



ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA (ICAI)

Degree in Electromechanical Engineering

**“Study for the implementation of a smart  
micro-grid in Talavera de la Reina”**

Author: Francisco Javier de la Pinta Pillin

Director: Julio Montes Ponce de León

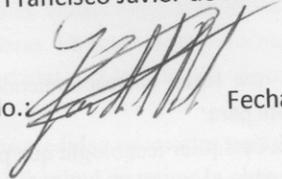


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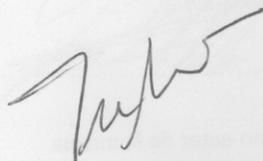
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## Executive Summary:

This project proposes the installation of a micro-grid in the city of Talavera de la Reina. The project will take advantage of local non-manageable resources such as wind, small-hydro or solar PV for electricity production purposes. This system requires a power backing source for moments when power demand or supply require it. In this case, the system will utilise waste products generated in the area of study, transforming them into hydrogen through a plasma gasification process. That hydrogen, that can be stored, will then feed fuel cells, producing the required energy providing a clean, fast and effective response to demand and supply changes.

The installation of the micro-grid responds to the broad advantages that distributed generation offers compared to the traditional centralised grid. This configuration will reduce significantly transport losses, as generation will be carried out next to consumption areas. It will as well integrate renewables effectively, eliminating the so-called special regime, that is one of the main contributors to the current increased price of electricity in Spain. In addition, the micro-grid will also provide a cutting-edge solution to EU regulations in the matter of waste management, being able to power-up the micro-grid with waste products in a clean and efficient way.

There are many micro-grid examples throughout the world: In the remote island of Ta'U for instance they have achieved energy independence through a combined generation of solar PV power plants and batteries, being able to operate for three days without sunlight. In New York University, a micro-grid was implemented as well, installing a Combined Heat & Power (CHP) plant, providing heat 37 buildings and power to 22 across campus, being able to perform as an island. In addition, it achieves a 68% decrease in CO<sub>2</sub>, NO<sub>x</sub> and SO<sub>2</sub> emissions.

In the case of plasma gasification solutions, the most remarkable example is the MEPL plant in Pune, India. This facility processes 72 tonnes a day of hazardous waste a day, having a rated power of 1,6 MW. It is the biggest facility processing hazardous waste in the world.

In this project, the goal is to install a micro-grid able to provide the 55,412 MWh o maximum demand for Talavera's 83303 inhabitants. Its privileged position allows it to obtain significant shares of solar energy in addition to acceptable levels of wind power and small-hydro nearby. These resources existing in less than 60 km will inform the distributed generation of the micro-grid, adding up to 100,32 MW of solar PV, 55,3 of wind and 9,214 of small hydro of rated power.

As it has been said, all of these non-manageable technologies will be backed by a plasma gasification plant combined with fuel cells. There are many waste-to-energy technologies, such as pyrolysis or incineration, but it is plasma gasification the most appropriate one for the micro-grid. It is a state of the art waste-to-energy solution, that takes advantage of the plasma properties, dissociating the organic matter into its fundamental components, eliminating dioxins. The result of the process is a clean hydrogen-rich syngas and a vitrified slag that can be used for construction.

For the purpose of feeding the plasma gasification plant, solid urban waste (SUW) and forest and agrarian residues will be collected. SUW, whose collection would be constant throughout the year, provides 26852,09 tons per year. In case of the forest residues, its collection will be seasonal, and will be stored for moments of lack of waste material. It supposes 31298,316 tons per year. Agrarian waste collection is also seasonal, adding up to 5763,12 tons per year.

This waste will be introduced in the plasma gasification station, where it will pass through the processes of feed handling, dissociation and metal recovery, gas cooling, filtering and sulphur removal. In the process gas cooling, a Rankine cycle will be implemented, cooling down the output syngas of the reactor and drying up the waste products introduced in it, generating power that will be used to power up the different devices that take part in the process, achieving a higher efficiency of the process. Given the existing waste resources, the plasma gasification plant will be able to produce 911,13 kg of hydrogen per hour.

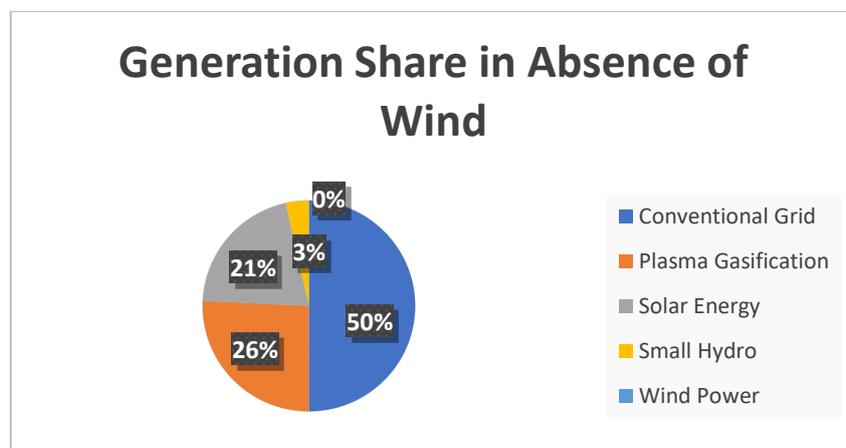
This hydrogen obtained is then introduced in the fuel cells. Fuel cells are electrochemical reactors that in the presence of hydrogen and an oxidant and through an electrolyte,

generates power and heat. Considering the hydrogen flow per hour, the number of fuel cells needed ascends to 24.

In the project, it has been considered to install a hydrogen-powered Combined Heat and Power (CHP) plant. Combining cycles will boost the efficiency of the process, and given the implementation of hydrogen, its emissions would be zero. Considering that hydrogen CHPs are still in its infancy as just one plant of such characteristics has been installed worldwide, the project has dismissed this option, although it would be a more than accurate choice.

For the micro-grid's operation, fuel cells will generate power only when local non-manageable technologies are not able to meet demand. For times where even with the plasma technology system is not able to meet demand, the micro-grid will import energy from the conventional one. In case renewable production exceeds the requirements of demand, the micro-grid will export energy, obtaining revenues for it.

The project has considered all possible scenarios, where the absence of wind power is clearly the most extreme and unfavourable one. In this case, the micro-grid will have a maximum 50% dependency on the conventional grid. As this situation is highly unlikely to happen continuously for a whole day, the technical effectiveness and viability of the micro-grid is then proven.



After the technical viability of the micro-grid has been accredited, it is then necessary to acknowledge the economic one. For this purpose, the levelized costs of each technology have been calculated, obtaining the cost of electricity production per technology. Adding up the weighted sum of the costs for all technologies, the cost of the electricity production per kWh produced in the micro-grid would be 9,2588 c€.

For the micro-grid to be economically viable, it should be both profitable for the investor and offer a more competitive price for the consumer.

For the consumer, the mean electricity price for small consumers in Spain in January 2017 was 13,263 c€/kWh, which means that the consumer will be paying a 30,19% less after the micro-grid's installation.

In case of the investor, all the micro-grid's investment will be payed-off from the 21<sup>st</sup> year of operation, and will then make profits for the following four years of operation for the micro-grid, making a total of 114058447 €.

All in all, it can be said that the micro-grid's installation will be both beneficial for consumers and investors, resulting into a remarkably cheaper electricity and attractive investments for investors. Economic viability is proven as well, and in can then be said that the micro-grid is viable in all ways, achieving its different goals and making it an effective and efficient solution for the grid's current challenges.

## Resumen:

En este proyecto se propone la instalación de una microrred inteligente en Talavera de la Reina. Se aprovecharán los recursos no gestionables en proximidad tales como la energía solar fotovoltaica, la eólica o la pequeña hidráulica con el propósito de generar energía. De esta manera, la red necesitará una fuente de energía gestionable de respaldo para situaciones en que la oferta o la demanda de energía lo requieran. En ese caso, se usarán los residuos generados en el área de estudio para transformarlos en hidrógeno mediante un proceso de gasificación por plasma. El hidrógeno, que es almacenable, alimentará a unas pilas de combustible que producirán la energía requerida, proporcionando una respuesta rápida, limpia y efectiva a los cambios mencionados.

La puesta en marcha de la microrred responde a las amplias ventajas que ofrece la generación distribuida en relación a la distribución centralizada tradicional. Esta configuración, por ejemplo, hará disminuir significativamente las pérdidas en el transporte, generando la energía en puntos cercanos a los consumos. También integrará las renovables de manera efectiva, eliminando el denominado régimen especial, que es uno de los factores que más contribuyen al actual alto precio de la electricidad en España. Además, la microrred supone una solución vanguardista en respuesta a las normativas europeas en relación al tratamiento de residuos, siendo capaz de integrarlos para generar energía de manera limpia y eficiente.

Hay muchos ejemplos de microrredes por todo el mundo: En la remota isla de Ta'U se hizo energéticamente independiente a partir de una instalación combinada de paneles solares fotovoltaicos y baterías, siendo capaz de operar tres días en ausencia de luz solar. En la New York University también se implementó una microrred, aunque en esta ocasión se trata de un ciclo combinado que proporciona calefacción a 37 edificios del campus y electricidad a 22, siendo capaz de operar en isla. Además, esta planta ha conseguido reducir en un 68% las emisiones de CO<sub>2</sub>, NO<sub>x</sub> y SO<sub>2</sub>.

En el caso de la tecnología de gasificación por plasma, el ejemplo más significativo es la planta de MEPL en Pune, India. Esta instalación es capaz de procesar 72 toneladas de residuos

peligrosos al día con una potencia de 1,6 MW, siendo la planta más grande del mundo procesando residuos peligrosos.

En el caso de este proyecto, el objetivo de la microrred es proporcionar energía a la ciudad de Talavera de la Reina, siendo capaz de satisfacer su demanda máxima de 55,412 MWh. La privilegiada situación de esta ciudad le permite obtener altas cuotas de energía solar, así como niveles aceptables de energía eólica y minihidráulica. Los recursos existentes en un radio de 60 km formarán parte de la microrred, siendo estos 100,32 MW de solar fotovoltaica, 55,3 de eólica y 9,214 MW de minihidráulica de potencia instalada.

Como se ha explicado, todo este conjunto no gestionable gozará de una planta de gasificación por plasma y pilas de combustible de soporte. Hay muchas tecnologías de valorización energética de residuos como la pirólisis o la incineración, pero es la gasificación por plasma la más adecuada para la microrred. Es una solución novedosa que aprovecha las propiedades del plasma, disociando la materia orgánica en sus componentes fundamentales y eliminando dioxinas y furanos. El resultado es un gas de síntesis rico en hidrógeno y un material vitrificado que puede ser utilizado en la construcción.

