-term, sustainable value.

Another inhibitor, which is improving but is still one of the main concerns for Smart Home users and developers is the scattered and different communication protocols and architectures. The lack of interconnectivity between different devices from different technology providers can frustrate customers without the right knowledge about the topic and then rebound like unsatisfied customers for Iberdrola.

2.3 Evolution of the Smart Home

“Shipments are expected to more than quadruple in the coming 10 years.” (Strother, 2016) Since the birth of the ECHO IV⁶ in 1966, the first smart home device, until the Apple HomePod released Q2 2017, the Smart Home technology, customers and market have experienced many different changes. The entry of the big IT companies during the past years (Apple HomeKit products, 2015; Google purchasing Nest, 2014...) and the transition from early adopters’ market to the mass market have risen the interest of consumers and companies towards the market.

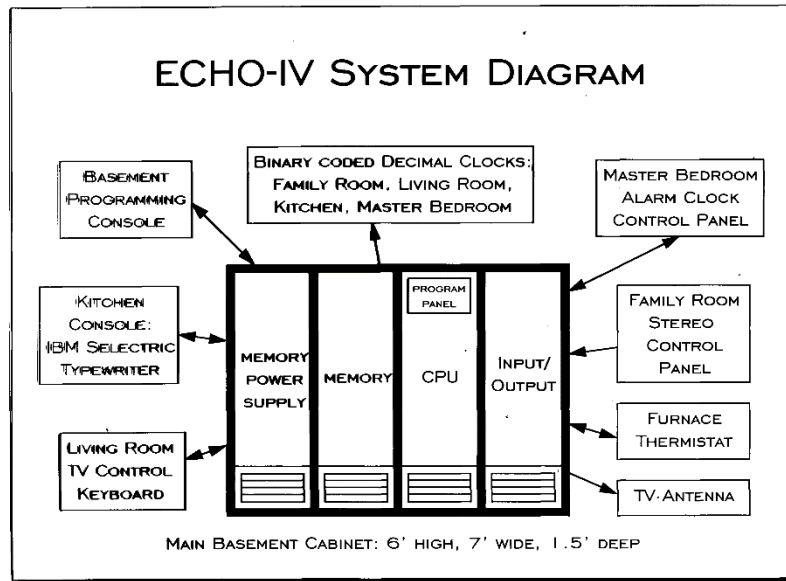


Figure 12. ECHO-IV System diagram. (Sutherland, 1967)

In 1975 the appeared X10⁷, an automation system that used the power lines to control different appliances around the home. The end 90's and early 2000's is when the technology starts to emerge. Smart home devices and technologies became more affordable and more attractive for early adopters. Companies like Xamboo, which was acquired by AT&T during 2010, or Alarm.com offered home and business management from different control devices. Other companies like LG, Siemens or Philips increased their interested on Smart Homes during the mid 2000s at the same time as the stardarization of the protocols started. Telekon was the first telecommunications company to step into the Smart Home market during 2007 developing Qivicon (See more details in 5.3.1). A couple years later the first utilities like Fortum or British Gas landed into the market, with demand response programs for customers or developing new brands, this could be called Precommercial phase.

⁶ “This device could compute shopping lists, control the home’s temperature and turn appliances on and off.” (Hendricks, 2014)

⁷ The electric interferences made the system very vulnerable.

The state of the market during the Q2 2017 is different than the one Telekom found ten years ago when Qivicon was founded. Smart Home devices have reached the mass market, according to IHS Markit more than 130 million Smart Home devices will be delivered world wide this year, this figure almost doubles the 80 million delivered during 2016⁸ (IHS Markit, 2017). Thus, big and small companies are moving towards a market chasing opportunities customers and consumers might open. The market has ramped up in the United States and now it is moving towards Europe.

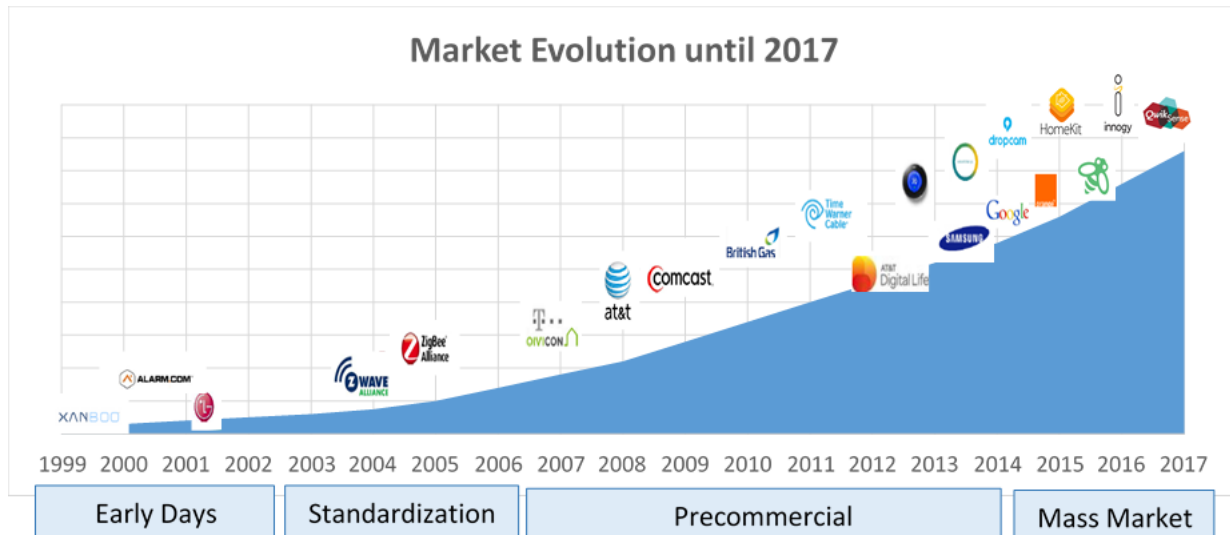


Figure 13. Market Evolution.

An increasing consumer acceptance, the advancement on fields like the Internet of Things, smartphones/wearables, standardization, connectivity, protocols, energy and digital ecosystems during the past years are some of the reasons the Smart Home market is expected to grow.

Customers and consumers are the key point of this boost. Nowadays they are identifying security, value and efficiency within Smart Home products. It has become easier to compare, purchase, monitor, manage and control the devices. Thus, the consumer acceptance has grown motivated as well for a broader number of vendors and an increase on standardization of different protocol to connect devices from different manufacturers. Moreover, *“technology attracts more technology, like bears to honey. If I connect my TV, my oven, and a lock for example I will be more willing to connect an alarm, a fridge, or a thermostat. The more personal success stories users collect regarding their connected home devices the more the home ecosystem of things will grow”*. (Samani & Alonso, 2016)

Furthermore, decreasing prices on crucial parts of the technology like sensors or processors and an improvement of the connectivity have brought the growth of the IoT (Transparency Market Research, 2017), which get reflected on business development on Smart Homes.

⁸ 80 million during 2016 represent a 64% increase from 2015.

Now, the Smart home technology cradle is the US. During 2016, 90% of the Smart Home revenues took place in the North American country (Statista, 2017), the household penetration is 14.9% and the expected revenue generation in the country is close to \$15bn. The second biggest market, according to expected revenue during 2017 is Europe, where the percentage of household penetration is five-fold smaller than in the US in 2017 with (3%⁹), but is expected to grow led by countries like Germany, UK or Austria.

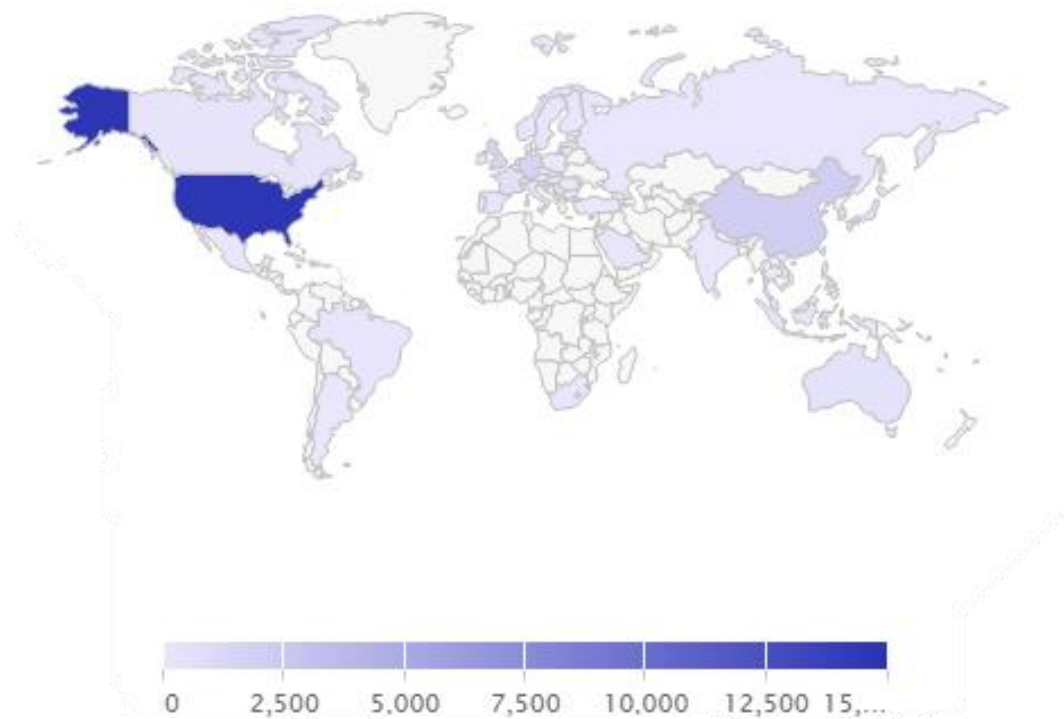


Figure 14. Smart Home Global revenue until 2017 in Million\$. (Statista, 2017)

⁹ Values differ depending on the source, Berenberg place the European penetration in 2.2% in 2017, while Statista's figure is 3%.

3 Growth scenarios

Different journalists, consultancy or technology firms differ on the expected growth of the global Smart Home market. The most optimistic reports from Strategy Analytics (Strategy Analytics, 2017) and PWC (PWC, 2017) set the expected growth up to \$158bn and \$150bn, others like Zion (ZiON, 2017) or GfK (GfK, 2017) set it on \$53bn and \$58bn. All of them agree on marked increase on the market size during the upcoming years, mainly driven by a cheaper and more evolved technology as well as an opening to other markets beyond the US borders.

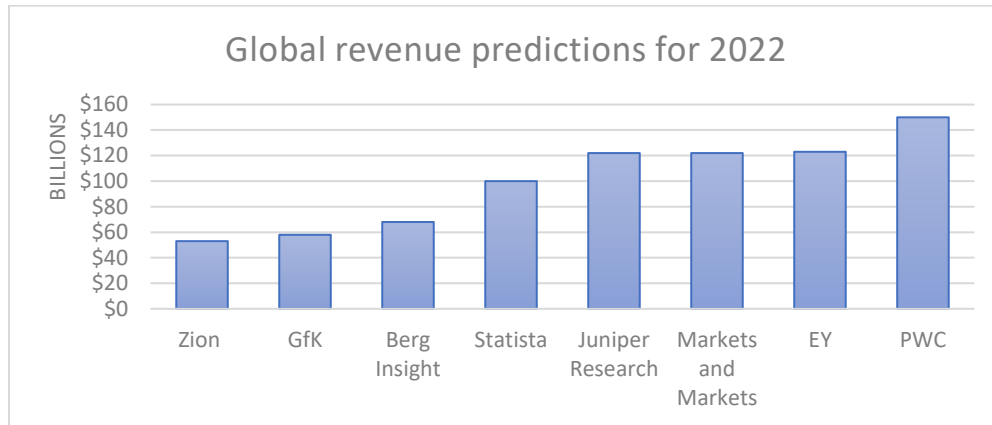


Figure 15. Global revenue predictions for 2021 by mayor companies. (Statista, 2017) (PWC, 2017) (GfK, 2017) (Ozler, et al., 2016) (ZiON, 2017) (Berg Insight , 2016) (Juniper Research, 2017)

Europe growth scenarios are between \$20bn and \$25bn led by countries like Germany, the UK, Austria and Finland (Statista, 2017) (Steele, et al., 2017). By 2022, one every three¹⁰ homes in Europe will be a Smart Home and one every two homes in Germany and the UK will have Smart Home devices in them.

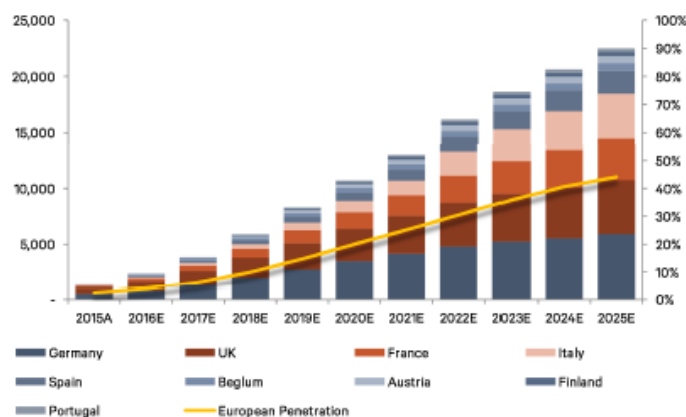


Figure 16. European Smart Home revenues by country (m€). (Statista, 2017) (Steele, et al., 2017)

¹⁰ Figures are between 33% and 37.7% depending on the source

Worldwide, Home Automation represents the Smart Home sector with the biggest growth. Chasing it, the security and the Energy management sectors. In total, including Home Entertainment and Home Assisting living, the share of the consumers with a Smart Home product will be 15.6%. The energy management sector, more interesting for Iberdrola, will increase from 1.7% penetration to 6.2% in five years.

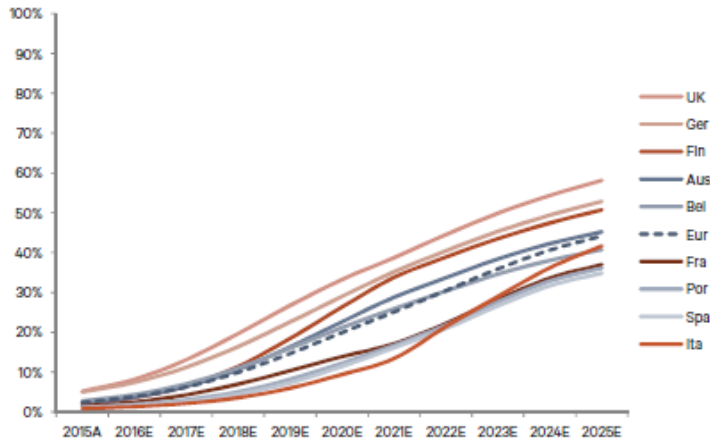


Figure 17. European Smart Home penetration rates (%). (Statista, 2017) (Steele, et al., 2017)

Inhibitors of market growth

If companies like LG have developed Smart home products since 2001, what have been holding up the market? The market encounters different stumbling blocks.

To date, one of the largest barriers to realizing the benefits of comprehensive smart home program offerings has been market confusion. The smart home products market is filled with a scattered jumble of communications protocols, closed systems, and proprietary technologies. This has resulted in a lack of interconnectivity between platforms, manufacturers, and products, frustrating customers and impeding efforts to create a unified smart home. (Snell, 2017)

Low barrier for vendors to entry. The cost to entry in the market after developing a product is very low, this can be an advantage for the technology providers but a drawback for the overall market. Since it fills with weak products that make smart home user confused and not happy with their purchases. This is the reason why HomeKit (Apple) has a team evaluating thoroughly every device that wants to work in their platform, increasing the quality barriers to devices that want to get into their portfolio.

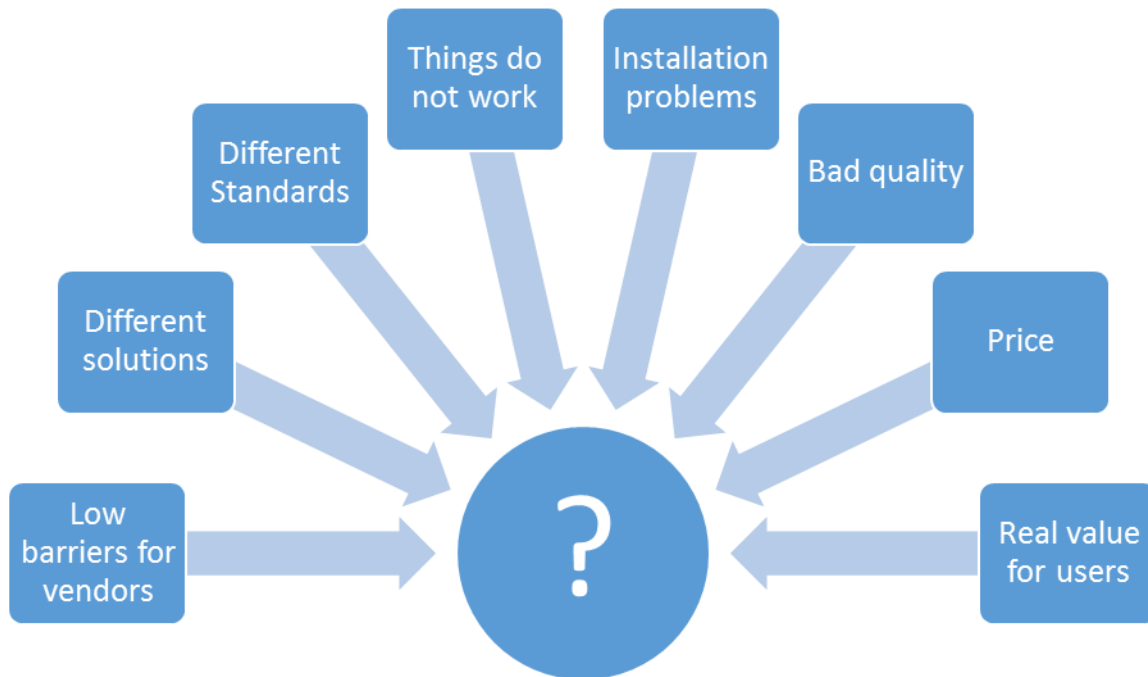


Figure 18. Inhibitors for market growth.

The different solutions, devices, platforms, hubs and standards all the devices have bring confusion to the market. This together with a lack of proper integration of devices in the home make consumers make an extra effort to control devices that are supposed to make their lives easier. Do It Yourself (DIY) products are very common but sometimes are not easy to install.

The price of quality products is another barrier to overcome. The expensive products open the market to cheaper versions of them, which do not perform as good as they should or reduce the security and safety of the home. Moreover, devices malfunctioning or not working are not a surprise among the early adopters' technology products. Even the Nest thermostat presented bugs in the 2016 version of it.

Furthermore, technology producer not always understand where users find value. Sometimes key points like Apps and interfaces are overlooked by producers very focused on the products. They need to understand people are not going to grade a device positively if the controlling app does not run smoothly and they are going to purchase the product once, but they are going to use the app daily.

Growth scenarios in the Iberian Peninsula

Spain and Portugal are forecast to have a slower development of the market than central European countries. “Within the relevant markets, Spain is forecast to be the slowest in terms of smart home penetration, but even there more than one in three homes will fit this description by 2025. By comparison, the US has been an earlier adopter of the technology and it is forecast to reach 65% penetration by 2025.” (Steele, et al., 2017) However, the size of the country makes Spain the fifth biggest market by revenue in Europe, behind Germany, UK, France and Italy.

Smart Home technology penetration will reach the 16.1% by 2021 and the biggest investments will be made in first place Home Automation and tied in second position Security and Energy Management, Appendix 9.1.

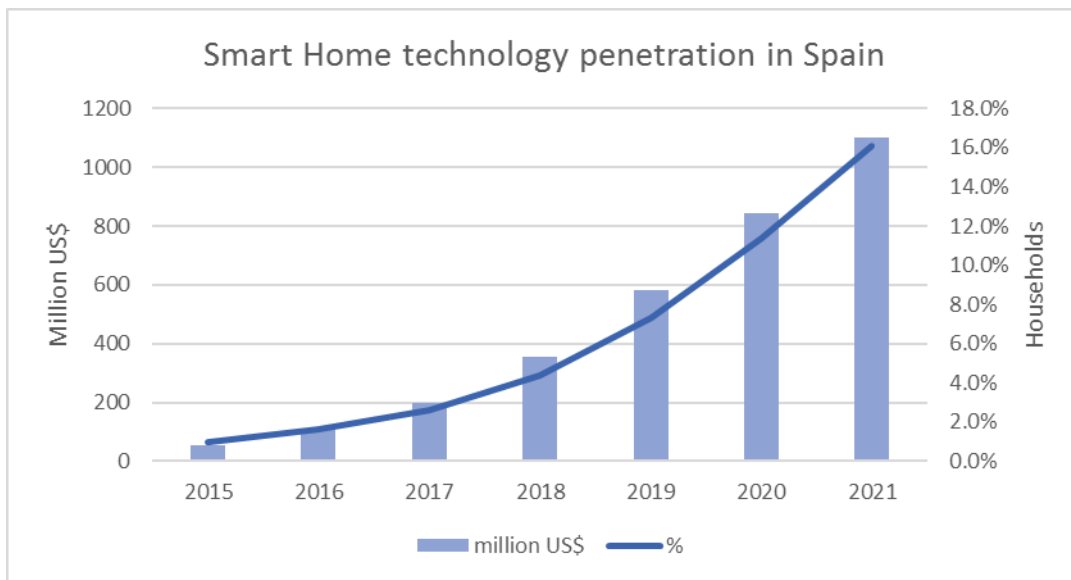


Figure 19. Smart Home penetration in Spain (Statista, 2017).

Portugal’s Smart Home market revenues are \$36m in 2017, Statista expects this market to grow up to \$175m by 2021. Thus, the Smart Home penetration will grow from 1.5% in 2017 to 16.7% in 2021. Appendix 9.1.

Iberdrola must be one of the first movers in the Smart home market in the Iberian Peninsula. Being able to be one of the first movers in the Spain and Portugal will allow to integrate other energy business within the same frame. Solar PV or batteries businesses could be slowly implemented within the Smart home as they become more affordable for customers.

3.1 Market structure scenarios

While most of the research firms and consultancy companies differ on the exact revenue the Smart Home market is bringing, all expect a growth. The market is still emerging and its structure is still unclear. Arthur D. Little research anticipates two different long-term potential market structures that companies must consider: Scattered solutions

market and Large Ecosystems market. Until 2016 the market was formed by only these three different business models. These three business plans differ on complexity and required different levels of customer engagement.

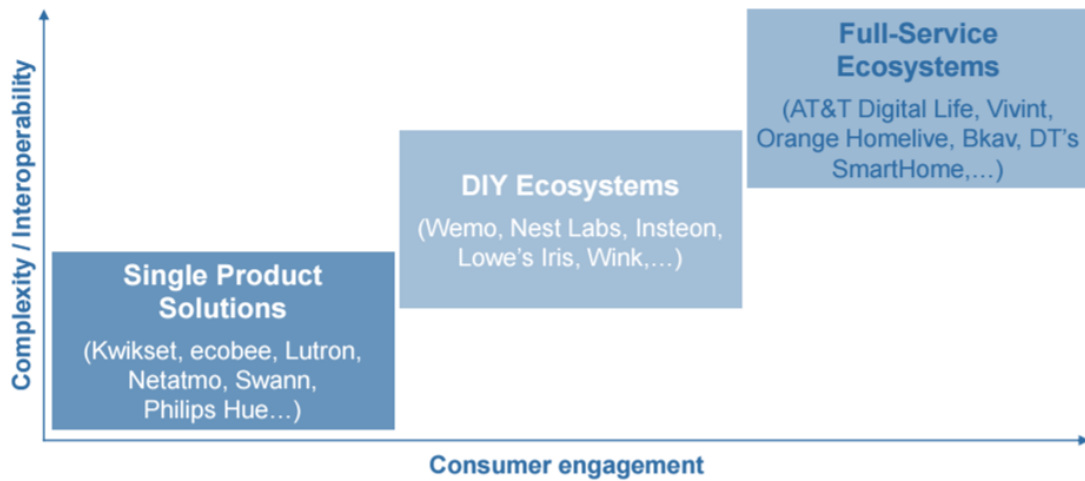


Figure 20. Different Smart Home Devices Approaches.

