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THE ENERGY INDUSTRY MARKET: Maximization of business benefits - The case of the Iberian Market

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Resumo

Um dos focos da estratégia empresarial é o desenvolvimento de vantagens competitivas, reduzindo custos ou diferenciando produtos. Neste contexto, a redução do custo de eletricidade, investimento em energias renováveis e eficiência energética revelam-se soluções eficazes, permitindo aos gestores criar estratégias que fortifiquem as suas vantagens perante os concorrentes.

Com o intuito de alavancar o potencial empresarial, o presente estudo visa apresentar uma análise holística da indústria elétrica ibérica e demonstrar de que forma as empresas podem beneficiar com este mercado.

Para a concretização deste objetivo, esta dissertação baseia-se numa abordagem qualitativa que compreende revisão de literatura e entrevistas semiestruturadas que permitem conhecer a perspetiva de especialistas deste mercado e cruzar dados adquiridos com a literatura e evidências de uma empresa real.

Entre os resultados desta tese destacou-se a transição energética como o principal fenómeno atual com impacto no setor elétrico ibérico, revelando-se uma prioridade das empresas energéticas. Neste sentido, constatou-se que qualquer empresário com um consumo considerável de eletricidade beneficiaria com o investimento em painéis fotovoltaicos. Relativamente à contratação de serviços de eletricidade, dependendo do posicionamento do mercado de energia elétrica (normal, favorável ou adverso), os gestores devem responder com diferentes estratégias.

Pese-se ainda as limitações deste estudo, nomeadamente o facto da amplitude territorial ser curta. Assim como o processo de recolha de dados se ter limitado a um número restrito de especialistas, interferindo com uma potencial generalização.

Palavras-chave: Mercado ibérico de eletricidade, Empresas, Eficiência de custos, Sustentabilidade

Sistema de Classificação JEL: Q01 Desenvolvimento Sustentável

Q41 Procura e Oferta • Preços

Abstract

The primary goal of business strategy is to generate and develop competitive advantages by lowering costs or differentiating products. In this context, cost-effective electricity, renewable energy and energy efficiency seem to be actual solutions, allowing managers to create strategic possibilities to build advantages upon competitors.

With the intent of leveraging business potential, the main purpose of this study is to provide a holistic analysis of the Iberian electricity industry and understand how businesses can take the greatest advantage of this market.

This paper uses a qualitative approach which comprises literature review and semi-structured interviews to learn from market experts and cross acquired data with the theoretical literature to date and real-world business evidence, therefore approximating the theory to practice.

A key finding of this study was that the main phenomenon impacting the Iberian electricity sector is the energy transition, which is a core priority of the electricity companies. Following this idea, any business owner with a considerable electricity consumption would benefit from investing in photovoltaic panels. Regarding electricity services contracting, depending on the position of the electricity market (normal, favourable or adverse), company managers should respond with different strategies.

One of the limitations of this research is the short territorial coverage. Besides, the data collection process was limited to a restricted number of experts, interfering with a potential generalization.

Keywords: Iberian electricity market, Businesses, Cost-efficiency, Sustainability

JEL Classification System: Q01 Sustainable Development

Q41 Demand and Supply • Prices

Table of Contents

List of Figures

List of Tables

1. Introduction

In this section, the background of the subject of study for this thesis is presented, along with a short presentation of the problem, study relevance, research questions and structure of the dissertation.

"We will make electricity so cheap that only the rich will burn candles."
- Thomas A. Edison

In this time of global market unpredictability, one thing it is known for certain: the world needs energy - and in growing amounts - to support economic and social progress and development.

In the modern world, nearly everything depends on electricity, one of the most significant innovations of all time, being its generation a main activity within the energy sector.

Every business requires electricity to operate and unnecessary high energy costs originate a negative impact on companies' internal and external competitiveness. According to Asia Pacific Economic Cooperation (2016), energy cost, particularly the relative level of energy expenditure from a global perspective, wield a substantial impact on competitiveness in energy-intensive industries.

Enterprise owners, usually, have lots of responsibilities and managing obligations to guarantee long-term financial stability is a significant part of the job. However, electricity costs dependent on the size, location, type of business and other vital factors, so it is tough to come up with an average benchmark for electricity price.

Energy consumption often represents an important overhead cost for businesses of completely different shapes and sizes but knowing how to secure and negotiate the best deal can be extremely problematic and confusing, leaving businesses forced to pay for unreasonably expensive bills. Understanding how the electricity market works and comprehend energy companies' operation and strategy can help avoid businesses from overpaying.

The Iberian electricity sector is a liberalized and freely competitive market but that is not a sufficient circumstance for reduced energy prices. Even though in both Portugal and Spain, customers are enabled to select the preferred electricity supplier, this does not ensure a more

effective and adequate competition. Commonly, consumers exhibit a significant aversion to change, which translates into a reluctance to swap to a different supplier, and even to drop out regulated tariffs in favour of the free market (García, García-Álvarez & Moreno, 2017).

In terms of environment, energy supply must be sustainable and diverse, and energy needs to be used more efficiently. Few issues are as controversial and important today as the challenges confronting the world energy sector: lowering energy dependency, expanding the security of energy supply, reinforce energy efficiency and diminishing greenhouse gases' emission (García et al., 2017). The electricity sector is one of the major players in this energy transition. Meeting the augmenting energy demand in a safe and environmentally responsible manner is a key challenge.

1.1 Problem Statement and Study relevance

The main goal of business strategy is to create and sustain competitive advantage by lowering costs or differentiating products. In this context, cost-effective electricity, green energy and energy efficiency appear to be effective solutions, allowing managers to create strategic possibilities to build advantages upon competitors.

With the introduction of the Iberian liberalized market, free competition has been introduced in the sector, so energy consumers can now select their supplier. However, these business decisions and negotiations can be hard since energy market functioning seems overly complex and unclear to company's owners and managers. Are managers prepared to make these important decisions regarding energy in a confident and informed manner?

The main purpose of this study is to provide a holistic analysis of the Iberian electricity industry and its effect on businesses, from the perspective of specialists in the area. It is also intended to clarify the organizational mode of operation of the current system in the Iberian Peninsula and understand the most suitable business strategies in order to increase businesses advantages and awareness for better energy alternatives, growing interest and concern with regard to electricity costs and efficiency.

1.2 Research Questions

The purpose of this thesis is to offer an extensive analysis of the Iberian electrical industry and its effect on businesses explained from Energy companies' perspective. The research questions, aiming to narrow and better define the study scope, are the following:

RQ1: What is the current position of Iberian energy companies: foreign investment, renewable energy, main challenges and perception of the sector future?

RQ2: Given different scenarios in the energy market, what are the main impacts and challenges for businesses?

RQ3: According to the electricity market experts, what are the main aspects businesses' managers should take into consideration when negotiating electricity contracts?

This study is advantageous to both the theoretical and the practical contexts. From the theoretical standpoint, it gives an inside view of this major and growing sector by industry experts, as well as enlarges knowledge in the academic area. From the practical point of view, it contributes with real-word insights on how businesses can take the maximum advantage from the electricity sector, recognizing the opportunities and challenges from this sector specific features. In addition, a practical business electricity costs and benefits analysis will be performed in order to implement and evaluate the recommendations of the recognized energy experts.

1.3 Structure of the thesis

This thesis includes five chapters. In the second chapter of this study, relevant existing literature will be reviewed in order to shape a theoretical basis for assessing the research questions. The third section outlines the methodological choices of this paper. The research methods will be defined while explanations on the selected data collection and analysis methods will be presented. In the fourth chapter, the findings and results will be determined, discussed, analysed and tested in the context of the research questions. Finally, in the fifth section, conclusions will be drawn and recommendations for future research will be given, while recognising the limitations of this study. In the opening of each of the main parts its following content will be outlined briefly in order to facilitate the reading.

2. Literature Review

This chapter provides an overview of the Global and European electricity markets, addresses the current energy sector transition related to sustainability, includes an outline of the Iberian electricity market, and explores how the energy sector impacts businesses.

2.1 Global Electricity Market

The electricity sector is both complex and strategic. Electricity is an essential good in our society and it is needed on a daily basis, at nearly all times during the 24 hours of the day. It not only provides us with light and warmth, but it is also a basic component of any industrial activity.

The electricity markets are the mode projected to drive efficient resource allocations in the power system sector. Their role and operation are being unceasingly designed and shaped by numerous aspects including, technological innovation, policy objectives and social behaviours (European Commission Joint Research Centre, 2021).

During the past decades, power markets all over the world became deregulated and, in numerous countries, electricity is currently traded under competitive rules. Frequently, as part of the deregulation, power pools or power exchanges were founded, where producers, traders, and large consumers manage to buy or sell power in organized markets (Mayer & Trück, 2018).

During the 1980s in South America, after primary efforts, the first power exchanges in developed countries arose in the 1990s, beginning with markets in the United Kingdom and Scandinavia. Afterwards, constantly more competitive electricity markets have been established, and by the end of the 1990s various markets in Europe, North America, and Australia were functioning.

Currently, there are markets all over the world, in developed likewise in developing countries, and with coverage from local to international territory.

With the appearance of wholesale markets for power, a new sort of commodity turned into a tradeable product. However due to some unique features, the behaviour of electricity spot prices contrasts notably from other commodities, or financial assets. At the present time, storing electricity continues financially unfeasible. This non-storable peculiarity of electricity is uncommon among most commodities. Consequently, sudden fluctuations of electricity supply

and demand cannot be sustained through inventory management, inferring that an equilibrium between supply and demand is needed at every time. Therefore, the efficient performance of electricity markets is a challenging job, imposing additional balancing services and the management of reserve resources further the common production and distribution services, what originates unique price attributes. Knittel and Roberts (2005) classify stationarity of prices, seasonal cycles, extreme price swings, and time-varying volatility as pertinent attributes of power prices. The most relevant characteristic of spot electricity prices are possibly the so-called price spikes, accounting for a great share of the high volatility in the markets.

Electricity markets can be arranged in two ways: as day-ahead markets, where are defined the energy production amounts and prices for the 24 hours of the following day, or intraday markets also named real-time markets, that are markets with regular trading until shortly before delivery (typically 5–15 min).

According to Mayer & Trück (2018), electricity markets organized as day-ahead markets revel a considerably inferior overall price fluctuation in comparison to markets with real-time trading. These differences stand in a cross-market observation, and also for markets that feature both trading schemes. In general, Mayer & Trück (2018) findings imply that in real-time electricity markets, retailers and large clients and consumers with direct approach to power exchanges will be forced to more comprehensively hedge their risks from severe price variation and price jumps in the spot market.

Previously to deregulation, in the majority of the countries present in the Mayer & Trück (2018) study, big, frequently state owned, monopolies were in charge for the electric power generation, transmission, and distribution. Beginning from this context, deregulation occurred in several forms, nonetheless the common goal was to foster competition in the electricity sector. Regularly the form to accomplish this was to privatize state owned utilities and divide vertically integrated power producers.

Considering the non-storability of electricity which requires the permanent balancing between production and demand, a real spot market with instantaneous delivery it is not possible for power. Thus, a huge number of markets adopted the day-ahead trading (Figure 2.1). Commonly the price assessment is established by an auctioning process. In a few markets, exist the two both trading mechanisms (real-time and day-ahead markets), but in those cases real-time trading is regularly used as a sort of balancing market to coordinate the predefined quantities of the day-ahead market.

Figure 2.1 – The power markets in Mayer & Trück study sample. The markets are painted with the colour red or blue in consonance with their structure: red corresponding to real-time markets and blue to day-ahead markets (Source: Mayer & Trück, 2018, p. 80)

2.2 European Electricity Market

The expansion of power markets in Europe began in the early 1990s in England and Wales, extended to Scandinavia, succeeded by numerous states in Central Europe. In England and Wales the market begun as a power pool, although later to the market design restructuration, it converted to a power exchange model that was managed by the Amsterdam Power Exchange (APX) since 2003. Excluding Italy, that in 2013 continued to have a pool model design, every other European markets were using a form of power exchange model (Mayer & Trück, 2018). Power Exchange is an organism granting a competitive spot market for electric power trading on intraday or a day ahead arranged market place. According to the Energy Community Secretariat (2020), there are currently 15 organized market places (Power exchanges) across the European Union, which are identified in figure 2.2.

Figure 2.2 – Power exchange overview in Europe (Source: Energy Community Secretariat, 2020, p. 6)

According to the European Commission (2020), a European energy market is the best way to guarantee affordable energy and to avoid power failures to European Union (EU) residents. As a result of shared energy market directives and cross-border infrastructure, energy may be generated in one EU country and distributed to customers in another. This maintains prices constrained by making competition and permitting clients to determine their energy suppliers.