Para alimentar la planta de gasificación por plasma se utilizarán residuos sólidos urbanos (RSU), residuos agrarios y forestales. Los RSU, que supondrán un flujo constante de residuos a lo largo del año, aportarán 26852,09 toneladas al año. En el caso de los residuos forestales, su recolección será estacional, y se podrá almacenar para momentos de necesidad. En total suponen 31298,316 toneladas al año. Los residuos agrarios, también estacionales, suponen 5763,12 toneladas al año.

Estos residuos serán introducidos en la planta de gasificación por plasma, donde pasará por procesos de alimentación, disociación y recuperación del material vitrificado, enfriamiento del gas, filtrado y extracción de sulfuros. En el proceso de enfriamiento del gas, se utilizará un ciclo de Rankine, que enfriará el gas que sale de la vasija y secará los que entran en ella. En el proceso generará energía que se utilizará para alimentar el resto de elementos que participan

en el proceso, alcanzando una eficiencia mayor. Teniendo en cuenta los recursos de los que se dispone, la planta producirá 911,13 kg de hidrógeno por hora.

El hidrógeno obtenido se utiliza posteriormente para alimentar las pilas de combustible. Las pilas de combustible son reactores electroquímicos que en presencia de hidrógeno y un oxidante y a través de un electrolito, generan energía y calor. Teniendo en cuenta el flujo máximo de hidrógeno generado por la planta de gasificación, el número de pilas necesarias calculado asciende a 24.

El proyecto también estudió la posibilidad de implementar un ciclo combinado de hidrógeno. Combinar ciclos incrementaría de manera significativa la eficiencia del proceso, y ya que el combustible utilizado sería hidrógeno, las emisiones serán cero. Considerando que los ciclos combinados de hidrógeno todavía están en una fase temprana de desarrollo (sólo una planta de estas características ha sido instalada en todo el mundo) y debido a la ausencia de referencias, se ha descartado esta opción, aunque se resalta que es una opción muy interesante y apropiada.

Cuando la microrred opere, se estableció que las pilas solo generen energía cuando las tecnologías no gestionables no puedan satisfacer la demanda. En los momentos en que ni siquiera sea posible satisfacerla con la ayuda de la tecnología de plasma, se importaría energía de la red convencional. Por último, cuando la producción renovable exceda la demanda, la microrred exportará el correspondiente excedente a la red convencional, obteniendo ingresos por ello.

Para su operatividad, todos los posibles escenarios han sido analizados, donde la ausencia de energía eólica es claramente la situación más desfavorable. En ese caso, la importación de energía ascendería al 50%. Como esta situación es altamente improbable para todo un día, la efectividad y viabilidad técnica del proyecto quedan probadas.

## Distribución de la generación en ausencia de eólica



Después de acreditar la viabilidad técnica de la microrred, es necesario probar que el proyecto es viable económicamente. Por ello, los costes de la producción de electricidad por tecnología han sido calculados, analizando los costes de inversión y los de operación. Considerando la media ponderada de los costes de las tecnologías por su producción, se obtiene un precio total de la energía en la microrred de 9,2588 c€/kWh.

Ya que se intenta probar la viabilidad económica, es preciso que sea beneficioso tanto para el consumidor como para el inversor.

Para el consumidor, la media del precio de la electricidad para pequeños consumidores (PVPC) en enero de 2017 fue de 13,263 c€/kWh, lo que significa que después de la implementación de la microrred el consumidor medio pagará un 30,19% menos.

Para el inversor, se obtiene que la inversión será amortizada a partir del año 21 de operación, generando beneficios desde ese año, acumulando al final de su vida útil un total de 114058447 €.

En definitiva, puede decirse que la instalación de la microrred será beneficiosa tanto para consumidores como para inversores, obteniendo un precio significativamente menor de la electricidad y suponiendo una inversión atractiva para el inversor. La viabilidad económica

queda por ello demostrada, alcanzando todos los objetivos propuestos y suponiendo una solución efectiva y eficiente para los desafíos del sistema eléctrico actual.

## Index

### Part I:

1.	Introduction .....	19
1.1.	Motivation.....	19
1.2.	Aims of the project.....	21
2.	State-of-the-art .....	22
2.1.	Micro-Grids.....	22
2.1.1.	Micro-grid in Ta'ú island, American Samoa .....	23
2.1.2.	New York University (NYU) micro-grid.....	24
2.1.3.	The Sendai Microgrid .....	25
2.2.	Plasma Gasification Stations .....	26
2.2.1.	Wuhan plant, China.....	26
2.2.2.	Maharashtra Enviro Power Limited plant in Pune, India .....	26
3.	Micro-grid in Talavera de la Reina.....	27
3.1.	Micro-grid placement.....	29
3.2.	Power Demand.....	32
3.3.	Analysis of existing non-manageable power plants around Talavera de la Reina.....	33
3.3.1.	Hydropower plants.....	35
3.3.2.	Wind power plants .....	37
3.3.3.	Solar PV plants:.....	38
3.3.4.	Biomass and CHP:.....	40
3.3.5.	Recapitulation of technologies:.....	40
4.	Plasma gasification process.....	41
4.1.	Waste energy recovery techniques.....	42
4.1.1.	Incineration (direct combustion) .....	42
4.1.2.	Pyrolysis.....	44
4.1.3.	Controlled Landfills.....	45
4.1.4.	Anaerobic Digestion .....	46
4.1.5.	Plasma Gasification .....	46
4.2.	Waste resources in Talavera de la Reina.....	47
4.2.1.	Solid Urban Waste (SUW) .....	48
4.2.2.	Forest residues .....	50
4.2.3.	Agrarian Waste.....	52
4.2.4.	Waste Compendium.....	53
4.3.	Plasma .....	54
4.4.	Plasma gasification technology features.....	55

4.5.	Direct Plasma Converter System .....	55
4.5.1.	Process Phases .....	55
4.5.2.	Syngas characteristics .....	67
4.5.3.	Dimensioning of the plasma gasification plant .....	68
4.5.4.	Energy balance .....	69
4.5.5.	Heat recovery system.....	71
4.5.6.	Waste drying through released heat.....	76
4.5.7.	Obtained Hydrogen .....	77
4.5.8.	Gasification plant in numbers .....	78
5.	Grid's backing and energy storage.....	79
5.1.	Introduction .....	79
5.2.	Fuel cells: How they work .....	79
5.3.	Fuel cell types.....	82
5.3.1.	PEMFC (Polymer Electrolyte Membrane Fuel Cell).....	83
5.3.2.	PAFC (Phosphoric acid fuel cells) .....	83
5.3.3.	MCFC (Molten Carbonate Fuel Cells) .....	84
5.3.4.	AFC (Alkaline Fuel Cells) .....	84
5.3.5.	SOFC (Solid Oxide Fuel Cells).....	85
5.4.	Fuel cell type selection.....	85
5.5.	Hydrogen storage.....	86
5.5.1.	Gaseous storage .....	86
5.5.2.	Liquid storage .....	87
5.5.3.	Solid storage.....	87
5.6.	Hydrogen storage selection .....	87
5.7.	Fuel cell energy production and number of units.....	88
5.8.	Possibility of implementing a hydrogen combined cycle plant .....	88
6.	Micro-grid's configuration .....	90
6.1.	Introduction .....	90
6.2.	Micro-grid's configuration .....	91
6.2.1.	Non-manageable technologies .....	91
6.2.2.	Manageable technologies: Plasma Gasification Plant .....	91
6.2.3.	Power exchanges with the conventional grid .....	92
6.3.	Possible scenarios .....	92
6.3.1.	All non-manageable generation available: .....	92
6.3.2.	Absence of one of the existing non-manageable sources: .....	96
6.4.	Analysis of results.....	99

Part II

1. Economic Study of the different energy sources that take part in the micro-grid. Levelized costs of electricity. .... 102

- 1.1.1. Initial Investment Costs ..... 103
- 1.1.2. Running Costs ..... 105
- 1.1.3. Electricity production final cost..... 106
- 1.2.1. Initial Investment Costs ..... 108
- 1.2.2. Running costs ..... 109
- 1.2.3. Electricity production final cost..... 109
- 1.3.1. Initial investment costs ..... 110
- 1.3.2. Running costs ..... 111
- 1.3.3. Electricity production final cost..... 111
- 1.4.1. Plasma gasification waste treatment evaluation ..... 112
- 1.4.2. Rankine cycle ..... 114
- 1.4.3. Fuel cells ..... 115
- 1.4.4. Conclusions on plasma technology total generation costs ..... 116

2. Economic Evaluation of the different energy sources that take part in the micro-grid ... 118

3. Cost-effectiveness of the micro-grid ..... 121

Part III:

Annex A: Ballard Fuel Cell Cathalogue: ..... 125

Annex B: Power plants in Toledo province: ..... 126

Annex C: Running Costs per technology: ..... 172

# I. Memoir

# 1. Introduction

## 1.1. Motivation

It was not until 1998 that large-scale introduction of renewable energy sources throughout the world took place. Increasing  $CO_2$  emissions encouraged 187 countries, including Spain and the EU to reduce them by at least 5% of the levels of 1990 by 2008, signing the Kyoto Protocol in 1997<sup>i</sup>.

During the first decade of the 21<sup>st</sup> century, Spain started investing firmly on renewables. The old energy system based on highly manageable technologies, such as thermal plants, coal or nuclear gave way to a much more diversified system when mainly wind and solar PV energy were introduced.