During the last two years, disruptors appeared in the market. Companies like Amazon, Apple, Google or Samsung launched Echo/Alexa, HomeKit, Google Home and SmartThings. These companies are moving the market from single solutions to certified ecosystems.

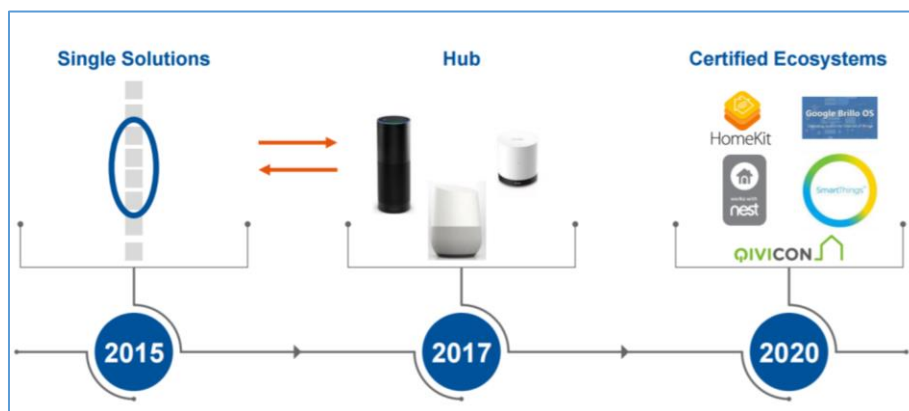


Figure 21. Move from single solutions to Certified Ecosystems. (Elizald & Goertz, 2016)

Garner’s predictions are that certified ecosystems will dominate the market by 2020 since these ecosystems, in most cases, provide certain quality and performance levels the consumers like.

Iberdrola must focus their products on the Single Product solution, but offer the control of these products from the same App to keep it simple for the customer. Moreover, potential partner of Iberdrola products with other ecosystems could be interesting, more in the long term, so this offers do not fall behind.

Ecosystems Will Dominate by 2020

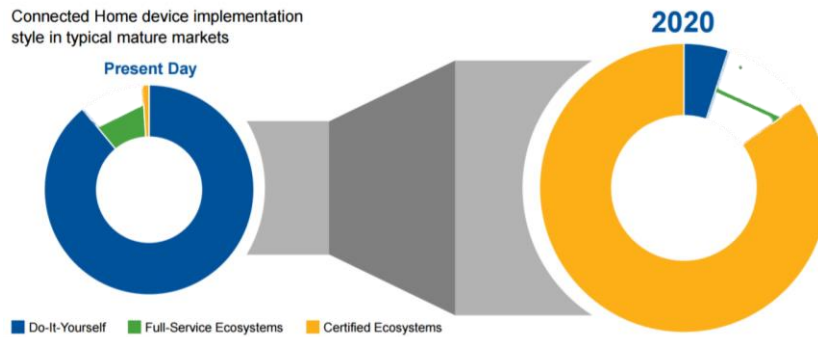


Figure 22. The Ecosystems will dominate by 2020. (Elizald & Goertz, 2016)

In this changing market, there are two long-term potential different market structures proposed by Arthur D. Little research which are:

Large Ecosystems

Global players like Apple, Amazon, Samsung or Google capture the Smart Home market and create large ecosystems (Levy & Taga, 2015), similar to the IOS and the Android. These global players drive the market and aggregate technology in their platforms. This model benefits the large corporations and IT players, which already offer products which in some cases can bypass energy utilities in the Smart Home field. Nest, in the US, offers ways to optimize the cost of energy for the households, reducing utilities income and potentially unbalancing the network. They appeared during the most recent years and they started to disrupt the market.

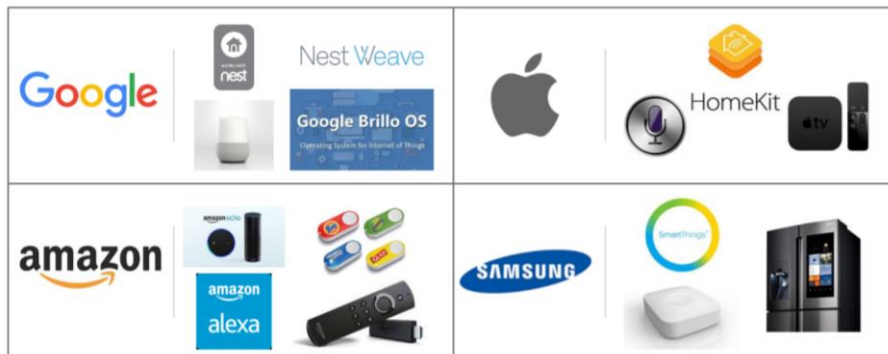


Figure 23. Main ecosystems competing in the world market.

The solution for energy utilities or even telecom companies for this scenario would be to form hybrid smart home platform, apps and products related to their core business. Which are able to be implemented in bigger ecosystems so the big players do not become direct competition and customers can still use their same apps to control devices from different ecosystems.

Scattered solutions

Scattered products bring scattered ecosystems. The market grows sharply but with a “patchwork of solutions and standards” (Levy & Taga, 2015). There are different competitors trying to reach the biggest value of the Smart Home market and this brings a mix of protocols, ecosystems and products from different brands. This would benefit utilities which want to develop their own products or ecosystems. Although generating full ecosystems could be expensive, it could generate different revenue streams and improve customer’s engagement. However, utilities would still have to compete with big IT companies like Apple, which already have millions of iPhones as an entrance for its Smart Home products into their customers’ homes.

This scattered option is less likely, since the efforts from many companies show their interest in communicating to other devices. Amazon is offering an open platform for anyone who want to make their devices compatible with Echo. Moreover, during the CES 2017¹¹ some device manufacturers announced improvements in communication, with the goal to reach the global mass. “By putting these announcements front and center at CES, it shows that some companies realize that their products, no matter how cool, cannot exist in a bubble by themselves” (McGrath, 2017).

Iberdrola must be ready to face a market with large ecosystems in which its value as an energy utility and energy provider levers its products, customers approach proposal and technologies.

¹¹ Consumers Electronic Show 2017, host in Las Vegas during January 2017

4 Technology and state of the art of Smart Home and Energy Management

An improvement of Machine to Machine communication technologies (M2M) brings a connection cost downtrend. This progression means more devices being built with network capabilities (Wi-Fi, Z-Wave, Bluetooth...) which allows them to connect to smartphones, computers and even other devices.

The network created by all these devices and their interaction with people and other devices is called the Internet of Things (IoT). Broadband Internet and Smartphones becoming more widely available benefits this IoT trends for businesses and people. "The IoT is a giant network of connected "things" (which also includes people). The relationship will be between people-people, people-things, and things-things." (Morgan, 2014)

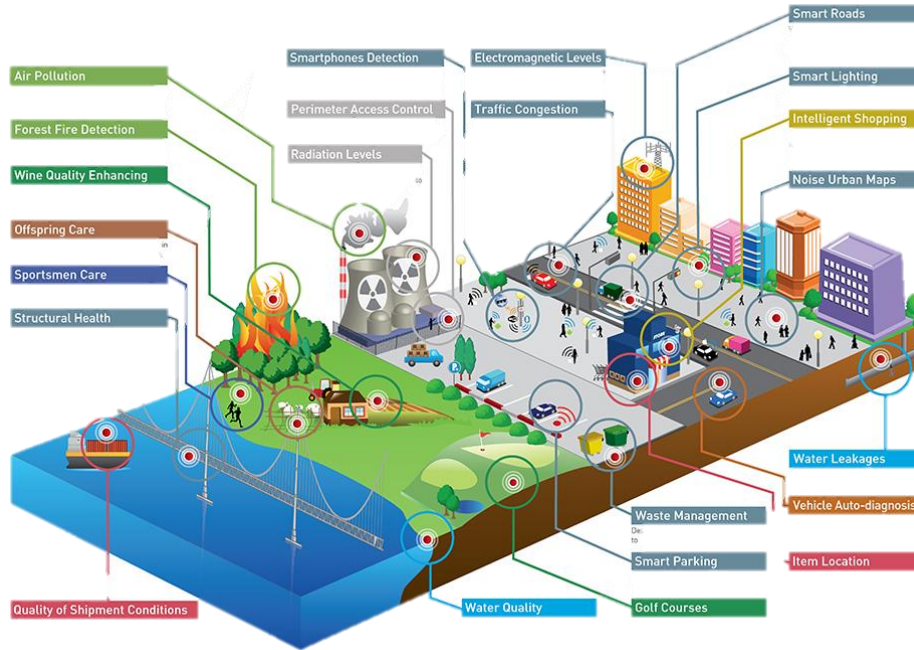


Figure 24. IoT in a Smart World. (Libelium, 2017)

Internet of things includes anything, from dishwashers to sensors in a jet engine. In the Smart home field coffee makers, door sensors, thermostats or fridges are some of the devices that can be connected. Anything with an On-Off switch connected to the Internet forms part of the IoT. According to Gartner by 2020 there will be over 26 billion connected devices. These connected devices open the door for new business models, cost reduction, business improved processes and risks depletion for Iberdrola.

Introduce IoT into the homes and the Smart Home concept is born. Any home equipped with connected devices via Wi-Fi, Z-Wave, Bluetooth or any other protocol for controlling, automating or optimizing becomes a Smart Home. These devices can be control or monitored remotely by different systems.

There are different segments within a Smart Home. Automation, Energy Management, Health, Security or Entertainment. For an utility company like Iberdrola its natural fit in the market is the Energy Management and Automation segments. In these two, Iberdrola can use its brand name and leverage different potential ideas. Thus, reaching all the different customer segments.

The two more-appealing sector for Iberdrola within the Smart Home are the Energy Management and the Home automation.

The appeal for Iberdrola and its customers varies from segment to segment, but Energy Management provides a strong entry case for Iberdrola, since as an energy utility it is Iberdrola's natural inlet point. Households in Spain pay are paying 12 to 15 cts€ per kWh, depending on the Electricity Supplier.

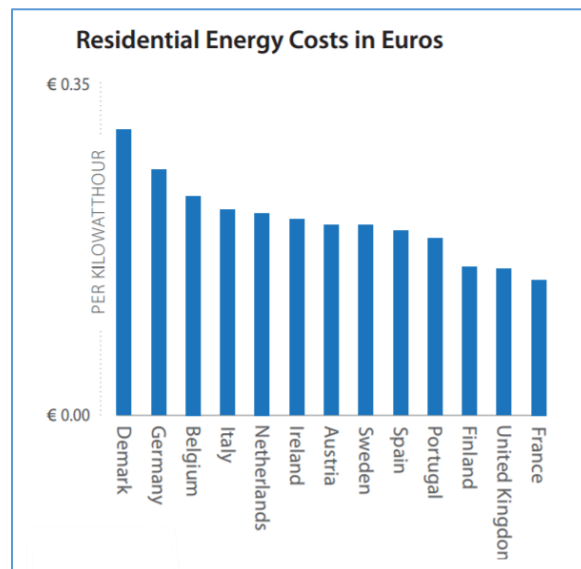


Figure 25. Residential Energy Costs. (Carter, 2017)

Despite not being one of the most expensive electricity prices in Europe according to Park Associates, an average Spanish household (Spanish Average: power = 4,4 kW & monthly consumption = 366 kWh) spent €56.3 per month in their electricity bill in 2015¹² (CNMC, 2016). However, this price might increase in some months, as it happened during the winter 2016-2017, when the electricity prices reached their peak since 2013. The bills during the first three

¹² Waiting for 2016 results 2016.

weeks of January reached €86.96, taking into account utility tariffs (M.T., 2017). With this prices, some customers can take advantage of energy management smart home products which help to save energy, and thus, save money.

Moreover, Home automation could be another Smart Home sector which is interesting for Iberdrola. Customers and clients can access to control devices or appliances through a mobile device and from anywhere in the world. It can be used from single products such Smart Thermostats, lights, appliances or plugs. But usually in the Smart Home everything is included in a remotely and automated controllable network.

Iberdrola could automate EV Charging stations in garages, HVAC systems in buildings or even aggregated energy consumption to provide Demand Side Response by taking advantage of Smart Home products.

4.1 Products and services usually offered



Figure 26. Smart Home Image. (Internet)

The spectrum of smart products is growing year by year together with the IoT. Smart Plugs, Smart Robot Vacuums and Smart Appliances are only some of the examples of the devices transforming a home into a Smart Home. Based on Iberdrola's interests this chapter focusses mainly on the Energy products a household-utility partnership may need in order to increase home's energy efficiency and potentially develop a revenue stream in the Smart home market.

Smart Home Energy Management

The centralized control of Home Automation and increase of intelligence of the home environment have the potential of not only increase the level of comfort of the homes but provide the households the opportunity of saving or optimizing energy, whilst being inside or outside the home.

Smartmeters, smart appliances, smart temperature sensors, PV solar, batteries or Electric Vehicles are some of the technologies related to the energy management being developed within the dwelling boundaries. Smart Home Energy Management (SHEM) “refers to the application of supervisory control and data acquisition with energy management systems, including the generation, the transmission and distribution systems of the electrical network” (Pau, et al., 2017)

For some utilities, like Austin Power, this SHEM concept has become essential in order to control and stabilized the grid thanks to demand response programs offered to households. Demand Response (DR) or Demand Side Management (DSM) help to reduce peak consumption as can shift great loads to improves the operability of the networks. Moreover, this concept is becoming more popular among customers since it offers an opportunity to save money and be greener. SHEM takes part monitoring and arranging home appliances and energy use in the home, based on the household’s predefined settings.

Other option for using SHEM is the monitoring and management of decentralized energy production from renewables. Specialized companies like Loxone¹³, Wattstor¹⁴ and Ingeteam¹⁵, combined with the rapid development of power electronics and intelligent systems, offer packages or inverters that allow to manage your smart home power production and consumption. They give the best usage to the energy produced or stored trying to consume when the renewable source is producing energy.

Being able to check the energy consumption at any time, turn off all the devices in Stand-by, control blinders according to the outside temperature, load control, statistical data procurement or Energy Saving Buttons¹⁶ are some of the offerings a company interested on Energy Management within the Smart Home should consider.

Many solar companies are partnering with or buying out Energy Management companies e.g. SunPower invested in the home energy software company Tendril and partnered with the solar-battery integrator Sunverge and with EnerNOC. All these partnerships aim to pair solar with commercial energy management. Companies like Nest,

¹³ Loxone: <https://www.loxone.com/eses/smart-home/energia/>

¹⁴ Wattstor launched a new energy storage smart switch

¹⁵ It offers an inverter that measures the solar PV energy produced and mixes it with the network to optimize the use of that electricity. It is not clear its legality, but some people are taking advantage of it.

¹⁶This button put the entire home in Low consumption mode when you press it. Devices and heating system turn-off or turn down when this button is pressed since it means no one stays in the home. Some smart thermostats offer a Geo-fencing option which uses the Smartphone GPS to enter in a Sleep mode when the households leave the home.

SunEdison, Panasonic or eVgo (Lacey, 2015) partnerships prove the importance the Energy Management is going to have in the upcoming years. Iberdrola’s investment in Stem, a company specialized in intelligent energy storage, followed this trend.



Figure 27. Solar companies moving out of their area. (Lacey, 2015)

Smart Home Energy Products

There are many Smart Home energy devices in the market. Their appealing to consumers is that they allow buyers to save energy and money. This is one of the reason of the booming the Smart Thermostats this past couple years. Mainly since Google announced the purchase of Nest, a Smart Thermostat company from the US, since it gave this technology a big echo.

There are many different Energy Management products that Iberdrola or its competitors offer to their clients. The highlight is the Smart Thermostat, but Radiator Controllers, Smartmeters, Smart lights, Smart Plugs or Smart Electric Vehicle Charging stations are becoming more popular and could bring potential benefits for Iberdrola. Moreover, the main Smart Home hubs of the Market will be analyzed due to their importance and the role the big IT companies are planning to have with them on the Smart Home structure.

Any device and product Iberdrola interests in must have basic characteristics: It cannot be a dead-end system. Every device must be able to work with other products, from their same or different ecosystem. It must have good connectivity. At least the ones provided by Iberdrola must share the same platform, usually an App. must produce transparent information about energy consumption and in some cases, they must allow DR mechanisms.

Smart thermostats.

The Smart thermostats are one of the main products utilities and Smart home technology retailers are developing due to the opportunities they offer to customers to save money on their energy bills. A Smart Thermostat is device which allows households to optimize the use of their energy heating or cooling down their home by automatically adapt to their time of use of the home and their specific needs. Smart thermostats could be use as a bridge to get

into customers' homes at the same time as in some cases could be use for demand response programs like the ones commonly offered by many utilities in the US.

Table 1. Market drivers for Smart Thermostats. Source: Personal

Market drivers for Smart Thermostats
Increasing awareness of energy consumption
Increase of the number of connected devices
Proliferation of retailer and technology providers
Integration in utility programs and webpages as retailers
Energy efficiency policies

Utilities do not usually benefit from business models which help customers to save energy and reduce energy consumption. However, providing smart thermostats and the support behind them to utility customers can become a great revenue source. Market forecasts from Navigant Research show increasing annual revenues for smart thermostats and all the products related. The market is moving towards Europe and Asia from the North American market in which Smart Thermostats are stronger, while the North American market still grows. (Leuschner & Strother, 2016)

The Smart thermostats will be sold, by a utility or someone else. If the utilities can position were retailers or the technology providers are since they count with a constant and steady link with customers.

As said before, smart thermostats market is offering maturity in the US and is gaining traction in Europe. Leading North American companies like Honeywell, Nest (from Google) and Ecobee are using the North America as runway for their products as they take off. At the same time, European companies and start-ups, like tado, Quby, Climote or Wattio, spring looking for a growing market motivated by the energy efficiency goals of the European Union.

Comparing Smart Thermostats

The broad number of companies providing well branded, new or white label smart thermostat has been growing for the past years. Since not all the thermostat companies offer similar devices, and Iberdrola retails thermostats in the Spain, the UK and the US; 25 leading Smart Thermostats companies were analyzed.

Smart thermostats could potentially be a key connection between Iberdrola and its customers, Iberdrola provides a technology able to offer them an energy efficiency improvement. However, there are many in the market and some of them are not that as “Smart” as expected or not suitable for a customer-utility partnership so market study for these devices is needed.

Iberdrola retails Netatmo Smart Thermostats. Its price is €179, it is able to control all the home and has a great learning algorithm. However, it has some drawbacks comparing it to the latest generation ones (Not a sharp display, it works with batteries or no geo-fencing nor presence detection. As an overall, it is a great thermostat and not expensive.

This thermostat is far in price from the latest Nest (€249) and EcoBee (€249) thermostats, which are the top two Smart Thermostats of the market. However, the Honeywell¹⁷ Smart Thermostat could offer some advantages comparing them to Netatmo and their price is in the same range (€170 – €200). Lyric T6 or EvoHomeCC are Smart Thermostats without batteries, retailed in Spain and that Avangrid are already offering for its customers in the US. Other advantage of the Lyric T6, it participates in Aggregated Demand Response Programs along the US.¹⁸

Other potential interesting companies for Iberdrola could be: Tado, Quby, Climote, Wattio, Momit or EcoBee.

Tado is a German company, which offers a high quality Smart Thermostat. It works with platforms like Homekit and it can be rented instead of bought. It still does not have a big reach. The Dutch company Quby produces white-labeled smart thermostats with DR capabilities¹⁹, ideal if Iberdrola wants to create a smart thermostat with its own brand. Climote is the Smart Thermostat provided by Scottish Power²⁰, moreover they started a Demand Response program with Electric Ireland at the end of 2016.²¹ Wattio and Momit are the only interesting Smart Thermostat companies from Spain; though they are in the beginning of their business lives and they have not tried DR programs, these companies from Gipuzcoa and Madrid offer good price and high quality products with capabilities like geolocation, presence detector and customizable options for less than €190.

All the previous companies are already working in Europe and they would find in Iberdrola a very interesting partner due to their size. However, the strongest company in the market, EcoBee (producer of the first Wi-Fi smart thermostat and named by Navigant Research Leaderboard Report as the best Smart thermostat company in the market) is focusing their sales in North America not even offering products for standard European households to this date (220V and 2 wires). “In the past year, EcoBee has become the second best selling Internet-connected thermostat

¹⁷ Honeywell (Based in New Jersey) is a diversified technology and manufacturing company with a considerable portfolio based on energy management solutions. By the end 2016 was helping clients of 60 different utilities around the globe.

¹⁸ South Sioux City Electric used for it “Total Connected comfort with ADR” program. Nebraska. US.

¹⁹ Quby also produces Joulo, a USB that tracks the energy behaviour of your home and does an study for you.

²⁰ Scottish Power has a platform called Scottish Power Connect. Clients have to pay a monthly fee for App access.

²¹ Electric Ireland and Climote used Smart Hot Water D

in the U.S., with 24% of the market, according to research firm NPD.” (Leuschner & Strother, 2016) A connection with Iberdrola could bring this company to Europe, so it could be interesting partner if the price range allows it.

Smart thermostats can offer different business plans to Iberdrola. Retail these devices is only a part of the benefits they can bring. Iberdrola retail of electricity could benefit from Demand Response programs using Iberdrola’s customers to balance energy consumption, it could bring higher levels of customer engagement and, being the first Spanish utility to do this in Spain could improve Iberdrola’s brand name.

Smart Plugs and Lights

Many companies from all around the world are developing smart plugs. A smart plug (sometimes called Wi-Fi smart plug) is a device that can be plugged into the power outlet to give you control of anything plugged into it. Simplicity and functionality make them an easy way to start creating a smart home. They come in all prices, shape and sizes and can be used to make coffee while showering or to switch everything off before going to sleep. From other devices (phones, remote controls or tablet) can be turned on and off as well as set schedules for their used.

Smart lights require more installation complexity; thus, its usage is lower. But they follow the same principle than the smart plugs.

Research on this chapter shows some leading brands, but with not very special characteristics. It does not go into deep details because they are not one of the key devices of the study.

In most of European and North American countries there are some companies selling smart plugs. According to CNET (Technology Online Magazine from the CBS Interactive Inc.) the smart plugs and lighting markets are led by companies Belkin and Lutron (CNET, 2017). However, in this paper it has been analyzed the performance as well of cheaper solutions that do not stay behind. For example, the Spanish based company Wattio, with *Pod*, offers not only control of the electricity running through the plug but a metering system.

Table 2. Comparison of Smart Plugs and Lights.

