TITLE OF THE PROJECT: OPTIMAGRID SOE2/P2/E322

GT 2: Definition and Modeling

DELIVERABLE: D3 Descriptive and quantitative report on consumption patterns of each type of test cases identified

ABSTRACT

In this deliverable quantitative data of each of the test cases chosen are shown. All available data is included in an overview table. Detailed data and information of each of the cases is presented.
Original, tables for data collection are included for each case in Annex 1.

CONTENTS

1 INTRODUCTION

The purpose of this deliverable is to show a descriptive and quantitative report of the test cases of industrial areas chosen in deliverable D2. In deliverable D3 a basis of useful data is created for the simulation and optimization models, which will be described in D7.

In this deliverable specific data are collected for each of the selected typologies of industrial areas. The selected typologies and actual industrial areas are the following:

- Technological Park: Walqa Technological Park (Huesca, Spain)
- Port: Port of Bayonne (Port area of Tarnos, France)
- Chemical industry: Polo Químico de Huelva (Huelva, Spain)
- Petrochemical Industry: Fuel storage Plant of Mitrena (Mitrena peninsula, Portugal)
- Car Industry: Different companies in the automotive sector in Navarra (Spain)
- Iron and Steel Industry: Villalonquejar industrial area (Burgos, Spain)
- Rural: irrigation pumping (Aragón, Spain)
- Generic case: Industrial area with small workshops and industrial stores (Spain/Portugal)
- Food industry: Almendras llopis (Alicante, Spain)
- Pavement industry: Pemarsa (Alicante, Spain)

For each of the the following topics are analyzed:

- Consumption:
  - Electricity
  - Gas – Oil
  - Fuel – Oil
  - Natural Gas
  - Liquefied Petroleum Gas (LPG)
  - Coal
  - Petroleum Coke
  - Solar thermal energy
  - Heat from cogeneration unit
  - Other fuels

- Generation
  - Electricity

- Key data of company production

In order to show the results in a condensed form, in chapter 2 a review table with main data of each test case has been elaborated. Not all parameters apply for all cases and in several cases some data was not available. In Annex 1, the complete data tables for each case are shown.

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In chapter 3 a detailed description of each study case is given.

2 Overview of Consumption Patterns

The following tables contain a condensed overview of the collected consumption and generation data for the ten selected study cases.

		Case 1	Case 2	Case 3	Case 4	Case 5
		Techno-logical Park	Port	Iron & steel industry	Chemical industry	Petro-chemical Industry
		Fha	ESTIA	USJ	AICIA	IST
Electricity						
From self-generation	kWh/month	65.625	0		451.000	
From electrical grid	kWh/month	230.104	95.989	53.885	800.000.000	906.341
Supplier		Endesa	EDF		Endesa	Galp Power
Cost	EUR/month	27.612	11.923	3.639	72.000.000	136.781
Tariff	EUR/kWh	0,12	0,12	0,07	0,09	0,15
Fuels (transport)						
Gas-Oil (internal transport)	Liter / month		4.622			
Supplier			TOTAL, DYNEFF			
Cost	EUR/month		6.247			
Tariff	EUR/Liter		1,35			
Essence SP95 (service vehicles)	Liter / month		3.576			
Supplier			TOTAL, DYNEFF			
Cost	EUR/month		5.342			
Tariff	EUR/Liter		1,49			
Fuels (Heat)						
Gas-Oil (Heating)	Liter / month	2.663				245.785
Supplier		Repsol				Galp Servi Express / Galp Energia
Cost	EUR/month	2.570				254.111
Tariff	EUR/Liter	0,97				1,03
Propane (Heat)	m3 / month	2.566				
Supplier		RepsolGas - Oscagas				
Cost	EUR/month	5.646				
Tariff	EUR/Liter	2,20				
Natural Gas						
Cogeneration	kWh/month				1.095.000.000	
Supplier					Gas Andalucia	
Cost	EUR/month				19.800.000	
Tariff	EUR/kWh				0,02	
Industrial uses					812.000.000	
Supplier					Gas Andalucia	
Cost	EUR/month				14.700.000	
Tariff	EUR/kWh				0,02	
Other fuels						

Eucalyptus (Cogeneration)	Tn/year				240.000	

Table 1. Overview of consumption and generation data, study cases 1-5.

		Case 6	Case 7	Case 8	Case 9	Case 10
		Car industry	Rural irrigation pumping	Industrial area (small workshops)	Food industry	Pavement industry
		CENER	CIRCE	CIRCE	SanVicente	SanVicente
Electricity						
From self-generation	kWh/month		45.833	0	0	
From electrical grid	kWh/month	68.046.037	100.000	73.000	257	180315
Supplier		Iberdrola	Endesa	Endesa	ALPIQ ENERGIA ESPAÑA, S.A.U.	HC Energía
Cost	EUR/month	5.058.533	12.000	8.760	25211	23954,47
Tariff	EUR/kWh	0,07	0,12	0,12		
Fuels (transport)						
Gas-Oil (internal transport)	Liter / month	17.140				55.55
Supplier		Repsol				Galp
Cost	EUR/month	23.139				66.6
Tariff	EUR/Liter	1,35				
Fuels (Heat)						
Gas-Oil (Heating)	Liter / month					16480 kg
Supplier						Galp
Cost	EUR/month					
Tariff	EUR/Liter					
Propane (Heat)	m3 / month					
Supplier						
Cost	EUR/month					
Tariff	EUR/Liter					
Fuels (Industrial uses)						
Gas-Oil	Liter / month	58.700				765
Supplier		Repsol				Repsol
Cost	EUR/month	#¡REF!				722
Tariff	EUR/Liter	#¡REF!				
Natural Gas						
Cogeneration	kWh/month				1177550	
Supplier					Gas Natural	
Cost	EUR/month				46384,25	
Tariff	EUR/kWh					
Industrial uses		219.000.000.000				
Supplier		Gas Navarra				
Cost	EUR/month	4.380.000.000				
Tariff	EUR/kWh	0,02				

Tabla 2. Overview of consumption and generation data, study cases 6-10.

3 TEST CASES

In this chapter each study case is described in detail.

3.1 Technological Park: Walqa Technological Park (Huesca)

3.1.1 General description of Walqa technological park

Walqa Technological Park (hereafter “Walqa”) is situated in the outskirts of Huesca, on the dual carriageway that directly links Madrid. It is 72 kilometers away from Zaragoza and 370 kilometers away from the capital city, Madrid. Situated in the North and separated by the Pyrenees, is in the French border, with Paris just over 1000 kilometers away.

Fig. 1. Situation of Walqa technological Park

Walqa is a joint initiative of the Government of Aragon, Huesca City Council, Ibercaja and Multicaja. The main goal is to promote the growth of the regional ICT sector and to make the best out of the high technological qualifications of the human resources existing in the area.
The objective of Walqa is to become a centre of interest to R+D innovation, especially in the field of communications technologies, Internet and E-commerce, contributing to the economic development of Huesca and consequently of Aragon.
The priority sectors in Walqa are telecommunications, R+D centers, computing, hardware and software, multimedia communications, advanced services to ICT companies and audiovisual. Other sectors of interest are engineering, domotics, electronics and biotechnology.
The webpage and the directory of companies is in the next link: http://www.walqa.com/

3.1.2 Consumption patterns

In this section we will present power consumption patterns of the four buildings property of Walqa, along with two other buildings of the companies OX - CTA and System One. At this point it should be mentioned that the company OX - CTA has installed solar panels on its roof so that it also has its own power generation. Historical data from the other buildings was not available. In order to obtain more data, within Optimagrid project, several electrical grid analyzers have been installed. Thus, data for some more buildings and companies will be included in the next deliverables.

In Figure 1 the evolution of the aggregated electricity consumption of the buildings discussed above is shown from January 2011 until December 2011. The corresponding emissions of $CO_2$are shown in Table 3.

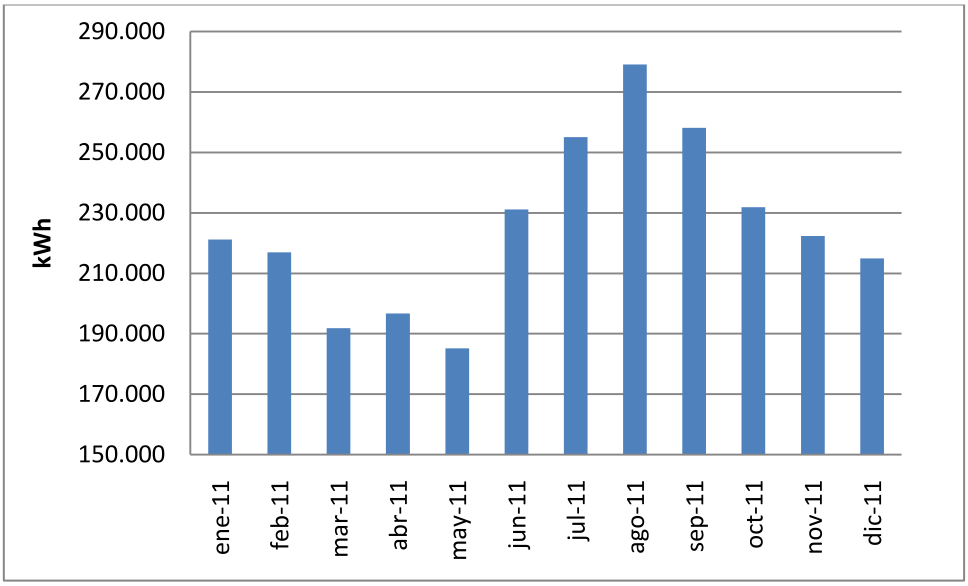

Fig. 1. Electric energy consumed in PT Walqa during 2011

Month	Electrical Consumption (kWh)	CO_2 Emissions(t)
ene-11	221.146	84,7
feb-11	216.988	83,11
mar-11	191.856	73,48
abr-11	196.728	75,35
may-11	185.128	70,9
jun-11	231.107	88,51
jul-11	255.061	97,69
ago-11	279.126	106,91
sep-11	258.127	98,86
oct-11	231.890	88,81
nov-11	222.398	85,18
dic-11	214.957	82,33

Table 3. Electrical consumption and CO2 emissions during 2011

Now we will present the heat consumption of the first buildings constructed in Walqa of which we have now registered the consumption of fossil fuels to meet the demands for heat. The corresponding emissions of CO_2 are depicted in Fig. 2.

Date	Propane consumption Build. A (m^3)	Propane consumption Build. B (m^3)	Diesel consumption Build. C (l)	Total CO_2 (t) emissions
ene-11	1313	5460	5667	163,3
feb-11	775	4284	4333	122,27
mar-11	442	3174	4200	90,71
abr-11	230	1925	3767	57,85
may-11	71	597	1457	188
jun-11	0	0	721	2,16
jul-11	0	0	637	1,91
ago-11	0	0	593	1,78
sep-11	0	0	2015	6,05
oct-11	202	585	3198	26,59
nov-11	605	1796	5949	69,71
dic-11	1637	5607	7130	177,86

Tabla 4. Thermal energy consumption of 2011 and CO2 emissions

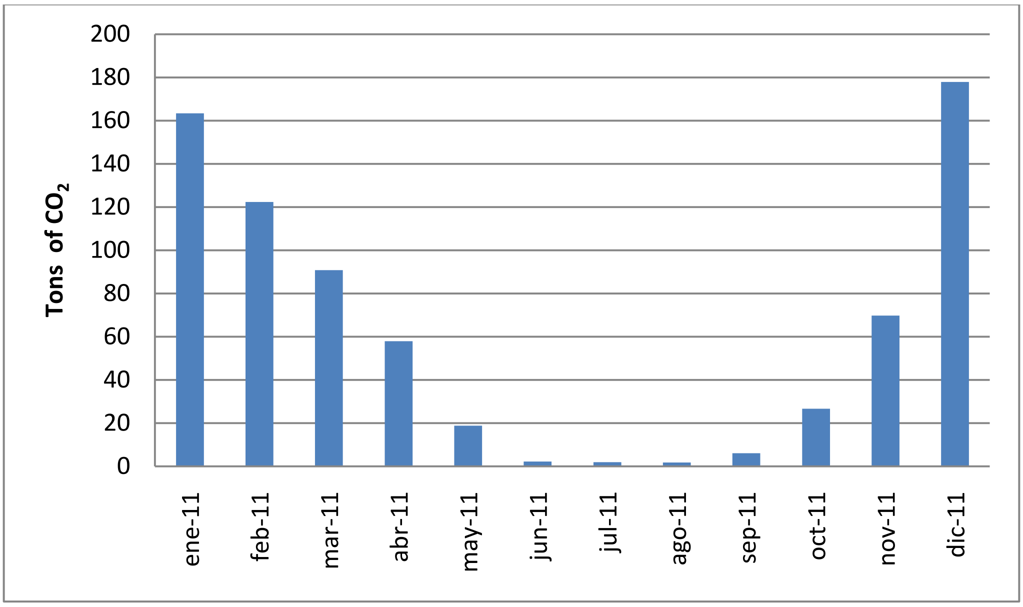

Fig 2. Total CO_2 emissions from fossil fuels for heat demand.

3.1.3 Renewable energy

In this section the electricity production capacity of Walqa is analyzed. A renewable energy infrastructure is installed and operating in Walqa, as part of the ITHER project carried out by the FHA (Foundation of Hydrogen in Aragon), consisting of 635 kW wind power and a 100 kW solar PV installation including fixed plates and trackers. Furthermore, as mentioned above, one of the buildings also has solar panels on the roof. The following chart shows the values of renewable electricity production from the infrastructure that is part of Walqa. Detailed values are given in Table 5. As can be observed, the contribution of renewable energy to supply the demand is very seasonal. This is mainly associated with the availaviliy of the wind resource.

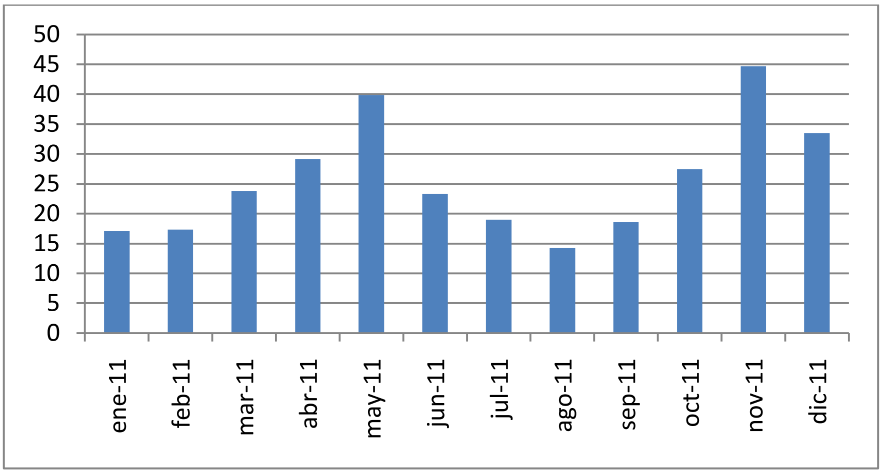

Figura 3. Demand covered by renewable energy production in Walqa.

Month	Walqa electrical consumption (kWh)	Walqa renewable energy production (kWh)	% consumption generated by renewable energy
ene-11	221.146	37.869	17,12
feb-11	216.988	37.561	17,31
mar-11	191.856	45.616	23,78
abr-11	196.728	57.402	29,18
may-11	185.128	73.814	39,87
jun-11	231.107	53.944	23,34
jul-11	255.061	48.470	19
ago-11	279.126	39.850	14,28
sep-11	258.127	48.011	18,6
oct-11	231.890	63.623	27,44
nov-11	222.398	99.407	44,7
dic-11	214.957	71.971	33,48

Tabla 5. Walqa renewable production

3.2 Port: Port of Bayonne (Port area of Tarnos)

3.2.1 General description

The port of Bayonne is a French commercial port at the Atlantic Ocean. Its right-of-way belongs to Bayonne, Anglet and Boucau in the regions of Pyrénées-Atlantiques and Tarnos in the region of Landes. It ranks the 9th place of French commercial ports. It also includes a naval base with a few patrol ships.

3.2.2 Economic activity

Since 1997, its annual traffic exceeds 4 million tones. As the port of Bayonne is located at the estuary of the Adour, it enjoys an excellent logistic location. It exports the agricultural and industrial products of the basins of Landes and Pyrénées-Atlantiques :

- sulphur (collected after the gas cleaning of Lacq)
- crude oil extracted in Lacq
- corn
- fertilizers
- wood

It houses a steelworks site.
Ford and General Motors chose Bayonne to distribute to all Europe cars manufactured in Spain and in Portugal. It is also the chemical Sotrasol (liquid chemicals) storage terminal. And finally, there is a pipeline between the port of Bayonne and Lacq .
The port of Bayonne employs directly 800 people with 3,000 induced jobs. The following figure illustrates the different outlets of the Port of Bayonne.

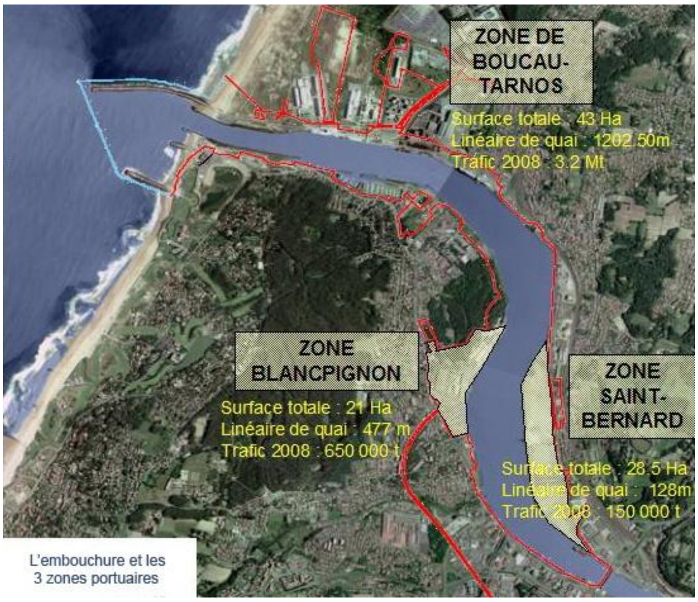

Fig. 2. Areas harbor of the Port of Bayonne

The port of Bayonne is composed of three port areas: Blancpignon, Saint Bernard and the area of Boucau Tarnos. According to figure 2, it appears that the Tarnos area is the largest consumer of energy of the three areas of the port of Bayonne.