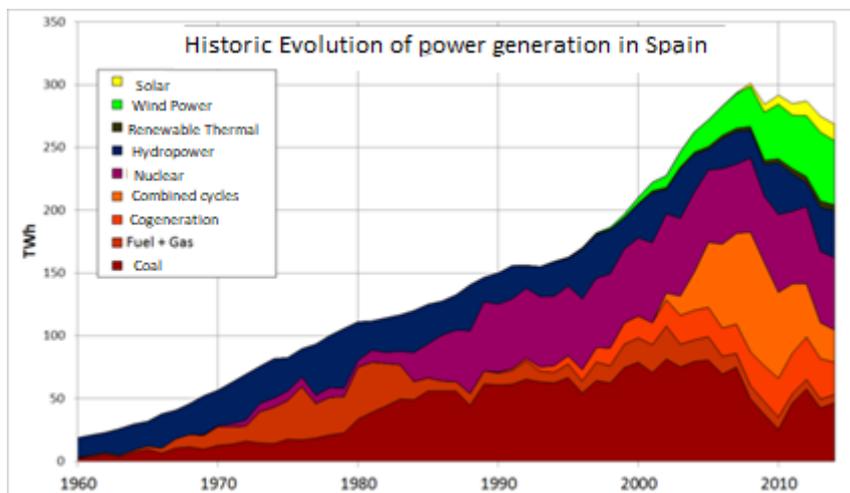


Figure 1: Evolution of power generation in Spain from 1960 to 2014. Source: Ministerio de Industria, Turismo y Comercio

In order to boost investments and to make them more profitable, a feed-in tariff system was introduced: It was called the “Special Regime”. The Spanish Energetic System was then divided into two generation groups<sup>ii</sup>:

- The ordinary regime: Where almost all technologies, such as thermal power plants, combined cycles, nuclear or hydropower competed to enter in the energy supply curve.
- The special regime: Technologies in this group could not compete in terms of costs with conventional technologies in the ordinary regime. They receive public aids towards electricity production and always enter the supply curve. Technologies included in this area were mainly wind power, solar energy, small hydro, biomass and cogeneration. Surprisingly, other renewable power sources, such as geothermal were not included

As a result of the implementation of this regime, since 2000 the income of the Spanish Electric System does not cover its costs. This deficit has been growing strongly since 2009, as access costs are above access tariffs (regulated part of the energy tariff that does not come from electricity production). Precisely, from 2003 to 2012, access tariffs increased by 82% and access costs by 230%<sup>iii</sup>. The access cost rise was led by the dramatic effect of feed-tariffs conceded randomly without any technical criteria and with disproportionate revenues for investors. However, running costs have been diminished noticeably due to the introduction of these renewable technologies that do not require any kind of fuel other than wind or sun. As a result, this tariff deficit has led the price of electricity in Spain to grow considerably over the last few years, while at the same time the cost of electricity production experienced a substantial decrease.

Indeed, the implementation of these technologies posed a wide variety of problems. Renewables have a strong dependency on climate conditions and as a result the matching between demand and supply begins to become a problem. Peak load generating technologies are then required to respond quickly to demand variations and also to have a reserve of energy for situations where there is a lack of renewable production. These tasks are often carried out by combined cycles, making a renewable-based energetic system strongly dependent upon conventional generation backing that is in some cases being underutilised. A system overcapacity is then an unavoidable externality.

To solve these problems locally, a smart micro-grid powered by non-manageable renewables and backed by biomass generation is presented in this project. In this way, the project will

tackle as well EU regulations towards waste product management, taking advantage of solid urban waste, and agricultural and forest residues in order to produce electricity.

As the traditional power generation system is generally formed by conventional power plants far away from consumption areas, it results into significant transport losses that add up to 15 %<sup>iv</sup>. In this particular solution, the local micro-grid will benefit from the proximity of the generation plants, that will be placed nearby as well as the back-up biomass plant, expecting transport power losses to be considerably lower.

This project proposes the conversion of biomass into energy through a plasma gasification process. This particular process enables the user to produce a syngas with a high hydrogen content out of waste products. It also produces a vitrified organic material fraction that can be used in construction, and thus be a useful way of recycling.<sup>v</sup> This hydrogen is then used to feed internal combustion engines or fuel cells.

Indeed, this solution enables us to obtain a manageable power source, as the hydrogen can be stored and used whenever energy supply requires it in order to meet demand. Thus, we will obtain a de-centralized, manageable and clean power system constituting a micro smart grid, meeting the requirements of today's power system scenario.

In this project, the technical and economic viability of the implementation of a micro grid of such characteristics will be studied in the city of Talavera de la Reina; evaluating the different possibilities that this town offers based on its needs.

## 1.2 Aims of the project

The main goal of this project is the implementation of a smart micro-grid in the city of Talavera de la Reina. Towards this goal, the following outcomes are expected to be achieved:

- Implement a smart grid that will reduce the price of electricity for consumers.

- Reduce carbon emissions caused by electricity production.
- Achieve a situation of energetic independence.
- Responsible management of waste products, obtaining hydrogen out of it and then electricity from that hydrogen.
- Improvement of the efficiency of energy transport. Energy generation in the micro-grid will be closer to consumption areas, and as a result, losses in transport are expected to be lower.

## 2. State-of-the-art

The goal of the Project would be the implementation of a micro-grid in Talavera de la Reina, where non-manageable local resources are combined with some kind of manageable backing. Taking advantage of waste produced in the area of study, a plasma gasification station will transform this waste into hydrogen, that will then be used to power up fuel cells.

Before delving into such a cutting-edge topic, it has been considered necessary to study thoroughly similar power plants and stations existing throughout the world.

### 2.1. Micro-Grids

Micro-grids were born with the aim of providing energy to isolated communities, but it has arisen in response to the current increased interest in decentralised power generation.

Micro-grids can be defined as a small-scale power grid that has its own generation and storage resources. They are commonly powered by non-manageable local resources, such as solar or wind power, and they are often backed by some kind of manageable source (e.g. diesel generator or batteries).

These distributed configurations tend to decrease drastically transport losses, as generation takes place much closer to consumption areas. Indeed, consumer engagement is usually encouraged, resulting into lower peaks in the demand curve. Its effective integration of renewables reduces significantly carbon emissions, and its combination achieves a greater manageability of these kind of power sources.

Below, different existing micro-grids throughout the world are exposed:

### 2.1.1. Micro-grid in Ta'ú island, American Samoa

This remote pacific island is the home for 873 people. Traditionally, electric power generation for this island was carried out by diesel generators, but in November 2016 it changed to a 100% solar power configuration.

In an 8 M\$ project carried out by SolarCity and funded by U.S. Department of Interior and the American Samoa Power Authority (ASPA), 5328 solar panels were installed, with an installed capacity of 13 MW. The generated energy is stored in 60 Tesla Powerpacks - batteries commercialised by Tesla, being able to satisfy power demand for three days without any sunlight.



*Figure 2: Micro-grid in Ta'U. Source: National Geographic*

The installation of this micro grid has allowed this island to achieve energy independence, which is crucial for an island situated 4000 miles away from California that had to import 110000 gallons of diesel a year plus the one that shipping requires.

### 2.1.2. New York University (NYU) micro-grid

NYU has produced power on-site since the 1960s, having in service since 1980 an oil-fired cogeneration system. In 2011, at the end of the plant's lifespan and in order to get rid of oil-fired technologies, the university built a natural gas-fired modern combined heat and power plant.

With an initial investment cost of 126 M€, it has a rated power of 13,4 MW. It provides power to 22 buildings and heat to 37 across campus. The micro-grid is connected to Con Edison distribution grid, and imports power when demand requires so. Yet, unlike before, the NYU micro-grid is able to perform as an island.

In addition, the micro-grid's installation has produced a wide number of benefits: The university evaluated total energy saving costs of 5 to 8 million dollars a year, and an estimated 68% decrease in EPA criteria pollutants (NO<sub>x</sub>, SO<sub>2</sub> and CO emissions).

### 2.1.3. The Sendai Microgrid

This one can probably be the most well-known micro-grid example in the world. It was built in Japan in 2005, under the plans of the New Energy and Industrial Technology Development Organisation. It is placed in the Tohoku Fukushi University Campus.

It is also well known for its robustness, when in the 2011 Fukushima earthquake and tsunami, after the loss of service for a few hours it was able to restart operation and provide power and heat to the Tohoku Fukushi University Hospital during the two-day blackout.

It consists of two 350 kW natural gas generator sets, 50 kW of solar PV and some batteries.

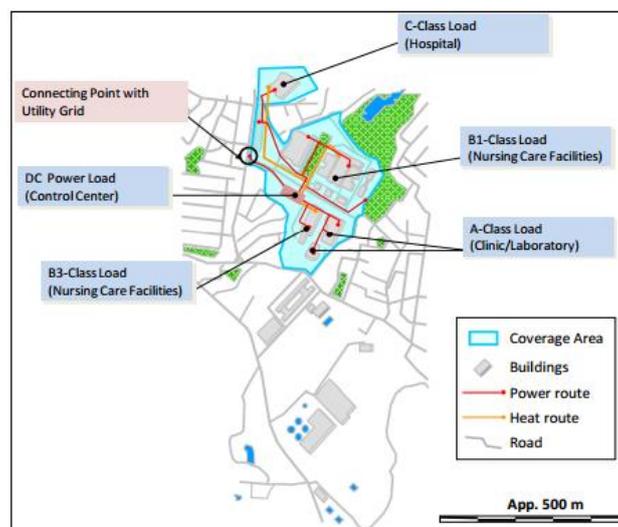


Figure 3: Scheme of Sendai Micro-Grid. Source: [microgridprojects.com](http://microgridprojects.com)

## 2.2. Plasma Gasification Stations

This cutting-edge technology is able to transform waste products into hydrogen-rich syngas. The micro-grid utilises this technology achieving two main goals:

- The micro-grid will be able to manage waste products in an efficient and effective way. Waste products are currently being underused, and by implementing this method, they will be used to produce electricity.
- The micro-grid will obtain manageable power source that can give power backing to the non-manageable local sources existing nearby, giving the micro-grid the possibility of storing energy.

### 2.2.1. Wuhan plant, China

The Wuhan Kaidi investment company has developed a plasma gasification station in Wuhan with the aim of transforming waste products into fuel. Installed in 2013, it consists of an Alter NRG Westinghouse plasma gasification station. It is designed to transform 100 tons of solid urban waste per day into syngas.

According to Wuhan Kaidi sources, it will be the first of many plasma gasification plants in central China, with the goal of transforming waste management and energy production in the region.

### 2.2.2. Maharashtra Enviro Power Limited plant in Pune, India

This facility processes 72 tonnes a day of hazardous waste. It was commissioned in 2008 and uses a Westinghouse Corporation plasma technology and reactor vessel. The produced gas is immediately combusted in a steam boiler feeding a steam turbine producing up to 1.6 MW of electricity. The facility is the largest plasma gasification plant in the world processing hazardous waste.

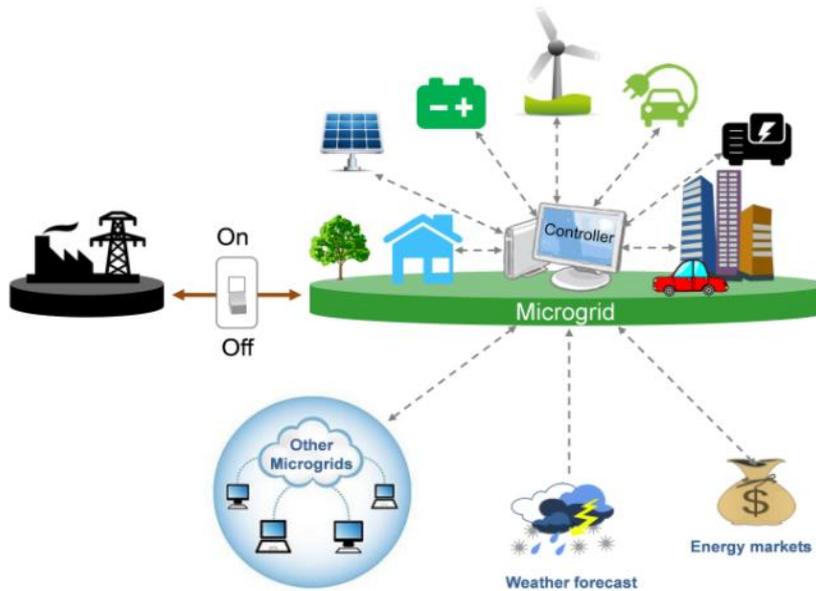


*Figure 4: Micro-grid in Pune. Source: MEPL*

### 3. Micro-grid in Talavera de la Reina

A micro-grid is defined as “a localized group of electricity sources and sinks (loads) that typically operates connected to and synchronous with the traditional centralized grid (macrogrid), but can disconnect and maintain operation autonomously as physical and/or economic conditions dictate”. They are characterized by two main features:

- A micro-grid is a locally-controlled system
- They can work both connected to the grid or electrically isolated.