Name	Brand	Price		Connected	Characteristics	Market
Belkin WeMo Insight Switch	Belkin	\$ 63.75	€ 49.99	HomeKit & Amazon Echo	PRO: Simple and good	US & EU
					CON: large and connectivity apps	
iDevices Switch ²²	iDevices	\$ 47.99	-	HomeKit	PRO: Simple, good and intuitive	US
					CON: Only IOS, no dimmer function	
Zuli Smartplug	Zuli	\$ 44.99	-	Nest integration	PRO: Precise, good energy tracking	US
					CON: No Android, no remote access	
Belkin WeMo Mini	Belkin	\$ 29.99	-	Amazon Echo	PRO: Best offer, price, size, connected	US
					CON: No apple homekit	
Caseta In-Wall Smart Lighting	Lutron	\$ 159.90	-	HomeKit & Amazon Echo	PRO: Compatible, performance	US
					CON: Price	
HS-100 ²³	TP-Link	\$ 29.99	€ 32.99	Amazon Echo	PRO: Price, compatible	US & EU
					CON: Some connection problems	
Wattio Pod ²⁴	Wattio	-	€ 49.99	Wattio	PRO: Meter, alarm, control	Europe
					CON: No HomeKit, no Amazon echo	

²² There is an outdoor version as well for \$74.

²³ The HS-110 has a metering system.

²⁴ Has a metering system.

Smart Radiator Controllers

Radiators, commonly use in Europe but not in North America, represent other of the devices which could be interesting for Iberdrola to research. In Spain, 37.4% of the homes are heated by electric radiators and 32.3% by gas boilers usually connected to radiators (INE, 2008).

Some of the brands are represented in the table, so the reader can have a grasp of the characteristics and price range in which these smart radiator thermostats are.

Table 3. Comparing Smart Radiator Controllers.

Name	Brand	Price		Connected	Characteristics	Market
Smart Radiator Thermostat ²⁵	tado	\$ 59.00	€ 79.00	Amazon Echo and HomeKit	PRO: Geolocation	EU
					CON: Expensive	
Eve Thermo	Elgato	-	€ 69.95	HomeKit	PRO: No need of central controller	EU
					CON: Only bluetooth, batteries	
HR92 radiator controller	Honeywell	-	€ 70.00	Evohome and Samsung	PRO: No need of central controller	UK/EU
					CON: No very flexible	
Smart Radiator Valve ²⁶	Netatmo	-	-	HomeKit	Coming Soon	

Their deployment and popularity is smaller than the smart thermostats' one due to price and the number of devices that must connect to have a full installation in the home. However, their location in different rooms of the home allows more precise readings and control.

Smart Home Hubs

Smart Home Hubs appear to connect all the devices of a smart home, even now when Amazon brought to market *Amazon Echo* with voice commands detection (*Alexa*) a previous Hub is needed to centralize and then control all the devices in a Smart Home.

The analysis and reviews realized show that a secure, compatible, easy to connect (to all technologies), well controlled (good App) and not expensive device is what customers search.

The following Hubs have been analysed: *Samsung Smart Things Hub*, *Wink Hub 2*, *Lenovo Smart Assistant*, *Insteon Hub*, *VeraLite*, *Staples Connect Hub*, *openHAB*, *Nexia*, *Home Google*, *Echo Amazon* and *Lowe's Iris*.

²⁵ Starting KIT with 2 Radiator controllers and the internet bridge is 200€.

²⁶ You need the starting kit or the Netatmo thermostat

The growing importance of connectivity makes the Hubs able to connect any protocol be one step ahead. The top two Hubs are *Smartthings* from *Samsung* and *The Wink Connected Home Hub*. Both are compatible with a large variety of smart devices and have got mostly positive reviews. As a difference Samsung offers a wide range of IFTTT²⁷ connections, which makes it ideal to control from other devices, and has a back up battery. However, it doubles the price of the *Wink Hub*.

Companies like Amazon and Google bet for the voice controller and make their products the central point of the home. However, since the connectivity of these products is not always perfect, they can be used a bridge to connect to other hubs. More about these IT companies will be analyzed in the chapter 5.2.

Table 4. Comparing Smart Home Hubs.

Name	Brand	Price		Connected	Characteristics	Market
Smartthings	Samsung	\$ 89.99	£ 99.00	IFTTT, Z-Wave, ZigBee, Wi-Fi, Bluetooth, Nest, Amazon Echo	PRO: Very well connected, backup CON: Set up	US & UK
Echo Dot	Amazon	\$ 49.99		Wi-Fi and Bluetooth	PRO: Cheap CON: Lack of the booming speakers	US, UK & Germany
Home	Google	\$ 129.00	£ 129.00	Chromecast, Nest, Philips Hue, SmartThings, IFTTT, WeMo, Honeywell	PRO: Google Assistant, Chromecast CON: Price	US & UK
Hub 2	Wink	\$ 99.00	€ 150.00	Zigbee, Z-Wave, Wi-Fi, Bluetooth LE, Lutron Clear Connect, Kidde, Thread, Alexa, Google Home	PRO: Great connectivity CON: Not advance features	US, UK & Germany
Harmony Hub	logitech	\$ 89.97	€ 119.00	Wi-Fi and Bluetooth	PRO: Easy to program	US, UK & EU

The central Smart Home hubs do not interested Iberdrola since most of the technologies interesting for them could be controlled by a central App. However, the growing that the Hubs are having in the market, plus the size and strength of the companies behind them make them a technology to keep into account. Since in a close future Iberdrola could be interested in include its products to one of those Ecosystems.

²⁷ If This Then That

4.2 System architectures

According to the IEEE (Institute of Electrical and Electronics Engineers) System Architecture is: “The fundamental organization of a system, embodied in its components, their relationships to each other and to the environment, and the principles governing its design and evolution.” (IEEE, 2017)

4.2.1 Smart Home System Architectures

There are many ways to connect the Smart Home devices to each other, the following three systems are the most common and they are used in the by different companies.

Smartphone Centric Architecture

In this system, the device is directly connected to the Smart phone, i.e. the device does not have a link to the internet. This architecture demands to have a smartphone in the home (or near the devices) all the time, since triggering any command or order would have to be done through it, even if you are using the internet.

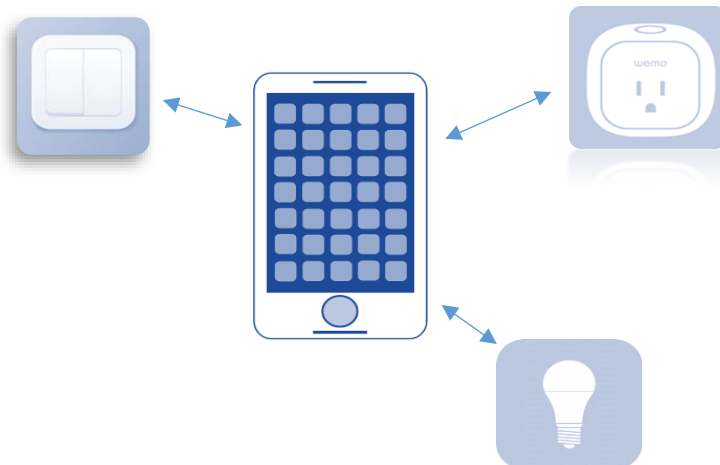


Figure 28. Smartphone Centric Architecture.

The dependency on the smartphone (or tablet, since this architecture is used by Apple Home) is total. However, the setup process is usually very straight forward and no other devices are needed.

Hub-centric Architecture

In this type of architecture all the devices use a hub as an intermediary. Even though the hub is usually connected to the internet, the rest of the devices can be smart without the need of the smartphone. The advantage of this architecture is that any device can be control via internet from anywhere, since the hub stays home.

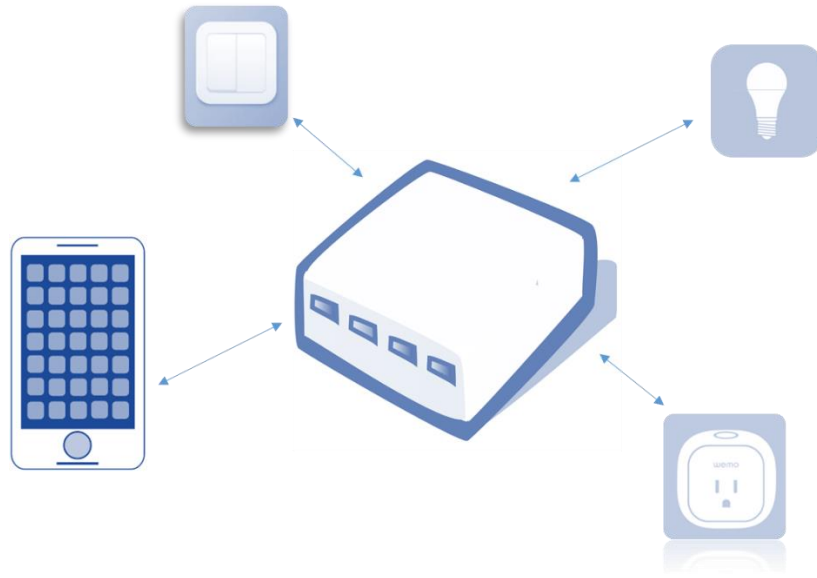


Figure 29. Hub-centric Architecture

“Background smart triggers, from integrations to the third-party services (IFTTT, stock market dynamics, etc) are easily achievable” (Pavlo Bashmakov, 2015)

Cloud Centric Architecture without hub

The devices in this system are directly connected to the Wi-Fi network, therefore they do not need any additional device nor hub to obtain the orders from the users. The master device is connected to the Wi-Fi network as well, therefore the “cloud” acts like a hub.

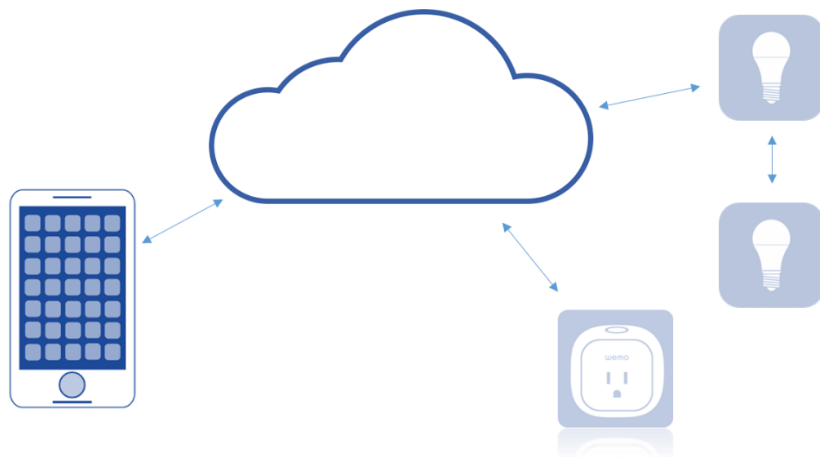


Figure 30. Cloud Centric Architecture without hub

The advantage about this architecture is that, it does not need any additional devices. Nevertheless, the energy consumption of the Wi-Fi devices is bigger than the ones with Bluetooth, ZigBee or Z-Wave. (Pavlo Bashmakov, 2015)

4.2.2 Network technologies

There are different network technologies or protocols connecting smart home devices, understanding the difference between them is important to know why the market is not only focusing in one. For example: there are Wi-Fi thermostats, Bluetooth switchers, ZigBee connected lights and Z-Wave sensors. Since all of them offer similar functionalities, why developers use them? (Miller, 2016)

Bluetooth.

It allows secure connections with devices in proximity. It uses frequency hopping and encryption to secure the communication. Therefore, there are very secure and its bandwidth is higher than Z-Wave and Zig-Bee. Bluetooth LE (Low Energy) uses a lower amount of power than Wi-Fi and can create mesh networks.

Wi-Fi

It is a “expensive” high bandwidth network, therefore it has a high energy and data consumption. That is why many smart home devices manufacturers avoid Wi-Fi, no one wants to replace the batteries of the door sensor every week nor pay more if there are cheaper solutions. However, it is useful for devices like security cameras (usually powered by a connected source) because of the type of data.

ZigBee

As well as the Z-wave; very low power consumption, low bandwidth with a great meshing ability. The meshing ability makes them reach broader networks and avoid signal loss problems. It is an open technology, so many companies offer it, but some of the products received critics because of their lack of security. Moreover, they were originally design for utilities and retail industries sometimes can be complex to install.

Z-Wave

Like the ZigBee; very low power consumption, low bandwidth with a great meshing ability. It was only created for home automation, which makes it very users friendly, but usually more expensive than the ZigBee devices. It has a strong security and broad community of producers, which make it very compatible.

Since yet none of the technologies has overtaken the others and they are being use by different manufacturers and technology providers the result is a complex compatibility between different products. As a result, every customer of smart home products should take a look to tables like the one made by Bick Merritt:

Table 5. Smart Home standards and compatibility of different products. (Merritt, 2016)

Standard/ Manufacturer	SmartThings	HomeKit	Works with Nest	Wink	Amazon Echo	IFTTT.com
Philips Hue	Y	Y	Y	Y	Y	Y
D-Link	Y	N	N	N	Y	Y
Samsung SmartThings	Y	N	N	N	Y	Y
Belkin WeMo	N	N	N	N	Y	Y
LG Thing	N	N	Y	N	N	Y
Nest	N	Y	Y	Y	Y	Y
Yale	Y	N	Y	N	N	N
SwannOne	Y	N	Y	N	N	N
Logitech Harmony	Y	N	Y	N	N**	Y
Honeywell	Y	N*	N	Y	N*	Y
Others	Bose, Cree, Osram, Leviton	Withings, Canary, Elgato, Hive, Smappee, Netatmo	Lutron, Pebble, Petnet, Whirlpool, Keen, Mimo	GE, Leviton, TCP, Kidde, Kwikset, Rheem, Lutron, Osram, Canary	Insteon, ecobee	Amazone Alexa, Bang & Olufsen, Smappee, ecobee, GE, Lutron, Lightwave, Netatmo, Wink, Withings
Supported protocols	Wi-Fi, Bluetooth Smart, Thread, Z- Wave, Zigbee	Wi-Fi, Bluetooth Smart	Wi-Fi, Bluetooth Smart, Thread	Wi-Fi, Bluetooth, Z-Wave, Zigbee	Wi-Fi, Bluetooth	Wi-Fi

4.3 Solar PV and Energy Storage for households.

The prices of Solar PV technology and Batteries are in depletion. Thus, the interest for households and companies is increasing due to the attraction that offers having control of your own consumption in the Smart Home.

Solar PV

The 42% of Compound Annual Growth Rate of PV installations during the first 15 years of the 21st century and the improvement of the PV technology systems²⁸ are some of the reasons for the abatement of the Solar PV technology prices.

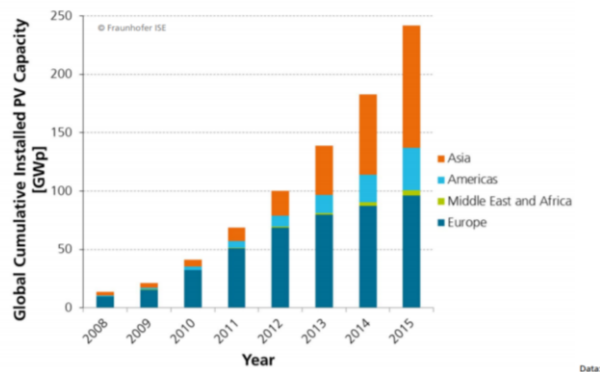


Figure 31. Global cumulative Installed PV capacity. (Philipps & Warmuth, 2016)

In most of the world is compelling the idea of a solar-powered home. This contrasts with the solar deployment in Spain, where the number of new installations in the past 8 years have been less than the capacity installed during 2008. Mainly driven by unfavourable policies comparing it to other countries in Europe.

²⁸ "The record lab cell efficiency is 25.6 % for mono-crystalline and 20.8 % for multi-crystalline silicon wafer-based technology. The highest lab efficiency in thin film technology is 21.0 % for CdTe and 20.5 % for CIGS solar cells." (Philipps & Warmuth, 2016)

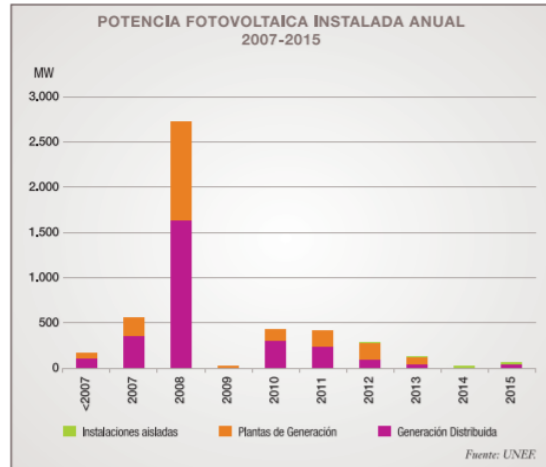


Figure 32. Power Capacity installed in Spain per year. (UNEF, 2016)

During June 6TH 2017 the *Tribunal Constitucional* of Spain (Bueno, 2017) open the door to communities of households living in the same building who want to share their energy production. This, together with the use of Internet of Things, Smart devices and Solar PV power might open PV power for the Smart Home. Since Early Solar adopters are more likely to purchase Smart Home products, since they represent a group of customers interested in new technologies to update their homes. These potential consumers around the world are using Smart energy monitoring, batteries and Solar Energy systems to produce and optimize their own energy. The right software and the right devices can bring smart home energy automation and Solar PV production together. This could benefit the communities, the energy industry and Iberdrola, which is interested on the topic and it already has a Smart Solar project²⁹ running.

Companies and households aim to shift the consumption of the most energy-consuming devices to times where the solar PV installation is producing energy (since one of the main issues with Solar PV is usually produced during the part of the day when the electricity is not needed it) or to storage this energy to later usage. Moreover, some big utilities like RWE are preparing a shift in their business models, since 2013 the big German multinational have been slowly shifting its business from a classic energy utility to a “renewable energy service provider” facilitating the implementation and deployment of renewable energy, including residential solar PV projects.

The approach leading companies are taking is not to offer the package of Solar + Batteries + Energy Management all together. It is a step by step approach in which customers with Solar installations are the target for potential batteries

²⁹ Iberdrola’ Smart Solar allows clients and potential consumers to check viability and feasibility of solar project in their properties. Although it is mainly used by farmers and off-grid locations, it is also offered for households even though the program is not very popular.

and load management systems and customers with PV potential are offered PV installations, mainly in countries in which the price of electricity is high, like Germany or Australia.

The Smart Home is a great complement to Solar PV installations. The electricity produced by the solar panels and the energy consumption of the home can be managed together to obtain higher returns and be greener (shifting devices or EV loads to times of the day were the PV panels are producing energy or to cheaper electricity prices). This, together with new regulation in Spain, could mean new opportunities for Iberdrola.

“Smart” Inverters

Although Iberdrola does not have any interest in Smart Inverters, it is important that understands the problems it might bring to be able to counteract if it considers it appropriate. The development of the called “Smart Inverters”, which are bringing control over the solar panels to the market. Their digital structure brings many benefits like allowing bidirectional communication and more control over the system and potential failure. However, in some cases, customers are using Feed-in or Net metering tariffs and Smart technology to take advantage of the system with “Smart” Inverters that transform part of the energy produced by the households solar PV system in heat and dump only a small percentage of the energy produced into the electricity network, which in most of the cases is enough to get the full payment for the electricity.

Battery Storage technology

“As RESS deployments continue to grow, utilities must be proactive or run the risk of significant load defection as customers may be offered competitive solar + storage solutions from new providers. Embracing residential storage can allow utilities to greatly improve grid stability and position themselves as orchestrators of an increasingly dynamic system.” (Eller & Dehamna, 2016)

Residential Battery Storage Systems (RESSs) are becoming more popular due to a combination of facts. Lowering battery prices, the dream of some customers of grid independent and governments dropping the favourable policies towards solar PV installations and promoting battery-storage are some of the reasons for this growing market.

Numerous vendors are releasing different RESSs, but it is a market that it is only starting to interest the utilities. In the States, bigger battery-based energy storage grew so much last year that it started producing cheap demand response with some problems. The governments had to regulate battery storage so the, potentially longer in duration, Gas Turbine power plants were competitive (Lacey & Kann, 2017).

RESSs bring different benefits for the Smart Home users. It can be used as private backup power, improve distributed generation, facilitate self-consumption, energy cost management or even grid services for load control. Smart Home

and IoT play a role in these usages since the Energy management systems are needed to optimize the performance of batteries at every moment to benefit the households.

Energy Management in the Smart Home can use Energy Storage as a great base. “Leading RESS providers recognize this trend and are configuring their systems to be the core of the HEM system” (Eller & Dehamna, 2016). Iberdrola must be ready to embrace this trend in case regulation changes bring it to countries in which it operates.

Despite their potential RESSs are not economically viable to the mass market and most of the utilities are against the development of such technology. Iberdrola, and mainly Iberdrola Retail, could get some benefits from it. In some cases, Feed-In tariffs brought problems to the electricity grid³⁰ and RESSs can be used to stabilize the grid and smooth the production during peak production times at the same time as benefit some customers and gain brand image for Iberdrola. Game changer would be if the utilities start seeing the RESSs as an infrastructure upgrade.

The latest Battery Storage technology hit is the REbus system for nanogrids (they called the USB of battery systems) produced by Pika Energy in collaboration with Panasonic. The American company aims to reach early adopters of Solar with their Fed-in tariffs phasing out, people with PV panels who want to protect their investments or customers that even without Solar Energy panels can get benefits of their tariffs by installing the battery system (Spector, 2017). Their AC battery approach makes the system easy to connect, since their system is added after the solar inverter or in the power inlet of the home (AC current)³¹, instead of traditional battery systems that are connected to the solar panel (DC current) and must be scalable for every different installation.

Even though the technology is not mature enough, it is important for Iberdrola be ready on this topic. Since it can be a source of revenue for Iberdrola or become a pain if companies’ “PV + Batteries” offers become cheaper than the grid.

³⁰ Mainly overcapacity or fluctuations in some cases.

³¹ Their system has a very good acceptance but a loss in efficiency must be taken into account since a DC to AC to DC to AC transformation is needed for every unit of electricity.

4.4 EV charger.

The advantages Electric Vehicles (EV) offer are many. Customers want them because they are greener, reduce fossil fuels consumption, they are quiet or they can be recharged at home instead than in a Gas Station. Furthermore, reduction of petroleum dependence, reducing CO2 emissions to reach Paris Agreement targets or reducing pollution within the big cities are some of the rewards for the governments.

These, together with a EV price depletion brings a gradual growth on EV sales and deployment all around the world, two-folding the number of EV in less than two years. During 2016, European EV sales increased by 13%, leaded mainly by Norway³², France, the Netherlands, Germany and the UK (EV Volumes - Database, 2017).