Considering the level of integration and developments in technology since 2009 and projected in years ahead, the EU electricity market has gradually been modernized to be in harmony with this reality. The Clean energy for all Europeans package has resized old energy market rules and announced new ones, while encouraging simultaneously the needed private and public investments grounded on market indicators.

Contemporary electricity market directives and regulation has been shaped, for instance, the share of electricity generated by sustainable sources is projected to raise from 25% to above 50% by 2030. Simultaneously, even if there is no sun and wind, electricity ought equally be generated and delivered in adequate amounts. Markets require to be improved in order to accommodate the needs of green energies and captivate investment in the resources, such as energy storage, which can balance the fluctuant energy production. The market should further grant stimulus and benefits for consumers to develop a more active behaviour and to contribute to maintain the electricity system balanced.

The present electricity market model rest on the rules of the "Third Energy Package" established in 2009. Afterwards, these rules have been integrated with regulation against market exploitation and enforcing legislation regarding grid operation rules and electricity transactions.

Considering these issues, the European Union approved in 2019, within the framework of the "Clean energy for all Europeans package", four segments of legislation that will help adapting EU market rules to new market realities.

The electricity directives enforced were on common rules for the internal market for electricity (EU) 2019/944, which will prioritize energy efficiency solutions, and the new regulation on the internal market for electricity (EU) 2019/943, that propose a new boundary for powerplants eligible to receive subsidies as capacity mechanisms (validating the phasing out of subsidies to generation capacity emitting 550gr CO2/kWh or more) (European Commission, 2020). Moreover, the customer is placed at the centre of the clean energy

transition and the new rules allow the dynamic contribution of consumers, whilst putting in place a robust agenda for consumer protection.

By conceding electricity to move freely to where it is most needed, society will progressively take advantage from competition and cross-border trade. They will ensure the investments required to provide security of supply, whereas decarbonising the European energy system.

The new rules support the EU's aim of being the world leader in energy generation from renewable energy sources by permitting more flexibility to integrate a growing share of renewable energy in the grid. The switch to renewables and enlarged electrification is vital to accomplish carbon neutrality by 2050. The new electricity market design will hence help to reach the objectives set out in the "European Green Deal" and encourage the creation of jobs and growth (European Commission, 2020).

2.2.1 Sustainability and Energy transition

Sustainability is a paradigm for reflecting about the future in which societal, environmental and economic evidences are balanced in the pursuit of an enhanced quality of life, and it is frequently assumed of as a long-term goal (UNESCO, 2021).

Sustainable development is the encompassing paradigm of the United Nations. The concept of sustainable development was labelled by the 1987 Bruntland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" and is related to the various processes and routes to achieve it (e.g. sustainable production and consumption, sustainable agriculture and forestry, research and technology transfer, good government, education and training, etc.).

Following the previous principles, the transition to a decarbonised energy system and economy is in motion. The deep transformations required by the energy transition entail ample social and political support. Energy prices and energy costs (prices multiplied by consumption) should guide the markets' modification to reach a climate neutral economy while maintaining energy unexpensive for citizens and businesses. In these problematic occasion triggered by the COVID-19 crisis, it is even more imperative to safeguard a fair energy transition that matches our efforts for recovery, provides a level playing field for our industry and keeps energy at a

fair price for households (Commission to the European Parliament, The Council, The European Economic and Social Committee, The Committee of the Regions, 2020).

During the last decade, the notion of the green economy has appeared as a strategic priority for numerous governments. According to the United Nations Environment Programme, "An inclusive green economy is one that improves human well-being and builds social equity while reducing environmental risks and scarcities. "

In 2008, UN Environment set in motion the Green Economy Initiative, a programme of country-level assistance and global research planned to instigate policymakers to support environmental investments. Sustainable energy is vital to a green economy.

"The green economy is the good economy. Technology is on our side. Those that will bet on the grey economy will have a grey future, and those that… are betting on the green economy will have a dominant role in the global economy in the decades to come."

– Antonio Guterres, Secretary General, United Nations

In the past few years, several proposals have been presented to mitigate climate change, but one that reappears over the time is the Green New Deal, a programme that attempts to recover the planet for new generations grounded on sustainable growth. Following this idea, one of the most outstanding project is the one that was introduced by the new European Commission in December 2019: The European Green Deal.

The European Green Deal provides a guidance for making the EU's economy sustainable by converting environmental and climate challenges into opportunities over all policy fields and turning the transition fair and inclusive for everyone. The European Green Deal comprises every sectors of the economy, notably energy, buildings, transport, agriculture and industries.

A prosperous energy transition approaching climate neutrality by 2050, as projected under the European Green Deal, will entail both reasonably priced energy and spark investments in technologies required for further decarbonisation. With the Clean energy for all Europeans package currently under execution and numerous Green Deal initiatives on taxation, energy and climate policies being arranged, monitoring energy prices and costs supports on better

understanding the impacts of existing policies and gives valuable insights for the development of the imminent proposals.

In 2020, COVID-19's damaging effect on economic activity instigated a substantial fall in the demand for electricity, which, along with growing renewable dissemination and falling gas prices, has brought wholesale electricity prices to reduced levels. Additionally, negative electricity prices have become far more common and widespread in wholesale markets.

This phenomenon, which happens when producers have to pay to dispose their production, reveals deficient interconnections and some generators missing the economic incentive or technical flexibility to reduce production.

Taxes and levies continue to be the most significant source of distinction in retail prices over Member States, revealing a dispersion that is, on average, three times higher than that of the network and energy components. According to the Commission to the European Parliament, The Council, The European Economic and Social Committee, The Committee of the Regions (2020), this is caused by the differences in Member States' fiscal instruments and policies impacting the taxation of electricity consumption. Environmental taxes paid by households in 2019 ranged from 1 €/MWh in Luxembourg to 118 €/MWh in Denmark, whilst applied VAT rates ranged from 5% in Malta to 27% in Hungary. Renewable levies vary from 3 €/MWh in Sweden to 67 €/MWh in Germany. Besides, in most countries, taxes and levies along with network charges, substantially surpass the energy component determined by market forces.

The European Union and its member states are pointing to coordinate energy taxation with the energy and climate goals in line with the Green Deal proposed initiatives. Furthermore, the joined effect on prices of all taxes and levies (not Energy only) could be considered when measuring how they stimulate behaviour lined up with a clean and fair energy transition.

2.2.1.1 Challenges of a Green Europe

The appearance and development of renewable energies, such as wind or solar, bring some challenges. Wind and solar power are irregular. Solar energy is only accessible during daytime and can be simply inhibited by cloud cover, and wind production can oscillate quickly from one hour to the following.

Dealing with these challenges entails distinct forms of flexibility to accomplish residual demand requirements, which is the volume of electricity demand unmet by low marginal cost

resources such as wind and solar power. This demand must be matched by other sources for the sake of meeting consumer demand and preserve grid stability.

According to Aurora Energy Research (2021), the immediate requirement is the reallocation of renewable energy from times when there is a surplus that is not consumed to periods to where there is not enough cheap renewable generation to meet demand, imposing more expensive, typically fossil-based generation to address the gaps. This can be accomplished through grid-level technologies namely flexible demand and storage.

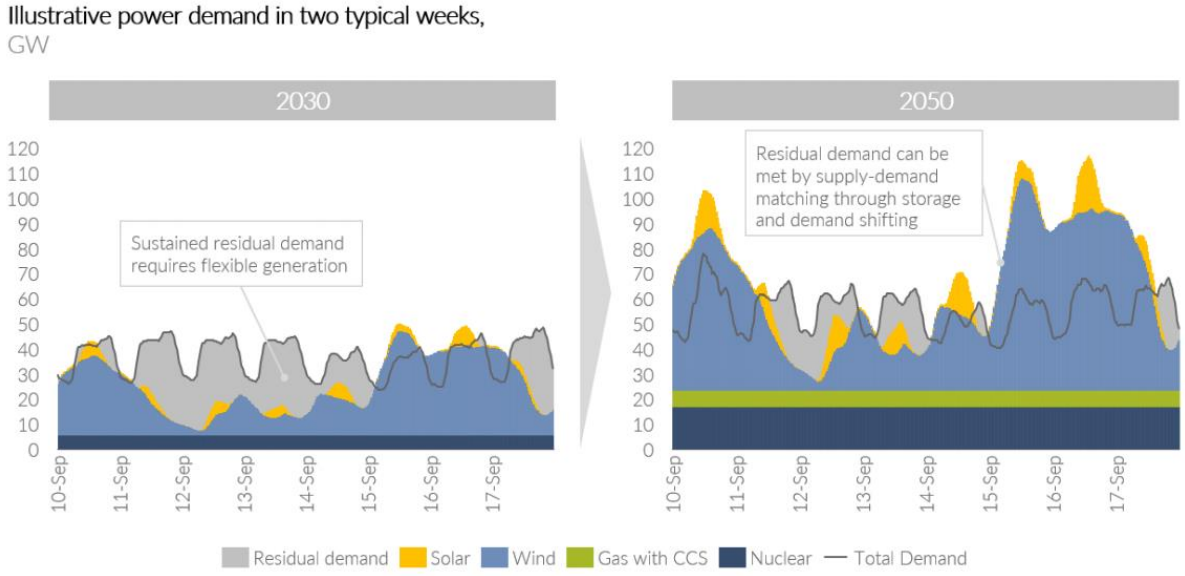


Figure 2.3 – Demand-supply matching: Approaching 2050, flexibility and storage becomes essential for the correct utilisation of renewables (Source: Aurora Energy Research, 2021, p. 15)

Since storing excess energy production is not conceivable because of restricted storage availability, expanding demand when renewable generation rises and responding contrarily when it decreases can support the integration of renewables into the grid. This demand and supply balancing increments revenues for renewable generators by lowering curtailment—shutting down generation due to an excess on the system or grid restraint hindering supply to reach demand centres. This approach enhances the overall economics of renewables and resiliency of electricity supply, and also economically enable other vital grid services like frequency response, inertia, voltage support, etc. (Aurora Energy Research, 2021).

2.3 Iberian Electricity Market

Addressing the goals defined by the European legislation, a strategy grounded on the formation of regional markets was developed to reach a more efficient and competitive energy market.

The integration process in the Iberian Peninsula was initiated in 1998. Next to some delays, in July 2007, the Iberian Electrical Energy Market (MIBEL) begun its operations as a common market for both the Portuguese and Spanish operators.

This was only possible through an exceptional harmonization effort, in which participated various regulatory bodies and system operators (ERSE and REN in Portugal, and CNE and REE in Spain). The process was complex because of technological and regulatory concerns.

The adjustment and adaptation processes were done gradually. A Portuguese branch of the Iberian Energy Market Operator (OMIP) was established as a forward market, and a Spanish branch of the Iberian Energy Market Operator (OMIE) as a spot electricity market with daily transactions. In January 1998, OMIE initiated its operation for the Spanish market and in July 2006 OMIP did the same. Ultimately, a combined operation for the entire Iberian market was in progress after a year. After all, in July 2007 MIBEL completely begun its activity, being the market outline specified bellow (García, García-Álvarez & Moreno, 2017):

Spot: OMIE is responsible for the management of the spot electricity market with daily transactions and intra-day readjustments (intra-day markets), where electricity sale (generation) and acquisition programmes are defined for the day succeeding that of the trade. Therefore, OMIE is accountable for the settlement of the daily and intra-day markets.

Forward/Derivatives: OMIP is the managing entity of the MIBEL futures market (Iberian Electricity Market) in Portugal and is presently a regulated market operator.

OMIClear is the clearing platform and assumes the role of clearing house and central counterparty in all the operations executed on the market managed by OMIP, being created on 6 April 2004.

System Services: In Portugal, REN (National Energy Networks) is accountable inside the national electricity system, as a public service via concession and for the electricity transmission network activity exclusively. The electricity transmission network activity comprises the operation, development and maintenance of the National Electricity Transmission Network (RNT) likewise its interconnection with additional networks and the global technical

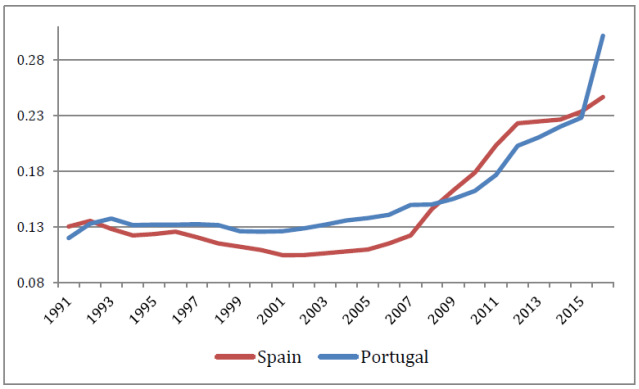
management of the National Electricity System (SEN), ensuring the harmonisation of its production and distribution plants.