High-Level Microgrid Schematic

Copyright Berkeley Lab

Figure 5: Microgrid Scheme. Source: Berkeley Lab

Micro-grids first came up as a solution for the energy supply in remote areas, but since then it is seen as a cutting-edge option that offers a wide variety of advantages, such as higher efficiency, lower transport losses, reduced environmental impact, easier voltage control and a more cost-efficient network.

We can distinguish four main types of micro-grids:

- True micro-grids: They are governed by themselves, and usually downstream of a single point of common coupling (PCC). It is the most common type of micro-grid. Just as consumers have a considerable freedom operating the power system on their side, so are restrictions for this kind of micro-grid.
- Utility micro-grids: They consist on a portion of the regulated grid. The main difference from a true micro-grid is essentially its regulatory and business model perspective, incorporating traditional utility infrastructure. As a result, this kind of micro-grid should deal with existing utility codes.
- Virtual micro-grids: They cover DER (distributed energy resources) at different locations, but it is presented to the system as a single controllable entity. The system should be capable of operating on island mode or to coordinate with different islands. This is the most uncommon configuration.

- Remote micro-grids: They are often not able to operate connected to the grid, and they operate on island mode. They use similar technology to remote power systems.

In this project, the implementation of a micro-grid is proposed in Talavera de la Reina, taking advantage of all the non-manageable renewable power stations installed nearby, minimizing transport losses, reducing energy’s carbon footprint, and diminishing the city’s dependency on the traditional grid and liberating combined cycles on the task of backing energy supply. Indeed, the project will tackle the problem of waste product management by transforming solid urban waste and forest and agricultural residues into hydrogen through a plasma gasification process. This hydrogen will then be stored in fuel cells or used to power up turbines, that will the back the system when there is a lack of renewable energy production or a peak in demand.

### 3.1. Micro-grid placement

The micro-grid will be placed in the city of Talavera de la Reina. It is the second most populated city in Toledo, and the fourth one in the region of Castilla-La Mancha after Albacete, Toledo and Guadalajara.



Figure 6: Map of Talavera de la Reina. Source: Google Maps

Located in the northwest of the region in a valley flanked by small mountain ranges called “El Berrocal” (highest peak in “La Atalaya del Matojo”, 624 metres), it is situated along the eastern margin of the river Tajo, 4 kilometres west of the Alberche’s mouth. It has an extension of 185,83  $km^2$  with an altitude of 371 metres above the sea level. The city is placed 71 km and 128 km away from Toledo and Madrid respectively.

As it has been said, Talavera de la Reina is the second most populated town in the province of Toledo, with 83303 inhabitants<sup>vi</sup>. Although the town is well known for its ceramist tradition, currently it is it’s the tertiary sector and the textile industry the ones that occupy most of the population. The construction crisis back in 2008 left Talavera as the city with highest unemployment rates in Castilla-La Mancha (32,60%<sup>vii</sup>). Its strategic position between Madrid and Lisbon and the future projections of the construction of a high-speed train line between those cities via Talavera de la Reina made the city remarkably attractive for investments during the “boom” years. The primary sector has also been traditionally one of the main activities of the region, where vines and olive-trees are the main crops and sheep farming the main cattle raising occupation.

Talavera de la Reina’s climate is classified as continental-mediterranean climate, characterized by soft winters and hot summers. Its mean temperature is 15,4°C and there exists a difference of mean temperatures of 19 °C throughout the year. Due to its location at the Tajo’s riverside, there exists a permanent humidity that oscillates along the year. It is also noticeable its low level of precipitations, with a mean value of 356mm, with a big difference between months during the year.

	Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre
Temperatura media (°C)	6.5	8.2	11.3	13.9	17.1	22.2	25.8	25	21.4	15.8	10.6	7.2
Temperatura min. (°C)	2.4	3.3	6	8.1	11.1	15.4	18.2	17.7	14.9	10.3	6	3.4
Temperatura máx. (°C)	10.7	13.2	16.7	19.8	23.2	29.1	33.5	32.4	28	21.3	15.2	11.1
Temperatura media (°F)	43.7	46.8	52.3	57.0	62.8	72.0	78.4	77.0	70.5	60.4	51.1	45.0
Temperatura min. (°F)	36.3	37.9	42.8	46.6	52.0	59.7	64.8	63.9	58.8	50.5	42.8	38.1
Temperatura máx. (°F)	51.3	55.8	62.1	67.6	73.8	84.4	92.3	90.3	82.4	70.3	59.4	52.0
Precipitación (mm)	34	28	37	38	41	22	6	7	25	39	40	39

Figure 7: Mean Temperatures. Source: climate-data.org

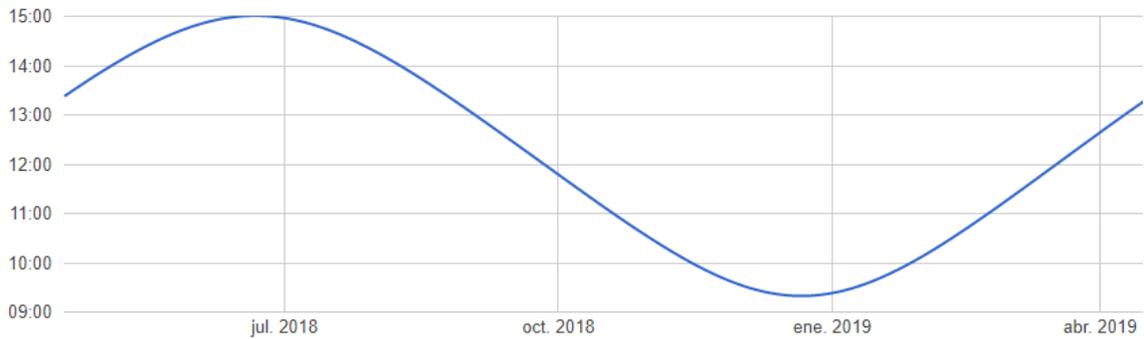


Figure 8: Sun hours throughout the year in Talavera de la Reina. Source: [salidaypuestadesol.com](http://salidaypuestadesol.com)

As it can be seen in figure 5, Talavera de la Reina has an important number of sun hours all along the year, which makes it a key spot for the installation of solar technology. As a result, a remarkable number of solar power stations are installed nearby the city. In addition, there exists two big hydropower plants and a few small hydro. Wind power stations are on the other hand very rare, as only two wind farms were planned, but still not authorized, and no other wind plant is installed in the area. The power distribution is carried out by Iberdrola, and Red Eléctrica Española (REE) is in charge of power transport.

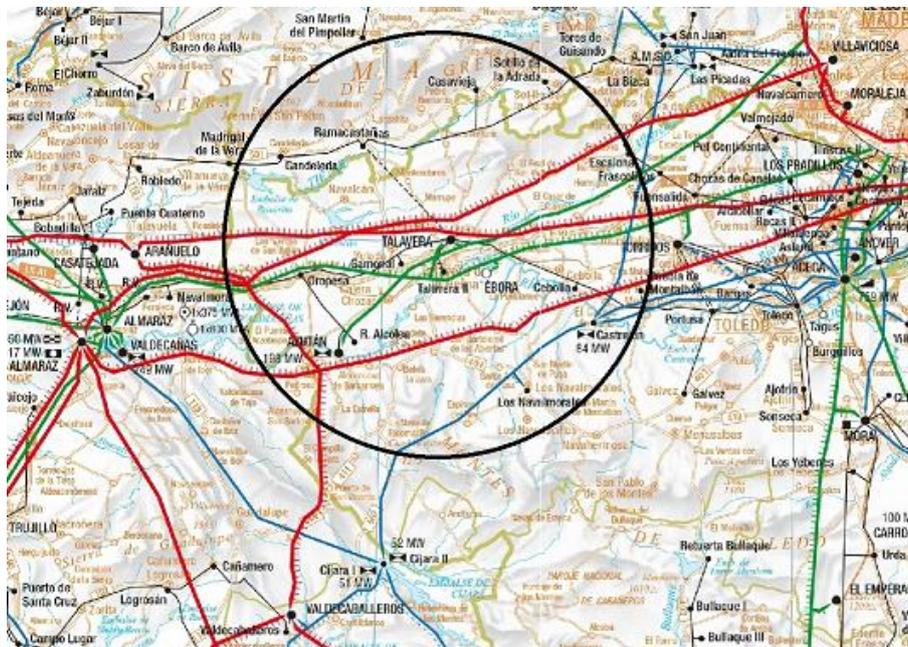


Figure 9: Power Network Map. Source: REE

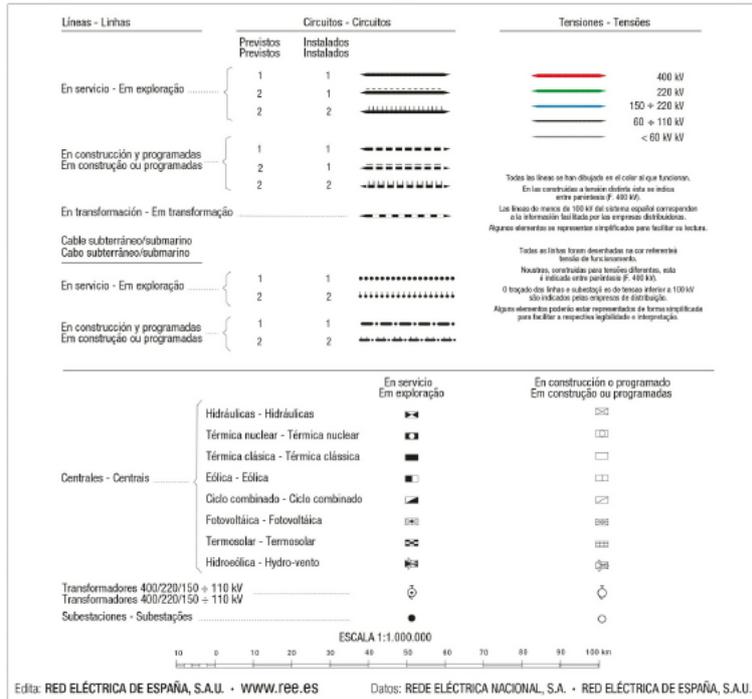


Figure 10: Map's Legend. Source: REE

### 3.2. Power Demand

The power distribution in this part of the province of Toledo is managed by Iberdrola. Due to the impossibility to access to the precise energy consumption data of Talavera de la Reina, the project has been done taking into account the total monthly consumption<sup>viii</sup> in the whole province of Toledo:

Month	Energy Consumed (MWh)
January	303499,76
February	307020,955
March	290174,47
April	267545,235
May	260292,435
June	285442,212
July	283425,489
August	320508,027

September	301443,554
October	279278,996
November	280099,761
December	284521,018
<b>Total</b>	<b>3463251,91</b>

Table 1: Energy consumption in the province of Toledo in 2017. Source: Junta de Comunidades de Castilla la Mancha.