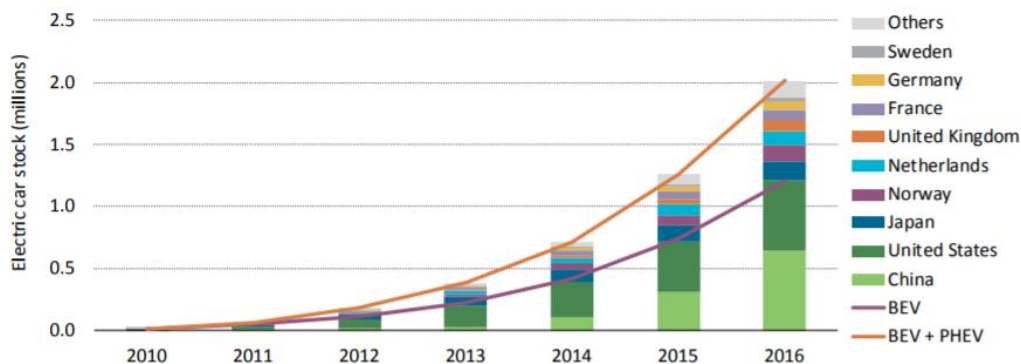


Figure 33. Evolution of the global electric car stock. (International Energy Agency, 2017)

This year, China overtook the US as the country in the world with more EV. “In France, Spain, Portugal and the United States (California), steps have been taken to adapt property laws to simplify and accelerate the process of approval procedures for electric car owners to deploy (private) EVSE infrastructure, notably in rented and/or owned multi-unit dwellings, including in parking garages (Legifrance, 2014; BOE, 2009; Diario da Republica, 2010; WXY Architecture, 2012).” In other countries, governments are providing financial incentives, fiscal advantages or providing direct investment on some types of technologies. (International Energy Agency, 2017)

³² In Norway 33% of all the car registered were Electric during 2016. (EV Volumes - Database, 2017)

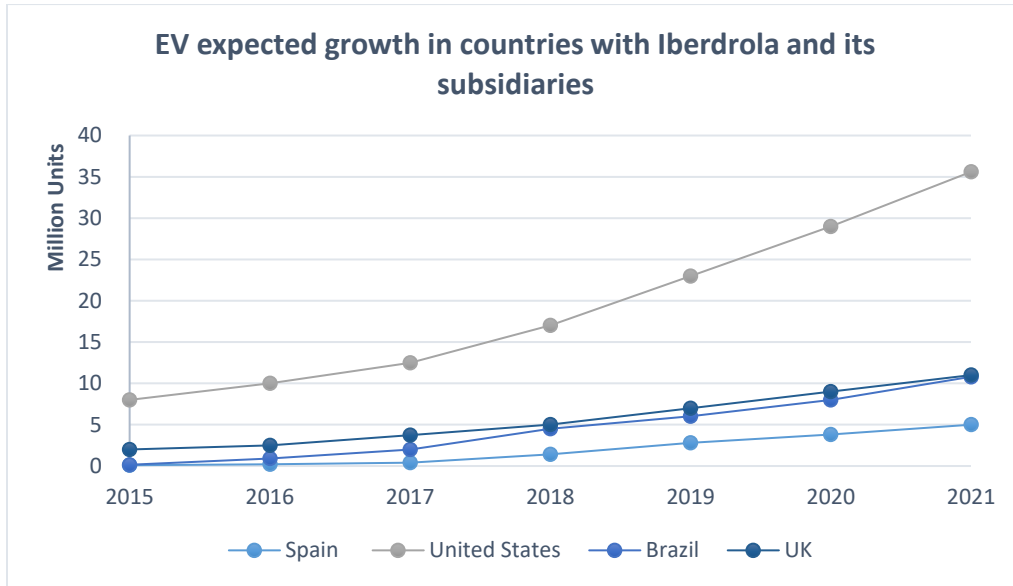


Figure 34. EV expected growth in countries with Iberdrola and its subsidiaries. (Statista, 2017)

In Spain, any neighbour can install a charging station in their own private parking (BOE, 2009). Moreover, in Spain the government introduced the “supervalle” tariff, which benefits EV owners allowing to charge their vehicles with lower energy prices some throughout some hours of the night. These bring the scenario, according to Statista, that one every ten Spanish households will own an EV by 2021, this means a 1200% growth from 2017 digits). Iberdrola counts with 10.2 Million clients of electricity in Spain 1T 2017, which reduced by 1% during the last year. (IBERDROLA, 2017). The opportunity of being open to 10% of the Spanish market by 2021 offers an opportunity to improve customer engagement and a way to increase the energy retailed to customers compromised with the environment.

Iberdrola EV charging station is “Recarga Verde Iberdrola”. For 590€, a charging station is installed in any private parking. However, the fact Iberdrola’s charging station is not as “smart” as others in the market, or that Iberdrola does not offer EV special tariffs means the charging station could be a point from which Iberdrola could underpin a smart home program.

An updatable, fast charging and connected Charging Station is what Iberdrola must look for with future charging stations models, which allow Iberdrola to engage customers and develop further Smart Home ideas.

4.5 Demand Response in Spain

Demand response has the following functions:

1. Reduce the demand peaks, decreasing thus the generation and storage capacity needed to satisfy the demand. Thus, reducing the investment cost in Capacity Payments and in new power plants.
2. Increase flexibility of the system at the same time as increases the energy efficiency. It can act reducing the demand during peak demand periods or even increase it when there is a maximum production from renewables³³.

Countries like Spain, Portugal, Italy³⁴, or the Czech Republic are not engaged with the Demand Response reforms required by specific Articles of the Energy Efficiency Directive (2012/27/EU):

Art. 15. 4 requires Member States to: “Ensure that network operators are incentivised to improve efficiency in infrastructure design and operation, and, within the framework of Directive 2009/72/EC, that tariffs allow retailers to improve consumer participation in system efficiency, including Demand Response, depending on national circumstances” (European Union, 2016). Moreover, “Art. 15.8 of the Directive establishes consumer access to energy markets, either individually or through aggregation” (Bertoldi, et al., 2016).

Integrating demand response in the home requires both the development of technology devices (Smartmeters, smart thermostats...) and Smart Grids. Moreover, the role of aggregators (DSMs) appears. The demand side management (DSM) companies group small and medium consumers and offer them as one load units.

Spain is behind in the topic of Demand Control. To ensure the balance between the demand and the supply Spain counts with payments for Capacity (for long and medium term) and the “demanda de interrumpibilidad”³⁵. However, these mechanisms to ensure balance between supply and demand are expensive and underused. During 2015, 9.2% of the price of electricity in the Spanish free market and 11.3% of the regulated market came from this infrastructure.

There are different ways to obtain Demand Response: Demand Management or Price-based Demand Response. The latter, already used in Spain, offers different prices and the customers shift the consumer patterns to avoid paying higher rates of electricity during some times of the day, already possible due to the Smartmeters’ deployment in

³³ This could indirectly increase the market value of renewable energy production and it could avoid the drop of the energy offer due to low prices of electricity.

³⁴ “Italy is aware of the issue and is undergoing a regulatory review, and the status may change within 2017-18” (Bertoldi, et al., 2016)

³⁵ Electrically heavy industries access to bids to, voluntarily, reduce their demand when it is requested.

Spain. Since 1 October 2011, some electricity retail companies offer “Supervalle” tariffs for low voltage consumers (Energía y sociedad, 2017) and their time changes depending on the power consumption. See Appendix 9.3.

Demand response in other Iberdrola markets

The US counts with capacity bids to offer load control. Electricity producers and Demand Response clients participate in the market. Besides the bids, there are voluntary programs for Demand Response. These programs usually offer revenues/discounts for the customers, which being notified one day ahead or during the same day, reduce their load consumption during peak hours.

Many US utilities are taking advantage of these programs to increase customer engagement, reduce black outs and improve the performance of their networks. In some cases, they use DR programs as a leverage to offer different tariffs, products or contracts.

The UK was the first country in Europe to open a market for Demand Response. “Today the DR is integrated in the control and capacity markets.” (Legorburu, 2016). In this market, “in order to meet the minimum volume requirements of the Balancing Services, smaller sites may be aggregated together with other sites” (NationalGrid, 2017). This service of gathering energy volume to reach the minimum size of 1MW is offered by Aggregators. Enhance response (EFR) and Dynamic Firm Frequency response are the ones that offer the biggest revenues for the DR side, see Appendix 9.4.

The UK is part of the group of countries, like Belgium, France or Ireland, in which the State allows Demand Response and Independent Aggregation. These markets adjusted market entry requirements to facilitate consumer participation and they experienced a three-fold growth of demand size resources from 2013 to 2015.

Demand Response potential for Iberdrola and the Smart Home.

Iberdrola acts as an aggregator of bigger consumers, the option of gathering smaller businesses or even households to offer Demand Response is an opportunity which might appear with the IoT and the Smart Home/Enterprise devices.

The Spanish regulation is not pushing this technology but it can benefit Iberdrola’s retail business to keep its consumption within the forecasted loads. Moreover, Demand Response approaches like the ones taken by utilities in countries like Germany, Nordic countries or the Netherlands could benefit even more Iberdrola because the service providers are the only ones allowed to sue DR. Iberdrola could bundle DR programs with electricity contracts and benefit the retail business from two different sides: selling electricity and improve accuracy of the electricity consumption forecast.

The 61% of the electricity consumption comes from buildings (offices and households), that means 142 TWh of electricity in 2015 (Ministerio de Fomento, 2017). Smart Buildings have a great potential in the Demand Response if loads from heating, which represents 14.9% of the electricity consumption of an average household, or devices, 55.2%³⁶ (Eurostat, 2015), can be shifted.

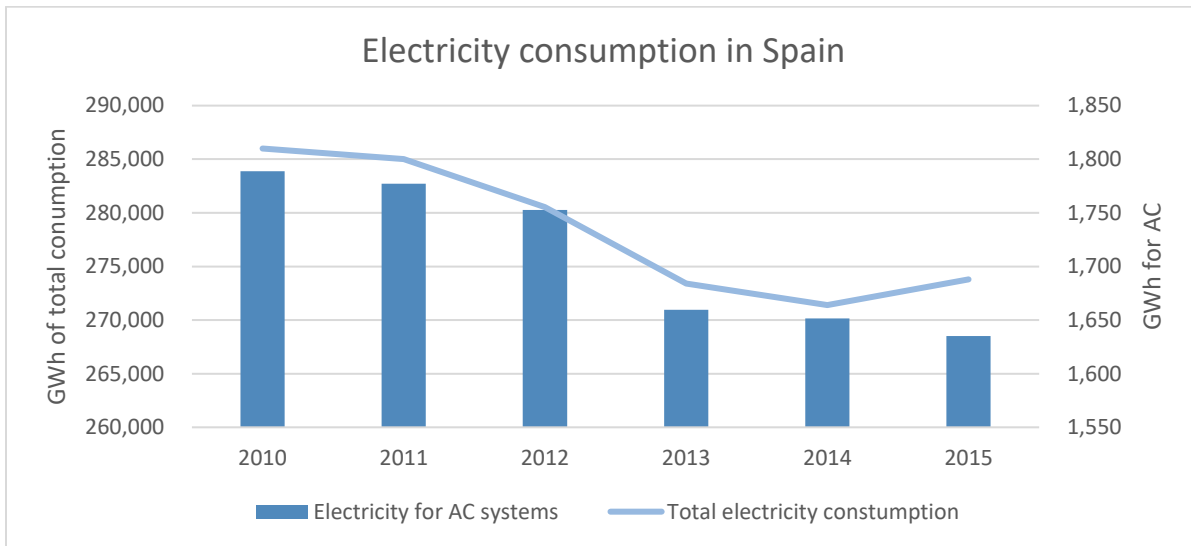


Figure 35. Electricity consumption in Spain. Comparison. (Ministerio de Fomento, 2017) (Eurostat, 2015)

Although the electricity consumption coming from heat pumps does not represent a great percentage of the total electricity consumption in Spain, the total number of heat pumps is 11.3 million (8.5 in dwellings, 2.3 million in commerce and services and more than one million in industry)³⁷. These heat pumps represent 77,673 MWt of installed power (IDAE, 2017). However, the intermittency of their usage (most of them only used for cooling despite they can also be use for heating) makes them do not represent a great share on the total electricity consumption.

The fact that heat pumps are not a cheap source of heat and both the maximum electricity consumption and the highest electricity prices happen during winter could represent an option for engaging Iberdrola customers, bundle energy saving programs with their ACs for households and office buildings.

However, throughout the year some of this Heat pumps are being used and offering programs like what Ecofactor (partnered with ComE) and PG&E offer to their clients, doing micro-adjustments in the devices or turning them off during some minutes every hour, might bring some load control for a big utility like Iberdrola, which is able to aggregate consumption.

³⁶30.6% of this consumption comes from refrigerators. 11.8% from the Washing machine. 12.2% from TV. 10.7% from Stand-by products.

³⁷ 80% of this pumps are in the Mediterranean region (Ministerio de Fomento, 2017)

4.6 The data in the Smart Home

Internet of Things opens the data market to utilities. Thanks to consumer profiles from Smartmeters (or other smart devices) a company like Iberdrola could get insights from their customers. Thus, a customer segmentation utilities understand better their clients and it can potentially offer different tariffs, products or services to their customers.

Other data from clients mixed with geographical, weather or financial data from customers might be useful not only for utilities. The data could be shared with companies like DR companies or from other sectors and potential partners. For example, EV charging stations could offer data to car insurance companies, which could offer discount rates depending of the time of use of the vehicles, or customers can allow HVAC manufacturers share energy demand response data with utility companies to get discounts for reduced energy usage.

4.7 Disaggregation

Energy consumption becoming a major concern within the home, disaggregation might be the solution for not intrusive energy consumption tracking for devices within the home. Knowing the energy consumption during different times of the day or when specific appliances are working might motivate households to change their behaviours, check the right performance of devices or simply to be more aware of their energy consumption.

“Disaggregation allows us to take a whole building (aggregate) energy signal, and separate it into appliance specific data (i.e., plug or end use data).” (Armel, 2011) In order to do that, a set of statistical approaches are applied.

There are two types of disaggregation. Both Hardware disaggregation and Software Disaggregation are able to track the consumption from different devices. However, while Hardware Disaggregation requires tracking plugs or smart appliances, Software disaggregation can be perform only using the data collected by the Smartmeters³⁸. Iberdrola’s deployment of Smartmeters in Spain, which measure the energy consumption of a home every 15 minutes, can be used by a software to offer households more information about their energy consumption.

Table 6. Types of disaggregation.

	Sensing technology	Cost / Installation cost
Software Disaggregation	Smart Meter	Low / Low
	House Level Current Sensor	Medium / Very High
Hardware Disaggregation	Plugs and Monitor	High / Medium
	Smart Appliances	High ³⁹ / Easy

The Software Disaggregation, particularly Smart Meters, offer the cheapest and the lowest installation effort for the final consumers.

³⁸ Software disaggregation can use Smartmeters or House Level Current Sensor. However, the latter are very expensive and not very common.

³⁹ Smart Appliances add more than €100 per device, compared to non-smart appliances.

5 Analysis of leading solution providers

The Smart Home technology has attracted many different players to the Smart Home ecosystem. Technology companies, telecommunication companies, security and insurance companies and utilities have become competitors in a market with expected double of sales in the upcoming years. Exact numbers differ depending on the research, “from USD 46.97 Billion in 2015 to USD 121.73 Billion by 2022” according to Markets and Markets or from “25 Billion in 2016 to 54 Billion by 2022” according to Zion Market Research; however, the market is clearly growing and it has become an attraction for many companies and positioning in this still “early market” be key movement for any company in these for sectors.

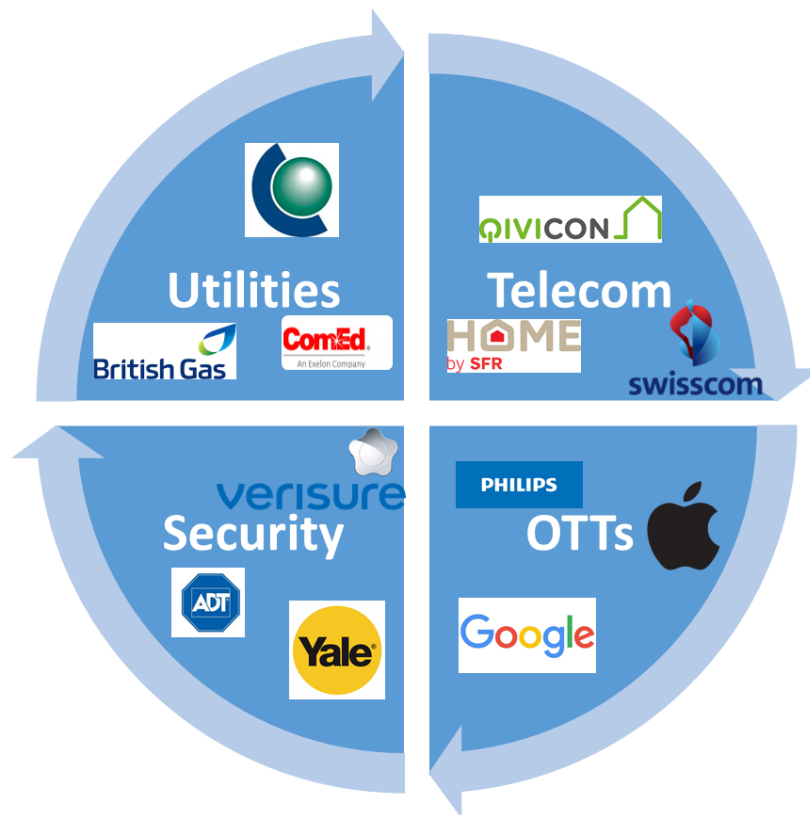


Figure 36. Competitive Lanscape Smart Home

All these companies target the same consumers and Telefonica addressed those customers in their study and their results obtained were that 34 percent of the customers prefer electronic retailers as Smart Home energy providers, followed by telecom (20%) and Utilities and Home appliances (15% each). (Telefónica, 2015)

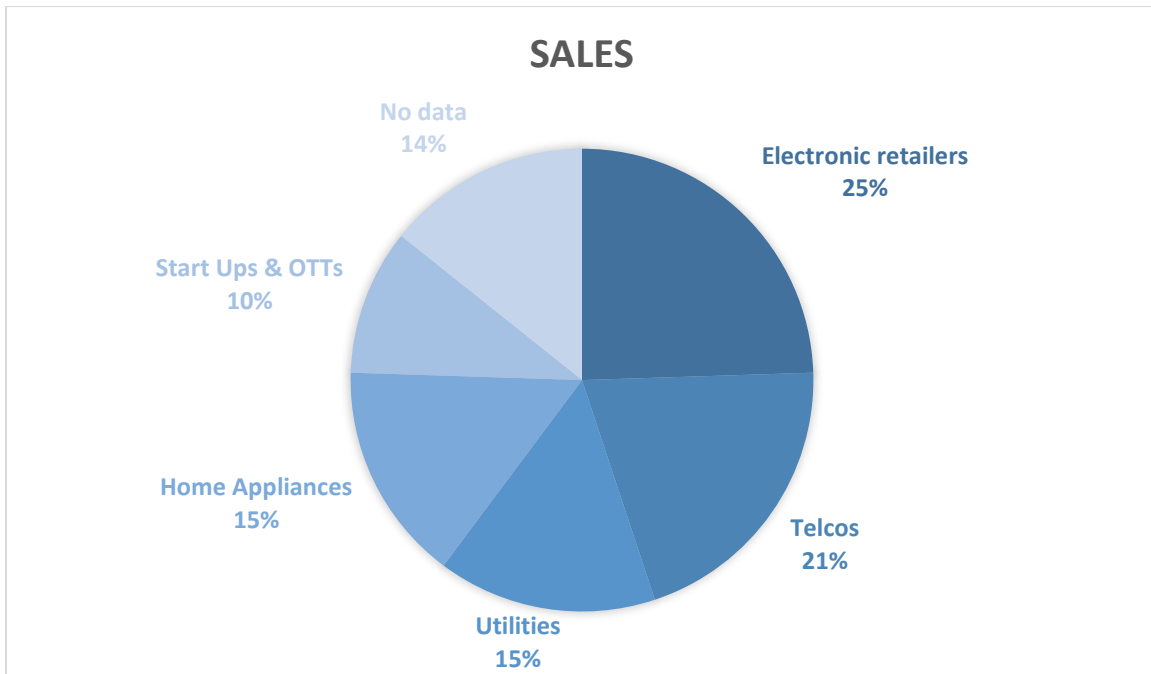


Figure 37. Customer's trust on different types of companies for Smart Home technology. Data source: (Telefónica, 2015)

5.1 Utilities

It is not surprising utilities are looking at Smart Homes. Their technology deployments from the utilities can bring them numerous benefits: new revenue streams, recovering losses higher energy efficiency in homes might generate, control of the demand or control the solar production flowing into the net among others. Expanding the utilities' business models bringing in Smart Homes makes sense.

Different utilities are using diverse strategies to take advantage of the Smart Home technology. In the US, Bring Your Own Thermostat programs are becoming popular and the smart home technology (though smart thermostats or SmartACs) is being used in different Demand Response (DR) programs.

It is in the US, where the smart home market is more developed. Nonenergy companies, like new players or big Its and even telecom companies, are offering smart home systems with energy management programs within a bundle of products and technologies. Some of them offer platforms to reduce your consumption based on the price of the electricity, which, once again, does not benefit utilities.

In Europe, where the Electricity Market is more liberalized and the Smart Home market is less shaped than in the US, the utilities are offering different approaches to get into the Smart Home market: Fortum developed the first Virtual Power Plant, British Gas creates a new company called Hive for their Smart Products, Enel developed a platform that even allows you to do groceries from your home...

Utilities have the advantage of having presence in the customer's homes (Iberdrola has 13.4 million of electricity clients) and must use that as a leverage to build a connection with the customers so both parties can take benefits from the Smart Home technologies. Moreover, Iberdrola must take advantage of being in Europe, where the big IT companies have been slow deployment their products and specially Spain, where no other Utility does more than a retail some smart products.

"Defining the services is just the beginning of the process; delivering a sustainable business will require new skills that many energy companies lack.

Even in markets like the US, where many nonenergy players have begun offering energy management [...], it is not clear that the energy portion of these bundles will yield sustainable, long-term profits." (Brinda, et al., 2014) However, thanks to customer's interest on Smart Home technologies, potential customer's engagement and potential new revenues (from better data collection, retailing or even more efficient control) the Smart Home market opens as a good opportunity for utilities.

This Chapter presents a benchmarking of the most important Utilities in the Smart Home field, to study what are their strategies and how they are positioning in the market. The study focus on the countries where Iberdrola and its subsidiaries are located:

5.1.1 North America

In North America, the existence of a federal government makes the electricity utility industry be regulated at state and federal levels. Market Electricity market in the United States follow to main broad models: a traditional regulated market and a centralize market.

In the traditional regulated market model the wholesale transactions are perform in different bilateral contracts and all the services are provided by one entity. The electricity pricing in this case is cost-based, this means the utilities' retail price of electricity is always enough to make them recover their investments.

Unlike the traditional model, in the centralized model the participants in the market bid and offer resources and are paid a same price for electricity. This centralized market model is applied where Iberdrola's company Avangrid works (states of New York, Vermont, New Hampshire, Massachusetts, Connecticut and Maine).

In the areas that do not count with Regional Transmission Organizations (RTO) nor Independent Systems Operators (ISOs) the utilities are responsible for the roles of being the reliability coordinator, balancing authority and the transmission operator. The need for balance power and the 30 years old investments made on Coal Fire Power Plants in the late 70s changing to smaller size investments have given the opportunity for Demand-side Management (DSM)

projects in some part of the US. “DSM create reductions in load growth and defer the need for new generation plant investment.” (Navigant Consulting, Inc., 2013)

Furthermore, Smart Grid has become a hot topic in politics and its implementation together with the Smart Home technology will generate potential savings to customers by providing them tools to manage their energy consumption habits.

The DSM opened the gate for utilities into the smart home market. First in Texas, where the transmission grid is not interconnected and the balance and there is a fear for blackouts during the summer hottest days and then to the rest of the states.

This chapter presents different approaches that American utilities are taken to position themselves in the smart home market.