In Spain, REE is an operator of the Spanish electric system. And encompasses the responsibility for the transport network.

Concerning the current Iberian liberalized electricity market, for the advantages of competition to reach the customers it is a required, but not a sufficient condition, that the latter have the ability to select their electricity supplier (García, García-Álvarez & Moreno, 2017). Even though in both Portugal and Spain, consumers are allowed to choose their electricity supplier, this does not ensure a more effective competition. Consumers express a particular aversion to change, which translates into a reluctance to change supplier, and even to abandoning regulated tariffs in favour of the liberalized market.

According to García, García-Álvarez & Moreno (2017), regardless of the measures put into action and a greater competition in the wholesale market, the retail market has not achieved its potential since it has not evolved enough.

Figures 2.4 and 2.5 demonstrate that electricity prices have faced a substantial growth. Even though, consumers do not seem to have adequate information or incentives to drop the regulated market or exert the right to switch the supplier (García, García-Álvarez & Moreno, 2017).



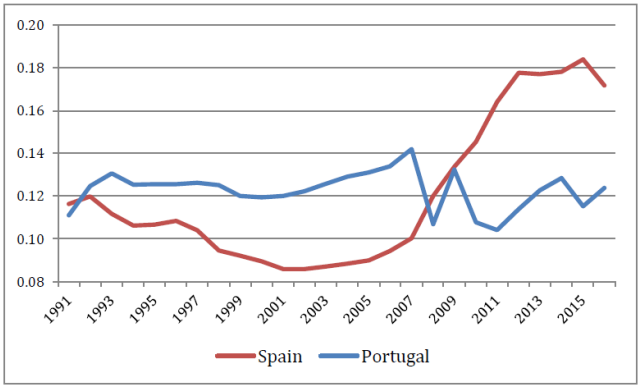


Figure 2.4 (Left side) – Electricity price (euro/KWh) – tax included (Source: Eurostat)

Figure 2.5 (Right side) – Electricity price – without tax (Source: Eurostat)

2.3.1 Portuguese Electricity Market

2.3.1.1 National Legislation and Renewable Energy

The electricity legislation and policy in Portugal is defined at a national and European Union level.

Within European Union, electricity policy is presently established under "Energy 2020" strategy. The previously mentioned "Clean Energy for all Europeans package" comprises eight distinct legal acts and highlights key objectives, like prioritizing energy efficiency, accomplishing global leadership in renewable energies, offering a fair agreement for consumers, and a strategic long-term vision for a contemporary, prosperous, competitive and climate-neutral economy by 2050.

About EU legislation, the principal instruments are Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009, which delineates joint rules for the internal market of electricity, and Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009, which encourages the use of energy from renewable sources. Equally pertinent is Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012, on energy efficiency (Amaro et al., 2019).

In Portugal, government policy for the energy sector is defined in the context of the National Plan for Energy and Climate for 2021– 2030, which substitutes National Plan of Action for Energy Efficiency 2013–2016 (PNAEE 2016) and the National Plan of Action for Renewable Energies 2013–2020.

According to the European Commission (2020), the National Plan includes demanding targets, for instance a 17 % decrease of greenhouse gas (GHG) emissions not covered by the EU emissions trading system (non-ETS) contrasting with 2005, and fixing consumption of renewable energy at 47 per cent by 2030.

In the context of reaching carbon neutrality by 2050, Portugal intends a total GHG emission diminution to -55% in 2030, compared with -45% in 2005.

Considering energy efficiency, the desired improvement based on the EU-level 2030 target is of moderate ambition and quantities of 21.5 million tonnes of oil equivalent of primary energy consumption, transformed into 14.9 of final energy consumption.

Regarding energy security and internal market goals, Portugal has remarkably settled the goal of lowering energy import dependency to 65% by 2030, which is rather challenging, given

that currently it is 79%. Nevertheless, this degree of ambition is reasonable given the predicted substantial deployment of renewable energy and sector integration potential. The projected interconnection level is 15% by 2030 (10% in 2020), with a target on implementing vital infrastructure projects.

The following figure 2.6 presents an overview of Portugal's targets, objectives and contributions under the Governance Regulation (EU) 2018/1999:

	National targets and contributions	Latest available data	2020	2030	Assessment of 2030 ambition level
	Binding target for greenhouse gas emissions compared to 2005 under the Effort-Sharing Regulation (ESR) (%)	-16%	1%	-17%	As in ESR, total GHG target implies higher reductions
	National target/contribution for renewable energy: Share of energy from renewable sources in gross final consumption of energy (%)	30.3%	31%	47%	Sufficiently Ambitious (42 % is the result of RES formula)
	National contribution for energy efficiency:				
	Primary energy consumption (Mtoe)	22.66 (2018)	22.5	21.5	Modest
	Final energy consumption (Mtoe)	16.9 (2018)	17.4	14.9	Modest
	Level of electricity interconnectivity (%)	8.0%	10%	15%	N/A

Figure 2.6 - Overview of Portugal's targets, objectives and contributions under the Governance Regulation (EU) 2018/1999 (Source: European Commission, 2020, p. 4)

Following the legislation and transposition of the European Union directives on renewable energy, Portugal has been also devoted to the enhancing of green energy through economic incentives attributed to renewable energy production. These were incorporated through feed-in tariffs from which renewable generation plants were able to benefit, through the application of a particular formula for calculating the tariffs to be paid to producers and for the electricity generated by power plants using renewable energy (excluding large hydropower plants). Through other statutory provisions, co-generation (combined generation of heat and electricity) also gains from a positive remuneration regime (Amaro et al., 2019).

Renewable energy producers rewarded with feed-in tariffs also have priority over conventional generators in selling their production to the grid and the assurance that electricity generated is purchased by an off taker at the feed-in tariff rate (Amaro et al., 2019).

2.3.1.2 Liberalized market

The liberalisation process of the electricity sector of most European countries was implemented in phases, beginning with the clients with the largest consumption and highest voltage levels.

According to the system operator ERSE (2021), in Portugal, an identical organization was adopted, and the market opening emerged gradually between 1995 and 2006. Since 4th September 2006, all customers in mainland Portugal can select their electricity supplier and change it free of charge, whenever they find a more satisfactory offer for their kind of consumption.

Suppliers, who shape their commercial proposals freely, buy electricity from the producers in the wholesale market and sell it to the clients by paying the regulated grid access tariffs, which are defined by ERSE, to the correspondent operators.

With the purpose of guaranteeing the supply of electricity to economically vulnerable consumers, consumers whose market-based trader has been hindered from doing business or in regions or market segments where there are no offers on the liberalised market, there are suppliers of last resort.

In Madeira and Azores there is only one supplier, the suppliers of last resort which applies regulated supply tariffs settled by ERSE.

The following figure 2.7 presents the suppliers in the liberalized market regime, in Portugal.

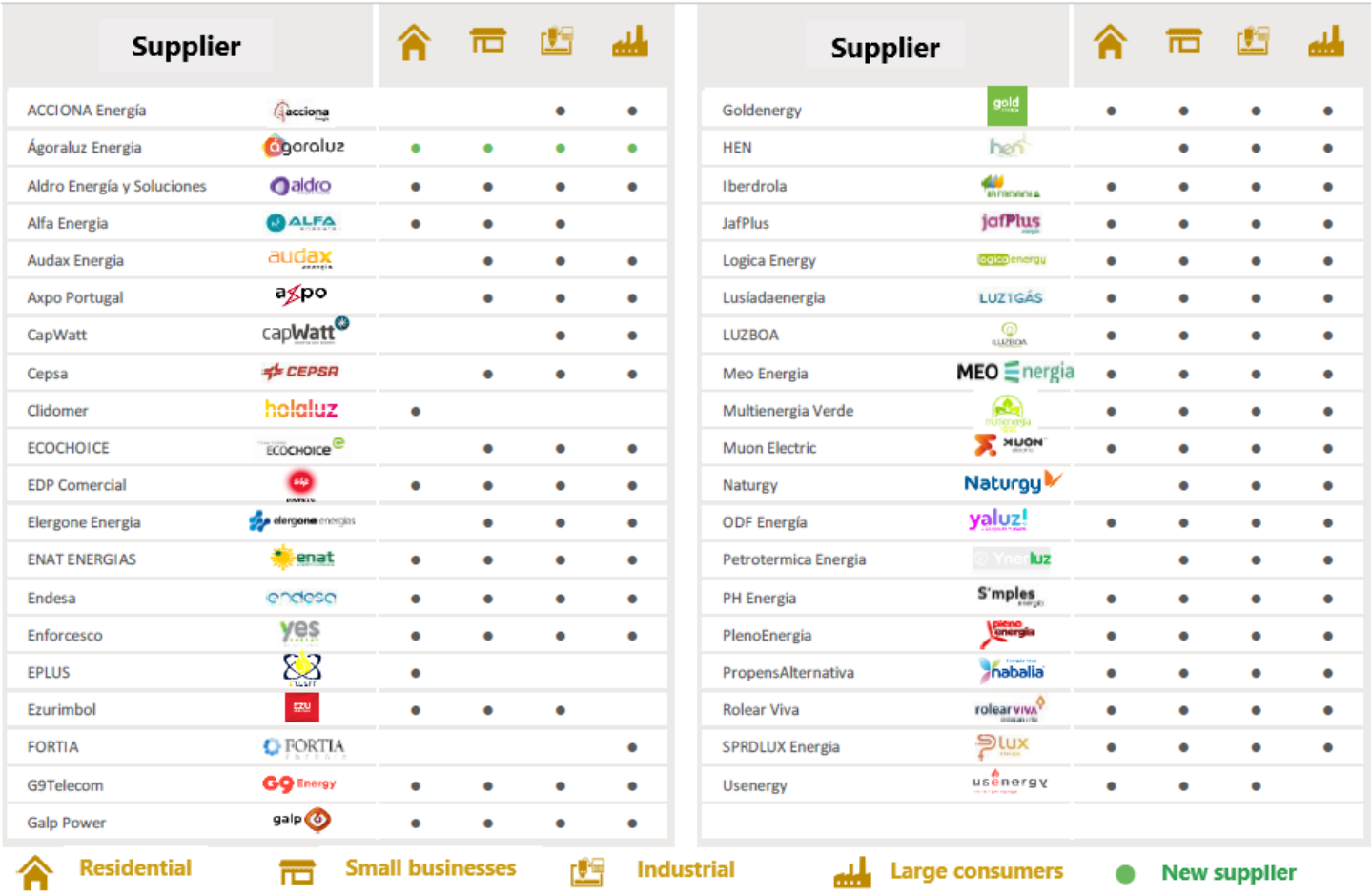


Figure 2.7 - Suppliers in the liberalized market regime, in Portugal (Source: Entidade Reguladora dos Serviços Energéticos, 2021, p. 2)

Concerning the market shares and competition indicators, the dynamics of the market's operation are typically also measured by the shares of the different operators (and their evolution over time), as well as with the use of indicators that monitor the competitive intensity of the market. The following figure 2.8 shows the market share in consumption supplied to small businesses, industrial consumers, and large consumers in February 2021.

In this informative summary, the designation “small businesses” refers to the set of customers whose consumption facilities are connected to low voltage networks, with a contracted power greater than 41.4 kW; industrial consumers concerns to the set of customers whose consumption facilities are connected to medium voltage networks; large consumers refers to the set of customers whose consumer facilities are connected to very high voltage and

high voltage networks; and finally, the designation “Others” includes suppliers that occupy the eighth and following positions in market share.