As it can be seen, it is August and May the months with the highest and the lowest consumption respectively, but it is February the month with the highest consumption **per day**. The highest and the lowest energy consumption per hour in the province will be approximated from the data from these months, and the data for Talavera de la Reina will be extrapolated regarding the fraction of population living in the area of study. All in all, we obtain a peak hour consumption in Toledo province of 456,875 MWh and a valley hour consumption of 349,855 MWh. Then, the city of Talavera de la Reina would have a maximum and a minimum consumption of **55,412 MWh** and **42,4319 MWh**, and should have 60 MW of manageable capacity installed.

### 3.3. Analysis of existing non-manageable power plants around Talavera de la Reina

The aim of this project is to integrate all non-manageable power plants in a smart micro-grid around the city of Talavera, in order to reduce energy dependency, transport losses and power generation's carbon footprint.

Non-manageable technologies are defined as “ the ones that its primary source is neither controllable or storable and its associated generation plants lack the possibility of controlling the production or the firmness of the future production profile it is not enough to be considered as a program, although it could be considered as a forecast.”<sup>ix</sup> Thus, the generating technologies that can be considered as “non-manageable” are:

wind power, solar power, small hydro (no reservoir) and those included in b.3 group of the second article of the *Real Decreto* 661/2007<sup>x</sup>.

As the project's main power resources are non-manageable, a power storage system is then required. The project will tackle the problem with fuel cells, that will supply power from hydrogen when required. This hydrogen is to be obtained from waste products by a plasma gasification process. In addition, a connection with the traditional grid is desired as well for situations in which the existing resources could not make it to meet demand, and for situations of excess of generation where power could be sold to the grid.

The project will include all existing and planned non-manageable power plants located less than 60 km away from Talavera de la Reina, in order to reduce transport losses. They are resumed in the following table:

	Rated Power(MW)	% total power (MW)	Nº plants
Small hydro	9,214	5,6	4
Wind power	55,3	33,61	2
Solar PV	100,32	60,79	14
Biomass	<1	-	-
<b>TOTAL</b>	<b>164,514</b>	<b>100</b>	<b>20</b>

*Table 2: Non-manageable power plants nearby Talavera de la Reina. Source: Mintad's records*

As it can be seen, biomass power production in the area of study is not very significant compared to the other sources, so it will not be taken into account for the micro-grid. The diverse sources of energy that exist in this area will guarantee a greater manageability of the system, given the different generating profiles that they have. The different power factor characteristics of the different technologies throughout the day are exposed in the following graph:

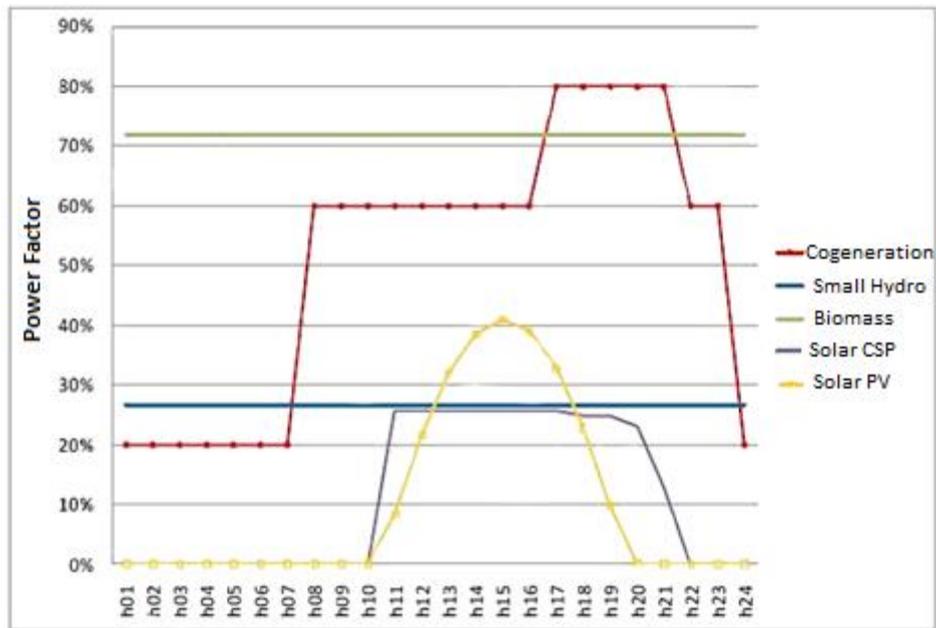


Figure 11: Power factor throughout the day by technology. Source: Textbook

### 3.3.1. Hydropower plants

In this area, there are six main hydropower plants situated all along the Tajo river. Two of them are medium-head hydropower stations that can deal with great flows, considered manageable power sources. The rest of them are non-manageable, characterized by being small-sized low head plants. The project will only consider the small-hydro plants, as the purpose of it is to integrate the non-manageable stations creating a smart micro-grid. The big hydropower plants are desired to stay feeding the traditional grid, that demands vast amounts of electricity and a considerable amount of power reserve for frequency control. All of them are collected in **Table 4**:

Name of the plant:	Distance to Talavera (km)	Rated power (MW)	Location
Talavera	0	2,854	Talavera de la Reina
Palomarejo	3	1,96	Talavera de la Reina
Montearagón	18	2,906	Montearagón
Cebolla	23	1,5	Cebolla
Castrejón	50	84	Castrejón

Azután	38	198	Azután
Total	-	290,054	

Table 3: Hydropower plants around Talavera de la Reina. Source: Mintad's records

The small-hydropower stations in the table are equipped with Semi Kaplan turbines, that require a head of less than 12 metres, can carry a maximum of 60, and can give up to 6 MW. As these power plants are diversion ones (run-of-river), they will give a constant output if the flow is constant. As the flow in the river Tajo is not very constant throughout the year, the power output of the power plants will vary significantly throughout the year. In the following graph we can observe the variability in the flow in July 2015 in Talavera<sup>xi</sup>:

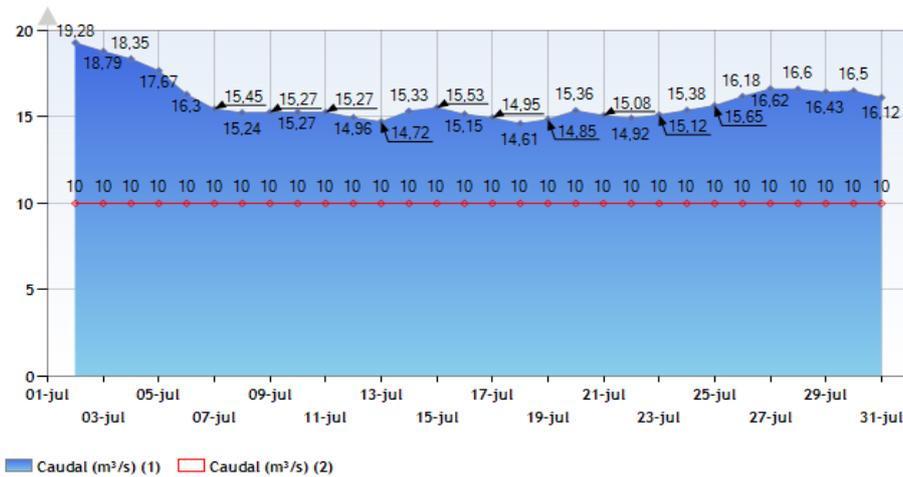


Figure 12: Tajo's flow at Talavera during July 2015. Source: Confederación Hidrográfica del Tajo

As we can observe, the river experiences low flows during some parts of the year, which makes it difficult for the plant to operate under a rated power condition during some parts of the year. Efficiency of the turbines is as well expected to fall during situations of low flows. Thus, a 70% of the total rated power will be taken into account for the calculations. We obtain the following daily generation profile for the small hydro:

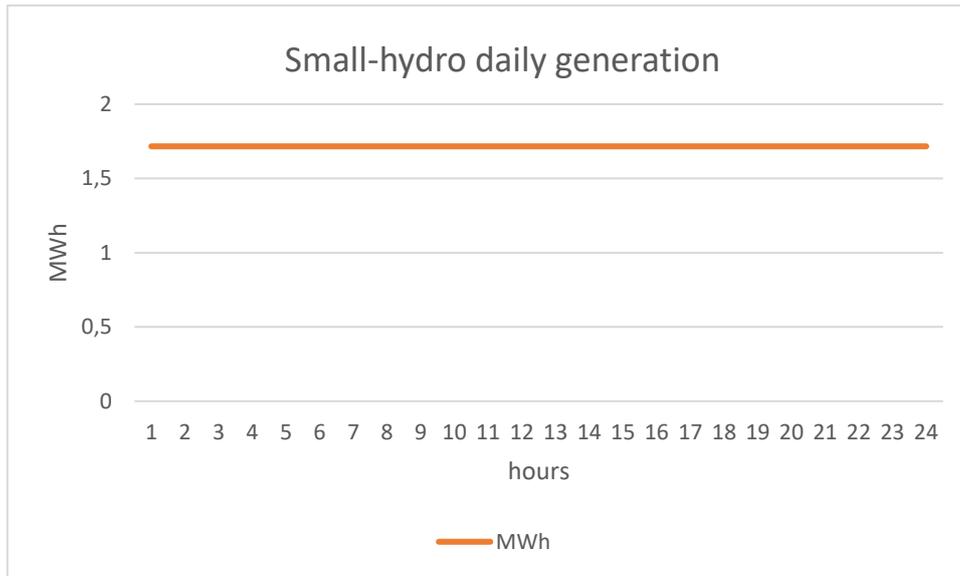


Figure 10: Daily generation profile of small hydro power units

### 3.3.2. Wind power plants

Wind power generation is one of the technologies with greater potential in the area, but currently there are no wind power plants in operation in the area of study. There are two windfarms planned in the area but its installation has not been authorised yet, due to problems with ecologist groups. The data of these windfarms will not be dismissed, as it is of great practical interest to develop a micro-grid that integrates diverse technologies. They are resumed in the following table:

Windfarm	Distance to Talavera de la Reina (km)	Rated power (MW)
La Nava de Ricomalillo	37,23	15,3
Puerto de San Vicente	54,47	40
<b>TOTAL</b>	0	55,3

Table 4: Windfarms nearby Talavera. Source: Boletín Oficial del Estado (BOE)

In the event of the installation of these windfarms, wind power generation will be the second largest renewable technology in the area. It will then play a major role in power generation in the micro-grid.