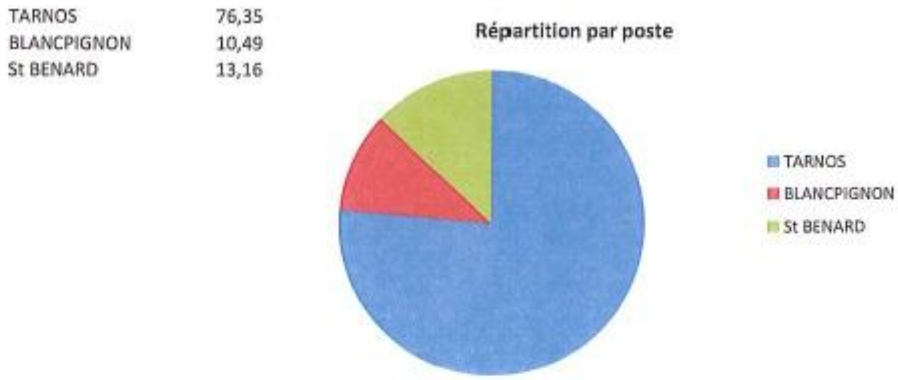

Figura 4. Distribution consumption through the port of Bayonne in July 2011

Due to the electrical power consumption, the remoteness of the housing areas and the offices proximity, the port area of Tarnos was chosen as a study case for the Optimagrid project.

3.3 Chemical industry: Polo Químico de Huelva

3.3.1 Introduction

This section is divided in two parts: Firstly, a general description of Polo Químico de Huelva (a chemistry industrial area located in Andalusia) is realized, and secondly, a particularized description of a pulp industry, ENCE, located in Polo Químico de Huelva, is done.

3.3.2 Polo Químico de Huelva

Polo Químico de Huelva is a Chemistry Industrial Area located in Huelva (Andalusia West, Spain). It is composed by 11 companies: Air Liquide, Angry Chemistry, Atlantic Cooper, Cepsa, Enagas, ENCE, Endesa, Ercros, Fertiberia, Gas Natural Fenosa and Repsol YPF.
The Area is located near to Huelva city, in the mouth of Rio Tinto River.
Its construction started in 1964 and it has become one of the most important Chemical Area in Spain, due to the number of companies, employees and extension. In Ilustración 3, a general overview of the industrial area is shown.

Ilustración 3. General overview of Polo Químico de Huelva.

The main activities of the companies in the industrial area are summarized below:

- **Air Liquide** produces gases for industrial and medical applications: oxygen, nitrogen and argon. The total production capacity exceeds 300 million cubic meters annually. This production mainly is destined to other companies of Polo Químico de Huelva.
- **Algry Chemistry** is one of the only two European manufacturers of derivatives of choline, an essential nutrient used in food and feed. The production is approximately 6 m^3/day.
- **Atlantic Copper**, mining company subsidiary of Freeport MacMoran, produces pure copper with a total year capacity of 255.000 tons and 255.000 tons of Cooper electrodes, the second in Europe and the twelfth in the world. As by-products include electrolytic sludge containing precious metals and sulfuric acid, largely consumed by other companies in the chemistry industrial area.

- **CEPSA Refinery** has a current processing capacity is 5 million tons of crude. In addition to fuels, it produces raw materials for the petrochemical industry, asphalt and sulfur. Also it has a cogeneration facility.
- **CEPSA Química** is closely associated with the products of the CEPSA refinery, which gives benzene and propylene. Its capacity is 600.000 tons/year of phenol and acetone 372,000, plus alpha methyl styrene, methylamines and its derivatives. Also it has a cogeneration power plant. Its production has applications in various industries, but mostly is used in the manufacture of polycarbonates, phenolic resins and a wide variety of industrial applications.
- **Ence** is one of the main industries of pulp manufacturing in Spain, with a production capacity of 410.000 tons/year, processing over one million cubic meters of eucalyptus wood. Its facilities also produce electrical energy using biomass and natural gas as primary energy.
- **Enagas** regasified liquefied natural gas. The production capacity of this plant, one of five in service in Spain, is 1.250.000 m^3/hour.
- **Endesa** is a company whose main activity is the electric power generation. The power plant of Polo Químico de Huelva has a natural gas combined cycle power plant of 400 MW, which replaced the old power plant fed with fuel and biogas.
- **Ercros** produces soda and chlorine derivatives based on sodium chloride obtained in the Odiel salt lakes. It annual productions are: 108.000 tons/year of dichloroethane, 110.000 tons/year of sodium hydroxide and 13.000 tons/year of sodium hypochlorite. The range of applications of their products is extremely large: detergents and bleach, water purification, organic solvents, metals, pharmaceuticals, etc..
- **Fertiberia** produces monoammonium phosphate and diammonium phosphate, phosphoric acid and complex fertilizers, using phosphate rock imported from Morocco as the main raw material and sulfuric acid as a reactant. The production capacity of phosphoric acid is 420.000 tons/year. The production capacity of phosphate is 577.000 tons/year and complex fertilizers are 270.000 tons/year. It also produces ammonia and urea using natural gas as main raw material, with atmospheric nitrogen. Its production capacity of ammonia is 400.000 tons/year, which is used almost entirely by other companies of the industrial area, while urea, whose capacity is 250.000 tons/year is used for direct agricultural applications mainly.
- **Repsol YPF** bottled liquefied petroleum gases (propane and butane) produced by the CEPSA refinery. They are destined to domestic distribution.
- **Union Fenosa** is a producer of electricity. The combined cycle power plant of Polo Químico de Huelva consists of three generating units of 400 MW each, which came into operation in 2005.

Concerning Economic Benefits in 2010 the Chemistry Industrial Area of Huelva had a turnover of 7.177,4 M€ with the next percentages: Electricity Production 6,5 %, Oil Refining 43,2 %, Gas Regasification 0,9 %, Chemistry Basic Products 19,1 %, Fertilizers 3,5 %, Metals 24,9 % and Pulp 2 %.

Due to the high energy consumption of the entire industrial area, and the lack of information from different factories, the study focuses on one of industries, in particular, Ence, dedicated to the production of pulp.

3.3.3 Pulp Industry

This section describes the process of pulp production in ENCE. Specifically, Kraft method is used for obtaining the paste.

The process is divided into three steps which are explained in detail in the following sections: cooking, bleaching, drying and packing.

3.3.4 Cooking

Chips made from the stockpile are driven into the hopper of chips, where they are impregnated with steam to eliminate its air content. To ensure greater uniformity of cooking in the digester, the chips pass through a high pressure tank where they are pre-impregnated with white liquor (an aqueous solution with sodium sulfide, Na_2S, and sodium hydroxide, NaOH).

The functions of the white liquor are: breaking joints of lignin and releasing the cellulose fibers. Physically, the continuous digester is a cylindrical pond with a large section, with a network of pipes through which are used to add or remove cooking liquids. Also, It has a vertical remover. The cooking temperature range varies between 130 °C and 170 °C, being higher in the top of the digester (early stage).

As the chips move down into the digester, they are transformed into pulp. This is why the cooking process operates continuously. At the end of cooking, in addition to the cellulose pulp generation a residue, called Black Liquor is also produced. It is composed by white liquor mixed with lignin and other wood substances. The Black Liquor is retrieved for processing in another part of the pulp mill called Chemical and Energy Recovery System. This important process allows recovery most of the chemical products. In practice, only a very small percentage of solid waste from digester should be poured into landfills.

When the pulp reaches the bottom of the digester, it is subjected to high temperature washing with water. Countercurrent water causes the removal of black liquor. Then the pulp goes through a blow tank, whose function is to reduce the pressure abruptly, in order to liberate the fibers that remain compact. The blowing process is carried out at lower temperatures, for this, cold water is injected to the slurry, in order to decrease its temperature to the range of 75-80 °C.

The pulp that leaves the digester is washed and classified through various filters. The knots of the wood and other chips that do not pass through the filters are sent back to the digester. The pulp is filtered and washed a second time. The result is called raw cellulose or unbleached pulp, and has the form of suspension fibers in water. This pulp still has an important content of lignin, which gives it a brown color.

The raw cellulose is the main input in the production of paper and brown paperboard. Also it is used to produce packaging containers such as bags, pouches and corrugated boxes.

3.3.5 Bleaching ECF

Since cellulose is the main input in the production of white papers, it is necessary to process the chemical pulp with chemicals in order to remove the remaining lignin, resins, metal ions and other substances that could affect the process paper production. Various chemicals such as chlorine dioxide, oxygen and hydrogen peroxide (H_2O_2) are added sequentially to the cellulose pulp to whiten extracting lignin. Thus, cellulose consumers receive a product that enables them to produce papers with the required attributes of whiteness and brightness, which are also not significantly decline over time. Chemicals currently in use at this stage have replaced others which were removed, because it was shown that generate noxious components to the environment.

The bleaching process necessarily mean a reduction in performance of the timber, measured in m^3 per ton of pulp, because it removes a significant portion of the lignin that remains in the brown pulp and also a part of the cellulose fibers are degraded due to chemicals involved in the process. Typically, throughout the bleaching process is lost between 5% and 9% of the brown pulp to achieve standard whiteness of 89% to 91% according to ISO-2470 (International Organization for Standardization).

The modern pulp mills have included in prior stages for improving the bleaching process, a stage called oxygen delignification, which as its name suggests, consist in delivering high doses of oxygen to the brown pulp to produce oxidation of the lignin. This chemical reaction is performed in a pressurized tank, at elevated temperatures and in an alkaline environment (pH 10). This stage has two important benefits: it reduces chemical consumption substantially in the later stages of bleaching and also allows the lignin, removed in the first washing station, can be reprocessed in the Recovery System Chemicals and Energy.

The bleaching of pulp in successive stages continues adding different chemicals that oxidize or modify the molecular structure of lignin and other elements present in the raw pulp, facilitating their dissolution and subsequent extraction. The pulp is washed after each step to remove the soluble organic materials. These chemical reactions are performed in ponds at high temperature and in an acid environment (pH <4). Since in this process are generated some organic compounds that are not soluble in an acidic environment, it is necessary to insert stages in which chemicals are used to generate an alkaline medium, so as to draw these components in the wash station.

The resulting pulp, essentially free of lignin, may be dried to obtain white Kraft pulp. Through recent advances, the residue levels in the liquid effluents from pulp mills have declined steadily. The liquid residue from the bleach plant is taken to treatment plants in order to be cleaned, eliminating all substances harmful to the environment before returning to the rivers.

The process of ECF (Elemental Chlorine Free), based on chlorine dioxide has long imposed on the pulp industry as the most accepted, replacing the old plants based on elemental chlorine bleaching.

3.3.6 Drying and Packing

The pulp from the bleaching plant is ready for drying. The percentage of fibers in the pulp at the inlet of the drying machine (initial consistency), is approximately 1% to 2%, so the water content is extremely high. From the headbox to this machine, the pulp is evenly distributed over the fourdrinier, or forming table leaf. This equipment is powered by several rollers which remove water from the slurry by gravity and suction boxes connected to vacuum pumps, into the shape of a sheet.

The sheet, with a consistency of about 46%, enters the pre-drying, large cylinders inside which steam circulates at high temperatures. Then it passes to the primary driers, which are composed by several heated rollers and a convective and infrared radiant heat transfer system. This system of drying rollers can be replaced by a hot air drying, where the cellulose sheet passes through the free flow of hot dry air to remove water. At the exit of this area, the sheet has a consistency of 87% to 92% dry.

Then, this sheet passes by the cutting unit, which leaves in the form of sheets, which are stacked, pressed and packed in a unit called bale, weighing 250 kg.

It is also possible to roll the sheet of cellulose (cellulose rolls), in which case it abandons its passage through the cutter.

3.4 Petrochemical Industry: Fuel storage Plant of Mitrena (Mitrena peninsula)

Fig. 4. Overview of the facility

Fig. 5. Aerial view of the facility

3.5 Car Industry: Different companies in the automotive sector in Navarra

In this report, data from automotive companies are studied in order to create a pattern for an industrial area comprised of this kind of companies. The following study is developed from the information taken from 8 automotive industries located in different parts of Navarra (Spain). The data correspond to 2009 and include information about electricity and natural gas consumption, and the type of tariff contracted.

In **¡Error! No se encuentra el origen de la referencia.** the total consumption of both resources in 2009 is hown.

Company	Electrical connection (kV)	Elec. Tariff type	Elec. consump. (MWh/year)	Gas tariff type	Gas consump. (MWh/year)
Company 1	13.2	6	1,244	2.2	3,234
Company 2	66.0	6.2	26,739	2.3	11,034
Company 3	30.0	6.1	1,472	2.2	906
Company 4	13.2	3.1A	435	-	-
Company 5	13.2	6.1	1,295	2.2	1,058
Company 6	13.2	3.1A	915	3.4	56
Company 7	13.2	6.1	2,849		144
Company 8	66.0	6.2	32,357	2.3	6,122

Tabla 6. Power and Natural gas consumption of the consulted companies

Companies 2 and 8 are taken as an example given their big consumption of both power and natural gas. Below, the monthly distribution of the electricity consumption for these companies is shown. We can see a decrease in consumption in August because of the holidays. In principle, the rest of the year does not show a particular shape. Maybe a little decrease can be identified in December related to Christmas holidays.

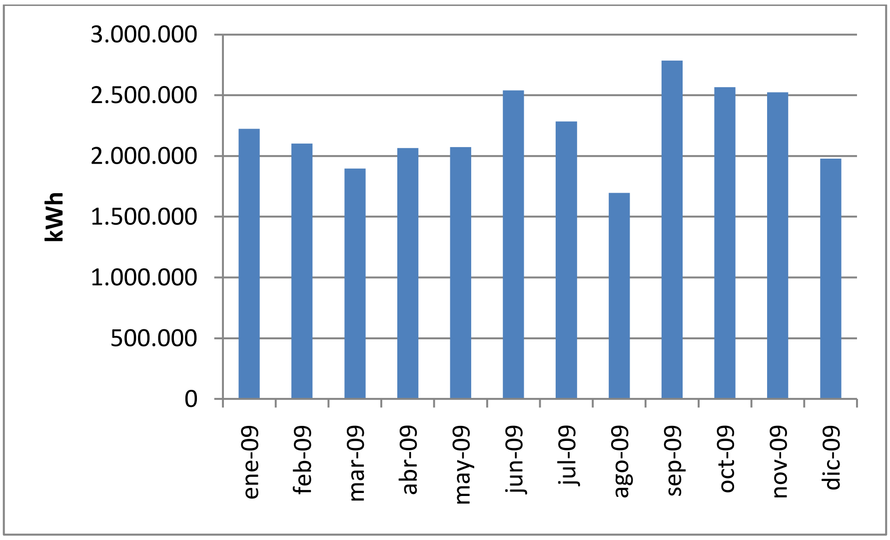

Figura 5. Monthly distribution of the consumption of electricity of Company 2

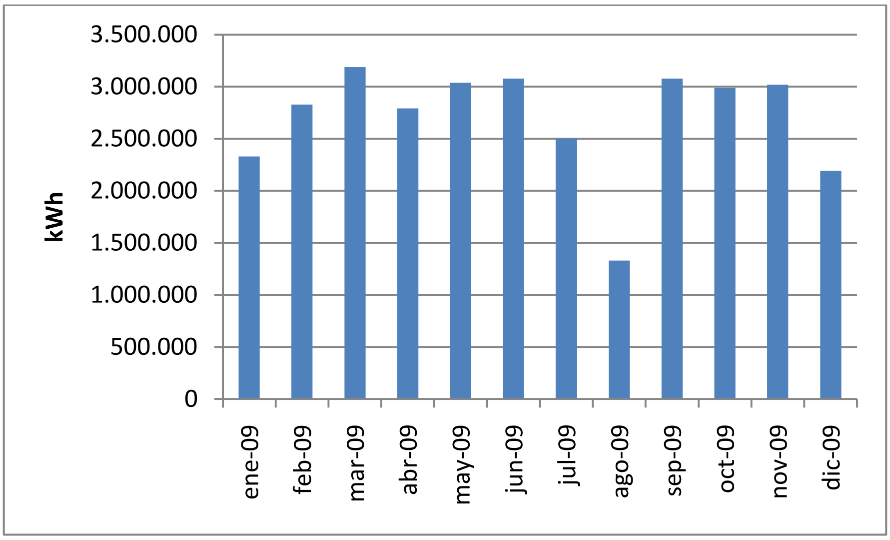

Figura 6. Monthly distribution of the consumption of electricity of Company 8

Finally, looking at the distribution for the aggregated consumption we can conclude that it is more or less constant throughout the year, with the exceptions for August and December.

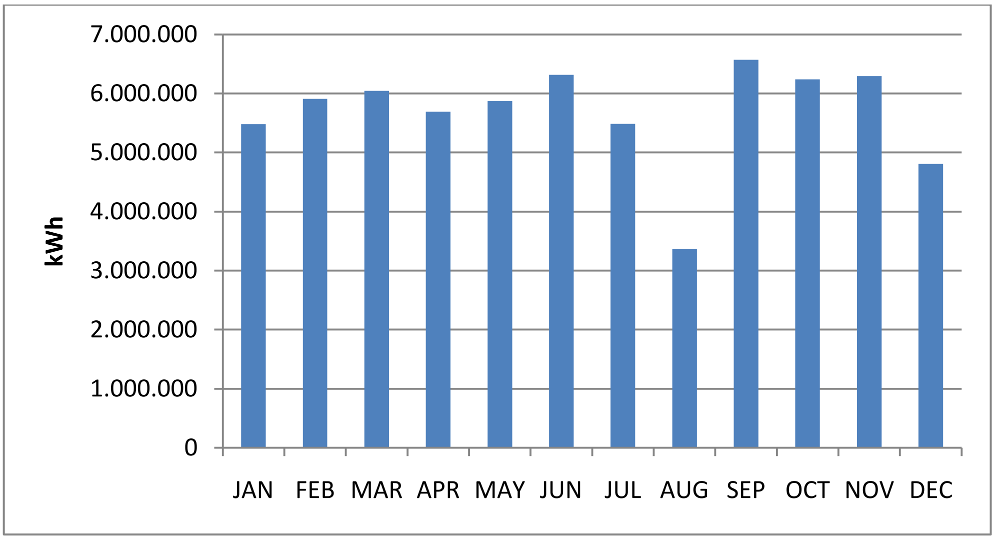

Figura 7. Monthly distribution of the consumption of electricity of the consulted companies

In **¡Error! No se encuentra el origen de la referencia.** the distribution of the periods in the tariffs 6.x is hown. We can see that during the night P6 prices apply, as well as during weekends and holidays. That means that more than 5,000 hours of the year belong to P6. On the contrary, P1 corresponds to the peak hours of the year, showing two daily peaks in winter and one longer peak in summer.

