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TRABAJO FIN DE MÁSTER

IMPLEMENTING AN APPROPIATE TIME RESOLUTION TO DEMAND SECTOR IN MASTER (Strategic Energetic Planning Model)

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Madrid

Julio 2022

Declaro, bajo mi responsabilidad, que el Proyecto presentado con el título

Implementing an appropiate time resolution to demand sector in MASTER (Strategic Energetic Planning Model)

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MÁSTER EN INGENIERÍA INDUSTRIAL

TRABAJO FIN DE GRADO

IMPLEMENTING AN APPROPIATE TIME RESOLUTION TO DEMAND SECTORS IN MASTER (Strategic Energy Planning Model)

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Julio 2022

IMPLEMENTAR UNA RESOLUCIÓN TEMPORAL ADECUADAA SECTORES DE DEMANDA EN MASTER (MODELO ESTRATÉTIGO DE PLANIFICACIÓN DE ENERGÍA)

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RESUMEN DEL PROYECTO

El objetivo del proyecto es crear perfiles de demanda de diferentes vectores energéticos en el sector industrial para ser incorporados en un modelo de planificación de estrategia energética. Se realizará un análisis de sensibilidad con los resultados de la aplicación de los datos en el modelo DEMO para estudiar la respuesta del modelo ante los cambios introducidos.

Palabras clave: Industria, modelo, energía, perfil, consumo.

1. Introducción

En el contexto actual, la energía desempeña un papel cada vez más importante, tanto a nivel económico como político. La atención se ha centrado en la descarbonización del sector energético mediante el uso de energías renovables, en la llamada transición ecológica. Además, teniendo en cuenta la situación actual de inestabilidad política y aumento de los precios de la energía, parece lógico que los países busquen la manera de reducir su dependencia energética en terceros países.

Ante esta situación de cambio que está llamada a revolucionar el sector, la investigación de nuevas fuentes de generación es de verdadera importancia. Para afrontar el reto que se presenta, se utilizan modelos de planificación de estrategia energética que sirven para optimizar y dar apoyo en el proceso de toma de decisiones identificando vulnerabilidades y trade-offs del sistema energético. En la aplicación de los modelos, es crucial conocer una serie de parámetros de entrada. Aunque el trabajo actual se centre en la demanda energética, también se deben definir otros parámetros como la generación, datos tecno-económicos, y la evolución de ellos en los años futuros. Los modelos se utilizan para periodos de entre 20 y 50 años futuros, por lo que también es importante definir las variaciones en los valores económicos y tecnológicos que pueden ocurrir.

2. Definición del proyecto

El presente proyecto pretende investigar y recopilar toda la información posible para definir la demanda energética de los diferentes subsectores industriales en España. La idea es obtener los datos más desagregados posibles para cada sector, para poder crear perfiles de demanda con la definición temporal más conveniente según el caso de estudio. Además, recopilar el consumo anual de los diferentes vectores energéticos que la industria demanda.

Todo este trabajo se está llevando a cabo con la ayuda del Instituto de Investigación Tecnológica de la universidad. La información y datos obtenidos de este trabajo serán útiles para su aplicación en el modelo MASTER, en el que han estado trabajando. Por ello, es importante que la información esté bien definida, para que sea realmente aplicable al modelo.

Como primera aplicación de los datos, se incorporarán al modelo DEMO para realizar un análisis de sensibilidad y poder extraer ciertas conclusiones del sector industrial y la situación energética del país.

3. Descripción del modelo/sistema/herramienta

Para crear los perfiles de demanda energética se ha hecho uso de diferentes fuentes de información. Principalmente, para el consumo de gas se ha recurrido a un informe de *Enagás* sobre el consumo diario de gas en España en diferentes años. En cuanto al perfil de demanda eléctrica se ha utilizado la herramienta del servicio de interrumpibilidad de *Red Eléctrica Española (REE).* Junto a otros estudios de *IDAE (Instituto para la Diversificación y el Ahorro Energético)* se han determinado los consumos energéticos del sector industrial.

En la segunda parte del trabajo se han incorporado estos valores numéricos de consumo al modelo DEMO, un modelo orientado a la aplicación de nuevas metodologías y cambios, como es la desagregación de sectores en la que se ha trabajado. Además, en DEMO a diferencia de MASTER se introduce la energía final demandada, precisamente en lo que se ha investigado. Por último, trabajar en DEMO permite realizar un análisis a lo largo de los años al ser un modelo dinámico y no estático como MASTER, en el que solo se muestran los resultados finales. Por tanto, introducir los valores obtenidos en el modelo ayudará a obtener conclusiones del sector industrial y energético además de validar lo investigado. Dicho modelo tiene en cuenta diferentes restricciones energéticas, económicas y de emisiones de gases para poder definir la generación energética necesaria para cumplir con la demanda. Los resultados del modelo muestran diferentes valores numéricos para las diferentes variables que definen la situación energética del país. En la siguiente imagen se puede observar el esquema del proceso que sigue el modelo.

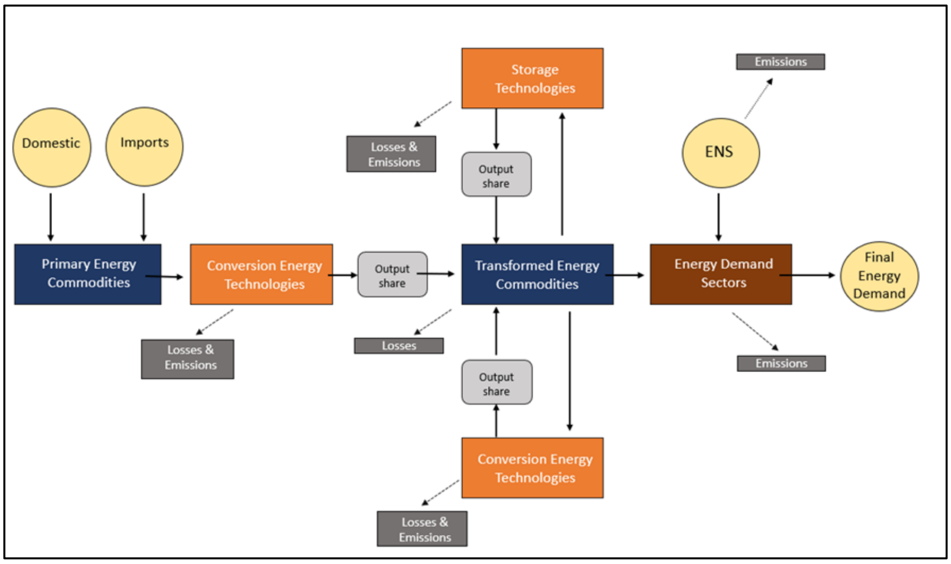

Figure 1. Modelado del proceso energético

4. Resultados

Se puede afirmar que el presente trabajo tiene dos resultados de las dos partes del presente trabajo. Por una parte, los datos obtenidos de la búsqueda información. Los perfiles de demanda de los diferentes subsectores industriales se muestran en las tablas de los anexos, así como sus consumos energéticos anuales.

Por otra parte, se muestran los resultados de implementar estos datos en el modelo DEMO. Los resultados del modelo muestran el parque de generación y las emisiones de CO_2 que habrá para cumplir con la demanda energética del país.

	2030	2040	2050
Nuclear	5,63	0,00	0,00
Gas	15	19	21
Hidro	13,96	11,05	8,14
Eólica	11,20	27,21	39,92
Fotovoltaica	12,24	38,66	59,44
Solar Térmica	1,56	0,00	0,00
Biomasa	47,83	56,43	93,41
Refinería	72,96	18,02	18,02
BioRefinería	4,66	5,84	8,65
Regasificación	30,4	28,93	29

Table 1. Capacidad de Potencia Instalada (GW) en el caso base.

	tCO_2 /year	Accumulated tCO_2
2030	110,05	1.969,94
2040	76,44	2.887,20
2050	33,35	3.450,66

Table 2. Emisiones de CO2 en el caso base.

5. Conclusiones

Tras una investigación exhaustiva de información y datos del consumo energético industrial en España, se puede afirmar que no se encuentran accesibles suficientes estudios en la materia que muestren información detallada y desagregada. Por tanto, se resalta la necesidad de hacer públicos datos de consumos industriales que den una información más detallada del sector industrial a la vez que no se vea comprometida la confidencialidad de las empresas. Esta publicación de datos permitiría una mayor investigación en el sector y seguramente un beneficio para todos como estudios para medidas de ahorro y eficiencia o de modelado como el presente.

A raíz de los resultados del análisis de sensibilidad del consumo energético industrial, se deduce que reducir el consumo energético del sector ayudará a realizar una transición energética más sosegada en los próximos años. En cambio, un aumento en el consumo industrial provocará que sean necesarias fuertes inversiones en infraestructura en renovables para cumplir con los requisitos de emisiones.

6. Referencias

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IMPLEMENTING AN APPROPIATE TIME RESOLUTION TO DEMAND SECTORS IN MASTER (STRATEGIC ENERGY PLANNING MODEL)

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ABSTRACT

The aim of the project is to create electricity and gas demand profiles in the industrial sector to be incorporated into an energy strategy planning model together with the annual energy consumption of different energy products. A sensitivity analysis will be performed with the results of the application of the data in the DEMO model.

Keywords: Industry, model, energy, profile, consumption.

1. **Introduction:**

   In the current situation, energy plays an increasingly important role, both economically and politically. The focus has been on the decarbonisation of the energy sector using renewable energies, in the so-called green transition. Moreover, taking into account the current situation of political instability and rising energy prices, it seems logical that countries are looking for ways to reduce their energy dependence on other countries.

   Considering this situation of change that is set to revolutionise the sector, research into new sources of generation is of real importance. To face the situation, energy strategy planning models are used to optimize and support the decision-making process by identifying vulnerabilities and trade-offs in the energy system. For the application of the models, it is crucial to know several input parameters. Although the current work focuses on energy demand, other parameters such as generation, techno-economic data, and the evolution of these in future years must also be defined. The models are used for periods between 20 and 50 years into the future, so it is also important to define the variations in economic and technological values that may occur.

2. **Project definition:**

   As a first application of the data, they will be incorporated into the DEMO model to carry out a sensitivity analysis and to be able to draw certain conclusions about the industrial sector and the country's energy situation.

   This project aims to research and collect as much information as possible to define the energy demand of the different industrial subsectors in Spain. The idea is to obtain the most disaggregated data possible for each subsector in order to create annual demand profiles with the most convenient time definition according to the case study. In addition, to collect the annual consumption of the different energy vectors that industry demands

   All this work is being carried out with the help of the University's Institute for Technological Research. The information and data obtained from this work will be useful for application in the MASTER model, which they have been working on. Therefore, it is important that the information is well defined, so that it is applicable to the model.

As a first application of the data, they will be incorporated into the DEMO model to carry out a sensitivity analysis and to be able to draw certain conclusions about the industrial sector and the country's energy situation.

3. Description of the model/system:

In order to create the energy demand profiles, different sources of information have been used. Mainly for gas consumption, an *Enagás* report on daily gas consumption in Spain in different years was consulted. As for the electricity demand profile, the interruptibility service tool of *Red Eléctrica Española (REE)* was used. Together with other studies by *IDAE (Institute for Energy Diversification and Saving)*, the energy consumption of the industrial sector has been determined.

In the second part of the work, these numerical consumption values have been incorporated into the DEMO model, a model oriented towards the application of new methodologies and changes, such as the disaggregation of sectors in which work has been carried out. In addition, DEMO, unlike MASTER, introduces the final energy demand, which is precisely what has been researched. Finally, working in DEMO allows an analysis to be carried out over the years as it is a dynamic model and not a static one like MASTER, in which only the final results are shown. Therefore, introducing the values obtained in the model will help to obtain conclusions from the industrial and energy sector as well as validating what has been collected.

The model considers different energy, economic and gas emission constraints in order to define the energy generation needed to meet the demand. The results of the model show different numerical values for the different variables that define the country's energy situation. The following image shows the outline of the process followed by the model.

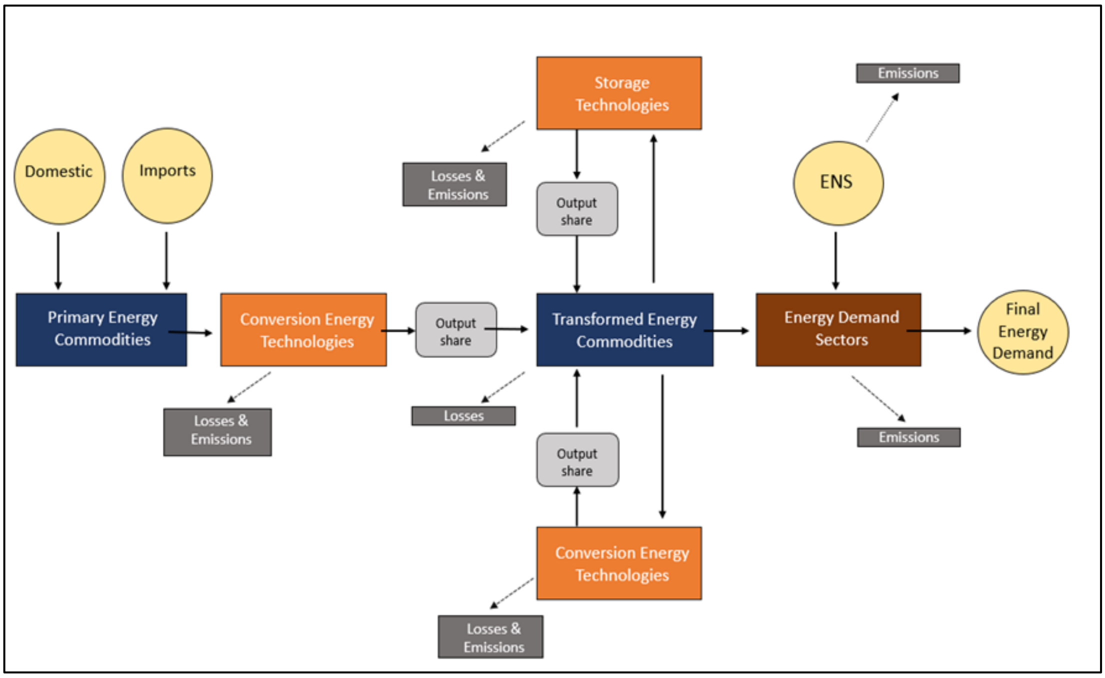

Figure 2. Energy modelling processes.

4. Results

It can be stated that the present project has two different outcomes from the two parts of the it. On the one hand, the data obtained from the information research. The demand profiles of the different industrial sub-sectors are shown in the tables in the annexes, as well as their annual energy consumptions.

On the other hand, the results of implementing these data in the DEMO model are shown. The results of the model show the generation park and the CO2 emissions that will be needed to meet the country's energy demand.

	tCO_2 /year	Accumulated tCO_2
2030	110,05	1.969,94
2040	76,44	2.887,20
2050	33,35	3.450,66

Table 3. CO2 Emissions in the base case.

	2030	2040	2050
Nuclear	5,63	0,00	0,00
Gas	15	19	21
Hydro	13,96	11,05	8,14
Wind	11,20	27,21	39,92
Solar PV	12,24	38,66	59,44
SolarTh	1,56	0,00	0,00
Biomass	47,83	56,43	93,41
Refinery	72,96	18,02	18,02
BioRefinery	4,66	5,84	8,65
Regasification	30,4	28,93	29

Table 4. Installed Power Capacity (GW) in the base case.

5. Conclusions

After an exhaustive investigation of information and data on industrial energy consumption in Spain, it can be stated that there are not enough studies on the subject that show detailed and disaggregated information. Therefore, the need for a national study on the industrial sector consumption by energy supply companies or governmental bodies is highlighted.

From the results of the sensitivity analysis of industrial energy consumption, it seems that reducing the energy consumption of the sector will help to achieve a smoother energy transition in the coming years. On the other hand, an increase in industrial consumption will mean that heavy investments in renewable infrastructure will be necessary to meet emission requirements.

6. References

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[2] Enagás, Demanda de gas por sectores. 2021. https://www.enagas.es/es/gestion-tecnica-sistema/energy-data/publicaciones/demanda-gas

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Chapter 1. INTRODUCTION

Throughout history, mankind has evolved and developed to a point where well-being has become the main goal rather than survival, as it was hundreds of years ago. Human beings have developed intellectual capacities that have enabled them to invent and manufacture tools that make life easier.

Since the industrial revolution in the 18th century, humanity has continued to grow exponentially, as consumer goods have grown. Since then, technological advances have followed one after the other and production capacity has increased. Not to mention the relevant development of means of transport and the invention of the Internet, which have completely revolutionised the history of mankind.

All this has led to an upward spiral of growth and consumerism that we now realise is totally unsustainable. There are currently almost 8.000 million human beings in the world, and it is expected to reach 9.700 million by 2050. Considering this growth coupled with the current pattern of resource use, one questions the viability of the Earth.

This unsustainability is already beginning to be reflected in life today. The effects of pollution and climate change are no longer a problem of the future, we are already suffering the consequences. We are witnessing how many resources are becoming scarce and climate change has become a reality.

In order to prevent this from escalating and to make the situation totally irreversible, it is urgent to take action and change the current model in favor of sustainability. In this way, mankind is facing one of the greatest challenges of the century for human beings, or perhaps of its history. To achieve so, United Nations set a goal of sustainable development. The European Union is fully aligned with these objectives and is leading the initiatives to fulfill them, being one of the most concerned regions of the world.

It is clear that energy is the driving force behind everything and the engine for activity. Energy is therefore the key resource for us. Hence, the main focus is on the energy sources to be used to achieve sustainability.

It goes without saying that today´s economy is based on the use of fossil fuels such as oil and natural gas. A world without these energy sources is currently unimaginable. They are used to produce food, to heat us, to produce electricity, to transport us... Almost everything we look at and we use is related or has been related to fossil fuel sources.

It has already been demonstrated that this system needs to be stopped and other sources of energy should be investigated. Other sources that supply us with energy, but without polluting the environment or emitting harmful gases to the atmosphere. At the same time, we should also try to reduce our consumption of all resources. Both sides have to be addressed, generation and demand.

Although it is not a simple challenge, at least it seems that most countries are already aware of the problem, and they will work to change it so as not to continue contributing to climate change.

In addition to the relevant issue of pollution, changing the energy model is also a matter of urgency for other reasons. Energy, as mentioned above, is present at all levels of life and is strongly related to the economy. An increase in the price of energy supply leads to an increase in the price of goods and services in the economy. Fossil fuels are extracted from certain countries such as Russia or Arab countries. As a result, the countries that import this energy are highly dependent on the exporting countries. This makes the economy of the energy buyers weaker and at the mercy of certain decisions of other countries and above all foreign policy. It has been witnessed that foreign conflicts, whether wars or diplomatic disputes, have a big impact on the price of gas or oil. Therefore, if a country is able to generate energy on its own territory to supply itself, it is in a stronger position and has more decision-making power over its economy. There is little that can be done with fossil fuels, as not all countries have fossil fuel reserves. However, clean energies can be installed in most countries, giving the country a certain energy independence. Moreover, Spain is one of the countries with the best meteorological conditions to make the most of its natural resources.

Furthermore, this change in the system contributes to creating value in the territory for all the stakeholders. Research into new technologies is encouraged, and a new industry is created to manufacture according to the needs of the new facilities. Moreover, if high growth is achieved, a country can become an energy exporter. In short, great opportunities are created. Therefore, the current situation is a great opportunity for Spain, in which it can emerge strengthened and play a very important role in the energy sector.

In view of the above, the European Union is now fully engaged in what is known as the ecological transition. Aware of the current situation and the need for change, the European Union has set a series of objectives to tackle the situation and make a commitment to the environment. The measures to be taken in the coming decades are aimed at achieving carbon neutrality by 2050. In other words, the countries that make up the European Union are committed to emitting no more gas emissions than the sinks can absorb. Until the date set, there are intermediate targets such as reducing emissions of polluting gases by 55% compared to emissions in 1990 by the year 2030. These mid-dates will determine whether the objectives are being met and the right path is being followed.

These targets concern the whole of society and will affect all sectors of the economy. There is a need of change in many different aspects of life as we know nowadays. It is needed a change in the way of commuting, betting on sustainable vehicles. Moreover, some efficient development in industrial processes as well as the resources used and the processes itself. Briefly, it can be said that all sectors must reconsider its habits.

Regarding energy generation, countries such as Spain have the responsibility to develop a plan to achieve the goals set. They should be able to decommission existing generation plants while replacing them with renewable generation plants. In this period, it is necessary to be very careful and everything must be planned in detail. Therefore, whenever a plant is replaced, it must be ensured that the supply meets the current demand of the moment. In addition to this, all emission restrictions and the cost of plants closure must be taken into account in this process.

For any long-term and ambitious objective as the explained above, a strategic plan is needed to set standards and guide the steps to be taken in future years. It should be taken into consideration that high budgets and investments of a country depend on the plan. This fact implies the allocation of a huge considerable number of economic resources, which explain its importance. To make strategic plans, it is very important to have a large amount of data that represents the situation and helps to obtain information from it.

With the aim of giving the appropriate treatment to these data and to be able to extrapolate decisions from them, models are necessary. A model makes possible to learn from energy sectors and make sensible decisions. Through technical links and certain constraints, the model simulates different possible scenarios. By analyzing the data and making sensitivity analyses, one can detect trade-offs, identify risks… Therefore, by doing so, one can get deeply into the sector and have a better insight of it. This is the reason why accurate models, that help to determine the way to move forward, are very important for governments and institutions.

The present project will make reference and will use an energy model known as DEMO, which is explained in more detail below. In short, this model relates generation and demand through the different conversion and generation technologies to show future scenarios that fulfills the requirements of economic constraints of emissions, energy and cost. However, in order to draw relevant conclusions from the model, it is not only sufficient that the model is robust, but also it is crucial that the data is of good quality and collects as much information as possible. A good programming of a model without valuable input data may lead to wrong conclusions.

For this reason, this project has two distinct parts.

On the one hand, special focus has been on working on the search for information from a part of the database from which the model takes the information. In this case, the model under development has adequate information on energy generation data. However, it has an important shortcoming in the area of demand data, which has not been worked on until now. Within demand there are different sectors: residential, transport, services, industry... It has been decided to go for the last one and obtain as much data as possible to provide information on it. Therefore, the first part of the work is research focused on this sector.

The first step is a general search for information on the main Spanish industrial subsectors. The aim is to obtain information about the energy consumption in the industrial sector. As a first approach it was tried to obtain the values by autonomous communities that will lead to a final national picture of the situation. What is more, looking also for information that can provide demand profiles that are applicable and useful for the system. For this purpose, the author of the project searches in different sources and documents provided either by energy suppliers, associations of companies or the companies in the subsector themselves. However, many difficulties to be faced during the process as most of the information is inaccessible and kept confidential so as not to give clues to the competition. Another reason for the difficulties at the time of finding data is that there are simply not many studies on the subject. It is important to state that whenever a search for this type of data is made, it is useful to obtain data that is applicable to the study. However, if it is not found, it is also very useful to determine where the gaps are and to limit or lay the groundwork for future work on the subject.

On the other hand, the second part of the project begins once a solid database is prepared, and it is incorporated into the model. Thus, the incorporated data becomes part of a large model that will guide future energy policies and meet both economic and environmental conditions. In this way, it is possible to obtain the energy stock to be had at a given time in the future and the steps to be taken in the intermediate years. This data can be included in different models. The idea is to be used in a MASTER model. However, in this project it will be incorporated in a DEMO model, a dynamic version.

As the model data is not yet complete, information on important energy-demanding sectors is still missing. The model is applied to the demand of the industrial sector and conclusions related to industrial activity will be drawn. Data collected will be entered into the model and the results of the base case will be analysis. From there, several scenarios with different conditions will be simulated. This will be used to apply the data to the model and draw different conclusions from the results comparing to the base case.

In conclusion, the main objective of the present project is to contribute valuable information to models on which researchers at the university have been working for years. The ultimate objective of all of this is to help Spain in its decision-making in the face of the challenge facing by the current energy situation. Hopefully, the model will be useful to adapt the best measures and make Spain a more sustainable and environmentally friendly country. It will also help to make Spain a country with less dependence on foreign energy and all this will help the country's economy. It is a great opportunity for Spain to position itself as a leading country in renewable energies and an outstanding country in the sector.

1.1 PROJECT APPROACH

As already mentioned, the present project supports and will give information to another large existing project developed at the University. The project has a first stage a process of searching for data that is representative of the demand of the industrial sector. Although in this work the data will later be applied to the DEMO model, it might also be applied to the original MASTER model in the future. Indeed, the industrial demand data collected will be considered as an important basis of information about the sector that concerns for different projects and models.

As a first step, the current situation with the data used by the models was explained to the student. It could be said that there are two very important parts of the data input, the generation part and the demand part. So far, currently, there is information on the energy generating sources. However, on the demand side the information is very limited and scarce. Even in some cases for some sectors there was no information in the database used by the model. Hence, the decision to start working in this area seemed to be a point to start.

Among all the energy demanding sectors there were many to choose from. Transport, residential, services... However, it was considered more appropriate to start with research in the industrial sector.

In this way, both the project co-directors and the student are involved in a research study in the industrial sector. This research involves trying to get to know the sector in as much detail as possible in terms of energy issues. It is crucial to know the situation of the sector and to know what kind of energies it demands.

The idea is to search for information in as many sources of information as possible. The objective was clearly to look for disaggregated data on demand that would be applicable to the model. From that moment on, it was established that the student would have frequent meetings with his co-directors to share the information found so far and analyse its usefulness together.

Both parties were aware of the difficulty of finding accurate information and the need to carry out an exhaustive search. The idea was even asking for collaboration from university researchers who have access to information that would be useful. These researchers are working in energy institutions or suppliers and have more access to the information we were looking for. It is known from the beginning that research work is a process that makes one follow different paths that sometimes have no way out and do not lead anywhere useful. However, even if the desired result was not achieved, it is known that it is being useful to know where the limits of the work are. It will also help to identify gaps that need to be filled in the future.

Once it was felt that enough research had been done in this area or the necessary data is collected, the next step is to start using the DEMO model. Initially, it was considered that at that point it would be possible to proceed with another energy demand sector. However, finally it was thought to be more interesting to work with the model for several reasons. On the one hand, it would be useful to learn how this type of model works. That is, to understand its logic, the variables it takes into account, its parameters, etc. This would be very useful to get to know the model and become familiar with how it works. In addition, another advantage of using the model is that one can see the usefulness of the first part of the work. Learning how these data is incorporated and how to work with them. Furthermore, to see the results of the model after incorporation and draw conclusions from them. In this way, even if it was not from the finished model, one would have a first approximation and some conclusions that could be very useful. Even if the consumption of some demand sectors is not accurate enough, a sensitivity analysis can be made to see how changes in industrial demand affect energy consumption in terms of generation and emissions.

In addition, it was also decided that although the data would be incorporated into the MASTER model in a future, it would be used in the DEMO model as a beginning. It was thought that it would be better to use this model because of different reasons. First of all, DEMO is used for changes in the methodology or changes in the data introduced in the models. Therefore, it is ideal to prove that the values obtained from the research work correctly in the model. Furthermore, in DEMO model the final energy demand is introduced, whereas MASTER goes a step forward having to define other parameters. Hence, DEMO model is more than appropriate to introduce the information researched.

In addition to this, in order to analyze the results and make a sensitivity analysis, DEMO model provide values for each year until the final one. As it is a dynamic model, it enables the user to observe the evolution of all the values along the years. In contrast, MASTER is static and only provide data for the final year.

Therefore, the data are introduced in DEMO instead of original MASTER. However, it should be highlighted that they are strongly linked, as DEMO is a version of MASTER.

Chapter 2. STATE OF ART

The Institute for Research in Technology (IIT) is continuously working on different projects. Among the wide range of research activities, it develops different energy models that are useful to get insights of the energy sector.

Among all the models, the DEMO model is the one used in this project. It is a linear optimization model. Based on established equations and restrictions, that simulates future scenarios and enable one to draw conclusions about energy sector. Moreover, by modifying parameters one can analyze different patterns and trade-offs of the resources. The model takes input information from a database. Equations and constraints can be added as desired to change situations and scenarios.

The model will be explained in more detail in the next chapter. However, this section provides a general explanation of this type of model and the programming tool in which it is programmed, GAMS.

Perhaps the best way to explain the meaning of GAMS and how it works, is to start by explaining the meaning of its acronym. GAMS stands for General Algebraic Modelling System. This means that GAMS is a program used for modelling and optimize problems that can be both linear and non-linear or even mixed through mathematical programming. In this way, GAMS solves very complex and sophisticated problems. The great advantage of GAMS is that it has a relatively simple interface, and it is very easy to add new conditions that establish new situations in the model.

GAMS has a language compiler and various associated solvers. Briefly explained, users who model the problem introduce the optimization problem that occurs in real life using a simple language. Then, it is the compiled GAMS language the responsible for converting it into a format that the solvers can understand. This is one of the most important points of GAMS, its architecture enables one to change the solvers without worrying about changing the modelling, as it will be in charge of doing the translation to the other languages.

GAMS is currently used all over the world, with more than 100 countries using it on a daily basis. Users range from large companies to universities. As a modelling tool it is mainly used by research institutions and economic institutions for financial modelling. It is also used, and this is strongly related to the present work, by governments and energy industries for planning.

Considering the mathematical definition, a model is a description of a real-world phenomenon. Models are mainly used to understand and study the behaviour of the phenomenon over a future period of time. In particular, energy planning models are very useful to help strategic decision making in the energy sector in order to implement the most appropriate measures. The models allow a better understanding of the energy system by identifying vulnerabilities and trade-offs. In conclusion, energy planning models are a very important tool and help to study energy generation and demand.Numerous energy planning models exist nowadays. These include TIMES, OSeMOSYS, Message and TEMOA.

The TIMES (The Integrated Markal-EFOM) model is a bottom-up model generator that uses linear-programming to maximise the benefit of energy consumers and producers. The most relevant difference compared to other models is that each technology is defined by a large number of economic and technical parameters. It is a dynamic and partial equilibrium model, because it only models the energy sector. TEMOA (Tools for Energy Model Optimization and Analysis) is an open source model for performing energy system analysis. The energy system is described algebraically as a network of linked processes that convert an energy feedstock into an end-use demand, through a series of intermediate products Each technology is defined by a set of engineering, economic and environmental features. MESSAGE is a system engineering optimization model used for the planning medium to long-term energy systems. Inputs on the supply side are very detailed, whereas the demand inputs are more aggregated. The objective is to estimate multi-sector mitigation strategies instead of defining climate targets.

This project focuses mainly on the use of the MASTER and DEMO models. Both models are closely related. It could be said that the DEMO model is a simplified version of the MASTER model. It is used to apply new methodologies and test new changes to validate them before applying them in MASTER. Both models are linear programming models, however, they have some differences.

Firstly, the MASTER model is static as it only shows the results of the final year defined in the model. In contrast, the DEMO model, by showing the results of all years until the end and their evolution, is said to be dynamic. In addition, another difference is that the MASTER model is said to be of fifth column because it takes into account the demand for energy services. For example, it would include the kilometers and cars consuming petrol. On the other hand, the DEMO model is known as a fourth column model because it defines demand as final energy. Continuing with the previous example, the DEMO model would define the liters of petrol that are consumed in total by all cars.

The DEMO model used in the project is already programmed. In other words, all the equations that relate the different variables are already incorporated into the program. In addition to all the restrictions that limit the solution to the linear problem.

Thus, there is no need for programming to add extra equations. However, it is important to understand the logic of the problem and the way it is solved, as it is important to know how to enter the data. Furthermore, once the case is simulated with the new data incorporated, the solution and data provided by the program once executed should be understood.

Therefore, this first part directly related to the modelling syntax is not of special concern. However, this is where more of the action of the work begins.

The model gets the data from an Excel document. This Excel document is on what the university has been working for years. It is a database that collects the energetic information necessary for the resolution of the model as well as the techno-economic data. The structure of the database is explained in more detail in the next chapter. However, it should be emphasized that this document should be known in detail in order to know what needs to be modified and what is lacking. These data are used for different models and research projects so that a large part of the parameters is not relevant for the model used. However, the main issue related to this database is to complete it with the data it does not have yet. As explained above, there is still work to do in the energy demand part. The data still could be disaggregated in more subsectors instead of only considering some general sectors that represent the whole. Moreover, one of the main objectives is to define the energy profile demands as currently the model assigns equal hourly demands.

Therefore, the search for data to complete it is the main work. The first step is to know what is being researched and what is the aim of the research. In this case, the objective was clear, to find demand profiles of the different industrial sub-sectors. Energy vectors demand profiles involved in industrial sector will be the core of the research. The model requires the pattern of consumption of the different energy sources that provide the sector with energy. However, considering the difficulties of defining the profiles for every energy vector, the work will focus on the profiles of electricity and gas consumption, as they are the main ones. Moreover, it was considered that these profiles could be applied to the rest of energies as it will be explained. Therefore, initial attention is devoted to electricity and gas.

It is important to turn to studies that have been carried out in the field or possible websites that can provide the desired information. Initially, it was thought that the main resources could be the energy suppliers in charge of distributing the different types of energy to consumers. This is the case, for example, of Iberdrola, Naturgy, Endesa, which are the major electricity distributors. Or Enagás or Nedgia, gas suppliers. However, this is where the difficulties begin. It turns out that electricity operators such as REE or important institutions or the Ministry of Industry do not have reports that gather information from the industry.

The process of searching for information and its difficulties are explained below. However, from this point on, it can already be stated that there is a lot of information on Spanish industry, but there is a lack of disaggregated information and studies that bring it all together.

INDUSTRIAL SECTOR

The industrial sector is the key for a country to have a stable and competitive economy. Having a strong industrial system involves other issues such as innovation, research, digitalisation and training that allow a country to grow and have a better position compared to the rest of the world. Having a sustainable and stable industrial sector ensures quality and well-being in the country's society in the long term. Therefore, there is a strong correlation between the industrial sector and the economy of a country. All in all, it could be said that the industrial sector creates value and has an effect on other related sectors.

Therefore, the industrial sector has been responsible for the country's development and progress as we know it today. Spain underwent these changes in the 19^{th} and 20^{th} century that enabled it to become an urbanised country with a modern transport network connecting the different regions.

Spain has been benefitting from being part of the European Union, as 22.1% of the industrial sector's sales in 2019 were from member states and 11.3% were made by other international countries. The remaining 66.6% of sales were national. The most exported products were transport materials and machinery. However, taking the whole sector, the food and beverage sub-sector is the most important in terms of employment and turnover. It is followed in importance by the metallurgy sector.

According to the *INE (Instituto Nacional de Estadística)*, the industrial sector in Spain accounted for 14.7% of GDP and directly employed more than 2.3 million people in 2019 just before the start of the pandemic, making it the second most important sector in the country after the services sector.

However, Spain has been undergoing a process of deindustrialisation since the 1980s. In the last decades, the sector has been losing importance in favour of the service sector. The reasons for this phenomenon are various and can be summarised in the following points: due to competition and foreign trade, the outsourcing and tertiarisation of industry.

Deindustrialisation has been strongly suffered in strong regions such as Cádiz or Cataluña. However, Cataluña continues to be one of the main industrial regions of Spain, followed by, País Vasco, La Rioja and Navarra. Between 2008 and 2016 Spain lost 25% of its industrial companies.

However, the European Union would like member states to reach the figure that the sector represents 20% of GDP. For this reason, it has proposed to carry out a reindustrialisation of the European Community's economy, to achieve an economy that is resilient to future crises. Moreover, the objective is to adapt it to the present requirements in a process of digitalisation and ecological transition,

Spanish Government has assumed this priority within its *National Plan for Recovery, Transformation and Resilience*, placing the commitment to industry as one of its main priorities.

Chapter 3. DESCRIPTION OF THE RESEARCH AND CONTRIBUTIONS TO THE MODEL

3.1 METHODOLOGY:

The main objective of the work is to create demand profiles for the different energy vectors consumed in the industrial sector. These profiles are created for each industrial subsector in order to achieve a disaggregation of the sector. Currently, the model has hardly any separation of groups and covers almost the entire clustered sector. In addition to the profiles, the annual consumptions have to be determined. In the data section of the report, the separation that has been carried out and the energy vectors that have been taken into consideration are described in more detail.

The process to determine the energy vectors demand profiles and their annual consumption values has been full of difficulties. It has been very complex to find clear information that would really help to achieve the objectives. It is noted that the initial idea is to define the demand profiles and annual consumptions with a view to disaggregating the industrial subsector in the model. The data values obtained should be accurate and appropriate to be introduced in the model.

In order to find numerical values, it was decided to turn to different sources of information that would contribute data and value to the work. It was considered that the most appropriate action to do would be to go to the websites of energy distributors, marketers, market operators... All companies linked to the energy market and supply. Perhaps some of them could provide information on their customers who demand a lot of energy.

In addition, we also thought of public institutions of the government or ministries that have carried out studies in the sector and can offer more information. Even private companies in the sector or their associations that show their own consumption data in annual reports were also considered.

However, throughout the process and in all the sources consulted, there has been great confidentiality. Nowadays, information is power and knowing your competitors' data is very powerful. Even more so, when it comes to energy issues, which is one of the main consumption areas for large companies and defines their long-term strategy. For this reason, companies are very reluctant to disclose data that gives information about their activity and might be an advantage for competitors. Consequently, in the case of providing data, they do so in the most aggregated way possible and not in a way that could be really useful for others. To be able to research and make studies in the future, it is essential to count on data on which to base the work. Having sources of data will enable to research and make more developments in different fields. It is important to bear in mind that we can all benefit from this, as these studies will lead to improvements for society. It has been seen that many companies may show energy consumption data in energy or economic values, but all of this is for very long periods of time or not for the whole sector. The way of sharing information makes very difficult to get data that will lead to demand profiles. It is important to use the same criteria for the data. Each source of information providing information with its own criteria may lead to misunderstandings. Hence, it should be highlighted the important of homogeneous information that gives insight of energy vectors and subsectors. There, it should be emphasized the importance of making public detailed information on the sector that provides value to students and researchers in this issue. This would improve the quality of work adding value to them.

As far as public bodies are concerned, no quality studies of the industrial sector were found. Probably for the same reason of confidentiality as explained above.

As a last option, researchers and collaborators from the university, who work in companies involved in the energy sector and have reliable people to ask for information, were consulted. Who better than these people who work every day in the sector and have extensive knowledge of it. However, none of them were able to contribute because they either claimed that the data was not as disaggregated as we wanted or that it would take a long time to try to get the information. In neither case did they claim to be able to have the information. This example shows how inaccessible such detailed industry sector information is.

They suggested certain information portals such as DataDis, a website to display electricity distribution data. However, the data was displayed by electricity tariffs and did not reveal the industrial subsector to which they correspond. In addition, many of the consumptions were private. Once again, we encountered obstacles.

Apart from all the problems we faced, we were able to collect useful data and information from the industrial sector. The methodology followed to obtain the final data to be included in the model is explained below.

To explain the process, it is best to make a distinction between the two energy sources that have focused the main work and whose profiles will be used as a proxy for the rest of energy vectors. Although, in fact, the hourly energy demand profiles were sought from both, and at many points the same methodology was followed. The final types of energy products we were focused on were natural gas and electricity.

3.1.1 RESEARCH ON GAS CONSUMPTION:

It was thought that the most convenient was to look for information in the main natural gas marketers in Spain. There are several companies such as Iberdrola, Endesa or EDP, which are the main distributors in the country. However, none of them had relevant information about what we were looking for.

Enagás website was found to be really useful. Enagás, whose name derives from "*Empresa Nacional del Gas*", is responsible for transporting and storing natural gas in Spain. It is the gas market operator in Spain.

On its website, a document was published with data about the annual gas consumption by industrial sub-sector groups and by autonomous community. Although this information does not help to create demand profiles, it is useful to know where consumption occurs in Spain and get more information about the energetic situation. The objective is not really to determine consumption in each region of the country, as the model is a single node model. However, it could provide more information and insight into the situation at a national level.

In addition to this, there was another report with daily data on gas consumption in different industrial sectors in Spain for the years 2019, 2020 and 2021.The report consisted of an Excel document with the values of gas consumption for different industrial subsectors for each day of the year. Therefore, one could know the daily gas consumption for each subsector for the last three years. However, the subsectors were not as disaggregated as desired, since some subsectors were grouped as an unique one. Probably, the reason for this fact is to keep the confidentiality in some subsectors. In any case, the document provided the daily gas consumption in recent years of some subsectors. Hence, this report would enable to create the demand profiles of these subsectors.