It is also important to take into consideration the high unpredictability of the wind for its use to produce electricity for the microgrid. This factor makes it extremely difficult to predict power supply from this technology in advance. Its notable weight in the micro-grid’s power production will make it necessary to install some kind of manageable technology that could secure power supply instantaneously. As a result, a typical production profile from this technology cannot be provided.

In the following figure the randomness of wind power production can be observed, with two very different production profiles in two consecutive days<sup>xii</sup>:

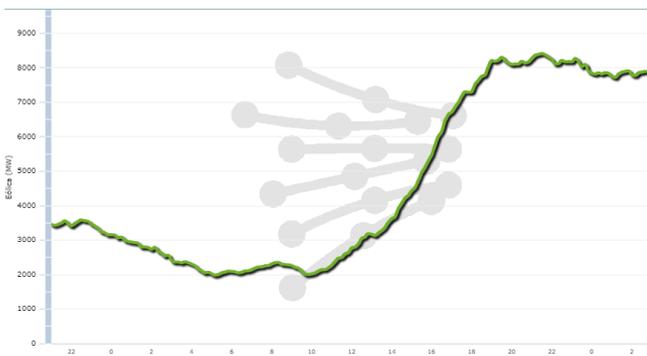


Figure 13: Wind power production in Spain on the 25th of April 2018. Source: REE

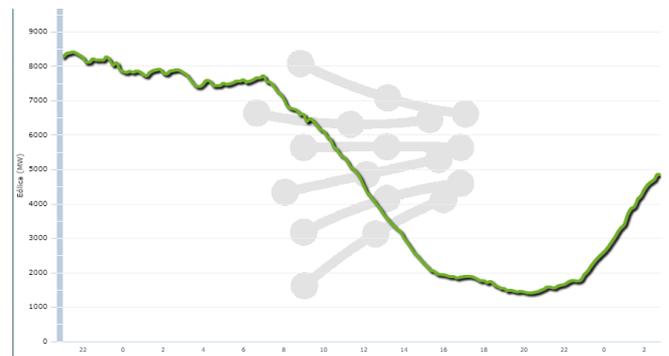


Figure 14: Wind power production in Spain on the 26th of April 2018. Source: REE

### 3.3.3. Solar PV plants:

In order to reduce costs and make the micro-grid simpler, only big-sized solar PV power plants will be taken into account in this project. Following the data from Minetad<sup>xiiiiv</sup>, there are currently 13 significant solar PV power plants in the area of study. Besides this, on the 13<sup>th</sup> of December of 2017, the official bulletin of the Castilla-La Mancha’s government (*“Diario Oficial de Castilla-La Mancha”<sup>xv</sup>*) published that a new solar PV plant was authorised to be installed in Carpio de Tajo. 158400 solar panels will be ready to provide power there by 2019. This power plant will be then included in the micro-grid, as it is a big power plant that will be installed in the near future. Thus, solar PV power plants are hereby presented:

<b>Name of Power Plant:</b>	<b>Power Installed (MW)</b>	<b>Distance to Talavera(km)</b>
Calzada de Oropesa	16	38,9
Los Navalmorales	8,12	38,3
Calera y Chozas	6	15,4
Alcolea de Tajo	4,4	31,9
Mejorada	4	7,2
San Martín de Pusa	2,8	31,16
Montearagón	1,8	16,96
La Pueblanueva	1,6	14,09
Erustes	1,5	28,36
Azután	1,1	32
San Bartolomé de las Abiertas	1	17,6
Talavera	1	5
Segurilla	1	7,5
Carpio de Tajo	50	30
<b>Total:</b>	<b>100,32</b>	-

*Table 5: Solar PV power plants nearby Talavera. Own elaboration*

Solar photovoltaic power production is highly dependent on weather conditions, as it can only produce power when there is daylight available, and its production is as well affected in situations of cloudiness and non-clear skies. As day hours and climate conditions are not stable throughout the year, it does not exist a unique production profile, but we can estimate one for an average day in Talavera de la Reina. Efficiency of the panels is as well affected by its inclination angle, varying significantly throughout the year and latitude. Given the fact that all these data are not known, the calculation of the daily profile is calculated with the power factor. The following figure is obtained:

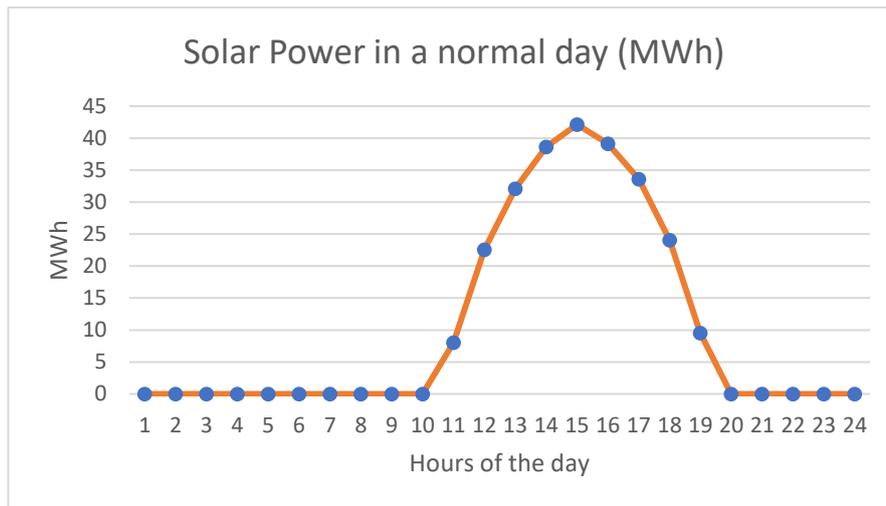


Figure 15: Solar Power in a normal day. Own elaboration

### 3.3.4. Biomass and CHP:

Biomass power plants produce energy out of burning biomass in a boiler. Due to its manageability, they could be very useful for the operation of the micro-grid. As there have not been found significant biomass power plants in the area, this particular power source will not be considered.

In the case of CHP (Combined heat and power), electricity is obtained by capturing residual heat from a thermal process, improving the overall efficiency of the plant. This kind of installations are as a result a great option for industries to obtain energy for themselves just by taking into advantage of existing process. The downside is that electricity production is strictly dependent on these industries. Existing cogeneration units installed in the area do not add up a very significant amount of energy. Also, a power profile would be very difficult to be made, so it has been decided not to include CHP in the micro-grid.

### 3.3.5. Recapitulation of technologies:

Given the data exposed before, only small hydro, solar PV and wind power plants will be included in the micro-grid. They are included in the following table:

<b>Technology:</b>	<b>Installed Capacity (MW)</b>	<b>Nº of units</b>
Solar PV	100,32	14
Wind Power	55,3	2
Small-hydro	8,054	4
<b>Total:</b>	<b>163,674</b>	<b>20</b>

*Table 6: Technologies included in the micro-grid. Own elaboration.*

As it can be seen, solar power generation is by far the largest installed technology in the micro-grid. It has the advantage that is more predictable than wind power, but it is as well less manageable, as at night there is no solar power generation. Wind power has as well a significant share of installed capacity, which will make it necessary to cope with its high variability. Solar power generation may make it easier to store energy for night periods, but still it will be important to pay attention to storage dimensioning.

#### 4. Plasma gasification process

As it has been observed in the previous section, it is necessary for the well-functioning of the micro-grid to complement its non-manageable renewable power plants with some kind of manageable resource that can give support to the micro-grid in situations of adverse climate conditions or peaks of demand. This manageable power source should react instantaneously to situations of fast changes in both the demand and the supply curve.

Moreover, there exists an increasing necessity to manage more efficiently waste products. EU regulations tighten more and more its specifications in terms of gas emissions and contamination. This project will take advantage of solid urban waste and forest and agricultural residues to produce hydrogen through a plasma gasification process, resulting into

an efficient and more clean way to produce energy and manage waste. This hydrogen will then be used to produce energy.

Below, a brief explanation of the different waste treatment techniques is exposed, and then it will be explained the reason towards the election of the plasma gasification process:

#### 4.1. Waste energy recovery techniques

There exist quite a few waste energy recovery technologies. In this section, all of them will be studied, and the most effective and efficient will be chosen for the micro-grid.

The main technologies are resumed in the following scheme<sup>xvi</sup>:

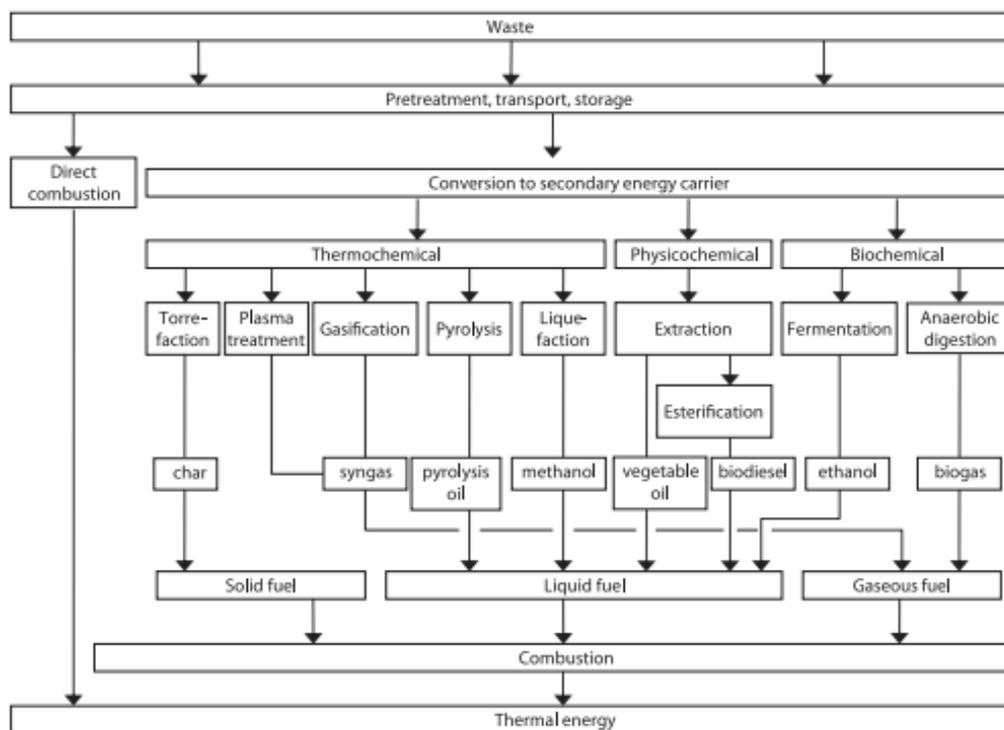


Figure 16: Waste-to-Energy Technologies. Source: Bosmans, Anouk, et al. "The crucial role of Waste-to-Energy technologies in enhanced landfill mining: a technology review." *Journal of Cleaner Production* 55 (2013): 10-23.