Austin Energy

The utility is running a residential BYOT⁴⁰ Demand Response program. Austin Energy arranged for retailers to sell the thermostats (it has approved 22 different devices by the end of the Q1 of 2017) and offer customers instant rebates. The utility is focussing on the integration and management of distributed energy resources and it is out of the retail business.

According to Karen Poff, Project Manager at Austin Energy, one of Austin Energy’s biggest challenges is “transitioning from obsolete, legacy systems to new systems that support open communication standards to optimize the integration and management of distributed energy resources.”

The results the utility has are successful, Austin Energy deployed the pilot in 2013 with 5,000 thermostats and by the end of the first quarter of 2017 have reached 16,000 participants (according to Cindy Berry from the Demand Response, Energy Efficiency Services of Austin Energy) and saved 5.8 MW and 48 MWh by the end of Q1 of 2016 (according to Breet Feldman from Navigant Research).

Their procedure is simple, the customers receive a rebate purchasing their Smart Thermostat and enrolling them into the DR program. The customers enrolled agree to let Austin Energy adjust their Smart Thermostat setting by no more than 2.2°C when the electricity demand requires it. The transparency of the program and the variety of vendors, channels and technologies are one more of the success reasons of the program. To manage all the customers’ data and the grid information Austin Energy partnered AutoGrid’s DROMS for their project.

⁴⁰ Bring Your Own Thermostat

ComEd

Commonwealth Edison, as well as Austin Energy, is running a BYOT program with similar characteristics. The program allows households to use 8 different thermostats of 7 different brands. However, ComEd uses EcoFactor to manage the Demand Response program, who uses a technology able to maintain the desired temperature of the home by making microadjustments to the thermostat (Tweed, 2015) so it is not necessary to precool the home nor increase the temperature of the rooms for some hours of the day. This approach might be more comfortable for household since they will not scarify comfort while being in the program.

Moreover, Commonwealth Edison wants to increase its influence in the Smart Home market and joint forces with Comcast⁴¹ (Tweed, 2015). Comcast offers its participation to ComEd's DR summer program. Comcast is offering Energy Rewards to their customers but their incursion in the smart home market will be studied in the Chapter 5.3.

Con Edison

Since 2010, Con Edison is running the program "coolNYC" in partnership with ThinkEco to make window AC units a controllable grid resource. "Con Edison deploys smartAC kits to its customers for free, and if the users participate in two DR events they get to keep the unit (whereas if they do not use it and do not return it, they are charged a fee). Users can earn coolPoints for their participation in DR events, which they can redeem for gift cards."

In addition, Con Edison offers a BYOT program in which their customers get rebates once they agree on letting Con Edison do 10 adjustments on the home thermostat.

Moreover, they offer a Commercial Demand Response program, in which enterprises can hired "certified aggregators" (a list of aggregators certified by Con Edison) to participate in demand response events. (Con Edison, 2017)

NV Energy

Energy began a mass deployment of EcoFactor thermostats in 2012 as part of its mPowered program. The acquisition of these thermostats from their customers are free in they fulfill certain conditions. They allow to automate and personalized the heating system, as well as see saving reports and participate in Energy events. EcoFactor's savings methods involve thermostats precooling the home prior to a DR event, thus shifting consumption outside of peak times. This deployment allows NV Energy to increase customer's engagement, to optimize DR events and to reduce load.

⁴¹ "An American global telecommunications conglomerate that is the largest broadcasting and cable television company in the world by revenue" according to the Institute of Media and Communications Policy

Oklahoma Gas and Electricity

OG&E (utility with more than 500,000 customers) partnered Energate and offered its customers a free Thermostat if during the summer months, customers opt in to a variable peak pricing program called SmartHours Price Plan (introduced in 2012). The program offers a 10 timer lower electricity price during off-peak hours, but do not allow Energate nor OG&E to control the thermostats. This only allows customers to track and manage their electricity use using a free service on OG&E's website, as well as receive a free SmartTemp thermostat (provided by Energate). "OG&E claims that over 99% of its customers save on their energy bills through this program, with an average savings of \$150, though some customers have been able to save up to \$100 per month during the summer, totaling around \$400 in savings. The utility also claims that customers who received a SmartTemp thermostat have seen an additional savings of 30% on the program."

Pacific Gas & Electricity

PG&E (9 Million customers) uses a different approach for DR, they install a device connected to the AC that receives signals from the utility and, when needed, turns the AC off for no more than 15 minutes every hour to reduce peak loads. In exchange, households get 50\$ per year. Even though the program does not guarantee customers to save money nor energy it had great success and now has over 150,000 participants.

SCE

Southern California Edison (5 Million customers) has partnered with vendors in home automation and energy management, including Nest, Alarm.com, EnergyHub, ecobee, Filtrete, Vivint, and RTCA to integrate communicating and smart thermostats into its DR programs. Households with compatible thermostats are recruited into the Save Power Day program, which pays participants \$1.25/kWh reduced during DR events.

SMUD

From 2012, SMUD (625,000 customers) has been offering SmartPricing Options program to their customers. The program relies on customers to adjust their thermostats based on variable pricing. Thanks to this program, SMUD could shift 10% of its peak load to shoulder hours during 2012.

Customers were offered two price options: TOU (Through Times of Use) and CPP (Critical Peak Pricing); and the studies carried out by the utility show customers prefer TOU pricing, since it offers better understanding of energy usage and DR events. "SMUD's retention rates for customers defaulted into the program were about 90%."

Xcel Energy

Xcel Energy is running a successful program called Saver's Switch. It does not rely on smart thermostats and instead uses a device to cycle a consumer's central HVAC system during peak periods. This program currently has around

600,000 participants and most of the people do not even notice it since they turn the AC off (for not more than 20min) since they keep the fan running to circulate the air around the home.

Last two years Ecel Energy partnered with the software company Boulder-based Simple Energy Inc. to make it easier and quicker for residential customers in Colorado to get \$50 rebates for new smart thermostats and participate in the Saver's Stat Program, where consumers allow Xcel to make small adjustments to their selected ecobee or Honeywell thermostats during peak periods for a \$25 gift card and up to \$50 in participation incentives. However, according to the program's team Saver's Stat was not renewed Q1 2017 since they did not obtain the expected results.

5.1.2 Western Europe

All the members from the European Union shifted from a regulated electricity market to a liberalized energy market. Environmental sustainability, security of supply and the reduction of price of electricity for the final consumer are some of the drivers of the European regulators of the electricity market, who aim to have single common European Electricity Market.

The 2020 policy package set 3 key energy targets for Europe that affect energy utilities: 20% cut in greenhouse gas emissions (from 1990 levels), 20% of EU energy from renewables, 20% improvement in energy efficiency.

43% Iberdrola's Group Net energy production came from Renewables during the Q1 2017. Their renewables production of energy is above the average of other utilities, however, the 20% improvement in energy efficiency might affect its income as well as the income of other utilities based in the EU. That is the reason why some of these utilities are trying to position themselves in other markets (like the Smart home) in order to increase their revenue streams.

There are some utilities in Europe like Centrica (British Gas) or RWE that stepped stronger into the Smart Home market creating other companies like Hive or Innogy. In the Nordic European companies the ecosystem of the "digital homes" is formed by partnerships between telecom companies, utilities and other players, in which the utilities and the telecom companies reach the costumers thanks to their broader scope and the other players provide the technology.

Using Smart Home technology to create VPP and DR programs is not very popular in Europe (even though Fortum created the first ever VPP based on customer's load shifting in 2012). This could be because, in most of the countries, the Transmission Systems Operators (TSOs)⁴² and not the utilities oversee the balance between the electricity production and demand.

European Smart Home market offers many opportunities to utilities, since the big IT companies are taking some time to cross the Atlantic and the Telecom and other utilities are still trying to position themselves in the market.

Centrica/British Gas

Inside centrica falls British Gas (BG) and it represents the largest energy supplier of the British domestic market and its interest on offering integrated home solutions for the connected home drove it to purchase AlertMe, a company

⁴² Some counties have only one TSO like Spain (Red Eléctrica Española) or Portugal (Redes Energéticas Nacionais) and other countries have many, like Germany (TransnetBW, Tennet TSO, Amprion, 50Hertz).

specialized on home software and hardware, renamed it as Hive and now is the soil for all their Centrica connected home products.

Their highlight is their branch of products Honeycomb, which is led by their smart thermostat “Hive Active Heating” and followed by lights, switchers, sensors and the Hive Hub. Each of these products can be purchased separately and there is no need to be a BG customer to buy one.

This is a big bet for British Gas (an utility with around 15 million customers), but it is hoping it will engage more customers besides finding more revenues streams. According to Centrica communication department and the BBC, BG lost 224,000 customers during the Q1 of 2016. That is why even when, being a BG customer is not needed to obtain Hive products, being client gives you access to benefits (the chance of paying the thermostat monthly and having a full ongoing warranty).⁴³

E.ON

In the UK E.ON came up two years ago with “E.ON touch” a platform that would allow customers control their thermostat and hot water through an app. Though this platform was launch during late 2015, it was the last of the 6 big utility companies to move towards smart homes, it was stopped.

E.ON plans to deliver home automation, networked lighting, customer energy management and rooftop solar monitoring via GreenWave’s Home2Cloud platform according to CEO Greg Memo in GreenTechMedia.

During March 2017 E.ON introduced E.ON See for its more than 32 million customers. It allows households to track their energy consumption from anywhere thanks to an App developed for their smartphone. So far E.ON See is only offered for E.ON clients with a Smartmeter installed by the company.

Even though E.ON retails energy in over 30 countries it is only in Romania where E.ON partnered with Secure and retail smart devices for the international brand. Smart thermostats, smart radiator controllers or smoke detectors are some of the devices offered by them. The households need to pay monthly for this service.

EDF

EDF is interested on Smart Home to transform the relationship with their clients. For that, it has its own incubator called Blue Lab, where during 2016 they invested on different new Smart Home start-ups like: Howz (intelligent system for the home which learns behaviour and notifies a person’s care network if needed it), Upside Energy (a cloud-based service that coordinates energy stored and creates a Virtual Energy Store), Momit (a Spanish smart

⁴³ With a cancelation fee if you unsubscribe the program in less than 2 years.

thermostat company which learns from the households' behaviour), Ipsum Energy (from the smart meters readings it is able to detect which appliance is being used) and Futurehome (an all in one home retailer). EDF's webpage is a Netatmo retailer.

Moreover, EDF has DR as one of the top priorities for this 2017. However, it is still only focussed to big clients since it is not sure the American approach of Demand Aggregation for Demand Response can be taken in Europe yet.

SSE

Scottish and Southern Energy and Dixons Carphone⁴⁴ will be building and trying new connected product and service proposition during 2017, paving the way for a consumer launch after that. Right now SSE offers and advertises in its webpage tado smart thermostats. However, it does not retail them.

SSE's goal is to use Carphone's platform technology and use their broad customers scope to position in this nascent market. Will Morris, SSE MD Retail said: "Together, we are developing a solution that isn't just focused on launching the latest technology, but on meeting customers' desire for a simple, flexible way to control, manage and maintain their homes." (SSE, 2016)

Dixons Carphone offers honeyBee as a leading platform that makes easier for customers to monitor and control different devices connected to it. Moreover, according to Andrew Harrison, CEO Dixons Carphone the platform would be complemented with their CurrysPCWorld and Knowhow branches that deliver, install and fix these products all along the year.

This is a win-win situation for two companies getting into the smart home market, in which one offer the technology and other the deployment of their products into their customers' homes.

Fortum

Fortum is a Nordic electric utility that supplies electricity to 1.3 million customers in Finland, Sweden and Norway.

In Finland, Fortum was the first utility to launch a commercial demand response system for Finnish consumers in October 2012. Control system developed by There Corporation, the system was claimed to be the first fully commercial market based demand response consumer product in the world. (Fortum, 2012)

The Fortum Smart ("Fortum Fiksu") system features an automatic control of electrically heated boilers in households to use the cheapest hours of the electricity spot market. Through this, the service can offer cost savings in the range

⁴⁴ "Dixons Carphone plc is a multinational electrical and telecommunications retailer and services company headquartered in London" <http://www.dixonscarphone.com/>

of 15 % of heating costs without any customers' intervention needed and offers a Virtual Power Plant approach for Demand Side Respond programs. To participate in this program at least a Waterborne heating system based on electric boiler and a spot-price electricity contract are needed. (Fortum, 2012)

Moreover, Fortum Smart offers a mechanism that compares the price of oil and the price of electricity each hour, and will automatically select the cheaper way to heat your home without any human interaction, it fits for household with oil and electricity as two options to heat the house as well.

In Norway, Fortum partnered with Schneider Electric to install and operate a smart metering system with two-way communication. The new smart meters constitute a new tool for consumers to get closer to their consumption habits as well as underpin the smart home platform in the house, since the smart metering system will include a variety of features and its platform will be easily expanded.

In Sweden, Fortum partnered with GreenWave systems, an IoT expert company specialized on software. Their highlight is the AXON Platform, a secure IP-based network platform that consists of a home area network (HAN) which connects and monitor and control devices at home.

Vattenfall

Vattenfall retails electricity to 6.3 million people in Denmark, Finland, the Netherlands, Germany, the UK and Sweden. The Parent Company, Vattenfall AB, is Swedish state owned.

In Sweden, Vattenfall created in 2015 the Smart Home i-Lab (their own laboratory where develop Smart Home projects) in order to find new revenue streams and they are hoping it become a support and resource for customer engagement (Roupe, 2015)

In Germany, Vattenfall has partnered Qivicon, a company created by Deutsche Telekom. Qivicon provides the technology, the app and some of the products that Vattenfall offers to its customers. Vattenfall uses the white labelled Smart home portfolio that Qivicon offers to retail products with their own brand and to bring their image into their smart home clients.

According to Thomas Rockmann, Vice President Connected Home Deutsche Telekom AG, Vattenfall is seeing considerable market interest in "different Smart Home packages bundling the QIVICON Home Base, app and hardware." One of the advantages of the Qivicon platform is that it has a broad range of devices that can be connected to them, without being Qivicon's. (IoT Bussiness News, 2017)

Besides it Smart Home products, Vattenfall have succeeded with their energy product Natur24, which promotes green energy and eco friendly house environments.

Gas Natural Fenosa

The Spanish utility retails its own smart thermostat. The Servicontrol Dual 4TL allows you to control the thermostat remotely and track your consumption through “Termoweb⁴⁵ systems”. Gas Natural Fenosa offers this service for €199.99 (installation included). It is not needed to be a Gas Natural Fenosa customer to purchase the thermostat.

Moreover, they focus their interest related to Smart technologies on Energy Storage, Smart energy distribution, Energy efficiency and automation and data management. The innovation department of Gas Natural Fenosa is currently developing projects, which could be included on Smart Homes like: 3EHouses (trying to improve energy efficiency of households and buildings) and Domocell (developing an EV charging system for condos’ garages). They do not act as a retail of any smart home product.

RWE

RWE AG supplies more than 20 million customers with gas and electricity. On the field of the Smart Home and clean technologies, during April 1st 2016, RWE created Innorgy. This entity manages the platform for customers and no customers of RWE who want to live in a Smart home in Germany.

Innorgy goes a step further, apart of Smart Home devices and an App, it offers “Quick Helpers” to support households setting up and optimizing their home. Innorgy acts as a retailer for other companies like Samsung, Entr, Netatmo or AXA. Moreover, it is an open platform in case you want to obtain other products from any of their partners.

Npower

Npower gets on the bandwagon and retail smart home products with a discount for their customers. It is selling Nest Labs’ products and soon D-Link and Yale will join. With these products RWE is aiming to create a smart home ecosystem which will be controlled through the Npower App. (Moore, 2015) (D Link, 2016)

They are collecting results from their trials in the West Midlands (UK), which started during 2016 Q1 and they are expecting to launch the project nationwide during 2017.

⁴⁵ Termoweb is a Spanish company, which provides smart products (thermostats and meters) as well as the platform for them to operate. It is partnered with Gas Natural Fenosa, ferrol, ecotermi and other 4 companies that sell their products, since they do not run any store.

Enel

Focusing on Italy and expecting the 24% of the houses sold in Italy to be energy efficient by 2025, Enel developed e-goodlife. E-goodlife is the Enel solution for the monitoring and management of home appliances and energy consumption via smartphones and tablets. It uses as a base a apps followed by a kit of products to remotely control your home.

Enel is trying to get into the Smarthome market partnering with device and appliances manufacturers (Electrolux, Philipps...) to offer only high efficiency products and sell its own products in their e-shop. Security smart home kits (camera + 2 sensors + HUB) or power management kits (2 smart plugs + 2 sensors + HUB) are the options that Enel offers for €329⁴⁶

However, e-goodlife is not only a product retailer. Enel goes further and trying to make the life of their users easier. Customers can order the groceries from the supermarket from the e-goodlife app (using Supermercato24 as a partner), obtain all the information about traffic, transport and strikes or simply check the weather. Enel's goal is to find new business streams while making the life of their customers easier while they are or not in their homes.

Engie (GDF Suez)

Although Engie does not have any smart home programs running now they are investing on research about the topic. Using Ecometering, one of their subsidiaries and CRIGEN⁴⁷ are involved at many phases of projects, from solution design through to live testing of energy systems, building heating technologies, algorithm development and connected sensor design.

Verbund

Verbund is Austria's largest electricity provider. It created Eco-Home, a platform thought to complement the Eco packages that offers. It allows to measure and visualize all the energy flows at the same time as automatically can control the EV charging by the self generated solar power.

The system is modular and easy to expand if it is desired. Partnered with Fibaro⁴⁸ they offer two basic packages the Eco-Home Security one (€399) and the Energy management one (€599).

⁴⁶ Price without discount is €399

⁴⁷ENGIE Lab Crigen is the GDF Group's research and operational expertise center dedicated to the gas, new and emerging technologies sectors.

⁴⁸ International company that provides smart home solutions.

Shell

Shell Technology Ventures do not target Smart Home products but it has invested in Sense Labs, which has developed a home energy usage and awareness device which allows to monitor the energy consumption for each of the house devices.

5.1.3 South America (Brasil)

A GfK survey in 2015 said that the 57% of the Brazilians think the smart home technologies are going to become more part of every households lives in the next 5 years. According to 80% of the interviews the most interesting devices and applications are the ones related to security and monitoring of the home. Followed by energy, lighting and connectivity devices. Furthermore, 61% of the people addressed prefer having only one company as a smart home service provider. (GfK, 2015)

The following Brazilian utilities have been analyzed: Cemig, Light, AES Eletropaulo, CPFL, Copel, Celesc and Ample However, only AES Eletropaulo and Light are moving forward in the Smarthome field.

AES Eletropaulo

AES Eletropaulo is developing a prototype of a smart grid in the city Barueri. Even though in its project smart home demand response programs are being studied it represents only potential business opportunities for them since they are not commercializing any solution right now.

Light

Light has partnered with Landis Gyr and Elster (Honeywell) for the operation of a Smart Grid in Rio de Janeiro and the deployment of Smart thermostats, but they are not offering the smart thermostats through the Light platform yet.

5.2 New Digital Players (ITs)

There is a public discussion about who is going to dominate the Smart Home business, Juniper research believes that companies like Amazon, Apple, Samsung or Google are the ones that are going to dominate the market. They are investing heavily in the technology and developing different devices to be the center of the Smart Home. (Barker, 2017)

The world technology leaders are focussing on voice commands platforms in these past years, at the same time they are increasing their portfolio of devices. The companies Amazon, Google, Samsung and Apple and Foxconn have been analyzed. (Burguess, 2017) (Dandekar, 2016) (The longevity network, 2017) (European Utility Week, 2015) (Eastwood, 2017) (Brown, 2017) (Gebhart, 2017) (Nellis, 2017) (The Economist, 2016) (Krause, 2016)

5.2.1 Amazon

Amazon Echo has been on everyone's lips since it was released on June 2015 (first version) in the US and has slowly become one of the top smart home products. Now, every tech company wants to integrate its products with Alexa (the Echo Voice Controller platform). Amazon is taking advantage of being the first developer of such an idea, though Google (with GoogleHome in the market since September) and Apple (announced plans to build a standard hub like Echo) are following Amazon close.

Amazon presents a product which hit the market before any other competitor and is taking advantage of it. Besides having product developers integrating connection with Echo, Amazon is allowing third-parties to build Alexa into their devices (only requires smart home companies to write software code and submit it to Amazon for review); Huawei and Ford built the Amazon's assistant into their phones and cars already. Moreover, Echo is open to outside developers making it grow in skills and potential to reach Amazon's top goal of learning how people spend their time, and make it easier for them to spend money by suggesting things they might buy.

5.2.2 Apple

Apple shows a completely different approach. While Amazon allows smart home product manufacturers to connect their devices within some hours/days following their "open" approach, Apple has more requirements, which gives them more control over the products HomeKit offers. Apple maintains strict control over its HomeKit platform, with a heavy focus on security and simplicity

To be compatible with their HomeKit developers must include a chip from Apple (at the cost of \$0.5 to \$2) and special Wi-Fi and networking chips which are not the cheapest ones in the market. Also, the production of these devices must take place in an Apple certified factory (there are more than 800 certifiers, but only some of them are specialized on automation products). Above that, producers must send product samples to Silicon Valley where they will be tested by Apple. This whole process can take up to 5 months.

Apple's strong point comes from having a deployment of a Billion iOS users around the world, to control the HomeKit you need an Apple device (even if you are not home and you take your phone with you will need an iPad or an Apple TV to connect your devices remotely). However, its drawbacks are that the app does not allow to use all the commands of some devices and the user (or users in the house) is always tied to use Apple products, with prices which are not for everyone.

The final goal for Apple is to put their star product, the iPhone, in the center of our lives and homes. More smart home products for HomeKit means more Apple deployment, more customers engagement, therefore more Apple product sales.

Moreover, on June 5th, Apple presented its own speakers to control the home with Siri (it ships December 2017) following the steps of Amazon and Google. The device, more expensive than its competitors (\$350) claims to be a better speaker and it can control all the devices part of the Apple Homekit.

5.2.3 Google




Google stepped into the smart home markets in 2014 when it acquired Nest (the Smart Thermostat). Since then, it has developed products (security cameras, smoke detectors...) and it is working on deploy Nest in Europe (Jan 18th announced that Nest will be expanding into Spain, Italy, Germany, and Austria).

Google strongest point is their AI, Google assistant is more developed than Siri and Alexa and now is materialized in a home device called GoogleHome (Google's Hub). Now, more companies (Hyundai announced that it would be partnering Google Assistant with its own Blue Link) are joining Google which allows them to follow and compete with Amazon's product Echo even though Google started the race 6 million units sold behind.

Google is trying to position their Search Engine in everyone's home, right now is following Amazon and will use the same information that uses to personally assist a person everyday to try to sell and locate advertisement later according to each person's needs. However, Google needs to increase the number of devices that work with it, since it is still behind Amazon.

Moreover, Google's constant presence in Android makes it reach millions of users that if they find useful the advantage of Google Assistant in their phones, they will start thinking about transferring it to their houses.

Table 7. Google, Amazon and Apple in different markets.

			
IT & Infrastructure	Google fiber	Amazon webservices	Apple SIM
Artificial Intelligence	Google Assistant	Amazon alexa	Siri
Hardware Devices	Pixel, Chromecast, nest	Amazon fireTV, amazon kindle, amazon echo	Iphone, IPad, watch...