Havingthe daily gas consumption, it was possible to profile the demand for natural gas in the sub-sectors for which data was available. From here the process was as follows The objective was to obtain the fraction of the year total consumption is consumed each day. Therefore, the daily consumptions are summed up to get the total year consumption. The consumption of each day is divided by the total to get the fraction. To show it graphically, the gas consumption in the paper subsector is taken as an example:

Year 2019		
Date	GWh	Fraction of the total
01-Jan	17,48	0,000979
02-Jan	48,10	0,002693
03-Jan	53,96	0,003021
04-Jan	55,76	0,003122
05-Jan	50,87	0,002848
…	…	…
31-Dec	16,81	0,000941
Total	17.858,33	1,00

Table 5. Calculations in the paper´s gas demand

The value of 17.858,33 GWh is obtained after summing up all the daily consumption of the year 2019. Then the consumptions of each day are divided by the total sum (17.858,33) to get the proportion of consumption for each day. Logically, the sum of all the fractions is one. Hence, the gas demand profiles for the year 2019 is obtained.

The same calculations are done for the other years for which data are available (2020 and 2021). Thus, the daily gas demand profiles are obtained for three years. Once, the fractions of the three years are calculated, the average is calculated for each day of the year. However, the average is done taking into account the weekday, as it has an important influence on the consumption. Otherwise, there might be a mistake in comparing days with different patterns of consumption. It is known that energy consumption is strongly related to the day of the week. Even more so, the industrial sector which can be very disrupted during weekends.

Weekday	Date	2019	Date	2020		2021	Average
Tue	1-Jan	0,000979	-	-	-	-	0,000979
Wed	2-Jan	0,002693	1-Jan	0,000965	-	-	0,001829
Thu	3-Jan	0,003021	2-Jan	0,003009	-	-	0,003015
Fri	4-Jan	0,003122	3-Jan	0,003227	1-Jan	0,002556	0,002968
Sat	5-Jan	0,002848	4-Jan	0,003040	2-Jan	0,000842	0,002243
…		…	…	…	…	…	…
Tue	31-Dec	0,000941	30-Dec	0,002480	28-Dec	0,001900	0,001774

Table 6. Example of gas data

It is important to note that the fractions were averaged and not the values of consumption of each year. If the values of consumption were averaged, another profile would have been obtained that is not representative. The way to do it is by averaging the demand profiles of each year.

Once we had the averages of the fractions, we were very close to the target. The demand profile for the different days of the year was obtained. To obtain the hourly profile, it was decided to apply flat curves. In other words, the consumption fraction for the day could be divided into 24 equal parts for the hours of the day. The hypothesis for this calculation is that natural gas can be stored. Thus, if the consumption of natural gas in a day is known, it is not so necessary to know the consumption per hour, as it is known that it can be stored in that short time. We consider that this approach is valid for the purpose.

$$\frac{Fraction\ Daily\ Gas\ consumption}{24} = Fraction\ Hourly\ gas\ consumption$$

After following all the steps mentioned above, the natural gas demand profile for all hours of the year is finally available, obtaining the fraction of consumption for the 8760 hours of a year.. However, including 8760 hours in the model is very costly for the model calculation and it would slow it down considerably. Therefore, it was decided to take a day representative for each season of the year, as the data had been set so far in the model. To achieve this, the average of all the fractions of consumption for a given hour of all the days of the same season was taken.

$$Fraction\ of\ consumption\ (Hour\ H, Season\ S) = \frac{\sum Fractions\ Hour\ X, Season\ S}{Numbers\ of\ days\ of\ Season\ S}$$

Hence, there are 96 time slices, 24 hours per each of the 4 seasons of the year. However, the year could be considered in different time slices.

Nevertheless, it was thought that the data were still very grouped and that an intermediate point could be reached, in which a greater detail of consumption could be given without being excessive. It was therefore proposed to obtain the consumption profile for the 24 hours a day, 7 days a week, of the 4 seasons of the year. In total there are 672 hours (24 x 7 x 4). This change now incorporated something that had not been taken into account until now, which is the days of the week. This really adds value, as previously it was considered that the day of the week did not have an impact on consumption and all the days follow the same patterns, and one general day could be considered as a representative one. Although it was not applied to the model, the tables are included in the annexes of this project. It was not applied to the model because it requires changes in the rest of the parameters. Nonetheless, this information is included in this project for future improvements in the models that make it more accurate.

To check that the data did not contain wrong measurements or values that could be anomalous, different statistical calculations were done. The most relevant one is the coefficient of variation. It results from dividing the standard deviation by the mean of the samples. The resulting coefficient is between 0 and 1. This value gives information about the dispersion of the samples, and it helps to identify if any value does not follow the same pattern as the rest.

As an extra activity, by combining both information, the natural gas consumption per autonomous community and the demand profiles, it would be possible to determine the natural gas consumption per day and Spanish region. However, this did not really add anything to the work as the model is single-node but could be used for future works in the sector.

This has been most relevant for gas consumption. Despite all the difficulties, natural gas demand profiles for various industrial sub-sectors have been obtained. The following section will show the data and will explain the values.

3.2 RESEARCH ON ELECTRICITY CONSUMPTION:

To obtain the electricity demand profiles of the different industrial sub-sectors, the following procedure was followed. It is very similar to the one applied for natural gas, following the same steps in many parts of the process.

First, the focus was on finding general electricity data for the industrial sub-sectors. We started with a report prepared by the IDAE (*Instituto para la Diversificación y Ahorro de la Energía*) that collected electricity consumption in the industrial sector in 2018. The institute is a public entity attached to the Spanish government's Ministry of Ecological Transition, so the numbers were reliable. However, there was no information on how this consumption was distributed across the Spanish territory as there was for gas. The report shows electricity consumption separated by industrial sub-sectors. However, the data corresponds to the national level, not differentiating by autonomous communities. Actually, when it comes to DEMO model is not important to map the consumption as it is a single node model. However, it was thought to be an interesting activity for future researches in the industrial subsector. Therefore, it was decided to get an idea of how it was distributed throughout the territory.

It was therefore decided to turn to industrial production reports. There is a 2018 report by the *"Cámara de Comercio de España"* that provides data on industrial production in economic value by industrial subsector and autonomous communities. The production values were expressed in millions of euros. With this data, the percentage of production by subsector and regions of the country was calculated. Although the data is economic, it is a good approximation to know the distribution of industry by territories. In this way, it is known in which Spanish territories each industrial subsector has a greater presence and, therefore, consumes more electricity. As the different sub-sectors are well differentiated, it is assumed that the value of production per unit of product is very similar in all regions. It should be noted that we are comparing data within the sub-sector itself and at no point are we comparing production values between sub-sectors.

This data proved to be useful for subsequent application to the data in the report on electricity consumption in the industrial sector in 2018 explained previously. Therefore, what we have proceeded to do is to combine the information from both reports (*Cámara de Comercio de España* and IDAE) in order to know the energy consumption by industrial subsector and by region in Spain. Although it is not exact, it was considered that, by applying the percentages calculated, a good picture of the distribution of industry throughout the country was obtained, mapping industry.

However, up to this point the data had been mapped across Spain, with no information yet on the profiles during the year. It was decided to go to the website of *Red Eléctrica Española (REE)*, the operator of the Spanish electricity network, imagining that it could provide more information. For example, in the case of electricity generation, there is much valuable information. *REE* shows real-time data on electricity generation. On its website one can see the amount generated by the different technologies and types of sources. In addition, it shows different graphs and statistics on renewable energies or greenhouse gas emissions. There are different windows where you can choose from multiple options to check the generation in different time slots, in different Spanish regions..., in short, multiple sections that provide a lot of detailed information.

On the other hand, the situation is very different for electricity demand data. If one accesses the "*Red Eléctrica*" website one will notice the large differences between the two data sections. When accessing the demand area, it is difficult to make a difference among subsectors. Moreover, the information is so limited that it can even be briefly explained. The portal only offers data for three parts of the demand side.

The first compares the current demand data with that of the previous year. That is, it shows two percentages, one monthly and one yearly, of the variation in electricity demand compared to the same period, but in the previous year. These are only two percentages, without showing the absolute value at any time, which is why this information is insufficient.

The next part shows the maximum power detected in the month. This is the only absolute value shown. However, this value corresponds to the total demand value of the country, so it is a very crude value. Again, it has two percentages associated with it to associate it with the same period, but from the previous year.

Finally, the last piece of data that appears on the website is the corrected electricity network index. It is known by its acronym *"IRE"*. This indicator was created to provide information on the evolution of the electricity consumption of medium and large companies. Companies with more than 450 kW of contracted power belong to this category. In fact, it is more of an economic indicator than an energy indicator. The indicator is a percentage that compares the electricity consumption of the consumers described above with their consumption in the same period over another year. This data is shown for both industrial and service sector companies. In this way, the index reflects the growth or decline in energy activity, which translates directly into their economic activity. These data are presented monthly and compare their current value with that of the previous year for the same date, cumulatively.

Therefore, it was evident that there was a lack of data and information on what was desired. After a lot of searching and research, the information provided by REE's interruptibility service was found. This portal would be a good tool for obtaining information. As it will be explained later, the interruptibility service is a mechanism used by large companies, mainly in the industrial sector.

REE has a website called *e.sios* (System Operator Information System). This website shows a wide variety of data and graphs related to the Spanish electricity operator. Among all this information, the demand for the interruptibility service stands out in this case.

The demand for the interruptibility service is shown separated into different industrial subsectors, as mentioned below. For each subsector, demand data is available for any time of the year since 2015. It should be borne in mind that demand is shown for companies in that sub-sector that have used the interruptibility service, so this data does not necessarily represent the entire sub-sector in question. This data represents the power the subsector may avoid consuming if required. However, it is considered to represent the pattern of the subsector´s consumption, that´s why is used a proxy for the whole subsector. It is well known that this calculated profile is an approximation of the subsectors demands. However, without further demand information available, it is the best tool that can be used to create the necessary demand profiles for the model. Later, this service is explained in more detail.

It is possible to access data from 2015 to the first half of 2020, when the service ended. The data can be grouped into hours, days, months, or years, as preferred. In the case of the present work, we have chosen to extract the hourly demand values. That is, each value corresponding to the 8760 hours of the year. These values can be downloaded from *e.sios* through an excel file. This process has been carried out for each available industrial subsector, obtaining the hourly value for each year between 2015 and 2019. The year 2020 has not been included as it is not complete and due to the large variations, that could be affected by the pandemic. Due to inaccuracies in the program, it was observed that the files did not have exactly 8760 hours, so that for each year there were hourly data that were not available. In these cases, a zero was assigned. As will be explained below, this did not prove to be a problem. Thus, for each industrial sub-sector the hourly values from 2015 to 2019 were available. As each year an auction is held with different values of interruptibility system power, it did not make sense to work with absolute values. Demand can vary from one year to the next simply because more companies access the service through the auction one year. For this reason, it was decided to work with percentages. For each year, the total electricity demand was looked at, adding up all the hourly demands for each year. The value for each hour was divided by the total annual demand, to find out what percentage of electricity is demanded for each hour of the year. In this way, a profile of the sector's electricity demand is obtained, showing at which times of the year the most and least energy is consumed. The following table is shown as an example:

Date	Hour	GWh	Fraction
1-Jan	01-01T00:00:00	118,00	0,00003841
1-Jan	01-01T01:00:00	121,75	0,00003963
1-Jan	01-01T02:00:00	119,87	0,00003902
1-Jan	01-01T03:00:00	120,08	0,00003909
1-Jan	01-01T04:00:00	119,28	0,00003883
1-Jan	01-01T05:00:00	115,82	0,00003770
1-Jan	01-01T06:00:00	120,40	0,00003919
1-Jan	01-01T07:00:00	117,40	0,00003822
1-Jan	01-01T08:00:00	113,83	0,00003706
1-Jan	01-01T09:00:00	113,08	0,00003681
1-Jan	01-01T10:00:00	115,32	0,00003754
1-Jan	01-01T11:00:00	117,10	0,00003812
1-Jan	01-01T12:00:00	118,22	0,00003848
1-Jan	01-01T13:00:00	115,40	0,00003757
1-Jan	01-01T14:00:00	118,18	0,00003847
1-Jan	01-01T15:00:00	118,02	0,00003842
1-Jan	01-01T16:00:00	118,33	0,00003852
1-Jan	01-01T17:00:00	120,30	0,00003916
1-Jan	01-01T18:00:00	122,38	0,00003984
1-Jan	01-01T19:00:00	123,38	0,00004016
1-Jan	01-01T20:00:00	123,00	0,00004004
1-Jan	01-01T21:00:00	122,05	0,00003973
1-Jan	01-01T22:00:00	121,12	0,00003943
1-Jan	01-01T23:00:00	120,82	0,00003933
2-Jan	01-02T00:00:00	126,58	0,00004121
…	…	…	…
31-Dec	12-31T23:00:00	60,45	0,00001968
Total	Year	3.071.980,30	1,00

Table 7. Interruptibility´s service demand in paper subsector in 2015.

As most of the industrial sub-sectors have values for five different years, a statistical study has been made with them. In this way, more concrete values can be obtained and influences and one-off deviations that may have occurred in some years are avoided. From this point on, the percentages of the demand were used and the absolute values of the demand were forgotten. From these values, the mean, median, standard deviation and variance were calculated for each hour of the year. The range was also seen, noting the maximum and minimum value for each hourly value.

In the Excel sheet the calculations were performed in such a way that the hours for which values were not available in some specific years, as mentioned above, were excluded from the calculations of the parameters mentioned above. Thus, they did not affect the calculation. However, to measure the dispersion of the measures, the coefficient of variation has been used as the main statistic. The coefficient of variation results from the division of the standard deviation by the mean of the samples. The resulting coefficient is between 0 and 1, but is usually multiplied by 100 to obtain it as a percentage. This value gives information about the dispersion of the samples. Above all, it is very useful when comparing between sub-sectors, in order to know which of them has more dispersed measurements.

$$\sigma = \sqrt{\frac{\sum_1^N (X_i - \bar{X})^2}{N}}$$

$$CV = \frac{\sigma}{\bar{\bar{X}}}$$

As in the case of the gas consumption data, it was finally averaged over the same days of the week instead of over the same dates, as had been done initially. The average of the hourly values has been plotted on a graph that will serve as a profile of electricity demand in the sub-sector, which is the main objective. These graphs are shown in the Data section of this document. As in the case of gas, the fractions of consumption are shown in different forms. For the 8760 hours of the year, for 672 hours and for 96 hours. It was necessary to do this in the same groups so that the consumptions of both energy sources are separated into the same time slots.

In the following section, the interruptibility service is explained to help a better understanding the source from which the data has been extracted.

3.2.1 INTERRUPTIBILITY SERVICE:

The interruptibility service is a tool used in the electricity system to provide flexibility to demand with a view to balancing generation and demand when required.

At a point when demand in the country exceeds generation, *Red Eléctrica de España (REE)* has the power to send an order to large consumers, mainly industries, that are part of this system to reduce their electricity demand. In this way, the correct functioning of the electricity sector would be ensured.

Although it is very unlikely to happen, the electricity system may not be able to meet all demand, either due to weather conditions that negatively affect renewable energies or due to very high demand peaks. For this reason, *REE* has this mechanism as one of the options among many others, such as secondary and tertiary regulation or the use of the tool Replacement Reserve.

The interruptibility system is managed by *REE*. The service is allocated through annual auctions supervised by the *CNMC (Comisión Nacional de los Mercados y la Competencia)*. They are allocated by 5 MW packages until the total power of the service is reached, which is different every year. The auction starts with a starting price and from that point onwards, the price decreases in each round. This auction is open to large consumers, such as industries or large companies.

The companies to which the interruptibility service is assigned will receive an annual remuneration according to the price set in the auction. This financial compensation will be received whether *REE* makes use of the tool or not. In case of using the tool, the company involved will receive a higher economic amount as this will be included in the variable part. In return, the companies undertake to reduce their electricity consumption immediately if they receive the order.

In recent years, this service has received a lot of criticism as it has been considered to a large extent a totally unnecessary service. It is difficult for Spain to have a situation where demand exceeds generation, as energy installed capacity in Spain is very high compared to demand requirements. In addition, there are many other mechanisms to balance the electricity system. There are power plants with reserves in case of unexpected peak demand. In addition to this, secondary and tertiary regulation also support the system. Such is the unlikelihood of this situation, that it has been more than ten years since the interruptibility service was last used.

However, more than 500 million euros are spent every year to pay for the service. This amount is paid by all electricity consumers. It is generally said that it could be considered that it has become a kind of subsidy received mainly by industry. For many industries, this remuneration is essential, as it is a great help to cover expenses, especially considering the high price of electricity.

In 2020 the government decided to suspend the interruptibility service. In that year's auction only the first six months of the year were taken into account. Therefore, from the first of July 2020, the interruptibility service was suspended. In view of this decision, the *AEGE (Asociación de Empresas con Grandes consumes Energéticos)* complained and highlighted the difficulties that the sector will face without this vital economic aid. Moreover, this service is still provided in the rest of the European countries.

Whereas the electro-intensive industry is the most disadvantaged by the measure, domestic consumers stand to gain from this decision. The payment of this service came from the electricity bill of all consumers, so they will see their bill reduced by these indirect costs. Or at least they were supposed to.

3.3 DATA

The data collected for the different industrial sub-sectors, following the processes explained, are shown below. For each of them, a brief explanation is given of its economic importance and the main processes that take place in the industry. Moreover, electricity and gas consumption data by autonomous community will be shown in order to map the situation.

As for the hourly demand profiles are included in the annexes in order to avoid large tables in this section. However, they should be consulted to complete the information for each subsector shown below, as they are really the most valuable numbers of the research. Only the fractions of consumption divided into 96 sections are included. As mentioned above, this has also been done for 672 hours and 8760 hours. In the annexes, the large table with the demand profile for the 672 hours are attached. Therefore, demand profiles have been created for different slots of time in case are needed in other models.

As a summary, these are the consumption and sub-sectors for which data are presented:

- Food and beverages subsector:
  - Electricity consumption
  - Gas consumption.
- Textile subsector:
  - Gas consumption.
- Paper subsector:
  - Electricity consumption.
  - Gas consumption.
- Chemistry subsector:
  - Electricity consumption.
  - Gas consumption. (Separating chemistry and refinery)
- Metallurgy subsector:
  - Electricity consumption.
  - Gas consumption. (Separating metallurgy and steel)

- Wood subsector:
    - Electricity consumption.

Apart from these subsectors, attached in the annexes to complete the information of the industrial subsector one can find the gas demand porfiles of:

- Mining and Construction.
- Other industrial subsectors.

The initial idea was to determine the demand profiles of the energy vectors involved in the industrial sectors. However, due to the lack of accurate information, the main focus is on the two most demanded energies: electricity and gas. Subsequently, gas profiles will be applied for other energy vectors, such as gasoline, biomass, diesel… Therefore, although these energy vectors are not so detailed, their annual consumptions are shown in below in the numerical implementation section. The information of these resources has been obtained from an energy balance report done by *IDAE*.

3.3.1 FOOD AND BEVERAGES SUBSECTOR:

The agri-food industry has become the main sector of the manufacturing industry in Spain, with a turnover of almost 130,000 million euros, which represents 2.7% of GDP. Moreover, in the country there are more than 500,000 people employed by the subsector. These figures make Spain the fourth largest manufacturing industry in Spain and the tenth largest in the world. This fact highlights the subsector´s importance for the country. An important part of its high food and beverage production is exported abroad, amounting to around 31,000 million euros, which makes it very relevant for maintaining a positive balance of trade balance.

3.3.1.1 Food consumption and processes:

In the food industry, a distinction can be made between different branches within this sector depending on the type of food to be prepared. On the one hand, there is the production of dairy products such as yoghurt, cheese, milk, etc. On the other hand, there is also the meat industry, confectionery and the so-called balanced foodstuffs.

The production process in the food industry is very varied and depends mainly on the type of food being processed. Generally, all food fulfils the following process: raw materials are processed to transform them into food that can be consumed by humans or animals.

As a summary, a distinction is made between a process of transporting the raw materials, which mainly requires fuel, and a process of transforming the raw materials, which usually requires electricity and heat. Finally, the storage of foodstuffs, which mainly requires electricity as the main source of energy. Those are the tree main activities that are carried out in the sector.

The process, that takes place, is as follows. First of all, the raw materials are received, from which a first selection and separation is made. Once the raw materials in poor condition have been discarded, the selected pieces are washed. Then, depending on the type of food, they are treated by cooking, cold treatment, etc. Finally, the final food is packaged and stored.

This whole process mainly consumes fuel and electricity. It is estimated that of the total consumption of energy sources, fuels account for 80%. The most commonly used fuels are natural gas and liquefied petroleum gas (LGP). They are used as a thermal source to provide heat for food. 80% of this thermal energy is consumed in cooking food. On the other hand, around 10% is used for food sterilisation.

The remaining 20% of the energy sources used is electricity. Within this percentage, estimates are also available. Around 45% of the electricity is used as a driving force for motors and equipment that work directly with foodstuffs. About 40% is used almost equally to produce heat for treatments such as baking or heating food, and to produce cold for preserving food. The remaining 15% of electricity is used for minor activities such as facility lighting, compressed air, ventilation...

3.3.1.2 Beverage's consumption and processes:

The beverage industry is responsible for the production of different types of products. Alcoholic beverages, such as wine, beer or rectified ethyl alcohol. It is also responsible for the production of soft drinks, juices or even bottled water. That is why this industry also needs many other raw materials, such as fruit, cereals and vegetables. The processes are very varied and depend mainly on the beverage to be produced. They range from boiling water with fruits or vegetables, fermentation of cereals to produce beer or distillation of alcohol for alcoholic beverages.

All these processes require a large amount of energy to move the machines and provide heat for the treatments. It is estimated that 75% of the energy consumption comes from fuels, as the aim is to generate thermal energy for the boiling and distillation of a large number of beverages. The remaining 25% is used to generate electricity to drive the required machines and for other processes.

If looking in depth, one realises that there are numerous processes for beverages such as fermentation, pasteurisation or distillation. However, one could highlight others that are common to most beverages such as bottle washing, bottling or filtering that require energy. These are the processes that demand a huge amount of energy.

3.3.1.3 Electricity consumption:

The subsector corresponding to the production of food and beverages had an annual consumption of 10,539.16 GWh in 2018, which means that it is the second most electric energy demanding sector in Spanish industry. The annual energy consumption occurred by autonomous communities as shown in the following table:

Food and beverages	10.539,16 GWh	
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	14,84%	1.564,3
Aragón	3,95%	416,0
Asturias	1,45%	152,7
Baleares	0,42%	44,5
Canarias	1,65%	173,5
Cantabria	1,18%	124,1
Castilla y León	9,17%	966,6
Castilla-La Mancha	8,79%	926,4
Cataluña	23,14%	2.438,9
C. Valenciana	8,57%	903,3
Extremadura	2,25%	237,6
Galicia	7,41%	780,6
Madrid	4,04%	426,0
Murcia	4,19%	441,5
Navarra	3,13%	329,8
País Vasco	3,76%	396,5
La Rioja	2,06%	216,9

Table 8 Electricity consumption in CC.AA: Food and Beverages

However, as it is not covered by the interruptibility service, it has not been possible to obtain its consumption distributed according to the time of year.

The following graph visually displays the communities with the highest electricity consumption in the subsector. Cataluña, Andalucia and Castilla y León stand out as the largest consumers in this subsector.

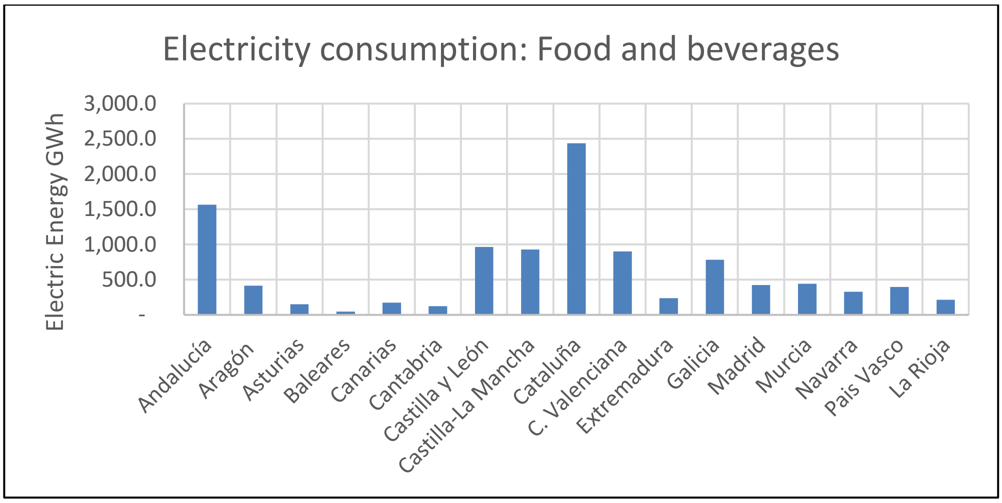

Figure 3. Electricity consumption in the CC.AA. Food and Beverages

3.3.1.4 Gas consumption:

As far as gas consumption is concerned, the data for 2019 in the agri-food subsector is shown. In that year, gas consumption in the subsector was 21,444 GWh, resulting in a daily average of 58.75 GWh. The following table shows how this consumption was distributed by autonomous community.

Food and beverages	21.440,51 GWh	
Autonomous Community	Percentage	Gas (GWh)
Andalucía	7,51%	1.609,6
Aragón	5,62%	1.204,3
Asturias	2,18%	467,6
Baleares	0,00%	-
Cantabria	1,61%	345,3
Castilla-La Mancha	13,02%	2.791,6
Castilla y León	5,39%	1.156,5
Cataluña	22,76%	4.879,0
Extremadura	4,26%	912,3

Galicia	4,24%	909,7
La Rioja	1,09%	234,3
Madrid	4,20%	899,9
Murcia	5,40%	1.157,0
Navarra	9,05%	1.939,3
País Vasco	5,40%	1.158,3
Valencia	8,28%	1.775,8

Table 9. Gas consumption in the CC.AA. Food and beverages

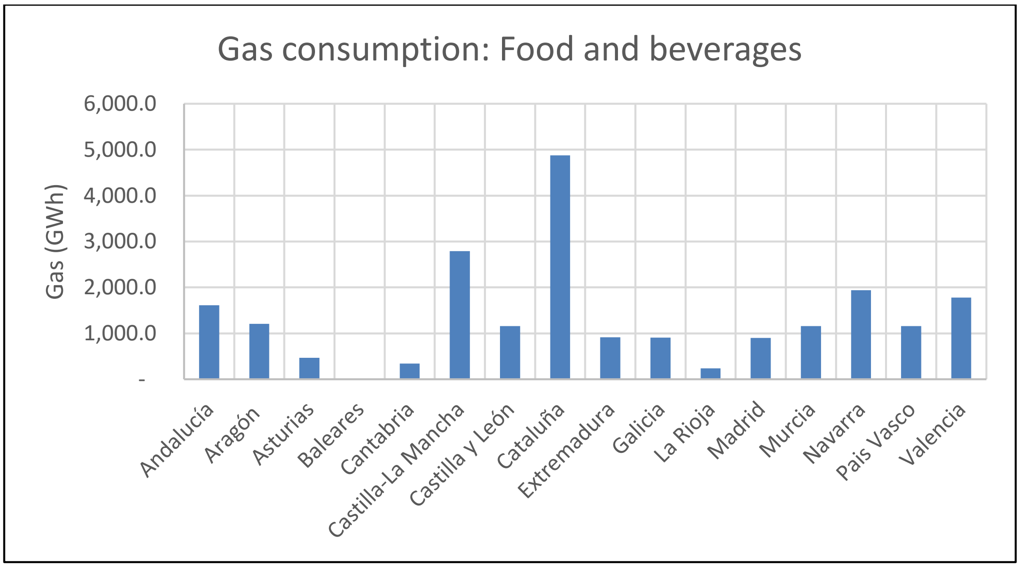

Figure 4 Gas consumption in CC.AA. Food and beverages

However, taking both chart into account, one gets to see that the electricity and gas consumption do not have the same tendency. This fact can be attributed to the fact that the industries along these regions might be very different, and they produce very different products.

The consumption during the year is as shown in the chart below. It doesn't seem to vary greatly during the year. However, looking at in more detail, it is clear that consumption varies during the months.

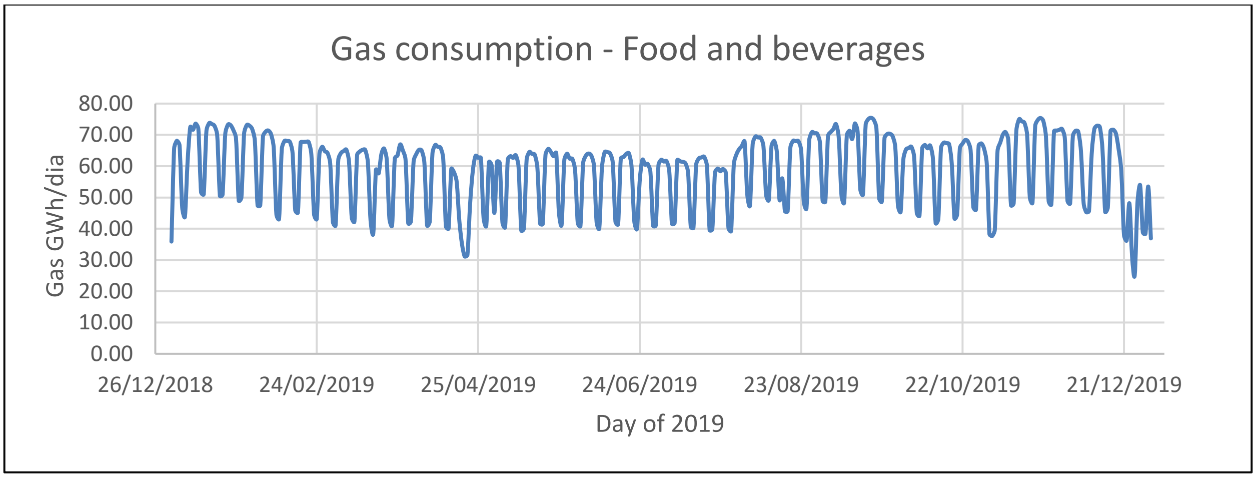

Figure 5. Annual Gas consumption: Food and beverages

3.3.2 TEXTILE

3.3.2.1 Consumption and processes

The textile sector in Spain is experiencing an upward growth. The interest in manufacturing in Spain is growing for both Spanish and international companies. In the last year, exports of textile products increased by 13%. The main competition is from Asian countries, which are the main players in the sector and have caused Spain to lose its role in this industry.

The textile industry directly employs more than 150,000 people in Spain. Currently, it represents 2.4% of Spanish GDP, having fallen from 2.8% before the pandemic.

Although compared to other industries, the textile sector does not have high energy consumption, it is always questioned on sustainability issues.

The processes in the textile sector are very varied. Depending on the type of garment, material and even colours, there will be different processes in the value chain.

There are processes for mixing raw materials to combine different fabrics. There are also spinning, washing, dyeing, sizing and gluing processes. Countless different processes to achieve the final product.

The main energy sources are electricity and oil as a source of thermal energy. The processes mentioned before are the main consumers. It is estimated that 20 % of energy consumption corresponds to electrical energy. The remaining 80% is oil. Thermal energy is used to supply heat from boilers to various processes

3.3.2.2 Electricity consumption

Electricity consumption in 2018 in the Spanish textile sector was distributed as follows. Being Cataluña, Comunidad Valencia y Galicia the most important ones in the fashion sector.

Textile	1.672,71 GWh	
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	4,40%	73,6
Aragón	1,82%	30,5
Asturias	0,00%	0
Baleares	0,95%	15,9
Canarias	0,00%	0
Cantabria	0,00%	0
Castilla y León	1,17%	19,5
Castilla-La Mancha	4,24%	71,0
Cataluña	33,21%	555,4
C. Valenciana	28,69%	479,8
Extremadura	0,00%	0
Galicia	12,95%	216,6
Madrid	3,60%	60,2
Murcia	2,77%	46,3
Navarra	0,99%	16,5
País Vasco	0,82%	13,7
La Rioja	4,40%	73,6

Table 10. Electricity consumption in the CC.AA. Textile

The following graph shows visually what is shown in the previous table on gas consumption by Autonomous Community.

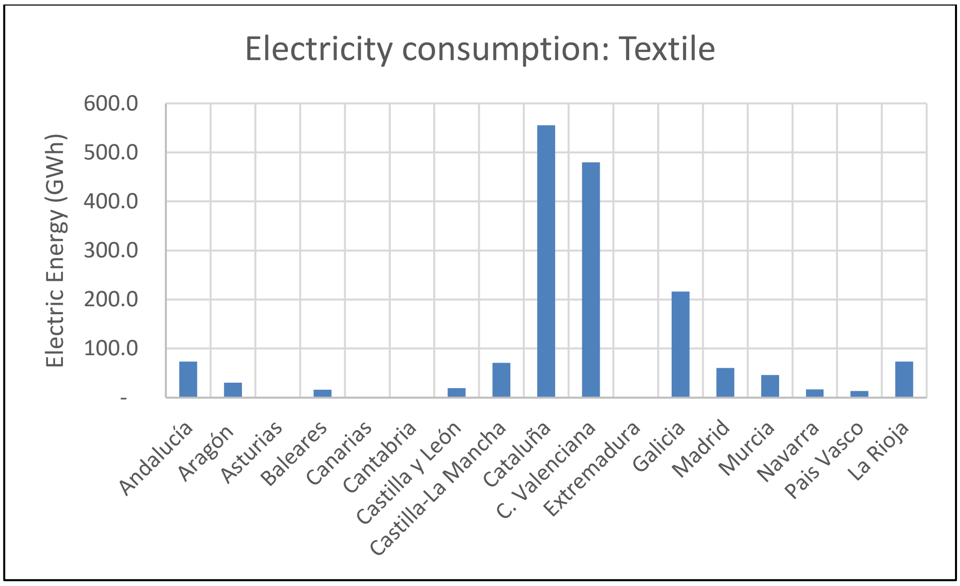

Figure 6. Electricity consumption in the CC.AA. Textile

3.3.2.3 Gas consumption

Gas consumption was distributed differently than electricity consumption. In this case, Cataluña and Valencia are the largest consumers. In contrast, Andalucia is the third largest consumer instead of Galicia. Nonetheless, the main areas continue to be the same ones.

Textile	2.276,88	GWh
Autonomous Community	Percentage	Gas (GWh)
Andalucía	23,69%	539,4
Aragón	1,91%	43,5
Asturias - Cantabria	6,76%	153,9
Baleares	0,00%	0
Castilla-La Mancha	0,56%	12,8
Castilla y León	3,36%	76,5
Cataluña	34,12%	776,9
Extremadura	0,00%	0
Galicia	3,34%	76,1
La Rioja - Navarra	0,33%	7,6
Madrid	0,73%	16,6
País Vasco	0,00%	0
Valencia - Murcia	25,19%	573,6

Table 11. Gas consumption in the CC.AA. Textile

Graphically, the predominance of the Spanish textile industry in certain regions of the country can be clearly seen in the following figure.

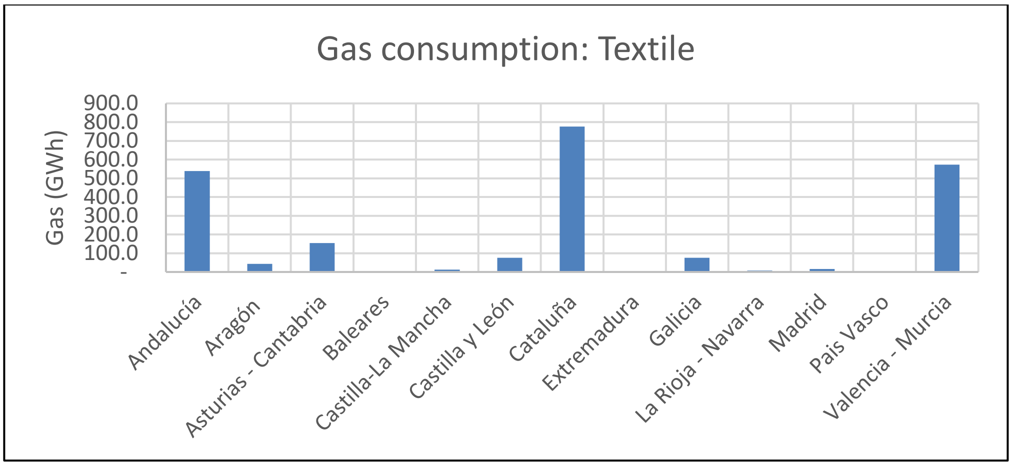

Figure 7. Gas consumption in the CC.AA. Textile

Daily gas consumption is shown in the following graph. It can be noted clear decreases in consumption during the summer and Christmas seasons.

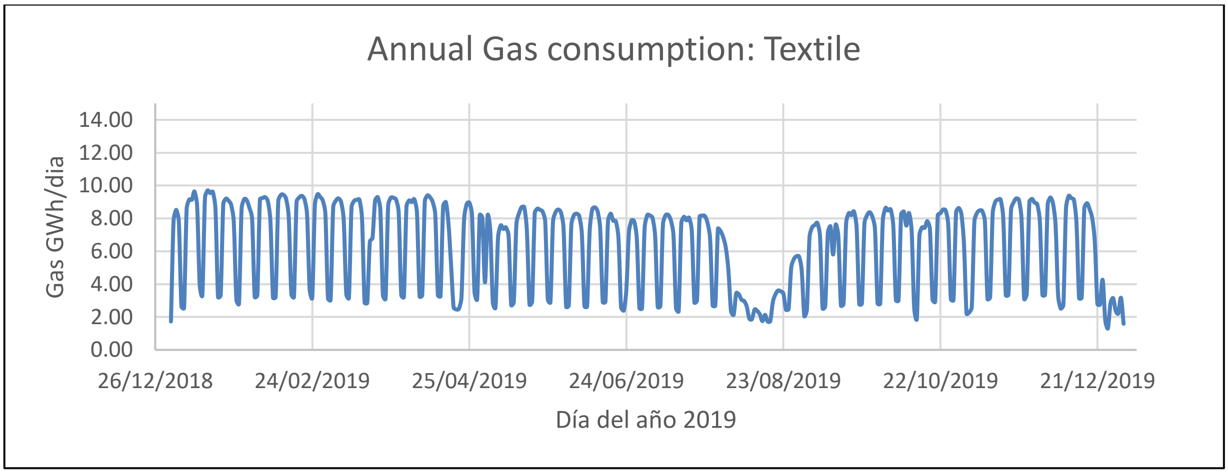

Figure 8. Annual Gas consumption. Textile

3.3.3 PAPER

3.3.3.1 Consumption and processes

The Spanish paper industry is one of the largest producers of pulp and paper in Europe, being the fifth largest producer. There are 81 factories in Spain, employing 220,000 people directly and with a turnover of 33,000 million euros.

In the papermaking process, chemicals, energy and water are used to transform cellulose into paper. Depending on the type of fibres used in the mixture, different types of paper stiffness are achieved.

The main energy consumed is electricity, which is used to move the machinery, and thermal energy for the boilers to generate the steam needed in the plants.

Whether from recycled paper or from wood, the process for making paper is the same. First, the incoming raw material is pre-treated and cleaned to form an initial pulp. This pulp undergoes a process of refining, pressing, drying, smoothing and finally winding. In this way, paper with different characteristics is obtained depending on the composition of the initial materials.

It is estimated that 87% of the paper industry's energy consumption comes from fuels and only 13% from electricity.

The most commonly used fuels are liquefied petroleum gas (LPG) and natural gas. Thermal energy is distributed as follows.

The thermal energy consumption of a paper industry is distributed as follows. Approximately, 60 % is for the boiler system for the generation of steam used in the paper machine, 30 % for process heating and the rest for the movement of the machines.

In terms of electricity consumption, the vast majority, with almost 80% of consumption, is for moving the machines and the rest is used for lighting systems and general factory overheads. A minimal part is also spent on heating and cooling processes.

The most energy-intensive machines are pulpers and paper machines. Pulpers disintegrate the cellulose pulp and require heat to do so. As for the paper machine, it dries the paper at high speed. First of all, with a vacuum drying process, which consumes a lot of electricity. Finally, a thermal drying process, which consumes almost all thermal energy from boilers and cogeneration.

3.3.3.2 Electricity consumption

The industry involved in the production of paper consumed 5.974.96 GWh of electricity in 2018. Once again, Cataluña is the strongest region in the sector. By consumption, it is followed by Comunidad de Madrid and Comunidad Valenciana.

Paper	5.974,96	GWh
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	5,74%	342,7
Aragón	9,23%	551,7
Asturias	2,09%	124,7
Baleares	0,27%	16,0
Canarias	1,21%	72,6
Cantabria	0,80%	47,7
Castilla y León	4,41%	263,6
Castilla-La Mancha	2,24%	133,5
Cataluña	27,36%	1.634,5
C. Valenciana	11,99%	716,4
Extremadura	0,40%	24,2
Galicia	3,82%	228,1
Madrid	15,47%	924,5
Murcia	1,62%	97,1
Navarra	5,00%	298,8
País Vasco	7,89%	471,3
La Rioja	0,46%	27,4

Table 12. Electricity consumption in the CC.AA. Paper

It is clearly visible, the presence of factories in the east of the country, mainly Cataluña and C. Valenciana.