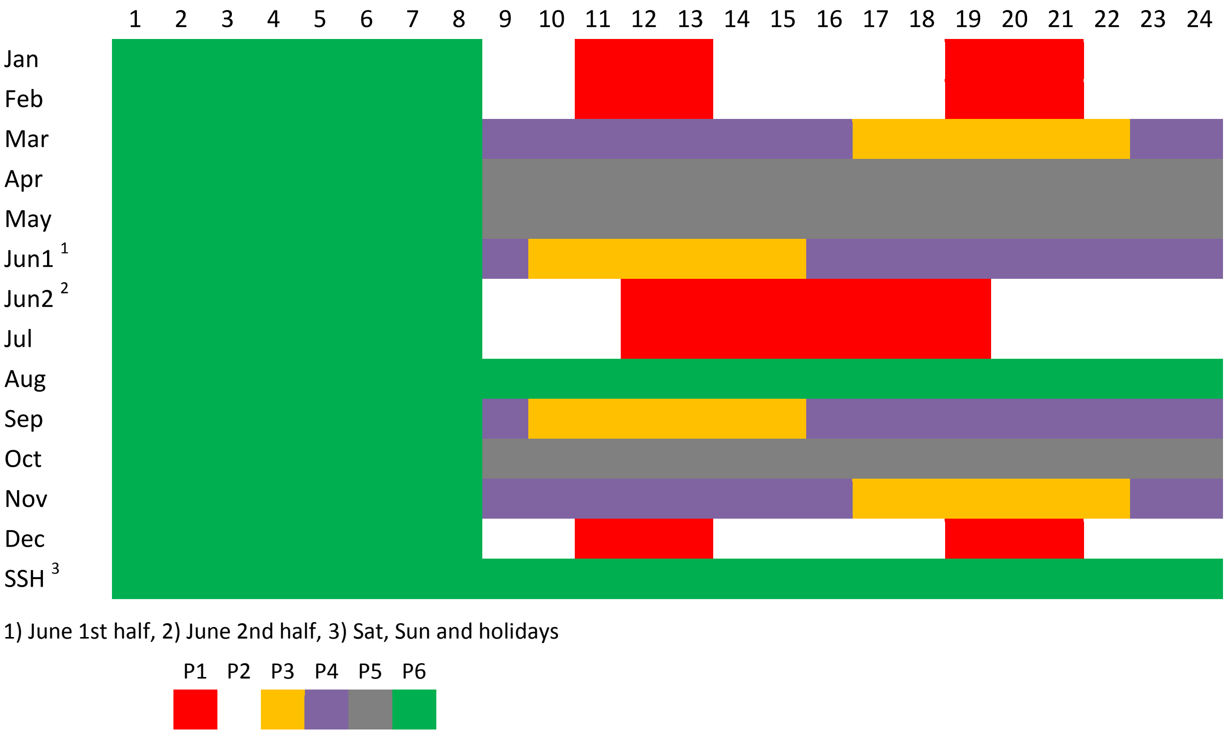

Tabla 7. Distribution of the tariff periods throughout the year for the tariffs 6.x

In order to have a reference for the prices, the average price for every period was calculated using the tariff of each company. The results are shown in **¡Error! No se encuentra el origen de la referencia.**, where the highest price is 11.3 c€/kWh and the lowest is 5.6 c€/kWh.

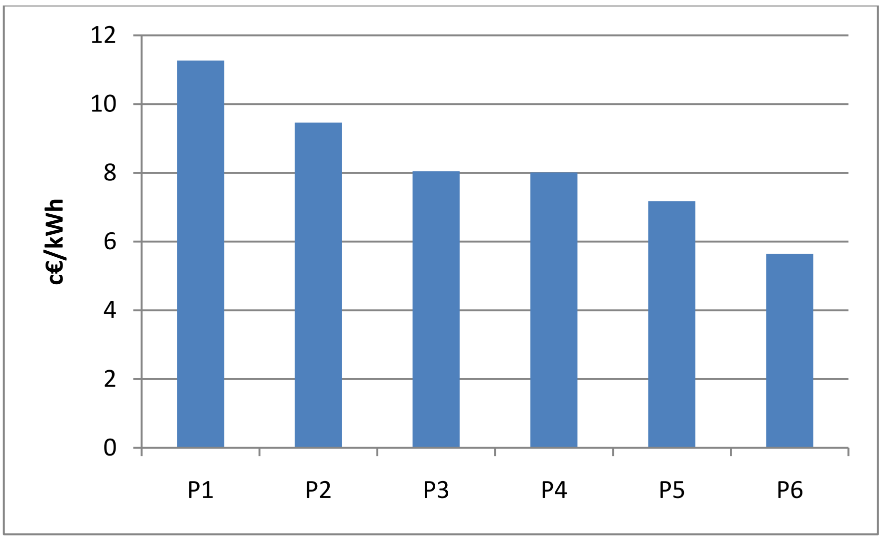

Figura 8. Average prices of the electricity contracts of the consulted companies

In Figura 9 and Figura 10 the distribution of the electricity consumption is shown for the companies already mentioned, company 2 and 8. A big deal of the annual consumption is located within the P6 period for both companies. The same happens for the total consumption of the consulted companies, as we can see in **¡Error! No**

se encuentra el origen de la referencia.. The rest of the periods show smaller differences among them, being more or less similar.

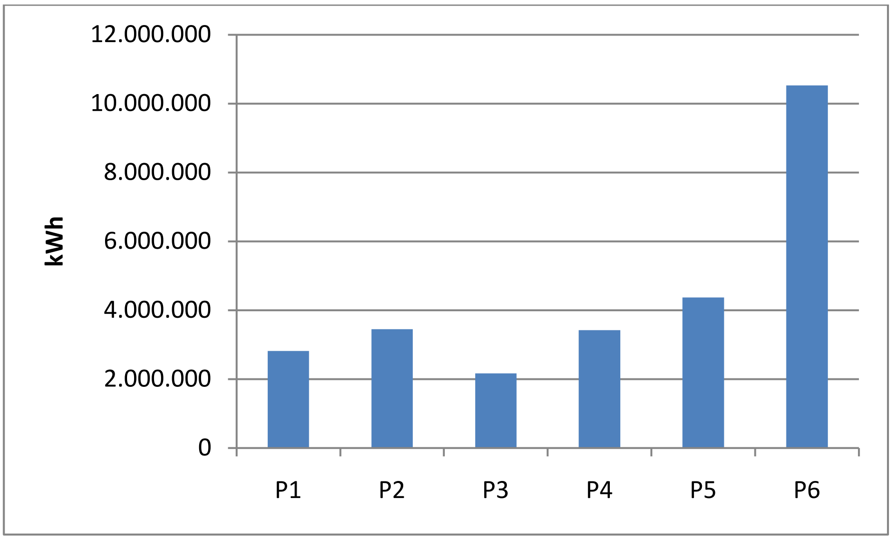

Figura 9. Distribution of the consumption of electricity of Company 2

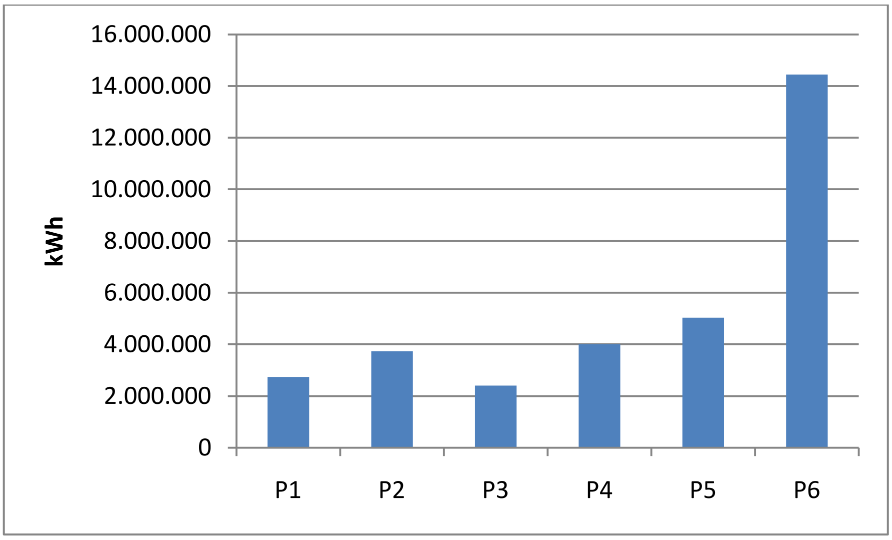

Figura 10. Distribution of the consumption of electricity of Company 8

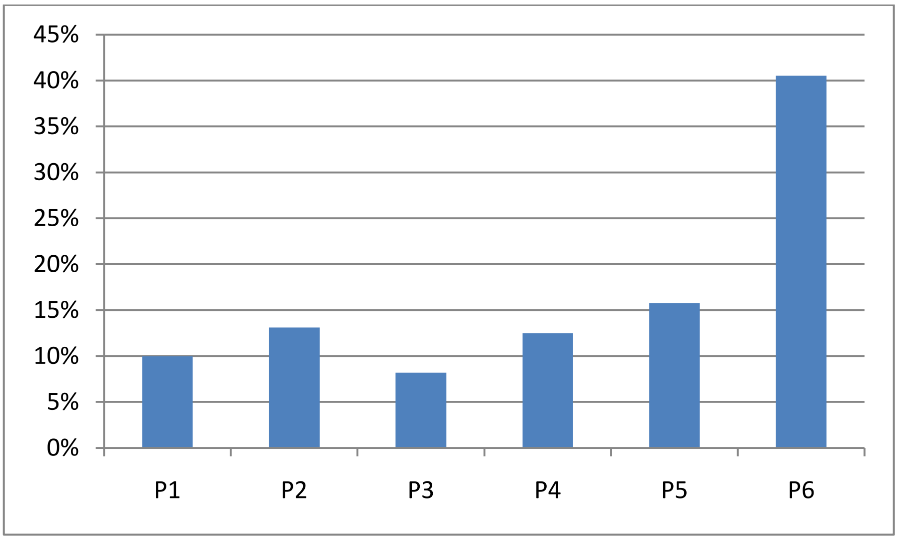

Figura 11. Distribution of the consumption of electricity of the consulted companies

In Figura 12 the average power along the year for every period is displayed for the whole group of companies. During the P6, period that includes nights, holidays and weekends, the average power is around half of the power consumed during the rest of periods. However, P6 amounts for more than 5,000 hours/year, so around 40% of the energy consumed annually belongs to P6 period.

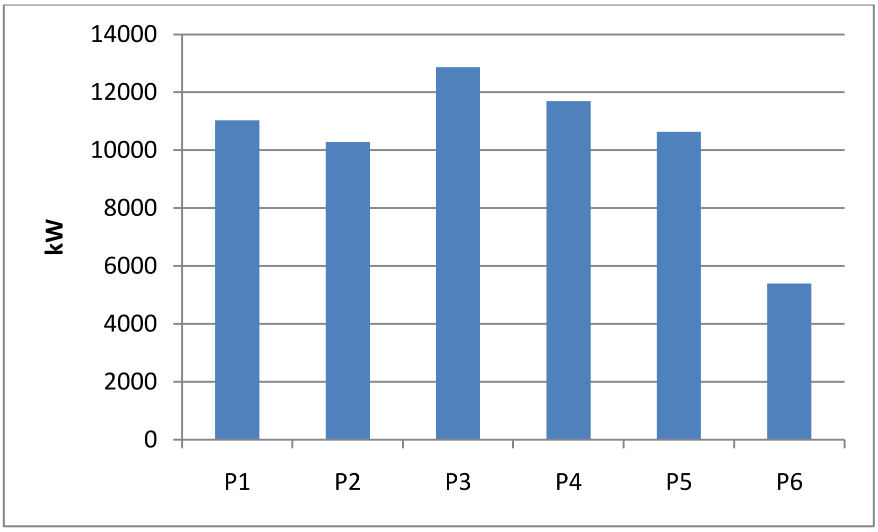

Figura 12. Average power consumption of the consulted companies in each period

The second part of this report deals with natural gas consumption of the same group of automotive companies.
In **¡Error! No se encuentra el origen de la referencia.** we can see the distribution for Company 2, where ugust is the only month that goes really different from the annual average. This indicates that natural gas is used for the manufacturing process during the whole year, decreasing somehow during the summer.
On the other hand, Company 8 seems to use natural gas for heating purposes only as shown in Figura 13. Monthly distribution of the consumption of natural gas of Company 8. This point is rather clear because there is no gas consumption at all during the summer months.

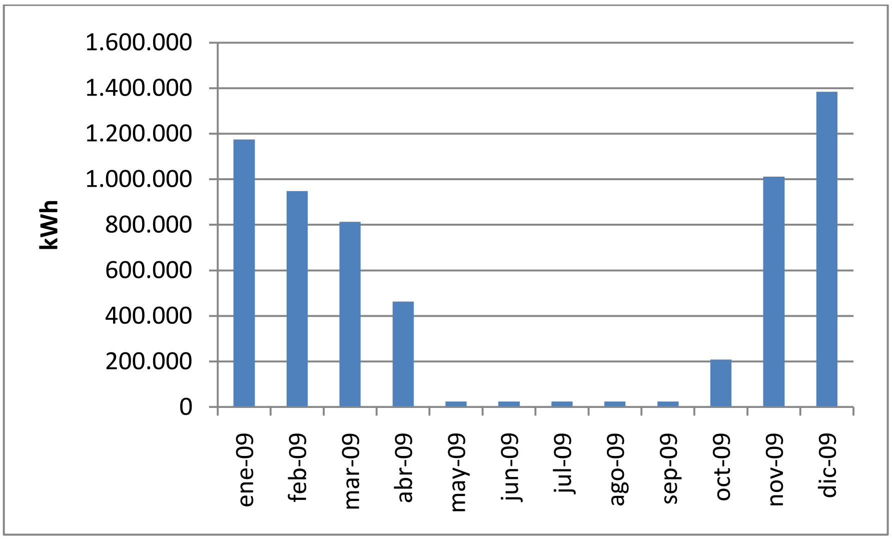

Figura 13. Monthly distribution of the consumption of natural gas of Company 8

Taking into account both shapes, together with the ones from the small companies, we get the general pattern of gas consumption, pictured in Figura 14. In this case, with some companies consuming gas just during some months, and others during the whole year, the consumption changes from one month to the next. Noticeably, the consumption in January is more than two times the one for August.

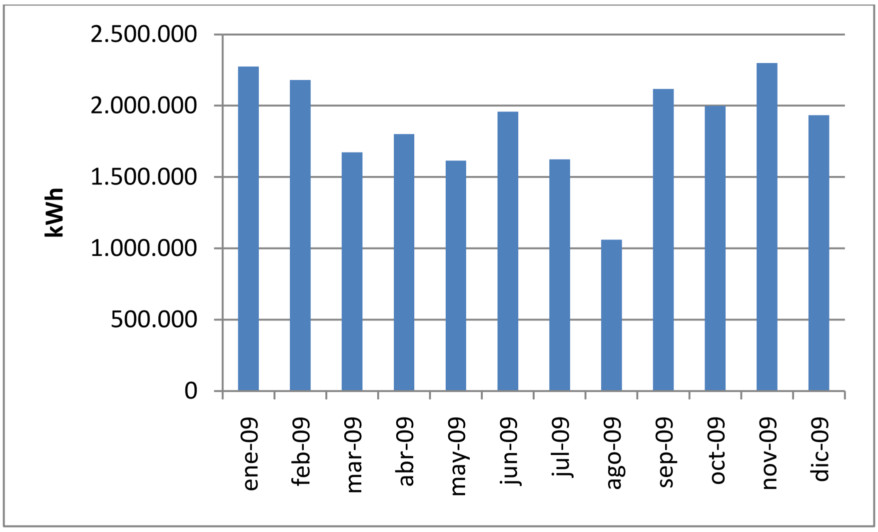

Figura 14. Monthly distribution of the consumption of natural gas of Company 2

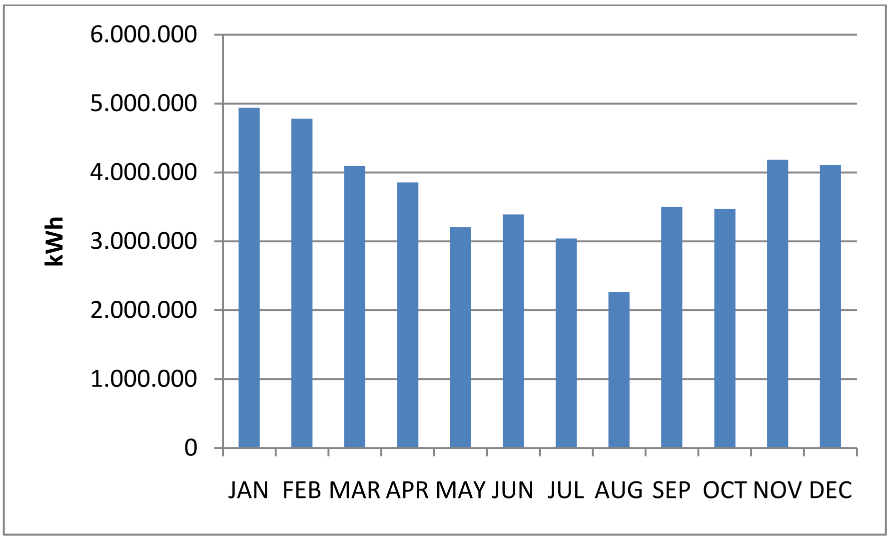

Figura 15. Monthly distribution of the consumption of natural gas of the consulted companies

3.6 Iron and Steel Industry: Villalonquejar industrial area (Burgos)

This chapter tries to define typical consumption patterns of industrial areas, especially in the iron and steel industry sector. Firstly the main features of Castille and Leon are exposed from the point of view of energy consumption, in order to lead the selection of a good representative of iron and steel industry activities. All work is focused on Villalonquéjar industrial area, in Burgos (Spain). After briefly reviewing the mathematic tools used in the study, as the wavelet theory and the singular spectrum analysis, the load time series is analyzed in several aspects to extract the useful information and get the model for prediction. The wavelets spectrum reveals, in the time-frequency domain, interesting information about the consumption pattern. To forecast the demand, SSA have been the proper tool within certain constrains, that has thrown out the best confident results.

3.6.1 Report objective.

The objective of this report is to define typical consumption patterns of industrial areas, especially in the iron and steel Industry sector. Activities is developed in small workshops, small factories and industrial stores. This type of industrial areas is very common in the entire zone of SUDOE (Portugal, Spain and south-west France).

The study in this GT2, carried out by USJ, was dedicated to regions of Madrid and Castille and Leon. But, since Madrid has huge population, with diverse and numerous industrial areas, this region is not a good representative of a tipycal SUDOE territory. So, the study was focused only at the community of Castille and Leon. Due its social and economic features, it is the best suitable to be the center of analysis, so that the results can be extrapolated throughout all SUDOE territories. Inside it the goal is to select an industrial area belonging to the iron-steel production field to perform the study of the consumption pattern.