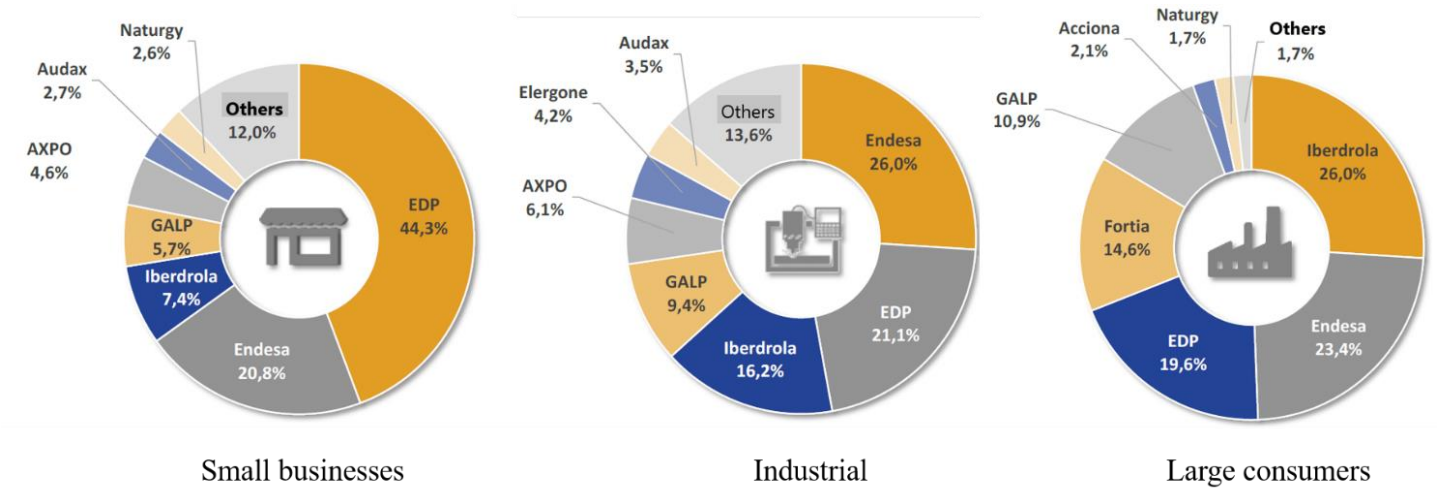


Figure 2.8 - Market share in consumption supplied to small businesses, industrial consumers, and large consumers in February 2021 (Source: Entidade Reguladora dos Serviços Energéticos, 2021, p. 10-11)

2.4 Energy Sector and its impact on businesses

Energy is a crucial factor on production for many industries around the world. Every business needs electricity to operate and unreasonably high energy costs originate a negative impact on companies' internal and external competitiveness. According to Asia Pacific Economic Cooperation (2016), energy cost, especially the relative level of energy cost from a global perspective, exerts a significant impact on competitiveness in energy-intensive industries.

The Iberian electricity sector is a liberalized and freely competitive market but that is not a sufficient circumstance for reduced energy prices. Although in both Portugal and Spain, customers are enabled to select the preferred electricity supplier, this does not ensure a more effective and adequate competition. In recent years, electricity consumers around the world are gradually becoming more connected, informed and demanding however consumers often exhibit a significant aversion to change, which translates into a reluctance to swap to a different supplier, and even to drop out regulated tariffs in favour of the free market (García, García-Álvarez & Moreno, 2017).

A key contributor to the electricity sector transformation is digital innovation. Digital technology is transforming businesses across varied sectors, lives and societies. The same principal applies for the power sector, which was habitually asset focused and utility driven (Deloitte Touche Tohmatsu India LLP, 2018).

Future utilities would entitle innovative business models like peer-to-peer transaction of energy using blockchain. Digital technologies like real time price trackers, mobile applications, and machine learning would be crucial enablers used by both, the consumers and the utilities. This could support solving the issues of peak demand management for utilities while granting lower costs for the consumers. (Deloitte Touche Tohmatsu India LLP, 2018)

According to Deloitte Insights (2019), the power and utilities industry is facing exceptional opportunities for growth and innovation from fast technological progress and cost drops in areas such as battery storage, solar power, wind power, smart buildings, electric vehicles, microgrids, two-way power flows, and more. As expected, these opportunities are further opening doors for entrepreneurs, start-ups and businesses from adjacent industries who might compete with incumbents and disrupt the industry. Simultaneously, big enterprises like current electricity companies can benefit of these opportunities to disrupt the industry status quo and be able to remain competitive and profitable.

Concerning the European industrial energy costs and in accordance with the information provided in figure 2.9, in 2017, for the average business in Europe, energy costs account for a rather small share of production costs (0-3%). The Energy costs share in production costs are more relevant for the most energy intensive manufacturing sectors (ranging from 3% to 20%) and can attain significant levels for some industrial subsectors (e.g. 40% in primary aluminium, 28% in ferro-alloys and silicon, 31% in zinc, 71% in fertilisers 25% in flat glass and 20% in electric arc furnace secondary steel). Besides manufacturing, the acquisition of energy can also be an important source of costs in certain industries providing information, transport and accommodation and restauration services.

Examples of sectors	Energy share of production costs (indicative range)
Average European business	0-3 %
Trade, computers, motor vehicles, electrical equipment, pharmaceutics, construction	0.4-1%
Waste management, plastics, textiles, grain	2-4 %
Accommodation and restaurants	3-5 %
Energy intensive sectors in manufacturing: Cement, clay building materials, pulp and paper, glass, iron and steel, basic chemicals, non-ferrous metals, refineries	3-20 %
Air transport, land transport	20-30%
Data centres	10-15%
Mining of metals and others, electricity and gas	10-20%

Figure 2.9 – Energy share of production costs across sectors (Source: Commission to the European Parliament, The Council, The European Economic and Social Committee, The Committee of the Regions, 2020, p. 10)

In the international perspective, European electricity industrial prices are inferior than those in Japan, comparable to those in China, double those in the US, and higher than those in most of the other non-EU G20 countries.

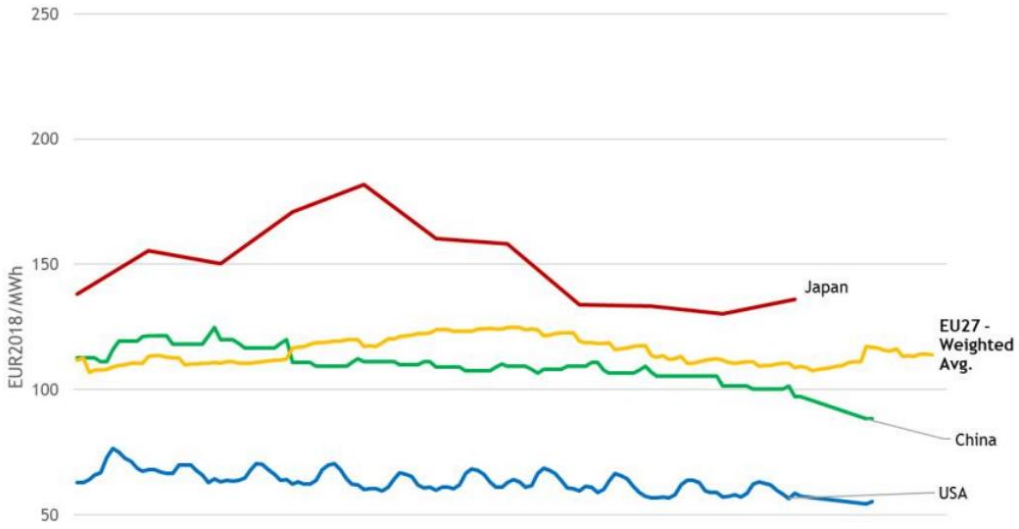


Figure 2.10 – Electricity industrial prices in EU27, Japan, China and the US (Source: Commission to the European Parliament, The Council, The European Economic and Social Committee, The Committee of the Regions, 2020, p. 11)

2.5 Literature Overview

Following the previous literature review, it can be stated that the electricity sector is a powerful growing industry which accommodates large amounts of investment worldwide. Nonetheless, the non-storable particularity of electricity brings lots of challenges as the efficient performance of the electricity markets is difficult, imposing additional balancing services and the management of reserve resources further the common production and distribution services, what instigates unique price features. Sudden fluctuations of electricity supply and demand cannot be sustained through inventory management, inferring that an equilibrium between supply and demand is needed at every time.

Concerning sustainable development, all over the world, there is a common concern around environmental protection which is strictly related with energy production and consumption.

During the past decades, most power markets became deregulated and, in several countries, electricity is presently traded under competitive rules. According to the European Commission (2020), a European energy market is the best way to ensure affordable energy and to avoid power failures to European Union residents, whereas decarbonising the energy system.

During the last decade, the notion of the green economy has appeared as a crucial concern for numerous governments. According to the United Nations Environment Programme, “An inclusive green economy is one that improves human well-being and builds social equity while reducing environmental risks and scarcities. “

Regarding the current Iberian liberalized electricity market, all businesses need electricity to operate and unreasonably high energy costs create a damaging impact on companies' internal and external competitiveness. However, even though in both Portugal and Spain, consumers are allowed to choose their electricity supplier, this does not guarantee a more effective competition, since consumers demonstrate a particular aversion to change, which translates into a unwillingness to change supplier, and even to drop regulated tariffs in favour of the liberalized market.

3. Methodology

The following section intends to outline how the research was conducted, highlighting the methods and strategies, while also explaining the research design, data collection and analysis techniques.

3.1 Research methodology

For this dissertation, a qualitative approach was applied. The choice of approach is linked to the purpose of the study, conducting to a better understanding of the Iberian electricity industry from the perspective of specialists in the area. The qualitative approach is relevant in order to gain an insight on how businesses can be affected and take the maximum advantages of the energy sector.

3.2 Data Collection

For this study, the data was collected through qualitative interviews. Interviews are valuable to all qualitative researchers as they provide a considerable amount of information collection both in quality and quantity. Interviews differ, amongst other things, in their degree of structure.

Semi-structured interviews were selected for this study to keep the conversation as flexible and open as possible. Additionally, semi-structured interviews were preferred for this thesis as they permit the researcher to redefine the flow of the interview depending on each specific situation while providing the chance to ask supplementary questions throughout the interview. Semi-structured interviews require that the inquiry guide is the same for each interviewee, nonetheless the order of the questions can vary based on the answers of each individual interviewee. This method with open-ended questions allow to adjust the questions depending on the attributes of the specific energy company, the background of the expert and the given type of know-how they share.

In order to assess the validity of the experts' contributions and recommendations, a practical real live case was considered and analysed. A Portuguese retail company was selected, its investment in photovoltaic panels were calculated and the benefits were examined comparing the initial and final expenditure, an invoice prior to the investment and another in the following year.

3.2.1 Interviewees

The selection criteria for the interviewees followed an approach which allowed to gather viewpoints of 5 energy specialists, 4 participants working in an Energy company and 1 participant working in an Energy consulting company. Thereby, it was determined that 5 energy specialists should be used to represent the energy experts in this study (Table 3.1).

The definition of an expert interview is grounded on the definition of an "expert". For the purpose of this report, the requisites to fulfil with the expert status include a proven expertise in the energy market and electricity. When interviewing specialists, the researcher is required to be conscious of his or her preconceptions and not expect certain outcomes. It is also imperative to keep in the wording of the questions, otherwise the interviewer might go against the interviewee viewpoint and opinion, risking being scolded by the interviewee (Gillham, 2005). An extra afford was made to make the wording of the questions impartial and avoid asking leading questions. This was taken into account when doing the interviews for this thesis, considering the researcher's previous experience on the energy sector.

Five semi-structured expert interviews were performed. Some of the interviews were via Zoom and Microsoft Teams' platforms whereas others were done in a written format. The main reason for choosing to perform distance interviews instead of interviewing face-to-face was the time saving and the Covid-19 situation. The original interview guide (which can be found in appendix A) was done in English, whereas the interviews were performed in Portuguese and lasted between 25 and 60 minutes. All online interviews were recorded and were later listened to multiple times and copied verbatim.

The industry specialists were nominated from four energy companies e one energy consulting firm (Table 3.1). The selection process was based on the high relevance that each of these energy companies have in the Iberian electricity market as well as the pertinent role that all specialists play in their respective companies. These was intended to obtain a deeper and broader understanding of the electricity sector. However, not all experts contacted during this study were willing to contribute to this research. In order to evaluate the representativeness of the performed interviews in relation to the electricity market, it was calculated the chosen energy companies' market share in consumption supplied. As demonstrated in the literature review (Figure 2.8), in February 2021, Iberdrola, Axpo, Audax Energia and Muon' s market share was approximately 14,7% for small businesses, 25,8% for industrial consumers, and 26% for large consumers.