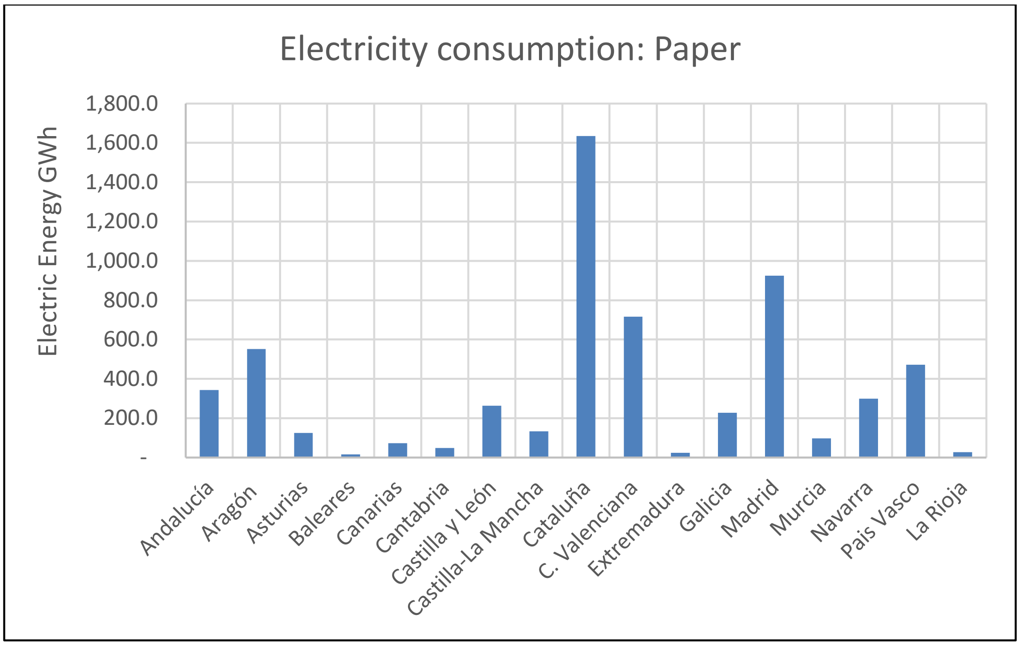

Figure 9. Electricity consumption in the CC.AA. Paper

In the following graphic, one gets to see the paper electric demand´s distribution during the year. It seems to follow a constant demand during the whole year, except for the beginning and ending of the year, when the demand is considerably lower. Moreover, there is a remarkable peak by the end of May, which corresponds to the hour 4260 of the year. Before this peak, there is a small step. Therefore, it seems that during the first quarter of the year the demand is higher than the rest of the year.

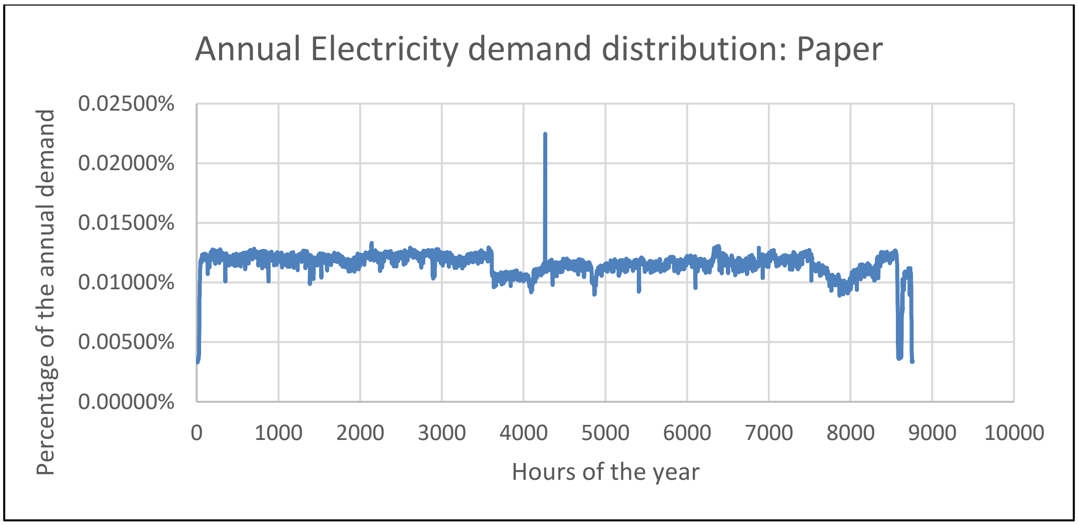

Figure 10. Annual electricity demand distribution. Paper

3.3.3.3 Gas consumption

Gas consumption data is also available for the sector. In 2019, the total gas consumption of the paper sector in Spain was 17.855.34 GWh. This chart differs from the electric demand, as Aragón turns out to be with much difference the main gas consumer of the sector.

Paper	17.855,34	GWh
Autonomous Community	Percentage	Gas (GWh)
Andalucía	4,33%	773,2
Aragón	37,12%	6.628,2
Asturias - Cantabria	11,65%	2.079,6
Baleares	0,00%	-
Castilla-La Mancha	2,61%	465,6
Castilla y León	0,00%	-
Cataluña	15,93%	2.844,5
Extremadura	0,00%	-
Galicia	0,75%	133,3
La Rioja	0,11%	19,6
Madrid	6,30%	1.125,3
Murcia	0,00%	-
Navarra	3,88%	692,5
Pais Vasco	14,50%	2.588,9
Valencia	2,83%	504,6

Table 13. Gas consumption in the CC.AA. Paper

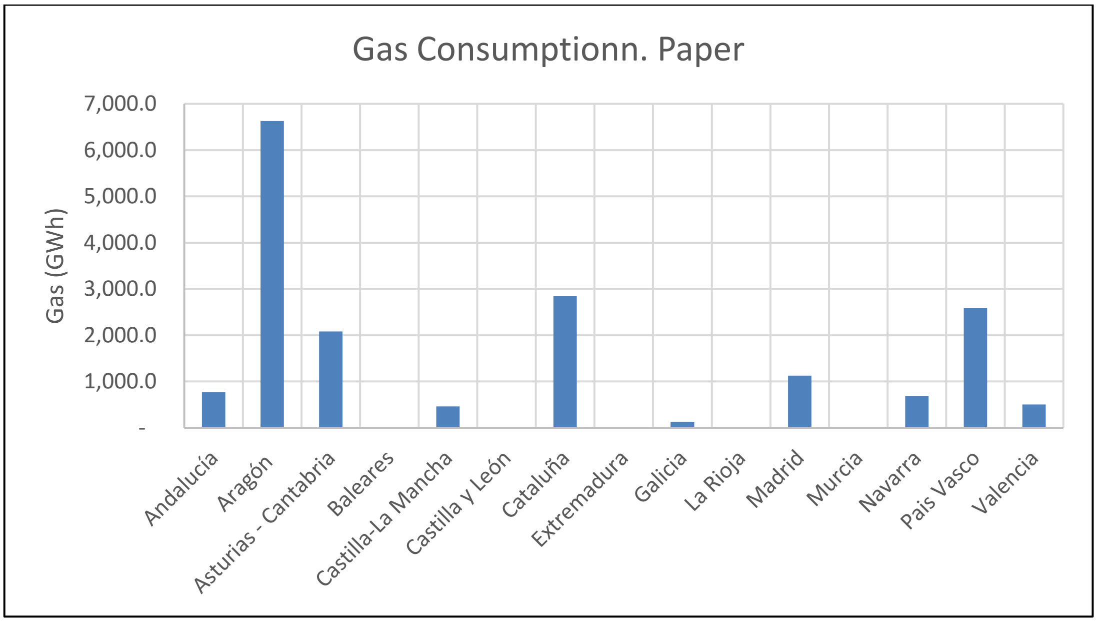

Figure 11. Gas consumption in the CC.AA. Paper

The gas consumption varies during the year as shown in the chart. As it happens in other subsector, it seems that the industry stops during Christmas. Apart from this general fact, it looks like the demand varies during the year. It starts the year demanding the most, however, the demand decrease as summer comes. After this season, there is a growing tendency until reaching the same level. Considering the variations in a same month, it could be said that there are many differences in the consumption depending on the day.

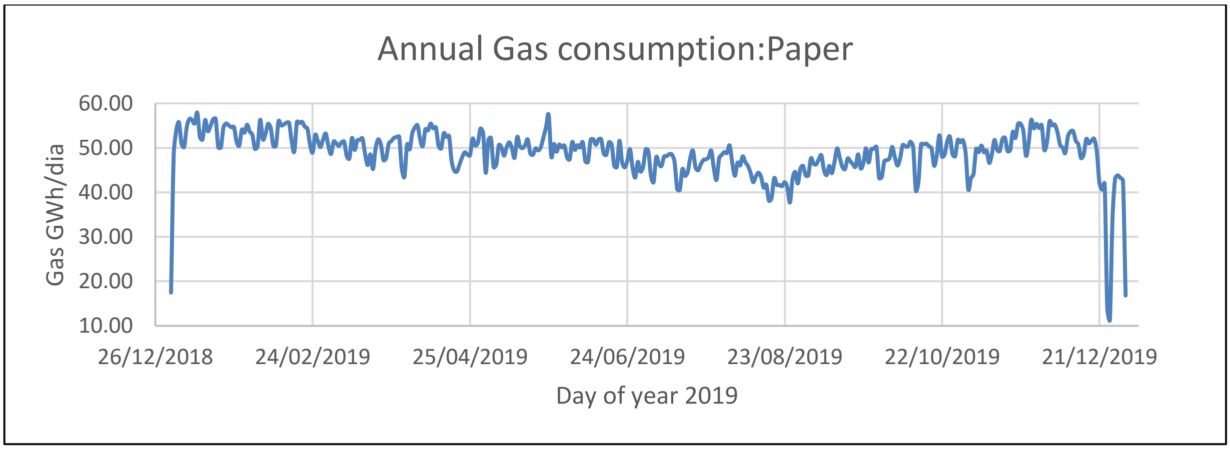

Figure 12. Annual Gas consumption. Paper

3.3.4 Chemistry

3.3.4.1 Consumption and processes

The chemical industry transforms raw materials, both organic and inorganic, into chemical products, intermediate products or consumer goods, by means of different chemical processes.

There are various types of industry within the chemical sector. However, two main groups can be distinguished: the basic chemical industry, responsible for producing intermediate or basic products that will be used by other factories or industries. The other large group is known as the transformation chemical industry, which produces a final consumer product that goes directly to the consumer.

A distinction is also often made for health chemistry, which is responsible for the production of pharmacological products.

The chemical sector is one of the main drivers of the Spanish economy. Such is its importance that in 2010 it accounted for 10% of Spanish GDP.

This industrial sub-sector also includes refining, a sub-sector that transforms oil into compounds and derivatives through different processes.

In terms of consumption, the chemical industry is also one of the most important within the sector, with considerable consumption. The main energy sources in this sector are natural gas, oil and electricity.

The chemical industry is a very heterogeneous group, so it is very difficult to distinguish between different types of energy consumption depending on the branch. Energy consumption is very high in the petrochemical industry and very low in pharmacology. Therefore, it is very varied.

Most of the consumption takes place in order to achieve the optimal conditions for chemical transformations to take place. Therefore, the major consumers are furnaces, burners and boilers. These devices require a large amount of energy to produce thermal energy. In the industry, more and more ways are being explored to be able to reduce energy consumption. Solutions include improving thermal insulation or upgrading auxiliary equipment. Cogeneration and biomass are also being used to make better use of other energy sources and to make better use of them.

3.3.4.2 Electricity consumption

The data shown below reflect the electricity consumption in the chemical sector, taking into consideration refining. It seems that the sector is centralized in some areas such as Cataluña, Andalucía and Murcia.

Chemistry	9.638,32	GWh
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	19,70%	1.898,6
Aragón	2,21%	212,8
Asturias	0,89%	85,6
Baleares	0,03%	0
Canarias	0,03%	0
Cantabria	0,90%	86,9
Castilla y León	1,99%	191,9
Castilla-La Mancha	5,90%	568,9
Cataluña	30,61%	2.950,5

C. Valenciana	8,44%	813,2
Extremadura	0,31%	29,6
Galicia	3,98%	383,5
Madrid	7,62%	734,1
Murcia	8,05%	775,9
Navarra	0,70%	67,4
País Vasco	8,42%	811,6
La Rioja	0,23%	22,2

Table 14. Electricity consumption in the CC.AA. Chemistry

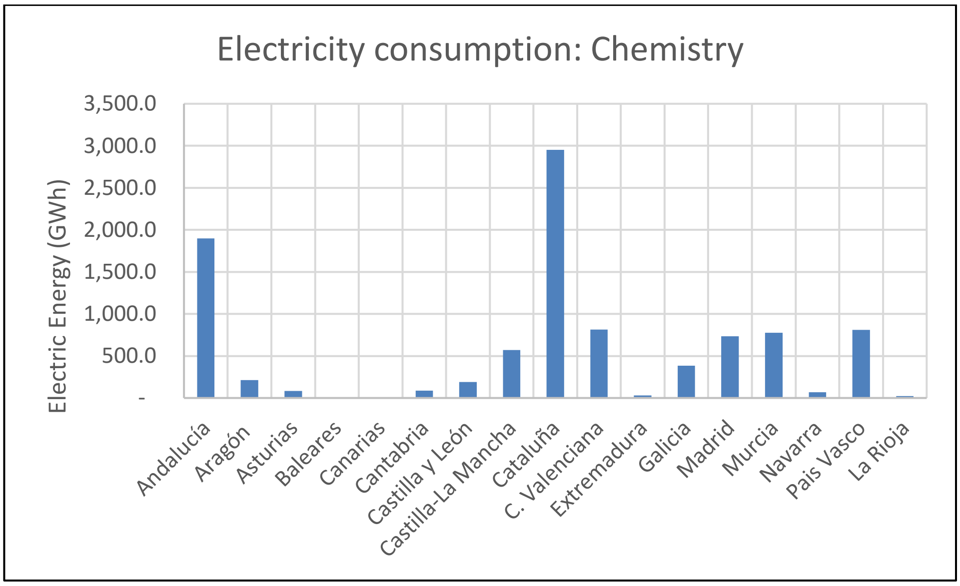

Figure 13. Electricity consumption in the CC.AA. Chemistry

The profile of the electricity demand is very constant during the whole year as one get to see in the following graphic.

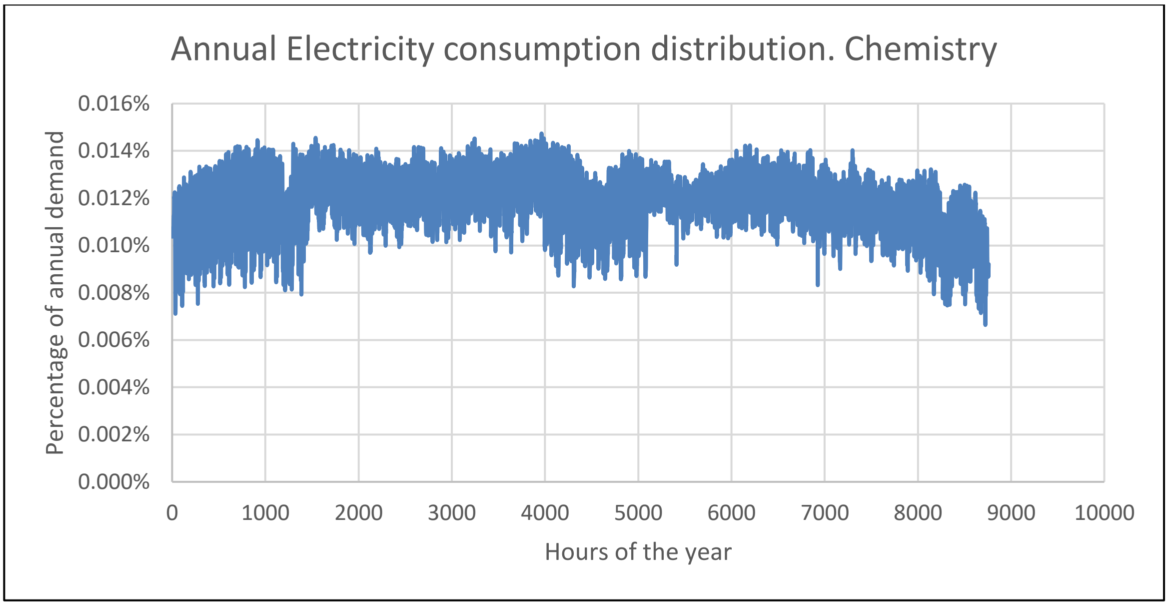

Figure 14. Annual Electricity consumption distribution. Chemistry

3.3.4.3 Gas consumption

Regarding gas consumption, the data is divided into the chemical and refining subsectors. Therefore, the information is more disgreggated.

As for the chemical subsector, the following data is available. It appears that the chemistry sector is more distributed comparing to the refining sector.

Chemistry	29.487,92	GWh
Autonomous Community	Percentage	Gas (GWh)
Andalucía	23,51%	6.933,3
Aragón	3,21%	945,7
Asturias	1,23%	363,5
Baleares	0,00%	-
Cantabria	4,77%	1.407,4
Castilla-La Mancha	5,68%	1.674,5
Castilla y León	13,12%	3.870,2
Cataluña	21,55%	6.354,3
Extremadura	0,00%	-
Galicia	3,20%	943,2
La Rioja - Navarra	0,15%	43,7
Madrid	0,77%	227,6

Murcia	12,92%	3.809,3
País Vasco	2,93%	865,0
Valencia	6,95%	2.050,4

Table 15. Gas consumption in the CC.AA. Chemistry

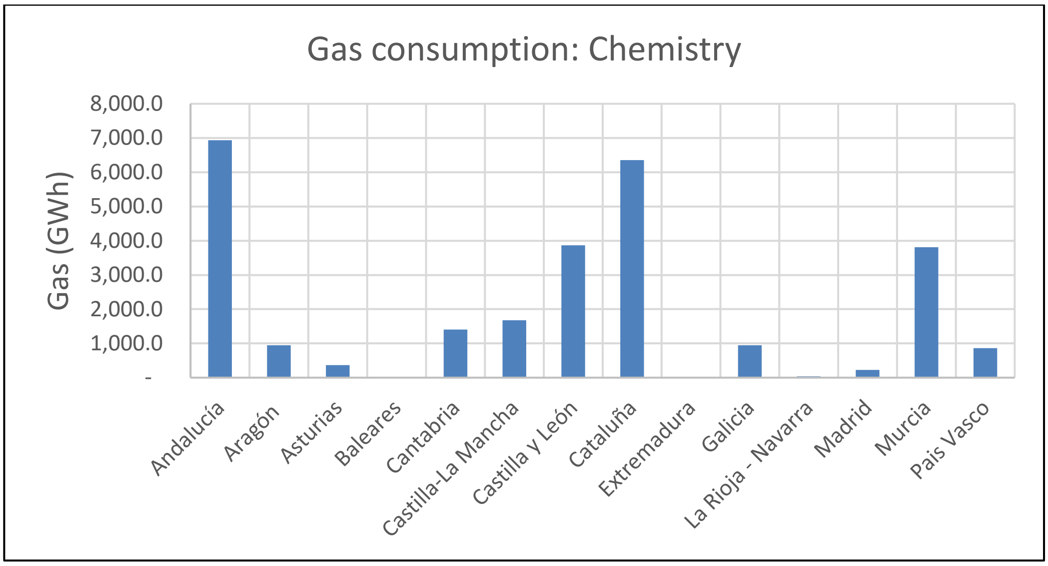

Figure 15. Gas consumption in the CC.AA. Chemistry

As for the consumption´s tendency, during the years. It is clear that it varies considerable during the month with a low consumption during summer and Christmas.

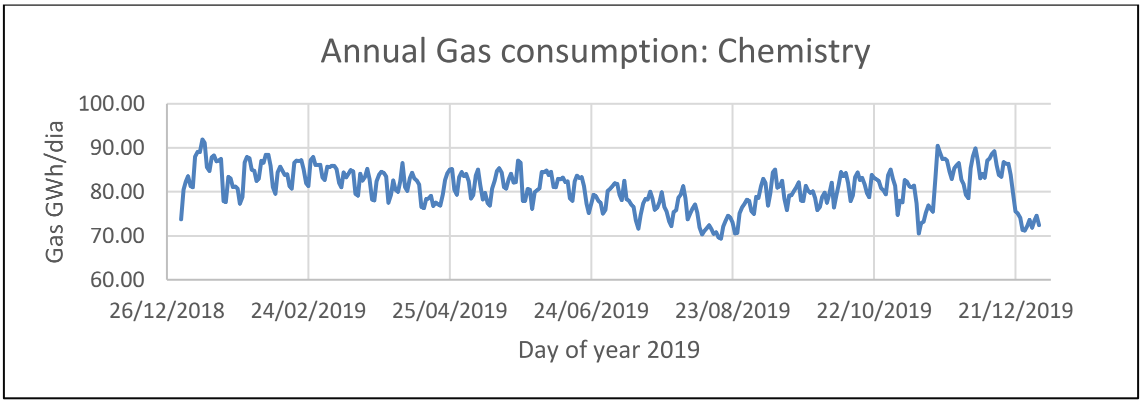

Figure 16. Annual Gas consumption. Chemistry

The following data were collected for the refining subsector.

Refining	41.765,93	GWh
Autonomous Community	Percentage	Gas (GWh)
Andalucía	19,84%	8.285,2
Aragón	0,00%	-
Asturias - Cantabria	2,96%	1.234,3
Baleares	0,00%	-
Castilla-La Mancha - Madrid	0,05%	21,1
Castilla y León	8,78%	3.665,6
Cataluña	21,96%	9.172,2
Extremadura	0,00%	-
Galicia	7,74%	3.231,4
La Rioja	0,00%	-
Murcia - C.Valenciana	27,90%	11.651,2
Navarra - Pais Vasco	10,79%	4.504,9

Table 16. Gas consumption in the CC.AA. Refining

The refining sector is clearly identified in some regions, whereas in other its presence is void. Andalucia, Cataluña and Murcia are the most important one considering gas consumption. This distribution matches with the one explained for the whole sector.

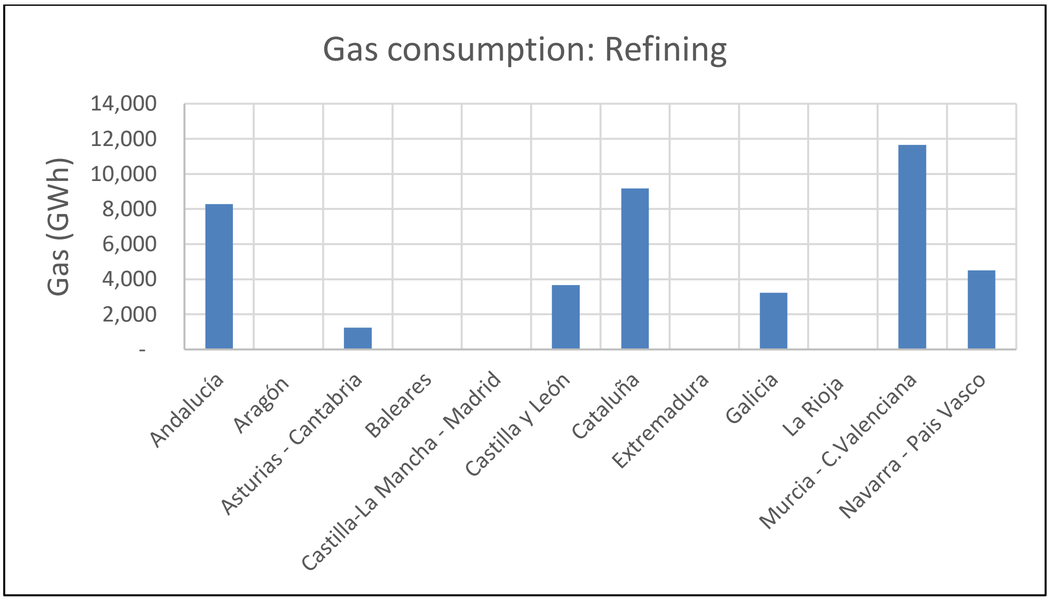

Table 17. Gas consumption in the CC.AA. Refining

Interestingly, refining´s gas consumption is very diverse during the year. Winter is the season when most gas is demanded in the sector. This demand decreasse during sumer, reaching its lowest values during autumn.

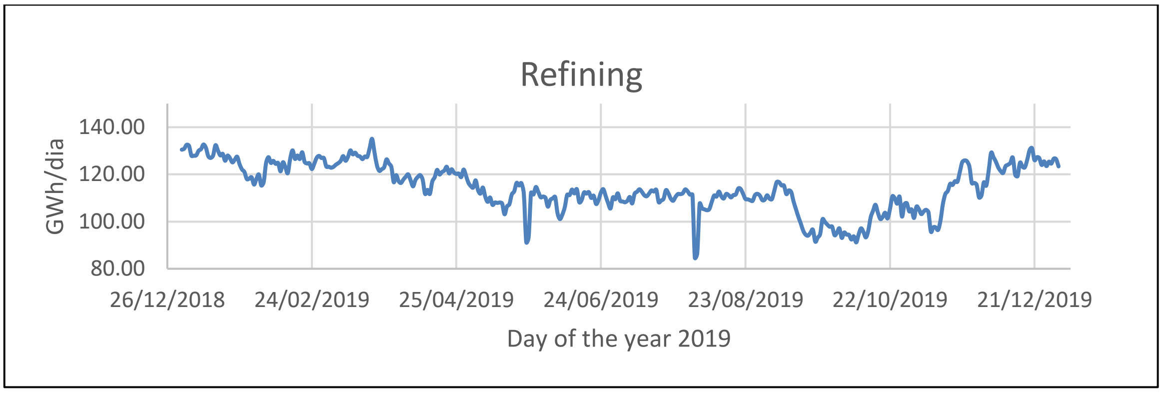

Table 18. Annual Gas consumption. Refining

3.3.5 METALLURGY

3.3.5.1 Consumption and processes

Metallurgy is the most important industrial sector in Spain with the greatest impact on the country's economy. Some figures that show its importance are that it represents more than 8% of the Spanish GDP and employs more than 1.800.000 people. It is also very important in terms of Spain's exports, accounting for 42% of exports according to *"ConfeMetal"*, the association of Spanish metallurgy companies. It is also a key sector in the industry in general as almost the rest of the industry depends on its production. It is said that the metallurgy industry is a good indicator to determine the development of a country. The metallurgy industry supplies other sectors with key parts for production. For example, the automobile industry, electronic devices and everything related to machinery depend on it. Almost every industry are related to the metallurgy.

The metallurgy industry is responsible for processing metals and metal ore alloys into products for different uses. Metallurgy is a very wide industrial sector and one could say that there is almost as much variety as there are different metallic elements present in ores. The most important are iron and steel metallurgy, aluminium metallurgy, zinc metallurgy, nickel metallurgy and copper metallurgy.

As there is such a variety of metals and products, the processes are very diverse. However, different classifications of metallurgy can be made according to the products that are obtained or the processes that are carried out.

Extractive metallurgy is that which applies a series of chemical processes to treat ores to obtain metals of varying purity. Generally, all ores undergo an initial washing and are separated. After a chemical process, the pure metal is obtained. Once the pure metal is obtained, the different metals are alloyed according to the desired result. In the chemical process there are different as known as unitary operations. These unitary operations can be dry, which require high temperatures and therefore a lot of energy, or wet, which is carried out at low temperatures and therefore does not require as much energy.

The other type of metallurgy is known as powder metallurgy. As its name indicates, it consists of obtaining metal powders in order to be able to elaborate and manufacture products. The two most important processes are compacting and sintering. Compacting requires high pressures and temperatures to mix the mineral powders and obtain an agglomerate. Sintering is a process by which the agglomerate is given mechanical strength through temperature changes according to its melting point. Both processes require a lot of energy.

Finally, there is the production process, which is responsible for shaping what is extracted to make the products. This involves molding and heat treatment processes. Obvously, there are thousands of other processes and their application depend on what is decided to produce.

In addition, metallurgy can also be classified according to the products obtained from it. A distinction is commonly made between metals that contain iron and those that do not. Those that do not contain iron are known as non-ferrous metals, the best known of which are copper, aluminium, lead and zinc. However, those that do contain iron in their composition are called ferrous. Examples of these are pure iron, steel and cast iron. The latter group is known as the iron and steel and foundry sub-sector. In this group only iron and steel are processed. Thus, iron and steel and foundry is part of metallurgy.

3.3.5.2 Electric consumption

Regarding electricity data, a separation is made between steel and foundry and metallurgy excluding this group.

3.3.5.2.1 Metallurgy

The metallic products are mainly produced in Cataluña and País Vasco. The rest of the production is distributed in small proportions throughout Spain.

Metallurgy	15.003,380	GWh
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	6,56%	984,22
Aragón	3,36%	504,11
Asturias	3,72%	558,13
Baleares	0,36%	54,01
Canarias	0,28%	42,01
Cantabria	2,12%	318,07
Castilla y León	6,55%	982,72
Castilla-La Mancha	3,29%	493,61
Cataluña	20,40%	3060,69
C. Valenciana	7,93%	1189,77
Extremadura	1,20%	180,04
Galicia	4,97%	745,67
Madrid	5,82%	873,20
Murcia	3,48%	522,12
Navarra	5,18%	777,18
País Vasco	23,19%	3479,28
La Rioja	1,58%	237,05

Table 19. Electric consumption in the CC.AA. Metallurgy

Visually, it is clearly visible the large consumption in Cataluña and País Vasco.

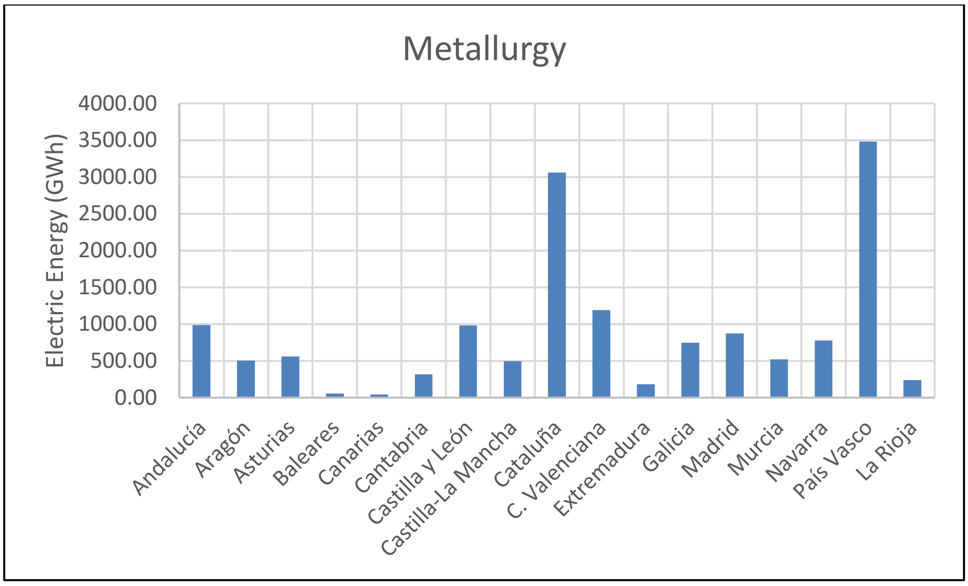

Figure 17. Electric consumption in the CC.AA. Metallurgy

Although there is a considerable decrease in electric consumption during summer, the profile of the electric demand is very constant during the whole year.

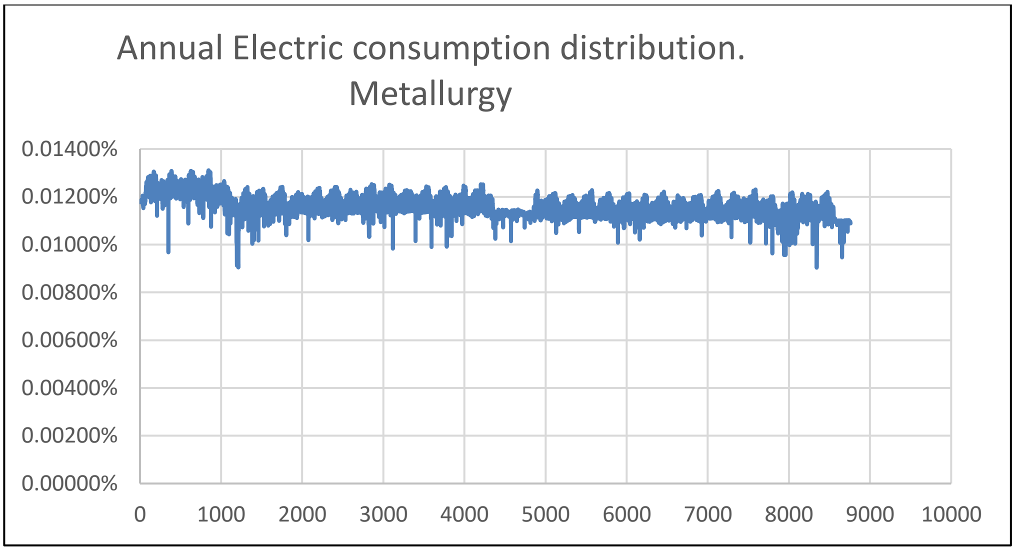

Figure 18. Annual Electric consumption distribution. Metallurgy

3.3.5.2.2 Steel and foundry:

Steel and foundry	14.409,49	GWh
Autonmous Community	Percentage	Electric Energy (GWh)
Andalucía	18,74%	2.700,5
Aragón	3,13%	451,0
Asturias	11,47%	1.653,0
Baleares	0,00%	0
Canarias	0,00%	0
Cantabria	3,98%	573,3
Castilla y León	3,45%	497,5
Castilla-La Mancha	1,35%	195,1
Cataluña	13,97%	2.013,4
C. Valenciana	4,89%	704,2
Extremadura	1,08%	156,1
Galicia	7,98%	1.149,7
Madrid	3,10%	447,1
Murcia	0,43%	62,5
Navarra	3,07%	442,2
País Vasco	23,03%	3.318,7
La Rioja	0,31%	45,0

Table 20. Electric consumption in the CC.AA. Steel and foundry

As in metallurgy, Cataluña and País Vasco also stand out, although this time Andalucía is the region with the second highest consumption.

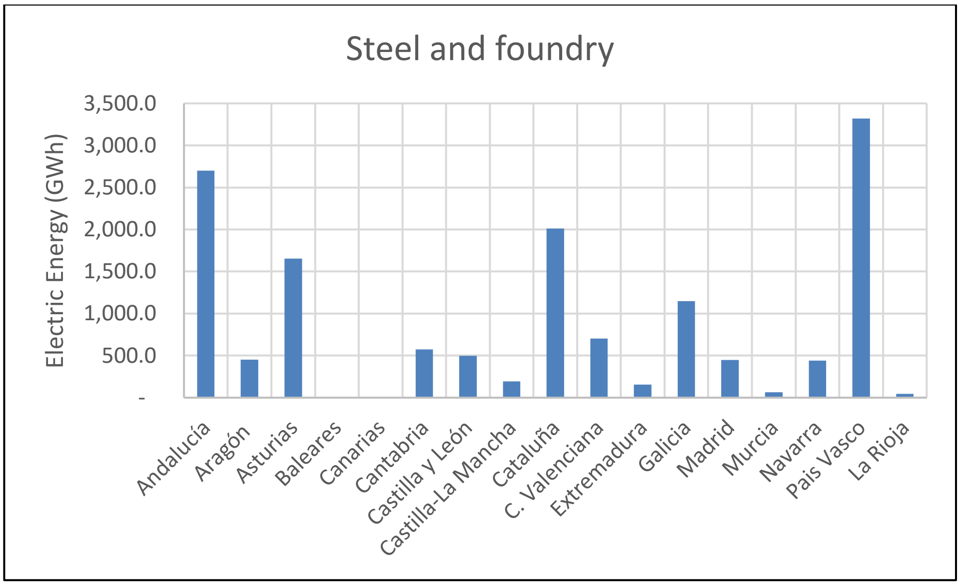

Table 21. Electricity consumption in the CC.AA. Steel and foundry

The distribution of electricity consumption is V shaped with peaks in winter and lower consumption in summer.

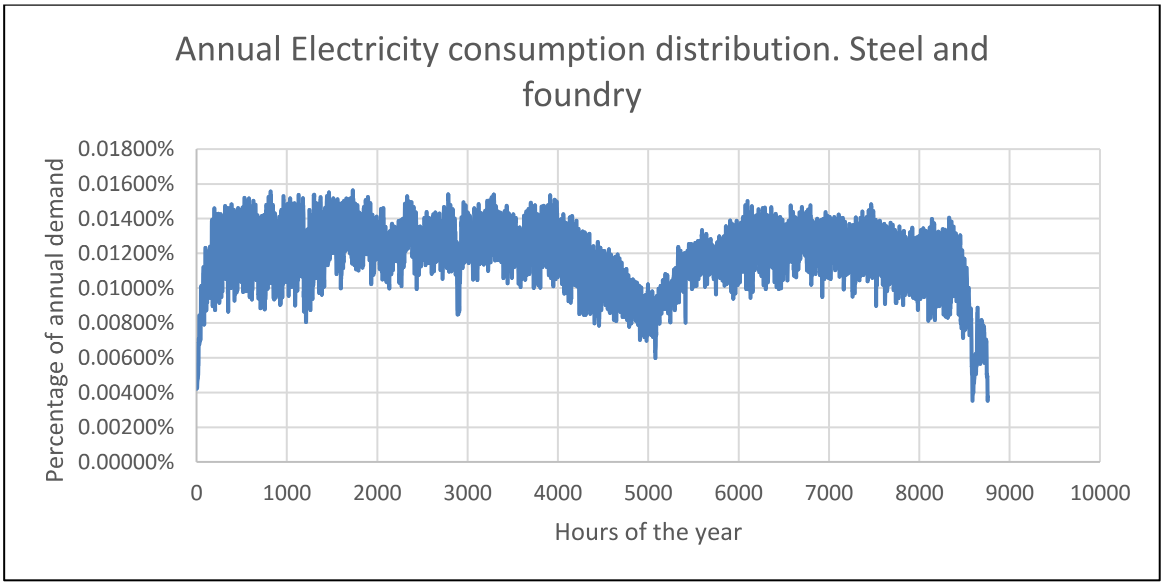

Figure 19. Annual Electricity consumption distribution. Steel and foundry

3.3.5.3 Gas consumption

Metallurgy	15.467,23	GWh
Autonomous Community	Percentage	Gas (GWh)
Andalucía	9,40%	1.454,55
Aragón	1,96%	302,90
Asturias - Cantabria	16,11%	2.492,05
Baleares	0,00%	0,00
Cantabria	4,68%	724,13
Castilla-La Mancha	2,61%	403,84
Castilla y León	0,38%	58,12
Cataluña	8,84%	1.366,82
Extremadura - Galicia	28,84%	4.460,90
La Rioja - Navarra	1,61%	248,94
Madrid	2,16%	333,48
Murcia	0,28%	42,72
Pais Vasco	18,82%	2.910,89
Valencia	4,32%	667,88

Table 22. Gas consumption in the CC.AA. Metallurgy

Gas consumption does not occur in the same communities as electricity consumption. The fact that certain regions are grouped together makes it difficult to map consumption. However, it seems that the north of the country has the highest consumption, with País Vasco, Cantabria, Asturias and Galicia with the highest consumptions.

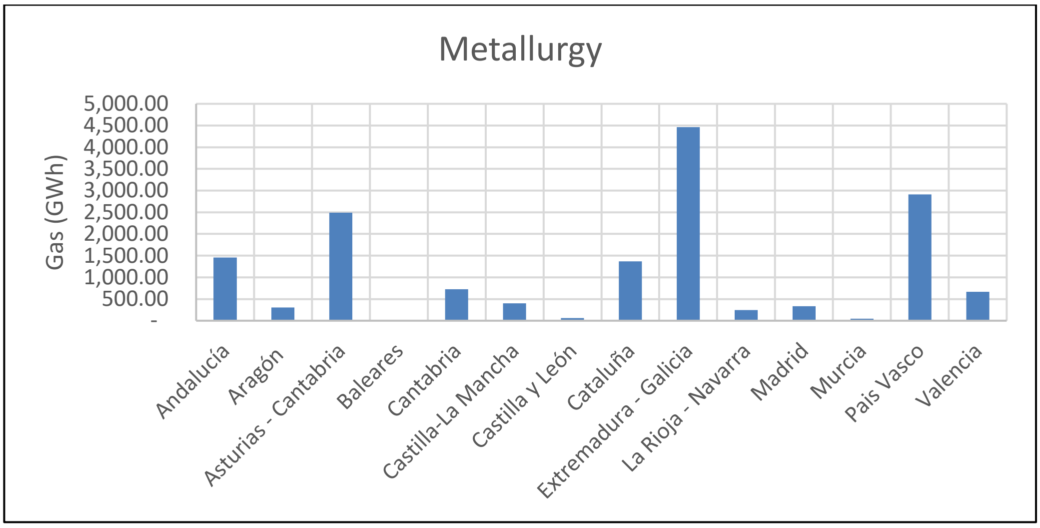

Figure 20. Gas consumption in the CC.AA. Metallurgy

The annual consumption profile has ups and downs during the year, although it could be said it is constant except for summer and Christmas when there are clearly a fall in conusmption.