##### 4.1.1. Incineration (direct combustion)

Incineration can be resumed as the oxygenation of the waste product's materials. Waste is normally a conglomerate of different elements, containing mainly organic matter, water and minerals. During the process, a wide variety of gases such as  $CO_2$ ,  $N_2$ ,  $H_2O$  and  $O_2$  are produced, containing in the form of heat the majority of fuel energy. In addition to this, depending on the conditions of the incineration and the composition of the materials other toxic gases and heavy metal compounds can remain as well. Depending on the combustion temperatures during the main stages of incineration, volatile heavy metals and inorganic compounds are totally or partly evaporated. These substances are transferred from the input waste to both the flue gas and the fly ash. The quantity of solid waste varies greatly on the type of material. In solid urban waste, ashes make up to 25-30% by weight of the total input.

Besides, waste incineration process can be an environmentally friendly method if combined with energy recovery, emission control and an appropriate protocol for residues. Although, in order to achieve optimal efficiencies and effectivity, incineration plants must perform with engines and turbines, with start times long enough not to be optimal for the implementation in the micro-grid, which will need fast start times to respond instantaneously to changes in demand or supply. Indeed, in Castilla-La Mancha this technique is prohibited.

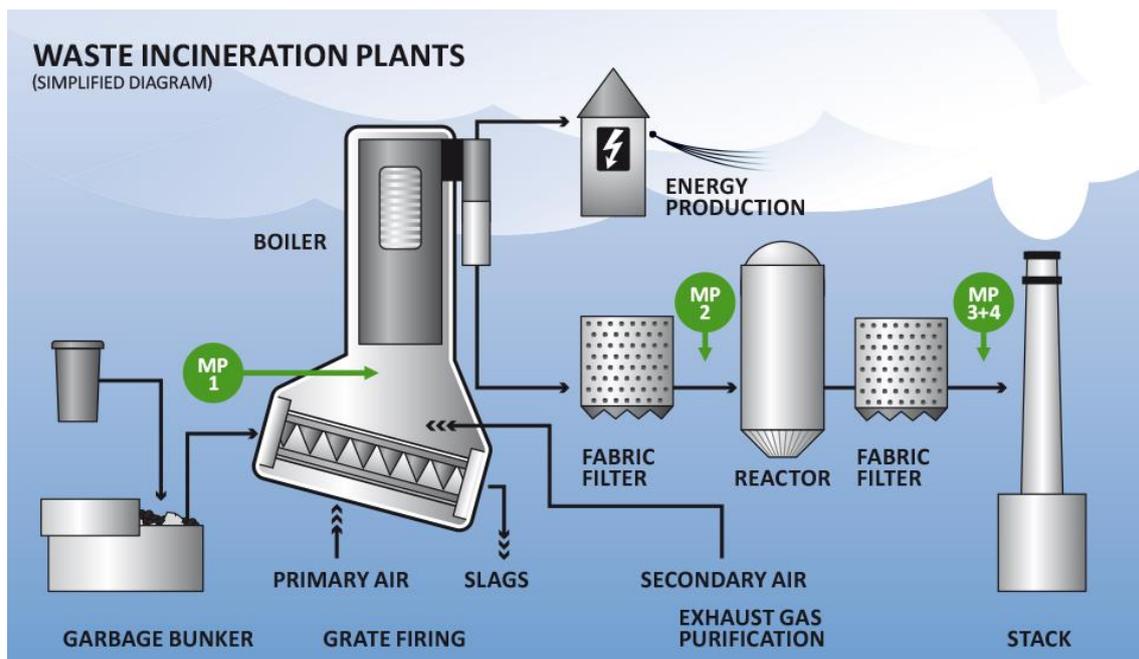


Figure 17: Waste incineration plant scheme. Source: M&C Tech Group

### 4.1.2. Pyrolysis

This process is carried out in absence of oxygen or, in some cases with only a small amount (e.g. partial gasification) in order to provide the necessary thermal energy that pyrolysis needs. It is characterised for low operating temperatures compared to plasma gasification (400-900 °C). Three substances are obtained through pyrolysis: solid coke a liquid product and a solid one. The process includes the following stages:

- Preparation: Waste products require some quality improvement in order to increase heat transfer.
- Drying: This process ameliorates the net calorific value of the gas and boosts efficiency of reactions.
- Waste pyrolysis: Not only the pyrolysis gas is obtained, but also a solid residue accumulates.
- Secondary processing of pyrolysis gas and coke: Condensation of the gases in order to obtain usable oil mixtures for energy purposes and/or incineration of coke and gas for destruction of organic matter and simultaneous energy utilization.

There exist a few pyrolysis technologies. They are summarized in the following table:

Pyrolysis technology	RT	HR	$T_{max}$ [°C]	Product
Carbonization	Hours-days	Very low	400	Charcoal
Slow	5–30 min	Low	600	Charcoal Pyrolysis oil Gas
Fast	0.5–5 s	Fairly high	650	Pyrolysis oil
Flash				
Liquid	<1 s	High	<650	Pyrolysis oil
Gas	<1 s	High	>650	Chemicals Fuel gas
Ultra	<0.5 s	Very high	1000	Chemicals Fuel gas
Vacuum	2–30 s	Medium	400	Pyrolysis oil
Hydropyrolysis	<10 s	High	<500	Pyrolysis oil Chemicals
Methanopyrolysis	<10 s	High	>700	Chemicals

Table 7: Waste-to-Energy Technologies. Source: Bosmans, Anouk, et al. "The crucial role of Waste-to-Energy technologies in enhanced landfill mining: a technology review." *Journal of Cleaner Production* 55 (2013): 10-23.

As it can be observed, waste products require to be treated before pyrolysis, and also the process itself has got a few complicated steps, that are presumed to increase significantly its cost. Thus, this technology will be as well discarded.

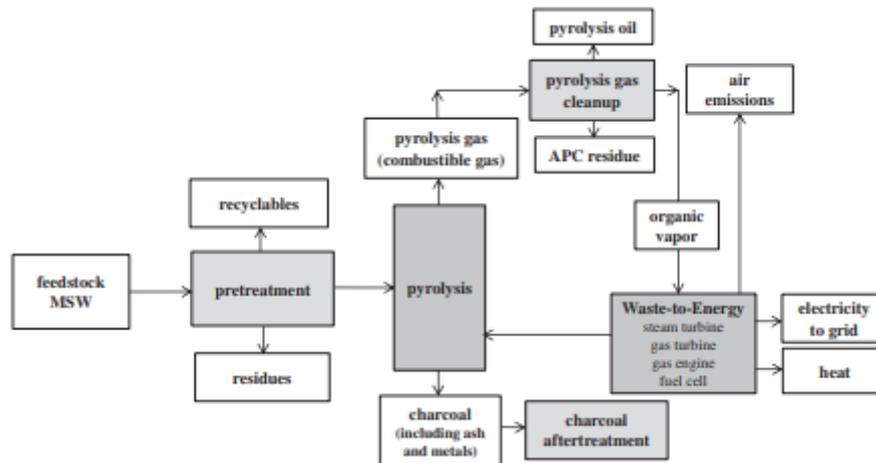


Figure 18: Pyrolysis process. Source: Bosmans, Anouk, et al. "The crucial role of Waste-to-Energy technologies in enhanced landfill mining: a technology review." *Journal of Cleaner Production* 55 (2013): 10-23.

#### 4.1.3. Controlled Landfills

Another practical way to manage waste is with controlled landfills. It is the most common way of managing waste in Spain and in Toledo province. A controlled landfill is a structured built in the ground isolated from it. Its main function is the elimination of residues minimizing the effects on the nearby habitat. Waste is placed in thin layers in the deposit.

Waste products suffer a process of fermentation, obtaining CH<sub>4</sub>, CO<sub>2</sub> and other contaminating materials that should be controlled. These gases are used to fuel combustion engines in order to produce electricity.

The advantages of this process are that far cheaper than the other technologies. The only costs related to this technology are the investment costs of the deposit and the running costs of the plant.

The downsides are few:

- The lifespan of a landfill is around 20 years. After the closure of the plant, it will still require control for the leachate formation and methane emission for about 40 years.
- The methane will be used to power up combustion engines with low efficiencies and slow start times, which make it an ineffective technology for the micro-grid's specifications.

#### 4.1.4. Anaerobic Digestion

Anaerobic fermentation of the residues in the presence of bacteria and muds. The biogas obtained from the process can be utilised in turbines, producing energy. This process has been dismissed for its utilisation in the micro-grid for the same reasons of the others. This technology is not suitable for its implementation in the micro-grid.

#### 4.1.5. Plasma Gasification

Plasma can be defined as an ionized gas at a high temperature. The high temperatures that take place during the plasma gasification process result in the division of the organic matter into its fundamental components. A high energy synthesis gas rich in hydrogen and carbon monoxide is produced. The main advantage of this process is that in this case dioxins are broken down, and the syngas is then a clean one. An important point to add is that all the inorganic matter is melted into a vitrified material that can be used as a material additive.