Table 3.1 - Description of the interviewees

Code	Current Company	Company Description	Current Position	Type of execution	Date
Expert A	Iberdrola	Iberdrola is a Spanish energy company and a global energy leader. Iberdrola produces, distributes, trades, and markets electricity in the United States, United Kingdom, Portugal, Spain and Latin America. The Company focusses in clean energy and more exactly wind power.	Head of PPAs (Power Purchase Agreement) for global customers	via Microsoft Teams meeting	06.05.2021
Expert B	Axpo	Axpo is an energy company that generates, distributes and markets electricity and is active in international energy trading, as well as in the energy services business. The company is present worldwide in approximately 30 countries. Axpo is the largest energy company in Switzerland, and according to its own statement, the largest Swiss producer of electricity from renewable energies. The focus abroad is on wind and solar energy.	Portugal's Key account manager	in written form	17.05.2021
Expert C	Audax Energia	AUDAX ENERGIA is a company in the Electricity Sector recognized by the Spanish Ministry of Industry as a company that sells electric energy and natural gas. Its area of activity is concentrated on the Peninsular Balearic, Canary, Portugal, Germany, Italy, Poland and the Netherlands and it is one of the five major traders in the Portuguese free market.	Operations director - Portuguese branch	in written form	18.06.2021
Expert D	Muon Electric	Muon Electric is a small energy company integrated in the Swiss group Smartenergy. According to the Regulatory Entity for Energy Services (ERSE), in the various profiles of electricity consumption, Muon was the most competitive supplier of the third quarter in Portugal.	Commercial manager - Portugal	via Zoom meetings	27.04.2021
Expert E	Master Vantagem	Master Vantagem is a Portuguese energy consulting firm with the largest professional energy sales network, energy efficiency solutions and connectivity that is present in 9 cities in Portugal and Spain.	Founder CEO	via Microsoft Teams meeting	15.05.2021

3.3 Data analysis

The data analysis process of this dissertation started with the transcription, formatting, and translation of the interview records. Secondly, hard copies of the transcripts were printed out for the first round of analysis and familiarization of the text. Finally, moved on to categorization and coding according to predetermined themes, constituting the research questions of this study, while comparison and synthesis allowed the theoretical interpretation of the findings, looking for trends and peculiarities.

Table 3.2 - Data analysis process

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Interview record transcript	Interview transcript translation from Portuguese to English	Individual case categorization, coding and analysis	Thematic analysis	Application of the experts' contributions and recommendations to a real-live company

3.3.1 Interview record transcript and translation

The examination of the recording by transcription was introduced by Brinkmann and Kvale (2015). The interviews were produced in written form or conducted through video calls on Zoom and Microsoft Teams. The videos were recorded using Zoom and Microsoft recording option. Moreover, in order to have a duplicated version of the audio files, the smartphone sound recorder was positioned next to the computer speakers during the interviews. The recordings were used with the exclusive purpose of transcribing the interviews. The procedure of transcribing interviews means to transform them from audio to text. This may contribute to the abstraction of tone and body language, nevertheless, it was considered essential if the data will be studied and evaluated (Brinkmann and Kvale, 2015). Each transcription was written linearly, precisely, and in its original language and afterwards was produced an accurate English translation in order to produce precise citations.

3.3.2 Singular case categorization, coding and analysis

Subsequently to the interviews record transcript and translation, the texts were read through several times and a separate analysis of each interview was conducted in order to identify and understand the opinion, experience and position of each expert independently. The categorization and coding made it possible to recognise patterns in expert's position concerning

the predetermined themes (Table 3.3). The findings will increase common understanding of the electricity market, validate the academic literature and also provide a guideline for business managers on how to better position their organizations to take the maximum advantage of this crucial resource market.

3.3.3 Thematic analysis

According to Braun & Clarke (2006), thematic analysis offers freedom and autonomy for the investigator and additionally can be used in numerous different theoretical backgrounds. In this paper, the used themes were based on the results of previous literature, while sustaining the connection to the research questions and purposes of the thesis. Nevertheless, the predetermined themes were revised throughout the data collection process, and any different emergent themes were added to the data analysis process. The definitive thematic coding has been delineated in more detail in the following table 3.3.

Furthermore, the data analysis process includes the confrontation of the research findings with a practical real-life case in order to assess the reliability of the study.

Table 3.3 – Thematic analysis

Theme	Description
Iberian energy market current position	The current biggest challenges and bets in the Iberian electricity market.
Foreign investment	Reason and origin of the Foreign investment in the Iberian market.
Renewable energy	Incentive to invest in green energy; Suitable sources of renewable energy for the Iberian Peninsula; and dependence on weather conditions.
Impacts and challenges for businesses arising from the electricity market operation	Given different scenarios in the energy market, what are the main impacts and challenges for businesses.
Businesses benefit maximization	According to the experts, how business can benefit the most from the electricity market.

3.3.4 Application of the experts' recommendations to a real-life company

A real-life case will be conducted in order to account for the gains and advantages that the designated company obtained by proceeding in accordance with the experts' recommendations.

The company was selected from the client list of an energy consulting company - *Optima Energia* - and it was considered to be a representative company taking into account its sector of activity. This firm is a food retail company with Portuguese classification of economic activities CAE - 47111 - Retail trade in supermarkets and hypermarkets, and it is located in the district of Porto.

The financial impacts arising from the installation of photovoltaic panels were examined by comparing the company electricity expenses and consumption before and after this renewable energy investment, and through the performance of an investment plan simulation based on the commercial proposal provided by the previously mentioned energy consulting company.

The company analysis was performed taking into account the available areas presented by the company, which sum an installed capacity of 25.20 kWp and it was based on a detailed analysis of the company's consumption profile, every 15 minutes, in 2018/2019, with the objective of determining consumption of energy in the solar period.

The energy production calculations have been performed considering the configuration used in the photovoltaic plant, the inverter model and the photovoltaic module model - AEG photovoltaic module AS-M1443 (specific features in appendix D). The software used to perform the energy production calculation was HELIOSCOPE.

The total investment cost considered the installation and supply of all equipment and materials, as well as accessories necessary for the execution of all electrical connections; Monitoring the DGEG (General Board of Energy and Geology) inspection and issuing the term of responsibility; Interconnection of the photovoltaic system at a single low connection point voltage.

The photovoltaic modules are IEC 61215 certified with guaranteed performance of 90% on full power in the first 10 years and 80% at 25 years. The useful life of the modules is 25 years.

In the development of the Investment Plan Simulation were applied mathematical bases and corporate finance valuation methods (ex. Discounted Cash Flow).

4. Findings and Analysis

In this section, the empirical findings collected from the five industry expert interviews are presented and discussed. Each theme will be analysed based on the energy specialists' perspective, knowledge and opinions, alongside with their professional recommendations and strategies for businesses to benefit the most from the electricity market.

In the following, the findings are applied from the interviews and divided into three sub-groups. This division is based on the three research questions inherent to this study:

RQ1: What is the current position of Iberian energy companies: foreign investment, renewable energy, main challenges and perception of the sector future?

RQ2: Given different scenarios in the energy market, what are the main impacts and challenges for businesses?

RQ3: According to the electricity market experts, what are the main aspects businesses' managers should take into consideration when negotiating electricity contracts?

In the fourth sub-section, it is going to be examined the validity of an energy experts' recommendation by performing a real-life case which will be conducted in order to account for the gains and advantages from investing in a photovoltaic panel installation.

4.1 Iberian electricity market position and foreign investment

As a result of the interviews outcome, it can be stated that, currently, the energy sector is essentially focused on the energy transition, which turns this phenomenon the core priority of the electricity companies and, consequently, its guide of direction. According to expert A, Portugal and Spain are two of the countries at the forefront of the energy transition in Europe.

Although the attention of society and government entities is fixed on the colossal environmental challenges of today, energy companies must continue to make profits while meeting the expectations and demands imposed by this new reality. This demand and pressure to which the market and its agents are submitted requires not only a great capacity for innovation and adaptability, but also the ability to attract investment and financial liquidity.

Due to the exposure and number of solar hours available annually as well as the rivers, the Iberian Peninsula has excellent characteristics with regard to renewable energy.

"The Iberian market, because of its geographic and legislative characteristics, is a market with enormous potential for investment", stated expert B. The renewable production (photovoltaic and hydropower) is in itself a source of attraction for foreign brands and investors, namely from Europe (France, Denmark and Switzerland) and the Asian continent.

The Iberian market also combine favourable legislation for investment, originating a notable growing demand for foreign entities in our market.

According to expert B and C, a core challenge for the Iberian market is effectively consolidating the Iberian market on a European scale and balancing and exponentiating the production side towards a clearly exporting balance in the EU, and in that way the Iberian Peninsula can exploit all the potential , monetizing the renewable energy production.

When the topic of renewable energies is addressed, another challenge arises: *"Significant amounts of new storage will be required to guarantee security of supply and the integration of higher volumes of renewable production."* - Expert D. This could be enabled by a framework for storage, which is under discussion as an alternative to today's dysfunctional merchant economics.

While nuclear energy is flat in terms of production and coal and combined cycle power plants switch on and off very easily to meet demand, in the production of renewable energy there is an intermittence that creates some volatility in the market, originating the so called "Duck Curve", which is a graphic representation of the correlation between excess solar supply during the day against peak demand in the early evening.

The expert A brought to the table "The Duck curve" and underlined that with the widespread of solar energy (especially on roof-tops), many businesses and households have become self-sufficient during the day, meaning that they do not need to draw power from the grid.

The difference in the Duck Curve and a regular load chart is that the Duck Curve shows two high points of demand and one very low point of demand, with the ramp up in between being extremely sharp. Since renewable energy has become more common over the years, the Duck Curve is appearing more often and is getting worse.

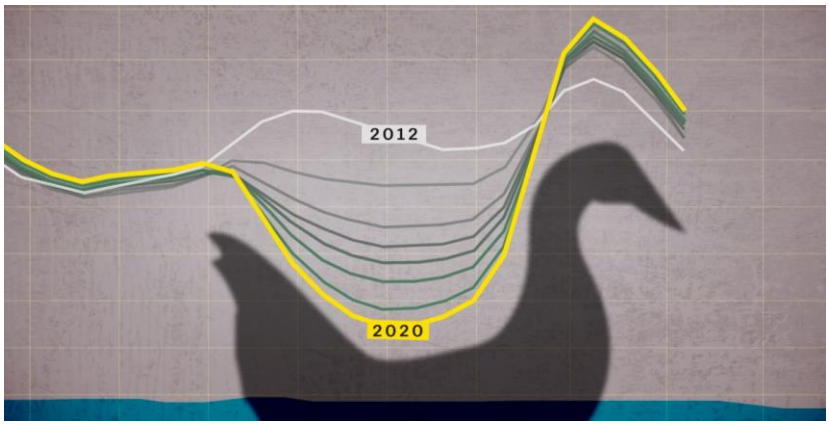


Figure 4.1 – The Duck Curve: Graphical representation of the electric power demand throughout a day (Source: Path to 100%, 2019)

Then, all specialists agreed that the biggest challenge with moving to a 100 percent renewable energy powered grid is storing it, so businesses can then utilise it at night.

Even though pumped hydro storage has existed in Portugal for several decades and battery storage is predictable to increase traction in the near future, electricity storage has only recently been precisely recognised as a National Electric System activity under the core legislative bodies of electricity regulation (particularly Decree-Law No. 172/2006 of 23 August, as amended by Decree-Law No. 76/2019, of 3 June), then it must be further addressed by legislation to be approved.

Following the "green only" challenge, no explicit research and development incentives for energy storage are assigned pursuant to the electricity regulatory framework in Portugal, what in the specialists' perspective is a mistake. All energy market experts agreed that the energy storage should be a main priority of today in order to make possible the extinction of non-renewable energy production.

Expert A raised another important challenge: *"In recent years, with the energy transition, the electricity companies' commercial force does not just sell electricity"*. Currently, added to the sale of electricity, there is a whole display of associated products, such as photovoltaic panels, chargers for electric cars, energy efficiency solutions, condenser batteries, etc. This requires that energy companies provide another type of training to the commercial department as it requires a deeper knowledge of this area. Thus, a greater degree of investment in workers is required. On the other hand, a more varied set and diversity of products is possible to sell to customers, enabling higher profits.

4.2 Impacts and challenges for businesses arising from the electricity market operation

In order to respond to the second research question, during the exploratory process of the interviews it was formulated a hypothesis with three alternative scenarios for the electricity market, each of them raising different advantages and disadvantages for electricity consumers.

Since in a liberalized market prices are formed according to the supply and demand balance which instigates a specific feature of the Iberian electricity market - price fluctuation, with this hypothesis formulation, it was intended to apply the specialists expertise to study the impacts and challenges faced by general businesses, being able to understand and evaluate the best response to electricity market oscillations. Depending on the response of each customer to each scenario, different impacts and challenges are presented.

4.2.1 Scenario 1: Market in a regular year –Electricity prices within average

In a regular year, in which the electricity market is stabilized, businesses have several advantageous options when choosing electricity negotiation strategy.

A company that needs a fixed annual budget and accurate financial forecasts, not having much liquidity for unforeseen costs, will be ideal to contract electricity with a fixed price. In this case, there are two viable options: trading a competitive annual fixed price or betting on the futures market, signing a contract for several years taking the advantage of a slightly lower price for a longer period of time. However, this business is committing to those conditions for a longer period of time, which implies the need for greater attention to detail when validating the contract. As an example, expert A mentioned that there are energy companies that, if the market price increases above a certain value, charge to the customer for this increase, affecting the settled price.