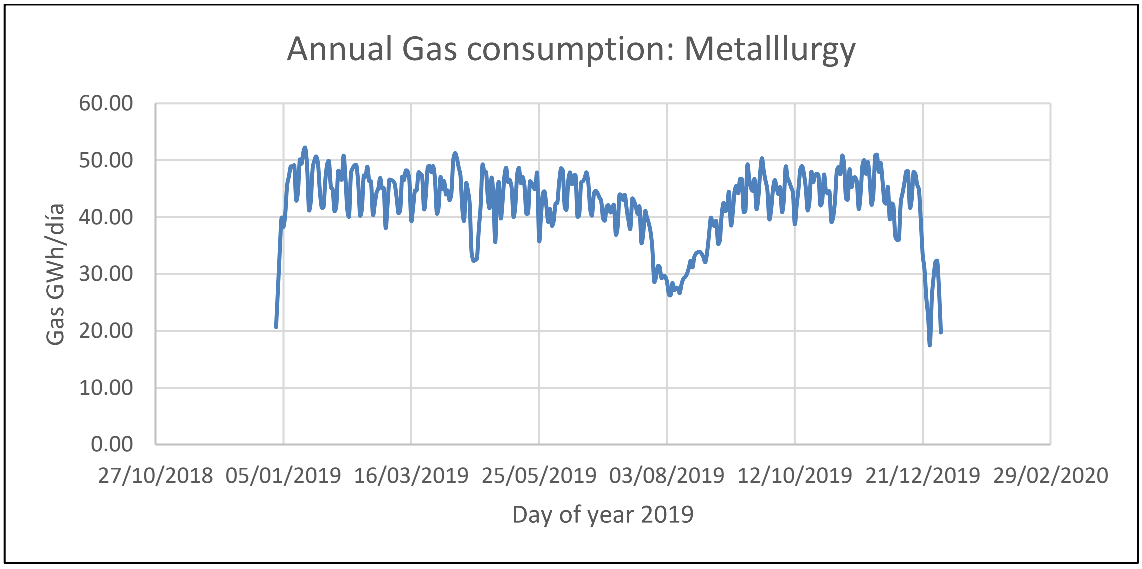

Figure 21. Annual Gas consumption. Metallurgy

3.3.6 WOOD

3.3.6.1 Consumption and processes

The wood sector covers all the processes from the planting of trees and forestry to the different transformations that are applied to the wood until the desired products are obtained. Normally in the process, after the felling of the trees, the trunks are treated to obtain wood and cork. These products can be sold directly or undergo a second process to manufacture furniture. Due to the type of products manufactured, it is commonly said that the sector is strongly linked to construction sector. Therefore, it undergoes a considerable increase in production when construction also reaches its peaks. For this reason, it was a sector that was particularly affected by the last construction crisis in 2008, although in recent years it has managed to recover.

In economic terms, the wood sector is not particularly relevant in Spain compared to other industrial subsectors. However, it has certain importance as it employs more than 150.000 people and represents 1.8% of Spain's GDP.

The main energy sources used in the sector are electricity and thermal energy. The last metioned is being particularly important due to its high consumption. Among the different operations carried out, it is considered that the compression, grinding and cutting activities require the most electrical energy. In terms of thermal energy consumption, drying processes are the most demanding as it requires to reach certain heat conditions.

3.3.6.2 Electricity consumption

For the wood sector only electric consumption data has been collected. Compared to the other industrial sector, it has a low consumption. Cataluña and Comunidad Valencia are the mainly consumers. Apart from them, there are many regions with similar consumptions.

Wood	1.592,72	GWh
Autonomous Community	Percentage	Electric Energy (GWh)
Andalucía	8,44%	134,4
Aragón	7,03%	112,0
Asturias	0,64%	10,1
Baleares	0,87%	13,9
Canarias	0,33%	5,3
Cantabria	0,69%	11,0
Castilla y León	5,87%	93,5
Castilla-La Mancha	5,31%	84,6
Cataluña	18,26%	290,9
C. Valenciana	15,54%	247,6
Extremadura	1,76%	28,0
Galicia	11,13%	177,3
Madrid	9,91%	157,8
Murcia	4,00%	63,7
Navarra	1,65%	26,3
País Vasco	5,87%	93,5
La Rioja	2,70%	43,0

Table 23. Electricity consumption in the CC.AA. Wood

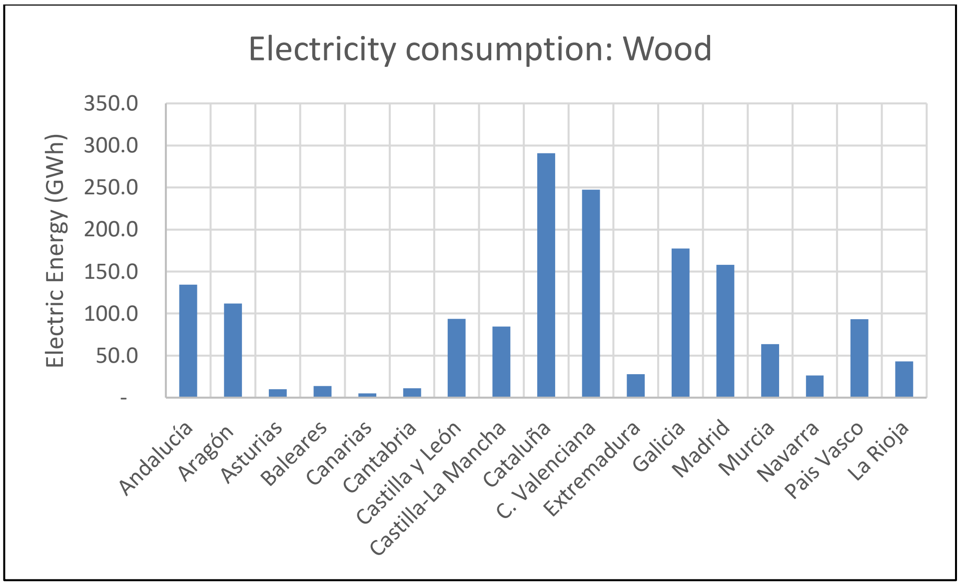

Table 24. Electricity consumption in the CC.AA. Wood

The profile of the electric demand is very constant during the first half of the year. Then during summer there is an important drop in consumption. It recovers its normal consumption during autumn and it finishes the year with an important drop reaching its lowest values

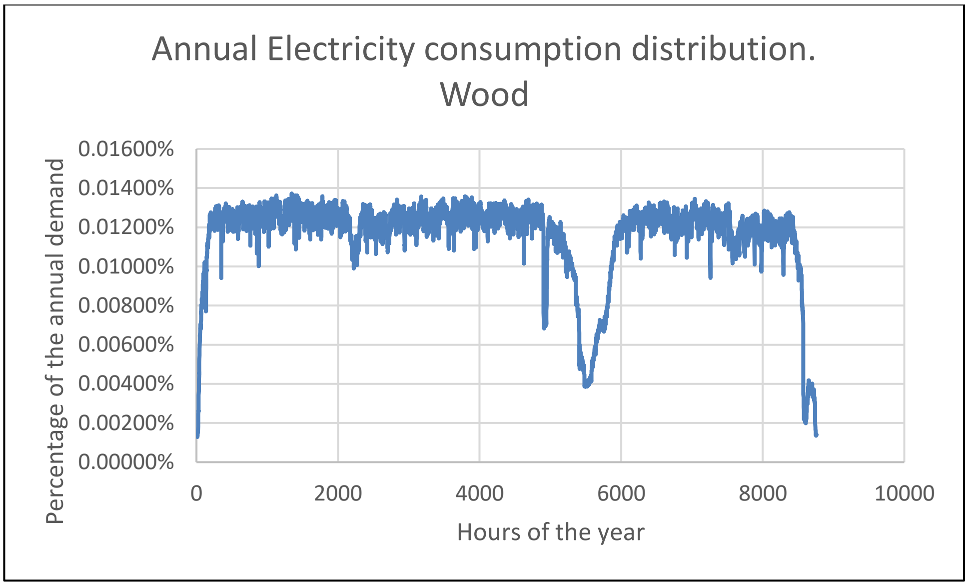

Figure 22. Annual Electricity consumption distribution. Wood

After the presentation of electricity and gas consumption in the different regions of Spain, it is possible to have an overview of how industry is distributed throughout the country. It can be seen that in general it is highly concentrated in certain regions such as Cataluña and País Vasco. Although this may vary depending on the sub-sector.

Furthermore, it is important to highlight differences observed between gas and electricity consumption in the same subsectors, which lead one to think that consumption is not directly proportional.

3.4 DEMO MODEL

DEMO model is a bottom-up partial equilibrium dynamic model of energy systems that has been created for sustainable energy policy analysis. It is said that it is bottom-up because it gets general data as total consumption of the resources from adding values of lower levels. Apart from this, it is said to be dynamic since the results show the evolution among the years and the data year by year, instead of giving the final values.

DEMO is known as a simpler version of MASTER, because it is used to check new methodologies and changes that are going to be applied in the model. Therefore, as a first step the changes are validated in DEMO for a later application in MASTER.

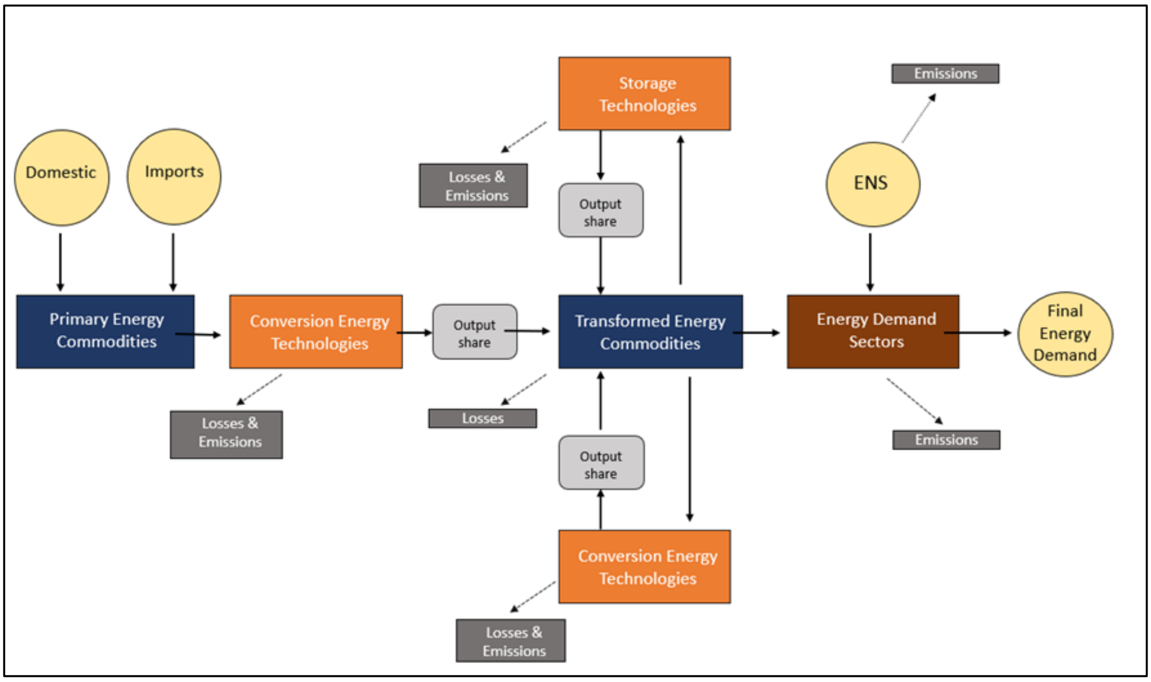

Figure 23. Energy process modelling

The DEMO model includes the entire process of the previous scheme. It can be said that it takes into account the entire energy value chain except for the final energy services, which MASTER model does. To give an example that explains it better, in MASTER model it is defined how many people and kilometers move by car, what type of car they use, etc... Whereas DEMO model finishes a step behind, being only necessary to define how much how much diesel, petrol, etc. is needed. DEMO model goes to the final energy demanded in the system.

It goes through the whole energy value chain:

PRIMARY ENERGY

Primary energy is classified into two types.

- Primary energy can be domestic. This type includes the resources that are generated or extracted within the country's borders. As the case study always refers to Spain, domestic primary energy would be renewable energy. Spain has many hours of wind and sun that can be used to generate electricity and thermal energy. It is necessary to add the water reservoirs that exist in the country that are used to generate electricity. To a lesser extent, biomass and biogas are also taken into account.
- The other group is the imported ones. All the resources that Spain is not capable of extracting or the raw materials that are not found in the country must be bought from abroad. This group includes crude oil and gas, which Spain imports mainly from Arab countries and Algeria. The uranium used in nuclear power plants are also into this group.

This first step of the primary energies shows the energy dependence of a country. The higher the value of the amount of imported energy compared to domestic energy, the greater a country's dependence on other countries, which is a negative aspect, as any external event will have an impact on its energy system and economy. Unfortunately for Spain, the amount of imported resources is very high, which makes it highly dependent on other countries suppliers of energy. This will continue to be the case as long as non-renewable energy consumption continues. That is the reason why the ecological transition is so important for the country, a process of trying to consume more renewable energy produced in Spain.

Moreover, the less dependency on external suppliers, the more control one has over its own energy system.

CONVERSION ENERGY PROCESSES

The next step corresponds to primary energy commodities. These are responsible for transforming primary energy into another type of energy, mainly electrical or thermal energy.

In this process there are already energy losses and polluting emissions that must be taken into account in the model. In renewable generation plants, no emissions are produced, as they do not use any type of fuel. However, obviously, as in all installations, there are energy losses that reduce the performance of the plants. In refineries and coal-fired power plants, there are both losses and emissions that should be considered. The model accounts for all losses and emissions, penalizing the last one economically.

In the diagram, a square with "Output Share" is shown below. This means that more than one product can be produced from the input. For example, in wind power plants, only electricity is produced from wind. However, taking the example of crude oil used in a refinery, several products can be obtained at the output, such as gasoline, paraffin, diesel... For these energies from which many products can be obtained at the output, the fraction of product desired at the output can be defined in the model.

TRANSFORMED ENERGY COMMODITIES

The next package represents the transformed commodities. That is, it is what is obtained once the first energy conversion step has been finalised. This product can be stored or converted to another type of energy, as explained below. It can also be the case that this transformed energy is ready for final consumption. In this group one can find the commodities such electricity, natural gas, gasoline… that have been produced in the different plants and are ready for the next step.

In this group, there are a conversion energy technologies. This represents the various sources of energy that are converted into another type of energy either for a period of time or to give rise to other types of energy. An example of this type of technology is liquefied natural gas (LNG). To import natural gas, it is typically converted to its liquid state to facilitate transportation. Once it arrives at its destination, a process known as regasification is carried out, by means of which the final natural gas is obtained. Combined cycles also belong to this group, using petrol and other petroleum derivatives to generate electricity.

STORAGE TECHNOLOGIES

Although there are several storage technologies, the model only considers one type. Therefore, it should be contemplated the introduction of other types of storage technologies to improve the quality of the model. Meanwhile, the model only considers pumped storage. Energy is stored by pumping water to higher elevations. The technique is as follows: during off-peak hours, which are usually at night when electricity is cheaper, water is pumped to water reservoirs at higher altitudes. In this way, energy is stored through the power energy of the water at a higher elevation. At peak times, when the demand for electricity is highest and the price of electricity is also higher, water is released from the reservoirs to generate electricity in the hydroelectric power plants.

In the model this process is set to follow a seasonal equilibrium. In other words, everything that enters a season must leave in that same station. However, in real life storage is typically intra-weekly, with what has been stored being consumed in the same week. In this specific case of pumping, emissions are zero since its water the energy vector used. However, the losses that occur in the process should be taken into consideration.

ENERGY DEMAND SECTORS

Finally, all the production of the different technologies involved in the process derives in the energy demanded by all sectors. This package includes the demand data of the different sectors of a country. For example, the residential sector, the transport sector... In this case the main focus will be on the industrial sector. There should be a balance between energy produced and demanded. To meet this condition, the energy not supplied (ENS) is included as a slack variable. This variable is given a very high cost economically to penalize it in the objective function to prevent it from taking a non-zero value. The purpose of using this variable is to find out what type of energy and what value is missing for a given year in the resolution of the model. In this way, with the help of this variable it is possible to find mistakes in the model that would not be possible to detect without it. However, this variable must have a value of zero in order to accept the resolution of the model. A different value would mean that in some sector not all the demand is being supplied. In real life this cannot happen.

The last step corresponds to the final energy demand. This is exogenous energy, that is energy that is consumed. In this group, one could give as an example the litres of petrol consumed, the electrical energy consumed...

3.5 DATA BASE: EXCEL DOCUMENT

An Excel file is used to provide the model with input data. GAMS, in which the model is programmed, has some difficulty in reading data directly from an Excel file. Therefore, to speed up the process and make the data reading process easier, text files (.txt) are used.

Thus, in this case the input data is defined in an Excel file. A macro is used to pass the data to a txt file to be read by GAMS. This macro generates different Excel files depending on the Excel sheets available.

The Excel file has at the beginning a number of parameters for general settings. These parameters are defined and shown below with their values.

PARAMETERS

- Calibration year: Year in which the simulation of the model starts. The year established will be included in the model.

- Time horizon year: Final year until the model simulates, also included.
- Coal phase-out target year: Corresponds to the year in which coal is no longer consumed.
- Nuclear dismantling target year: The year in which nuclear power plants are shut down and production stops.
- Hours of time period: Hours of a year. (8760 hours)
- Discount rate: is assigned to the discount rate of money.
- Greenfield/Brownfield:

  Greenfield is when having a value of 1. It means that a country starts from zero, no plants installed. On the other hand, if it is assigned the value zero, it means Brownfield, therefore, there is already installed park.
- There are a set of parameters that refer to CO2 emissions:
  - Strong restriction/Cost penalization:

    If a 1 is assigned, this means that a hard constraint is assigned. An equation enters the model that establishes the maximum value of emissions that can be present.

    If a 0 is assigned, a soft constraint is assigned to the model. A cost is assigned to the CO2 emissions that impacts on the objective function, which seeks the minimum cost.

  - CO2 emission cost in 2019: A cost value is defined in euros per tons of CO2 emitted.

  - CO2 initial emission cap: Amount of CO2 that is emitted the first year.
  - CO2 NZ-year emission cap: This is the amount of CO2 that sinks such as forests, plants, etc. can absorb. It is measured in Mt CO2. This figure is annual.
  - CO2 NZ-year carbon budget: A "budget" was made for the CO2 that the earth can emit. This number was distributed proportionally among the

countries, with Spain receiving a value of 3451 MtCO2. This number means the accumulated CO2 from the initial year until 2050,

- Budget: If a value of 1 is assigned, the model takes into account the above restriction. If, on the other hand, a 0 is assigned, it will not take into account the limit of the accumulated CO2 value.

- Max storage of pumping storage: Corresponds to the maximum storage capacity. In the model it coincides that all storage capacity is pumping capacity. It is measured in the form of energy, in GWh.
- Non-Supplied energy cost: this is a slack variable as explained above. It has a very high-cost value assigned to it in order to avoid non-supplied energy in the model.
- Time slice: 24 hours a day are defined for the four seasons of the year. Therefore, the time is separated in 1/96 slots.

Description	***Value***
Calibration year	2019
Time Horizon year	2075
Coal phase-out target year	2025
Nuclear dismantling target year	2035
Net-Zero target year	2050
Hours of time period	8760
Discount Rate	0,09
Greenfield=1; Brownfield=0	0
Forecasting Window length (years)	57

Decision Window length (years)	57
Tail Effect length (years)	20
CO2: Strong restriction = 1; Cost penalization=0	1
CO2 emission cost in 2019 (€/tCO2)	30
CO2 initial emission cap (MtCO2)	255
CO2 NZ-year emission cap (MtCO2)	29
Budget = 1; No Budget = 0	1
CO2 NZ-year carbon budget (MtCO2)	3.451
Max Storage of Pumping Storage (GWh)	1.000
Non supplied energy cost (slack variable) (€/MWh or €/tCO2)	10.000
Time Slice	0,0104167

Table 25. Definition of parameters.

Going through the Excel, the process explained above with the energy sources and materials in more detail is included in the Excel. The different phases are specified:

PRIMARY ENERGY COMMODITIES

These are the energy resources available. Two large groups, and nuclear energy which is not included in either of the two groups.

- Nuclear energy
- Fossil primary energy sources: Spain needs to import them as they are not extracted in the country.
    - Imported Coal
    - Natural Gas
    - Crude Oil
- Renewable energy sources: Corresponds to the group of domestic energy sources, which are generated in the territory itself.
    - Hydro run off the river
    - Hydro with reservoir capacity
    - Mihi hydro
    - Wind Onshore
    - Wind Offshore
    - Solar photovoltaic
    - Solar thermoelectric
    - Solar thermal
    - Biomass energy crops
    - Biomass agriculture Waste
    - Biomass forestry waste
    - Solid waste
    - Bioethanol production inputs
    - Biodiesel production inputs
    - Biogas

A number of parameters are associated with each primary energy source:

- Cost per energy generated in the initial year (€/MWh):

This is the cost of producing one unit of energy in the year in which the model starts.

- Cost per energy generated in the final year (€/MWh):

This is the cost it costs to produce one unit of energy in the final year of the model.

- Annual growth (%):

Annual price growth rate.

- Primary Energy Domestic Consumption Capacity:

Refers to the maximum power that can be installed depending on the type of primary energy source. A very high value is assigned to renewable energy plants in order to make the capacity unlimited, so that the model can install as much as it wishes. In this way, the installation of plants is not limited. However, no renewable energy plants are assigned a value of zero, because as explained above there is no extraction in the country.

- Primary Energy Imported Capacity

This case is analogous to the previous one. However, this time it refers to the maximum primary energy capacity that can be imported. Logically, this time renewable energy sources have a value of zero, because the energy is not imported but generated in the country itself. Similarly, non-renewable energy sources are assigned a very high value, since all the raw materials of uranium, oil, coal and liquefied natural gas can be imported. However, the import of natural gas is limited to a value of 13 GW, which is the maximum capacity of the pipelines to Spain. In case of a change in the capacity of the pipelines for any reason, the indicated value would have to be changed. The other imported energy sources are not limited as they do not depend on a specific infrastructure that makes it impossible to increase their capacity in a considerably fast way.

TRANSFORMED ENERGY

The transformed energy is the energy that is obtained after an energy process of a conversion in an energy installation. This product can be stored or converted to another type of energy.. It can also be the case that this transformed energy is ready for final consumption. The transformed energy included in the model are the following ones:

- Electricity
- Heat
- Oil product:
  - Gasoline
  - Diesel
  - Fuel oil
  - Liquefied Petroleum Gas (LPG)
  - Kerosene
- Bioethanol
- Biodiesel
- Natural gas
- Coal
- Biomass

CONVERSION TECHNOLOGIES

The conversion technologies are responsible to produce energy from the primary energy.

Each conversion technology has different sets and parameters associated with it to represent what happens in reality and to take into account all characteristics.

The sets and parameters are as follows:

The first parameters are related to physical energy variables. Ratio of energy types at the input and output of each type of conversion technology.

- PE Input commodity:

Used to indicate the energy source from which the conversion technology is sourced. For example, it refers to a nuclear power plant. This must have uranium consumption associated with it, as this is what happens in real life. Logically, the model must know that it cannot consume oil or coal to produce energy in a nuclear power plant.

- TE Input Commodity:

It may be that instead of sourcing from a primary energy source, an energy transport process is used as an input.

- TE Output Commodity:

In the same way that the type of input energy is defined, the energy output of the conversion plant must also be defined. This output energy leaves as a transport energy process set, as this energy will be transported in the form of some vector to another part of the process.

To give a practical example, at the output of a refinery you get gasoline, paraffin, etc... but you cannot get electrical energy, for example. Therefore, for each conversion technology, the energy at the output is associated.

- Minimum and output share:

This parameter is used at the output of conversion technologies that allow to choose between a series of products, being able to define what fraction of each product is to be obtained. As an example of the previous case, in a refinery it is possible to choose the quantity of petrol, paraffin, etc. to be obtained from a given quantity of crude oil. A minimum and maximum value is defined so that the model has an interval in which it can define the most optimal quantity. It is expressed as a percentage and is only used for refineries, biomass plants and gas technologies.

The following parameters are related to the decision to invest in the installation of further conversion plants or alternatively to choose to decommission. In the current context of ecological transition, the focus is on renewable energy sources and independence from polluting sources. All this process has an infrastructure and technology cost that the model must take into account.

- Conversion losses:

The energy conversion process is not 100% efficient and fully efficient. Logically, losses occur in the conversion process that will depend on the type of technology used. There are technologies that are highly efficient and others that are lower. This percentage is used to determine the energy output from the input.

- CO2 emission factor:

Each technology has an associated number of tonnes of CO2 emitted into the atmosphere per unit of energy (tCO2/MWh). In the case of renewable conversion technologies, this number is zero.

- Efficiency ratio:

Not all technologies can operate all hours of the year and at the same efficiency. Therefore, a performance value has been defined for each hour of the day and for the four seasons of the year, with a total of 96 different values for the 24 hours of the day of the four seasons.

There are technologies that can operate at the same efficiency regardless of the time of day. However, other energies, such as solar energy, cannot operate at night. Moreover, in the sunniest hours of the day, its performance will be increased. As well as in the summer it will also increase. All these details must be considered.

- Life cycle:

Plants do not have an infinite life. After a number of years the plant has to be renewed and the installation has to be changed in order to keep the technology working with a good performance. For example, a solar photovoltaic plant has to replace its solar panels after 20 years. With each passing year its performance decreases and from that year onwards its operation is no longer efficient. Therefore, the life cycle year is defined for each conversion technology.

- Spanish Calibration previous:

It is the capacity in Gigawatt of each technology already installed in the country.

- Greenfield Previous installed capacity:

The power in Gigawatt of the conversion technology installed in the starting year of the model is defined. The total capacity of the existing plants in the country is counted.

- Maximum capacity installed:

This value refers to the maximum capacity that could be installed for different reasons. There are some technologies that have a limited installed capacity, while others are unlimited and can be installed as much as desired.

- Investment cost:

Measured in €/kW. Any installation of new technology will have a considerable cost of the infrastructure to be built that must be accounted for.

- Investment cost in 2050:

Measured in €/kW. This cost mentioned above will have a different value in 2050. There are technologies that will see their costs reduced as they develop and others that will increase.

- Annual investment cost rate:

This is a percentage that is used to find out how much the cost of investment in the technology will increase or decrease each year. This gives the expected price of the investment for all years of the model.

- Decommission cost:

Measured in €/kW. Decommissioning an installation also has a cost that can even be very high. Therefore, the model must account for the cost of decommissioning many installations. One of the major costs of the energy transition will be the closure of nuclear plants.

- Fixed O&M cost:

These are the fixed costs of the different technologies. They are measured in €/kW, i.e. each unit of power has an associated cost. Regardless of how much energy the plant produces, there are fixed costs for the operation and maintenance of the facilities. Between this parameter and the previous decommissioning parameter, the model will decide when it is appropriate to close the plant.

- Variable O&M cost:

Measured in €/MWh, so the cost is associated with energy production. Plants and facilities will have a variable O&M cost depending on the amount of energy produced.

- Nuclear Power:

There are currently five nuclear power plants in Spain, although all of them are planned to be closed by 2035. Therefore, the closure and shutdown of its nuclear reactors will be taken into account. At the moment nuclear energy accounts for just over 20 % of Spain's electricity production.

The only input is uranium, and the only output is centralised electricity.

- Conversion technologies that use imported coal and produce centralised electricity:
  - o CE Imported Coal traditional
  - o CE Imported Coal Integrated Gasification Combine Cycle
  - o CE Imported Coal Super - critical Pulverised Coal

o CE Imported Coal Super - critical Pulverised Coal with CCS

- Conversion technologies that use imported Natural Gas to generate centralised electricity:

o CE Combined Cycle Gas turbine traditional

o CE Combined Cycle gas turbine with CCS

o CE open cycle gas turbine traditional

o CE open cycle gas turbine with CCS

o CE cogeneration in industry. Natural Gas" o CE cogeneration in other uses.

o CE cogeneration in other uses. Natural Gas

- Conversion technologies using fuel oil and generating centralised electrical energy.

o CE Fuel Oil traditional

- Hydro" conversion technologies, using water to generate centralised electricity.

o CE Hydro run off the river

o CE Hydro with reservoir capacity

o CE Hydro with pumping storage

o CE Mini Hydro

- Conversion technologies that use wind to produce centralised electrical energy:

o CE Wind onshore

o CE Wind offshore

- Conversion technologies that use solar energy to generate electricity to produce electricity although not all of them are fed into the grid:
    - Photovoltaic:
        - CE Solar photovoltaic Centralised with tracking (if to the grid)
        - CE Solar photovoltaic Solar photovoltaic distributed without tracking in industry".
        - CE Solar Photovoltaic Distributed without Tracking in Other Uses".
    - Thermoelectric:
        - CE Solar thermoelectric centralised"
        - CE Solar thermal distributed in industry" o Thermoelectric: "CE Solar thermoelectric centralised
        - CE Solar thermal distributed in other uses
- Conversion technologies that generate centralised electricity from biomass:

o CE Biomass energy crops centralised

o CE Biomass agriculture waste centralised

o CE Biomass forestry waste centralised

o "CE Cogeneration in Industry. Biomass".

o "EC Cogeneration in Other Uses. Biomass" o "CE Cogeneration in Other Uses.

- CE solid waste:
- Refineries: Transform crude oil into other petroleum products:

o "CE Refinery Low Complexity" o "CE Refinery Low Complexity" o "CE Refinery High Complexity".

o "CE Refinery High Complexity".

- Biorefineries:
  - "CE Bioethanol Production Plant" o "CE Bioethanol Production Plant" o "CE Biodiesel Production Plant
  - "CE Biodiesel Production Plant".
- Regasification or "CE Regasification Terminal".

DEMAND BY SECTORS:

All the parameters and sets mentioned above are related to the generation and transportation of energy that will be consumed by different demand sectors.

In order to determine the generation of each energy source and to invest in the different facilities, the demand to be covered must be known. Therefore, the demands of the different sectors are introduced in the model.

This is the part of the model that is currently being worked on. It is very important to know the energy demand in detail in order to be able to determine what needs to be produced.

The sectors included in the demand are the following:

- Demand in the primary sector
- Demand in the residential sector
- Demand in the service sector
- Demand in air transport
- Demand in maritime transport
- Demand in land transport
- Demand in the industrial sector.

For each sector the annual energy demand is defined, indicating the type of energy consumed. It is important to maintain throughout the model the actual flow of energy through the different processes. Therefore, it is important to define the type of energy consumed by each sector as not all sources will be able to supply it.

The most important aspect, and what has been worked on in the current project, is the modelling of this consumption. Trying to define the demand for the different hours. Currently in the model the demand is equally distributed for the 96 hours of the model explained above.

In the data search work that has been carried out, data has been sought for the 8760 hours of the year, trying to detail the demand of the sectors as much as possible.

This number of hours is very high for the model. Therefore, the data will be adapted for the 96 hours of the current model. In order to make the information more precise but not excessive, we will also define the demand for 24 hours a day, 7 days a week, for the 4 seasons of the year.

This calculation (24 x 7 x 4) results in a total of 672 hours in which demand values should be available. The decision to take this number of hours is motivated by the fact that the demand varies greatly depending on the day of the week, whether it is a weekend or a working day. Therefore, the demand is more disaggregated than it has been so far.

The demand side has been explained above and has been the focus of most of this project.

3.6 NUMERICAL IMPLEMENTATION

The data collected for the different sub-sectors after the research has been shown above. Finally, once the numerical values are available, they are to be entered into the Excel sheet, which provides the data to the model. The data entered were explained above and are shown below.

The annual energy consumption (in GWh) of the following energy sources has been incorporated:

- Biodiesel.
- Biomass.
- Coal.
- Natural Gas.
- Oil Product Diesel.
- Oil Product Fuel Oil.
- Oil Product Gasoline.
- Oil Product Liquefied Petroleum Gas.
- Other Oil products.
- Heat.
- Electricity.

For the following industrial sub-sectors:

- Food and Beverages.
- Textile.
- Paper.
- Chemistry and Refinnery.
- Metallurgy.
- Steel and Foundry.
- Wood.
- Mining, Constructions and Materials.
- Others Industrial Subsectors.

In addition, for each energy source for each sub-sector the annual demand profile had to be entered. For all energy sources except electricity, the demand profile for gas has been applied. This approximation was assumed to be correct because all mentioned sources can be stored in the same way as gas, therefore the profile should be similar.

Energy profiles were available for all subsector except for wood. In this situation, an equal distribution has been applied for all season and hours of the year. Logically, this does not represent the reality, but it is the solution found to incorporate the data.

The same situation happens for the food and beverage subsector and the textile subsector in the case of electricity, for which no data were available.

Therefore, the data incorporated into the model are as follows:

	Biodiesel	Biomass	Coal	Oil Product Diesel	Oil Product Fuel Oil
Food and Beverages	31,69	5233,88	113,24	2197,78	684,55
Textile	0,00	69,16	0,00	238,89	22,45
Paper	0,00	7486,94	0,00	513,62	269,33
Chemistry and Refinery	0,00	73,34	1338,88	477,77	404,00
Metallurgy	0,00	0,56	0,00	262,78	482,55
Steel and foundry	0,00	0,00	0,00	215,00	549,89
Wood	0,00	4857,50	0,00	167,23	89,77
Mining and Construction	295,81	2594,72	106,58	7118,89	594,78
Other industries	10,56	693,89	0,00	2974,15	516,23

Figure 24. Annual energy consumption (GWh) in Industrial subsectors.

	Oil Product Gasoline	Oil Product Liquefied Petroleum Gas	Other Oil Products	Natural Gas	Heat
Food and Beverages	0,00	381,02	3263,37	21479,36	10290,00
Textile	0,00	39,41	300,75	2159,62	1674,00
Paper	0,00	144,53	927,47	16448,86	7738,00
Chemistry and Refinery	0,00	65,70	947,47	68666,70	41680,00
Metallurgy	0,00	91,97	837,30	15081,87	11060,00
Steel and foundry	0,00	157,67	922,55	6787,74	11060,00
Wood	0,00	13,14	270,14	874,25	1704,00
Mining and Construction	0,00	604,39	37044,43	44330,25	28410,00
Other industries	24,61	170,81	3685,81	18943,42	9590,00

Figure 25. Annual energy consumption (GWh) in Industrial subsectors.

	Electricty
Food and Beverages	10.539,16
Textile	1.672,71
Paper	5.974,96
Chemistry and Refinery	9.638,32
Metallurgy	15.003,38
Steel and foundry	14.409,49
Wood	1.592,72
Mining and Construction	8.668,49
Other industries	13.505,64

Figure 26. Annual electricity consumption (GWh) in Industrial subsectors.

Chapter 4. ANALYSIS OF RESULTS

Based on the collected data, different scenarios will be simulated to see how the variation in industrial energy consumption affects energy generation. To analyse these changes, the base case will be simulated, and two scenarios will be proposed to compare it with the base case.

Three main aspects will be considered to determine the changes. The first of these corresponds to primary energy generation. The second refers to the installed power of each generation source, and finally, CO_2 emissions will be analysed. The values of these parameters will be taken for the years 2030, 2040 and 2050, as these are the key years with set targets. For some variables, the cumulative value up to that year will also be taken into account.

4.1 BASE CASE RESULTS

It corresponds to the data presented in the previous section. It represents the future situation according to the current situation of the industrial sector in Spain.

- Energy generation (GWh):

	2030	2040	2050
Nuclear	33.527	0	0
Coal	995	347	120
Gas	113.698	105.277	53.786
Hydro	18.697	13.609	10.079
Wind	21.655	52.527	77.101
Solar PV	21.932	69.283	104.234
SolarTh	4.957	0	0
Biomass	896	25.889	151.490
Refinery	250.596	128.808	77.089
BioRefinery	15.348	22.718	33.629
Regasification	49.940	41.940	29.674

Table 26. Energy generation (GWh) in the base case.

- Installed Power Capacity (GW):

	2030	2040	2050
Nuclear	5,63	0,00	0,00
Gas	15	19	21
Hydro	13,96	11,05	8,14
Wind	11,20	27,21	39,92
Solar PV	12,24	38,66	59,44
SolarTh	1,56	0,00	0,00
Biomass	47,83	56,43	93,41
Refinery	72,96	18,02	18,02
BioRefinery	4,66	5,84	8,65
Regasification	30,4	28,93	29

Table 27. Installed Power Capacity (GW) in the base case.

- CO_2 Emissions (tCO_2):

It is recalled that the model sets a mandatory maximum cumulative emission of 3.451 Mega tones until 2050. In addition to this, a maximum emissions value of 29 Mega tones is established for the year 2050. However, this restriction is not compulsory and in case this condition is not met, financial penalties are imposed that will have an impact on the total cost of the system.

	tCO_2 /year	Accumulated tCO_2
2030	110,05	1.969,94
2040	76,44	2.887,20
2050	33,35	3.450,66

Table 28. CO2 Emissions in the base case.

4.2 SENSITIVITY ANALYSIS

Once the data is collected, it should be analyzed how the model responds to the new demand structure introduced. It is necessary to check that the results make sense and how they vary when the input data is modified. Apart from checking that the model works effectively, the sensitivity analysis may lead to interesting conclusions in the sector. By changing the input data of the consumptions, some patterns of the industrial sector might be identified. Moreover, it will provide useful information about the generation, analyzing how capacity of different resources change depending on the demand.

The two scenarios and the base case considered are the following ones:

- Base case:
  It is the scenario that is obtained by optimizing the model by applying the current data collected from the industrial sector. Its results will be used as a reference for comparison with the other future scenarios. Moreover, the different scenarios should result from changes in this one.
- First scenario (High-demand):
  The industry consumptions are considered to be 25% higher than in the base case. The aim is to significantly increase demand in order to verify that the model really responds properly to this change, This value is chosen to avoid increasing demand in a way that could compromise the feasibility of the model´s resolution. On the other hand, this scenario will show the impact of a higher consumption in the industrial sector in the energy generation.
- Second scenario:
  It is applied a reduction of 25% in consumptions values of the base case to the most consumer sectors, which are the following ones: food and beverages, metallurgy, steel and foundry, chemistry.
  Moreover, a reduction of the 15% in consumptions values of the base case to the sectors that consume the least. Paper, textile and wood are in this group.

The decision to take these values is to see what would happen if a reduction in demand. Moreover, to get to know the situation if we focus in the most demanding sectors to improve their efficiency and adjust their consumption.

The reduction in consumption has been applied to some resources (Natural Gas, electricity, coal, heat, diesel, fuel-oil, gasoline). However, bio-consumption (Biodiesel, biomass) has been increased in the same proportion to try to compensate the reduction in the other resources.

One more time, this scenario will show if the model provides reasonable data according to the changes introduced. At the same time, it will show how a decrease in the use of polluting resources in the initial year has an impact on generation.

- First scenario:

The results shown below are based on the assumption that all industry consumptions for the initial year are 25% higher than actual. In other words, 25% of their value has been added to the data presented.

- Energy generation (GWh):

	2030	2040	2050
Nuclear	41.721	0	0
Gas	113.698	110.301	65.873
Coal	1141,89	398,12	138,83
Hydro	18.697	13.635	9.922
Wind	21.655	33.385	53.129
Solar PV	20.837	78.068	127.518
SolarTh	3.226	0	0
Biomass	8.357	125.909	207.814
Refinery	258.223	136.366	81.602
BioRefinery	15.504	22.949	33.971
Regasification	75.273	11.969	40

Table 29. Energy generation (GWh) in the first scenario.

The following table represents the percentage by which it is higher or lower than the base case:

	2030	2040	2050
Nuclear	24%	-	-
Gas	0%	5%	22%
Coal	15%	15%	15%
Hydro	0%	0%	-2%
Wind	0%	-36%	-31%
Solar PV	-5%	13%	22%
SolarTh	-35%	-	-
Biomass	833%	386%	37%
Refinery	3%	6%	6%
BioRefinery	1%	1%	1%
Regasification	51%	-71%	-100%

Table 30. Percentages compared to the Energy generation of the base case.