3.6.2 Electricity growth outlook in Castille and Leon

During the last decade, coinciding with one of the greatest periods of economic growth in recent years in Spain, consumption of electricity has grown significantly. Although, not evenly throughout Spain and equally in all communities, the growth is clearly influenced by the demographic and labor factor. During this period, consumption has risen more than 70,000 GWh, which have been attended mostly by combined cycle plants and renewable, without forgetting the importance the nuclear remains in the Spanish energy mix. However, while regions like Andalusia, Madrid and Catalonia electricity consumption has tripled the national growth, in others such as Castilla y León, Cantabria and La Rioja, growth has been much lower than the Spanish average of the last decade. The regional electricity demand in Catille and Leon has grown by only 1,364 GWh from 1999 to 2010, a figure only exceeded that of Cantabria (1,241 GWh) (**¡Error! No se encuentra el origen de la referencia.**) and Rioja (590 GWh). The region of Spain where the highest rise in electricity consumption during the last decade (**¡Error! No se encuentra el origen de la referencia.**), thanks largely to demographic takeoff, was 11,822 GWh Andalusia, followed by Catalonia with 8,392 GWh, the Community of Madrid with 8,226 GWh and the Valencian Community 6,815 GWh.

Province	Thermic	Hydro	Nuclear	Wind	Photov.	TOTAL	% of year	% of last year
ÁVILA	0	87,463	0	305,896	78,164	471,523	1.73	81.31
BURGOS	979,001	114,854	3,837,169	2,757,956	28,620	7,717,600	28.39	8.03
LEÓN	326,669	1,304,434	0	508,443	45,942	2,185,488	8.04	-58.05
PALENCIA	106,925	220,912	0	1,136,785	37,403	1,502,025	5.53	-32.46
SALAMANCA	175,892	6,838,855	0	102,910	84,013	7,201,670	26.49	110.7
SEGOVIA	144,223	9,990	0	93,882	39,249	287,345	1.06	33.73
SORIA	267,988	29,762	0	2,291,317	30,228	2,619,295	9.63	10.61
VALLADOLID	496,369	9,511	0	226,182	139,357	871,419	3.21	28.45
ZAMORA	61,357	3,212,240	0	937,318	118,655	4,329,570	15.93	76.90
Total	2,558,424	11,828,022	3,837,169	8,360,690	601,631	27,185,936	100.00	13.45
Total	128,592,253	43,110,492	61,914,620	43,031,000	6,630,741	283,279,106	----	1.99

Tabla 8. Gross production of electricity (MWh).Annual Summary 2010. Sources: Energy EREN (Ente Regional de Castilla y Leon)

Ten years later, in 2010, the producer profile in Spain and Castile and Leon in relation to energy production has changed dramatically (**¡Error! No se encuentra el origen de la referencia.**). In this decade, the combined cycle has been installed in 13 of the 17 regions with an output of 82,237 GWh, well ahead of coal for example. The production of the latter has fallen 38,481 GWh. Particularly in the case of domestic coal, the most affecting Castilla y Leon (**¡Error! No se encuentra el origen de la referencia.**), where production fell 65% against 26% drop in production of imported coal. Only in the last three years, especially after 2008, energy production associated with coal in Spain has fallen to 50%. In the case of Castile and Leon, conventional energy production in this decade has fallen by 11,791 GWh, especially on coal, as has happened in Asturias (8606 GWh) and Galicia (3708 GWh).

Provence	Residential	Industrial	Others	TOTAL	% of year	% of last year
ÁVILA	267,976	410,122	11,094	689,192	5.47%	-7.58%
BURGOS	510,042	1,831,980	12,014	2,354,036	18.67%	2.78%
LEÓN	766,242	1,482,665	4,396	2,253,303	17.87%	-2.17%
PALENCIA	218,316	788,756	14,172	1,021,244	8.10%	2.12%
SALAMANCA	526,725	889,984	10,669	1,427,378	11.32%	-2.76%
SEGOVIA	354,392	535,629	11	890,032	7.06%	-4.29%
SORIA	144,086	433,532	8,319	585,937	4.65%	4.49%
VALLADOLID	668,758	1,911,996	11,453	2,592,207	20.56%	-0.03%
ZAMORA	293,733	495,246	4,310	793,289	6.29%	-1.61%
Total	3,750,270	8,779,910	76,438	12,606,618	100.00%	-0.71%

Tabla 9. Consumption of electricity (MWh).Annual Summary 2010. Sources: Energy EREN (Ente Regional de Castilla y Leon).

A very important change in the Spanish electricity market is due to the emergence of renewable energy generation, complementing hydroelectric production. Special importance in the last five years, are sources from wind and the incipient solar thermal and biomass. During the last decade, Castile and Leon would have been the second region of Spain where renewable energy production would have grown up near the 8,000 GWh, ahead of Galicia and Andalusia. Interestingly, in two communities with the greatest increase in energy consumption, such as Catalonia and Madrid, the growth of green energy has been very low, almost nonexistent in the case of Madrid.

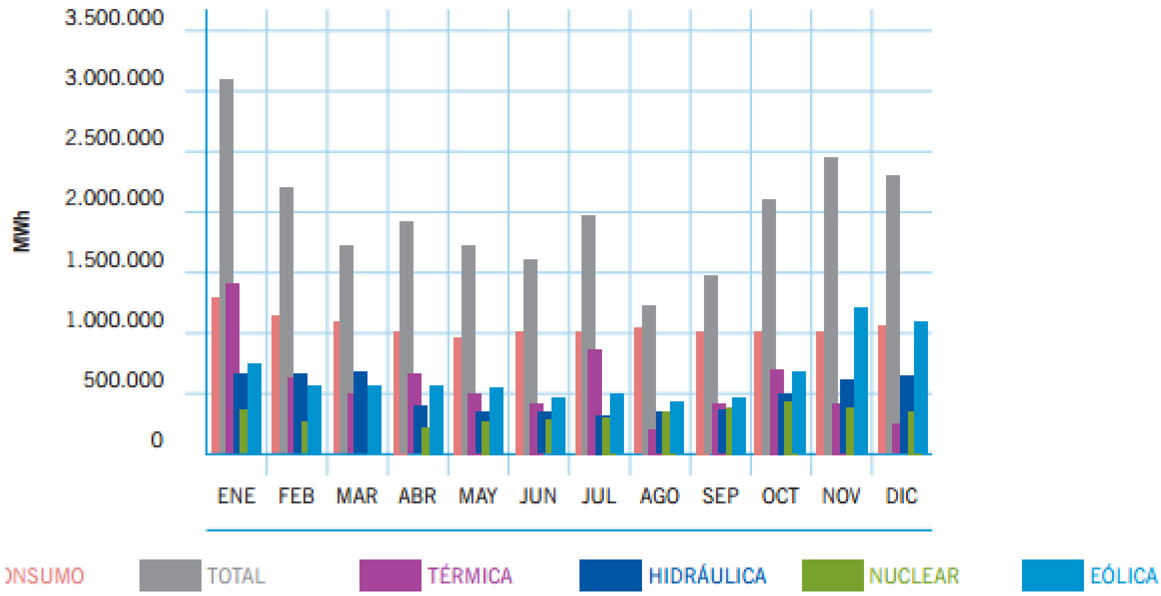

Figura 16. Monthly evolution of the Gross Electrical Energy Production and Total Consumption. Sources: Energy EREN (Ente Regional de Castilla y Leon).

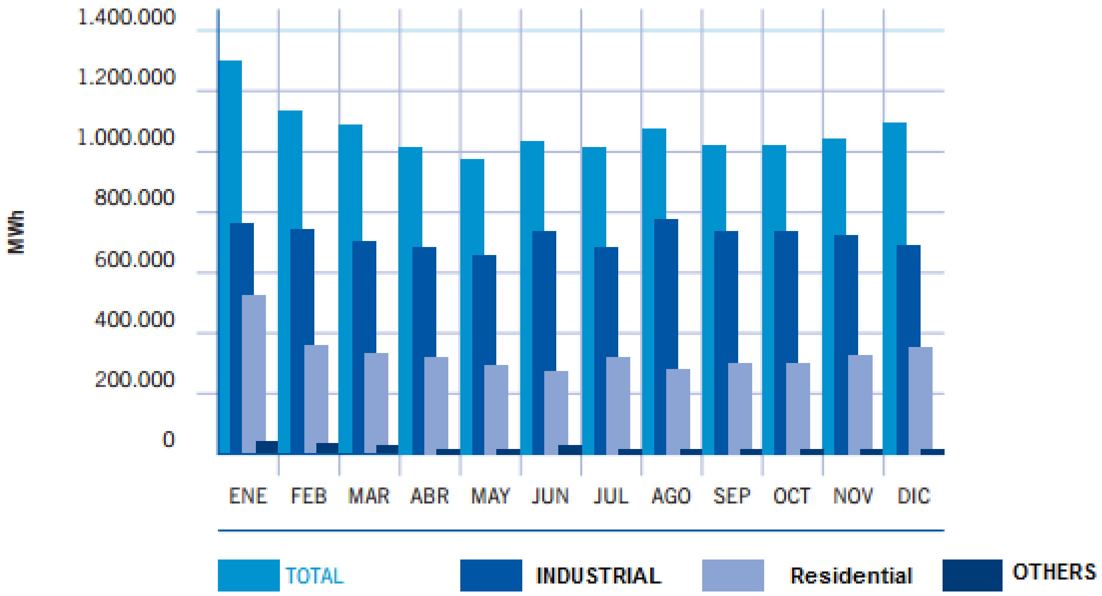

Figura 17. Monthly change in electricity consumption by sector in Castille and León. Sources: Energy EREN (Ente Regional de Castilla y Leon).

3.7 Rural: irrigation pumping (Aragón)

3.7.1 General description

The microgrid to be simulated in detail is an irrigation pumping station with wind power support and storage, located in the Valdabra reservoir (Huesca). Under the project SINTER (Intelligent Systems Stabilization Network) [1] a stabilizing system was installed with capacity to work both in islanding mode and connected to the grid. In this microgrid there are integrated wind power generation, a reversible hydraulic pump, hydrogen storage and ultracapacitors. With this demonstrator, not only the pumping needs are satisfied, but also the transport capacity of the rural network is increased, allowing the connection of new consumption without the need of investing in grid extension.

The pumping station is located at Valdabra, next to the reservoir of the same name, near the town of Huesca (see **¡Error! No se encuentra el origen de la referencia.**). The Valdabra reservoir has a capacity of 1,997,000 cubic meters.

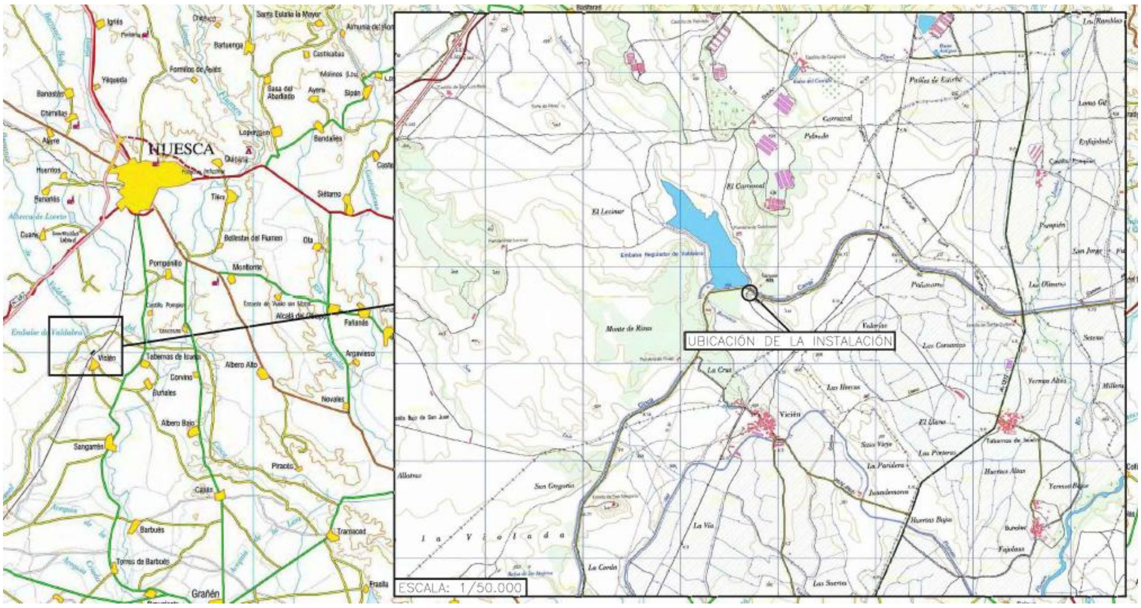

Figura 18. Location of Valdabra pumping station.

The building of the pumping station (Illustration 6) of 7 x 16 m, contains three conventional pumps and one reversible pump and electrical installations. The building also contains the low-voltage distribution devices with their respective general and individual protections for each line. The transformer which feeds the installation (owned by ERZ Endesa) is located near to the building.

The centrifugal pumps are rated at 150 hp (110.4 kW) each, able to elevate 289 m^3 / h to a height of 92.3 m (see **¡Error! No se encuentra el origen de la referencia.**). The suction pipes are galvanized steel and have check valves to prevent reversed flows. The discharge pipe is equipped with a gate valve and a check valve for each pump.

Ilustración 6. Building of the pumping station.

Ilustración 7. Existing pumps with intake for reversible pump.

3.7.2 Configuración de la instalación

The installation consists of the following elements:

- AC/DC converter for grid connection
- Chopper with resistors
- Wind Turbine 250 kW
- Three simple and one reversible hydraulic pump
- Energy storage with ultracaps
- Portable energy storage system
- Control and communication system

The wiring diagram with the elements of this demonstrator is shown in Fig. 21.

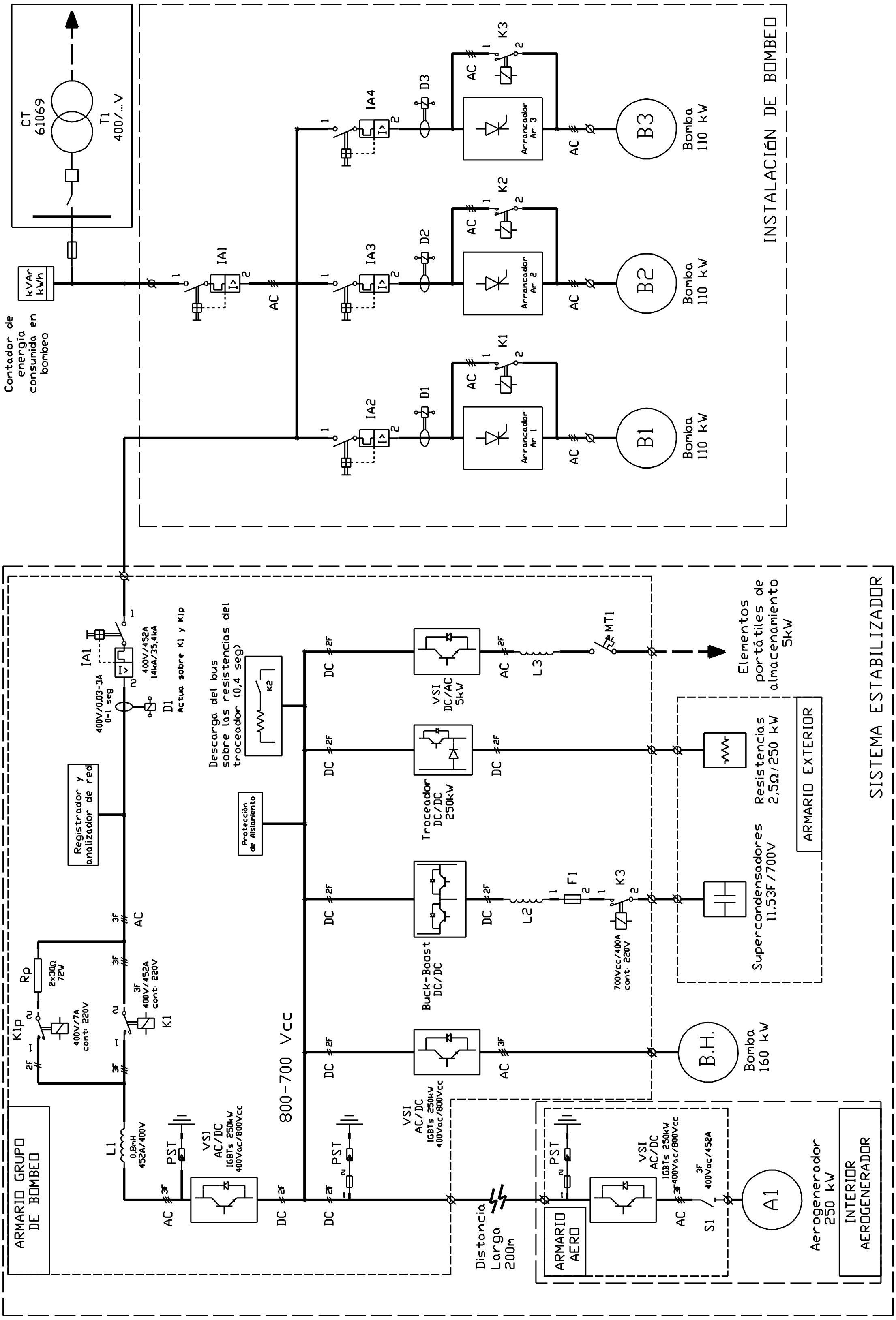

Figura 19. Single phase diagram of the microgrid with pumping station.

The single phase diagram shows the transformer (T1) which feeds the installation from the main grid, the three pumps (B1 - B3) and the SINTER equipment (SISTEMA ESTABILIZADOR).
In the following paragraphs, a summary is given on the characteristics of the main elements used in the microgrid.

3.7.3 Grid converter, wind turbine and reversible pump

The converter used for the connection to the main grid and for controlling the wind generator is a three-phase AC/DC VSI converter using IGBT (insulated gate bipolar transistor) switches. A 250 kW compact module from Semikron was chosen, which comes integrated with the IGBTs, the drivers with their protections, the DC-bus capacitor bank, and includes sensors for voltage, current and temperature. For 250 kW two Semikubes are needed, since each Semikube incorporates up to two branches of IGBTs. The converter of the pump is similar, but consists of a single Semikube, as its power is only 160 kW. Illustration 8 shows the power cabinet and grid-side filters.

Ilustración 8. Power cabinet (left) and grid-side filters (right).