When a company has some liquidity available and is more susceptible to a flexible budget, it can choose to have the price indexed to the market by negotiating with energy companies to find the lowest possible margin. This type of contract has a significant advantage: even though some months are more expensive and others cheaper, there is no risk associated for the energy company, so the risk premium is significantly lower, making electricity cheaper in a normal year and on average, in comparison with the fixed price.

4.2.2 Scenario 2: Market in a good year –Electricity prices historically below average

In a year in which the price of electricity is at historically low levels, as happened in 2020, the businesses that immediately benefit most are those with prices indexed to the energy market. These can save substantial amounts of money compared to those that have fixed electricity prices.

However, according to some experts interviewed, the best long-term option for all companies is, at this time of such low prices, to take the opportunity to set a low price for as many years as possible, since there is a very high probability that the market will stabilize and normalize to the regular price. Companies that follow this strategy are able to keep prices very low even after the market normalizes.

A challenge often faced by businesses and energy consultants is figuring out whether prices will drop further or increase in the near future. If a company signs its electricity contract today, prices may continue to fall and the company has missed an opportunity to profit from the market or the prices can suddenly increase the next day.

4.2.3 Scenario 3: Market in a bad year –Electricity prices historically above average

In the event of a year in which electricity prices are historically high, businesses should avoid negotiating new electricity contracts.

Companies that have prices indexed to the electricity market and, simultaneously, have the necessary liquidity to endure this bad year, should stay with the same agreement since it is very likely that the market will normalize soon. After this troubled period, it has the advantages of being indexed to the market.

According to the energy specialist A and E, when companies are already at the time of renewal, and it is not possible to postpone the negotiation of a new contract, there are two reasonable options: if the company is going through a crisis and wants the lowest possible price now, it should sign a contract for several years in the electricity futures market, where the current high prices will be diluted for more years. If the company is stabilized, it should contract

an indexed price because at any time, when the prices fall, it can close a fixed price, avoiding setting the future price at the worst possible time.

4.3 Businesses benefit maximization - Experts' recommendations

Addressing the last research question, below it can be find the general recommendations that the experts presented during the interviews in order to be applied for business managers regarding electricity consumption strategies.

a) Photovoltaic Panels installation

All experts agreed that a major recommendation they could provide to any business owner with a considerable electricity consumption would be to invest in photovoltaic panels.

Photovoltaic panels are increasing in popularity as increasingly more people become conscious of the positive impact that this cost-effective energy alternative has on the environment.

Among the renewable energy sources, solar energy is a sustainable choice and one that can be used in various applications. Many businesses are now tapping into this alternative source of energy, hoping to benefit from its many advantages. Some examples are reduced overhead business costs, energy independence and protection against future unpredictability. Furthermore, by using this renewable source, a company can reveal its contribution in the battle against global warming. Going green will not only mitigate operation expenses but also serve as a great marketing tool. Having an environmentally responsible image is good for any company, as it can generate a positive response from customers.

b) Business energy consultancy

It is necessary to realize that the impact and variations that general businesses experience on the cost of electricity does not always come directly from the functioning and fluctuations of the market. Trading and negotiating through commercial agents can impact electricity costs both in a positive or negative way. From the perspective of specialist D, "the commercial action can distort what the product is in its essence. Since the commercial agents earn commissions depending on the sale of certain products, they do not always present the product with the greatest transparency". The sales pitch is always based on the guarantee that one has the best

tariffs and prices, totally green energy and all the possible advantages, although this may or may not be the reality.

First, it is important to understand that an energy consultant creates and search in the market for the best solution for businesses achieve their specific goal and a commercial agent wants to sell a specific product.

Some experts agree that businesses usually take advantage from having a consulting company negotiating and searching for the best deals, being attentive to the market and to its specific features. However, company managers should always do some market research before contacting the consultants in order to avoid being deceived by a commercial tactic. If the company already has some energy company proposals available, the consultant is forced to reduce his margins and be more aggressive when negotiating with the energy companies.

c) Aspects to consider when signing an electricity contract

According to the electricity market experts, there are several aspects to take into consideration when signing an electricity contract.

One of the first aspects a company should be aware is the length of the contract. The duration of the contract that a business chooses must consider the risks of committing to a long-term contract against the financial benefits that the agreement offers.

A longer-term agreement is habitually associated to more legal obligations, so this should be balanced by an equivalent reward. If a long-term contract is being considered, then close attention should be paid to the termination clauses needed to exit the contract early.

Another aspect to take into consideration is the verification of the energy contract hidden fees. Retailers and other suppliers sometimes charge a fixed additional annual fee which is on top of the contracted energy rate. It is important to understand every extra charge.

Finally, expert A highlighted that as the Iberian electricity market is strongly marked by hydropower, the trend is for prices in the first semester of the year to be cheaper than in the second one. In this context, *"if I had to negotiate or renew an annual contract, I would do it in the first semester, within February, March or April, for the following year"*, commented expert A.

4.4 Validity of an experts' recommendation: Case Study

Following the previously assessed findings, it is highlighted a business benefit from investing in green energy.

In order to explore one of the findings in more detail, it is going to be examined the validity of an energy experts' recommendation - Photovoltaic panel installation. In this sub-section, the financial impacts arising from the installation of photovoltaic panels will be examined by comparing the company electricity expenses and consumption before and after this renewable energy investment and through the performance of an investment plan simulation based on the commercial proposal provided by an energy consulting company - *Optima Energia*.

The company in study was considered to be a representative company taking into account its sector of activity – Retail company – and it is located in the district of Porto. This firm is a food retail company with Portuguese classification of economic activities CAE - 47111 - Retail trade in supermarkets and hypermarkets.

This study on the implementation of the photovoltaic plant took place in the first quarter of 2020, considering the customer's consumption profile of 2018/2019, the number of solar hours and the existing available area, which make up the installed power of 25.20 kilowatts peak (kWp), which is the peak power of a Photovoltaic system or panel.

The energy production calculations have been performed considering the configuration used in the photovoltaic plant, the inverter model and the photovoltaic module model - *AEG photovoltaic module AS-M1443* (specific features in appendix D). The software used to perform the production calculation was *HELIOSCOPE*.

The useful life of the modules is 25 years.

a) Consumption analysis/ Energy production calculation

For the projection of the photovoltaic plant, a detailed analysis of the consumption profile was carried out, in order to determine the energy consumption in the solar period.

Following the study developed by *Optima energia* professionals and technicians, the values presented in table 4.1 were found, revealing the electricity production estimation via photovoltaic panels after implementation.

Table 4.1 – Electricity production estimation via photovoltaic panels

Month	Photovoltaic (KW)
Jan	2018
Feb	2522
Mar	3323
Apr	3827
May	4438
Jun	4447
Jul	4761
Aug	4450
Sep	3890
Oct	2653
Nov	2209
Dec	1623
Total	**40161**

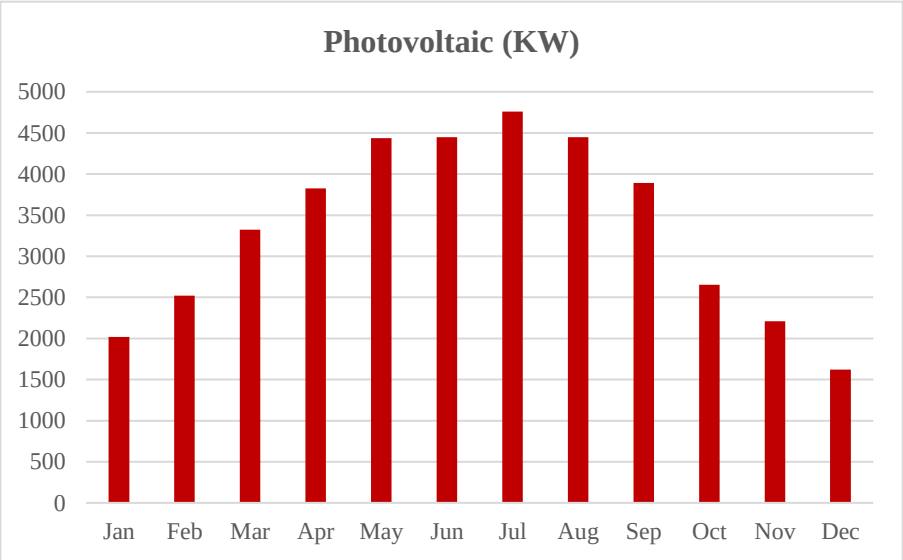


Figure 4.2– Electricity production estimation via photovoltaic panels

Table 4.2 – Estimated monthly savings as a result of photovoltaic panels installation

Month	Estimated monthly savings
Jan	232,07 €
Feb	290,03 €
Mar	382,15 €
Apr	440,11 €
May	510,37 €
Jun	511,41 €
Jul	547,52 €
Aug	511,75 €
Sep	447,35 €
Oct	305,10 €
Nov	254,04 €
Dec	186,65 €
Total	**4 618,52 €**

Figure 4.3 – Estimated monthly savings as a result of photovoltaic panels installation

Considering a weighted tariff of €0.156/kWh for consumption in the solar period and observing the values presented in table 5.5, it can be concluded that the expected savings in the first year after the installation of the solar panels is €4 618,52. More significant savings are registered in the spring and summer months due to the greater solar intensity and more hours of the daylight.

Taking into account that the value of the construction and purchase of the photovoltaic plant is €20 500, the estimated saving represents a return on investment of 22.5% in the first year.

b) Investment Plan Simulation

The financial costs and benefits are a major part of whether company would consider implementing photovoltaic panels. In this case, an investment analysis implies a combination of engineering and economic studies. Engineering studies applied on panel selection in Photovoltaic modules and on thermodynamic calculations were conducted in to estimate its expected electricity generation. On the other hand, economic studies, which deeply involved with their cost and projected revenue estimations, were developed through an investment plan simulation.

Table 4.3 – Investment Plan Simulation (Part I)

Installed power of photovoltaic panel [kWp]	25,2
Investment without VAT	20 500
Energy produced per year [kWh]	40 161
Percentage of self-consumption	100%
Excess percentage	0%
Equivalent day tariff [€/kWh]	0,156
Surplus sell tariff [€/kWh]	0,045
Annual inflation [%]	2,50%
Decrease in the maximum annual production [%]	0,7
Maintenance expenses [€/year]	700 €

By observing table 5.6, it is perceivable that the total amount of electricity produced will be consumed by the company, translating into no waste of produced energy. It is also noticeable that over the years the photovoltaic panels generation will gradually decrease due to the normal depreciation of materials.

Table 4.4 – Investment Plan Simulation (Part II)

Invest.	20 500 €	IRR	28,8%	
VAT	0%	Payback (years)	3,6	
Total	20 500 €	Net Value Added	150 783 €	

Year	Energy produced [kWh/year]	Equivalent energy purchase tariff [€/kWh]	Surplus selling tariff [€/kwh]	Nominal savings [€]	Nominal sale [€]	Maintenance expenses [€]	Nominal annual Cash-Flow [€]	Nominal Accumulated Cash-Flow [€]
0							-20 500 €	-20 500 €
1	40 161	0,1560 €	0,0450 €	6 265 €	0 €	700 €	5 565 €	-14 935 €
2	39 880	0,1599 €	0,0461 €	6 377 €	0 €	718 €	5 659 €	-9 276 €
3	39 601	0,1639 €	0,0473 €	6 490 €	0 €	735 €	5 755 €	-3 521 €
4	39 324	0,1680 €	0,0485 €	6 606 €	0 €	754 €	5 852 €	2 332 €
5	39 048	0,1722 €	0,0497 €	6 724 €	0 €	773 €	5 951 €	8 283 €
6	38 775	0,1765 €	0,0509 €	6 844 €	0 €	792 €	6 052 €	14 335 €
7	38 503	0,1809 €	0,0522 €	6 966 €	0 €	812 €	6 154 €	20 489 €
8	38 234	0,1854 €	0,0535 €	7 090 €	0 €	832 €	6 258 €	26 747 €
9	37 966	0,1901 €	0,0548 €	7 216 €	0 €	853 €	6 363 €	33 110 €
10	37 701	0,1948 €	0,0562 €	7 345 €	0 €	874 €	6 471 €	39 581 €
11	37 437	0,1997 €	0,0576 €	7 476 €	0 €	896 €	6 580 €	46 160 €
12	37 175	0,2047 €	0,0590 €	7 609 €	0 €	918 €	6 691 €	52 851 €
13	36 914	0,2098 €	0,0605 €	7 745 €	0 €	941 €	6 803 €	59 654 €
14	36 656	0,2150 €	0,0620 €	7 883 €	0 €	965 €	6 918 €	66 572 €
15	36 399	0,2204 €	0,0636 €	8 023 €	0 €	989 €	7 034 €	73 606 €
16	36 145	0,2259 €	0,0652 €	8 166 €	0 €	1 014 €	7 153 €	80 759 €
17	35 892	0,2316 €	0,0668 €	8 312 €	0 €	1 039 €	7 273 €	88 032 €
18	35 640	0,2374 €	0,0685 €	8 460 €	0 €	1 065 €	7 395 €	95 427 €
19	35 391	0,2433 €	0,0702 €	8 611 €	0 €	1 092 €	7 519 €	102 946 €
20	35 143	0,2494 €	0,0719 €	8 764 €	0 €	1 119 €	7 645 €	110 591 €
21	34 897	0,2556 €	0,0737 €	8 921 €	0 €	1 147 €	7 774 €	118 364 €
22	34 653	0,2620 €	0,0756 €	9 080 €	0 €	1 176 €	7 904 €	126 268 €
23	34 410	0,2686 €	0,0775 €	9 241 €	0 €	1 205 €	8 036 €	134 305 €
24	34 169	0,2753 €	0,0794 €	9 406 €	0 €	1 235 €	8 171 €	142 475 €
25	33 930	0,2822 €	0,0814 €	9 574 €	0 €	1 266 €	8 308 €	150 783 €

The financial analysis of the Retail company photovoltaic project intends to assess the financial performance of the project over the lifetime period.