Communication & Messaging	Google Play, Youtube	-	iMessage
Digital Media & Entertainment	Androidauto	Amazon Prime	iTunes, tv, Music
Connected Car & e-Mobility	Google shopping	Alexa Integration	CarPlay
E-Commerce and Retail	Google Wallet, Pay	Amazon.com, etc., primenow	iBeacon, Store
Fintech and payment	Google Maps	Amazon paymenrs	Pay
Navigation and Location Services	AdExchange, doubleclick	Amazon Maps API, Maps.me integration	Apple Maps
Advertising	-	amazonassociates	Apple Search Ads

5.2.4 Samsung

Samsung is leading the smart home device manufacturing, “Samsung is one of the largest device makers in the smart home space — it makes everything from smart lights to smart refrigerators.” (BI Intelligence, 2017). Though it is behind Amazon, Google and Apple in the race for being the central image of the connected home (Samsung just started integrating a voice assistant to its devices, “Bixby”, which could be embedded and compatible with third party products, and its new App called “Samsung Connect” following the Homekit one from Apple) it has a strong position on the hidden part. Samsung offers more devices than any of the previous mentioned companies and its Smartthings Hub (market’s top hub) is used and sometimes needed to compliment the Google Home and the Amazon Echo.

Samsung is following a bottom-up approach; started from small devices, then growing and now completing the smart home integration with “Bixby” and “Samsung Connect”. Unlike Amazon and Google, who are interested on the user’s data, Samsung wants to keep being the leader as a product manufacturer.

5.2.5 Foxconn

Foxconn is a device manufacturer company, based in Taiwan and was the third world IT company in the world by revenue in 2016. Foxconn subsidiary Ennoconn is the company in charge of developing the Smart Home products for the brand. Their approach is different than other IT companies.

They created a new brand, Dexatek, which offers a broad range of Smart Home devices which are thought to be compatible and complementary to any other device from other brands. It offers technology adaptable to most of the countries in the world interested on Smart Homes and their products work with Apple Home Kit, Samsung, Amazon or Google technologies. Moreover, in some cases they have been able to take advantage of the success of other brands e.g. Their product *Elli* is thought to expand the capabilities of the *Amazon Echo*.

They are different to the previous companies analyzed because they offer customized modules and services for other companies, which makes them more flexible and with a broader reach.

5.3 Telecom and Cable Companies

The Telecom companies see in Smart Home a way to get into other segments of the market. Deutsche Telekom creation Qivicon is at the front of all Smart Home companies in Europe for its international reach. Iberdrola must not forget Telecom companies will be its competitors in the Smart Home market and in countries like Germany, they go one step ahead.

Usually, while utility smart home products focus on energy saving, telecoms focus on connectivity (i.e. Fortum and Vattenfall go for controlled electricity consumption while Sonera or TDC focus on real time connectivity and security. However, some of them are stepping into the energy market but, most of the time, just as a retailers.

However, in Spain and Portugal the telecom companies are slow to change. They are not presenting game changing programs and are leaving room for Iberdrola.

5.3.1 Europe

In Europe, the interest on Smart Home coming from the telecom companies is growing as well. Companies in Germany and France are the ones leading the development. Most the companies analyzed in this chapter, all of them but the Italian Telecom (TIM), provide security devices (like cameras or sensors). Moreover, four of them (SFR, mobil.com debitel, Vodafone and proximus have partnered with security services companies.

Telekom, with its platform QIVICON, is the leader of the telecom companies in the European smart home market since it is the company that more products offers. Including Smart thermostats, smart plugs and smart lighting, competing against Smart home companies from other branches, like energy utilities.

Telefónica

It is specializing in the M2M communication within Smart Home products and the IoT. It partnered to Sigfox (Specialist providing low consumption IoT connectivity) and to Huawei being one of the first companies (and the first Telco) to offer Smart Home products and technology in South America.

Their main product is the IoT Connectivity Hub, which is flexible and tailored to each project (works successfully with companies like ONCE, GTX, the UK Department of Energy & Climate Change) and it could be implemented for Smart Home companies and data collection.

They are positioning themselves into the Smart Mobility, Smart Retail, Smart Cities and Energy Efficiency markets (the latest, working with Electrobras, C&A, Inversis and the UK government). Moreover, they are selling Smart Home products by Verisure through Telefonica companies like O2 and Movistar.

Their own highlight Smart Home Product is “Thinking things”. A modular and flexible end-to-end and Plug & Play solution for building intelligent and connected products in the IoT area.

Moreover, as well as Iberdrola, Telefónica is interested on upcoming start-ups and have a platform “Open Future” and an incubator “WAYRA”, where many Smart Home products (NUBINGS, Switchee, Smart Pet) are being developed among others.

Swisscom

In March 2016, Swisscom announced that it will be deploying a Swiss-wide network for the IoT called the Low Power Network, which is designed for the transmission of small amounts of data independently of the electric grid.

Swisscom uses examples such as parking spaces transmitting information on occupancy, recycling containers transmitting information on fill levels, meters transmitting readings for exact billing, and even mailboxes sending notifications for package arrivals. Their offering is being expanded and covering 80% of Switzerland’s population

Aside, they distributed Tado smart thermostats for its customers and partnered with Icontrol to implement SmartLiving, its connected home platform.

Deutsche Telekom

Deutsche Telekom is the biggest telecommunications company in Europe. It has subsidiaries in 10 different European countries and in the US.

Deutsche Telekom is one of the pioneers in the European Smart Home market. It developed QIVICON as their home automation platform. QIVICON sells smart home devices, technologies and software and it has been used for different energy utilities in Europe to deploy their Smart Home products into the market.

QIVICON was able to address some companies with interest on keeping then brand name in the products, that is why has been able to introduce this White Label Smart Home portfolio that includes a full suite of platform gateways, apps, compatible devices and services. (Carter, 2017)

Energy utilities like EnBW, Rheinenergie, entega, eww Gruppe and Vattenfall use QIVICON as a Smart Home energy provider. In some cases, this association is complemented by the company GreenPocket, a German software company that controls and optimize the home to induce savings automatically. (IoT Business News, 2017)

Their diversity of options, their market size and how they are moving towards home security and energy fields increase the number of companies and consumers looking at QIVICON as a reference or an opportunity to get into the Smart Home market.

Orange

The French company developed HomeLive at the end of 2014 partnered with two vendors: Vera (provides their controllers) and MiOS (provides the platform). Homelive is only available in the French market (Q2 2017), but it is not necessary to be an Orange customer to purchase their products. Besides their own products Homelive retails other brands like Fibaro, Netatmo or Philips. Orange ask for a 10€ monthly fee for the control service and their products offered grew fast during the last year.

SFR

SFR is the second mobile and telecommunications company in France. They created Home by SFR as their own brand to get into the smart home market in 2013 and by the end of 2014 they had already 150.000 customers.

They offer different products and packages like Pack energy heating (without monthly fees) or Alarm video package (10€/month). Moreover, SFR has partnered with the security company *europ assistance* to provided customers with a premium security package (20€/month).

Mobil.com debitel

The German mobile company built its own Smart Home platform and retails some products (windows sensors, cameras, movement sensors...) from companies like D-Link or Smartfrog. This year they added brought to their retail some energy packages for controlling the energy consumption of your home for a monthly fee. The technology behind their Smart Home platform is provided by the French telecom SFR.

Vodafone

Although Vodafone does not have is own Smart Home platform, nor retail Smart Home products, it acts as a reseller of the company Gigaset elements. Vodafone offers their products in packages next to the internet, the router or the phone. Furthermore, Vodafone participated and provide IoT technology to other companies like Somfy⁴⁹, a specialist on the field of Smart Homes.

Telecom Italia

Telecom Italia (TIM) decided to use the principal brand webpage as a big retail platform of smart home devices. Smart thermostats, appliances or TVs from different brands can be purchase through the same platform in which you can top up you SIM card. The platform that TIM uses to control the devices in the home is developed by essence and together they created WeR@Home, a kit of hub sensors and a camera sold at the TIM's online store.

⁴⁹ French company founded in 1960 specialized on home automation, mainly doors, windows and lighting,

Proximus

The former Belgacom sells its own “Equipment” for the home. Different products, like phones, security cameras, speakers or TVs are sold in their platform. Although some of their products are from its own brand, Proximus retails as well other brands products. Incamac was the partner begacom chose to control the home. They offered remote monitoring and security propositions.

5.3.2 North America

AT&T and Comcast are the two companies leading the telecom Smart Home market. They stepped hard into the market, diversifying and offering technology, products and services in different areas.

AT&T

The American telecommunication company got into the smart home market in 2013 with their own platform Digital Life and focusing their offer on the security side of the house.

Now, Q2 2017, AT&T is offering 3 packages for smart homes: Smart security, Smart security and automation and a Premium offer. Each of the deals are paid monthly and a 2-year contract is required. The premium package includes a Smart Thermostat and 2 smart plugs. However, they do not aim to go further in the energy business than providing the devices.

Comcast

Comcast, as well as AT&T, got into the smart home market in 2013 with Xfinity Home. This digital home platform was developed by the software company iControl. Xfinity offers its own cameras and devices to any potential consumer. Even though Xfinity devices are growing and they are even running some DR programs with ComEd; its focus goes to Home security and monitoring. Comcast customers would have to pay monthly for the service and at least compromise into a 2-year program.

Verizon

Verizon’s strategy is to act as a reseller for other brands. In their webpage, products from Nest, Canary or Belkin among others can be found. They do not offer security systems nor monthly services. Their only partner in Greenwave, who developed their Routers.

Rogers

The Canadian company partnered to iControl, as well as Comcast, to develop Roger’s Smart Home monitoring platform. Different packages from home monitoring (\$12.99/month) to Smart Thermostat control (\$3.5/month) are

offered. As well as for Comcast and AT&T options, a 2-year contract is needed. They do not offer security alarms nor devices, but monitoring and safety sensors.

5.3.3 South America (Brazil)

In Brazil, only one of the telecom companies called Vivo tested the Smart Home market. Its program Vivo automação sold sensors, cameras and some energy related devices until it was cancelled. Right now, there is no main telecom company in Brazil exploring the Smart Home market.

5.4 Energy management aggregators

European utilities under threat of renewable energy effects on traditional energy economic markets are starting to look for business opportunities in the demand response field, Fortum was the first utility in the world to use customer's energy consumption to produce demand load control and they called it VPP (Virtual Power Plant). In the United States, where the term Demand response (DR) comes from. The business come from controlling customer power during peak periods (mainly during the summer due to AC), reducing their load to avoid running their backup generators.

In contrast, European utilities are not worried about summer peak loads, but about intermittent wind and solar power which is starting to bring grid instabilities and economics stress (John, 2013). But in both continents in the world the result is the same, utilities are starting to collaborate with their customers, shifting their relationship from one seeing them as clients to one seeing them as business partners.

To put together utility customer's portfolio and sum customers up in order to form a larger energy block, which can be used as load controller, the utilities require DR aggregators. DR aggregators gather together the energy demand from a wide range of households, commercial users or industrial operators to guarantee DR for the system. Leading aggregators in Europe and in the US, were studied. The following benchmarking highlights the most important characteristics of each of them.

5.4.1 North America

EnergyHUB (New York, US)

It is focused on Bring Your Own Thermostat (BYOT) programs. It has a great partnership network and a very innovative way to give DR with a "Virtual Battery" mode through *Mercury*. So far, it is only based in the US, so its location and position in the DR market make it one of the best Avangrid potential partners. (EnergyHub, 2016) (Leuschner & Strother, 2016)

EcoFactor (California, US)

EcoFactor offers "tailor-made" energy programs for utilities. Its agnostic design, its advance technology and its effectiveness make EcoFactor a competitive DR company for utilities that want their own brand-named throughout all the DR program. So far only based in the US and they are not growing as fast, mainly because more and more utilities interested on DR are taking BYOT programs as solutions. It could be interesting for Iberdrola if they want to keep their image along all the process. (Leuschner & Strother, 2016) (Ecofactor, 2016). Moreover, their approach to control the load by microadjustments of the HVAC systems offer a differential point from other aggregators.

[WeatherBug \(US\)](#)

WeatherBug offers a great weather data network and take the savings of the smart thermostats to further level. This American company from Earth Networks is specialize in optimize set points according to the weather. Moreover, utilities can use WeatherBug to predict loads and DR capacities. Its growing network of partners must make Avangrid and Iberdrola take a look to what they offer. (Leuschner & Strother, 2016) (Earth Networks, 2016)

[Energate \(ON, Canada\)](#)

Apart of providing the platform and the load management systems Energate designs its own thermostats and gateway. It partners with Advance Metering Infrastructure (AMI) providers. They offer hardware, software and installation to utilities which want to go into smart meters and smart thermostats. Its wide range of services provided make Energate an example of a company that can partner with any utility and provide DR from top to bottom for them, while keeping a great customer's satisfaction. (Leuschner & Strother, 2016) (Energate Inc., 2016)

[PowerOn Advantage, General Electric \(US\)](#)

GE offers an Advanced Distribution Management System (ADMS) able to increase productivity and efficiency with active network control. PowerOn Advantage integrates one network model to monitor operations, interphase and database. It collects all the data from different sources to implement fast solutions to restore the well-functioning of the network. This aggregator is not specialized on Smart Homes, but its technology and its reputation make it become a potential partner for Iberdrola. (General Electric, 2016)

[Demand Response Automation Server \(DRAS\), Honeywell \(US\)](#)

Smart Grid Solutions from Honeywell have helped more than 60 utilities around the world. They offer an end to end solution (from design and planning to customers marketing) with an Automatic Demand Response software and IT services. They use DRAS and OpenADR Standards to give solutions to utilities taking mainly big facilities as partners. Households are, however, keeping Honeywell's attention. The proof is Honeywell Wifi thermostat is one of the leaders in the market (Avangrid even offers in its webpage among others like EcoBee and Nest). Being a well experienced company in DR, plus its technology and expertise make Honeywell be one of the companies to consider to manage the aggregation of households for international Iberdrola's future projects. (Honeywell, 2016)

[IntelliSOURCE, Comverge \(US\)](#)

Comverge is a US based company leader on demand management solutions for electric utilities. It does not only work in the US (where it collaborates with Investors-owned, public, cooperatives or retail energy providers) (Comverge, 2016), but it left the US to perform DR programs in Australia, with Eskom (Eskom, 2016) (South Africa), where the DR program delivers 15 GWh of Load reduction, and with METI (Japan's Ministry of Economy, Trade and Industry) where is studying how to position Japan ahead in the Asian energy market technologies. The results that Comverge obtained

in South Africa and the amount of customers that has in the US makes the company one of the one utilities should contact to check what they have to offer.

Silver Spring Networks (US)

This international company offers “Consumerization” of DR for utilities (Silver Spring Networks, 2015). Its proposal brings together third parties and utilities technologies, it prepares the utilities to perform load reductions thanks to engaged customers who obtain their own smart products or obtain one from the utility. Silver Spring Networks play with this flexibility and offers platform, communications, optimization and customer’s engagement through different channels. The business opportunities that Silver Spring offers plus the international character of the brand makes it one of the top potential partners for Iberdrola.

EnerNOC (US)

EnerNOC is able to aggregate medium and small-sized utility customers to deliver DR. It gives utilities and their big customer’s real time data and monitoring. Moreover, provides cost-effective alternatives to peak time power plants. Even though its projects are currently in the US, it shows a company which has been able to deploy its technology among a different types of customers (from Honey farms till Hotels) so it is useful to study different business cases for future Iberdrola partners.

5.4.2 Europe

European aggregators market is formed mainly by younger companies and big ones like Siemens or Schneider Electric, which taking advantage of new technologies to try to reduce the energy consumption during peak loads and the capacity power.

ECOISME (EN, EU)

Based in London, this start-up tracks household’s energy consumption by machine learning. It helps saving energy sending notification to the devices linked to the Ecoisme. The device cannot turn appliances on and off by itself, but it provides home analyses without having to set smart plugs or smart appliances around the house. Although nowadays it does not represent a potential partner for Iberdrola its technology is very interesting and it could move it business model to DR in a near future. (Ecoisme, 2016)

Siemens (Germany)

In the US Siemens started in Texas to perform DR programs for commercial buildings (DRMS) and worked seamless. Siemens offers Intelligent Load Management to reduce energy costs for its clients. The program enables a two-ways communication and do not subtract comfort from the buildings by planning the needed load and rescheduling cooling (Siemens, 2016). Moreover, it offers Energy Engage to have a better understanding of utilities’ clients and their data

and promote client's engagement. But it falls short since the tool do not offer automatic control of clients loads just yet. Philipps needs to work on this systems taking into account that households and utilities are moving towards smart control for DR or simply to save money.

[Kiwi Power \(UK\)](#)

It is the leading DR aggregator in the UK. It is working with Shell in Electric Vehicle DR programs (Shell, 2016) at the same time as is developing an App for energy consumption tracking for the mayor of London. Since it is in close proximity to Scottish Power branch of Iberdrola it would be interesting to know what they have to offer, although nowadays they are not running anything similar to smart home response programs. (KIWI Power, 2016)

[Schneider Electric](#)

Schneider Electric is a specialist on Energy management and automation from low to high voltage applications, there comes its interest towards Smart homes. It is mainly focused on the European and the Asian markets with: Wiser Home Control for Asia and Wiser Home Energy Management for Europe.

For the European market, they retail their own products (Smartplugs, smart thermostats, radiator valves...), which are categorize by countries and on DIY and Pro products. "Wiser" provides the platform for Schneider's products and their new system for energy efficiency management in residential buildings.

Moreover, they offer Life space management systems for motion control in the house, automatic lighting and products to increment the reach of the radio products. They added Safety and style products to upgrade the homes further than based only on energy efficiency.

[REstore \(Belgium\)](#)

This leading European aggregator during January 2017 announced large-scale deployment of connected smart home appliances together with Orange and imec. Restore is betting for smart cities in which energy consumption is mainly shifted towards renewable energy production peaks. "FlexPond (Automated DR platform SaaS for utilities) is the ideal Demand Side Management platform for Smart Cities of the future, as it ensures end-user comfort and safety", says REstore co-CEO Pieter-Jan Mermans. Moreover, FlexPond used machine learning to predict households and utilities behaviour.

5.5 What are new start-ups doing?

Start-ups are boosting the Smart Home market. New companies with different products and services like WITTI (offering a Smart Alarm Clock) or Ecobee (offering a Smart Thermostat able to overtake Google's Nest) are taking advantage of a new market.



Figure 38. Start-ups.

The Energy Management sector of the Smart Home is not an exception. Many start-ups bring promising ideas to the market. Some of the most promising ones are listed below (Li, 2017) (Harper, 2017) (Rock Start, 2017) (Richardson, 2016) (Gool, 2016) (Swuto, 2017) (Schiller, 2016) (Fielding, 2016) (Lakamp, 2017)⁵⁰:

- Smappee (Belgium): Energy Consumption is tracked by their Smart Energy monitor which identifies high consumption devices and appliances in the home. Households can take actions to substitute those power-hungry appliances.
- Sympower (Estonia): It is a DR Aggregator specialized on offering demand-side balance power with smart appliances. Commercially launched in Finland with the utilities TenneT, Stedin and ENGIE.

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- Vebbu (Croatia): “Monitor, purify and optimise indoor air quality using heat recovery ventilation, IoT sensors and a mobile app” (Harper, 2017). Focusing on The Netherlands, Germany and Ireland during 2017.
- TEQ Charging (USA): This start-up offers a solution for the bottlenecks that might appear in EV charging stations. Their software takes into account the time the cars have to be charged by and runs the power from one station to another. Thus more than one station can be placed in one power input and EV Drivers do not need to unplug their cars right away to let other users charge their vehicles.
- QwikSense (The Netherlands): Helps companies to save money and energy at the same time by providing actionable data to improve the work environment.
- Brightup (Germany): Their product is a connected smart plug which controls the home lighting.
- Watty (Sweden): Households control the home energy consumption since they make energy data more accessible thanks to their home energy management platform. The system identifies the most used appliances without the need of additional hardware. Company finance by Innoenergy.
- DAJIE (Italy): Offers an open sourced peer to peer energy data sharing. Thanks to blockchain, they empower prosumers to peer to peer energy sharing.
- Totem (USA). Their solution is to combine everything. “the foundation for smart city tech that brings it all together: IoT, distributed systems (blockchain), EV charging services, autonomous vehicles, nanogrids, microgrids, smart lighting, energy storage, WiFi, 4G communications, virtual power plants, and more: all powered by clean, renewable energy” (TOTEM, 2017). The first model set for release in 2017.
- Wapo.io (Greece): A personal smart virtual facility manager, which connects the stakeholders in a facility in a single interface. “Wapo is designed in a way that it can communicate with IoT sensors, BMS systems, Automation controllers” (Wapo, 2017)
- Wirewatt (Mexico): In their business plan Wirewatt provides solar leases. Using Institutional funds, the customers keep their solar panels after the 25-year period. Moreover, they offer a software platform in which installers can design the system.
- Swuto (UK/The Netherland): This start-up compares automatically the home consumption, the energy bill and the offers from other energy provider and switches the customer automatically to the cheaper energy provider.
- LO3 Energy (USA): They are running microgrid projects which uses blockchain to enable electricity trading between neighbours. It is “One of the 2 startups behind TransActive Grid (the other is blockchain developer ConsenSys) as well as Brooklyn Microgrid and Project Exergy” (LO3 ENERGY, 2017). Their software Ethereum builds “self-executing contracts” among the parties.
- Sharge (Spain): Offers an infrastructure of EV Charging stations. Plugs are shared by owners with the EV drivers who want to charge their vehicle. The App allows to see the charging stations and perform the payment for the electricity consumed.

6 Smart Home Business Models

The Smart Home business models go further than traditional utilities businesses. Utilities around the world base their Smart Home proposals in different business models. Although a rocking market like the Smart Home has a growing number of business opportunities most of the utilities base their business plans on:

Hardware retail

It consists in selling Smart Home products. It is not an innovative business model. Companies act as technology retailers usually selling third-parties' products with the company's name/brand on them. Iberdrola is currently selling Netatmo thermostat. Other utilities like Innogy and the Austrian utility Verbund retails energy management products. The latter used its deployment to include security Smart Home devices. Park Associates says that for Energy utilities "performs well, and not just for traditional high street retailers⁵¹". Juniper research say that Smart Home sales are rapidly increasing while overtaking the subscription services.

"Pay as you go" business models

Some utilities offer prepaid smart home packages that last for a certain time (e.g. one year). This reduces the barriers for consumers, simplifies billing and ensures customer engagement (Carter, 2017).

Monthly subscription services

Among utilities, telecoms, security providers or any other company providing Smart Home technology exists this business model. Centrica, E.On, Orange or Mobil.com are some of the companies offering monthly payments to its customer, usually accompanied by a 24-month contract.

Service-tariff business plan

It connects products or devices with energy tariffs. Endesa uses this with the EV charging stations. Customers purchase a device and at the same time they sign-up to a tariff with different energy prices depending on the time of the day.

Different partner services

Utilities like SFR or companies like Vodafone in Germany partner with third party companies to offer a more complete Smart Home experience for the household. They usually partnered with security companies (Securitas or

⁵¹ It means that selling high quality brands have a good acceptance from the costumers. If Iberdrola decides to act a Smart Home product retailer should not stay in cheap brands.

Europassistance) to extend their reach and use a mature connected home market to leverage their Smart Energy technologies deployment.

Regulatory based models

The Smartmeters in Spain are a great example for this. Some regulators in Europe allow devices to be included in the energy obligation targets. This has allowed utilities to deploy devices successfully among clients. This brings engagement opportunities for utilities.

Loyalty based models

Some utilities are using Smart Home devices to increase customer satisfaction and customer engagement by providing them with the latest technologies. These products are sometimes used to reward customers for their loyalty.