3.7.4 Wind turbine

This is a 250 kW single-bladed turbine (Illustration 9), designed and built by the company ADES, Its most interesting features are the oscillating rotor and a powertrain pendulum, which compensates for torque and power peaks, with incidence of wind to leeward. Nominal wind speed is 11.5 m/s, cut-in wind speed is 4 m/s and cut-off 20 m/s.

Ilustración 9. 250 kW single-bladed ADES wind turbine with oscillating rotor and powertrain pendulum.

3.7.5 Chopper with resistors and ultracapacitors

The converter used for the power supply of resistors is a buck converter with a single switch. The one used for charging and discharging the ultracapacitors is a Buck-Boost converter. In both cases a DC/DC Buck-Boost type Semikron Skiip was chosen which counts with a branch of two IGBTs of 250 kW (only one IGBT is used in the first converter), which includes transistors, firing drivers, current sensor, temperature, and heat sink.

Chopper resistors

The resistors chosen, from Tyco Electronics, are placed in three cabinets 2200 mm high, 700 mm wide and 450 mm deep (see Illustration 10). Each cabinet contains a set of resistors giving a resulting ohmic value of 7.5 Ω, which are able to dissipate up to 100 kW. In addition, they count with an over-temperature detector (bimetal contact).

Ilustración 10. Chopper resistor cabinets, situated outside the building.

Ultracapacitors

The installed ultracapacitors from Maxwell are 3000 F (farad) each. It was included a kit that performs active compensation for balancing. Each individual cell has a voltage of 2.7 V, thus, to achieve the required 700 V, 260 ultracapacitors were connected in series (see Illustration 11). The total combined capacity is 11.5 F.

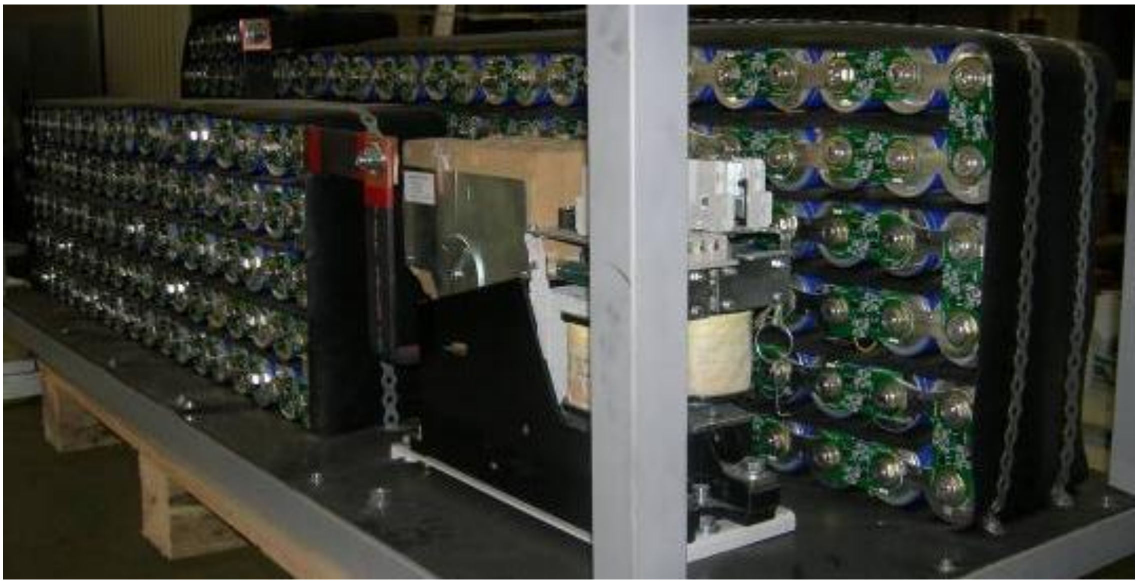

Ilustración 11. Detail of the cabinet with ultracapacitors.

3.7.6 Reversible hydraulic pump

The variable power reversible pump is a centrifugal pump, which complies with DIN normative relating to dimensions and hydraulic performance.

Usage area of the pump:

- Flow: Q = up to 400 m^3/h
- Height: H = up to 150 m.c.l.
- Speed: n = up to 3000 r.p.m

Ilustración 12. Installed reversible pump.

3.7.7 Control and communication system

In this installation the control system coordinates the operation of the three pumps and SINTER equipment, including communications between them. The schema of elements and communications can be seen in **¡Error! No se encuentra el origen de la referencia.**. The control and communication system includes the following elements:

- AIRE equipment: Monitoring of electrical variables, including grid power quality in alternating current.
- ET200 Siemens PLC for automated control system. There is also a Siemens S7-1200 controller installed which acts as a MODBUS gateway management system of the existing pumping station.
- Local SCADA installed on a Simatic Panel PC 677B from Siemens.

The developed SCADA system allows users to act on the installation and access relevant information. It consists of a main screen with the outline of the demonstrator (see **¡Error! No se encuentra el origen de la referencia.**), which gives access by clicking on each element that composes it, to other subordinate screens with information specific to them. It is also possible to configure system variables and manage warnings and alarms.

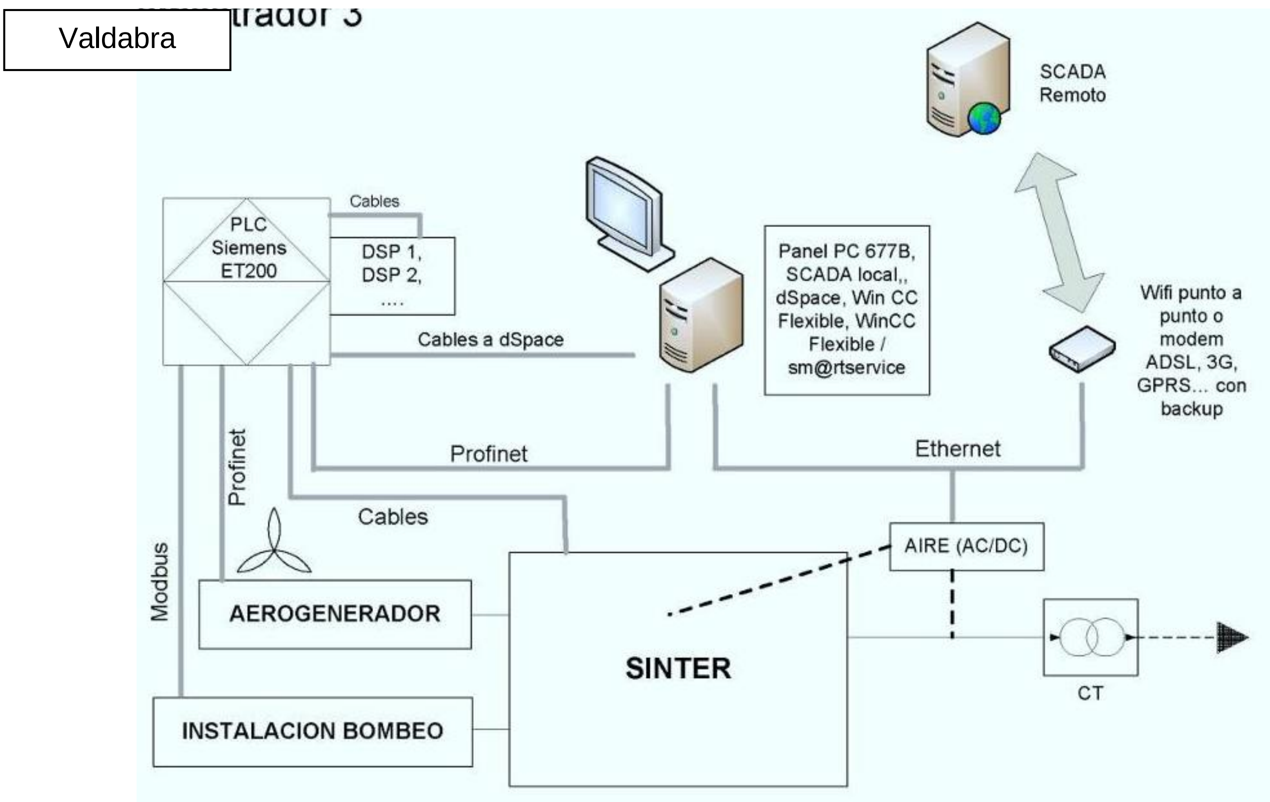

Figura 20. Schema of the control and communications System of the Valdabra microgrid.

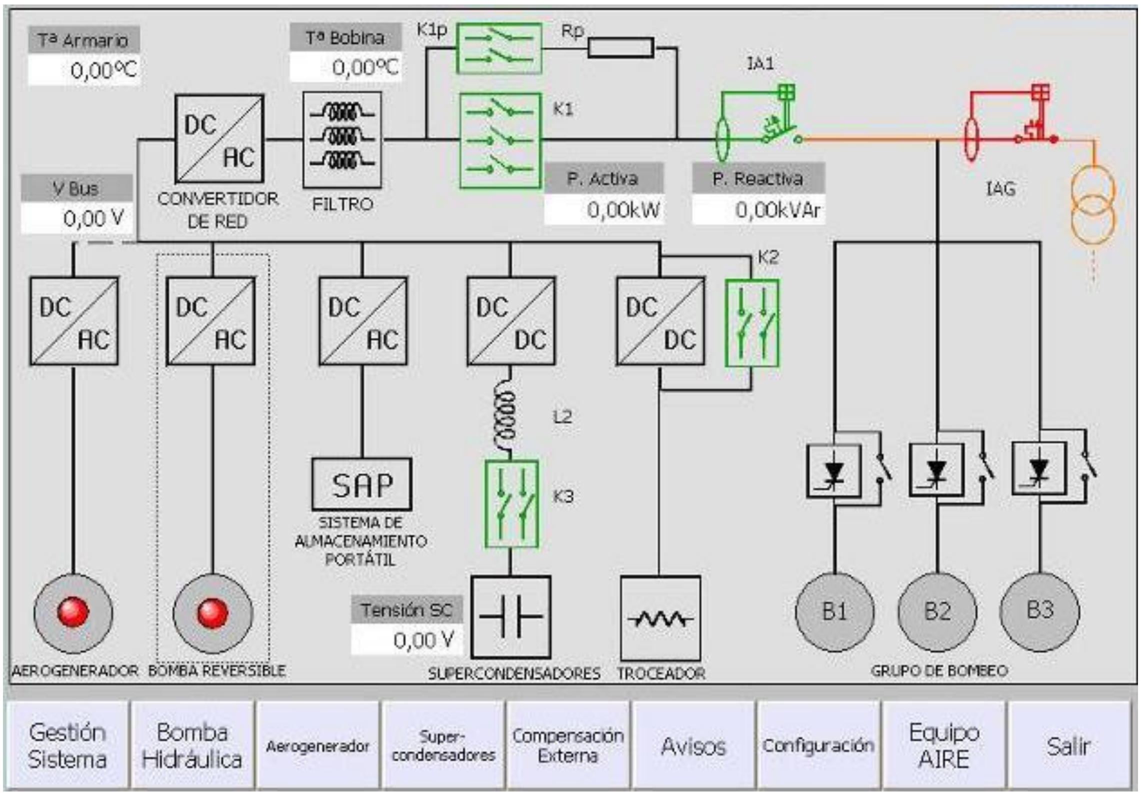

Figura 21. SCADA main screen of the installed system.

3.7.8 Demand profile of irrigation pumping stations

The consumption of the pumps is highly seasonal. Due to the lack of measured data, the estimation of the expected consumption of the Valdabra pumping station is based on load curves published by the Spanish National Energy Commission (Comisión Nacional de Energía) (CNE) [2] and published data of the Energy Efficiency Project in irrigation of Navarre ("Proyecto de eficiencia energética en los regadíos de Navarra") [3]. In the report of the CNE, in paragraph 4.10 ("Curvas de Carga de riegos") two load curves are presented, which can be seen in **¡Error! No se encuentra el origen de la referencia.**. In this case, the terms "summer" and "winter" are used to distinguish the summer irrigation season of the year from the wet season with very low irrigation.

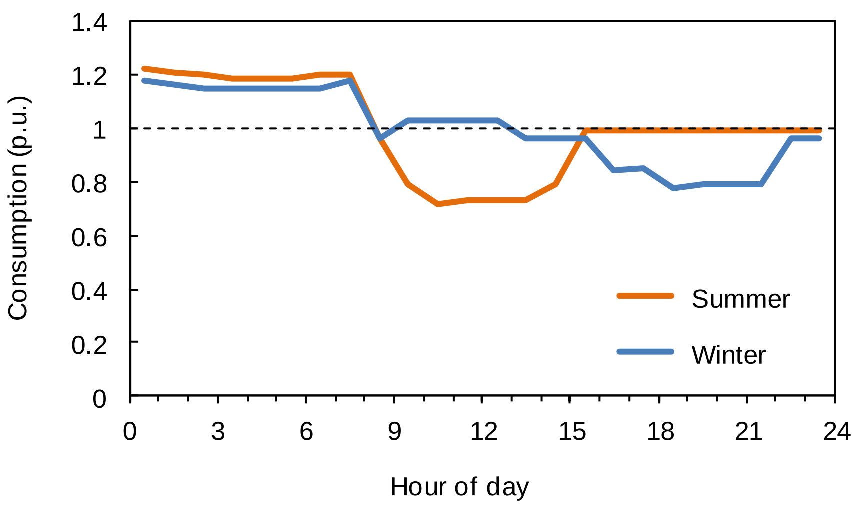

Figura 22. Load curves relative to the mean, published by CNE [2].

As the curves in **¡Error! No se encuentra el origen de la referencia.** are profiles relative to the mean, in order to get the absolute consumption values, some reference to the mean consumption is required. Therefore, monthly data are used here from [3]. As stated in this report, those data were obtained through the evaluation of electricity bills from the years 2004 and 2005, and the analysis of other electrical information and the basic characteristics of irrigation that affect consumption. As shown in **¡Error! No se encuentra el origen de la referencia.**, the power consumption is highly seasonal.

80% of consumption occurs from May to September (irrigation season). Furthermore, only the months of July and August account for nearly 50% of global consumption. To assign the curves of irrigation, summer is defined as the six months of highest consumption (May-October) and the remaining months as winter. Thus, the average of the summer represents 85% and winter 15% of the annual total consumption (see Table 9).

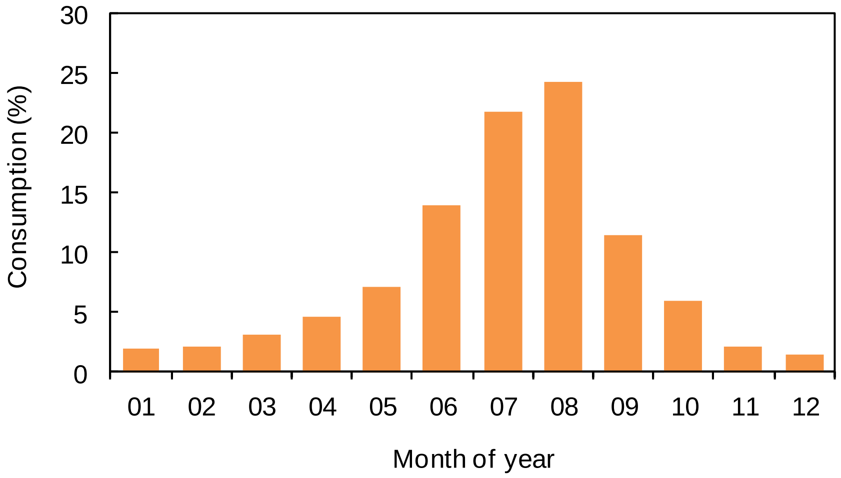

Figura 23.Seasonality of the electric consumption of irrigation pumping [3].

	Month	Mean of 2004 and 2005 [%]	Seasonal mean consumption [%]
Summer	May	7.1	84.75
	Jun	14.0	
	Jul	21.9	
	Aug	24.4	
	Sep	11.5	
	Oct	5.9	
Winter	Nov	2.1	15.25
	Dec	1.4	
	Jan	1.9	
	Feb	2.1	
	Ma	3.1	
	Apr	4.6	

Tabla 10. Monthly mean electricity consumption for irrigation pumping [3].

Finally, combining the information from the two sources [2] and [3] two curves as shown in **¡Error! No se encuentra el origen de la referencia.** can be generated, scaling the curves in **¡Error! No se encuentra el origen de la referencia.** by the seasonal mean values.

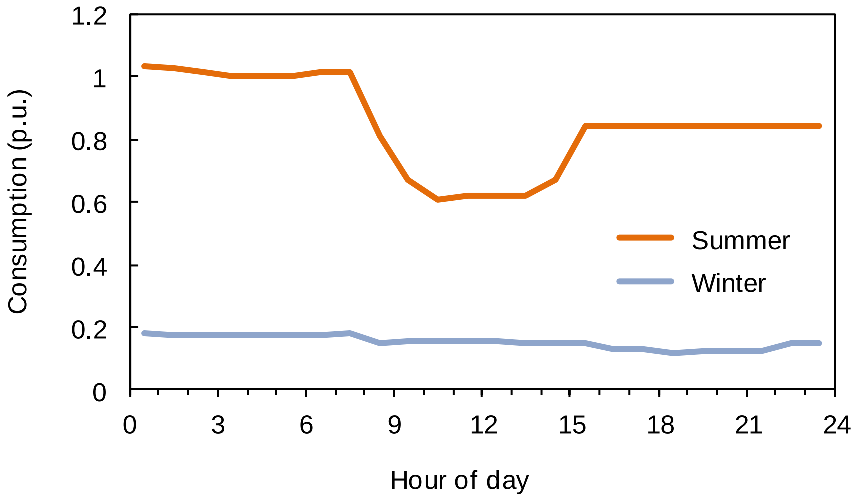

Figura 24. Relative load curves scaled by seasonal mean (0.85 in summer and 0.15 in winter).

For the simulation monthly averages can also be used. We propose to assign the monthly averages of summer (May to October) to the summer profile and the others the winter profile. This way, 12 different profiles are obtained as shown in **¡Error! No se encuentra el origen de la referencia.**. In this case it is appropriate to assume that there is a maximum pumping power and all the curves are represented relative to that power.