- Installed Power Capacity (GW):

	2030	2040	2050
Nuclear	7,08	0,00	0,00
Combined Cyclo Gas	13	11	13
Hydro	13,96	11,05	8,14
Wind	11,20	17,32	28,07
Solar PV	11,62	43,55	71,39
SolarTh	1,01	0,00	0,00
Biomass	59,02	77,53	110,45
Refinery	75,14	19,11	19,11
BioRefinery	4,68	5,91	8,74
Regasification	30,4	18,76	19,39

Table 31. Installed Power Capacity (GW) in the first scenario.

The following table represents the percentage by which it is higher or lower than the base case:

	2030	2040	2050
Nuclear	26%	0%	0%
Combined Cyclo Gas	0%	-40%	-39%
Hydro	0%	0%	0%
Wind	0%	-36%	-30%
Solar PV	-5%	13%	20%
SolarTh	-35%	0%	0%
Biomass	23%	37%	18%
Refinery	3%	6%	6%
BioRefinery	0%	1%	1%
Regasification	0%	-35%	-33%

Table 32. Percentages compared to the Installed Power Capacity of the base case.

- CO_2 Emissions:

	tCO2/year	Accumulated
2030	115,86	2.082,41
2040	65,49	2.952,93
2050	37,08	3.450,63

Table 33. CO2 Emissions in the first scenario.

	tCO2/year	Accumulated
2030	5%	6%
2040	-14%	2%
2050	11%	0%

Table 34. Percentages compared to the CO2 Emissions of the base case.

Analyzing the results presented above, the first aspect to be highlighted is that the model responds effectively to an increase in the demand. As it can be noticed, in the year 2050 the energy generation of most of the energy sources are much higher than the values in the base case. Therefore, it can be stated that the input data and the new structure with the subgroups disaggregated are well introduced in the model.

Taking the comparison to the base case into consideration, one might notice that the model increased the capacity of generation of some energy sources to face the increase in demand. In the first years, the model opts to install nuclear energy and use biomass. Therefore, it seems that these are the most suitable resources to be used, at least in a short term. As it will be highlighted in the following points, thermal energy is discarded.

It is interesting to observe the values of year 2040 as a mid-year that show how the generation evolves. Compared to the base case, one might realize that the generation capacity installed differs considerably. There is a higher capacity in renewable energies, except from wind, and lower capacity in traditional sources. Therefore, it seems that as the model has to increase the capacity, it does it so by installing renewable energy sources. Therefore, renewable energy is key when the demand increases in order to fulfill with the requirements. This fact can also be observed in the emissions results. It is interesting to notice that in the year 2040 the emissions are a 14% lower than in the base case, whereas in the 2050 is a 11% higher not meeting with the target of emissions established for this year. Therefore, the commissioning of renewable energies is done previous to how it is done in the base case.

Second scenario (Low-demand):

In the second case, different sub-sectors and energy sources are modified. A 25% reduction in consumption is applied to the sectors that are the main energy consumers (food and beverages, metallurgy, steel and foundry, chemistry) and 15% to the sectors that consume the least (paper, textile, wood). This reduction in consumption has been applied to polluting resources (Natural Gas, electricity, coal, heat, diesel, fuel-oil, gasoline) and has been increased in the same proportion to bio-consumption (Biodiesel, biomass)

Energy generation:

	2030	2040	2050
Nuclear	28.971	0	0
Coal	876,68	305	106
Gas	113.667	103.503	47.317
Hydro	18.697	13.251	9.417

Wind	21.655	43.436	84.676
Solar PV	22.234	63.546	95.048
SolarTh	5.242	0	0
Biomass	924	0	112.737
Refinery	245.556	124.752	74.632
BioRefinery	15.431	22.841	33.810
Regasification	28.354	63.541	534

Table 35. Primary Energy generation (GWh) in the second scenario.

	2030	2040	2050
Nuclear	-14%	-	-
Coal	-12%	-12%	-12%
Gas	0%	-2%	-12%
Hydro	0%	-3%	-7%
Wind	0%	-17%	10%
Solar PV	1%	-8%	-9%
SolarTh	6%	-	-
Biomass	3%	-100%	-26%
Refinery	-2%	-3%	-3%
BioRefinery	1%	1%	1%
Regasification	-43%	52%	-98%

Table 36. Percentages compared to the Energy generation of the base case.

Installed Power Capacity:

	2030	2040	2050
Nuclear	4,86	0,00	0,00
Combined Cyclo Gas	15	21	28
Hydro	13,96	11,05	8,14
Wind	11,20	23,07	45,48
Solar PV	12,40	35,45	53,03
SolarTh	1,64	0,00	0,00
Biomass	41,12	45,33	77,73
Refinery	71,43	17,49	17,49
BioRefinery	4,68	5,89	8,70
Regasification	30,4	31,84	34,01

Table 37. Installed Power Capacity (GW) in the second scenario.

	2030	2040	2050
Nuclear	-14%	0%	0%
Combined Cyclo Gas	0%	15%	30%
Hydro	0%	0%	0%
Wind	0%	-15%	14%
Solar PV	1%	-8%	-11%
SolarTh	5%	0%	0%
Biomass	-14%	-20%	-17%
Refinery	-2%	-3%	-3%
BioRefinery	0%	1%	1%
Regasification	0%	10%	17%

Table 38. Percentages compared to the Installed Power Capacity of the base case

- CO_2 Emissions:

	tCO_2 /year	tCO_2 Accumulated
2030	104,37	1.869,87
2040	84,38	2.800,52
2050	31,08	3.450,63

Table 39. CO2 Emissions in the second scenario.

	tCO2/year	tCO_2 Accumulated
2030	-5%	-5%
2040	10%	-3%
2050	-7%	0%

Table 40. Percentages compared to the CO2 Emissions of the base case

Taking the results into consideration, it makes sense that generation is lower than in the base case except for bio-energies in the different years. Due to the decrease in the consumption, the installed capacity in the mid-year is much lower than in the base case. It is observed that by reducing the consumption of products with considerable emissions such as natural gas, petrol, ... There is no need to install many renewable energy sources such as in the other case. The fact of reducing demand means that there are less emissions. Therefore, there is more time to adjust production technologies and optimize costs in order to meet the emission targets set.. The system relies for a longer time on traditional energy sources. Thisstatement is supported by the fact that emissions are higher in year 2040 than they are in the base case. However, as the energy consumption is lower is logical that finally in year 2050 the emissions are lower.

Chapter 5. CONCLUSIONS

5.1 CONCLUSIONS ON METHODOLOGY

The first conclusions that can be drawn from the methodology applied for the mapping is that it generates some doubts. As explained, the distribution of gas consumption was known for some subsectors. In the case of electricity consumption, these data were not available.

Ideally, it would be best to have the data from the factories in the different sub-sectors to have a real understanding of the situation. However, being aware of this impossibility, different solutions are being sought. The solution found is to apply a distribution of electricity according to the production of industries according to regions. In most of the sub-sectors there are considerable differences between the two mappings, so it seems that higher industrial activity in certain communities does not imply higher gas and electricity consumption. Obviously, the higher the activity, the higher the energy consumption, however, it does not seem that all industry in the sub-sectors consumes the same amount of gas and electricity depending on their production. Therefore, the results suggest that perhaps the consumption depends more on the type of factory. Both consumptions do not grow at the same rate if the production is higher. The result of applying this approach confirms the doubts we had previously and shows that the approach is not entirely adequate. Although in the case of the model it does not really affect the model because it is a single node model, it does affect the collection of data and information on the sector. Therefore, it would be an aspect to work on in the future in order to be able to specify the data in greater depth.

Taking as an example the paper industry, it appears that Cataluña and Community of Madrid are the largest consumers. However, in terms of gas consumption, Aragón is by far the largest consumer. Thus, it seems that industry is not the same in all communities and the consumption of energy sources is not in proportion to production.

In conclusion, more information about the consumption of individual industries needs to be made public, either by types of invoices or by sub-sectors. This fact will allow for a more detailed study. In the meantime, this approach has been used, which seems to be the best solution for the time being.

As far as consumption profiles are concerned, the gas profile should be adequate, as it has been obtained from an *Enagás* report showing consumption by subsector and by day. Therefore, these profiles are correct. However, it should be considered that it was not possible to obtain the gas demand profile for wood. Hence, it is something to work on in the future.

With regard to electricity profiles, it would have been more convenient to obtain it from the industry's electricity consumption directly. However, as this information was not available, the interruptibility service was used as an approximation. As only part of the industry is covered by this service, it may not be entirely accurate, although it is probably very similar to the one described in the paper. It would be appropriate to work on these profiles on the basis of industry consumption if they become available in the future. Meanwhile, using this approximation is a valid solution.

Finally, applying gas demand profiles to the rest of the energy products is a good approximation that can be made by their storage capacity as explained above. Logically, it would be more appropriate to have the daily consumptions of each product, although this seems to be a really complicated task. However, electricity demand profiles are not applicable for other energies since its impossibility of storage makes it very particular.

In conclusion, taking into account how the consumption and demand data are displayed in the reports, it can be said that a good method has been followed to obtain valuable information from them that is useful for the model. In addition to the data explained in the paper, it has also been useful to set the basis of the research and to know where the limits are for future research. It might be useful as a guide.

5.2 CONCLUSIONS ON RESULTS:

It is important to note that the most relevant aspect of incorporating the data was to verify that the model responded to the new inputs. By doing so, it was verified that the disaggregation of the industrial sub-sectors and the new demand profiles were indeed correct. In the sensitivity analysis, it has been observed that the model responds to the changes and the results are consistent with what was expected beforehand. Therefore, the main objective has been satisfactorily fulfilled and the data can be considered valid for being used by the model.

Several interesting conclusions can be drawn from the simulation of the three scenarios. The most complete conclusion may be obtained from the variations of the two scenarios with respect to the base case. With regard to the latter, it is not a good option to look deeply on it as the other consumer sectors do not yet contain the detailed data. Nevertheless, certain statements can be drawn from it.

Firstly, the most important aspect to emphasise, that conditions the results, are the accumalated emissions established until 2050. This is a necessary condition introduced in the model as it is supposed to happen. To achieve this requirement, in the base case the model opts for biofuels and biomass instead of oil derivatives from refineries. In this way it manages to reduce the carbon footprint to such an extent that it allows for a slight growth in the installed capacity of combined cycle gas plants. In terms of renewables energies, there is a clear preference for solar photovoltaic over wind power. Although both are increasing their capacity over the years, solar photovoltaic has a higher growth rate. In addition, it should be noted that solar thermal does not account for the country's energy generation.

However, where the influence of the industrial sector on the generation park can be really seen is when its consumption has been modified in the different scenarios.

For this scenario, there is an increase of a 25% in industrial consumption. It is noted that the condition to comply with carbon neutrality continues. What can be observed is that the installed capacity varies considerably with respect to the base case. This fact means that due to the increase in demand, the modification of the generation power must be carried out more abruptly in order to meet the targets.

As a result, in 2030 the installed nuclear power capacity would be 26% higher than in the base case, even knowing that it will have to be decommissioned in that year. This fact is very relevant, due to all the controversy surrounding this energy source. However, it seems that on a theoretical level it is a great solution. In addition, it once again boosts the use of biofuels. Until 2050, the installation of renewable energy plants is growing, with solar photovoltaic plants being more popular than wind power. Both grow at a higher rate than in the base case. However, it should be noted that in 2050 the installed capacity of wind power is 30% lower than in the base case, while for photovoltaic solar it is 20% higher. Therefore, it seems that in order to tackle the problem quicklier, it is better to go for solar photovoltaic. As with the growth of renewables, the reduced use of gas and fuels also follows a faster rate. To cover this generation, biofuels are up to 20% higher than in the base case.

As for the case in which the consumption of polluting energies decreases and the consumption of biofuels increases depending on the sub-sector, other conclusions can be drawn.

Obviously, a decrease in consumption means that it is not necessary to install as much generating capacity in the country. In this case, the capacity of renewable energy sources grows at a slower rate and finally the installed capacity is lower than in the base case, except for wind power. Therefore, according to the results, it is better to build wind farms rather than photovoltaic plants when the objectives are in a long-term.

In addition, another very relevant fact is that in the end the installed power of combined cycle using gas is 30% higher than in the base case and the model still complies with the emissions. Therefore, if consumption is reduced, it is even possible to use more gas without the need to grow so fast in biomass and biofuels. Hence, it can be stated that if energy consumption is reduced, a transition of the currently used energy sources is not required within a short period of time. Reducing consumption would give more time for transition and to develop other technologies.

As a conclusion, one can learn from the above explained it is as important to change the way energy is produced as it is to reduce consumption through energy saving and efficiency measures.

As far as CO_2 emissions are concerned, the model has to comply with the restriction of the accumulated emissions until 2050. However, in any of the three case the emissions in 2050 are lower than 29 Mt of CO_2, value established for carbon neutrality. Therefore, the system opts to pay a penalty for exceeding the value instead of commissioning other types of energies. Therefore, the final values should be revised in order to fulfill the targets.

In conclusion, several important points emerge from this analysis.

The first is that a decrease in energy consumption in the industrial sector will facilitate the ecological transition. It has already been highlighted how reducing consumption by 25% and 15%, depending on the sub-sector, can achieve such good results. Therefore, the sector should make an effort to try to reduce consumption. One of the solutions is to improve energy efficiency. Improving the performance of processes and avoiding losses will lead to a lower consumption and better results. Attention should also be paid to the use of other types of energy sources with lower emissions in certain industrial processes.

On the other hand, it has been seen that a disproportionate growth in consumption will lead to the construction of facilities in the short term, which will imply large investments. In addition, this is coupled with a very high increase in the use of biomass and biofuels, which are currently not as developed as other resources. Reducing the energy consumption of the sector will allow more time for further research and improvement of other sources.

5.3 RECOMMENDATIONS FOR FUTURE STUDIES

As it has been explained throughout the document, there has been great difficulty in finding appropriate disaggregated information on the industrial sector. Therefore, the recommendation would be to carry out a more in-depth study of the industrial consumption of the different sub-sectors. However, this should be done at an institutional level, as many difficulties have been faced at a student level. In fact, as we were informed, this will be done and the government will lead a study to determine these consumptions more concretely and make a report that will be published. Therefore, there should be a way to publish useful information without affecting the company's data protection.

In any case, the data collected in this document describe the demand and consumption of the industrial sector in Spain, although not in the detail that would be desired. These data are useful for all the different models that work with industrial demand and consumption data. In this case it has been highlighted that they will be used for MASTER and DEMO.

It would not be needless to review some of the consumption data that have been included in the document. For example, heat consumption values are complicated to calculate as many industries use heat from other processes that occur internally. Therefore, it is difficult for *IDAE* report to determine this value correctly. Furthermore, as explained above, approximations have been applied in the lack of information, such as applying the gas demand profile for the rest of energy products. Therefore, as different studies are carried out and more report will be published, there will be the opportunity to detail the information and complete the study.

In addition, it should also be noted that work needs to be done on the different energy consumption sectors to complete the model. The current model includes values for residential, transport and service sector consumption. However, these values are very general and approximate. Therefore, it would be interesting to carry out the same work developed in the industrial sector in the other sectors mentioned. It can almost certainly be stated that the search for data in the other sectors will be easier, as it will probably not have the confidentiality of this sector.

Furthermore, for future projects it would be interesting to separate the time slices in 672 hours, using the data included in the annexes. These data will make the model more accurate, and it will take into consideration the weekdays. All these developments will help to get better results from the model and make more precise decisions.

When the data from the different consumption sectors are collected, a good analysis of the results can be made after running the model in GAMS. Having adequate information from all of them will help to draw interesting conclusions and to develop energy strategies. Moreover, it will be interesting to see the energy impact of the industrial sector compared to other consumption sectors. It is important to see how different sectors are affected and how sensitive they are to the use of primary energy sources.

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ANNEX I. SUSTAINABLE DEVELOPMENT GOALS (SDG)

The aim of the work is to gather as much information as possible on the industrial sector in Spain. For this purpose, different sources of information are investigated in order to be able to create energy demand profiles and determine the consumption of different energy products.

This dataset is useful for incorporation into an energy strategy planning model. The models that have been named in this report are MASTER and DEMO. These models enable to simulate different future scenarios that will help in defining the best strategies for the future.

In an energy context of ecological transition, where a change of the current energy model is sought, they are very useful. As this work is framed within these models, it could be said that it meets two sustainable development goals fundamentally. This project can be related to:

- SDG 11 ("Sustainable cities and communities").

When investigating the consumption of a sector, the aim is to analyse what types of energy resources it consumes. This will allow in the future to determine how to reduce these consumptions or how to change them to other more sustainable sources. In addition, the results of the model are used to develop strategies aimed at achieving a sustainable country that meets the carbon emissions neutrality objective. The work is therefore fully aligned with this goal.

- SDG 7 ("Affordable and clean energy")

As the model takes into account economic constraints and emission constraints, it is looking for energy sources that meet this goal.

Therefore, the project is a search for information that seeks to contribute to the sustainable development of the country fully committed to the Sustainable Development Goals.

ANNEX II. ELECTRICITY DEMAND PROFILES (24 HOURS X 4 SEASONS)

The tables below show how electricity consumption is distributed according to the time of year. The following percentages are to be entered in the model.

The table below show how consumption is distributed according to season and time of day. The year is separated in 96 times slices (24 hours x 4 seasons)

PAPER

Hour	Winter	Spring	Summer	Fall
0	0,0094230	0,0109710	0,0105974	0,0114182
1	0,0094227	0,0109648	0,0105612	0,0114194
2	0,0094037	0,0108149	0,0105143	0,0113706
3	0,0093781	0,0109533	0,0105103	0,0113956
4	0,0093784	0,0108079	0,0104893	0,0113701
5	0,0093032	0,0108209	0,0103669	0,0112563
6	0,0093022	0,0108070	0,0103706	0,0112699
7	0,0093263	0,0107964	0,0103709	0,0112808
8	0,0091944	0,0107027	0,0102402	0,0111450
9	0,0090638	0,0105773	0,0101077	0,0109623
10	0,0090004	0,0105300	0,0101023	0,0109134
11	0,0089588	0,0105279	0,0101255	0,0109004
12	0,0090180	0,0105516	0,0101634	0,0109171
13	0,0090160	0,0105418	0,0102202	0,0109833
14	0,0090949	0,0106190	0,0103322	0,0110957
15	0,0091869	0,0107870	0,0105159	0,0111569
16	0,0092197	0,0108288	0,0104503	0,0111793
17	0,0092719	0,0108499	0,0105065	0,0112626
18	0,0092761	0,0108666	0,0105030	0,0112712
19	0,0093331	0,0109213	0,0105452	0,0113108
20	0,0093668	0,0109321	0,0105618	0,0113267
21	0,0093273	0,0108956	0,0105043	0,0113069
22	0,0093565	0,0109285	0,0105303	0,0113407

23	0,0094202	0,0109684	0,0105658	0,0113842

Figure 27. Electricity Demand profile. Subsector: Paper

CHEMISTRY AND REFINERY

Hour	Winter	Spring	Summer	Fall
0	0,0099500	0,0119739	0,0117975	0,0120955
1	0,0102564	0,0123072	0,0120052	0,0124535
2	0,0103488	0,0123652	0,0120873	0,0125758
3	0,0103693	0,0123847	0,0119645	0,0123950
4	0,0102553	0,0121011	0,0118863	0,0123605
5	0,0103585	0,0124383	0,0120177	0,0125863
6	0,0103377	0,0123900	0,0119446	0,0124257
7	0,0099038	0,0118205	0,0115057	0,0117945
8	0,0087246	0,0104715	0,0105379	0,0106412
9	0,0082944	0,0102188	0,0102735	0,0103276
10	0,0075755	0,0101962	0,0100315	0,0100270
11	0,0075398	0,0100739	0,0095980	0,0099109
12	0,0075506	0,0100028	0,0095960	0,0098769
13	0,0079100	0,0100953	0,0096873	0,0100569
14	0,0081270	0,0102180	0,0097609	0,0101654
15	0,0082161	0,0103923	0,0098431	0,0102751
16	0,0082220	0,0104449	0,0099258	0,0103382
17	0,0080957	0,0104859	0,0100057	0,0103544
18	0,0076746	0,0105158	0,0100584	0,0102496
19	0,0077249	0,0105470	0,0104168	0,0103193
20	0,0077837	0,0106609	0,0107299	0,0104399
21	0,0084422	0,0108499	0,0109483	0,0107152
22	0,0088086	0,0109683	0,0110427	0,0109162
23	0,0090957	0,0111931	0,0111722	0,0111816

Figure 28. Electricity Demand profile. Subsector: Chemistry and Refinery.

METALLURGY

Hour	Winter	Spring	Summer	Fall
0	0,0095827	0,0109567	0,0107804	0,0116083
1	0,0096084	0,0109609	0,0107878	0,0116169
2	0,0095840	0,0108430	0,0107789	0,0116219
3	0,0095779	0,0109813	0,0107650	0,0116240
4	0,0095915	0,0108645	0,0107714	0,0116257
5	0,0095590	0,0109788	0,0107459	0,0116003
6	0,0095271	0,0109262	0,0106996	0,0115314
7	0,0094984	0,0109185	0,0106813	0,0115083
8	0,0093118	0,0108653	0,0105977	0,0114114
9	0,0092487	0,0107606	0,0105099	0,0112827
10	0,0091121	0,0107026	0,0104890	0,0112350
11	0,0091055	0,0106892	0,0104383	0,0112268
12	0,0090759	0,0105352	0,0103543	0,0111107
13	0,0089836	0,0103419	0,0102499	0,0109214
14	0,0089785	0,0103190	0,0102768	0,0108814
15	0,0089600	0,0103311	0,0102447	0,0108365
16	0,0089469	0,0103321	0,0102387	0,0108757
17	0,0089993	0,0103287	0,0102508	0,0109163
18	0,0089999	0,0103299	0,0102389	0,0108943
19	0,0090235	0,0103573	0,0102759	0,0109010
20	0,0090477	0,0103759	0,0102794	0,0109444
21	0,0090779	0,0104322	0,0103150	0,0110057
22	0,0092636	0,0108303	0,0105791	0,0113733
23	0,0093497	0,0109564	0,0106747	0,0114924

Figure 29. Electricity Demand profile. Subsector: Metallurgy.

STEEL AND FOUNDRY

Hour	Winter	Spring	Summer	Fall
0	0,0107279	0,0127202	0,0109881	0,0128576
1	0,0108677	0,0128032	0,0110828	0,0129927
2	0,0107966	0,0126598	0,0110415	0,0130022
3	0,0108133	0,0127778	0,0109834	0,0129603
4	0,0107678	0,0125119	0,0109676	0,0128932
5	0,0106781	0,0125425	0,0108177	0,0127723
6	0,0105561	0,0124190	0,0105624	0,0125528
7	0,0103338	0,0121787	0,0103825	0,0123238
8	0,0089814	0,0111797	0,0095471	0,0110368
9	0,0085567	0,0106401	0,0092037	0,0104478
10	0,0078939	0,0103366	0,0089681	0,0100458
11	0,0078728	0,0102426	0,0086328	0,0099292
12	0,0078817	0,0102847	0,0086499	0,0098967
13	0,0082327	0,0104549	0,0087550	0,0101581
14	0,0082979	0,0105892	0,0089031	0,0102510
15	0,0084113	0,0108541	0,0091338	0,0104567
16	0,0084234	0,0108941	0,0092551	0,0104433
17	0,0084401	0,0109381	0,0093330	0,0105305
18	0,0080945	0,0109889	0,0093902	0,0104305
19	0,0081919	0,0110668	0,0096352	0,0104405
20	0,0081621	0,0110883	0,0096799	0,0104007
21	0,0086285	0,0111736	0,0097837	0,0106228
22	0,0089827	0,0115080	0,0098902	0,0110491
23	0,0092146	0,0117344	0,0101096	0,0114149

Figure 30. Electricity Demand profile. Subsector: Steel and Foundry

WOOD

Hour	Winter	Spring	Summer	Fall
0	0,0094572	0,0115647	0,0098636	0,0117614
1	0,0095097	0,0116358	0,0099211	0,0118211
2	0,0094679	0,0114555	0,0098706	0,0117502
3	0,0094933	0,0116596	0,0099054	0,0118244
4	0,0094859	0,0115321	0,0098950	0,0118164
5	0,0093941	0,0115307	0,0097778	0,0116501
6	0,0093172	0,0114061	0,0097181	0,0115298
7	0,0094370	0,0115314	0,0098444	0,0116770
8	0,0093547	0,0113731	0,0097263	0,0115222
9	0,0091943	0,0111232	0,0095652	0,0112374
10	0,0089779	0,0108863	0,0094050	0,0110162
11	0,0089587	0,0108737	0,0094440	0,0110031
12	0,0089380	0,0109079	0,0094468	0,0110168
13	0,0089089	0,0108871	0,0094872	0,0110503
14	0,0089193	0,0108975	0,0094986	0,0110585
15	0,0090671	0,0111248	0,0096169	0,0112144
16	0,0091100	0,0111530	0,0096250	0,0112668
17	0,0091277	0,0112023	0,0096370	0,0113543
18	0,0091926	0,0112205	0,0096223	0,0113567
19	0,0092976	0,0112915	0,0096947	0,0114789
20	0,0093833	0,0113840	0,0097648	0,0116003
21	0,0093343	0,0113746	0,0097540	0,0115247
22	0,0092654	0,0112910	0,0096844	0,0114250
23	0,0094448	0,0114944	0,0098360	0,0116020

Figure 31. Electricity Demand profile. Subsector: Wood.

ANNEX III. GAS DEMAND PROFILES (24 HOURS X 4 SEASONS)

FOOD AND BEVERAGES

Hour	Winter	Spring	Summer	Autumn
0	0,0101443	0,0099322	0,0106469	0,0109433
1	0,0101443	0,0099322	0,0106469	0,0109433
2	0,0101443	0,0099322	0,0106469	0,0109433
3	0,0101443	0,0099322	0,0106469	0,0109433
4	0,0101443	0,0099322	0,0106469	0,0109433
5	0,0101443	0,0099322	0,0106469	0,0109433
6	0,0101443	0,0099322	0,0106469	0,0109433
7	0,0101443	0,0099322	0,0106469	0,0109433
8	0,0101443	0,0099322	0,0106469	0,0109433
9	0,0101443	0,0099322	0,0106469	0,0109433
10	0,0101443	0,0099322	0,0106469	0,0109433
11	0,0101443	0,0099322	0,0106469	0,0109433
12	0,0101443	0,0099322	0,0106469	0,0109433
13	0,0101443	0,0099322	0,0106469	0,0109433
14	0,0101443	0,0099322	0,0106469	0,0109433
15	0,0101443	0,0099322	0,0106469	0,0109433
16	0,0101443	0,0099322	0,0106469	0,0109433
17	0,0101443	0,0099322	0,0106469	0,0109433
18	0,0101443	0,0099322	0,0106469	0,0109433
19	0,0101443	0,0099322	0,0106469	0,0109433
20	0,0101443	0,0099322	0,0106469	0,0109433
21	0,0101443	0,0099322	0,0106469	0,0109433
22	0,0101443	0,0099322	0,0106469	0,0109433
23	0,0101443	0,0099322	0,0106469	0,0109433

Figure 32. Gas Demand profile. Subsector: Food and beverages.

METALLURGY

Hour	Winter	Spring	Summer	Autumn
0	0,0106188	0,0105702	0,0094623	0,0110154
1	0,0106188	0,0105702	0,0094623	0,0110154
2	0,0106188	0,0105702	0,0094623	0,0110154
3	0,0106188	0,0105702	0,0094623	0,0110154
4	0,0106188	0,0105702	0,0094623	0,0110154
5	0,0106188	0,0105702	0,0094623	0,0110154
6	0,0106188	0,0105702	0,0094623	0,0110154
7	0,0106188	0,0105702	0,0094623	0,0110154
8	0,0106188	0,0105702	0,0094623	0,0110154
9	0,0106188	0,0105702	0,0094623	0,0110154
10	0,0106188	0,0105702	0,0094623	0,0110154
11	0,0106188	0,0105702	0,0094623	0,0110154
12	0,0106188	0,0105702	0,0094623	0,0110154
13	0,0106188	0,0105702	0,0094623	0,0110154
14	0,0106188	0,0105702	0,0094623	0,0110154
15	0,0106188	0,0105702	0,0094623	0,0110154
16	0,0106188	0,0105702	0,0094623	0,0110154
17	0,0106188	0,0105702	0,0094623	0,0110154
18	0,0106188	0,0105702	0,0094623	0,0110154
19	0,0106188	0,0105702	0,0094623	0,0110154
20	0,0106188	0,0105702	0,0094623	0,0110154
21	0,0106188	0,0105702	0,0094623	0,0110154
22	0,0106188	0,0105702	0,0094623	0,0110154
23	0,0106188	0,0105702	0,0094623	0,0110154

Figure 33. Gas Demand profile. Subsector: Metallurgy.

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Hour	Winter	Spring	Summer	Autumn
0	0,0105253	0,0105255	0,0098295	0,0107864
1	0,0105253	0,0105255	0,0098295	0,0107864
2	0,0105253	0,0105255	0,0098295	0,0107864
3	0,0105253	0,0105255	0,0098295	0,0107864
4	0,0105253	0,0105255	0,0098295	0,0107864
5	0,0105253	0,0105255	0,0098295	0,0107864
6	0,0105253	0,0105255	0,0098295	0,0107864
7	0,0105253	0,0105255	0,0098295	0,0107864
8	0,0105253	0,0105255	0,0098295	0,0107864
9	0,0105253	0,0105255	0,0098295	0,0107864
10	0,0105253	0,0105255	0,0098295	0,0107864
11	0,0105253	0,0105255	0,0098295	0,0107864
12	0,0105253	0,0105255	0,0098295	0,0107864
13	0,0105253	0,0105255	0,0098295	0,0107864
14	0,0105253	0,0105255	0,0098295	0,0107864
15	0,0105253	0,0105255	0,0098295	0,0107864
16	0,0105253	0,0105255	0,0098295	0,0107864
17	0,0105253	0,0105255	0,0098295	0,0107864
18	0,0105253	0,0105255	0,0098295	0,0107864
19	0,0105253	0,0105255	0,0098295	0,0107864
20	0,0105253	0,0105255	0,0098295	0,0107864
21	0,0105253	0,0105255	0,0098295	0,0107864
22	0,0105253	0,0105255	0,0098295	0,0107864
23	0,0105253	0,0105255	0,0098295	0,0107864

Figure 34. Gas Demand profile. Subsector: Paper.

CHEMISTRY AND REFINERY

Hour	Winter	Spring	Summer	Autumn
0	0,0108825	0,0105491	0,0102902	0,0099449
1	0,0108825	0,0105491	0,0102902	0,0099449
2	0,0108825	0,0105491	0,0102902	0,0099449
3	0,0108825	0,0105491	0,0102902	0,0099449
4	0,0108825	0,0105491	0,0102902	0,0099449
5	0,0108825	0,0105491	0,0102902	0,0099449
6	0,0108825	0,0105491	0,0102902	0,0099449
7	0,0108825	0,0105491	0,0102902	0,0099449
8	0,0108825	0,0105491	0,0102902	0,0099449
9	0,0108825	0,0105491	0,0102902	0,0099449
10	0,0108825	0,0105491	0,0102902	0,0099449
11	0,0108825	0,0105491	0,0102902	0,0099449
12	0,0108825	0,0105491	0,0102902	0,0099449
13	0,0108825	0,0105491	0,0102902	0,0099449
14	0,0108825	0,0105491	0,0102902	0,0099449
15	0,0108825	0,0105491	0,0102902	0,0099449
16	0,0108825	0,0105491	0,0102902	0,0099449
17	0,0108825	0,0105491	0,0102902	0,0099449
18	0,0108825	0,0105491	0,0102902	0,0099449
19	0,0108825	0,0105491	0,0102902	0,0099449
20	0,0108825	0,0105491	0,0102902	0,0099449
21	0,0108825	0,0105491	0,0102902	0,0099449
22	0,0108825	0,0105491	0,0102902	0,0099449
23	0,0108825	0,0105491	0,0102902	0,0099449

Figure 35. Gas Demand profile. Subsector: Chemistry and Refinery.

TEXTILE

Hour	Winter	Spring	Summer	Autumn
0	0,0110948	0,0101423	0,0090791	0,0113505
1	0,0110948	0,0101423	0,0090791	0,0113505
2	0,0110948	0,0101423	0,0090791	0,0113505
3	0,0110948	0,0101423	0,0090791	0,0113505
4	0,0110948	0,0101423	0,0090791	0,0113505
5	0,0110948	0,0101423	0,0090791	0,0113505
6	0,0110948	0,0101423	0,0090791	0,0113505
7	0,0110948	0,0101423	0,0090791	0,0113505
8	0,0110948	0,0101423	0,0090791	0,0113505
9	0,0110948	0,0101423	0,0090791	0,0113505
10	0,0110948	0,0101423	0,0090791	0,0113505
11	0,0110948	0,0101423	0,0090791	0,0113505
12	0,0110948	0,0101423	0,0090791	0,0113505
13	0,0110948	0,0101423	0,0090791	0,0113505
14	0,0110948	0,0101423	0,0090791	0,0113505
15	0,0110948	0,0101423	0,0090791	0,0113505
16	0,0110948	0,0101423	0,0090791	0,0113505
17	0,0110948	0,0101423	0,0090791	0,0113505
18	0,0110948	0,0101423	0,0090791	0,0113505
19	0,0110948	0,0101423	0,0090791	0,0113505
20	0,0110948	0,0101423	0,0090791	0,0113505
21	0,0110948	0,0101423	0,0090791	0,0113505
22	0,0110948	0,0101423	0,0090791	0,0113505
23	0,0110948	0,0101423	0,0090791	0,0113505

Figure 36. Gas Demand profile. Subsector: Textile

MINING, CONSTRUCTION AND MATERIALS

Hour	Winter	Spring	Summer	Autumn
0	0,0101296	0,0103331	0,0098426	0,0113614
1	0,0101296	0,0103331	0,0098426	0,0113614
2	0,0101296	0,0103331	0,0098426	0,0113614
3	0,0101296	0,0103331	0,0098426	0,0113614
4	0,0101296	0,0103331	0,0098426	0,0113614
5	0,0101296	0,0103331	0,0098426	0,0113614
6	0,0101296	0,0103331	0,0098426	0,0113614
7	0,0101296	0,0103331	0,0098426	0,0113614
8	0,0101296	0,0103331	0,0098426	0,0113614
9	0,0101296	0,0103331	0,0098426	0,0113614
10	0,0101296	0,0103331	0,0098426	0,0113614
11	0,0101296	0,0103331	0,0098426	0,0113614
12	0,0101296	0,0103331	0,0098426	0,0113614
13	0,0101296	0,0103331	0,0098426	0,0113614
14	0,0101296	0,0103331	0,0098426	0,0113614
15	0,0101296	0,0103331	0,0098426	0,0113614
16	0,0101296	0,0103331	0,0098426	0,0113614
17	0,0101296	0,0103331	0,0098426	0,0113614
18	0,0101296	0,0103331	0,0098426	0,0113614
19	0,0101296	0,0103331	0,0098426	0,0113614
20	0,0101296	0,0103331	0,0098426	0,0113614
21	0,0101296	0,0103331	0,0098426	0,0113614
22	0,0101296	0,0103331	0,0098426	0,0113614
23	0,0101296	0,0103331	0,0098426	0,0113614

Figure 37. Gas Demand profile. Subsector: Mining and Construction.

OTHER INDUSTRIAL SUBSECTORS

Hour	Winter	Spring	Summer	Autumn
0	0,0112771	0,0097634	0,0093957	0,0112304
1	0,0112771	0,0097634	0,0093957	0,0112304
2	0,0112771	0,0097634	0,0093957	0,0112304
3	0,0112771	0,0097634	0,0093957	0,0112304
4	0,0112771	0,0097634	0,0093957	0,0112304
5	0,0112771	0,0097634	0,0093957	0,0112304
6	0,0112771	0,0097634	0,0093957	0,0112304
7	0,0112771	0,0097634	0,0093957	0,0112304
8	0,0112771	0,0097634	0,0093957	0,0112304
9	0,0112771	0,0097634	0,0093957	0,0112304
10	0,0112771	0,0097634	0,0093957	0,0112304
11	0,0112771	0,0097634	0,0093957	0,0112304
12	0,0112771	0,0097634	0,0093957	0,0112304
13	0,0112771	0,0097634	0,0093957	0,0112304
14	0,0112771	0,0097634	0,0093957	0,0112304
15	0,0112771	0,0097634	0,0093957	0,0112304
16	0,0112771	0,0097634	0,0093957	0,0112304
17	0,0112771	0,0097634	0,0093957	0,0112304
18	0,0112771	0,0097634	0,0093957	0,0112304
19	0,0112771	0,0097634	0,0093957	0,0112304
20	0,0112771	0,0097634	0,0093957	0,0112304
21	0,0112771	0,0097634	0,0093957	0,0112304
22	0,0112771	0,0097634	0,0093957	0,0112304
23	0,0112771	0,0097634	0,0093957	0,0112304

Figure 38. Gas Demand profile. Other Industrial Subsectors,

ANNEX IV. ELECTRICITY DEMAND PROFILES (7 DAYS X 24 HOURS X 4 SEASONS)

The tables below show how electricity consumption is distributed according to the time of year. The following percentages are included for future improvements in the model.