After the analysis of table 5.7, it can be determined that the Payback Period is 3,6 years, which represents the minimum amount of time in years required for the positive cash flows to surpass the initial investment. The value of the nominal accumulated is only positive after the fourth year.

The internal rate of return (IRR) obtained for this project is 28,8%, which is the annual rate of growth that the investment is expected to generate.

Following the investment plan analysis, it can be concluded that this project has a high profitability. Although the production in kWh drops 0,7% per year, the return is gradually higher over the years due to the price/Kwh increasing by 2.5% per year.

If the company does not have liquidity to self-finance the investment, it can always request external financing and pay a monthly amount smaller than the savings. In this way, the investment for the company is virtually non-existent and after the settlement of this debt, the benefit becomes total.

c) *Impact on electricity consumption*

The electricity bills from before and after the photovoltaic panels can be founded in the appendixes B and C, where the electricity consumption can be retrieved. The section corresponding to electricity consumption can be accessed in the figures 5.13 and 5.14.

From the analysis of the following values, it can be concluded that in July 2019 the electricity consumed in kWh by the food retail company was superior to the one consumed almost one year later, which was due to the production of energy through photovoltaic panels specially in the peak hours, when the price of electricity is higher.

	PONTA	CHEIA	VAZIO	SUPER VAZIO
Leitura Atual (03-07-2019)	274,00 kWh	667,00 kWh	285,00 kWh	174,00 kWh
Leitura Atual (03-08-2019)	2.842,00 kWh	6.999,00 kWh	2.997,00 kWh	1.832,00 kWh
Consumo	3.116,00 kWh	7.666,00 kWh	3.282,00 kWh	2.006,00 kWh

Figure 4.4 – Electricity consumption in July 2019 (before solar panels installation)

	PONTA	CHEIA	VAZIO	SUPER VAZIO
Leitura Atual (30-06-2020)	2.442,00 kWh	6.127,00 kWh	2.608,00 kWh	1.670,00 kWh
Consumo	2.442,00 kWh	6.127,00 kWh	2.608,00 kWh	1.670,00 kWh

Figure 4.5 – Electricity consumption in June 2020 (after solar panels installation)

d) Analysis overview

The solar photovoltaic power market is growing rapidly and thus it is critical to establish efficient investment strategies, including adequate distribution of company resources.

Thus, the goal of this case study was to assess the potential feasibility of installing a solar energy generation system on this food retail company. To be able to analyse the economic and financial results of solar PV plant investment, it was necessary to conduct a detailed study bearing in mind all the parameters involved in assessing the installations specific features and the financial viability of investments.

Based on the performed analysis, this food retail company benefit from the installation a photovoltaic system since it is a project with high profitability. The internal rate of return is 28,8%, which is the annual rate of growth that the investment is expected to generate, and it was determined that the Payback Period is 3,6 years.

From the analysis of the retail company bills, it can be concluded that, due to the production of energy through photovoltaic panels, the electricity consumption decreased from 2019 to 2020, which resulted in a reduction in the electricity bill of approximately 800 euros in one year (appendixes B and C).

Solar PV power is presently the fastest growing renewable energy source, being both environmentally friendly and a high return investment.

5. Conclusion

The purpose of the next chapter is to conclude this study and present the most pertinent contributions and findings of this research, aligning the conclusions with the established research questions. Lastly, the limitations of this study will be assessed and suggestions for further studies will be provided.

The main purpose of this study was to explore the Iberian electricity industry and its effect on businesses, from the perspective of specialists in the area. Thereby, the present dissertation was conducted in order to find answers to the following research questions:

RQ1: What is the current position of Iberian energy companies: foreign investment, renewable energy, main challenges and perception of the sector future?

RQ2: Given different scenarios in the energy market, what are the main impacts and challenges for businesses?

RQ3: According to the electricity market experts, what are the main aspects businesses' managers should take into consideration when negotiating electricity contracts?

Thus, this research embodies a theoretical overview of the Iberian electricity market operation as well as several practical implications, equipping business managers with significant knowledge about this sector which enables the creation of possible strategies.

Some suitable findings which answer to the first research question were found and a relevant input was that, according to the experts, the main phenomenon impacting the Iberian electricity sector is the energy transition, which is a core priority of the electricity companies. Such statement is compatible with the literature review in which it is mentioned that, during the last decade, the notions of sustainability and green economy have appeared as strategic priorities for numerous governments and countries.

Due to the exposure and number of solar hours available annually as well as the rivers, the Iberian Peninsula has excellent characteristics with regard to renewable energy, which combined with positive legislation for investment, originates a notable growing demand for foreign entities.

According to the interviewees, the biggest challenge with moving to a 100 percent renewable energy powered grid is storing it. This difficulty is supported by the literature review, where it is referred that the immediate requirement regarding renewable energy is its

reallocation from times when there is a surplus to periods when there is not enough cheap renewable generation. This can be accomplished through grid-level technologies namely flexible demand and storage (Aurora Energy Research, 2021).

In order to respond to the second research question, during the exploratory process of the interviews it was formulated a hypothesis with three alternative scenarios for the electricity market (favourable, adverse or normal). Company managers should respond with different strategies, in order to take the highest possible benefit from this market:

- In a year in which the price of electricity is at low levels, the companies that instantly most benefit are those with prices indexed to the energy market. Nevertheless, the best long-term option for all businesses is to set a low price for as many years as possible, before the market normalize to the normal prices.
- In the event of a year in which electricity prices are high, companies should avoid negotiating new electricity contracts.
- In a regular year, in which the electricity market is stabilized, businesses have several valuable options when choosing electricity negotiation strategy.

Addressing the last research question, general recommendations of the experts were presented during the interviews in order to be applied for business managers regarding electricity consumption strategies, such as Photovoltaic Panels installation, business energy consultancy and aspects to consider when signing an electricity contract.

Finally, all experts agreed that a major recommendation they could provide to any business owner with a considerable electricity consumption would be to invest in photovoltaic panels. This suggestion was tested by assessing the performance of a real-life company before and after the respective implementation. Based on the performed analysis, the case study company benefit from installing a photovoltaic system since it is a project with high profitability. This type of investment decisions, besides understanding the production of a PV system and interpretation of a system proposal, requires an economic analysis of expected costs and benefits.

Concerning the limitations of the research, even though one cannot study the Portuguese electricity market without address the Iberian electricity market, the present study was limited to the singular perspective of Portuguese specialists, so not all the contexts and perceptions were analysed and validated. This research also was restricted in its data sample to five energy experts interviewed and therefore cannot be stated to embody the truth for all energy experts in

general. Furthermore, all the specialists interviewed were male. The fluctuating nature of the energy market should also be recognized, as emerging new events have the capability of altering the current market position and consequently impact or revoke some conclusions.

As a result of this study limitations, future research on this subject should reflect on selecting for a larger pool of data sample. Additionally, researchers are recommended to conduct an in-depth analysis of the frequently developed new technologies related to renewable energy and their impact on business processes. It is also suggested to seek for a more varied sample of experts, especially in terms of nationality, gender and culture. To conclude, the realization of a systematic review on the topic of electricity market trends and digital transformation is also proposed.

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Appendix A: Interview guide

Interviewee Background

1. Could you tell me about your own role in the company? How many years have you been working in the energy sector and what was that path?

Opinions on Energy and the future

2. What are the main differences between the Iberian and Portuguese electricity markets? Why?

3. What are the current biggest challenges in the Iberian energy market?

4. What is the origin of investment in the Iberian market?

5. Why has foreign investment appeared in the Iberian market? Is it a market that is still little explored? What is the benefit?

6. In the present, is it possible to have profit by storing energy? If not, how do energy exchanges and futures markets work?

9. How do you manage this essential balance between environmental sustainability, reducing costs, increasing commercial margin and reducing customer prices?

10. Is there a real incentive to invest in green energy? Regardless of the environmental impact, is renewable energy more economically viable?

11. What are the most suitable sources of renewable energy for the characteristics of the Iberian Peninsula? Why?

12. Does green energy depend too much on weather conditions? Is it necessary to always have a percentage of non-renewable energy?

13. In the near future, is it possible for electricity in the Iberian Peninsula to come only from renewable sources? If so, in how many years would this be expected?

Opinion on business impact

14. In your opinion, how will the new technologies associated with sustainable energy change the way that managers should negotiate electricity?

15. Applying your knowledge and experience, what strategies can companies have to reduce energy costs as much as possible?

Appendix B: Food retail company's July 2019 electricity bill

aldro
energia e soluções

Aldro Energía y Soluciones, SLU sucursal em Portugal
NIPC 980575931
Av da Quinta Grande, nº 53/53A, 8ºA
2610-156 Alfragide (Amadora), Lisboa

DADOS DA FATURA DE ELETRICIDADE

VALOR DA FATURA: 3.036,51 €

Nº FATURA
DATA EMISSÃO: 09/08/2019
DATA LIMITE DE PAGAMENTO:
PERÍODO FATURAÇÃO: 01/07/2019 a 03/08/2019

RESUMO DA FATURA

ELETRICIDADE:	2.450,04 €
TAXAS E IMPOSTOS:	586,47 €
TOTAL VALOR DA FATURA	**3.036,51 €**

INFORMAÇÃO DO CONSUMO

	PONTA	CHEIA	VAZIO	SUPER VAZIO
Leitura Atual (03-07-2019)	274,00 kWh	667,00 kWh	285,00 kWh	174,00 kWh
Leitura Atual (03-08-2019)	2.842,00 kWh	6.999,00 kWh	2.997,00 kWh	1.832,00 kWh
Consumo	3.116,00 kWh	7.666,00 kWh	3.282,00 kWh	2.006,00 kWh

EMISSÕES DE CO_2

ELETRICIDADE: 6.763,70Kg CO_2

Para o cálculo de CO_2, foi considerado o fator de emissão de 2018. O valor de CO_2 negativo resulta do acerto de fatura anteriores.