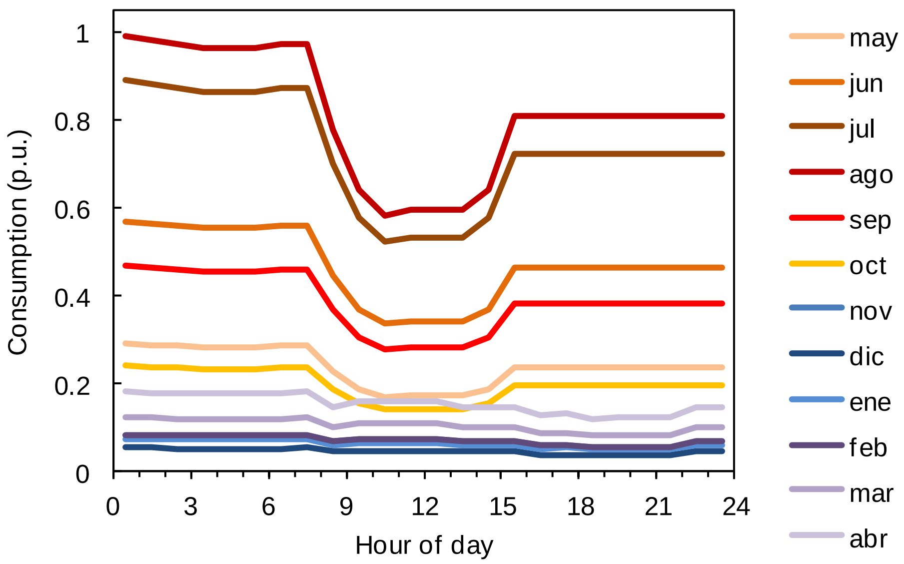

Figura 25. Daily load curves, scaled with monthly mean consumption, relative to the maximum.

3.8 Generic case: Industrial area with small workshops and industrial stores

3.8.1 Introduction

The objective of this report is to define typical consumption patterns of industrial areas where the activity is dominated by small workshops, small factories and industrial stores. This type of industrial areas is very common in the entire zone of SUDOE (Portugal, Spain and south-west France). The presented results are inspired by real data from several industrial areas, situated in northern Spain. Aggregated consumption measurements have been used from two transformer stations which supply together about 150 companies. From the data, consumption patterns could be identified.

¡Error! No se encuentra el origen de la referencia. shows the distribution of activities for the study case. In rder to show the degree of representativeness, the distribution of activities for the metropolitan area of Zaragoza is also shown, which includes about 1400 companies [4]. This is considered as a sufficiently large sample which permits the assumption that it may be used as a reference for SUDOE zone. Although the trade and distribution sector seems to be the most important, it accounts only for 30% of total activity. Almost all other categories (except transportation and service) could be described as industry and workshops which represent 54% of the total and thus represent the dominating activity.

Comparing the values of Metropolitan Zaragoza with the study case, some differences can be observed. While in the study case there are less industrial workshops in the sector "Metal" (13.4% compared to 20.8% in Zaragoza), the share of "Construction" and "Wood & Furniture" is sensibly higher. Finally the number of companies in the sector of "Transport and Communications", which in Zaragoza amounts to 9.8%, only reaches 3.8% in the study case.

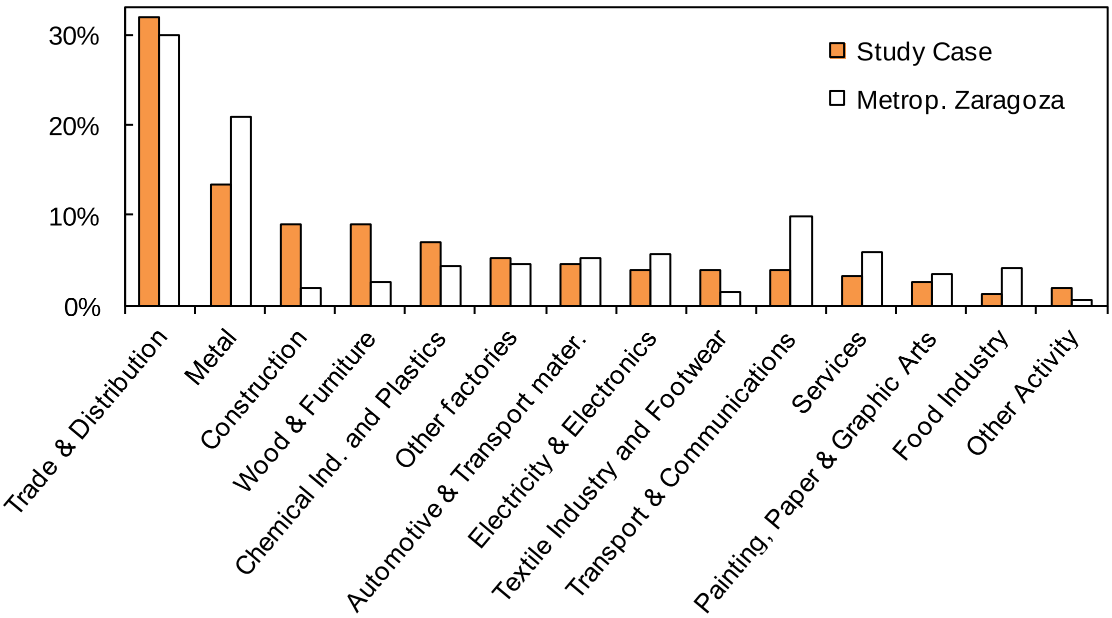

Figura 26. Distribution of activities in the observed industrial areas (Study Case) compared to the metropolitan area of the city of Zaragoza (Spain).

Despite these differences, the profile of activities is quite similar in both cases. Therefore it is assumed here that the results of the study case can be widely generalized for the entire SUDOE zone. Values from **¡Error! No se ncuentra el origen de la referencia.** are shown also in the following **¡Error! No se encuentra el origen de la referencia.**.

	Study Case	Metropolitan Zaragoza
Trade & Distribution	31.8	30.0
Metal	13.4	20.8
Construction	8.9	1.9
Wood and furniture	8.9	2.5
Chemical Ind. and Plastics	7.0	4.4
Other factories	5.1	4.6
Automotive & Transport material	4.5	5.1
Electricity / Electronics	3.8	5.6
Textile Industry and Footwear	3.8	1.4
Transport and Communications	3.8	9.8
Services	3.2	5.9
Painting/Paper & Graphic Arts	2.5	3.4
Food Industry	1.3	4.1
Other Activity	1.9	0.5

Tabla 11. Shares in percentage of activity of the study case compared to 1400 companies within Metropolitan Zaragoza.

3.8.2 Mean load curves of the industrial area

In this paragraph, load curves are presented. In **¡Error! No se encuentra el origen de la referencia.** the daily attern of the power factor (cos ϕ) is shown. In **¡Error! No se encuentra el origen de la referencia.** apparent and active power are represented. Due to lower power factors during demand peak hours, the peak of active power consumption is less emphasized compared to the peak of apparent power.
As a consequence, with power factor compensation (for example with FACTS) the daily consumption peak can be reduced from 1.37 p.u. down to 1.01 p.u., which would set free considerable line capacity.

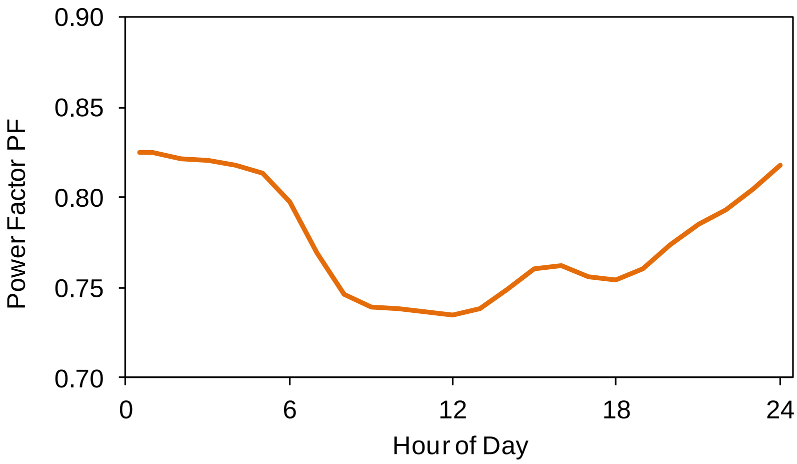

Figura 27. Daily mean profile of the power factor.

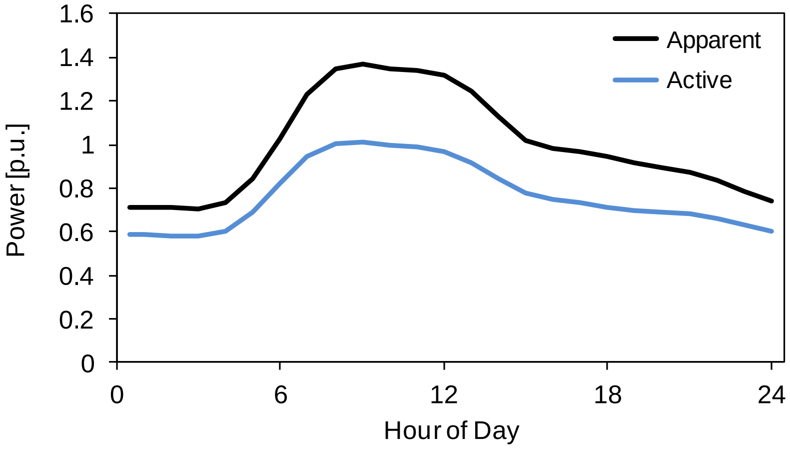

Figura 28. Demand profile of apparent power and associated active power, relative to the total mean apparent power.

The curves are representing mean values without taking into account the different curves for workdays and weekend. In **¡Error! No se encuentra el origen de la referencia.** and **¡Error! No se encuentra el origen la referencia.** daily mean profiles for the power factor and apparent power are shown for workdays, Saturday and Sunday. It can be observed that increased activity leads to slightly reduced values between 0.7 and 0.8. At night in general and at the weekend, power factors increase well above 0.8.

The reference power for calculation of [p.u.] values of apparent power is the total mean power, which is the same value as in **¡Error! No se encuentra el origen de la referencia.**.

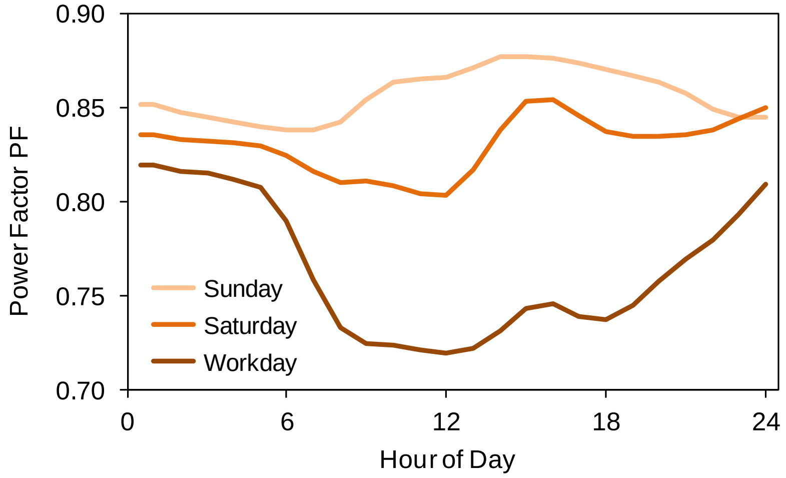

Figura 29. Daily mean profile of the power factor for workday, Saturday and Sunday

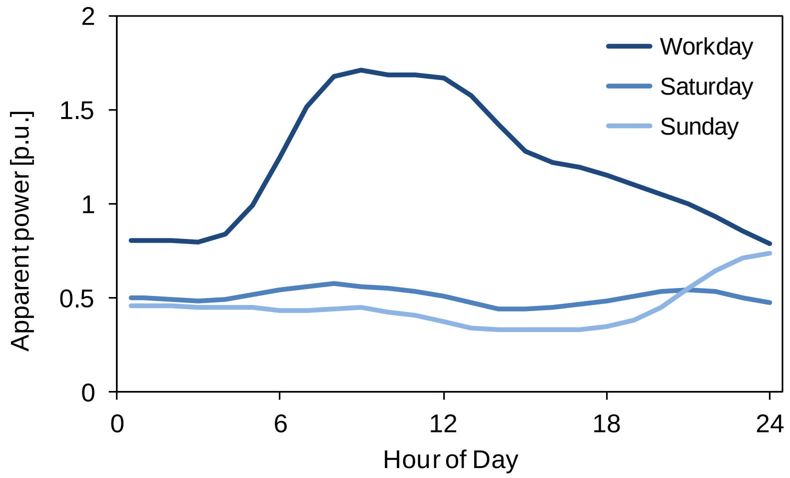

Figura 30. Different demand profiles of apparent power for workday, Saturday and Sunday, relative to total apparent mean power.

The assumed values for the weekly load profiles and power factors are summarized in Annex 2.
Taking into account different profiles for workdays and weekend, power factor compensation becomes even more important. Compensating a power factor of 0.72 reduces the daily peak from 1.71 p.u. down to 1.23 p.u.. While from **¡Error! No se encuentra el origen de la referencia.** reductions of 0.36 p.u. could be achieved, in this case the eduction reaches 0.48 p.u..

3.8.3 Variability of the load curves

Mean load curves are a good tool for having an orientation of global consumption patterns of an industrial area. But even distinguishing curves for workday and weekend is only a very rough approximation of real consumption conditions, especially regarding small areas, where large rapid fluctuations can be observed in the consumption. Therefore, this section aims to give some additional tools in order to characterize the demand. In **¡Error! No se encuentra el origen de la referencia.**, several percentiles are plotted together with the median (50% percentile) of the curves presented previously in this study. Tables with detailed values of **¡Error! No se encuentra el origen e la referencia.** can be found in Appendix A. It may be mentioned, that 30-min mean values were used for this study, but for reasons of simplicity in the presentation of the results, these values were grouped in hourly values.

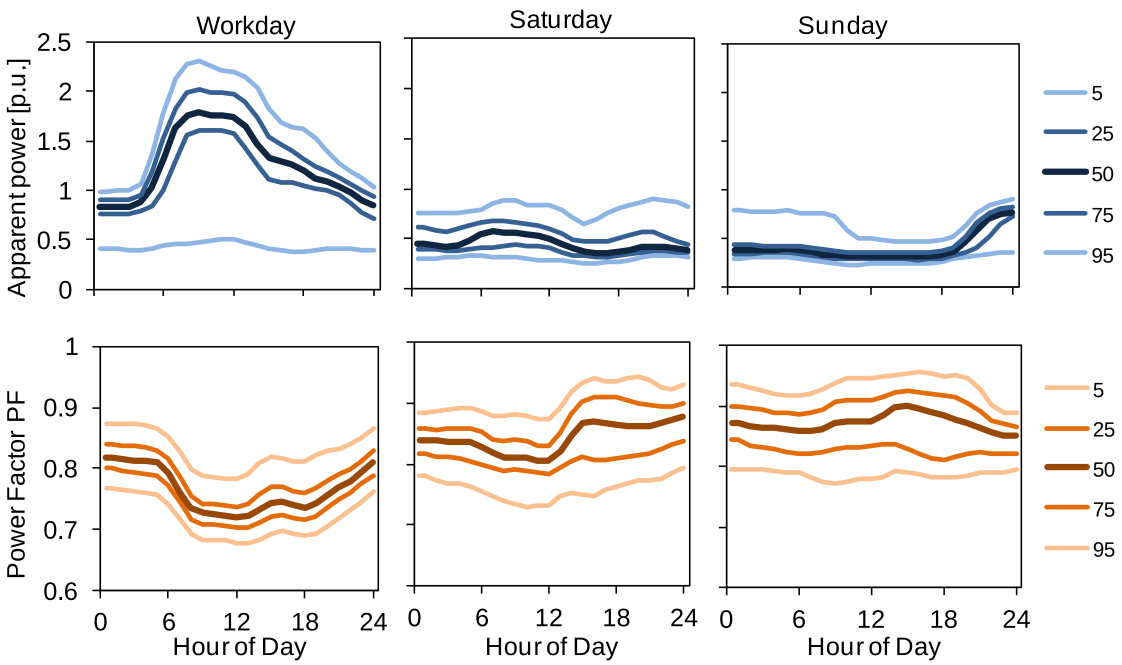

Figura 31. Percentile plot of daily load profiles for apparent power (above) and power factor (below).

It can be observed that the variability of apparent power is higher on workdays with a wide range between the 5 and 95% percentile. It should be mentioned that the low 5% percentile on workdays may be due to holidays which have not been removed from the workday dataset. Most critical is the observation that the peak load between 8-12h for the 95% percentile reaches values approximately 25% higher than the median (50% percentile). That means also that 5% of the power data are even higher. These load peaks are rare and could be smoothed out very well with an adequately sized energy storage unit.

Power factors in general show very low variability. Even though, power factor compensation (with FACTS for example) could reduce the apparent power consumption and set free considerable amounts of distribution power capacity. As lowest power factors occur at consumption peaks, these peaks can be reduced up to 30%, which corresponds to a power factor of 0.7.

3.8.4 Conclusions

Typical mean demand profiles have been derived for industrial areas with small factories and industrial supply stores (retail and wholesale). In a first step, a typical power demand profile was identified, presenting the daily patterns of apparent power and power factor.

In a second step, different mean load profiles are established for workdays, Saturdays and Sundays. This gives some more detail for modeling, but the essential information about power factor and daily profile are widely the same as for the total mean.

Finally, additional information is obtained from a statistical study of the variability of the load curves. It could be seen that 50% of the power values are situated rather close to the mean curve, but the remaining data are widely scattered. This large variability is typical of these relatively small industrial areas.

From the presented load curves, important conclusions can be derived for the usefulness of distributed resources such as FACTS, energy storage and renewable generation.

Distributed renewable generation, FACTS and/or energy storage in the proximity of these industrial areas can compensate for large amounts of reactive power and smooth the power curve. Only with power factor compensation, the daily peak power may be reduced considerably, which increases distribution line capacity. Energy

storage systems can smooth out rapid fluctuations and rare power peaks, which further increases line capacity, as the load curve is approximated to the hourly mean values. Finally, distributed generation systems (such as solar) can further reduce daily peak demand as the maximum of the consumption is located in the central hours of the day where solar radiation is highest.
All these aspects are part of the concept of intelligent microgrids and are considered in the following tasks of the Optimagrid project.

3.8.5 Total mean demand profile

Hour	Apparent Power [p.u.]	Active power [p.u.]	Power Factor
1	0.71	0.59	0.82
2	0.71	0.59	0.82
3	0.71	0.58	0.82
4	0.71	0.58	0.82
5	0.74	0.60	0.82
6	0.84	0.69	0.81
7	1.03	0.82	0.80
8	1.23	0.95	0.77
9	1.35	1.00	0.75
10	1.37	1.01	0.74
11	1.35	1.00	0.74
12	1.34	0.99	0.74
13	1.32	0.97	0.73
14	1.24	0.92	0.74
15	1.13	0.84	0.75
16	1.02	0.78	0.76
17	0.98	0.75	0.76
18	0.97	0.73	0.76
19	0.94	0.71	0.75
20	0.91	0.69	0.76
21	0.89	0.69	0.77
22	0.87	0.68	0.78
23	0.83	0.66	0.79
24	0.79	0.63	0.80

Tabla 12. Values for apparent power and power factors of total mean daily profiles.