The table below show how consumption is distributed according to weekday, season and time of day. The year is separated in 672 times slices (24 hours x 7 days 4 seasons)

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Day	Hour	Winter	Spring	Summer	Fall
1	0	0,0013300	0,00155128	0,00149506	0,0016981
1	1	0,0013308	0,00154971	0,00149074	0,0016944
1	2	0,0013250	0,00154869	0,0014861	0,0016871
1	3	0,0013306	0,00155092	0,00148956	0,0016937
1	4	0,0013295	0,00154858	0,00148754	0,0016866
1	5	0,0013214	0,00153584	0,00147876	0,0016739
1	6	0,0013169	0,00153539	0,00148248	0,0016708
1	7	0,0013264	0,00153247	0,00148071	0,0016777
1	8	0,0013110	0,00151498	0,00145015	0,0016521
1	9	0,0012980	0,00149893	0,00142806	0,0016256
1	10	0,0012986	0,0014971	0,00143507	0,0016090
1	11	0,0012738	0,00149323	0,00143824	0,0016022
1	12	0,0012807	0,00149257	0,00143969	0,0016086
1	13	0,0012898	0,0014684	0,00144225	0,0016159
1	14	0,0013032	0,00147817	0,00145748	0,0016195
1	15	0,0013097	0,00151993	0,00144922	0,0016300
1	16	0,0013127	0,00151902	0,00145737	0,0016336
1	17	0,0013202	0,00152602	0,00145672	0,0016460
1	18	0,0013217	0,00153182	0,00145601	0,0016488
1	19	0,0013265	0,0015229	0,00146212	0,0016468
1	20	0,0013286	0,00152748	0,001464	0,0016440
1	21	0,0013176	0,0015254	0,00145892	0,0016391
1	22	0,0013182	0,00152828	0,00145796	0,0016490

1	23	0,0013254	0,00153409	0,00146602	0,0016562
2	0	0,0013195	0,00152877	0,00147027	0,0016622
2	1	0,0013195	0,00153747	0,00146451	0,0016632
2	2	0,0013163	0,00152651	0,00144743	0,0016428
2	3	0,0013149	0,00152894	0,0014305	0,0016453
2	4	0,0013071	0,00151058	0,00141696	0,0016439
2	5	0,0012729	0,0014651	0,00137764	0,0016073
2	6	0,0012679	0,00145079	0,0013706	0,0016056
2	7	0,0012626	0,00144154	0,00136257	0,0015983
2	8	0,0012348	0,00141753	0,0013372	0,0015569
2	9	0,0012031	0,00139162	0,00131105	0,0015019
2	10	0,0011903	0,00138354	0,00130372	0,0014813
2	11	0,0011864	0,00139084	0,00130423	0,0014621
2	12	0,0011990	0,0013971	0,0013043	0,0014759
2	13	0,0012095	0,00140902	0,00134053	0,0014993
2	14	0,0012211	0,00143518	0,00137855	0,0015284
2	15	0,0012556	0,00146916	0,00151889	0,0015527
2	16	0,0012710	0,00148995	0,00142148	0,0015655
2	17	0,0012720	0,00150299	0,00143894	0,0015802
2	18	0,0012755	0,00151134	0,00144182	0,0015839
2	19	0,0012968	0,0015229	0,00145157	0,0015997
2	20	0,0013039	0,00152119	0,00145152	0,0015955
2	21	0,0013047	0,00151667	0,00144659	0,0016176
2	22	0,0013099	0,00152355	0,00145058	0,0016192
2	23	0,0013194	0,00153455	0,00145376	0,0016247
3	0	0,0013332	0,00153426	0,00145614	0,0016327
3	1	0,0013343	0,00151994	0,00144795	0,0016309
3	2	0,0013290	0,00152327	0,00144291	0,0016260
3	3	0,0013245	0,00152634	0,0014474	0,0016288
3	4	0,0013205	0,00152685	0,00144922	0,0016229
3	5	0,0013115	0,00151268	0,00142965	0,0016104
3	6	0,0013160	0,00150991	0,00142865	0,0016162
3	7	0,0013199	0,00150513	0,00142632	0,0016170
3	8	0,0012910	0,00148904	0,00140104	0,0015958
3	9	0,0012609	0,00146244	0,00137988	0,0015670
3	10	0,0012370	0,00145062	0,00137714	0,0015612
3	11	0,0012300	0,00143839	0,00137808	0,0015653
3	12	0,0012487	0,00144993	0,00139779	0,0015573
3	13	0,0012662	0,00146232	0,00141071	0,0015838
3	14	0,0012784	0,00147922	0,00144568	0,0015974
3	15	0,0012971	0,00152225	0,00146344	0,0016151
3	16	0,0013012	0,00153348	0,00146309	0,0016231
3	17	0,0013124	0,00154357	0,00148139	0,0016281

3	18	0,0013160	0,001552	0,0014794	0,0016355
3	19	0,0013223	0,00156044	0,00148817	0,0016428
3	20	0,0013257	0,00156052	0,00149173	0,0016460
3	21	0,0013227	0,00155627	0,00148653	0,0016383
3	22	0,0013289	0,00156062	0,00149067	0,0016404
3	23	0,0013418	0,00156555	0,00149206	0,0016448
4	0	0,0013594	0,00156475	0,00150469	0,0016523
4	1	0,0013563	0,00156785	0,00149982	0,0016562
4	2	0,0013626	0,00156252	0,00149651	0,0016526
4	3	0,0013295	0,00156369	0,00147726	0,0016573
4	4	0,0013320	0,00156416	0,00146924	0,0016525
4	5	0,0013221	0,0015504	0,00144979	0,0016369
4	6	0,0013226	0,00154845	0,00144862	0,0016341
4	7	0,0013251	0,00154333	0,00145286	0,0016294
4	8	0,0012852	0,00152766	0,00143945	0,0015911
4	9	0,0012575	0,00149326	0,00141442	0,0015549
4	10	0,0012446	0,00147378	0,00141413	0,0015601
4	11	0,0012418	0,00147343	0,00142423	0,0015631
4	12	0,0012478	0,00148306	0,00143399	0,0015597
4	13	0,0012356	0,0014829	0,00143876	0,0015974
4	14	0,0012526	0,00149647	0,00144966	0,0016169
4	15	0,0012616	0,00151438	0,00145984	0,0016238
4	16	0,0012601	0,00151835	0,0014725	0,0016175
4	17	0,0012892	0,00151481	0,00148218	0,0016443
4	18	0,0012889	0,00152369	0,00148742	0,0016531
4	19	0,0012998	0,00153871	0,00149758	0,0016624
4	20	0,0013131	0,00154039	0,001503	0,0016671
4	21	0,0013129	0,00153485	0,00149643	0,0016630
4	22	0,0013169	0,00154342	0,00149947	0,0016699
4	23	0,0013276	0,00155331	0,00150736	0,0016766
5	0	0,0014065	0,00156285	0,00152064	0,0015629
5	1	0,0014075	0,00156255	0,00151497	0,0015616
5	2	0,0014036	0,00156017	0,00150352	0,0015643
5	3	0,0014081	0,00155387	0,00151689	0,0015652
5	4	0,0014071	0,00155621	0,001516	0,0015538
5	5	0,0014045	0,00154286	0,00150186	0,0015335
5	6	0,0014054	0,00154906	0,00150537	0,0015449
5	7	0,0014076	0,00155107	0,00150868	0,0015560
5	8	0,0013870	0,00153394	0,0014806	0,0015573
5	9	0,0013694	0,00152231	0,00146989	0,0015417
5	10	0,0013634	0,00151329	0,00147812	0,0015336
5	11	0,0013628	0,00151817	0,00148147	0,0015357
5	12	0,0013801	0,00151848	0,00148796	0,0015497

5	13	0,0013699	0,00151977	0,00149381	0,0015569
5	14	0,0013921	0,00152417	0,00149384	0,0015705
5	15	0,0014066	0,00154275	0,00150268	0,0015701
5	16	0,0014052	0,00154821	0,00151404	0,0015714
5	17	0,0014021	0,00155286	0,00152214	0,0015891
5	18	0,0013980	0,00154935	0,00151946	0,0015892
5	19	0,0014065	0,00155897	0,00152129	0,0015977
5	20	0,0014137	0,00156022	0,00152746	0,0015976
5	21	0,0014093	0,00155593	0,00152236	0,0015872
5	22	0,0014120	0,00156073	0,00152401	0,0015896
5	23	0,0014182	0,00156466	0,00153051	0,0016007
6	0	0,0013326	0,00166438	0,00153673	0,0016026
6	1	0,0013360	0,00166407	0,00153352	0,0016055
6	2	0,0013363	0,00165998	0,00152806	0,0015965
6	3	0,0013380	0,00166799	0,00153316	0,0016013
6	4	0,0013407	0,0016664	0,00153266	0,0016051
6	5	0,0013359	0,00165829	0,00152242	0,0015987
6	6	0,0013371	0,00166039	0,00152359	0,0015990
6	7	0,0013426	0,00166589	0,00152773	0,0016016
6	8	0,0013470	0,00166658	0,00152132	0,0015990
6	9	0,0013432	0,00165991	0,0015152	0,0015929
6	10	0,0013392	0,0016626	0,00151019	0,0015898
6	11	0,0013399	0,00166284	0,00151267	0,0015922
6	12	0,0013365	0,00165778	0,00151379	0,0015870
6	13	0,0013189	0,00165322	0,0014988	0,0015792
6	14	0,0013191	0,00165981	0,00150062	0,0015859
6	15	0,0013245	0,00166779	0,00150715	0,0015906
6	16	0,0013325	0,0016672	0,0015069	0,0015916
6	17	0,0013363	0,0016629	0,00151059	0,0015933
6	18	0,0013378	0,00165828	0,00150784	0,0015851
6	19	0,0013406	0,00166718	0,00151208	0,0015872
6	20	0,0013420	0,00166905	0,00150955	0,0015956
6	21	0,0013324	0,00166238	0,00149567	0,0015891
6	22	0,0013376	0,00166799	0,00150028	0,0015967
6	23	0,0013500	0,00167155	0,00150877	0,0016032
7	0	0,0013419	0,00156471	0,00161385	0,0016074
7	1	0,0013383	0,00156323	0,00160964	0,0016076
7	2	0,0013309	0,00143374	0,00160982	0,0016012
7	3	0,0013324	0,00156153	0,00161551	0,0016041
7	4	0,0013413	0,00143516	0,0016177	0,0016052
7	5	0,0013347	0,00155575	0,00160679	0,0015957
7	6	0,0013363	0,00155302	0,0016113	0,0015994
7	7	0,0013422	0,00155693	0,00161202	0,0016008

7	8	0,0013384	0,00155295	0,00161043	0,0015928
7	9	0,0013317	0,0015488	0,00158921	0,0015783
7	10	0,0013273	0,0015491	0,00158392	0,0015785
7	11	0,0013240	0,001551	0,00158662	0,0015798
7	12	0,0013252	0,00155266	0,00158592	0,0015788
7	13	0,0013261	0,00154619	0,00159529	0,0015508
7	14	0,0013284	0,00154596	0,00160635	0,0015770
7	15	0,0013318	0,00155073	0,00161466	0,0015747
7	16	0,0013370	0,00155255	0,00161497	0,0015767
7	17	0,0013397	0,00154676	0,00161458	0,0015817
7	18	0,0013381	0,00154014	0,001611	0,0015757
7	19	0,0013406	0,00155018	0,00161239	0,0015743
7	20	0,0013398	0,00155329	0,00161453	0,0015809
7	21	0,0013277	0,00154411	0,00159778	0,0015726
7	22	0,0013329	0,0015439	0,00160735	0,0015759
7	23	0,0013378	0,00154466	0,0016073	0,0015779

Figure 39. Electricity Demand profile. Subsector: Paper

CHEMISTRY AND REFINERY

Day	Hour	Winter	Spring	Summer	Fall
1	0	0,0014852	0,00174089	0,00169361	0,0018660
1	1	0,0015009	0,00176811	0,00170268	0,0019072
1	2	0,0015100	0,00177947	0,00171098	0,0019044
1	3	0,0014928	0,00175324	0,00169852	0,0018569
1	4	0,0014819	0,00173586	0,00167927	0,0018598
1	5	0,0015000	0,00175042	0,00169123	0,0018775
1	6	0,0014662	0,00171866	0,0016783	0,0018108
1	7	0,0013700	0,00161447	0,00160112	0,0017026
1	8	0,0011520	0,00136049	0,00140222	0,0014681
1	9	0,0010704	0,00128929	0,00135745	0,0014013
1	10	0,0009249	0,00126229	0,00129108	0,0013555
1	11	0,0009075	0,00124551	0,00119529	0,0013358
1	12	0,0009093	0,0012475	0,0011956	0,0013130
1	13	0,0009827	0,00124833	0,00120076	0,0013250
1	14	0,0010210	0,00127421	0,00120437	0,0013386
1	15	0,0010361	0,00131665	0,00119933	0,0013727
1	16	0,0010385	0,00132238	0,001212	0,0013778

1	17	0,0010136	0,0013334	0,00122424	0,0013689
1	18	0,0009258	0,00132711	0,00123538	0,0013565
1	19	0,0009370	0,00133014	0,00131332	0,0013734
1	20	0,0009456	0,00135328	0,00137537	0,0014046
1	21	0,0010746	0,00139776	0,00141779	0,0014559
1	22	0,0011438	0,0014245	0,00143286	0,0015015
1	23	0,0012029	0,00146684	0,00146354	0,0015474
2	0	0,0013642	0,00159363	0,0015797	0,0017129
2	1	0,0014151	0,00165579	0,00161112	0,0017660
2	2	0,0014234	0,00168785	0,00162009	0,0017834
2	3	0,0014375	0,00168292	0,0015715	0,0017437
2	4	0,0014131	0,00163939	0,00156622	0,0017364
2	5	0,0014357	0,00168357	0,00159815	0,0017971
2	6	0,0014522	0,00169878	0,00159915	0,0017838
2	7	0,0013789	0,00159757	0,00152742	0,0016625
2	8	0,0011571	0,0013376	0,00134012	0,0014273
2	9	0,0010605	0,00129087	0,00129278	0,0013513
2	10	0,0009095	0,0012868	0,00124924	0,0012703
2	11	0,0009025	0,00126598	0,00116338	0,0012398
2	12	0,0008948	0,00124887	0,00115097	0,0012224
2	13	0,0009725	0,00125771	0,0011793	0,0012692
2	14	0,0009997	0,0012753	0,00118838	0,0012865
2	15	0,0010149	0,00129516	0,00120319	0,0013029
2	16	0,0010202	0,00130363	0,00122014	0,0013286
2	17	0,0009950	0,00131775	0,00123613	0,0013357
2	18	0,0009190	0,00131246	0,00125079	0,0013098
2	19	0,0009309	0,00131041	0,00132314	0,0013239
2	20	0,0009416	0,00133701	0,00138431	0,0013495
2	21	0,0010801	0,00136564	0,00143216	0,0014084
2	22	0,0011473	0,00139077	0,00145593	0,0014432
2	23	0,0012000	0,00143888	0,00147837	0,0014895
3	0	0,0013602	0,00158639	0,00159098	0,0016479
3	1	0,0014100	0,00163767	0,00162468	0,0017158
3	2	0,0014182	0,00168475	0,00163695	0,0017345
3	3	0,0014301	0,00165788	0,00161946	0,0017051
3	4	0,0014080	0,00163645	0,00160175	0,0017007
3	5	0,0014254	0,00167792	0,00163254	0,0017626
3	6	0,0014356	0,00167173	0,00163368	0,0017530
3	7	0,0013568	0,00157724	0,00155705	0,0016286
3	8	0,0011304	0,00133264	0,00137606	0,0014128
3	9	0,0010514	0,0012931	0,00131707	0,0013544
3	10	0,0009016	0,00128309	0,00126881	0,0013009
3	11	0,0008987	0,00124678	0,00119206	0,0012853

3	12	0,0009041	0,00124017	0,00119437	0,0012764
3	13	0,0009761	0,00124822	0,00119628	0,0012993
3	14	0,0010059	0,00125816	0,00121923	0,0013137
3	15	0,0010102	0,00129199	0,00123814	0,0013278
3	16	0,0010083	0,00131205	0,00124936	0,0013315
3	17	0,0009894	0,00132463	0,0012707	0,0013448
3	18	0,0009151	0,00134102	0,00128911	0,0013127
3	19	0,0009253	0,00134222	0,00135792	0,0013171
3	20	0,0009320	0,00137021	0,00141572	0,0013381
3	21	0,0010669	0,00141279	0,00145738	0,0014049
3	22	0,0011406	0,00143707	0,0014757	0,0014499
3	23	0,0011949	0,00148105	0,00150456	0,0015018
4	0	0,0013755	0,00163805	0,00162942	0,0016482
4	1	0,0014263	0,0016975	0,00167154	0,0017086
4	2	0,0014426	0,0017374	0,0016816	0,0017408
4	3	0,0014246	0,00171238	0,00165355	0,0017147
4	4	0,0013966	0,00166774	0,00162942	0,0016795
4	5	0,0014187	0,00171174	0,00165667	0,0017190
4	6	0,0014122	0,00169934	0,00163083	0,0017150
4	7	0,0013101	0,00157332	0,00153884	0,0015817
4	8	0,0010809	0,00129998	0,00135116	0,0013588
4	9	0,0010039	0,00124445	0,00129977	0,0012983
4	10	0,0008670	0,00123481	0,00125511	0,0012368
4	11	0,0008635	0,00120776	0,00116862	0,0012205
4	12	0,0008724	0,00120056	0,00117629	0,0012291
4	13	0,0009482	0,00122994	0,00120287	0,0012884
4	14	0,0009890	0,00125485	0,00122294	0,0013062
4	15	0,0010034	0,00129042	0,00124974	0,0013339
4	16	0,0010022	0,00131492	0,00126396	0,0013606
4	17	0,0009875	0,00133526	0,00127593	0,0013682
4	18	0,0009063	0,00134357	0,00129184	0,0013373
4	19	0,0009174	0,00135798	0,00136009	0,0013573
4	20	0,0009277	0,00138421	0,00142705	0,0013862
4	21	0,0010520	0,00141765	0,00146682	0,0014453
4	22	0,0011293	0,00145297	0,00149026	0,0015014
4	23	0,0011900	0,0015063	0,00152035	0,0015585
5	0	0,0014243	0,00167885	0,00164187	0,0016343
5	1	0,0014899	0,0017502	0,00168602	0,0017037
5	2	0,0015063	0,00178847	0,0016937	0,0017235
5	3	0,0015157	0,00177561	0,0016977	0,0017112
5	4	0,0014931	0,00175662	0,0016886	0,0017158
5	5	0,0015024	0,00177214	0,0016972	0,0017227
5	6	0,0015047	0,00176761	0,00168017	0,0017053

5	7	0,0014504	0,00171209	0,00162086	0,0016504
5	8	0,0012192	0,00150501	0,00148909	0,0014769
5	9	0,0011189	0,00145906	0,00145944	0,0014150
5	10	0,0009702	0,00145284	0,00142344	0,0013867
5	11	0,0009692	0,00144813	0,00136859	0,0013995
5	12	0,0009803	0,00144464	0,00137352	0,0014153
5	13	0,0010551	0,00146034	0,0013833	0,0014309
5	14	0,0011041	0,00147185	0,00139946	0,0014405
5	15	0,0011355	0,00149288	0,0014272	0,0014713
5	16	0,0011449	0,00150943	0,00144478	0,0014891
5	17	0,0011254	0,00151963	0,00144755	0,0014794
5	18	0,0010425	0,00152399	0,00144805	0,0014647
5	19	0,0010537	0,00153617	0,00151296	0,0014840
5	20	0,0010702	0,00156397	0,00156457	0,0015055
5	21	0,0012151	0,00159623	0,00158632	0,0015425
5	22	0,0012888	0,00161021	0,00160461	0,0015709
5	23	0,0013341	0,00162681	0,00163051	0,0015999
6	0	0,0014202	0,00190011	0,00174667	0,0017685
6	1	0,0014857	0,00196683	0,00178663	0,0018346
6	2	0,0015148	0,00197069	0,00179595	0,0018377
6	3	0,0015291	0,00197136	0,00177689	0,0018137
6	4	0,0015126	0,00194882	0,00178615	0,0018488
6	5	0,0015231	0,00199952	0,00180049	0,0018626
6	6	0,0015316	0,0020035	0,00177504	0,0018366
6	7	0,0015249	0,00197023	0,00176839	0,0018140
6	8	0,0014860	0,0019382	0,00176517	0,0018117
6	9	0,0014918	0,0019453	0,00175535	0,0018382
6	10	0,0015040	0,00198007	0,00175991	0,0018373
6	11	0,0015129	0,00196879	0,00174975	0,0017866
6	12	0,0015111	0,00193636	0,00175236	0,0017918
6	13	0,0014953	0,00196228	0,00178354	0,0018119
6	14	0,0015077	0,00198608	0,0017732	0,0018161
6	15	0,0015098	0,00198397	0,00176266	0,0017972
6	16	0,0015120	0,00196146	0,00176178	0,0017931
6	17	0,0015004	0,00195396	0,00177123	0,0018149
6	18	0,0014961	0,00197747	0,00177802	0,0018461
6	19	0,0014988	0,00198031	0,00177218	0,0018185
6	20	0,0014943	0,00195612	0,0017588	0,0017808
6	21	0,0014854	0,00195717	0,00177611	0,0017931
6	22	0,0014997	0,0019577	0,00177859	0,0018037
6	23	0,0015091	0,00196628	0,00176564	0,0018071
7	0	0,0015205	0,00183597	0,0019153	0,0018178
7	1	0,0015286	0,00183112	0,00192253	0,0018178

7	2	0,0015335	0,00171658	0,00194804	0,0018515
7	3	0,0015394	0,00183134	0,00194684	0,0018498
7	4	0,0015501	0,00171619	0,00193491	0,0018194
7	5	0,0015532	0,00184303	0,00194148	0,0018447
7	6	0,0015351	0,00183038	0,00194741	0,0018213
7	7	0,0015128	0,00177559	0,00189198	0,0017547
7	8	0,0014990	0,00169754	0,00181408	0,0016856
7	9	0,0014973	0,00169673	0,00179164	0,0016690
7	10	0,0014983	0,00169628	0,0017839	0,0016396
7	11	0,0014855	0,00169096	0,0017603	0,0016433
7	12	0,0014787	0,00168475	0,00175294	0,0016289
7	13	0,0014803	0,00168849	0,00174128	0,0016322
7	14	0,0014996	0,0016975	0,00175332	0,0016638
7	15	0,0015061	0,00172126	0,00176284	0,0016694
7	16	0,0014958	0,00172099	0,00177373	0,0016575
7	17	0,0014844	0,00170126	0,0017799	0,0016424
7	18	0,0014697	0,0016902	0,00176521	0,0016225
7	19	0,0014618	0,00168973	0,0017772	0,0016451
7	20	0,0014723	0,0016961	0,00180413	0,0016752
7	21	0,0014681	0,00170265	0,00181171	0,0016651
7	22	0,0014591	0,00169505	0,00180473	0,0016457
7	23	0,0014648	0,00170695	0,00180919	0,0016774

Figure 40. Electricity Demand profile. Subsector: Chemistry and Refinery.

METALLURGY

Day	Hour	Winter	Spring	Summer	Fall
1	0	0,0013623	0,00152337	0,00152903	0,0017146
1	1	0,0013619	0,00152667	0,00152569	0,0017093
1	2	0,0013567	0,00150208	0,00152431	0,0017158
1	3	0,0013554	0,00152525	0,00153063	0,0017110
1	4	0,0013505	0,001497	0,00152812	0,0017100
1	5	0,0013413	0,00151831	0,00151933	0,0017084
1	6	0,0013363	0,00151565	0,00151579	0,0016979
1	7	0,0013408	0,00151989	0,0015167	0,0016972
1	8	0,0013176	0,00151382	0,00150018	0,0016793
1	9	0,0013114	0,00150024	0,00149041	0,0016658
1	10	0,0012812	0,00149861	0,00148513	0,0016542
1	11	0,0012811	0,00149442	0,00147475	0,0016499
1	12	0,0012829	0,00148047	0,00146989	0,0016358

1	13	0,0012767	0,00143945	0,00145555	0,0016178
1	14	0,0012712	0,00143397	0,0014556	0,0016050
1	15	0,0012695	0,00145365	0,0014333	0,0015976
1	16	0,0012652	0,00145479	0,00143453	0,0016076
1	17	0,0012711	0,00145741	0,00143514	0,0016223
1	18	0,0012713	0,00145472	0,00143204	0,0016205
1	19	0,0012744	0,00145762	0,00143593	0,0016247
1	20	0,0012770	0,00145837	0,00143714	0,0016225
1	21	0,0012798	0,00146462	0,00143763	0,0016242
1	22	0,0013143	0,00152164	0,00147058	0,0016811
1	23	0,0013259	0,00153777	0,00148578	0,0017015
2	0	0,0013519	0,00152548	0,00150432	0,0017189
2	1	0,0013539	0,00153724	0,00150271	0,0017264
2	2	0,0013468	0,00153869	0,00150535	0,0017250
2	3	0,0013536	0,00154013	0,00148188	0,0017258
2	4	0,0013588	0,00153492	0,00148499	0,0017290
2	5	0,0013563	0,00153394	0,00148188	0,0017188
2	6	0,0013475	0,00152431	0,00147601	0,0017064
2	7	0,0013450	0,0015259	0,00147386	0,0017098
2	8	0,0013060	0,00151526	0,00144881	0,0016849
2	9	0,0013006	0,00149876	0,0014348	0,0016363
2	10	0,0012723	0,00148993	0,00143276	0,0016206
2	11	0,0012551	0,00148894	0,00141771	0,0016246
2	12	0,0012652	0,00145951	0,00141385	0,0016003
2	13	0,0012661	0,00144046	0,00142074	0,0015848
2	14	0,0012693	0,00144593	0,00142629	0,0015710
2	15	0,0012545	0,00144244	0,00142789	0,0015552
2	16	0,0012528	0,00144208	0,00142611	0,0015731
2	17	0,0012588	0,0014442	0,00143477	0,0015844
2	18	0,0012673	0,00144274	0,00143291	0,0015816
2	19	0,0012847	0,0014493	0,00143626	0,0015865
2	20	0,0012869	0,00145229	0,00143592	0,0015843
2	21	0,0012867	0,00146073	0,0014389	0,0015951
2	22	0,0013002	0,00151028	0,00146213	0,0016448
2	23	0,0013063	0,00152606	0,00147343	0,0016547
3	0	0,0013406	0,00153256	0,0014908	0,0016836
3	1	0,0013450	0,00151632	0,00149048	0,0016827
3	2	0,0013468	0,00152688	0,00149085	0,0016820
3	3	0,0013461	0,00153113	0,00149272	0,0016863
3	4	0,0013486	0,00153391	0,00148769	0,0016807
3	5	0,0013453	0,00153433	0,00148948	0,0016811
3	6	0,0013402	0,00152759	0,00148055	0,0016676
3	7	0,0013350	0,00153482	0,00148157	0,0016733

3	8	0,0013012	0,00152168	0,0014675	0,0016544
3	9	0,0012870	0,00150109	0,00145235	0,0016365
3	10	0,0012577	0,00149792	0,00145129	0,0016327
3	11	0,0012663	0,00149348	0,00144629	0,0016251
3	12	0,0012664	0,00146322	0,00143681	0,0016096
3	13	0,0012694	0,00143326	0,00142546	0,0015750
3	14	0,0012746	0,00144783	0,00145042	0,0015772
3	15	0,0012661	0,00147326	0,00144955	0,0015755
3	16	0,0012584	0,00146857	0,00144398	0,0015865
3	17	0,0012711	0,0014635	0,00145102	0,0015898
3	18	0,0012757	0,001473	0,00145165	0,0015888
3	19	0,0012816	0,00147709	0,00145985	0,0015842
3	20	0,0012883	0,00148297	0,00146044	0,0015940
3	21	0,0012872	0,00148473	0,00146136	0,0015943
3	22	0,0013069	0,00154866	0,00149855	0,0016543
3	23	0,0013197	0,00157382	0,00151367	0,0016700
4	0	0,0013850	0,00157582	0,00153031	0,0016963
4	1	0,0013960	0,00158161	0,00153305	0,0016953
4	2	0,0013853	0,00158453	0,00152939	0,0016977
4	3	0,0013662	0,0015862	0,00153339	0,0016942
4	4	0,0013729	0,0015872	0,00153913	0,0016976
4	5	0,0013648	0,00158621	0,00153248	0,0016948
4	6	0,0013637	0,00157842	0,00152566	0,0016872
4	7	0,0013433	0,00155439	0,00150619	0,0016601
4	8	0,0013048	0,00154655	0,00149084	0,0016233
4	9	0,0012859	0,00152578	0,00147256	0,0016007
4	10	0,0012574	0,00150822	0,00146781	0,0015983
4	11	0,0012583	0,00150716	0,00145794	0,0016037
4	12	0,0012526	0,00148368	0,00144564	0,0015924
4	13	0,0012260	0,00145802	0,00143998	0,0015847
4	14	0,0012231	0,00146135	0,00144187	0,0015808
4	15	0,0012243	0,00145465	0,00144175	0,0015814
4	16	0,0012232	0,00145947	0,00144203	0,0015842
4	17	0,0012449	0,00145923	0,00143557	0,0015893
4	18	0,0012418	0,00145871	0,00143811	0,0015768
4	19	0,0012399	0,00145999	0,00144551	0,0015743
4	20	0,0012504	0,00146587	0,00144583	0,0015960
4	21	0,0012541	0,00147684	0,00145479	0,0016085
4	22	0,0012744	0,00155405	0,0014975	0,0016640
4	23	0,0012906	0,00156578	0,00151564	0,0016870
5	0	0,0014226	0,00158305	0,00153255	0,0015810
5	1	0,0014269	0,00157217	0,00153373	0,0015850
5	2	0,0014235	0,00156936	0,00152906	0,0015845

5	3	0,0014293	0,00157472	0,00152835	0,0015877
5	4	0,0014306	0,00158307	0,00152694	0,0015855
5	5	0,0014294	0,00158551	0,00152048	0,0015810
5	6	0,0014239	0,00157174	0,00151623	0,0015728
5	7	0,0014101	0,00157063	0,00151401	0,0015636
5	8	0,0013761	0,00156068	0,00150453	0,0015697
5	9	0,0013620	0,0015344	0,00148376	0,0015543
5	10	0,0013414	0,00150939	0,0014758	0,0015372
5	11	0,0013462	0,0015134	0,00147181	0,0015315
5	12	0,0013469	0,00150364	0,00146147	0,0015214
5	13	0,0013362	0,00148784	0,00143945	0,0015013
5	14	0,0013473	0,00147829	0,00145087	0,0015008
5	15	0,0013609	0,00147244	0,00145172	0,0014952
5	16	0,0013612	0,00147386	0,00145123	0,0014926
5	17	0,0013646	0,00147213	0,00145166	0,0014971
5	18	0,0013604	0,00147031	0,00144706	0,0014967
5	19	0,0013573	0,00147411	0,00145445	0,0014930
5	20	0,0013670	0,00147797	0,0014538	0,0015066
5	21	0,0013702	0,00149021	0,00146238	0,0015172
5	22	0,0013905	0,00154271	0,00149763	0,0015639
5	23	0,0013977	0,00156065	0,00150745	0,0015797
6	0	0,0013550	0,00167154	0,0015304	0,0016063
6	1	0,0013608	0,00167628	0,00153809	0,0016095
6	2	0,0013610	0,00167088	0,00153805	0,0016090
6	3	0,0013616	0,00167384	0,00153589	0,0016067
6	4	0,0013630	0,00167632	0,00153787	0,0016124
6	5	0,0013599	0,00167314	0,00153581	0,0016075
6	6	0,0013564	0,00166595	0,00152945	0,0015996
6	7	0,0013600	0,00166981	0,00153131	0,0016014
6	8	0,0013468	0,00166547	0,00152935	0,0015966
6	9	0,0013424	0,00166264	0,00152575	0,0015910
6	10	0,0013444	0,00166111	0,00152571	0,0015938
6	11	0,0013387	0,00165435	0,00152361	0,0015957
6	12	0,0013231	0,00162852	0,001503	0,0015712
6	13	0,0013015	0,00159927	0,00147536	0,0015306
6	14	0,0012944	0,00158348	0,0014685	0,0015229
6	15	0,0012948	0,00157662	0,00146282	0,0015156
6	16	0,0012947	0,00157556	0,00146287	0,0015157
6	17	0,0012964	0,00157516	0,00146383	0,0015168
6	18	0,0012936	0,0015728	0,00146105	0,0015143
6	19	0,0012973	0,00157696	0,00146469	0,0015189
6	20	0,0012843	0,00157699	0,00146596	0,0015207
6	21	0,0013020	0,00158359	0,00147562	0,0015367

6	22	0,0013386	0,00164194	0,00151987	0,0015885
6	23	0,0013535	0,00166626	0,0015322	0,0016066
7	0	0,0013653	0,00154485	0,00166297	0,0016076
7	1	0,0013640	0,00155064	0,00166405	0,0016088
7	2	0,0013639	0,0014506	0,00166186	0,0016079
7	3	0,0013657	0,00155007	0,00166214	0,0016122
7	4	0,0013671	0,00145203	0,00166669	0,0016106
7	5	0,0013620	0,00154734	0,00166645	0,0016086
7	6	0,0013590	0,00154254	0,0016559	0,0015999
7	7	0,0013643	0,0015431	0,00165762	0,0016028
7	8	0,0013592	0,00154182	0,00165653	0,0016031
7	9	0,0013593	0,00153765	0,00165027	0,0015981
7	10	0,0013577	0,00153742	0,00165045	0,0015981
7	11	0,0013598	0,00153746	0,00164618	0,0015963
7	12	0,0013387	0,00151618	0,00162365	0,0015800
7	13	0,0013076	0,00148358	0,00159338	0,0015271
7	14	0,0012987	0,00146815	0,00158321	0,0015236
7	15	0,0012898	0,00145808	0,00157765	0,0015161
7	16	0,0012914	0,00145777	0,00157798	0,0015160
7	17	0,0012924	0,00145703	0,00157884	0,0015168
7	18	0,0012900	0,0014576	0,0015761	0,0015155
7	19	0,0012883	0,00146227	0,00157918	0,0015194
7	20	0,0012938	0,00146142	0,00158032	0,0015202
7	21	0,0012979	0,00147152	0,00158434	0,0015298
7	22	0,0013386	0,00151101	0,00163281	0,0015768
7	23	0,0013559	0,00152609	0,00164651	0,0015930

Figure 41. Electricity Demand profile. Subsector: Metallurgy.

STEEL AND FOUNDRY

Day	Hour	Winter	Spring	Summer	Fall
1	0	0,0015434	0,00181098	0,00153129	0,0019542
1	1	0,0015477	0,00180423	0,00155569	0,0019525
1	2	0,0015205	0,00179227	0,00153969	0,0019490
1	3	0,0015454	0,00177269	0,00153306	0,0019501
1	4	0,0015390	0,00176379	0,00153324	0,0019508
1	5	0,0015231	0,00174937	0,00152322	0,0019188
1	6	0,0015061	0,00175791	0,00149738	0,0019102
1	7	0,0014790	0,00174763	0,00148361	0,0018685
1	8	0,0012258	0,00156138	0,00132323	0,0015969
1	9	0,0011572	0,00146631	0,00126304	0,0014981
1	10	0,0010309	0,00139342	0,00122439	0,0014007
1	11	0,0010076	0,00135138	0,00113058	0,0013520
1	12	0,0010126	0,00135957	0,00114135	0,0013384
1	13	0,0010827	0,00138743	0,00115804	0,0013829
1	14	0,0010884	0,00140909	0,00118345	0,0013929
1	15	0,0011124	0,00147046	0,00120409	0,0014227
1	16	0,0011067	0,00146106	0,00122119	0,0014235
1	17	0,0010941	0,00146938	0,00123151	0,0014447
1	18	0,0010276	0,00147423	0,00124878	0,0014176
1	19	0,0010441	0,00148781	0,00129651	0,0014280
1	20	0,0010469	0,00147545	0,00130267	0,0014203
1	21	0,0011340	0,0015201	0,00130982	0,0014602
1	22	0,0011959	0,00154824	0,00132745	0,0015315
1	23	0,0012427	0,00159786	0,0013713	0,0015968
2	0	0,0015382	0,00176651	0,00154859	0,0018856
2	1	0,0015628	0,00179567	0,00155201	0,0019204
2	2	0,0015610	0,00179701	0,00155417	0,0019224
2	3	0,0015694	0,00179571	0,00152397	0,0019129
2	4	0,0015564	0,00178791	0,00152708	0,0018993
2	5	0,0015366	0,00175487	0,00151583	0,0018859
2	6	0,0015263	0,00173606	0,00148464	0,0018561
2	7	0,0014835	0,00170936	0,00144814	0,0018047
2	8	0,0012087	0,00152518	0,00128174	0,0015480
2	9	0,0011225	0,00143944	0,00121457	0,0014233
2	10	0,0009986	0,00138669	0,00119078	0,0013381
2	11	0,0009939	0,00136071	0,00112152	0,0013176
2	12	0,0009896	0,0013799	0,00111715	0,0013057
2	13	0,0010757	0,00139978	0,00114185	0,0013507
2	14	0,0010721	0,00143772	0,00116781	0,0013605

2	15	0,0010833	0,00146549	0,00119745	0,0013921
2	16	0,0010702	0,00146171	0,00123149	0,0013991
2	17	0,0010844	0,00146757	0,00123688	0,0014163
2	18	0,0010072	0,00147549	0,00123144	0,0013884
2	19	0,0010260	0,0014838	0,00128979	0,0013902
2	20	0,0010333	0,0014872	0,00129493	0,0013874
2	21	0,0011249	0,00150557	0,00131774	0,0014347
2	22	0,0011965	0,00158797	0,00134457	0,0015284
2	23	0,0012333	0,00163563	0,00137072	0,0015819
3	0	0,0015393	0,00185038	0,00153678	0,0018552
3	1	0,0015601	0,00185275	0,00155868	0,0018722
3	2	0,0015523	0,00185439	0,0015531	0,0018714
3	3	0,0015601	0,00186736	0,00155778	0,0018716
3	4	0,0015489	0,00185138	0,00153768	0,0018594
3	5	0,0015415	0,00181917	0,00151445	0,0018331
3	6	0,0015154	0,00178611	0,00146363	0,0017743
3	7	0,0014731	0,00172221	0,00142443	0,0017219
3	8	0,0011825	0,0015032	0,001262	0,0014680
3	9	0,0010917	0,00137503	0,0011732	0,0013430
3	10	0,0009713	0,00131425	0,00110982	0,0012767
3	11	0,0009645	0,00131212	0,00107137	0,0012598
3	12	0,0009467	0,00131894	0,00107647	0,0012650
3	13	0,0010219	0,00133576	0,00108819	0,0013002
3	14	0,0010277	0,00136343	0,00113606	0,0013155
3	15	0,0010491	0,00142016	0,0011767	0,0013542
3	16	0,0010422	0,00142312	0,00118001	0,0013386
3	17	0,0010447	0,00142945	0,00119485	0,0013494
3	18	0,0009787	0,00144061	0,00120148	0,0013335
3	19	0,0009859	0,00147096	0,00125736	0,0013356
3	20	0,0009873	0,00148046	0,00126739	0,0013453
3	21	0,0010968	0,00148734	0,00127394	0,0013851
3	22	0,0011532	0,00153095	0,00130126	0,0014570
3	23	0,0011890	0,00156184	0,0013346	0,0015188
4	0	0,0015250	0,00178307	0,00150709	0,0018166
4	1	0,0015329	0,00180449	0,00152639	0,0018249
4	2	0,0015300	0,00178852	0,00152165	0,0018252
4	3	0,0015040	0,00176825	0,00151042	0,0018252
4	4	0,0015055	0,00175841	0,00150389	0,0018025
4	5	0,0014857	0,00173202	0,00147122	0,0017879
4	6	0,0014343	0,00169248	0,0014166	0,0017432
4	7	0,0013817	0,00161001	0,00136044	0,0016569
4	8	0,0011032	0,00141669	0,00119634	0,0013843
4	9	0,0010247	0,00133211	0,00113991	0,0012899

4	10	0,0009086	0,00127098	0,00108833	0,0012011
4	11	0,0008939	0,00124764	0,0010133	0,0011768
4	12	0,0009052	0,00126201	0,00103347	0,0011889
4	13	0,0009690	0,00130846	0,00105672	0,0012745
4	14	0,0009859	0,00132167	0,00108667	0,0013112
4	15	0,0010077	0,00136972	0,00112649	0,0013427
4	16	0,0010061	0,0013944	0,00116171	0,0013605
4	17	0,0010394	0,00141391	0,00119188	0,0013809
4	18	0,0009839	0,00142966	0,001221	0,0013881
4	19	0,0010057	0,00146044	0,00127391	0,0014032
4	20	0,0010118	0,00148265	0,00131422	0,0013953
4	21	0,0011162	0,00149662	0,00132534	0,0014351
4	22	0,0011705	0,00155155	0,00135307	0,0015069
4	23	0,0012087	0,00158681	0,00139266	0,0015780
5	0	0,0015629	0,00179411	0,00157022	0,0017554
5	1	0,0015817	0,0017964	0,00157844	0,0017765
5	2	0,0015779	0,00180537	0,00156459	0,0017798
5	3	0,0015719	0,00179651	0,00157488	0,0017753
5	4	0,0015667	0,00177946	0,00156976	0,0017610
5	5	0,0015625	0,00176639	0,00154217	0,0017436
5	6	0,0015431	0,00175714	0,00150266	0,0017080
5	7	0,0014929	0,00169479	0,00147267	0,0016806
5	8	0,0012531	0,00150751	0,0013083	0,0014722
5	9	0,0011762	0,00141914	0,00124056	0,0013683
5	10	0,0010601	0,00137756	0,00120939	0,0013065
5	11	0,0010544	0,0013701	0,00114783	0,0012843
5	12	0,0010632	0,00136313	0,00114095	0,0012930
5	13	0,0011302	0,00139505	0,00116827	0,0013517
5	14	0,0011407	0,00143451	0,00118765	0,0013649
5	15	0,0011713	0,00147172	0,00123968	0,0014009
5	16	0,0011756	0,00149133	0,00125867	0,0013942
5	17	0,0011752	0,00149034	0,00127229	0,0014118
5	18	0,0010958	0,00150028	0,00128159	0,0013833
5	19	0,0011211	0,00150993	0,00131715	0,0013815
5	20	0,0011169	0,0015101	0,00133787	0,0013905
5	21	0,0012112	0,0015249	0,00134017	0,0014215
5	22	0,0012787	0,00159773	0,00137795	0,0015058
5	23	0,0013277	0,00164673	0,00141916	0,0015886
6	0	0,0014912	0,00192074	0,00158239	0,0017964
6	1	0,0015510	0,00194482	0,00160468	0,0018398
6	2	0,0015313	0,00195024	0,0016089	0,0018401
6	3	0,0015333	0,00196415	0,0015909	0,0018186
6	4	0,0015343	0,00194264	0,00160077	0,0018333

6	5	0,0015276	0,00194823	0,00158503	0,0018310
6	6	0,0015326	0,00193994	0,00155183	0,0018078
6	7	0,0015294	0,00194651	0,00156486	0,0018431
6	8	0,0015154	0,00192748	0,00155143	0,0018268
6	9	0,0014912	0,00188872	0,00154846	0,0017990
6	10	0,0014764	0,0018969	0,0015406	0,0017967
6	11	0,0014961	0,00190102	0,00154881	0,0017945
6	12	0,0014997	0,00189589	0,00154041	0,0017829
6	13	0,0014916	0,00191353	0,00153491	0,0017895
6	14	0,0014905	0,00190111	0,00151658	0,0017728
6	15	0,0014960	0,00192705	0,00154219	0,0017886
6	16	0,0015169	0,00192269	0,00154199	0,0017790
6	17	0,0015133	0,00193708	0,00155291	0,0017708
6	18	0,0015013	0,00191977	0,00154272	0,0017670
6	19	0,0015085	0,00190635	0,00154943	0,0017511
6	20	0,0014710	0,00189335	0,00152496	0,0017166
6	21	0,0014688	0,00188735	0,00154918	0,0017310
6	22	0,0014922	0,00191184	0,00153295	0,0017522
6	23	0,0014972	0,00192116	0,00155295	0,0017636
7	0	0,0015279	0,00179436	0,0017117	0,0017942
7	1	0,0015315	0,00180487	0,00170693	0,0018064
7	2	0,0015236	0,001672	0,00169939	0,0018143
7	3	0,0015292	0,0018131	0,00169238	0,0018067
7	4	0,0015170	0,00162827	0,00169514	0,0017870
7	5	0,0015010	0,00177243	0,00166581	0,0017721
7	6	0,0014982	0,00174933	0,00164562	0,0017533
7	7	0,0014943	0,00174821	0,00162835	0,0017481
7	8	0,0014927	0,00173823	0,00162405	0,0017405
7	9	0,0014931	0,00171932	0,00162396	0,0017263
7	10	0,0014480	0,00169679	0,00160476	0,0017260
7	11	0,0014624	0,00169965	0,00159939	0,0017442
7	12	0,0014646	0,00170527	0,00160014	0,0017227
7	13	0,0014616	0,00171488	0,00160699	0,0017086
7	14	0,0014927	0,00172166	0,00162489	0,0017331
7	15	0,0014915	0,0017295	0,00164722	0,0017555
7	16	0,0015056	0,00173978	0,00166001	0,0017485
7	17	0,0014890	0,00173031	0,00165268	0,0017565
7	18	0,0015000	0,00174889	0,00166318	0,0017525
7	19	0,0015006	0,00174753	0,00165109	0,0017510
7	20	0,0014949	0,00175907	0,00163788	0,0017452
7	21	0,0014764	0,0017517	0,00166755	0,0017551
7	22	0,0014956	0,00177975	0,00165294	0,0017672
7	23	0,0015161	0,00178436	0,00166817	0,0017872