DADOS DO CONTRATO:

PRODUTO: BTE
POTÊNCIA: P1: 41,410 kW

ATENDIMENTO AO CLIENTE: 808 450 056 (dias úties, das 9h as 18h, custo de chamada local)
www.aldroportugal.pt
AVARIAS ELECTRICAS: 800 506 506 (24h chamada grátis)
COMUNICAÇÃO DE LEITURAS: 800 507 507 (24h chamada grátis)

DETALHE DA FATURAÇÃO

ENERGIA ATIVA:

Preço tarifas acceso às redes:

Ponta (01/07/2019 - 03/08/2019): 3.116,0000 kWh * 0,073400 €/kWh (23% IVA)	228,7144 €
Cheia (01/07/2019 - 03/08/2019): 7.666,0000 kWh * 0,052700 €/kWh (23% IVA)	403,9982 €
Vazio (01/07/2019 - 03/08/2019): 3.282,0000 kWh * 0,021000 €/kWh (23% IVA)	68,9220 €
Super vazio (01/07/2019 - 03/08/2019): 2.006,0000 kWh * 0,019300 €/kWh (23% IVA)	38,7158 €

Preço da energia:

Ponta (01/07/2019 - 03/08/2019): 3.116,0000 kWh * 0,073392 €/kWh (23% IVA)	228,6895 €
Cheia (01/07/2019 - 03/08/2019): 7.666,0000 kWh * 0,071009 €/kWh (23% IVA)	544,3550 €
Vazio (01/07/2019 - 03/08/2019): 3.282,0000 kWh * 0,066652 €/kWh (23% IVA)	218,7519 €
Super vazio (01/07/2019 - 03/08/2019): 2.006,0000 kWh * 0,058778 €/kWh (23% IVA)	117,9087 €

ENERGIA REATIVA:

Escalão 1 - En.React.cons.FV (01/07/2019 - 03/08/2019): 1.078,0000 kVArh * 0,009800 €/kVArh (23% IVA)	10,5644 €
Escalão 2 - En.React.cons.FV (01/07/2019 - 03/08/2019): 1.078,0000 kVArh * 0,029600 €/kVArh (23% IVA)	31,9088 €
Escalão 3 - En.React.cons.FV (01/07/2019 - 03/08/2019): 1.608,0000 kVArh * 0,088800 €/kVArh (23% IVA)	142,7904 €

POTÊNCIA:

Preço tarifas acceso às redes:

(01/07/2019 - 03/08/2019): 41,4100 kW * 34 dias * 0,042500 €/dia (23% IVA)	59,8375 €

POTÊNCIA HORAS PONTA:

(01/07/2019 - 03/08/2019): 22,9100 kW * 34 dias * 0,455600 €/dia (23% IVA)	354,8851 €

TOTAL ENERGIA E POTÊNCIA	**2.450,0417 €**

TAXAS E IMPOSTOS SOBRE ENERGIA

Taxa IEC	16.070,00kWh * 0,001000€/kWh (23% IVA)	16,0700 €
DGGE	2,00 meses * 0,07€/mês (23% IVA)	0,1400 €
Contribuição Audiovisual	1,00 mês * 2,85€/mês (6% IVA)	2,8500 €

TOTAL TAXAS E IMPOSTOS	**19,0600 €**

TOTAL SEM IVA:		2.469,10 €
	IVA 23 % s/2.466,2517 €	567,24 €
	IVA 6 % s/2,8500 €	0,17 €

TOTAL VALOR FATURA **3.036,51 €**

O preço da eletricidade inclui o valor de 800,19 € (sem IVA) correspondente às tarifas de acesso às redes, que contêm o valor dos Custos de Interesse Económico Geral (CIEG) no valor de 464,11 €. Estes valores são independentes do comercializador. Zona de qualidade de serviço: B

Appendix C: Food retail company's June 2020 electricity bill

aldro
energia e soluções

Aldro Energía y Soluciones, SLU sucursal em Portugal
NIPC 980575931
Av da Quinta Grande, nº 53/53A, 8ºA
2610-156 Alfragide (Amadora), Lisboa

DADOS DA FATURA DE ELETRICIDADE

VALOR DA FATURA: 2.257,31 €

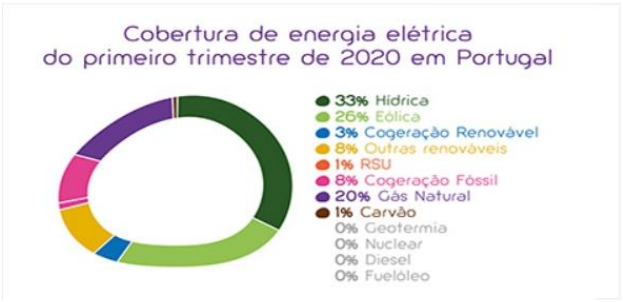
Nº FATURA:
DATA EMISSÃO: 03/07/2020
DATA LIMITE DE PAGAMENTO:
PERÍODO FATURAÇÃO: 04/06/2020 a 30/06/2020

RESUMO DA FATURA

ELETRICIDADE:	1.819,91 €
TAXAS E IMPOSTOS:	437,40 €
TOTAL VALOR DA FATURA	**2.257,31 €**

INFORMAÇÃO DO CONSUMO

	PONTA	CHEIA	VAZIO	SUPER VAZIO
Leitura Atual (30-06-2020)	2.442,00 kWh	6.127,00 kWh	2.608,00 kWh	1.670,00 kWh
Consumo	2.442,00 kWh	6.127,00 kWh	2.608,00 kWh	1.670,00 kWh



EMISSÕES DE CO_2

ELETRICIDADE: 5.407,17Kg CO_2

Para o cálculo de CO_2, foi considerado o fator de emissão de 2018. O valor de CO_2 negativo resulta do acerto de fatura anteriores.

DADOS DO CONTRATO:

PRODUTO: BTE
POTÊNCIA: P1: 41,410 kW

ATENDIMENTO AO CLIENTE: 808 450 056 (dias úteis, das 9h às 18h, custo de chamada local)
www.aldroportugal.pt
AVARIAS ELECTRICAS: 800 506 506 (24h chamada grátis)
COMUNICAÇÃO DE LEITURAS: 800 507 507 (24h chamada grátis)
INFORMAÇÕES EDP DISTRIBUIÇÃO: 808 100 100 / 218 100 100 (dias úteis, das 8h às 22h, custo de chamada local)

DETALHE DA FATURAÇÃO

ENERGIA ATIVA:

Preço tarifas acesso às redes:

Ponta (04/06/2020 - 30/06/2020): 2.442,0000 kWh * 0,083800 €/kWh (23% IVA)	204,6396 €
Cheia (04/06/2020 - 30/06/2020): 6.127,0000 kWh * 0,054600 €/kWh (23% IVA)	334,5342 €
Vazio (04/06/2020 - 30/06/2020): 2.608,0000 kWh * 0,020400 €/kWh (23% IVA)	53,2032 €
Super vazio (04/06/2020 - 30/06/2020): 1.670,0000 kWh * 0,018700 €/kWh (23% IVA)	31,2290 €

Preço da energia:

Ponta (04/06/2020 - 30/06/2020): 2.442,0000 kWh * 0,073392 €/kWh (23% IVA)	179,2233 €
Cheia (04/06/2020 - 30/06/2020): 6.127,0000 kWh * 0,071009 €/kWh (23% IVA)	435,0721 €
Vazio (04/06/2020 - 30/06/2020): 2.608,0000 kWh * 0,066652 €/kWh (23% IVA)	173,8284 €
Super vazio (04/06/2020 - 30/06/2020): 1.670,0000 kWh * 0,058778 €/kWh (23% IVA)	98,1593 €

ENERGIA REATIVA:

Escalão 1 - En.React.cons.FV (04/06/2020 - 30/06/2020): 453,0000 kVArh * 0,009900 €/kVArh (23% IVA)	4,4847 €

POTÊNCIA:

Preço tarifas acesso às redes:

(04/06/2020 - 30/06/2020): 41,4100 kW * 27 dias * 0,042800 €/dia (23% IVA)	47,8534 €

POTÊNCIA HORAS PONTA:

(04/06/2020 - 30/06/2020): 22,6100 kW * 27 dias * 0,422100 €/dia (23% IVA)	257,6794 €

TOTAL ENERGIA E POTÊNCIA		**1.819,9066 €**

TAXAS E IMPOSTOS SOBRE ENERGIA

Taxa IEC	12.847,00kWh * 0,001000€/kWh (23% IVA)	12,8470 €
Contribuição Audiovisual	1,00 mês * 2,85€/mês (6% IVA)	2,8500 €

TOTAL TAXAS E IMPOSTOS		**15,6970 €**
TOTAL SEM IVA:		1.835,60 €
	IVA 23 % s/1.832,7536 €	421,53 €
	IVA 6 % s/2,8500 €	0,17 €

TOTAL VALOR FATURA **2.257,31 €**

O preço da eletricidade inclui o valor de 671,45 € (sem IVA) correspondente às tarifas de acesso às redes, que contêm o valor dos Custos de Interesse Económico Geral (CIEG) no valor de 416,30 €. Estes valores são independentes do comercializador. Zona de qualidade de serviço: B

Appendix D: AEG – Photovoltaic Module AS-M1443 (G1 CELLS)

AEG

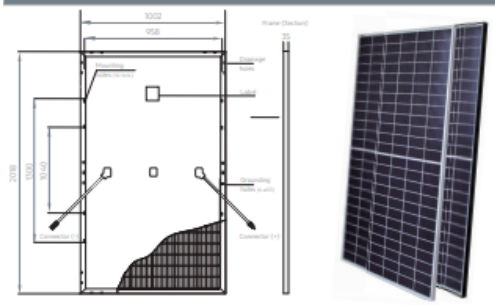
AS-M1443 (G1 CELLS)

PRODUCT SERIES & NAMECODE (PNC)
AEG HIGH EFFICIENCY SERIES
AS-M1443-H(G1)-410/415/420, silver frame
AS-M1443Z-H(G1)-410/415/420, black frame

CERTIFICATIONS		
System	ISO 9001, ISO 14001, OHSAS 18001	
Product	IEC 61215-1/-2:2016 (EN: 2017)	
	IEC 61730-1/-2:2016 (EN: 2018)	

ELECTRICAL CHARACTERISTICS AT STC[1,2]				
Nominal Power (Pmax)	[Wp]	410	415	420
Power Sorting[3]	[Wp]	-0/+5	-0/+5	-0/+5
Maximum Power Voltage (Vmp)	[V]	41.85	42.11	42.35
Maximum Power Current (Imp)	[A]	9.80	9.86	9.92
Open Circuit Voltage (Voc)	[V]	49.80	50.06	50.32
Short Circuit Current (Isc)	[A]	10.38	10.45	10.52
Module Efficiency (ηm)	[%]	20.3%	20.5%	20.8%
Maximum System Voltage	[V]	1000	1000	1000
Series Fuse Maximum Rating	[A]	20	20	20

TECHNICAL DRAWINGS

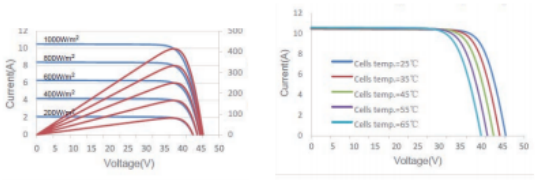


ELECTRICAL CHARACTERISTICS AT NMOT[4]				
Maximum Power (Pmax)	[W]	304.8	308.5	312.2
Maximum Power Voltage (Vmp)	[V]	38.84	39.08	39.31
Maximum Power Current (Imp)	[A]	7.85	7.89	7.94
Open Circuit Voltage (Voc)	[V]	46.64	46.88	47.12
Short Circuit Current (Isc)	[A]	8.36	8.42	8.48

TEMPERATURE CHARACTERISTICS		
NMOT	[°C]	44± 2
Pmax Temp. Coefficient (γ)	[%/°C]	-0.35
Voc Temp. Coefficient (β)	[%/°C]	-0.28
Isc Temp.Coefficient (α)	[%/°C]	+0.04
Operating temperature	[°C]	-40~+85

MECHANICAL CHARACTERISTICS		
Solar cells	monocrystalline [pcs]	120
	Dimensions [mm]	158.75 x 79.3
Front glass	High-transparency	
	Thickness [mm] / [in]	3.2 / 0.12
Backsheet	White	
Encapsulant	EVA	Transparent
Frame	Anodized aluminum alloy	Silver or black
Junction box	Standard	IP68
	Bypass diodes	3
UV-resistant cables	Length [cm] / [in]	120 / 47.24
	Section [mm2]	4
Connectors	MC4	compatible
Dimensions	H x L x W [mm]	2018 x 1002 x 35
	H x L x W [in]	79.45 x 39.45 x 1.37
Weight	[kg] / [lbs]	22.6 / 49.82
Maximum load	Wind / Snow [Pa]	2400 / 5400

I/V CURVES - IRRADIANCES



WARRANTIES		
Product warranty	[years]	15
Performance warranty (linear)[5]	[years]	25

PACKAGING		
Packing configuration	[pcs/pallet]	31
Loading capacity	[pcs/40 ft container]	682

CONTACT US

Solar Solutions GmbH

Brückenstrasse 94, 60594 Frankfurt am Main, Germany

+49 (0)69 400500810 | info@aeg-industrialsolar.de

www.aeg-industrialsolar.de

1-Standard Test Conditions (STC): Irradiance 1000 W/m², Air Mass AM = 1.5, Cell Temperature 25°C)

2-Measurement tolerances (IEC 61215:2016): Pmax±3%, Voc±3%, Isc±5%

3-AEG photovoltaic modules are classified according to a principle of positive power tolerance: the Power Output measured at STC of the delivered modules exceeds their assigned Nameplate Nominal Power

4-NMOT: Nominal operating temperature of module, Irradiance 800 W/m², Wind Speed 1m/s, Ambient Temperature 20°C, Air Mass AM=1.5

5-No less than 98% of the minimum "Peak Power at STC"in the first year; power output decline no more than 0.55% per year thereafter). Full text of the Warranty Terms available at: www.aeg-industrialsolar.de

6-Dimensions in the technical picture are expressed in mm with tolerance ±2 mm (±0.079 ")

Code AS-M1443(Z)-H(G1)-KM0N1-9BB 410/420 Version 2020.10.V1.EN