3.8.6 Weekly demand profiles

	Apparent Power [p.u.]			Power Factor		
H	Workday	Saturday	Sunday	Workday	Saturday	Sunday
1	0.81	0.50	0.46	0.82	0.84	0.85
2	0.81	0.50	0.46	0.82	0.84	0.85
3	0.80	0.49	0.46	0.82	0.83	0.85
4	0.80	0.49	0.45	0.81	0.83	0.85
5	0.84	0.49	0.45	0.81	0.83	0.84
6	0.99	0.51	0.45	0.81	0.83	0.84
7	1.24	0.54	0.43	0.79	0.82	0.84
8	1.52	0.56	0.43	0.76	0.82	0.84
9	1.68	0.57	0.44	0.73	0.81	0.84
10	1.71	0.56	0.45	0.72	0.81	0.85
11	1.69	0.55	0.42	0.72	0.81	0.86
12	1.68	0.54	0.40	0.72	0.80	0.87
13	1.67	0.51	0.37	0.72	0.80	0.87
14	1.58	0.47	0.34	0.72	0.82	0.87
15	1.42	0.44	0.33	0.73	0.84	0.88
16	1.28	0.44	0.33	0.74	0.85	0.88
17	1.22	0.45	0.33	0.75	0.85	0.88
18	1.19	0.46	0.33	0.74	0.85	0.87
19	1.16	0.48	0.35	0.74	0.84	0.87
20	1.10	0.50	0.38	0.74	0.84	0.87
21	1.05	0.53	0.45	0.76	0.83	0.86
22	1.00	0.54	0.55	0.77	0.84	0.86
23	0.93	0.53	0.65	0.78	0.84	0.85
24	0.86	0.50	0.71	0.79	0.84	0.85

Tabla 13. Values for apparent power and power factors of daily mean profiles for workdays, Saturday and Sunday

3.8.7 Percentiles of weekly demand profiles

	Workday					Saturday					Sunday				
H	5	25	**50**	75	95	5	25	**50**	75	95	5	25	**50**	75	95
1	0.41	0.77	**0.84**	0.90	0.99	0.31	0.39	**0.46**	0.62	0.75	0.30	0.35	**0.39**	0.43	0.79
2	0.40	0.76	**0.83**	0.90	0.99	0.31	0.39	**0.44**	0.58	0.75	0.30	0.35	**0.38**	0.43	0.78
3	0.40	0.76	**0.83**	0.90	1.00	0.31	0.38	**0.43**	0.57	0.75	0.30	0.35	**0.38**	0.43	0.77
4	0.40	0.79	**0.87**	0.96	1.07	0.32	0.39	**0.44**	0.60	0.76	0.30	0.35	**0.39**	0.43	0.78
5	0.41	0.84	**1.03**	1.19	1.36	0.33	0.39	**0.48**	0.64	0.77	0.31	0.35	**0.39**	0.43	0.79
6	0.43	1.00	**1.33**	1.53	1.79	0.33	0.41	**0.54**	0.67	0.78	0.30	0.34	**0.38**	0.42	0.77
7	0.45	1.31	**1.63**	1.84	2.13	0.32	0.42	**0.57**	0.68	0.85	0.28	0.33	**0.36**	0.41	0.75
8	0.46	1.56	**1.76**	1.99	2.28	0.32	0.43	**0.57**	0.69	0.89	0.26	0.31	**0.34**	0.39	0.76
9	0.47	1.61	**1.79**	2.03	2.31	0.32	0.44	**0.55**	0.66	0.88	0.24	0.30	**0.33**	0.37	0.73
10	0.49	1.60	**1.77**	2.00	2.25	0.31	0.43	**0.54**	0.65	0.84	0.24	0.29	**0.32**	0.36	0.58
11	0.50	1.61	**1.76**	1.98	2.21	0.29	0.43	**0.53**	0.64	0.83	0.24	0.29	**0.32**	0.35	0.51
12	0.50	1.58	**1.74**	1.98	2.21	0.28	0.41	**0.50**	0.60	0.83	0.24	0.29	**0.32**	0.35	0.50
13	0.48	1.43	**1.64**	1.90	2.16	0.28	0.37	**0.45**	0.55	0.79	0.24	0.29	**0.32**	0.35	0.49
14	0.44	1.25	**1.47**	1.73	2.03	0.27	0.34	**0.41**	0.50	0.70	0.24	0.29	**0.32**	0.35	0.47
15	0.41	1.12	**1.33**	1.54	1.83	0.26	0.33	**0.38**	0.47	0.65	0.24	0.29	**0.32**	0.35	0.46
16	0.40	1.08	**1.29**	1.46	1.68	0.26	0.32	**0.36**	0.47	0.69	0.24	0.28	**0.32**	0.35	0.47
17	0.38	1.07	**1.26**	1.40	1.63	0.27	0.32	**0.36**	0.48	0.76	0.25	0.29	**0.32**	0.36	0.48
18	0.38	1.05	**1.20**	1.32	1.62	0.27	0.33	**0.37**	0.51	0.81	0.27	0.30	**0.33**	0.37	0.49
19	0.39	1.02	**1.12**	1.24	1.53	0.29	0.34	**0.39**	0.54	0.84	0.29	0.33	**0.36**	0.41	0.52
20	0.41	0.99	**1.08**	1.18	1.39	0.32	0.36	**0.41**	0.57	0.87	0.31	0.36	**0.46**	0.52	0.62
21	0.41	0.95	**1.04**	1.13	1.27	0.33	0.38	**0.42**	0.56	0.89	0.32	0.40	**0.59**	0.66	0.76
22	0.40	0.87	**0.97**	1.07	1.20	0.33	0.37	**0.42**	0.52	0.89	0.34	0.51	**0.70**	0.76	0.84
23	0.39	0.78	**0.90**	1.00	1.13	0.33	0.36	**0.40**	0.47	0.86	0.36	0.64	**0.75**	0.80	0.88
24	0.38	0.70	**0.84**	0.93	1.04	0.32	0.36	**0.40**	0.44	0.82	0.36	0.72	**0.77**	0.82	0.90

Tabla 14. Percentiles for apparent power (p.u.) of daily profiles for workdays, Saturday and Sunday.

	Workday					Saturday					Sunday				
H	5	25	**50**	75	95	5	25	**50**	75	95	5	25	**50**	75	95
1	0.77	0.80	**0.82**	0.84	0.87	0.78	0.82	**0.84**	0.86	0.88	0.80	0.84	**0.87**	0.90	0.93
2	0.77	0.80	**0.82**	0.84	0.87	0.78	0.82	**0.84**	0.86	0.88	0.80	0.84	**0.87**	0.90	0.93
3	0.76	0.80	**0.81**	0.84	0.87	0.77	0.81	**0.84**	0.86	0.89	0.80	0.83	**0.87**	0.90	0.93
4	0.76	0.79	**0.81**	0.84	0.87	0.77	0.81	**0.84**	0.86	0.89	0.80	0.83	**0.87**	0.89	0.93
5	0.76	0.79	**0.81**	0.83	0.87	0.77	0.81	**0.84**	0.86	0.89	0.79	0.83	**0.87**	0.89	0.92
6	0.76	0.79	**0.81**	0.83	0.87	0.76	0.81	**0.84**	0.86	0.89	0.79	0.82	**0.86**	0.89	0.92
7	0.74	0.77	**0.79**	0.82	0.85	0.75	0.80	**0.83**	0.85	0.89	0.79	0.82	**0.86**	0.89	0.92
8	0.72	0.74	**0.76**	0.78	0.83	0.75	0.79	**0.82**	0.84	0.88	0.78	0.82	**0.86**	0.89	0.92
9	0.69	0.72	**0.73**	0.75	0.80	0.74	0.79	**0.81**	0.84	0.88	0.77	0.82	**0.86**	0.90	0.93
10	0.68	0.71	**0.73**	0.74	0.79	0.73	0.79	**0.81**	0.84	0.88	0.77	0.83	**0.87**	0.91	0.94
11	0.68	0.71	**0.72**	0.74	0.79	0.73	0.79	**0.81**	0.84	0.88	0.77	0.83	**0.88**	0.91	0.95
12	0.68	0.71	**0.72**	0.74	0.78	0.73	0.79	**0.81**	0.83	0.87	0.78	0.83	**0.87**	0.91	0.95
13	0.68	0.70	**0.72**	0.74	0.78	0.73	0.78	**0.81**	0.83	0.87	0.78	0.83	**0.88**	0.91	0.95
14	0.68	0.70	**0.72**	0.74	0.79	0.75	0.79	**0.82**	0.85	0.89	0.78	0.84	**0.89**	0.91	0.95
15	0.68	0.71	**0.73**	0.76	0.81	0.75	0.81	**0.85**	0.88	0.92	0.79	0.84	**0.90**	0.92	0.95
16	0.69	0.72	**0.74**	0.77	0.82	0.75	0.81	**0.87**	0.90	0.93	0.79	0.83	**0.90**	0.93	0.95
17	0.70	0.72	**0.75**	0.77	0.82	0.75	0.81	**0.87**	0.91	0.94	0.79	0.82	**0.90**	0.92	0.96
18	0.69	0.72	**0.74**	0.76	0.81	0.76	0.81	**0.87**	0.91	0.94	0.78	0.81	**0.89**	0.92	0.95
19	0.69	0.72	**0.74**	0.76	0.81	0.76	0.81	**0.87**	0.91	0.94	0.78	0.81	**0.88**	0.92	0.95
20	0.69	0.72	**0.74**	0.77	0.82	0.77	0.81	**0.86**	0.91	0.94	0.78	0.82	**0.88**	0.92	0.95
21	0.71	0.74	**0.76**	0.78	0.83	0.77	0.81	**0.86**	0.90	0.94	0.78	0.82	**0.87**	0.90	0.95
22	0.72	0.75	**0.77**	0.79	0.83	0.77	0.82	**0.86**	0.90	0.94	0.79	0.82	**0.87**	0.89	0.93
23	0.73	0.76	**0.78**	0.80	0.84	0.78	0.82	**0.87**	0.89	0.92	0.79	0.82	**0.86**	0.88	0.90
24	0.74	0.77	**0.79**	0.81	0.85	0.79	0.83	**0.87**	0.90	0.92	0.79	0.82	**0.85**	0.87	0.89

Tabla 15. Percentiles for power factor of daily profiles for workdays, Saturday and Sunday.

4 REFERENCES

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[3] Idoia Ederra Gil y Pilar Larumbe Martín, "Primera fase del 'Proyecto de eficiencia energética en los regadíos de Navarra' ", Servicio de Asesoramiento al Regante de Riegos de Navarra, S.A., available online: http://www.riegosdenavarra.com/ publica/publicaciones.htm

[4] Town council (Ayuntamiento) of Zaragoza, "Los polígonos industriales en Zaragoza y su entorno metropolitano: Deficiencias y potencialidades"

[5] ZEROHYTECHPARK Project, http://www.zerohytechpark.eu/

[6] Parque Tecnológico Walqa, http://www.walqa.com/

ANNEX 1

A1. Technological Park: Walqa Technological Park (Huesca)

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
Electricity	Own consumption from self generation			65625.33	kWh per month		
	From other self generators				kWh		
	From electrical grid	Tariff	Market	If tariff is known, indicate it. TUR: Last Resource Tariff			
			Regulated	230103.67	kWh per month	Endesa	27612.44
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)					
Gas-Oil A (For internal transport)			litters kg		
Gas-Oil B	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating	2663.42	Litter per month	Repsol	
Gas-Oil C	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				

Fuel-Oil types: Fuel-1; Fuel-2; Cogeneration	Electrical generation			litters / kg / Ton		
	Industrial uses					
	Heating					
Liquefied Natural Gas (GNL)	Electrical generation			kWh		
	Raw material (no energetic uses)					
	Industrial uses					
	Heating					
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market / Other: TUR,...		kWh		
Raw material (no energetic uses)		Liberalizated market / Other: TUR,...				
Industrial uses		Liberalizated market / Other: TUR,...				
Heating		Liberalizated market / Other: TUR,...				

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
LPG tanks	Electrical generation	Liters / kg / tonnes		
	Raw material (no energetic uses)			
	Industrial uses			
	Heating			
LPG pipe	Electrical generation	kg		
	Raw material (no energetic uses)			
	Industrial uses			
	Heating			
LPG cylinder	Bottle 12,5 Kg	kg		
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
	Other bottle type			

Coal		Especify type: Anthracite, Lignite, Bituminous coal, Coke	
Raw material (no energetic uses)		kg	
Industrial uses		tonnes	
Heating			
Petroleum coke	Raw material (no energetic uses)	kg	
	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water	10^3 kcal	
	Heating		
	Industrial uses		
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	quantity	Use(8)	Suppliers
Propane	2566.33 m^3 per month	Heat	RepsolGas - Oscagas

KEY DATA OF COMPANY's PRODUCTION (MAIN)

Description	Annual total production: Quantity	Annual total production: Units of measure

A.2 Port: Port of Bayonne (Port area of Tarnos)

Type d'énergie				Montant	Unités	Fournisseurs	Coût (€) (TVA incl.)
	Auto génération				kWh		
	Par d'autres generations				kWh		
				Si le tarif est connue l'indiqué.			
		Tarif	Marché	TUR: Dernier Tarif Connu			
			Réglementé	95 989 kWh (2009)		EDF	11 923 €
			Marché électrique libéralisé				
			Autres: TUR,...				
			Réglementé				
			Marché électrique libéralisé				
			Autres: TUR,...				
			Réglementé				
			Marché électrique libéralisé				
			Autres: TUR,...				
			Réglementé				
			Marché électrique libéralisé				
Electricité	A partir du réseau électrique		Autres: TUR,...		kWh		

Type d'énergie		Montant	Unité	Fournisseurs	Coût (€) (TVA incl.)
Gas-Oil (Pour le transport interne)		4622	litres kg[1]	TOTAL DYNEFF	6.247 €
Gas-Oil A (Pour le transport interne)			litres kg		
	Production électrique		litres		
	Transport (interne)		kg		
	Utilisation industrielles				
Gas-Oil B	Chauffage				
	Production électrique		litres		
	Transport (interne)		kg		
	Utilisation industrielles				
Gas-Oil C	Chauffage				
Mazout	Production électrique		litres		

types: Fuel-1; Fuel-2; Cogeneration				kg Tonne		
	Utilisation industrielles					
	Chauffage					
Gaz Naturel Liquéfié (GNL)	Production électrique			kWh		
	Matières premières (aucune untilisation énérgétique)					
	Utilisation industrielles					
	Chauffage					
Gaz Naturel du Réseau	**Tarif**	**Marché**	Si le tarif est connue l'indiqué TUR: Dernier Tarif Connu			
Electrical generation		Marché libéralisé Autres: TUR,...		kWh		
Matières (pas d'énergie utilisée)		Marché libéralisé Autres: TUR,...				
Utilisation industrielles		Marché libéralisé Autres: TUR,...				
Chauffage		Marché libéralisé Autres: TUR,...				

Type d'énergie		**Unité**	**Fournisseurs**	**Coût (€) (TVA incl.)**
Gaz de Pétrole Liquéfiée (GPL)				
Réservoirs GPL	Production d'électricité	Litres		
	Matières (aucune énergique utilise)	kg		
	Utilisations industrielles	tonnes		
	Chauffage			
Gazoduc GPL	Production d'électricité	kg		
	Matières (aucune énergique utilise)			
	Utilisations industrielles			
	Chauffage			
Bouteilles GPL	Bouteille 12,5 Kg	kg		
	Bouteille de 35 Kg			
	Bouteille de 12 Kg			
	Bouteille de 11 Kg			
	Autre type de bouteille			
Charbon	**Spécifiez type :** Anthracite, Lignite, de la houille, Coke			
Matières (aucune énergique utilise)		kg		

Utilisations industrielles		tonnes	
Chauffage			
Coke de pétrole	Matières (aucune énergique utilise)	kg	
	Utilisations industrielles	tonnes	
	Chauffage		
Énergie solaire thermique	m^2 total	m^2	
	eau chaude domestique		
	Chauffage		
	Utilisations industrielles	10^3 kcal	
La chaleur de l'unité de cogénération		10^6 kcal	

Autres carburants.				
Types (précisez : déchets de bois, de l'Agriculture / sylviculture, fusain, biogaz, biocarburants, kérosène de puissance, hydrogène, autres gaz de procédé, etc..).				
Carburant	**quantité**	**Utilisation[8]**	**Fournisseurs**	**Montant**
Essence SP95	3576	Voitures de service	TOTAL DYNEFF	5342 €

DONNÉES clés de la PRODUCTION de l'entreprise

Description	**Production totale annuelle**	
	Quantité	**Unités de mesure**
Données non transmises, faire la demande à la direction de la CCI		

A.3 Chemical industry: Polo Químico de Huelva

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
Electricity	Own consumption from self generation				kWh		
	From other self generators				kWh		
	From electrical grid	Tariff	Market	If tariff is known, indicate it. TUR: Last Resource Tariff			
			Regulated Liberalizated electrical market Other: TUR,...	-451.000	MWh	Unknown	-13,53 M€/year
			Regulated Liberalizated electrical market Other: TUR,...	800.000		Unknown	+ 72 M€/year
			Regulated Liberalizated electrical market Other: TUR,...				
			Regulated Liberalizated electrical market Other: TUR,...				

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			litters kg[1]		
Gas-Oil A (For internal transport)			litters kg**¡Error! Marcador no definido.**		
Gas-Oil B	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Gas-Oil C	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				

Fuel-Oil types: Fuel-1; Fuel-2; Cogeneration	Electrical generation			litters kg Ton		
	Industrial uses					
	Heating					
Liquefied Natural Gas (GNL)	Electrical generation			kWh		
	Raw material (no energetic uses)					
	Industrial uses					
	Heating					
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation (cogeneration)		Liberalizated market Other: TUR,...	-1.095.000	MWh	Gas Natural Fenosa	-19,8 M€/year
Raw material (no energetic uses)		Liberalizated market Other: TUR,...				
Industrial uses (Steam Production)		Liberalizated market Other: TUR,...	-812.000		Gas Natural Fenosa	-14,7 M€/year
Heating		Liberalizated market Other: TUR,...				