Figure 42. Electricity Demand profile. Subsector: Steel and Foundry

WOOD

Day	Hour	Winter	Spring	Summer	Fall
1	0	0,0013106	0,00161082	0,00140145	0,0017502
1	1	0,0013164	0,00161265	0,00140568	0,0017563
1	2	0,0013181	0,0016062	0,00139783	0,0017470
1	3	0,0013180	0,00161699	0,00140187	0,0017558
1	4	0,0013198	0,00161875	0,00140068	0,0017467
1	5	0,0013089	0,00160303	0,00138278	0,0017164
1	6	0,0013313	0,00162228	0,00138762	0,0017231
1	7	0,0013658	0,00165856	0,00140641	0,0017643
1	8	0,0013586	0,00164481	0,00138218	0,0017407
1	9	0,0013334	0,00161309	0,00135503	0,0016939
1	10	0,0012938	0,00156697	0,00132806	0,0016584
1	11	0,0012851	0,0015424	0,00132142	0,0016424
1	12	0,0012636	0,00154274	0,00132899	0,0016367
1	13	0,0012779	0,00153026	0,00133674	0,0016480
1	14	0,0012927	0,00153832	0,00133109	0,0016501
1	15	0,0013123	0,00157599	0,00131296	0,0016722
1	16	0,0013044	0,00157372	0,00131008	0,0016745
1	17	0,0012998	0,0015761	0,00130801	0,0016832
1	18	0,0013066	0,00158537	0,00131869	0,0016906
1	19	0,0013225	0,00159968	0,00132761	0,0017060
1	20	0,0013377	0,00160784	0,00133774	0,0017169
1	21	0,0013389	0,00160547	0,00133541	0,0017014
1	22	0,0013282	0,00159533	0,00131924	0,0016880
1	23	0,0013567	0,00162744	0,00134329	0,0017213
2	0	0,0013777	0,00163775	0,00135104	0,0017331
2	1	0,0013864	0,00166281	0,00135618	0,0017338
2	2	0,0013783	0,00164831	0,00134753	0,0017188
2	3	0,0013872	0,00165932	0,00132919	0,0017350
2	4	0,0013860	0,00165599	0,00132679	0,0017308
2	5	0,0013724	0,00164203	0,00131169	0,0017120
2	6	0,0013639	0,00161376	0,00129869	0,0016898
2	7	0,0013737	0,00162616	0,00131304	0,0016987
2	8	0,0013609	0,00160237	0,00128782	0,0016605
2	9	0,0013375	0,00154768	0,00125119	0,0015879
2	10	0,0013066	0,00150543	0,00123454	0,0015231

2	11	0,0012988	0,00148928	0,00123368	0,0015078
2	12	0,0012924	0,00149645	0,00123649	0,0015228
2	13	0,0012905	0,00150558	0,00126988	0,0015330
2	14	0,0012729	0,00152335	0,0012731	0,0015458
2	15	0,0012925	0,00154268	0,00129205	0,0015639
2	16	0,0013065	0,00153757	0,00130165	0,0015853
2	17	0,0012959	0,0015485	0,00130891	0,0016007
2	18	0,0013135	0,00156166	0,00131291	0,0016000
2	19	0,0013339	0,00156877	0,00132456	0,0016141
2	20	0,0013496	0,00158458	0,00133094	0,0016314
2	21	0,0013445	0,00158512	0,00133772	0,0016276
2	22	0,0013307	0,00158125	0,00132898	0,0016077
2	23	0,0013649	0,00161327	0,00134758	0,0016383
3	0	0,0013730	0,00162771	0,00134976	0,0016595
3	1	0,0013841	0,00162254	0,00136257	0,0016694
3	2	0,0013733	0,00162042	0,00135962	0,0016590
3	3	0,0013804	0,00164343	0,00136588	0,0016686
3	4	0,0013823	0,00164109	0,00135819	0,0016724
3	5	0,0013559	0,00162171	0,00133465	0,0016496
3	6	0,0013385	0,00158939	0,00132722	0,0016315
3	7	0,0013516	0,00159796	0,00134327	0,0016412
3	8	0,0013287	0,00155824	0,00132682	0,0016126
3	9	0,0012968	0,00150554	0,00129666	0,0015716
3	10	0,0012408	0,0014619	0,00127159	0,0015349
3	11	0,0012365	0,0014635	0,00128558	0,0015117
3	12	0,0012305	0,00147891	0,00128867	0,0015120
3	13	0,0012375	0,0014883	0,00128038	0,0015275
3	14	0,0012526	0,00149162	0,00131136	0,0015427
3	15	0,0012814	0,00154155	0,00133414	0,0015715
3	16	0,0012812	0,00155192	0,00132562	0,0015813
3	17	0,0012793	0,00156731	0,00133051	0,0015952
3	18	0,0012962	0,0015762	0,00133858	0,0015962
3	19	0,0013124	0,00158719	0,0013502	0,0016200
3	20	0,0013352	0,0016066	0,0013648	0,0016340
3	21	0,0013404	0,00161159	0,00136816	0,0016329
3	22	0,0013330	0,00159947	0,00136	0,0016188
3	23	0,0013580	0,00163124	0,00138441	0,0016412
4	0	0,0013830	0,00164759	0,00139219	0,0016581
4	1	0,0013880	0,00166296	0,00139901	0,0016638
4	2	0,0013786	0,0016519	0,00139478	0,0016521
4	3	0,0013648	0,00166079	0,00140581	0,0016604
4	4	0,0013685	0,00166404	0,00140963	0,0016606
4	5	0,0013575	0,00164675	0,00139796	0,0016418

4	6	0,0013340	0,00162068	0,00139084	0,0016157
4	7	0,0013396	0,00162815	0,0014091	0,0016412
4	8	0,0013027	0,00156985	0,00137869	0,0015743
4	9	0,0012513	0,00151175	0,00134791	0,0015002
4	10	0,0012167	0,00146732	0,0013204	0,0014719
4	11	0,0012155	0,00146915	0,00132826	0,0014947
4	12	0,0012234	0,00148341	0,0013259	0,0015002
4	13	0,0012209	0,00149004	0,00133195	0,0015479
4	14	0,0012295	0,00150073	0,00133932	0,0015477
4	15	0,0012445	0,00154516	0,00136787	0,0015697
4	16	0,0012527	0,00156021	0,00137127	0,0015829
4	17	0,0012795	0,00156694	0,00138028	0,0016057
4	18	0,0012869	0,00156242	0,00138072	0,0016148
4	19	0,0013050	0,00157572	0,00139116	0,0016368
4	20	0,0013345	0,00160409	0,0014026	0,0016709
4	21	0,0013317	0,0016157	0,00140012	0,0016567
4	22	0,0013233	0,00160817	0,00138322	0,0016453
4	23	0,0013446	0,00163465	0,00141078	0,0016733
5	0	0,0013886	0,00165954	0,001421	0,0016374
5	1	0,0013974	0,00167392	0,00143029	0,0016586
5	2	0,0013937	0,00165996	0,00141999	0,0016464
5	3	0,0014031	0,00165651	0,00143464	0,0016563
5	4	0,0013970	0,00167034	0,00142987	0,0016580
5	5	0,0013817	0,00165243	0,00141645	0,0016266
5	6	0,0013667	0,00162986	0,00140173	0,0016075
5	7	0,0013943	0,00164858	0,00141995	0,0016343
5	8	0,0013819	0,00163111	0,0014012	0,0016433
5	9	0,0013615	0,0015905	0,00138227	0,0016127
5	10	0,0013313	0,00156011	0,00134782	0,0015833
5	11	0,0013259	0,00156021	0,0013408	0,0015805
5	12	0,0013276	0,00156862	0,00133828	0,0015876
5	13	0,0013256	0,0015784	0,001362	0,0015895
5	14	0,0013433	0,0015807	0,00136089	0,0015966
5	15	0,0013646	0,00161181	0,00139146	0,0016210
5	16	0,0013777	0,0016253	0,00139753	0,0016165
5	17	0,0013818	0,00163458	0,00139894	0,0016389
5	18	0,0013934	0,00163463	0,00137729	0,0016334
5	19	0,0014119	0,00164937	0,00139175	0,0016521
5	20	0,0014203	0,00165488	0,00140927	0,0016729
5	21	0,0014010	0,00164538	0,001403	0,0016603
5	22	0,0013816	0,00162737	0,00138791	0,0016325
5	23	0,0014038	0,00165766	0,00140939	0,0016533
6	0	0,0013185	0,00177656	0,00141572	0,0016721

6	1	0,0013238	0,00178807	0,00143083	0,0016831
6	2	0,0013187	0,00178344	0,00142235	0,0016773
6	3	0,0013218	0,00179887	0,00143114	0,0016889
6	4	0,0013227	0,001791	0,00142739	0,0016906
6	5	0,0013149	0,00176728	0,00141307	0,0016691
6	6	0,0012978	0,00174499	0,00140271	0,0016463
6	7	0,0013138	0,00176349	0,00141984	0,0016580
6	8	0,0013220	0,00176488	0,00142076	0,0016518
6	9	0,0013147	0,00176551	0,00142071	0,0016422
6	10	0,0012994	0,00174538	0,00140628	0,0016367
6	11	0,0013066	0,00175641	0,0014254	0,0016467
6	12	0,0013081	0,0017467	0,00141578	0,0016401
6	13	0,0012758	0,00172096	0,00140279	0,0016195
6	14	0,0012601	0,00170252	0,0013867	0,0016037
6	15	0,0012798	0,0017224	0,00139841	0,0016228
6	16	0,0012939	0,00172069	0,001401	0,0016257
6	17	0,0012977	0,00173146	0,00139514	0,0016266
6	18	0,0012986	0,00172567	0,00138556	0,0016203
6	19	0,0013083	0,00172902	0,00139311	0,0016351
6	20	0,0013085	0,0017336	0,00140108	0,0016502
6	21	0,0012905	0,00172507	0,00139799	0,0016384
6	22	0,0012850	0,0017026	0,00139527	0,0016329
6	23	0,0013066	0,00172733	0,00140915	0,0016530
7	0	0,0013058	0,00160474	0,00153243	0,0016510
7	1	0,0013136	0,00161282	0,00153659	0,0016561
7	2	0,0013073	0,00148526	0,00152849	0,0016497
7	3	0,0013181	0,00162371	0,00153684	0,0016595
7	4	0,0013095	0,00149088	0,00154242	0,0016574
7	5	0,0013028	0,0015975	0,00152125	0,0016347
7	6	0,0012850	0,00158512	0,00150925	0,0016160
7	7	0,0012982	0,00160849	0,00153276	0,0016394
7	8	0,0013001	0,00160184	0,00152885	0,0016392
7	9	0,0012991	0,00158917	0,00151147	0,0016290
7	10	0,0012892	0,00157919	0,00149634	0,0016080
7	11	0,0012903	0,00159275	0,00150884	0,0016192
7	12	0,0012923	0,00159102	0,0015127	0,0016175
7	13	0,0012806	0,00157354	0,00150343	0,0015849
7	14	0,0012681	0,00156028	0,00149615	0,0015721
7	15	0,0012919	0,00158525	0,00152007	0,0015934
7	16	0,0012935	0,00158362	0,0015178	0,0016007
7	17	0,0012937	0,00157746	0,00151515	0,0016041
7	18	0,0012974	0,00157452	0,00150858	0,0016014
7	19	0,0013036	0,00158175	0,00151631	0,0016148

7	20	0,0012975	0,00159241	0,00151833	0,0016240
7	21	0,0012872	0,00158625	0,00151156	0,0016073
7	22	0,0012835	0,00157686	0,00150982	0,0015997
7	23	0,0013103	0,00160283	0,00153145	0,0016216

Figure 43. Electricity Demand profile. Subsector: Wood.

ANNEX V. GAS DEMAND PROFILES (24 HOURS X 7 DAYS X 4 SEASONS)

FOOD AND BEVERAGES

Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0016248	0,0015558	0,0016404	0,0016898
1	1	0,0016248	0,0015558	0,0016404	0,0016898
1	2	0,0016248	0,0015558	0,0016404	0,0016898
1	3	0,0016248	0,0015558	0,0016404	0,0016898
1	4	0,0016248	0,0015558	0,0016404	0,0016898
1	5	0,0016248	0,0015558	0,0016404	0,0016898
1	6	0,0016248	0,0015558	0,0016404	0,0016898
1	7	0,0016248	0,0015558	0,0016404	0,0016898
1	8	0,0016248	0,0015558	0,0016404	0,0016898
1	9	0,0016248	0,0015558	0,0016404	0,0016898
1	10	0,0016248	0,0015558	0,0016404	0,0016898
1	11	0,0016248	0,0015558	0,0016404	0,0016898
1	12	0,0016248	0,0015558	0,0016404	0,0016898
1	13	0,0016248	0,0015558	0,0016404	0,0016898
1	14	0,0016248	0,0015558	0,0016404	0,0016898
1	15	0,0016248	0,0015558	0,0016404	0,0016898
1	16	0,0016248	0,0015558	0,0016404	0,0016898
1	17	0,0016248	0,0015558	0,0016404	0,0016898
1	18	0,0016248	0,0015558	0,0016404	0,0016898
1	19	0,0016248	0,0015558	0,0016404	0,0016898
1	20	0,0016248	0,0015558	0,0016404	0,0016898
1	21	0,0016248	0,0015558	0,0016404	0,0016898
1	22	0,0016248	0,0015558	0,0016404	0,0016898
1	23	0,0016248	0,0015558	0,0016404	0,0016898
2	0	0,0016824	0,0016022	0,0016801	0,0017512
2	1	0,0016824	0,0016022	0,0016801	0,0017512
2	2	0,0016824	0,0016022	0,0016801	0,0017512
2	3	0,0016824	0,0016022	0,0016801	0,0017512
2	4	0,0016824	0,0016022	0,0016801	0,0017512
2	5	0,0016824	0,0016022	0,0016801	0,0017512
2	6	0,0016824	0,0016022	0,0016801	0,0017512

2	7	0,0016824	0,0016022	0,0016801	0,0017512
2	8	0,0016824	0,0016022	0,0016801	0,0017512
2	9	0,0016824	0,0016022	0,0016801	0,0017512
2	10	0,0016824	0,0016022	0,0016801	0,0017512
2	11	0,0016824	0,0016022	0,0016801	0,0017512
2	12	0,0016824	0,0016022	0,0016801	0,0017512
2	13	0,0016824	0,0016022	0,0016801	0,0017512
2	14	0,0016824	0,0016022	0,0016801	0,0017512
2	15	0,0016824	0,0016022	0,0016801	0,0017512
2	16	0,0016824	0,0016022	0,0016801	0,0017512
2	17	0,0016824	0,0016022	0,0016801	0,0017512
2	18	0,0016824	0,0016022	0,0016801	0,0017512
2	19	0,0016824	0,0016022	0,0016801	0,0017512
2	20	0,0016824	0,0016022	0,0016801	0,0017512
2	21	0,0016824	0,0016022	0,0016801	0,0017512
2	22	0,0016824	0,0016022	0,0016801	0,0017512
2	23	0,0016824	0,0016022	0,0016801	0,0017512
3	0	0,0016384	0,0015852	0,0016732	0,0017809
3	1	0,0016384	0,0015852	0,0016732	0,0017809
3	2	0,0016384	0,0015852	0,0016732	0,0017809
3	3	0,0016384	0,0015852	0,0016732	0,0017809
3	4	0,0016384	0,0015852	0,0016732	0,0017809
3	5	0,0016384	0,0015852	0,0016732	0,0017809
3	6	0,0016384	0,0015852	0,0016732	0,0017809
3	7	0,0016384	0,0015852	0,0016732	0,0017809
3	8	0,0016384	0,0015852	0,0016732	0,0017809
3	9	0,0016384	0,0015852	0,0016732	0,0017809
3	10	0,0016384	0,0015852	0,0016732	0,0017809
3	11	0,0016384	0,0015852	0,0016732	0,0017809
3	12	0,0016384	0,0015852	0,0016732	0,0017809
3	13	0,0016384	0,0015852	0,0016732	0,0017809
3	14	0,0016384	0,0015852	0,0016732	0,0017809
3	15	0,0016384	0,0015852	0,0016732	0,0017809
3	16	0,0016384	0,0015852	0,0016732	0,0017809
3	17	0,0016384	0,0015852	0,0016732	0,0017809
3	18	0,0016384	0,0015852	0,0016732	0,0017809
3	19	0,0016384	0,0015852	0,0016732	0,0017809
3	20	0,0016384	0,0015852	0,0016732	0,0017809
3	21	0,0016384	0,0015852	0,0016732	0,0017809
3	22	0,0016384	0,0015852	0,0016732	0,0017809
3	23	0,0016384	0,0015852	0,0016732	0,0017809
4	0	0,0015133	0,0016569	0,0016408	0,0017429
4	1	0,0015133	0,0016569	0,0016408	0,0017429

4	2	0,0015133	0,0016569	0,0016408	0,0017429
4	3	0,0015133	0,0016569	0,0016408	0,0017429
4	4	0,0015133	0,0016569	0,0016408	0,0017429
4	5	0,0015133	0,0016569	0,0016408	0,0017429
4	6	0,0015133	0,0016569	0,0016408	0,0017429
4	7	0,0015133	0,0016569	0,0016408	0,0017429
4	8	0,0015133	0,0016569	0,0016408	0,0017429
4	9	0,0015133	0,0016569	0,0016408	0,0017429
4	10	0,0015133	0,0016569	0,0016408	0,0017429
4	11	0,0015133	0,0016569	0,0016408	0,0017429
4	12	0,0015133	0,0016569	0,0016408	0,0017429
4	13	0,0015133	0,0016569	0,0016408	0,0017429
4	14	0,0015133	0,0016569	0,0016408	0,0017429
4	15	0,0015133	0,0016569	0,0016408	0,0017429
4	16	0,0015133	0,0016569	0,0016408	0,0017429
4	17	0,0015133	0,0016569	0,0016408	0,0017429
4	18	0,0015133	0,0016569	0,0016408	0,0017429
4	19	0,0015133	0,0016569	0,0016408	0,0017429
4	20	0,0015133	0,0016569	0,0016408	0,0017429
4	21	0,0015133	0,0016569	0,0016408	0,0017429
4	22	0,0015133	0,0016569	0,0016408	0,0017429
4	23	0,0015133	0,0016569	0,0016408	0,0017429
5	0	0,0014350	0,0013358	0,0015631	0,0014921
5	1	0,0014350	0,0013358	0,0015631	0,0014921
5	2	0,0014350	0,0013358	0,0015631	0,0014921
5	3	0,0014350	0,0013358	0,0015631	0,0014921
5	4	0,0014350	0,0013358	0,0015631	0,0014921
5	5	0,0014350	0,0013358	0,0015631	0,0014921
5	6	0,0014350	0,0013358	0,0015631	0,0014921
5	7	0,0014350	0,0013358	0,0015631	0,0014921
5	8	0,0014350	0,0013358	0,0015631	0,0014921
5	9	0,0014350	0,0013358	0,0015631	0,0014921
5	10	0,0014350	0,0013358	0,0015631	0,0014921
5	11	0,0014350	0,0013358	0,0015631	0,0014921
5	12	0,0014350	0,0013358	0,0015631	0,0014921
5	13	0,0014350	0,0013358	0,0015631	0,0014921
5	14	0,0014350	0,0013358	0,0015631	0,0014921
5	15	0,0014350	0,0013358	0,0015631	0,0014921
5	16	0,0014350	0,0013358	0,0015631	0,0014921
5	17	0,0014350	0,0013358	0,0015631	0,0014921
5	18	0,0014350	0,0013358	0,0015631	0,0014921
5	19	0,0014350	0,0013358	0,0015631	0,0014921
5	20	0,0014350	0,0013358	0,0015631	0,0014921

5	21	0,0014350	0,0013358	0,0015631	0,0014921
5	22	0,0014350	0,0013358	0,0015631	0,0014921
5	23	0,0014350	0,0013358	0,0015631	0,0014921
6	0	0,0011250	0,0010289	0,0011513	0,0011756
6	1	0,0011250	0,0010289	0,0011513	0,0011756
6	2	0,0011250	0,0010289	0,0011513	0,0011756
6	3	0,0011250	0,0010289	0,0011513	0,0011756
6	4	0,0011250	0,0010289	0,0011513	0,0011756
6	5	0,0011250	0,0010289	0,0011513	0,0011756
6	6	0,0011250	0,0010289	0,0011513	0,0011756
6	7	0,0011250	0,0010289	0,0011513	0,0011756
6	8	0,0011250	0,0010289	0,0011513	0,0011756
6	9	0,0011250	0,0010289	0,0011513	0,0011756
6	10	0,0011250	0,0010289	0,0011513	0,0011756
6	11	0,0011250	0,0010289	0,0011513	0,0011756
6	12	0,0011250	0,0010289	0,0011513	0,0011756
6	13	0,0011250	0,0010289	0,0011513	0,0011756
6	14	0,0011250	0,0010289	0,0011513	0,0011756
6	15	0,0011250	0,0010289	0,0011513	0,0011756
6	16	0,0011250	0,0010289	0,0011513	0,0011756
6	17	0,0011250	0,0010289	0,0011513	0,0011756
6	18	0,0011250	0,0010289	0,0011513	0,0011756
6	19	0,0011250	0,0010289	0,0011513	0,0011756
6	20	0,0011250	0,0010289	0,0011513	0,0011756
6	21	0,0011250	0,0010289	0,0011513	0,0011756
6	22	0,0011250	0,0010289	0,0011513	0,0011756
6	23	0,0011250	0,0010289	0,0011513	0,0011756
7	0	0,0011254	0,0011674	0,0012980	0,0013109
7	1	0,0011254	0,0011674	0,0012980	0,0013109
7	2	0,0011254	0,0011674	0,0012980	0,0013109
7	3	0,0011254	0,0011674	0,0012980	0,0013109
7	4	0,0011254	0,0011674	0,0012980	0,0013109
7	5	0,0011254	0,0011674	0,0012980	0,0013109
7	6	0,0011254	0,0011674	0,0012980	0,0013109
7	7	0,0011254	0,0011674	0,0012980	0,0013109
7	8	0,0011254	0,0011674	0,0012980	0,0013109
7	9	0,0011254	0,0011674	0,0012980	0,0013109
7	10	0,0011254	0,0011674	0,0012980	0,0013109
7	11	0,0011254	0,0011674	0,0012980	0,0013109
7	12	0,0011254	0,0011674	0,0012980	0,0013109
7	13	0,0011254	0,0011674	0,0012980	0,0013109
7	14	0,0011254	0,0011674	0,0012980	0,0013109
7	15	0,0011254	0,0011674	0,0012980	0,0013109

7	16	0,0011254	0,0011674	0,0012980	0,0013109
7	17	0,0011254	0,0011674	0,0012980	0,0013109
7	18	0,0011254	0,0011674	0,0012980	0,0013109
7	19	0,0011254	0,0011674	0,0012980	0,0013109
7	20	0,0011254	0,0011674	0,0012980	0,0013109
7	21	0,0011254	0,0011674	0,0012980	0,0013109
7	22	0,0011254	0,0011674	0,0012980	0,0013109
7	23	0,0011254	0,0011674	0,0012980	0,0013109

Figure 44. Gas Demand profile. Subsector: Food and beverages.

METALLURGY

Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0016166	0,0015657	0,0013821	0,0016428
1	1	0,0016166	0,0015657	0,0013821	0,0016428
1	2	0,0016166	0,0015657	0,0013821	0,0016428
1	3	0,0016166	0,0015657	0,0013821	0,0016428
1	4	0,0016166	0,0015657	0,0013821	0,0016428
1	5	0,0016166	0,0015657	0,0013821	0,0016428
1	6	0,0016166	0,0015657	0,0013821	0,0016428
1	7	0,0016166	0,0015657	0,0013821	0,0016428
1	8	0,0016166	0,0015657	0,0013821	0,0016428
1	9	0,0016166	0,0015657	0,0013821	0,0016428
1	10	0,0016166	0,0015657	0,0013821	0,0016428
1	11	0,0016166	0,0015657	0,0013821	0,0016428
1	12	0,0016166	0,0015657	0,0013821	0,0016428
1	13	0,0016166	0,0015657	0,0013821	0,0016428
1	14	0,0016166	0,0015657	0,0013821	0,0016428
1	15	0,0016166	0,0015657	0,0013821	0,0016428
1	16	0,0016166	0,0015657	0,0013821	0,0016428
1	17	0,0016166	0,0015657	0,0013821	0,0016428
1	18	0,0016166	0,0015657	0,0013821	0,0016428
1	19	0,0016166	0,0015657	0,0013821	0,0016428
1	20	0,0016166	0,0015657	0,0013821	0,0016428
1	21	0,0016166	0,0015657	0,0013821	0,0016428
1	22	0,0016166	0,0015657	0,0013821	0,0016428
1	23	0,0016166	0,0015657	0,0013821	0,0016428
2	0	0,0016349	0,0015498	0,0013875	0,0016407
2	1	0,0016349	0,0015498	0,0013875	0,0016407
2	2	0,0016349	0,0015498	0,0013875	0,0016407
2	3	0,0016349	0,0015498	0,0013875	0,0016407
2	4	0,0016349	0,0015498	0,0013875	0,0016407

2	5	0,0016349	0,0015498	0,0013875	0,0016407
2	6	0,0016349	0,0015498	0,0013875	0,0016407
2	7	0,0016349	0,0015498	0,0013875	0,0016407
2	8	0,0016349	0,0015498	0,0013875	0,0016407
2	9	0,0016349	0,0015498	0,0013875	0,0016407
2	10	0,0016349	0,0015498	0,0013875	0,0016407
2	11	0,0016349	0,0015498	0,0013875	0,0016407
2	12	0,0016349	0,0015498	0,0013875	0,0016407
2	13	0,0016349	0,0015498	0,0013875	0,0016407
2	14	0,0016349	0,0015498	0,0013875	0,0016407
2	15	0,0016349	0,0015498	0,0013875	0,0016407
2	16	0,0016349	0,0015498	0,0013875	0,0016407
2	17	0,0016349	0,0015498	0,0013875	0,0016407
2	18	0,0016349	0,0015498	0,0013875	0,0016407
2	19	0,0016349	0,0015498	0,0013875	0,0016407
2	20	0,0016349	0,0015498	0,0013875	0,0016407
2	21	0,0016349	0,0015498	0,0013875	0,0016407
2	22	0,0016349	0,0015498	0,0013875	0,0016407
2	23	0,0016349	0,0015498	0,0013875	0,0016407
3	0	0,0015939	0,0015336	0,0013681	0,0016314
3	1	0,0015939	0,0015336	0,0013681	0,0016314
3	2	0,0015939	0,0015336	0,0013681	0,0016314
3	3	0,0015939	0,0015336	0,0013681	0,0016314
3	4	0,0015939	0,0015336	0,0013681	0,0016314
3	5	0,0015939	0,0015336	0,0013681	0,0016314
3	6	0,0015939	0,0015336	0,0013681	0,0016314
3	7	0,0015939	0,0015336	0,0013681	0,0016314
3	8	0,0015939	0,0015336	0,0013681	0,0016314
3	9	0,0015939	0,0015336	0,0013681	0,0016314
3	10	0,0015939	0,0015336	0,0013681	0,0016314
3	11	0,0015939	0,0015336	0,0013681	0,0016314
3	12	0,0015939	0,0015336	0,0013681	0,0016314
3	13	0,0015939	0,0015336	0,0013681	0,0016314
3	14	0,0015939	0,0015336	0,0013681	0,0016314
3	15	0,0015939	0,0015336	0,0013681	0,0016314
3	16	0,0015939	0,0015336	0,0013681	0,0016314
3	17	0,0015939	0,0015336	0,0013681	0,0016314
3	18	0,0015939	0,0015336	0,0013681	0,0016314
3	19	0,0015939	0,0015336	0,0013681	0,0016314
3	20	0,0015939	0,0015336	0,0013681	0,0016314
3	21	0,0015939	0,0015336	0,0013681	0,0016314
3	22	0,0015939	0,0015336	0,0013681	0,0016314
3	23	0,0015939	0,0015336	0,0013681	0,0016314

4	0	0,0014633	0,0016683	0,0013783	0,0016360
4	1	0,0014633	0,0016683	0,0013783	0,0016360
4	2	0,0014633	0,0016683	0,0013783	0,0016360
4	3	0,0014633	0,0016683	0,0013783	0,0016360
4	4	0,0014633	0,0016683	0,0013783	0,0016360
4	5	0,0014633	0,0016683	0,0013783	0,0016360
4	6	0,0014633	0,0016683	0,0013783	0,0016360
4	7	0,0014633	0,0016683	0,0013783	0,0016360
4	8	0,0014633	0,0016683	0,0013783	0,0016360
4	9	0,0014633	0,0016683	0,0013783	0,0016360
4	10	0,0014633	0,0016683	0,0013783	0,0016360
4	11	0,0014633	0,0016683	0,0013783	0,0016360
4	12	0,0014633	0,0016683	0,0013783	0,0016360
4	13	0,0014633	0,0016683	0,0013783	0,0016360
4	14	0,0014633	0,0016683	0,0013783	0,0016360
4	15	0,0014633	0,0016683	0,0013783	0,0016360
4	16	0,0014633	0,0016683	0,0013783	0,0016360
4	17	0,0014633	0,0016683	0,0013783	0,0016360
4	18	0,0014633	0,0016683	0,0013783	0,0016360
4	19	0,0014633	0,0016683	0,0013783	0,0016360
4	20	0,0014633	0,0016683	0,0013783	0,0016360
4	21	0,0014633	0,0016683	0,0013783	0,0016360
4	22	0,0014633	0,0016683	0,0013783	0,0016360
4	23	0,0014633	0,0016683	0,0013783	0,0016360
5	0	0,0014536	0,0014594	0,0014365	0,0015466
5	1	0,0014536	0,0014594	0,0014365	0,0015466
5	2	0,0014536	0,0014594	0,0014365	0,0015466
5	3	0,0014536	0,0014594	0,0014365	0,0015466
5	4	0,0014536	0,0014594	0,0014365	0,0015466
5	5	0,0014536	0,0014594	0,0014365	0,0015466
5	6	0,0014536	0,0014594	0,0014365	0,0015466
5	7	0,0014536	0,0014594	0,0014365	0,0015466
5	8	0,0014536	0,0014594	0,0014365	0,0015466
5	9	0,0014536	0,0014594	0,0014365	0,0015466
5	10	0,0014536	0,0014594	0,0014365	0,0015466
5	11	0,0014536	0,0014594	0,0014365	0,0015466
5	12	0,0014536	0,0014594	0,0014365	0,0015466
5	13	0,0014536	0,0014594	0,0014365	0,0015466
5	14	0,0014536	0,0014594	0,0014365	0,0015466
5	15	0,0014536	0,0014594	0,0014365	0,0015466
5	16	0,0014536	0,0014594	0,0014365	0,0015466
5	17	0,0014536	0,0014594	0,0014365	0,0015466
5	18	0,0014536	0,0014594	0,0014365	0,0015466

5	19	0,0014536	0,0014594	0,0014365	0,0015466
5	20	0,0014536	0,0014594	0,0014365	0,0015466
5	21	0,0014536	0,0014594	0,0014365	0,0015466
5	22	0,0014536	0,0014594	0,0014365	0,0015466
5	23	0,0014536	0,0014594	0,0014365	0,0015466
6	0	0,0014127	0,0013558	0,0012221	0,0014203
6	1	0,0014127	0,0013558	0,0012221	0,0014203
6	2	0,0014127	0,0013558	0,0012221	0,0014203
6	3	0,0014127	0,0013558	0,0012221	0,0014203
6	4	0,0014127	0,0013558	0,0012221	0,0014203
6	5	0,0014127	0,0013558	0,0012221	0,0014203
6	6	0,0014127	0,0013558	0,0012221	0,0014203
6	7	0,0014127	0,0013558	0,0012221	0,0014203
6	8	0,0014127	0,0013558	0,0012221	0,0014203
6	9	0,0014127	0,0013558	0,0012221	0,0014203
6	10	0,0014127	0,0013558	0,0012221	0,0014203
6	11	0,0014127	0,0013558	0,0012221	0,0014203
6	12	0,0014127	0,0013558	0,0012221	0,0014203
6	13	0,0014127	0,0013558	0,0012221	0,0014203
6	14	0,0014127	0,0013558	0,0012221	0,0014203
6	15	0,0014127	0,0013558	0,0012221	0,0014203
6	16	0,0014127	0,0013558	0,0012221	0,0014203
6	17	0,0014127	0,0013558	0,0012221	0,0014203
6	18	0,0014127	0,0013558	0,0012221	0,0014203
6	19	0,0014127	0,0013558	0,0012221	0,0014203
6	20	0,0014127	0,0013558	0,0012221	0,0014203
6	21	0,0014127	0,0013558	0,0012221	0,0014203
6	22	0,0014127	0,0013558	0,0012221	0,0014203
6	23	0,0014127	0,0013558	0,0012221	0,0014203
7	0	0,0014438	0,0014376	0,0012877	0,0014976
7	1	0,0014438	0,0014376	0,0012877	0,0014976
7	2	0,0014438	0,0014376	0,0012877	0,0014976
7	3	0,0014438	0,0014376	0,0012877	0,0014976
7	4	0,0014438	0,0014376	0,0012877	0,0014976
7	5	0,0014438	0,0014376	0,0012877	0,0014976
7	6	0,0014438	0,0014376	0,0012877	0,0014976
7	7	0,0014438	0,0014376	0,0012877	0,0014976
7	8	0,0014438	0,0014376	0,0012877	0,0014976
7	9	0,0014438	0,0014376	0,0012877	0,0014976
7	10	0,0014438	0,0014376	0,0012877	0,0014976
7	11	0,0014438	0,0014376	0,0012877	0,0014976
7	12	0,0014438	0,0014376	0,0012877	0,0014976
7	13	0,0014438	0,0014376	0,0012877	0,0014976

7	14	0,0014438	0,0014376	0,0012877	0,0014976
7	15	0,0014438	0,0014376	0,0012877	0,0014976
7	16	0,0014438	0,0014376	0,0012877	0,0014976
7	17	0,0014438	0,0014376	0,0012877	0,0014976
7	18	0,0014438	0,0014376	0,0012877	0,0014976
7	19	0,0014438	0,0014376	0,0012877	0,0014976
7	20	0,0014438	0,0014376	0,0012877	0,0014976
7	21	0,0014438	0,0014376	0,0012877	0,0014976
7	22	0,0014438	0,0014376	0,0012877	0,0014976
7	23	0,0014438	0,0014376	0,0012877	0,0014976

Figure 45. Gas Demand profile. Subsector: Metallurgy

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Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0016039	0,0015353	0,0014090	0,0015642
1	1	0,0016039	0,0015353	0,0014090	0,0015642
1	2	0,0016039	0,0015353	0,0014090	0,0015642
1	3	0,0016039	0,0015353	0,0014090	0,0015642
1	4	0,0016039	0,0015353	0,0014090	0,0015642
1	5	0,0016039	0,0015353	0,0014090	0,0015642
1	6	0,0016039	0,0015353	0,0014090	0,0015642
1	7	0,0016039	0,0015353	0,0014090	0,0015642
1	8	0,0016039	0,0015353	0,0014090	0,0015642
1	9	0,0016039	0,0015353	0,0014090	0,0015642
1	10	0,0016039	0,0015353	0,0014090	0,0015642
1	11	0,0016039	0,0015353	0,0014090	0,0015642
1	12	0,0016039	0,0015353	0,0014090	0,0015642
1	13	0,0016039	0,0015353	0,0014090	0,0015642
1	14	0,0016039	0,0015353	0,0014090	0,0015642
1	15	0,0016039	0,0015353	0,0014090	0,0015642
1	16	0,0016039	0,0015353	0,0014090	0,0015642
1	17	0,0016039	0,0015353	0,0014090	0,0015642
1	18	0,0016039	0,0015353	0,0014090	0,0015642
1	19	0,0016039	0,0015353	0,0014090	0,0015642
1	20	0,0016039	0,0015353	0,0014090	0,0015642
1	21	0,0016039	0,0015353	0,0014090	0,0015642
1	22	0,0016039	0,0015353	0,0014090	0,0015642
1	23	0,0016039	0,0015353	0,0014090	0,0015642
2	0	0,0015658	0,0015274	0,0014062	0,0015590

2	1	0,0015658	0,0015274	0,0014062	0,0015590
2	2	0,0015658	0,0015274	0,0014062	0,0015590
2	3	0,0015658	0,0015274	0,0014062	0,0015590
2	4	0,0015658	0,0015274	0,0014062	0,0015590
2	5	0,0015658	0,0015274	0,0014062	0,0015590
2	6	0,0015658	0,0015274	0,0014062	0,0015590
2	7	0,0015658	0,0015274	0,0014062	0,0015590
2	8	0,0015658	0,0015274	0,0014062	0,0015590
2	9	0,0015658	0,0015274	0,0014062	0,0015590
2	10	0,0015658	0,0015274	0,0014062	0,0015590
2	11	0,0015658	0,0015274	0,0014062	0,0015590
2	12	0,0015658	0,0015274	0,0014062	0,0015590
2	13	0,0015658	0,0015274	0,0014062	0,0015590
2	14	0,0015658	0,0015274	0,0014062	0,0015590
2	15	0,0015658	0,0015274	0,0014062	0,0015590
2	16	0,0015658	0,0015274	0,0014062	0,0015590
2	17	0,0015658	0,0015274	0,0014062	0,0015590
2	18	0,0015658	0,0015274	0,0014062	0,0015590
2	19	0,0015658	0,0015274	0,0014062	0,0015590
2	20	0,0015658	0,0015274	0,0014062	0,0015590
2	21	0,0015658	0,0015274	0,0014062	0,0015590
2	22	0,0015658	0,0015274	0,0014062	0,0015590
2	23	0,0015658	0,0015274	0,0014062	0,0015590
3	0	0,0015588	0,0015150	0,0013966	0,0015963
3	1	0,0015588	0,0015150	0,0013966	0,0015963
3	2	0,0015588	0,0015150	0,0013966	0,0015963
3	3	0,0015588	0,0015150	0,0013966	0,0015963
3	4	0,0015588	0,0015150	0,0013966	0,0015963
3	5	0,0015588	0,0015150	0,0013966	0,0015963
3	6	0,0015588	0,0015150	0,0013966	0,0015963
3	7	0,0015588	0,0015150	0,0013966	0,0015963
3	8	0,0015588	0,0015150	0,0013966	0,0015963
3	9	0,0015588	0,0015150	0,0013966	0,0015963
3	10	0,0015588	0,0015150	0,0013966	0,0015963
3	11	0,0015588	0,0015150	0,0013966	0,0015963
3	12	0,0015588	0,0015150	0,0013966	0,0015963
3	13	0,0015588	0,0015150	0,0013966	0,0015963
3	14	0,0015588	0,0015150	0,0013966	0,0015963
3	15	0,0015588	0,0015150	0,0013966	0,0015963
3	16	0,0015588	0,0015150	0,0013966	0,0015963
3	17	0,0015588	0,0015150	0,0013966	0,0015963
3	18	0,0015588	0,0015150	0,0013966	0,0015963
3	19	0,0015588	0,0015150	0,0013966	0,0015963