Bring your own device models

This business model is more common among utilities in the US. The customers are allowed to buy products from a list set by the energy provider, usually Smart Thermostats in Bring Your Own Thermostat programs, while participating in different tariffs. Thus, the customers have more flexibility choosing devices and the utilities benefits from Smart thermostats with load control.

Data business models

A data business model is brought by the Internet of Things (IoT). The vast amount of generated data makes companies find ways to store it, track, analyze it or even get revenues from them. For example, "IoT data from car plug-in systems that track driving habits can be sold to insurance companies to offer good driver discounts to policyholders" says Aylan Networks. Data can benefit different part of Iberdrola's value chain such as customer support, electricity retail and marketing.

7 Positioning proposals

Iberdrola has seen a business opportunity in the Smart Home market. In Spain, it encounters a market in which there are not big players but with good forecasts. There are many reasons for Iberdrola to invest in this market: Iberdrola can find new revenue streams, can benefit from DR programs, could improve customer's acquisition and engagement and could bring a better image for the company.

Moreover, Iberdrola wants to ensure its strong position in the Spanish energy market by being the first utility stepping head into the Smart Home technology and it needs some business proposal in a very early stage.

This chapter will present four different proposals. The proposals are individual business ideas, which require different technologies. The proposals in this chapter try to be new and disruptive for the Spanish electricity market.

The approach

In order to develop a Smart Home strategy for Iberdrola an Incremental Approach is followed. The Smart Home market positioning will underpin on businesses and departments already existing in Iberdrola.

It must be taken into account that this paper represents the envision of the project, which is the first step of the six Business Reengineering Life Cycle has (Subashish Guha, 1993).

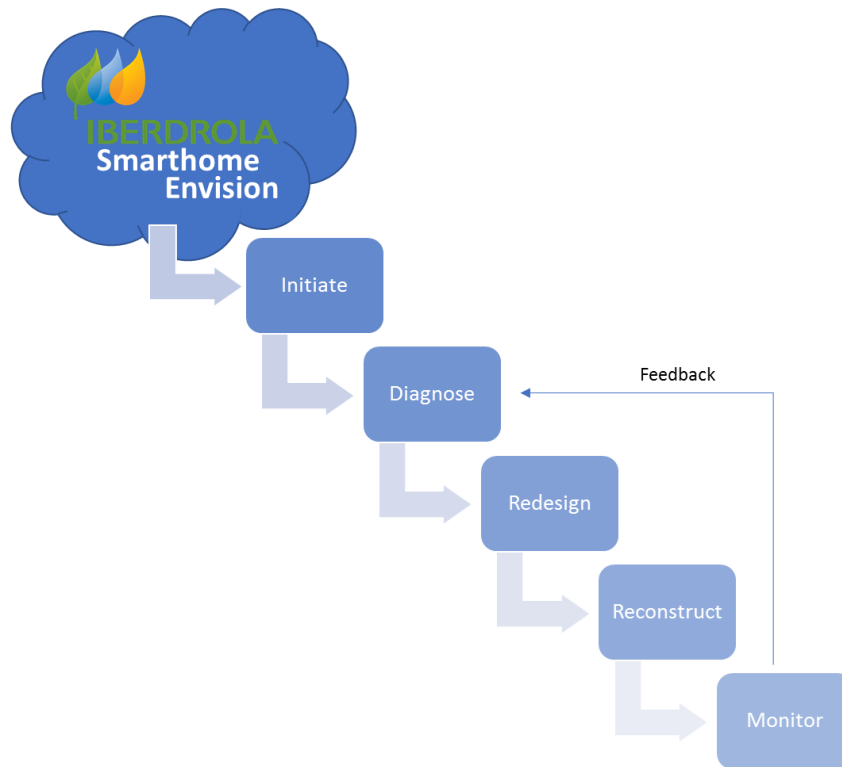


Figure 39. Business Reengineering Life-cycle for Iberdrola.

Iberdrola Smart Home Envision has two main steps:

1. Identify potential opportunities for Iberdrola and potential reengineer opportunities to improve the products and technologies that Iberdrola offers or retails to its customers.
2. Identify Enabling Technologies that could benefit Iberdrola's positioning in the Smart Home market and Iberdrola's customers acquisition within the retail market.

Moreover, the opportunities must align with Iberdrola's corporate strategy in the retail business and do not risk Iberdrola's customers.

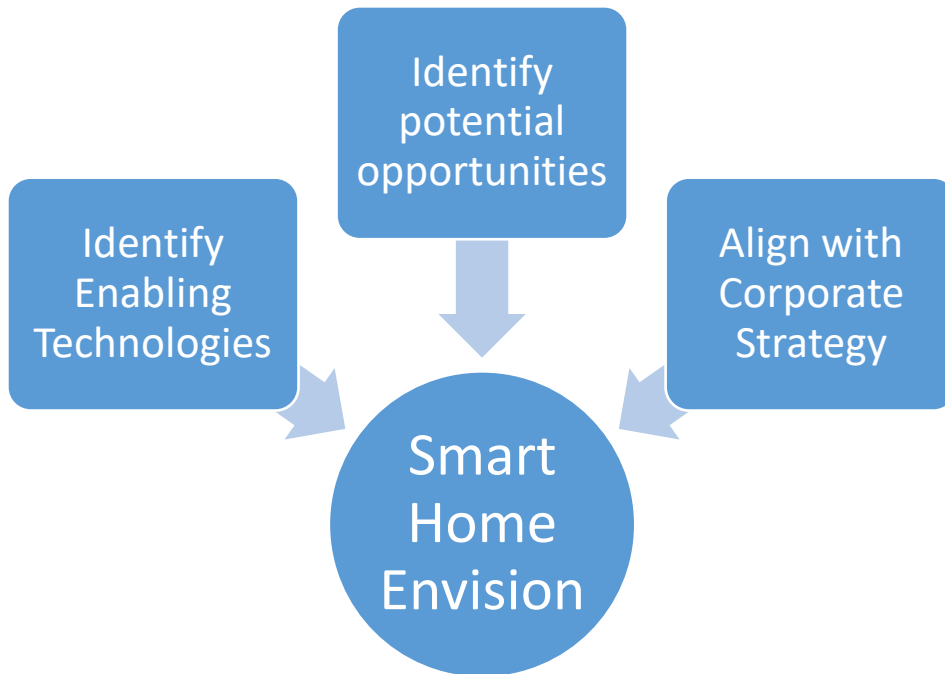


Figure 40. First Step, the Smart Home Envision.

The interaction between Iberdrola’s products, Iberdrola and its clients must be smooth and seamless. A good online platform becomes a key point to impress customers that who are interested on Smart Home products and trust Iberdrola as a technology provider.

Iberdrola provides different Apps as a way to connect their costumers. “Tu consumo” app allows to track your consumption if you form part of the households with a Smartmeter connected to your home⁵². The potential customers who can benefit from this app is growing parallel to the Smarmeters deployment in Spain, which will have to be completed by 2019.

⁵² Even though the Smartmeters measure the energy consumption every 15 minutes the App only represents 1 hour intervals.

7.1 Proposal Ideas

Iberdrola wants to take advantage of the expected growth of the Smart Home market by being one of the first movers in Spain. There are many different technologies which could be interesting for Iberdrola and that for some reasons, economical, political, or because they are innovative no companies have exploited yet.

Iberdrola is currently only retailing some smart products. Different brands, like Netatmo from Iberdrola Spain or Nest and Ecobee from Avangrid in the US, are retailed. Keeping this retail is still interesting for Iberdrola since it brings small incomes, while giving an image of a modern energy utility. However, Iberdrola cannot retail every product and these devices must keep some characteristics (like being englobed within the same ecosystems) so the final users do not experience complications with the use of them, or their installation, and blame Iberdrola for them. Iberdrola can partner with “certified” ecosystems and connect its App and Smart Home devices with them to benefit from the push that the big IT companies are having around the globe. Moreover, being part of on of these ecosystems could allow Iberdrola offer Bring Your Own Device within those ecosystems for customers interested to take their Smart Home a step further, without Iberdrola investing in that technology.

On the other hand, Iberdrola can take advantage of these technologies and use it to develop projects in which it is interested. Solar Power, EV charging stations or Smartmeters are some of the products in which Iberdrola is investing already and which can be easily updated with modern Smart Home technology.

Product differentiation might be hard to achieve with a single-product basis, but bundling all Iberdrola’s products within the same App and the fact that Iberdrola has already a deployment of customers and Smartmeters positions Iberdrola on a great place for customer acquisition and deployment of their new products, specially in the energy sector area of the Smart Home.

This paper proposes the following four positions for Iberdrola to take advantage of the Smart Home technologies and the boom of its market. The proposals vary in technology but they are all within the energy management area in which Iberdrola have the strongest position.

The Smart EV Charging Station Proposal

The EV purchases are expected to grow within the next 10 years, Statista's data shown in the Chapter 4.1 say by 2021 one every 10 households in Spain will have an EV. Offer these Electric drivers a modern and unique place to charge their vehicles bring benefits for Iberdrola and for its customers. Moreover, future customers could be attracted by the new technology.

The proposal is to upgrade "Recarga Verde Iberdrola", the EV Charging stations sold by Iberdrola, so they become smart. The idea is simple: There are many companies providing EV charging stations, but the more developed ones are in the US. A partnership with one of this companies could bring the technology to Iberdrola without making an considerable investment on technology. Moreover, Iberdrola could provide the Charging Station company an

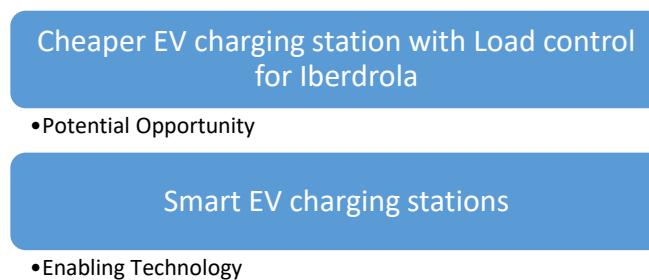


Figure 41. Envision Smart EV Charging station.

increase on their market deployment.

The are key points the Smart EV Charging Station must have to benefit Iberdrola and its clients:

- It must provide a faster charging time than a conventional outlet.
- Technology able to program/decide according to the cheaper energy hours. These would allow customers to take advantage of "Supervalle" tariffs, improving their interest in the product, or Iberdrola decide when to charge these vehicles.
- Load control technology. The option of controlling the time of charging from Iberdrola side could bring potential benefits to Iberdrola Retail. Helping them to fulfill daily and hourly energy consumption goals. Customers could set the time the car must be charged by and Iberdrola could charge the battery whenever is convenient.
- The price of an standard installation must be included in the price and a professional must be in charge. Moreover, maintenance service must be offer.⁵³
- The EV charging station must have an App to connect to the customer. Allowing the owner of the EV to know the battery charge level, the energy consumption or the expected time until full charge are some data

⁵³ Endesa offers maintenance 24h in less than 3 hours.

very easy to provide and it transmits transparency to the energy transaction. Furthermore, the potential connectivity to bigger international Smart Home platforms could be appealing for some clients, although Iberdrola should not choose a single ecosystem to connect the EV charging station.

- The software of the charging station must be easily updatable. Moreover, it is important if Iberdrola is able to keep access to it. This could resolve problems or optimize solutions in case of malfunction.
- Different lengths of cable must be offered.

In order to find the Electric Vehicle Service Equipment (EVSE) or EV charge station which fits the most with Iberdrola's interests, the top EVSE companies have been compared. Although Philipps model Versicharge is well rated by most of the users and technology journalist Eric C. Evarts named it as the "the most convenient to use (charging station)"; it is not a model that would interest Iberdrola to retail to its customers on the long term since it does not offer Load control and this could be a further benefit of having customers connected to a Smart Home environment.

Companies like GE, JuiceBox or even Bosch offer products very interesting for Iberdrola. However, it is ChargePoint the one going one step ahead. Firstly, they have all the characteristics Iberdrola is interested in in terms of EV Charging Stations. Secondly, the company is implementing Smart Grid technologies in their latest designs. Thirdly, the price range is similar to the "Recarga Verde Iberdrola", with much more skills and charging capacity. Furthermore, they are an American company planning to expand and which have actively partnering other companies in the US to increase the reach of their market, the increase of scope Iberdrola could provide them could be beneficial for them.



Figure 42. ChargePoint EV Charging Station. (ChargePoint, 2017)

A partnership with this company would allow Iberdrola take the lead on EV Charging technology in Spain and potentially in Europe. Right now, Endesa is the leader of this product in the Spanish market. It offers lower electricity prices during from 1am to 7am, it partnered with the German company Smart and with the EVSE company Wallbox.

Endesa, during June 2017, launched the App, which allows the customer to program the best hours to charge their vehicle, control their consumption and configured their charger. The prices of the charging station go from 999€ to 1899€ depending on the length of the cable (See Endesa prices table in Appendix 9.5). They offer daily payments, installation and sales in kWh prices.

Nowadays, Iberdrola's "Recarga verde" offers a simple charging station for 590€. In a market in which the price of the battery technology has been decreasing in a logarithmic rate since 2005 (Nykvist & Nilsson, 2015) the prices of the Charging stations are becoming more and more competitive and have more to offer. Iberdrola's charging station offer do not match the state of the art of the technology in the international frame, nor benefits Iberdrola further



Figure 43. Iberdrola and Endesa EV charging stations.

than retailing the product.

ChargePoint offers a cost competitive product, which starts at \$549 for an indoor garage⁵⁴ with 32A/240V (Cheaper than Recarga Verde) and which can be upgraded. Other companies offer Vehicle to Grid options, but this technology is not a reality yet for Iberdrola. Whereas Load control with EV vehicle charging stations which are integrated in other platforms already (like Chargepoint) might bring benefits to Iberdrola and to its customers.

⁵⁴ The price of the product comes without installation costs.

Using Smart Meters for Data Disaggregation

Gathering the load consumption from customers using Smartmeters not only benefits utilities by reducing the costs of the readings. Many companies are using the data collected from Smartmeters to create different client profiles depending of their load consumption.

Disaggregation can be used for many purposes, but the most important ones are the ones which turn data collected from households into value.

Data acquisition for disaggregation, customers' segmentation and load prediction

- Potential Opportunity

Smartmeters deployment

- Enabling Technology

Figure 44. Smart Home envision for Disaggregation.

There are companies which bet for extra devices (like Bidgely, Smappee, Intel (John, 2012) or Sense) to gather more data in shorter intervals to make the measurements more precise. Their value proposition is to know which devices are being used at every moment in the home. But their usually high price and their complexity (John, 2016) make them not very interesting for a company like Iberdrola and its customers, even though retailing them could be interesting to prove Iberdrola is an innovative utility. But selling this product direct to customers is a tough approach, since in some cases it has a significant upfront cost and in some cases clients do not want them.

The more interesting business plan for Iberdrola is the one that uses Smartmeters information to give customers profiles. Many companies are specialized on this technology around the world and Iberdrola must take an advantage of the 15min interval the Smartmeters deployed that Spain has. Thus, trying to differentiate from its competition.



Figure 45. Smartmeter deployed in Spain. (Mediavilla, 2014)

Start-ups like eeme or Navetas can get the exact power your appliances and devices are consuming just from household's Smartmeter readings. Other utilities in the world, specially in the US, have partnered with energy disaggregation companies. TXU Energy (Energy utility from Texas) was the first utility to partner with Bidgely back in 2014.

Offering customers disaggregation technology not only improves customer engagement and help them to be more aware about their energy consumption, but also allows utilities to provide more personalized information across its web and mobile tools. Also, it improves load forecasting and it could be use to study customer's profiles if they complain about the cost of their bill. Moreover, in some cases, even failures in appliances, malfunction or efficiency failures could be detected.

The data obtained from these studies could be further used. Giving some examples. The data could even be sold to third parties, such as appliance sales, internet suppliers or companies specialized on fixing appliances. They would be able to know the age of the appliances by their energy consumption and offer special deals to these customers. Moreover, some brand names might be interested as well in knowing whether their product behaviour or malfunction detections on appliances could automatically offer to contact companies specialized on fixing them.

Moreover, some utilities like EON, EDF or ComEd are starting to have Marketplaces. Marketplaces are online platforms which retail and offer energy efficient products and devices, the data collected from the Smartmeters could be use to develop a platform like this one in the long term and it would help with the efficiency of the retailing (by offering the products to the exact customers).

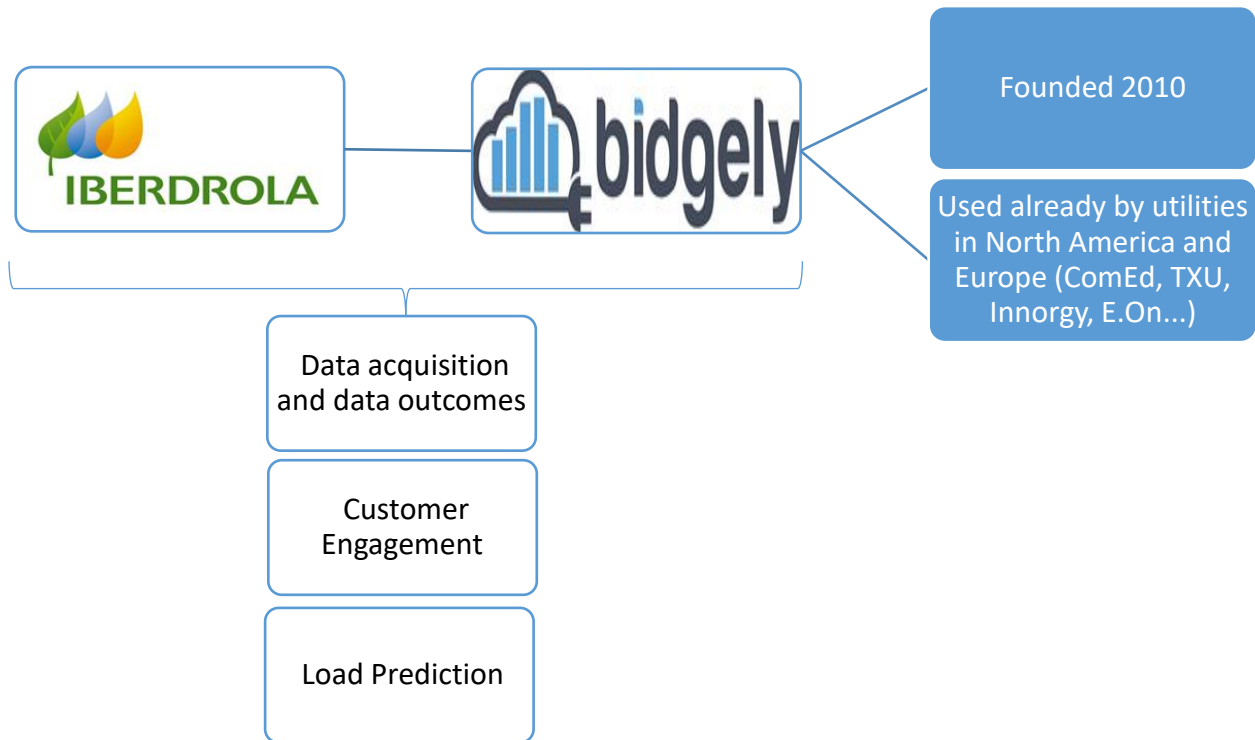


Figure 46. Iberdrola and bidgely.

The proposal would be to partner with Bidgely (or eeme depending on the stage of company development Iberdrola wants to involve) to offer customers, with their Smartmeters installed, consumption tracking at the same time as Iberdrola personalized their customer profile and take advantage of the disaggregated data. Iberdrola can underpin this project on the Smartmeter deployment it is having (taking more advantages from it) and use the App “Tu Consumo” to share the disaggregated consumption.

Solar in community buildings

Sharing energy with your neighbour was illegal in Spain this last June. A trial from the “Tribunal Supremo” has allowed Neighbour Communities to install shared Solar Panels in the rooftops of condos. Now, the households do not need



Figure 47. Smart Home Envision for Solar in Community Buildings.

to have their own energy installation and can share the costs of the project and the bureaucracy with their direct neighbours.

This could mean an increase in the installation of PV panels on the rooftops due to two main facts⁵⁵:

- The bureaucracy costs will be shared by households. Thus, the price and costs will be reduced by sharing them among the more stakeholders.
- The energy produced will be more easily consumed by the building. Since there are dwellings in the building, there is more likely someone will be consuming energy at every time of the day. Spain is the European country with the bigger amount of people living in Neighbour Communities (65.9% of people (31millions) live this way, according to Eurostat). Therefore, there is a big market opportunity. Iberdrola could take advantage of this resolution and prepare business plan in which it would not be left out if some communities decide to produce their own electricity.



Figure 48. Smart Solar de Iberdrola for neighbor communities.

Underpinning the business model in Smart Solar from Iberdrola, the Smart Home or Smart Building concept could benefit Iberdrola in this aspect. Iberdrola, with Smart Solar, could offer solar installations for buildings and at the same time offer Building Energy Management Control.

Since the regional government will be one in charge of the regulations in this subject, the way electricity will be shared is still an unknown. However, Iberdrola could use the technology behind the Smart Buildings and offer Building

⁵⁵ Besides the decreasing price of Solar PV technology experienced during the last years.

Energy Management Control units for the households. Different approaches of sharing will be could be discussed, but the community will have to know who is consuming the energy from the grid or from the solar panels.

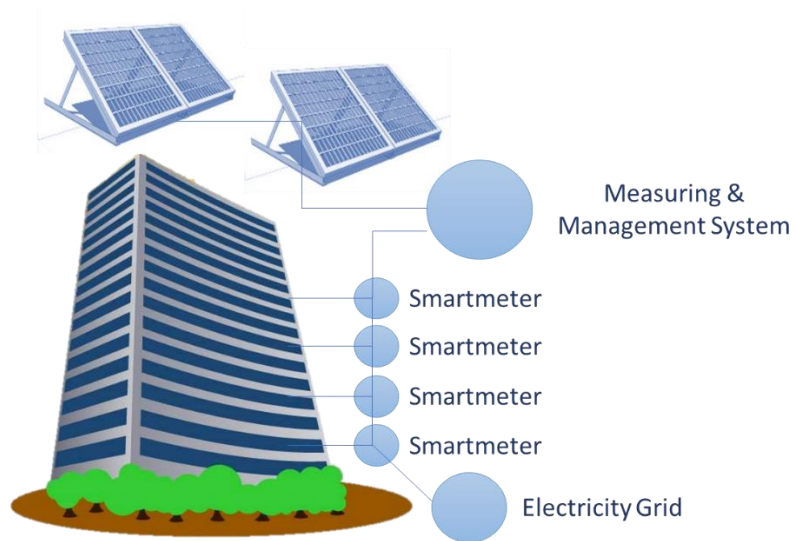


Figure 49. Proposal Smart Solar System.

Smart Solar Iberdrola can offer the installation upgraded with a PV Energy production measuring and monitoring system. An Smart Energy measurement system could track the energy production from the solar installations at the same time as the Smartmeters track the energy consumption from each of the households. Contrasting this two data sets, Iberdrola could offer a Building Energy Management System for communities interested in developing decentralized energy solutions.

Use HVAC systems in offices for Smart Control and DSR

The Demand Side Response (DSR) is increasing its attraction in North America and Northern European countries around the world. Utilities in the US, the UK or Finland are taking advantage of this technology to balance energy production and consumption at the same time as displace certain loads to times of the day when it is more convenient for the utilities. Moreover, the HVAC control segment got the biggest market share in 2016 within the Smart Home and Navigant Research expects this to continue during the upcoming years thanks to the impulse of the Smart Thermostats.