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
LPG tanks	Electrical generation	Liters kg tonnes		
	Raw material (no energetic uses)			
	Industrial uses			
	Heating			
LPG pipe	Electrical generation	kg		
	Raw material (no energetic uses)			
	Industrial uses			
	Heating			
LPG cylinder	Bottle 12,5 Kg	kg		
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
	Other bottle type			
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			

Raw material (no energetic uses)		kg	
Industrial uses		tonnes	
Heating			
Petroleum coke	Raw material (no energetic uses)	kg	
	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water		
	Heating		
	Industrial uses	10^3 kcal	
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use[(8)]**	**Suppliers**
Eucalyptus	240.000 Tn/year	Cogeneration	

KEY DATA OF COMPANY's PRODUCTION (MAIN)

	Annual total production	
Description	**Quantity**	**Units of measure**
Kraft paper pulp	410.000	Tn/year

A.4 Petrochemical Industry: Fuel storage Plant of Mitrena (Mitrena peninsula)

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
	Self generation for own consumption				*kWh*		
	Self generation to sell to the grid				*kWh*		
		Tariff	**Market**	*(Specify tariff and choose market) (TUR: Last Resource Tariff)*			
		Medium >3,000 MWh	Regulated	906.341 kWh		Galp Power	136.780,98 €
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
Electricity	**From electrical grid**		Other: TUR,...		*kWh*		

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			litters or kg[1]		
Gas-Oil A[2] (For internal transport)			*litters or kg*[1]		
	Electrical generation				
	Transport (internal)				
	Industrial uses				
Gas-Oil B[2]	Heating		*litters or kg*[1]		
	Electrical generation				
	Transport (internal)				
	Industrial uses				
Gas-Oil C[2]	Heating	204.493 kg	*litters or kg*[1]	Galp Servi Express / Galp Energia	254.110,88 €

Fuel-Oil[3]	Electrical generation					
types: Fuel-1; Fuel-2; Cogeneration	Industrial uses					
	Heating			*litters or kg*[1]		
Liquefied Natural Gas (GNL)	Electrical generation					
	Raw material (no energetic uses)					
	Industrial uses					
	Heating			*kWh*		
Natural Gas from grid						
	Tariff	**Market**	*(Specify tariff and choose market)* *(TUR: Last Resource Tariff)*			
Electrical generation		Liberalizated market				
		Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market				
		Other: TUR,...				
Industrial uses		Liberalizated market				
		Other: TUR,...				
Heating		Liberalizated market				
		Other: TUR,...		*kWh*		

Energy type		**Amount**	**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)					
	Electrical generation		*liters*		
	Raw material (no energetic uses)		*kg*		
	Industrial uses		*tonnes*		
LPG tanks	Heating				
	Electrical generation				
	Raw material (no energetic uses)				
	Industrial uses				
LPG pipe	Heating		*kg*		

LPG cylinder	Bottle 12,5 Kg				
	Bottle 35 Kg				
	Bottle 12 Kg				
	Bottle 11 Kg				
	Other bottle type		*kg*		
Coal (Specify type: Anthracite, Lignite, Bituminous coal, Coke)					
Raw material (no energetic uses)			*kg*		
Industrial uses			*tonnes*		
Heating					
Other					
Petroleum coke	Raw material (no energetic uses)		*kg*		
	Industrial uses		*tonnes*		
	Heating				
Thermo-solar energy	m^2 total		*m^2*		
	domestic hot water				
	Heating				
	Industrial uses		*10^3 kcal*		
Heat from cogeneration unit			*10^6 kcal*		

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**Quantity**	**Use**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)		
	Annual total production	
Description	**Quantity**	**Units of measure**
Total product expedition and reception	637.145	tonnes

A.5 Car Industry: Different companies in the automotive sector in Navarra

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
	Own consumption from self generation				kWh		
	From other self generators				kWh		
				If tariff is known, indicate it.			
		Tariff	Market	TUR: Last Resource Tariff			
			Regulated	6,782,748		Power	Price
			Liberalizated electrical market			1st semester / 2nd semester (c€/kW)	(c€/kWh)
		P1	Other: TUR,...			90.11 / 84.10	11.26
			Regulated				
			Liberalizated electrical market				
		P2	Other: TUR,...	8,928,224		45.10 / 42.09	9.46
			Regulated				
			Liberalizated electrical market				
		P3	Other: TUR,...	5,573,756		33.04 / 30.80	8.05
		P4		8,481,335		33.04 / 30.80	8.00
		P5		10,718,987		33.04 / 30.80	7.17
Electricity	From electrical grid	P6		27,560,987	kWh	15.03 / 14.05	5.64

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			-		
Gas-Oil A (For internal transport)		17,140 l			
	Electrical generation		litres		
	Transport (internal)		kg		
	Industrial uses				
Gas-Oil B	Heating				
	Electrical generation		liters		
	Transport (internal)	Unknown use	kg		
	Industrial uses	58,700 l			
Gas-Oil C	Heating				
Fuel-Oil			liters		
			kg		
types: Fuel-1; Fuel-2; Cogeneration	Electrical generation		Ton		

	Industrial uses					
	Heating					
Liquefied Natural Gas (GNL)	Electrical generation					
	Raw material (no energetic uses)					
	Industrial uses					
	Heating			kWh		
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market Other: TUR,...	Unknown use			
Industrial uses		Liberalizated market Other: TUR,...	229 GWh			
Heating		Liberalizated market Other: TUR,...		kWh		

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
LPG tanks	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
	Heating			
LPG pipe	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
	Heating	kg		
LPG cylinder	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		
Industrial uses		tonnes		
Heating				
Petroleum	Raw material (no energetic uses)	kg		

coke	Industrial uses	tonnes	
	Heating		
	m^2 total	m^2	
	domestic hot water		
	Heating		
Thermo-solar energy	Industrial uses	10^3 kcal	
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use[8]**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)

	Annual total production	
Description	**Quantity**	**Units of measure**
Volkswagen Polo	330,000	Units/year
Dies (troqueles)	1,600,000	Units/year
Metallic supports for brakes (Soportes metálicos para frenos)	23,600,000	Units/year
Seats for buses	160	Units/year
Screws (tornillos)	580,000,000	Units/year
Alloy parts (piezas de aleación)	2,500,000	kg/year
Glass for cars	6,100,000	kg/year

A.6 Iron and Steel Industry: Villalonquejar industrial area (Burgos)

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
Electricity	Own consumption from self generation				kWh		
	From other self generators				kWh		
	From electrical grid	Tariff	Market	If tariff is known, indicate it. TUR: Last Resource Tariff			
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...	53,885		Iberdrola	0.067533
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...		kWh		

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			-		
Gas-Oil A (For internal transport)			litters kg		
Gas-Oil B	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Gas-Oil C	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Fuel-Oil types: Fuel-1; Fuel-2; Cogeneration	Electrical generation		litters		
			kg		
			Ton		

	Industrial uses					
	Heating					
Liquefied Natural Gas (GNL)	Electrical generation					
	Raw material (no energetic uses)					
	Industrial uses					
	Heating		kWh			
Natural Gas from grid	Tariff	Market	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market Other: TUR,...				
Industrial uses		Liberalizated market Other: TUR,...				
Heating		Liberalizated market Other: TUR,...		kWh		

Energy type		Units	Suppliers	Cost (€) (VAT incl.)
Liquefied Petroleum Gas (LPG)				
LPG tanks	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
	Heating			
LPG pipe	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
	Heating	kg		
LPG cylinder	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		
Industrial uses		tonnes		
Heating				
Petroleum	Raw material (no energetic uses)	kg		

coke	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water	10^3 kcal	
	Heating		
	Industrial uses		
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use[(8)]**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)

	Annual total production	
Description	**Quantity**	**Units of measure**

A.7 Rural: irrigation pumping (Aragón)

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
Electricity	**Own consumption from self generation**			45833.33	**kWh**		
	From other self generators				kWh		
	From electrical grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...	100000		Endesa	12000
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...		kWh		

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)					
Gas-Oil A (For internal transport)			litters kg		
Gas-Oil B	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Gas-Oil C	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Fuel-Oil			litters		
	Electrical generation		kg		

types: Fuel-1; Fuel-2; Cogeneration				Ton		
	Industrial uses					
	Heating					
	Electrical generation					
	Raw material (no energetic uses)					
Liquefied Natural Gas (GNL)	Industrial uses					
	Heating			kWh		
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market Other: TUR,...				
Industrial uses		Liberalizated market Other: TUR,...				
Heating		Liberalizated market Other: TUR,...		kWh		

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
LPG tanks	Heating			
	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
LPG pipe	Heating	kg		
	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
LPG cylinder	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		
Industrial uses		tonnes		

Heating			
Petroleum coke	Raw material (no energetic uses)	kg	
	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water	10^3 kcal	
	Heating		
	Industrial uses		
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use(8)**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)

Description	**Annual total production**	
	Quantity	**Units of measure**

A.8 Generic case: Industrial area with small workshops and industrial stores

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
	Own consumption from self generation			45833.33	**kWh**		
	From other self generators				kWh		
				If tariff is known, indicate it.			
		Tariff	**Market**	TUR: Last Resource Tariff			
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...	100000		Endesa	12000
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
			Other: TUR,...				
			Regulated				
			Liberalizated electrical market				
Electricity	**From electrical grid**		Other: TUR,...		kWh		

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			-		
Gas-Oil A (For internal transport)			litters kg		
	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
Gas-Oil B	Heating				
	Electrical generation		litters		
	Transport (internal)		kg		
	Industrial uses				
Gas-Oil C	Heating				
Fuel-Oil			litters		
	Electrical generation		kg		

types: Fuel-1; Fuel-2; Cogeneration			Ton		
	Industrial uses				
	Heating				
Liquefied Natural Gas (GNL)	Electrical generation				
	Raw material (no energetic uses)				
	Industrial uses				
	Heating		kWh		
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff		
Electrical generation		Liberalizated market Other: TUR,...			
Raw material (no energetic uses)		Liberalizated market Other: TUR,...			
Industrial uses		Liberalizated market Other: TUR,...			
Heating		Liberalizated market Other: TUR,...	kWh		

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
LPG tanks	Heating			
	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
LPG pipe	Heating	kg		
	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
LPG cylinder	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		
Industrial uses		tonnes		

Heating			
Petroleum coke	Raw material (no energetic uses)	kg	
	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water		
	Heating		
	Industrial uses	10^3 kcal	
Heat from cogeneration unit		10^6 kcal	

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use(8)**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)

	Annual total production	
Description	**Quantity**	**Units of measure**

A.9 Food industry: Almendras llopis (San Vicente del Raspeig)

Energy type		Tariff	Market	Amount	Units	Suppliers	Cost (€) (VAT incl.)
Electricity	Own consumption from self generation				kWh		
	From other self generators				kWh		
	From electrical grid			If tariff is known, indicate it.			
				TUR: Last Resource Tariff			
						Power	Price
		6.1	Regulated				
			Liberalizated electrical market	200181		ALPIQ ENERGIA ESPAÑA, S.A.U.	23.384,51
			Other: TUR,…				
		P2	Regulated				
			Liberalizated electrical market				
			Other: TUR,…				
		P3	Regulated				
			Liberalizated electrical market				
			Other: TUR,…				
		P4					
		P5					
		P6					

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil (For internal transport)			-		
Gas-Oil A (For internal transport)					
Gas-Oil B	Electrical generation		litres		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Gas-Oil C	Electrical generation		liters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Fuel-Oil			liters		
			kg		
types: Fuel-1; Fuel-2; Cogeneration	Electrical generation		Ton		

	Industrial uses					
	Heating					
	Electrical generation					
	Raw material (no energetic uses)					
	Industrial uses					
Liquefied Natural Gas (GNL)	Heating			kWh		
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market Other: TUR,...				
Industrial uses		Liberalizated market Other: TUR,...				
Heating	2.3	Liberalizated market Other: TUR,...	1150886	kWh	GAS NATURAL	47.431,00

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
LPG tanks	Heating			
	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
LPG pipe	Heating	kg		
	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
LPG cylinder	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		
Industrial uses		tonnes		
Heating				
Petroleum	Raw material (no energetic uses)	kg		

coke	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water		
	Heating		
	Industrial uses		
Heat from cogeneration unit			

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	quantity	Use[8]	Suppliers

KEY DATA OF COMPANY's PRODUCTION (MAIN)			
Description	Period total production		
	Quantity	Units of measure	Cost (€) (VAT incl.)
Product type 1: ALMENDRA NATURAL	76.910,00	KG	305.926,61
Product type 2: ALMENDRA REPELADA	645.945,00	KG	2.786.020,99
Product type 3: ABC´S REPELADOS	425.312,50	KG	1.796.265,73
Product type 4: HARINAS	401.107,50	KG	1.571.319,41
Product type 5: ALMENDRAS TOSTADAS	25.900,00	KG	127.710,70
Product type 6: ABC´S TOSTADOS	189.480,00	KG	923.145,59
Product type 7: OT FRUTOS SECOS	1.387,50	KG	19.715,28
Product type 8: MAQUILAS		KG	
Product type 9: EMBOLSADOS	137.366,70	KG	604.399,34
Product type 10: OTROS PRODUCTOS	20.361,00	KG	25.735,06
Product type 11: PASTAS Y ELABORADO	82.122,00	KG	335.663,09

A.10 Pavement industry: Pemarsa (San Vicente del Raspeig)

Energy type				Amount	Units	Suppliers	Cost (€) (VAT incl.)
	Own consumption from self generation				**kWh**		
	From other self generators				kWh		
				If tariff is known, indicate it.			
		Tariff	**Market**	TUR: Last Resource Tariff			
		6.1	Regulated	180315		Power	Price
			Liberalizated electrical market			HC Energía	23954,47
			Other: TUR,…				
		P2	Regulated				
			Liberalizated electrical market				
			Other: TUR,…				
		P3	Regulated				
			Liberalizated electrical market				
			Other: TUR,…				
		P4					
		P5					
Electricity	**From electrical grid**	P6					

Energy type		Amount	Units	Suppliers	Cost (€) (VAT incl.)
Gas-Oil A (For internal transport)					
Gas-Oil A (For external transport)		55,55	litters	GALP	66.6
Gas-Oil B	Electrical generation		litres		
	Transport (internal)	765	litters		722,16
	Industrial uses				
	Heating				
Gas-Oil C	Electrical generation		liters		
	Transport (internal)		kg		
	Industrial uses				
	Heating				
Fuel-Oil			liters		
	Electrical generation		kg		

types: Fuel-1; Fuel-2; Cogeneration				Ton		
	Industrial uses					
	Heating		16480		Galp Energía	10189,91
Liquefied Natural Gas (GNL)	Electrical generation					
	Raw material (no energetic uses)					
	Industrial uses					
	Heating			kWh		
Natural Gas from grid	**Tariff**	**Market**	If tariff is known, indicate it. TUR: Last Resource Tariff			
Electrical generation		Liberalizated market Other: TUR,...				
Raw material (no energetic uses)		Liberalizated market Other: TUR,...				
Industrial uses		Liberalizated market Other: TUR,...				
Heating	2.3	Liberalizated market Other: TUR,...	1150886	kWh	GAS NATURAL	47.431,00

Energy type		**Units**	**Suppliers**	**Cost (€) (VAT incl.)**
Liquefied Petroleum Gas (LPG)				
	Electrical generation	Liters		
	Raw material (no energetic uses)	kg		
	Industrial uses	tonnes		
LPG tanks	Heating			
	Electrical generation			
	Raw material (no energetic uses)			
	Industrial uses			
LPG pipe	Heating	kg		
	Bottle 12,5 Kg			
	Bottle 35 Kg			
	Bottle 12 Kg			
	Bottle 11 Kg			
LPG cylinder	Other bottle type	kg		
Coal	**Especify type:** Anthracite, Lignite, Bituminous coal, Coke			
Raw material (no energetic uses)		kg		

Industrial uses		tonnes	
Heating			
Petroleum coke	Raw material (no energetic uses)	kg	
	Industrial uses	tonnes	
	Heating		
Thermo-solar energy	m^2 total	m^2	
	domestic hot water		
	Heating		
	Industrial uses		
Heat from cogeneration unit			

Other fuels			
Types (Specify: wood, agricultural waste / forestry, charcoal, biogas, biofuels, power kerosene, hydrogen, other process gases, etc.).			
Fuel	**quantity**	**Use[8]**	**Suppliers**

KEY DATA OF COMPANY's PRODUCTION (MAIN)			
Description	**Period total production**		
	Quantity	**Units of measure**	**Cost (€) (VAT incl.)**
Product type 1: ALMENDRA NATURAL	76.910,00	KG	305.926,61
Product type 2: ALMENDRA REPELADA	645.945,00	KG	2.786.020,99
Product type 3: ABC´S REPELADOS	425.312,50	KG	1.796.265,73
Product type 4: HARINAS	401.107,50	KG	1.571.319,41
Product type 5: ALMENDRAS TOSTADAS	25.900,00	KG	127.710,70
Product type 6: ABC´S TOSTADOS	189.480,00	KG	923.145,59
Product type 7: OT FRUTOS SECOS	1.387,50	KG	19.715,28
Product type 8: MAQUILAS		KG	
Product type 9: EMBOLSADOS	137.366,70	KG	604.399,34
Product type 10: OTROS PRODUCTOS	20.361,00	KG	25.735,06
Product type 11: PASTAS Y ELABORADO	82.122,00	KG	335.663,09

ANNEX 2 SUMMARY OF CONSUMPTION DATA

Following the unified format for the presentation of consumption patterns, some assumptions are taken, which are explained below.

Real Case: Rural microgrid for irrigation pumping:

The total power of all pumps (3 normal and 1 reversible pump) is 490 kW, which is here assumed as the reference power. The energy consumption can now be calculated using the 12 different daily consumption profiles presented in **¡Error! No se encuentra el origen de la referencia.**

In addition, the wind generator is assumed to achieve 2200 equivalent hours. With a nominal power of 250 kW, an annual energy of 550 MWh is assumed.

	days	Mean charge rate [p.u.]	Mean power [kW]	Demand [MWh]
may	31	0.24	116	87
jun	30	0.47	229	165
jul	31	0.73	357	266
ago	31	0.81	398	296
sep	30	0.38	188	135
oct	31	0.20	96	71
nov	30	0.07	35	25
dic	31	0.05	22	17
ene	31	0.06	31	23
feb	28	0.07	35	23
mar	31	0.10	51	38
abr	30	0.15	76	54
Sum	365			1200

Tabla 16. Monthly and annual demand of irrigation pumping station, assuming total pumping power of 490 kW.

The applied equations to calculate mean power and energy values are:

Mean power [kW] = Mean charge rate [p.u.] x 490 kW (5.1)

Demand [MWh] = Mean power [kW] x days x 24 / 1000 (5.2)

Generic case: Industrial area with small workshops and industrial stores

For the generic case, a mean annual power of 100 kW is assumed. As a result, the annual demand sums up to 876 MWh (8760h x 100 kW).