3	20	0,0015588	0,0015150	0,0013966	0,0015963
3	21	0,0015588	0,0015150	0,0013966	0,0015963
3	22	0,0015588	0,0015150	0,0013966	0,0015963
3	23	0,0015588	0,0015150	0,0013966	0,0015963
4	0	0,0014213	0,0016290	0,0014154	0,0015938
4	1	0,0014213	0,0016290	0,0014154	0,0015938
4	2	0,0014213	0,0016290	0,0014154	0,0015938
4	3	0,0014213	0,0016290	0,0014154	0,0015938
4	4	0,0014213	0,0016290	0,0014154	0,0015938
4	5	0,0014213	0,0016290	0,0014154	0,0015938
4	6	0,0014213	0,0016290	0,0014154	0,0015938
4	7	0,0014213	0,0016290	0,0014154	0,0015938
4	8	0,0014213	0,0016290	0,0014154	0,0015938
4	9	0,0014213	0,0016290	0,0014154	0,0015938
4	10	0,0014213	0,0016290	0,0014154	0,0015938
4	11	0,0014213	0,0016290	0,0014154	0,0015938
4	12	0,0014213	0,0016290	0,0014154	0,0015938
4	13	0,0014213	0,0016290	0,0014154	0,0015938
4	14	0,0014213	0,0016290	0,0014154	0,0015938
4	15	0,0014213	0,0016290	0,0014154	0,0015938
4	16	0,0014213	0,0016290	0,0014154	0,0015938
4	17	0,0014213	0,0016290	0,0014154	0,0015938
4	18	0,0014213	0,0016290	0,0014154	0,0015938
4	19	0,0014213	0,0016290	0,0014154	0,0015938
4	20	0,0014213	0,0016290	0,0014154	0,0015938
4	21	0,0014213	0,0016290	0,0014154	0,0015938
4	22	0,0014213	0,0016290	0,0014154	0,0015938
4	23	0,0014213	0,0016290	0,0014154	0,0015938
5	0	0,0014266	0,0014672	0,0015205	0,0015420
5	1	0,0014266	0,0014672	0,0015205	0,0015420
5	2	0,0014266	0,0014672	0,0015205	0,0015420
5	3	0,0014266	0,0014672	0,0015205	0,0015420
5	4	0,0014266	0,0014672	0,0015205	0,0015420
5	5	0,0014266	0,0014672	0,0015205	0,0015420
5	6	0,0014266	0,0014672	0,0015205	0,0015420
5	7	0,0014266	0,0014672	0,0015205	0,0015420
5	8	0,0014266	0,0014672	0,0015205	0,0015420
5	9	0,0014266	0,0014672	0,0015205	0,0015420
5	10	0,0014266	0,0014672	0,0015205	0,0015420
5	11	0,0014266	0,0014672	0,0015205	0,0015420
5	12	0,0014266	0,0014672	0,0015205	0,0015420
5	13	0,0014266	0,0014672	0,0015205	0,0015420
5	14	0,0014266	0,0014672	0,0015205	0,0015420

5	15	0,0014266	0,0014672	0,0015205	0,0015420
5	16	0,0014266	0,0014672	0,0015205	0,0015420
5	17	0,0014266	0,0014672	0,0015205	0,0015420
5	18	0,0014266	0,0014672	0,0015205	0,0015420
5	19	0,0014266	0,0014672	0,0015205	0,0015420
5	20	0,0014266	0,0014672	0,0015205	0,0015420
5	21	0,0014266	0,0014672	0,0015205	0,0015420
5	22	0,0014266	0,0014672	0,0015205	0,0015420
5	23	0,0014266	0,0014672	0,0015205	0,0015420
6	0	0,0014865	0,0014095	0,0013287	0,0014498
6	1	0,0014865	0,0014095	0,0013287	0,0014498
6	2	0,0014865	0,0014095	0,0013287	0,0014498
6	3	0,0014865	0,0014095	0,0013287	0,0014498
6	4	0,0014865	0,0014095	0,0013287	0,0014498
6	5	0,0014865	0,0014095	0,0013287	0,0014498
6	6	0,0014865	0,0014095	0,0013287	0,0014498
6	7	0,0014865	0,0014095	0,0013287	0,0014498
6	8	0,0014865	0,0014095	0,0013287	0,0014498
6	9	0,0014865	0,0014095	0,0013287	0,0014498
6	10	0,0014865	0,0014095	0,0013287	0,0014498
6	11	0,0014865	0,0014095	0,0013287	0,0014498
6	12	0,0014865	0,0014095	0,0013287	0,0014498
6	13	0,0014865	0,0014095	0,0013287	0,0014498
6	14	0,0014865	0,0014095	0,0013287	0,0014498
6	15	0,0014865	0,0014095	0,0013287	0,0014498
6	16	0,0014865	0,0014095	0,0013287	0,0014498
6	17	0,0014865	0,0014095	0,0013287	0,0014498
6	18	0,0014865	0,0014095	0,0013287	0,0014498
6	19	0,0014865	0,0014095	0,0013287	0,0014498
6	20	0,0014865	0,0014095	0,0013287	0,0014498
6	21	0,0014865	0,0014095	0,0013287	0,0014498
6	22	0,0014865	0,0014095	0,0013287	0,0014498
6	23	0,0014865	0,0014095	0,0013287	0,0014498
7	0	0,0014624	0,0014421	0,0013532	0,0014813
7	1	0,0014624	0,0014421	0,0013532	0,0014813
7	2	0,0014624	0,0014421	0,0013532	0,0014813
7	3	0,0014624	0,0014421	0,0013532	0,0014813
7	4	0,0014624	0,0014421	0,0013532	0,0014813
7	5	0,0014624	0,0014421	0,0013532	0,0014813
7	6	0,0014624	0,0014421	0,0013532	0,0014813
7	7	0,0014624	0,0014421	0,0013532	0,0014813
7	8	0,0014624	0,0014421	0,0013532	0,0014813
7	9	0,0014624	0,0014421	0,0013532	0,0014813

7	10	0,0014624	0,0014421	0,0013532	0,0014813
7	11	0,0014624	0,0014421	0,0013532	0,0014813
7	12	0,0014624	0,0014421	0,0013532	0,0014813
7	13	0,0014624	0,0014421	0,0013532	0,0014813
7	14	0,0014624	0,0014421	0,0013532	0,0014813
7	15	0,0014624	0,0014421	0,0013532	0,0014813
7	16	0,0014624	0,0014421	0,0013532	0,0014813
7	17	0,0014624	0,0014421	0,0013532	0,0014813
7	18	0,0014624	0,0014421	0,0013532	0,0014813
7	19	0,0014624	0,0014421	0,0013532	0,0014813
7	20	0,0014624	0,0014421	0,0013532	0,0014813
7	21	0,0014624	0,0014421	0,0013532	0,0014813
7	22	0,0014624	0,0014421	0,0013532	0,0014813
7	23	0,0014624	0,0014421	0,0013532	0,0014813

Figure 46. Gas Demand profile. Subsector: Paper.

CHEMISTRY AND REFINERY

Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0015876	0,0014965	0,0014579	0,0014200
1	1	0,0015876	0,0014965	0,0014579	0,0014200
1	2	0,0015876	0,0014965	0,0014579	0,0014200
1	3	0,0015876	0,0014965	0,0014579	0,0014200
1	4	0,0015876	0,0014965	0,0014579	0,0014200
1	5	0,0015876	0,0014965	0,0014579	0,0014200
1	6	0,0015876	0,0014965	0,0014579	0,0014200
1	7	0,0015876	0,0014965	0,0014579	0,0014200
1	8	0,0015876	0,0014965	0,0014579	0,0014200
1	9	0,0015876	0,0014965	0,0014579	0,0014200
1	10	0,0015876	0,0014965	0,0014579	0,0014200
1	11	0,0015876	0,0014965	0,0014579	0,0014200
1	12	0,0015876	0,0014965	0,0014579	0,0014200
1	13	0,0015876	0,0014965	0,0014579	0,0014200
1	14	0,0015876	0,0014965	0,0014579	0,0014200
1	15	0,0015876	0,0014965	0,0014579	0,0014200
1	16	0,0015876	0,0014965	0,0014579	0,0014200
1	17	0,0015876	0,0014965	0,0014579	0,0014200
1	18	0,0015876	0,0014965	0,0014579	0,0014200
1	19	0,0015876	0,0014965	0,0014579	0,0014200
1	20	0,0015876	0,0014965	0,0014579	0,0014200
1	21	0,0015876	0,0014965	0,0014579	0,0014200
1	22	0,0015876	0,0014965	0,0014579	0,0014200

1	23	0,0015876	0,0014965	0,0014579	0,0014200
2	0	0,0016370	0,0014999	0,0014628	0,0014287
2	1	0,0016370	0,0014999	0,0014628	0,0014287
2	2	0,0016370	0,0014999	0,0014628	0,0014287
2	3	0,0016370	0,0014999	0,0014628	0,0014287
2	4	0,0016370	0,0014999	0,0014628	0,0014287
2	5	0,0016370	0,0014999	0,0014628	0,0014287
2	6	0,0016370	0,0014999	0,0014628	0,0014287
2	7	0,0016370	0,0014999	0,0014628	0,0014287
2	8	0,0016370	0,0014999	0,0014628	0,0014287
2	9	0,0016370	0,0014999	0,0014628	0,0014287
2	10	0,0016370	0,0014999	0,0014628	0,0014287
2	11	0,0016370	0,0014999	0,0014628	0,0014287
2	12	0,0016370	0,0014999	0,0014628	0,0014287
2	13	0,0016370	0,0014999	0,0014628	0,0014287
2	14	0,0016370	0,0014999	0,0014628	0,0014287
2	15	0,0016370	0,0014999	0,0014628	0,0014287
2	16	0,0016370	0,0014999	0,0014628	0,0014287
2	17	0,0016370	0,0014999	0,0014628	0,0014287
2	18	0,0016370	0,0014999	0,0014628	0,0014287
2	19	0,0016370	0,0014999	0,0014628	0,0014287
2	20	0,0016370	0,0014999	0,0014628	0,0014287
2	21	0,0016370	0,0014999	0,0014628	0,0014287
2	22	0,0016370	0,0014999	0,0014628	0,0014287
2	23	0,0016370	0,0014999	0,0014628	0,0014287
3	0	0,0015909	0,0015017	0,0014629	0,0014391
3	1	0,0015909	0,0015017	0,0014629	0,0014391
3	2	0,0015909	0,0015017	0,0014629	0,0014391
3	3	0,0015909	0,0015017	0,0014629	0,0014391
3	4	0,0015909	0,0015017	0,0014629	0,0014391
3	5	0,0015909	0,0015017	0,0014629	0,0014391
3	6	0,0015909	0,0015017	0,0014629	0,0014391
3	7	0,0015909	0,0015017	0,0014629	0,0014391
3	8	0,0015909	0,0015017	0,0014629	0,0014391
3	9	0,0015909	0,0015017	0,0014629	0,0014391
3	10	0,0015909	0,0015017	0,0014629	0,0014391
3	11	0,0015909	0,0015017	0,0014629	0,0014391
3	12	0,0015909	0,0015017	0,0014629	0,0014391
3	13	0,0015909	0,0015017	0,0014629	0,0014391
3	14	0,0015909	0,0015017	0,0014629	0,0014391
3	15	0,0015909	0,0015017	0,0014629	0,0014391
3	16	0,0015909	0,0015017	0,0014629	0,0014391
3	17	0,0015909	0,0015017	0,0014629	0,0014391

3	18	0,0015909	0,0015017	0,0014629	0,0014391
3	19	0,0015909	0,0015017	0,0014629	0,0014391
3	20	0,0015909	0,0015017	0,0014629	0,0014391
3	21	0,0015909	0,0015017	0,0014629	0,0014391
3	22	0,0015909	0,0015017	0,0014629	0,0014391
3	23	0,0015909	0,0015017	0,0014629	0,0014391
4	0	0,0014685	0,0016228	0,0014633	0,0014387
4	1	0,0014685	0,0016228	0,0014633	0,0014387
4	2	0,0014685	0,0016228	0,0014633	0,0014387
4	3	0,0014685	0,0016228	0,0014633	0,0014387
4	4	0,0014685	0,0016228	0,0014633	0,0014387
4	5	0,0014685	0,0016228	0,0014633	0,0014387
4	6	0,0014685	0,0016228	0,0014633	0,0014387
4	7	0,0014685	0,0016228	0,0014633	0,0014387
4	8	0,0014685	0,0016228	0,0014633	0,0014387
4	9	0,0014685	0,0016228	0,0014633	0,0014387
4	10	0,0014685	0,0016228	0,0014633	0,0014387
4	11	0,0014685	0,0016228	0,0014633	0,0014387
4	12	0,0014685	0,0016228	0,0014633	0,0014387
4	13	0,0014685	0,0016228	0,0014633	0,0014387
4	14	0,0014685	0,0016228	0,0014633	0,0014387
4	15	0,0014685	0,0016228	0,0014633	0,0014387
4	16	0,0014685	0,0016228	0,0014633	0,0014387
4	17	0,0014685	0,0016228	0,0014633	0,0014387
4	18	0,0014685	0,0016228	0,0014633	0,0014387
4	19	0,0014685	0,0016228	0,0014633	0,0014387
4	20	0,0014685	0,0016228	0,0014633	0,0014387
4	21	0,0014685	0,0016228	0,0014633	0,0014387
4	22	0,0014685	0,0016228	0,0014633	0,0014387
4	23	0,0014685	0,0016228	0,0014633	0,0014387
5	0	0,0014730	0,0014898	0,0015619	0,0014233
5	1	0,0014730	0,0014898	0,0015619	0,0014233
5	2	0,0014730	0,0014898	0,0015619	0,0014233
5	3	0,0014730	0,0014898	0,0015619	0,0014233
5	4	0,0014730	0,0014898	0,0015619	0,0014233
5	5	0,0014730	0,0014898	0,0015619	0,0014233
5	6	0,0014730	0,0014898	0,0015619	0,0014233
5	7	0,0014730	0,0014898	0,0015619	0,0014233
5	8	0,0014730	0,0014898	0,0015619	0,0014233
5	9	0,0014730	0,0014898	0,0015619	0,0014233
5	10	0,0014730	0,0014898	0,0015619	0,0014233
5	11	0,0014730	0,0014898	0,0015619	0,0014233
5	12	0,0014730	0,0014898	0,0015619	0,0014233

5	13	0,0014730	0,0014898	0,0015619	0,0014233
5	14	0,0014730	0,0014898	0,0015619	0,0014233
5	15	0,0014730	0,0014898	0,0015619	0,0014233
5	16	0,0014730	0,0014898	0,0015619	0,0014233
5	17	0,0014730	0,0014898	0,0015619	0,0014233
5	18	0,0014730	0,0014898	0,0015619	0,0014233
5	19	0,0014730	0,0014898	0,0015619	0,0014233
5	20	0,0014730	0,0014898	0,0015619	0,0014233
5	21	0,0014730	0,0014898	0,0015619	0,0014233
5	22	0,0014730	0,0014898	0,0015619	0,0014233
5	23	0,0014730	0,0014898	0,0015619	0,0014233
6	0	0,0015631	0,0014630	0,0014349	0,0013984
6	1	0,0015631	0,0014630	0,0014349	0,0013984
6	2	0,0015631	0,0014630	0,0014349	0,0013984
6	3	0,0015631	0,0014630	0,0014349	0,0013984
6	4	0,0015631	0,0014630	0,0014349	0,0013984
6	5	0,0015631	0,0014630	0,0014349	0,0013984
6	6	0,0015631	0,0014630	0,0014349	0,0013984
6	7	0,0015631	0,0014630	0,0014349	0,0013984
6	8	0,0015631	0,0014630	0,0014349	0,0013984
6	9	0,0015631	0,0014630	0,0014349	0,0013984
6	10	0,0015631	0,0014630	0,0014349	0,0013984
6	11	0,0015631	0,0014630	0,0014349	0,0013984
6	12	0,0015631	0,0014630	0,0014349	0,0013984
6	13	0,0015631	0,0014630	0,0014349	0,0013984
6	14	0,0015631	0,0014630	0,0014349	0,0013984
6	15	0,0015631	0,0014630	0,0014349	0,0013984
6	16	0,0015631	0,0014630	0,0014349	0,0013984
6	17	0,0015631	0,0014630	0,0014349	0,0013984
6	18	0,0015631	0,0014630	0,0014349	0,0013984
6	19	0,0015631	0,0014630	0,0014349	0,0013984
6	20	0,0015631	0,0014630	0,0014349	0,0013984
6	21	0,0015631	0,0014630	0,0014349	0,0013984
6	22	0,0015631	0,0014630	0,0014349	0,0013984
6	23	0,0015631	0,0014630	0,0014349	0,0013984
7	0	0,0015625	0,0014754	0,0014465	0,0013967
7	1	0,0015625	0,0014754	0,0014465	0,0013967
7	2	0,0015625	0,0014754	0,0014465	0,0013967
7	3	0,0015625	0,0014754	0,0014465	0,0013967
7	4	0,0015625	0,0014754	0,0014465	0,0013967
7	5	0,0015625	0,0014754	0,0014465	0,0013967
7	6	0,0015625	0,0014754	0,0014465	0,0013967
7	7	0,0015625	0,0014754	0,0014465	0,0013967

7	8	0,0015625	0,0014754	0,0014465	0,0013967
7	9	0,0015625	0,0014754	0,0014465	0,0013967
7	10	0,0015625	0,0014754	0,0014465	0,0013967
7	11	0,0015625	0,0014754	0,0014465	0,0013967
7	12	0,0015625	0,0014754	0,0014465	0,0013967
7	13	0,0015625	0,0014754	0,0014465	0,0013967
7	14	0,0015625	0,0014754	0,0014465	0,0013967
7	15	0,0015625	0,0014754	0,0014465	0,0013967
7	16	0,0015625	0,0014754	0,0014465	0,0013967
7	17	0,0015625	0,0014754	0,0014465	0,0013967
7	18	0,0015625	0,0014754	0,0014465	0,0013967
7	19	0,0015625	0,0014754	0,0014465	0,0013967
7	20	0,0015625	0,0014754	0,0014465	0,0013967
7	21	0,0015625	0,0014754	0,0014465	0,0013967
7	22	0,0015625	0,0014754	0,0014465	0,0013967
7	23	0,0015625	0,0014754	0,0014465	0,0013967

Figure 47. Gas Demand profile. Subsector: Chemistry and Refinery.

TEXTILE

Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0019593	0,0017413	0,0015446	0,0019280
1	1	0,0019593	0,0017413	0,0015446	0,0019280
1	2	0,0019593	0,0017413	0,0015446	0,0019280
1	3	0,0019593	0,0017413	0,0015446	0,0019280
1	4	0,0019593	0,0017413	0,0015446	0,0019280
1	5	0,0019593	0,0017413	0,0015446	0,0019280
1	6	0,0019593	0,0017413	0,0015446	0,0019280
1	7	0,0019593	0,0017413	0,0015446	0,0019280
1	8	0,0019593	0,0017413	0,0015446	0,0019280
1	9	0,0019593	0,0017413	0,0015446	0,0019280
1	10	0,0019593	0,0017413	0,0015446	0,0019280
1	11	0,0019593	0,0017413	0,0015446	0,0019280
1	12	0,0019593	0,0017413	0,0015446	0,0019280
1	13	0,0019593	0,0017413	0,0015446	0,0019280
1	14	0,0019593	0,0017413	0,0015446	0,0019280
1	15	0,0019593	0,0017413	0,0015446	0,0019280
1	16	0,0019593	0,0017413	0,0015446	0,0019280
1	17	0,0019593	0,0017413	0,0015446	0,0019280
1	18	0,0019593	0,0017413	0,0015446	0,0019280
1	19	0,0019593	0,0017413	0,0015446	0,0019280
1	20	0,0019593	0,0017413	0,0015446	0,0019280

1	21	0,0019593	0,0017413	0,0015446	0,0019280
1	22	0,0019593	0,0017413	0,0015446	0,0019280
1	23	0,0019593	0,0017413	0,0015446	0,0019280
2	0	0,0020646	0,0018430	0,0016169	0,0020633
2	1	0,0020646	0,0018430	0,0016169	0,0020633
2	2	0,0020646	0,0018430	0,0016169	0,0020633
2	3	0,0020646	0,0018430	0,0016169	0,0020633
2	4	0,0020646	0,0018430	0,0016169	0,0020633
2	5	0,0020646	0,0018430	0,0016169	0,0020633
2	6	0,0020646	0,0018430	0,0016169	0,0020633
2	7	0,0020646	0,0018430	0,0016169	0,0020633
2	8	0,0020646	0,0018430	0,0016169	0,0020633
2	9	0,0020646	0,0018430	0,0016169	0,0020633
2	10	0,0020646	0,0018430	0,0016169	0,0020633
2	11	0,0020646	0,0018430	0,0016169	0,0020633
2	12	0,0020646	0,0018430	0,0016169	0,0020633
2	13	0,0020646	0,0018430	0,0016169	0,0020633
2	14	0,0020646	0,0018430	0,0016169	0,0020633
2	15	0,0020646	0,0018430	0,0016169	0,0020633
2	16	0,0020646	0,0018430	0,0016169	0,0020633
2	17	0,0020646	0,0018430	0,0016169	0,0020633
2	18	0,0020646	0,0018430	0,0016169	0,0020633
2	19	0,0020646	0,0018430	0,0016169	0,0020633
2	20	0,0020646	0,0018430	0,0016169	0,0020633
2	21	0,0020646	0,0018430	0,0016169	0,0020633
2	22	0,0020646	0,0018430	0,0016169	0,0020633
2	23	0,0020646	0,0018430	0,0016169	0,0020633
3	0	0,0020302	0,0017813	0,0015907	0,0021148
3	1	0,0020302	0,0017813	0,0015907	0,0021148
3	2	0,0020302	0,0017813	0,0015907	0,0021148
3	3	0,0020302	0,0017813	0,0015907	0,0021148
3	4	0,0020302	0,0017813	0,0015907	0,0021148
3	5	0,0020302	0,0017813	0,0015907	0,0021148
3	6	0,0020302	0,0017813	0,0015907	0,0021148
3	7	0,0020302	0,0017813	0,0015907	0,0021148
3	8	0,0020302	0,0017813	0,0015907	0,0021148
3	9	0,0020302	0,0017813	0,0015907	0,0021148
3	10	0,0020302	0,0017813	0,0015907	0,0021148
3	11	0,0020302	0,0017813	0,0015907	0,0021148
3	12	0,0020302	0,0017813	0,0015907	0,0021148
3	13	0,0020302	0,0017813	0,0015907	0,0021148
3	14	0,0020302	0,0017813	0,0015907	0,0021148
3	15	0,0020302	0,0017813	0,0015907	0,0021148

3	16	0,0020302	0,0017813	0,0015907	0,0021148
3	17	0,0020302	0,0017813	0,0015907	0,0021148
3	18	0,0020302	0,0017813	0,0015907	0,0021148
3	19	0,0020302	0,0017813	0,0015907	0,0021148
3	20	0,0020302	0,0017813	0,0015907	0,0021148
3	21	0,0020302	0,0017813	0,0015907	0,0021148
3	22	0,0020302	0,0017813	0,0015907	0,0021148
3	23	0,0020302	0,0017813	0,0015907	0,0021148
4	0	0,0018307	0,0018132	0,0015214	0,0019861
4	1	0,0018307	0,0018132	0,0015214	0,0019861
4	2	0,0018307	0,0018132	0,0015214	0,0019861
4	3	0,0018307	0,0018132	0,0015214	0,0019861
4	4	0,0018307	0,0018132	0,0015214	0,0019861
4	5	0,0018307	0,0018132	0,0015214	0,0019861
4	6	0,0018307	0,0018132	0,0015214	0,0019861
4	7	0,0018307	0,0018132	0,0015214	0,0019861
4	8	0,0018307	0,0018132	0,0015214	0,0019861
4	9	0,0018307	0,0018132	0,0015214	0,0019861
4	10	0,0018307	0,0018132	0,0015214	0,0019861
4	11	0,0018307	0,0018132	0,0015214	0,0019861
4	12	0,0018307	0,0018132	0,0015214	0,0019861
4	13	0,0018307	0,0018132	0,0015214	0,0019861
4	14	0,0018307	0,0018132	0,0015214	0,0019861
4	15	0,0018307	0,0018132	0,0015214	0,0019861
4	16	0,0018307	0,0018132	0,0015214	0,0019861
4	17	0,0018307	0,0018132	0,0015214	0,0019861
4	18	0,0018307	0,0018132	0,0015214	0,0019861
4	19	0,0018307	0,0018132	0,0015214	0,0019861
4	20	0,0018307	0,0018132	0,0015214	0,0019861
4	21	0,0018307	0,0018132	0,0015214	0,0019861
4	22	0,0018307	0,0018132	0,0015214	0,0019861
4	23	0,0018307	0,0018132	0,0015214	0,0019861
5	0	0,0016213	0,0012498	0,0012420	0,0014176
5	1	0,0016213	0,0012498	0,0012420	0,0014176
5	2	0,0016213	0,0012498	0,0012420	0,0014176
5	3	0,0016213	0,0012498	0,0012420	0,0014176
5	4	0,0016213	0,0012498	0,0012420	0,0014176
5	5	0,0016213	0,0012498	0,0012420	0,0014176
5	6	0,0016213	0,0012498	0,0012420	0,0014176
5	7	0,0016213	0,0012498	0,0012420	0,0014176
5	8	0,0016213	0,0012498	0,0012420	0,0014176
5	9	0,0016213	0,0012498	0,0012420	0,0014176
5	10	0,0016213	0,0012498	0,0012420	0,0014176

5	11	0,0016213	0,0012498	0,0012420	0,0014176
5	12	0,0016213	0,0012498	0,0012420	0,0014176
5	13	0,0016213	0,0012498	0,0012420	0,0014176
5	14	0,0016213	0,0012498	0,0012420	0,0014176
5	15	0,0016213	0,0012498	0,0012420	0,0014176
5	16	0,0016213	0,0012498	0,0012420	0,0014176
5	17	0,0016213	0,0012498	0,0012420	0,0014176
5	18	0,0016213	0,0012498	0,0012420	0,0014176
5	19	0,0016213	0,0012498	0,0012420	0,0014176
5	20	0,0016213	0,0012498	0,0012420	0,0014176
5	21	0,0016213	0,0012498	0,0012420	0,0014176
5	22	0,0016213	0,0012498	0,0012420	0,0014176
5	23	0,0016213	0,0012498	0,0012420	0,0014176
6	0	0,0007653	0,0007023	0,0006305	0,0007645
6	1	0,0007653	0,0007023	0,0006305	0,0007645
6	2	0,0007653	0,0007023	0,0006305	0,0007645
6	3	0,0007653	0,0007023	0,0006305	0,0007645
6	4	0,0007653	0,0007023	0,0006305	0,0007645
6	5	0,0007653	0,0007023	0,0006305	0,0007645
6	6	0,0007653	0,0007023	0,0006305	0,0007645
6	7	0,0007653	0,0007023	0,0006305	0,0007645
6	8	0,0007653	0,0007023	0,0006305	0,0007645
6	9	0,0007653	0,0007023	0,0006305	0,0007645
6	10	0,0007653	0,0007023	0,0006305	0,0007645
6	11	0,0007653	0,0007023	0,0006305	0,0007645
6	12	0,0007653	0,0007023	0,0006305	0,0007645
6	13	0,0007653	0,0007023	0,0006305	0,0007645
6	14	0,0007653	0,0007023	0,0006305	0,0007645
6	15	0,0007653	0,0007023	0,0006305	0,0007645
6	16	0,0007653	0,0007023	0,0006305	0,0007645
6	17	0,0007653	0,0007023	0,0006305	0,0007645
6	18	0,0007653	0,0007023	0,0006305	0,0007645
6	19	0,0007653	0,0007023	0,0006305	0,0007645
6	20	0,0007653	0,0007023	0,0006305	0,0007645
6	21	0,0007653	0,0007023	0,0006305	0,0007645
6	22	0,0007653	0,0007023	0,0006305	0,0007645
6	23	0,0007653	0,0007023	0,0006305	0,0007645
7	0	0,0008235	0,0010114	0,0009330	0,0010762
7	1	0,0008235	0,0010114	0,0009330	0,0010762
7	2	0,0008235	0,0010114	0,0009330	0,0010762
7	3	0,0008235	0,0010114	0,0009330	0,0010762
7	4	0,0008235	0,0010114	0,0009330	0,0010762
7	5	0,0008235	0,0010114	0,0009330	0,0010762

7	6	0,0008235	0,0010114	0,0009330	0,0010762
7	7	0,0008235	0,0010114	0,0009330	0,0010762
7	8	0,0008235	0,0010114	0,0009330	0,0010762
7	9	0,0008235	0,0010114	0,0009330	0,0010762
7	10	0,0008235	0,0010114	0,0009330	0,0010762
7	11	0,0008235	0,0010114	0,0009330	0,0010762
7	12	0,0008235	0,0010114	0,0009330	0,0010762
7	13	0,0008235	0,0010114	0,0009330	0,0010762
7	14	0,0008235	0,0010114	0,0009330	0,0010762
7	15	0,0008235	0,0010114	0,0009330	0,0010762
7	16	0,0008235	0,0010114	0,0009330	0,0010762
7	17	0,0008235	0,0010114	0,0009330	0,0010762
7	18	0,0008235	0,0010114	0,0009330	0,0010762
7	19	0,0008235	0,0010114	0,0009330	0,0010762
7	20	0,0008235	0,0010114	0,0009330	0,0010762
7	21	0,0008235	0,0010114	0,0009330	0,0010762
7	22	0,0008235	0,0010114	0,0009330	0,0010762
7	23	0,0008235	0,0010114	0,0009330	0,0010762

Figure 48. Gas Demand profile. Subsector: Textile

MINING, CONSTRUCTION AND MATERIALS

Day	Hour	Winter	Spring	Summer	Autumn
1	0	0,0015258	0,0015055	0,0014235	0,0016696
1	1	0,0015258	0,0015055	0,0014235	0,0016696
1	2	0,0015258	0,0015055	0,0014235	0,0016696
1	3	0,0015258	0,0015055	0,0014235	0,0016696
1	4	0,0015258	0,0015055	0,0014235	0,0016696
1	5	0,0015258	0,0015055	0,0014235	0,0016696
1	6	0,0015258	0,0015055	0,0014235	0,0016696
1	7	0,0015258	0,0015055	0,0014235	0,0016696
1	8	0,0015258	0,0015055	0,0014235	0,0016696
1	9	0,0015258	0,0015055	0,0014235	0,0016696
1	10	0,0015258	0,0015055	0,0014235	0,0016696
1	11	0,0015258	0,0015055	0,0014235	0,0016696
1	12	0,0015258	0,0015055	0,0014235	0,0016696
1	13	0,0015258	0,0015055	0,0014235	0,0016696
1	14	0,0015258	0,0015055	0,0014235	0,0016696
1	15	0,0015258	0,0015055	0,0014235	0,0016696
1	16	0,0015258	0,0015055	0,0014235	0,0016696
1	17	0,0015258	0,0015055	0,0014235	0,0016696
1	18	0,0015258	0,0015055	0,0014235	0,0016696

1	19	0,0015258	0,0015055	0,0014235	0,0016696
1	20	0,0015258	0,0015055	0,0014235	0,0016696
1	21	0,0015258	0,0015055	0,0014235	0,0016696
1	22	0,0015258	0,0015055	0,0014235	0,0016696
1	23	0,0015258	0,0015055	0,0014235	0,0016696
2	0	0,0015395	0,0015139	0,0014433	0,0016985
2	1	0,0015395	0,0015139	0,0014433	0,0016985
2	2	0,0015395	0,0015139	0,0014433	0,0016985
2	3	0,0015395	0,0015139	0,0014433	0,0016985
2	4	0,0015395	0,0015139	0,0014433	0,0016985
2	5	0,0015395	0,0015139	0,0014433	0,0016985
2	6	0,0015395	0,0015139	0,0014433	0,0016985
2	7	0,0015395	0,0015139	0,0014433	0,0016985
2	8	0,0015395	0,0015139	0,0014433	0,0016985
2	9	0,0015395	0,0015139	0,0014433	0,0016985
2	10	0,0015395	0,0015139	0,0014433	0,0016985
2	11	0,0015395	0,0015139	0,0014433	0,0016985
2	12	0,0015395	0,0015139	0,0014433	0,0016985
2	13	0,0015395	0,0015139	0,0014433	0,0016985
2	14	0,0015395	0,0015139	0,0014433	0,0016985
2	15	0,0015395	0,0015139	0,0014433	0,0016985
2	16	0,0015395	0,0015139	0,0014433	0,0016985
2	17	0,0015395	0,0015139	0,0014433	0,0016985
2	18	0,0015395	0,0015139	0,0014433	0,0016985
2	19	0,0015395	0,0015139	0,0014433	0,0016985
2	20	0,0015395	0,0015139	0,0014433	0,0016985
2	21	0,0015395	0,0015139	0,0014433	0,0016985
2	22	0,0015395	0,0015139	0,0014433	0,0016985
2	23	0,0015395	0,0015139	0,0014433	0,0016985
3	0	0,0015075	0,0014766	0,0014072	0,0016591
3	1	0,0015075	0,0014766	0,0014072	0,0016591
3	2	0,0015075	0,0014766	0,0014072	0,0016591
3	3	0,0015075	0,0014766	0,0014072	0,0016591
3	4	0,0015075	0,0014766	0,0014072	0,0016591
3	5	0,0015075	0,0014766	0,0014072	0,0016591
3	6	0,0015075	0,0014766	0,0014072	0,0016591
3	7	0,0015075	0,0014766	0,0014072	0,0016591
3	8	0,0015075	0,0014766	0,0014072	0,0016591
3	9	0,0015075	0,0014766	0,0014072	0,0016591
3	10	0,0015075	0,0014766	0,0014072	0,0016591
3	11	0,0015075	0,0014766	0,0014072	0,0016591
3	12	0,0015075	0,0014766	0,0014072	0,0016591
3	13	0,0015075	0,0014766	0,0014072	0,0016591

3	14	0,0015075	0,0014766	0,0014072	0,0016591
3	15	0,0015075	0,0014766	0,0014072	0,0016591
3	16	0,0015075	0,0014766	0,0014072	0,0016591
3	17	0,0015075	0,0014766	0,0014072	0,0016591
3	18	0,0015075	0,0014766	0,0014072	0,0016591
3	19	0,0015075	0,0014766	0,0014072	0,0016591
3	20	0,0015075	0,0014766	0,0014072	0,0016591
3	21	0,0015075	0,0014766	0,0014072	0,0016591
3	22	0,0015075	0,0014766	0,0014072	0,0016591
3	23	0,0015075	0,0014766	0,0014072	0,0016591
4	0	0,0013714	0,0015798	0,0013945	0,0016319
4	1	0,0013714	0,0015798	0,0013945	0,0016319
4	2	0,0013714	0,0015798	0,0013945	0,0016319
4	3	0,0013714	0,0015798	0,0013945	0,0016319
4	4	0,0013714	0,0015798	0,0013945	0,0016319
4	5	0,0013714	0,0015798	0,0013945	0,0016319
4	6	0,0013714	0,0015798	0,0013945	0,0016319
4	7	0,0013714	0,0015798	0,0013945	0,0016319
4	8	0,0013714	0,0015798	0,0013945	0,0016319
4	9	0,0013714	0,0015798	0,0013945	0,0016319
4	10	0,0013714	0,0015798	0,0013945	0,0016319
4	11	0,0013714	0,0015798	0,0013945	0,0016319
4	12	0,0013714	0,0015798	0,0013945	0,0016319
4	13	0,0013714	0,0015798	0,0013945	0,0016319
4	14	0,0013714	0,0015798	0,0013945	0,0016319
4	15	0,0013714	0,0015798	0,0013945	0,0016319
4	16	0,0013714	0,0015798	0,0013945	0,0016319
4	17	0,0013714	0,0015798	0,0013945	0,0016319
4	18	0,0013714	0,0015798	0,0013945	0,0016319
4	19	0,0013714	0,0015798	0,0013945	0,0016319
4	20	0,0013714	0,0015798	0,0013945	0,0016319
4	21	0,0013714	0,0015798	0,0013945	0,0016319
4	22	0,0013714	0,0015798	0,0013945	0,0016319
4	23	0,0013714	0,0015798	0,0013945	0,0016319
5	0	0,0013675	0,0014857	0,0015511	0,0016045
5	1	0,0013675	0,0014857	0,0015511	0,0016045
5	2	0,0013675	0,0014857	0,0015511	0,0016045
5	3	0,0013675	0,0014857	0,0015511	0,0016045
5	4	0,0013675	0,0014857	0,0015511	0,0016045
5	5	0,0013675	0,0014857	0,0015511	0,0016045
5	6	0,0013675	0,0014857	0,0015511	0,0016045
5	7	0,0013675	0,0014857	0,0015511	0,0016045
5	8	0,0013675	0,0014857	0,0015511	0,0016045

5	9	0,0013675	0,0014857	0,0015511	0,0016045
5	10	0,0013675	0,0014857	0,0015511	0,0016045
5	11	0,0013675	0,0014857	0,0015511	0,0016045
5	12	0,0013675	0,0014857	0,0015511	0,0016045
5	13	0,0013675	0,0014857	0,0015511	0,0016045
5	14	0,0013675	0,0014857	0,0015511	0,0016045
5	15	0,0013675	0,0014857	0,0015511	0,0016045
5	16	0,0013675	0,0014857	0,0015511	0,0016045
5	17	0,0013675	0,0014857	0,0015511	0,0016045
5	18	0,0013675	0,0014857	0,0015511	0,0016045
5	19	0,0013675	0,0014857	0,0015511	0,0016045
5	20	0,0013675	0,0014857	0,0015511	0,0016045
5	21	0,0013675	0,0014857	0,0015511	0,0016045
5	22	0,0013675	0,0014857	0,0015511	0,0016045
5	23	0,0013675	0,0014857	0,0015511	0,0016045
6	0	0,0014118	0,0014007	0,0013235	0,0015417
6	1	0,0014118	0,0014007	0,0013235	0,0015417
6	2	0,0014118	0,0014007	0,0013235	0,0015417
6	3	0,0014118	0,0014007	0,0013235	0,0015417
6	4	0,0014118	0,0014007	0,0013235	0,0015417
6	5	0,0014118	0,0014007	0,0013235	0,0015417
6	6	0,0014118	0,0014007	0,0013235	0,0015417
6	7	0,0014118	0,0014007	0,0013235	0,0015417
6	8	0,0014118	0,0014007	0,0013235	0,0015417
6	9	0,0014118	0,0014007	0,0013235	0,0015417
6	10	0,0014118	0,0014007	0,0013235	0,0015417
6	11	0,0014118	0,0014007	0,0013235	0,0015417
6	12	0,0014118	0,0014007	0,0013235	0,0015417
6	13	0,0014118	0,0014007	0,0013235	0,0015417
6	14	0,0014118	0,0014007	0,0013235	0,0015417
6	15	0,0014118	0,0014007	0,0013235	0,0015417
6	16	0,0014118	0,0014007	0,0013235	0,0015417
6	17	0,0014118	0,0014007	0,0013235	0,0015417
6	18	0,0014118	0,0014007	0,0013235	0,0015417
6	19	0,0014118	0,0014007	0,0013235	0,0015417
6	20	0,0014118	0,0014007	0,0013235	0,0015417
6	21	0,0014118	0,0014007	0,0013235	0,0015417
6	22	0,0014118	0,0014007	0,0013235	0,0015417
6	23	0,0014118	0,0014007	0,0013235	0,0015417
7	0	0,0014061	0,0013709	0,0012995	0,0015561
7	1	0,0014061	0,0013709	0,0012995	0,0015561
7	2	0,0014061	0,0013709	0,0012995	0,0015561
7	3	0,0014061	0,0013709	0,0012995	0,0015561

7	4	0,0014061	0,0013709	0,0012995	0,0015561
7	5	0,0014061	0,0013709	0,0012995	0,0015561
7	6	0,0014061	0,0013709	0,0012995	0,0015561
7	7	0,0014061	0,0013709	0,0012995	0,0015561
7	8	0,0014061	0,0013709	0,0012995	0,0015561
7	9	0,0014061	0,0013709	0,0012995	0,0015561
7	10	0,0014061	0,0013709	0,0012995	0,0015561
7	11	0,0014061	0,0013709	0,0012995	0,0015561
7	12	0,0014061	0,0013709	0,0012995	0,0015561
7	13	0,0014061	0,0013709	0,0012995	0,0015561
7	14	0,0014061	0,0013709	0,0012995	0,0015561
7	15	0,0014061	0,0013709	0,0012995	0,0015561
7	16	0,0014061	0,0013709	0,0012995	0,0015561
7	17	0,0014061	0,0013709	0,0012995	0,0015561
7	18	0,0014061	0,0013709	0,0012995	0,0015561
7	19	0,0014061	0,0013709	0,0012995	0,0015561
7	20	0,0014061	0,0013709	0,0012995	0,0015561
7	21	0,0014061	0,0013709	0,0012995	0,0015561
7	22	0,0014061	0,0013709	0,0012995	0,0015561
7	23	0,0014061	0,0013709	0,0012995	0,0015561

Figure 49. Gas Demand profile. Subsector: Mining and Construction.