The companies providing DSR usually partner with an Aggregator, a company whose job is to put together demand loads so they behave as one which can be reduced when needed it.

There are 3 companies, which could be interesting for Iberdrola: Siemens, EcoFactor and Kiwi Power. They could aggregate the energy consumption from office buildings. Due to their size and since most of them use heat pumps as a method of refrigeration and ventilation, the aggregated load which could be obtained from them could be useful for a retail company like Iberdrola, specially during the summer when there is more consumption due to AC loads.



Figure 50, EcoFactor and Kiwi Power logos.

Spanish regulation is still ambiguous about the possibility of allowing DSR and Red Eléctrica Española (REE) and the needed size of the aggregated households varies with each country. In Spain, the minimum is 5MW if Iberdrola wants to use smart home technology as DR for the “servicio de interrumpibilidad” (Red Eléctrica Española, 2014). However, creating a Virtual Power Plant, based on rewards for consumers reducing the loads, can bring more benefits at a smaller scale for Iberdrola retail helping it to improve the energy consumption forecast on one specific area and help to hit the right forecasted energy retailed of each hour or each day

Demand Response using HVAC systems from office building

- Potential Opportunity

Aggregators and Demand Response

Figure 51. Smart Home Envision for DR using big buildings HVAC

Moreover, the proposal goes an step further adding some more modern features to this service. Using machine learning from the smart thermostats and feedback from the workers in the building the temperature inside the building can be optimized each day, depending on forecast, temperature, humidity and feedback from the workers. This keeps the workers involve with the control of the office and improve the engagement in the DSR process. MeteoViva or US-American BuildingIQ are some companies which use machine learning for model prediction control which could be added for better integration of the HVAC systems in office buildings.

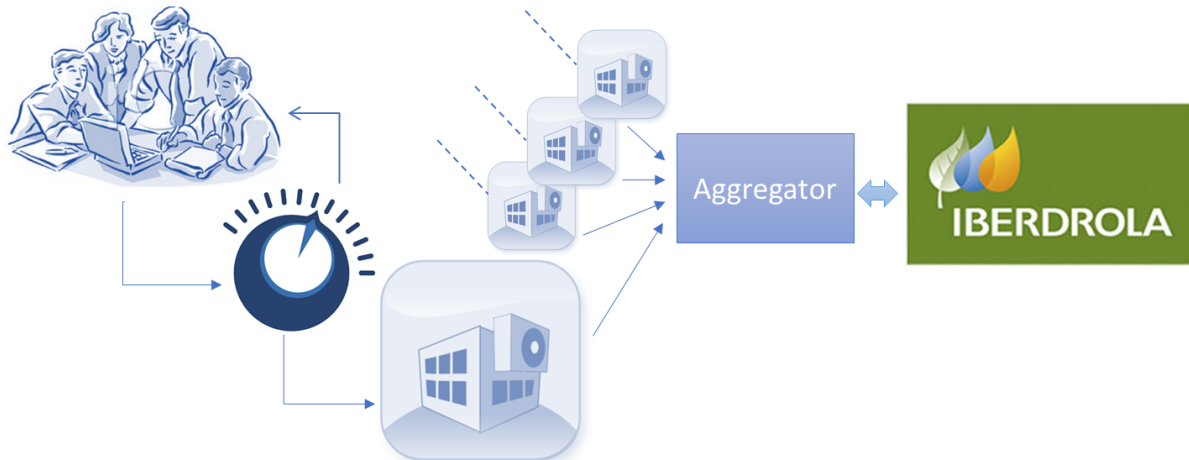


Figure 52. DSR proposal for office buildings.

Due to regulation, this proposal must have further studies.

7.2 Other Key points of any digital business model proposal: The Data and The App

There are some key points Iberdrola must take care of while developing its digital business model. Besides the technology, the projects and the start-ups in which Iberdrola is investing, there must be a clear focus on Iberdrola's App since it is going to become the way to connect and interact with its clients. The App "Mi consumo" can be upgraded with the other proposals as a way to centralized all the interaction with the energy of the home, the customer and Iberdrola. The App must be stellar at every moment according to Garter and Park Associates the App must be, at least, over 4.2 over 5 (Carter, 2017).

The proposals come from different business models and the internet business models, like the disaggregation proposal, support quick market penetration due to the lack of extra devices. However, the other proposals have a part of installation and purchase which must be take care of. Thus, customer engagement and experience will be improved. Furthermore, there are some key points, like the engagement process, which must be carefully designed and ready to address different customer groups. Iberdrola is one of the first movers towards this technology in the peninsula and must take advantage of it.

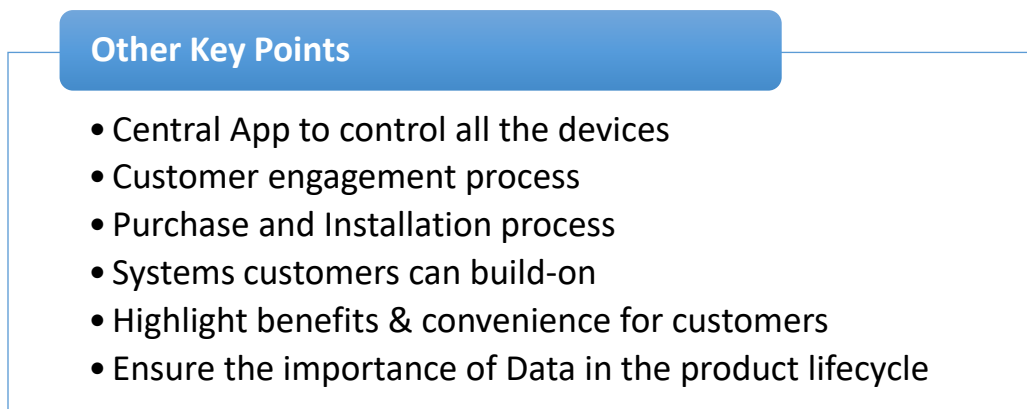


Figure 53. Other Key points

Moreover, every product Iberdrola offers cannot be a dead-end system. Every device must be able to work with other products and controlled smoothly via one main App. This will simplify the use and improve customers' perspective.

Iberdrola must ensure customers understand the product and technology benefits behind it. Iberdrola must be clear so the potential customers understand the environment benefits that some of these technologies might have. Thus, the interest towards the technology will increase further than the devotes' market segment.

Being able to collect the right data and address the right customers depending on their interests will help Iberdrola with the proposals and with any further businesses. Develop different marketing strategies or products for different clients might enhance the proposals so even the most skeptical become more interesting in the energy products for the home. During the last 6 months, Utilities have begun to develop what they call "Marketplaces", in which utilities

retail energy related products and energy efficient appliances. The data collected from Smartmeters, retail webpages and customers could help evolve the customers' profiles for further segmentation within Iberdrola.

The data collected by any Smart Home devices must be understood so products can be created, upgraded or simply fixed. Furthermore, customers can be better addressed, which saves money from marketing and improve customer's experience. Each of the Iberdrola's Smart Home products must come with an optimized IoT data plan throughout all its lifecycle, which will help the Smart Home positioning development in the long term (Ayla Networks, 2017).

8 Conclusions

Iberdrola must embrace the growth of the Smart Home market. The Smart Home technology is expected to reach the 16.1% of Spanish households by 2021 and being one of the first movers in the peninsula will put Iberdrola in an advantaged position. Risks diversification, customer acquisition, customer engagement, new revenues and having a growth opportunity are some of the drivers that support Iberdrola to move into this market. On the other hand, customers benefit from having more control over their homes and their energy consumption, which can lead to money savings. The utility is particularly well-placed to benefit from the Smart Home market, not just because its infrastructure has already touched homes, but because of its already strong customer relationship, its vast experience marketing and billing, and the fact that customers already trust it with their data. These factors set Iberdrola in a strong position to address the different segments potentially interested in the Smart Home technology (“Devotees,” “Functional households” and “Potentially addressable”). However, the blurred solutions, different standards, market confusion and low barriers for new vendors are some of the market inhibitors Iberdrola must consider while designing a differentiating business plan.

The current market structure is formed by scattered solutions. However, some companies, and more recently big ITs, are betting for large certified ecosystems to try to control the market. Trends show their investments are moving the market towards these ecosystems. Therefore, Iberdrola must differentiate itself with its proposals, offer something different in the energy management side of the Smart Home and avoid creating dead-end products that cannot be built on other potential ecosystems.

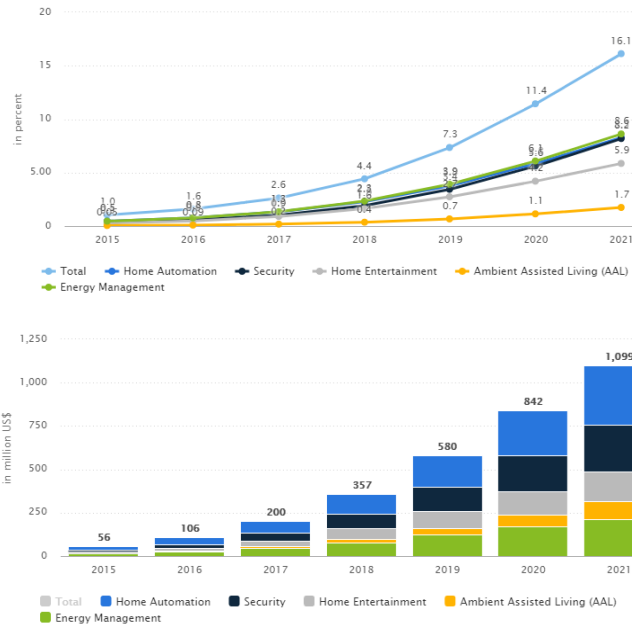
Due to its energy utility position, focussing on the Energy side of the Smart Home is a natural fit for Iberdrola, where products like Smart thermostats are taking the lead. However, the size and different aspects of the market, bring in competitors from different sectors. The benchmarking of the energy utilities, telecoms, aggregators and big ITs within the areas Iberdrola is interested in exploring (US, Europe and Brazil) showed a matured American market followed by the growing European market and underdeveloped Brazilian market. US utilities have for years been taking advantage of the Smart Home technology, mainly Smart Thermostats, for Demand Response programs, whereas ITs or Telecoms are more interested in retailing Smart Home products and programs. However, there is a blurred line between areas in the market. Therefore, ITs and telecoms are using their positions to get into the energy management side of the Smart Home as well and, in some cases, offer energy savings programs which could reduce utilities’ revenues. In Europe, the utilities British Gas and Deutsche Telekom, with their full ecosystems, Hive and Qivicon, are great investors in the Smart Home field. However, despite the fact that there are no Smart Home ecosystems offered by any big Spanish company, developing a full ecosystem is not interesting for Iberdrola due to the complexity, investment needs, risks and Smart home technology forecasts that expect the big ITs to get stronger in the area.

Differentiating and specialized business models based on Hardware retail, Service-tariffs and Data are the most promising ones for the Spanish utility. The four business plans proposed in this paper, in their envision stage, show how different the Smart Home market is. The proposals base their business plans on already existing areas for Iberdrola. However, the broad scope of this innovative market, in some cases pushed by start-ups, proves the Innovation Department of Iberdrola must be ready for the shift if it wants to keep Iberdrola at the head of the European Utilities. Iberdrola must become synonymous with energy efficiency in the Smart Home technology.

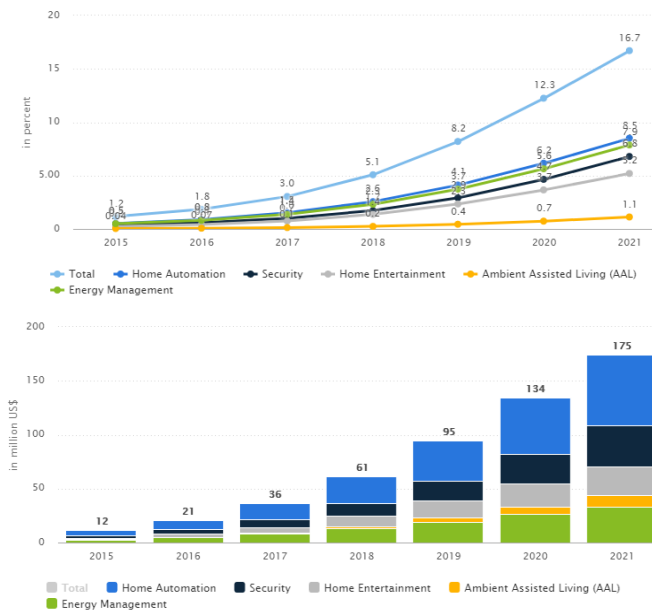
9 Appendix

9.1 Statista Smart Home graphs for Spain and Portugal (Statista, 2017)

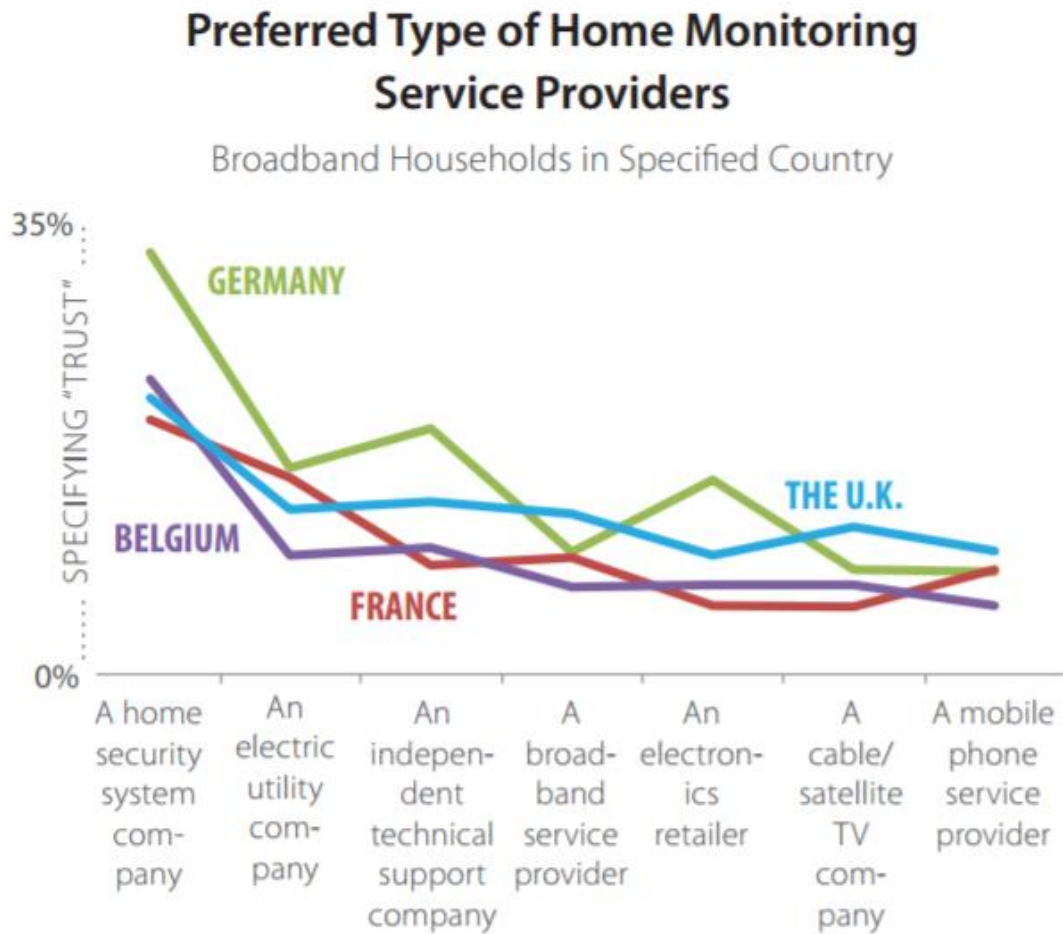
Spain



Portugal



9.2 Preferred type of home monitoring Service providers (Carter, 2017)



9.3 Times of use tariffs in Spain

DH en las tarifas de acceso BT y AT ($T \leq 36kV$)

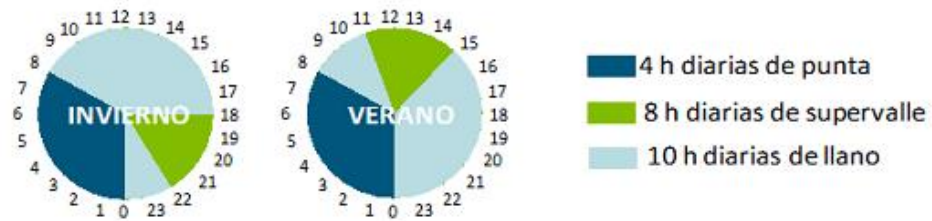
2.0DHA y 2.1DHA, 2p (BT con $P_c \leq 15 kW$)



2.0DHS y 2.1DHS, 3p supervalle (BT con $P_c \leq 15 kW$)



3.0A, 3p (BT con $P_c > 15 kW$) (**)

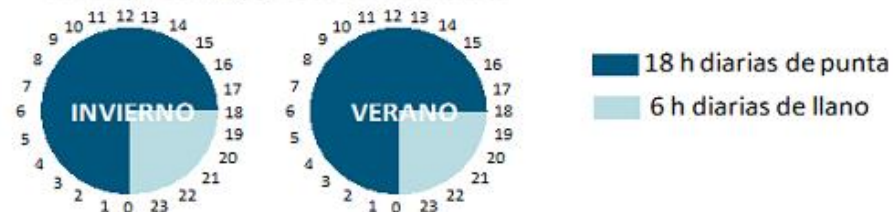


3.1A, 3p (AT con $T \leq 36kV$)

Lunes a viernes laborales



Sábado, domingo y festivos nacionales



(**) Para suministros fuera del territorio peninsular los horarios son diferentes

9.4 Balancing services in the UK (Power Responsive, 2016)

Scheme	Minimum size*	Notice period	Duration	Regularity**	Value***	Contract	
FREQUENCY RESPONSE SERVICES	Static Firm Frequency Response (FFR)	10 MW	30 sec	Max 30 min Typically 5 min	10–30	££	Monthly electronic tender
	Dynamic FFR	10 MW	2 sec	Max 30 min Typically 3–4 min	Daily	£££	Monthly electronic tender
	FFR Bridging	< 10 MW	30 sec	30 min	10–30	££	Bilateral contract of 12–24 months to transition in to the FFR market (either Static or Dynamic).
	Frequency Control by Demand Management (FCDM)	3 MW	2 sec	30 min	-10	££	Bilateral contracts for 1–2 yrs. Week ahead notification of daily load able to shed
	Enhanced Response (EFR)	1–50 MW	1 sec Dynamic	Max 15 min Typically 3–4 min		£££	New product – trial tender
RESERVE SERVICES	Short Term Operating Reserve (STOR)	3 MW	20 min	2–4 hrs Typically <20 min	Able to deliver 3x per week	£	3 tenders p.a. 'Committed' or 'Flexible' service
	STOR Runway	< 3 MW	20 min	2–4 hrs Typically <20 min	Able to deliver 3x per week	£	Bilateral contract
	Fast Reserve	50 MW	2 min, reaching 50 MW in 4 min	15 min		£	Monthly tender
	Demand Turn Up	1 MW	10 min, sometimes requested day-ahead	Min 30 min		£	New product – trial tender

9.5 Economic conditions for “Solución Integral” EV charging station. (endesa, 2017)

Condiciones Económicas en caso de contratar Solución Integral																
# Pack	Descripción Pack	Duración contrato (años)	Cuota (€/día)	Opción de compra (€)										Valor residual fin contrato (€)	Condiciones en caso de Venta de Equipo (€)	
				≤6m	>6m ≤12m	>12m ≤18m	>18m ≤24m	>24m ≤30m	>30m ≤36m	>36m ≤42m	>42m ≤48m	>48m ≤54m	>54m ≤60m			
Solución Integral Recarga Vehículo Eléctrico	1	Instalación monofásica 16 / 32 A – ≤ 5 metros	3	1,33 €	999 €	819 €	674 €	445 €	350 €	250 €					160 €	999 €
			5	1,05 €	999 €	999 €	679 €	679 €	360 €	360 €	253 €	253 €	147 €	147 €	60 €	
	2	Instalación monofásica 16 / 32 A – 5 < metros ≤ 10	3	1,43 €	1.149 €	942 €	776 €	512 €	402 €	287 €					184 €	1.149 €
			5	1,12 €	1.149 €	1.149 €	782 €	782 €	414 €	414 €	292 €	292 €	169 €	169 €	69 €	
	3	Instalación monofásica 16 / 32 A – 10 < metros ≤ 15	3	1,52 €	1.249 €	1.024 €	843 €	557 €	437 €	312 €					200 €	1.249 €
			5	1,20 €	1.249 €	1.249 €	850 €	850 €	450 €	450 €	317 €	317 €	184 €	184 €	75 €	
	4	Instalación monofásica 16 / 32 A – 15 < metros ≤ 20	3	1,62 €	1.299 €	1.065 €	877 €	579 €	455 €	325 €					208 €	1.299 €
			5	1,27 €	1.299 €	1.299 €	884 €	884 €	468 €	468 €	330 €	330 €	191 €	191 €	78 €	
	5	Instalación monofásica 16 / 32 A – 20 < metros ≤ 25	3	1,72 €	1.399 €	1.147 €	944 €	623 €	490 €	350 €					224 €	1.399 €
			5	1,35 €	1.399 €	1.399 €	952 €	952 €	504 €	504 €	355 €	355 €	206 €	206 €	84 €	
	6	Instalación monofásica 16 / 32 A – 25 < metros ≤ 30	3	1,82 €	1.449 €	1.188 €	978 €	646 €	507 €	362 €					232 €	1.449 €
			5	1,42 €	1.449 €	1.449 €	986 €	986 €	522 €	522 €	368 €	368 €	213 €	213 €	87 €	
	7	Instalación monofásica 16 / 32 A – 30 < metros ≤ 35	3	1,92 €	1.549 €	1.270 €	1.046 €	690 €	542 €	387 €					248 €	1.549 €
			5	1,50 €	1.549 €	1.549 €	1.054 €	1.054 €	558 €	558 €	393 €	393 €	228 €	228 €	93 €	
	8	Instalación monofásica 16 / 32 A – 35 < metros ≤ 40	3	2,01 €	1.649 €	1.352 €	1.113 €	735 €	577 €	412 €					264 €	1.649 €
			5	1,57 €	1.649 €	1.649 €	1.122 €	1.122 €	594 €	594 €	418 €	418 €	243 €	243 €	99 €	
	9	Instalación monofásica 16 / 32 A – 40 < metros ≤ 45	3	2,23 €	1.829 €	1.500 €	1.235 €	815 €	640 €	457 €					293 €	1.829 €
			5	1,74 €	1.829 €	1.829 €	1.244 €	1.244 €	659 €	659 €	464 €	464 €	269 €	269 €	110 €	
	10	Instalación monofásica 16 / 32 A – 45 < metros ≤ 50	3	2,35 €	1.899 €	1.557 €	1.282 €	846 €	665 €	475 €					304 €	1.899 €
			5	1,83 €	1.899 €	1.899 €	1.292 €	1.292 €	684 €	684 €	482 €	482 €	279 €	279 €	114 €	

Todos los precios incluyen IVA.

Estos precios incluyen la instalación estándar especificada en el Anexo de Precios. No están incluidos trabajos adicionales que solicite el cliente durante la instalación así como aquellos detallados en la Condición Específica 2ª del presente Anexo de Precios.

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