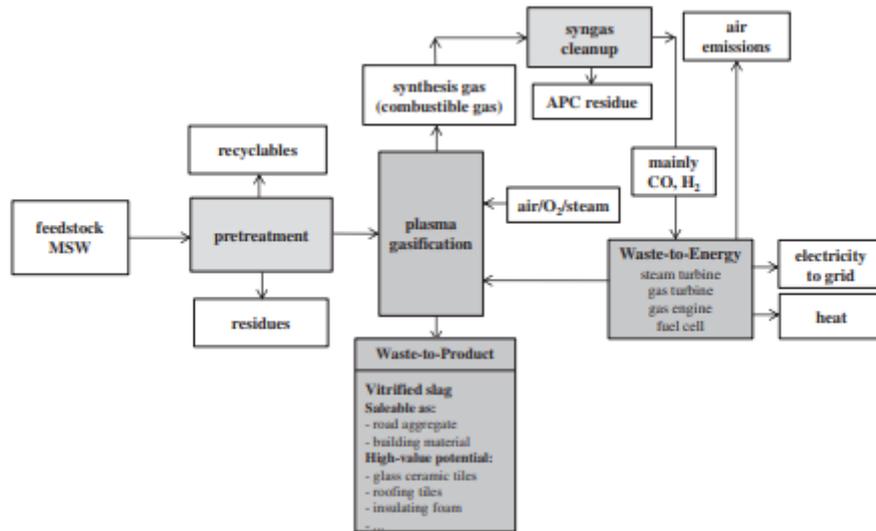


Figure 19: Plasma gasification scheme. Source: Bosmans, Anouk, et al. "The crucial role of Waste-to-Energy technologies in enhanced landfill mining: a technology review." *Journal of Cleaner Production* 55 (2013): 10-23.

This technology is finally the most appropriate one to be implemented in the microgrid, as it allows a great manageability through the usage of hydrogen in fuel cells, being able to respond to demand or supply shifts accurately. Moreover, no additional process prior to the introduction of the waste material is needed, and all kind of residues can be used to be processed. Gas emissions related to the process are much lower than in other cases like incineration, and no contaminating waste products are obtained. All in all, it can be said that it is the most clean and practical option available.

## 4.2. Waste resources in Talavera de la Reina

Talavera, as a city of 83303 inhabitants, produces a significant amount of waste product. One of the main goals of the project is to take advantage of them and produce power, and at the same time to manage them in a sustainable and efficient way. Thus, the city of Talavera is a source of solid urban waste, and the area around the city produces forest and agricultural residues as well.

### 4.2.1. Solid Urban Waste (SUW)

Solid urban waste can be defined as all kinds of residues generated by households or companies; collected by municipal entities. Cities are, as a result, the main source of SUW. This phenomenon has experienced throughout the last decade a substantial decrease, due to an improvement in efficiency and a significant drop of demand. In addition, through the last decade, recycling and waste-to-energy technologies have been in the spotlight on waste treatment terms. In the following figure, the evolution of the production of SUW in Europe over 2004 and 2012 can be observed<sup>xvii</sup>:

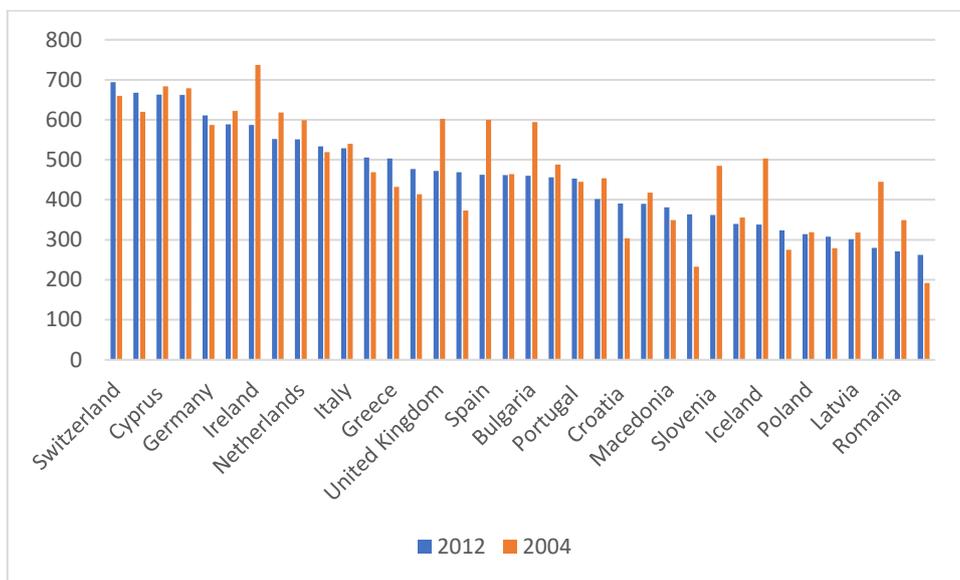


Figure 20: SUW in Europe per capita in kg. Source: Eurostat

Solid Urban Waste in Talavera de la Reina is currently managed by GEACAM, the regional waste management company of Toledo province. This company manages the collection and treatment of SUW in 98% of the total municipalities of the province, which constitutes 68% of its total population<sup>xviii</sup>.



Figure 21: Evolution of SUW collection by GEACAM. Source: GEACAM

Currently the energetic valorization of SUW produced in Talavera is carried out in the “Ecoparque de Toledo”. This plant was thought on the forecast of a growth of population in the province and with the necessity of the improvement of efficiency of SUW management centralising its operation. It was inaugurated in March 2012, designed to give service up to 650000 persons and being able to manage as much as 250000 tons of waste per year. It has the following specifications:

- Access area for waste control.
- Vehicle unloading platform.
- SUW selection and valorisation plant. Capacity: 250000 t/year.
- Bio-stabilization plant for the treatment of the organic SUW fraction. 125000 t/year of capacity.
- Fuel generation plant from waste products. Potential of 6000 t/year.
- Deposit for the rejection fraction of SUW.
- Several deposits for the treatment of leachates generated in the controlled deposit.

The problem that the existing system poses for the project is the location of this plant. The micro-grid requires a nearby location in order to achieve the goal of lower transport losses and increased efficiency. Thus, the SUW treatment should be carried out in another plant. In the past, the valorisation of SUW produced in Talavera was managed in Talavera’s waste treatment centre, finishing its operations in July 2015, transferring its full capacity to Toledo’s Ecoparque. Now it has been converted into a waste transfer and light packaging treatment centre. As the main objective of the project is to decentralise and generate power near its consumption, the waste treatment centre of Talavera will be recovered for Talavera’s SUW production.

SUW in Talavera de la Reina will be collected for the project, which in words of GEOMAT make it 15,2% of mass of total SUW (194944,25 tons in 2016) collected and transferred to Toledo's Ecoparque. In the Ecoparque, in 2016, 9,38% of the total input is recovered for recycling. The rest passes a process of bio-stabilisation. In the recovered Talavera's SUW treatment centre, it will be supposed an equal fraction of recovered materials, and the rest will be used to fuel the plasma gasification plant. As a result, it can be deducted:

$$194944,25 \times 0,152 = 29631,53 \text{ tons collected in Talavera}$$

$$29631,53 \times 0,0938 = 2779,44 \text{ tons recovered for recycling}$$

Given these data, it can be seen that 26852,09 tons a year could be used for plasma gasification purposes.

Taking into account that the majority of this waste is organic matter, with a calorific value of 30000 kcal/kg, the following energy could be obtained out of it:

As 1kcal/h is equal to 1,163 W:

The waste produced will be able to provide 10,695 MW per hour without considering efficiencies of the plasma gasification process.

#### 4.2.2. Forest residues

Forest residues will be utilised through the collection of residual forest biomass. **Residual forest biomass** includes any forest biomass obtained through the realisation of any treatment or forestry utilisation of forest mass, without considering commercialised products<sup>xix</sup>.

Specifically, it encompasses:

- Tree regeneration felling
- Improvement felling or intermediate treatments
- Pruning: With different goals like fire prevention, fruit production improvement, health or aging.
- Thicket grubbing.

Forest areas in Castilla- La Mancha can be seen in the following map:

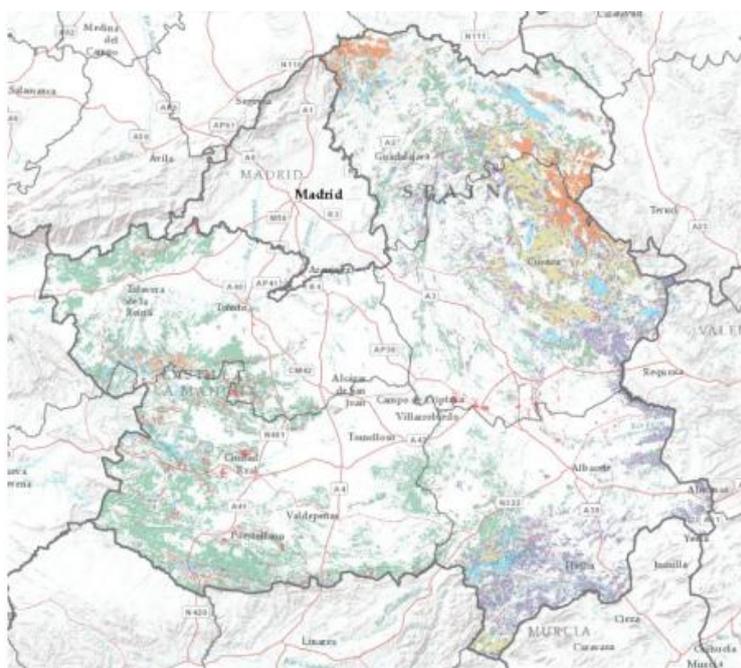


Figure 22: Forest Areas Castilla- La Mancha. Source: Junta de Comunidades de Castilla-La Mancha

It can be observed that the province of Toledo is the one with less forest resources in Castilla-La Mancha, and inside the province it is in fact the area of study the one that concentrates

more forest biomass. The residual forest biomass data of the region is resumed in the following table:

<b>Name:</b>	<b>Residual Forest Biomass (t/yr)</b>
Tree fraction	517393
Underwood Scrub	128801
Sparse woodland	21390
Other	46207
<b>Total:</b>	<b>713791</b>

*Table 7: Usable Forest Biomass Fractions. Source: "Regional Strategy for Forest Biomass", Council of Agriculture, Environment and Rural Development of Castilla-La Mancha*

It can be observed that the tree fraction is the main contributor of RFB in the region, and that underwood scrub is a significant contributor as well. From the document, it was stracted as well that it is the 10,44% of the total tree fraction the one that corresponds to Toledo's province. If we extend that proportion to the total RFB, it makes 74519,8 tons a year of usable forest biomass a year in the province.

It would not be accurate to make the calculations if the ground's slope is not considered. This factor is regularly considered in a coefficient, being 0,6 the one for slopes smaller than 12,5%, that is by far the most common in the area. As said before, the area of study makes the majority of the forest biomass in Toledo province. A 70% fraction of the total resources of the province will be used. All in all, taking into account all these factors, the following is obtained:

$$0,6 \times 0,7 \times 74519,8 = 31298,316 \frac{\text{tons}}{\text{year}}$$

If this forest residues have a mean calorific value of about 4300 kJ/kg, following the same procedure as for Solid Urban Waste, a total of 17,868 MW.

### 4.2.3. Agrarian Waste

Agrarian waste encompasses all waste products derived from the primary sector activity: This is agricultural residues and farming waste.

Following the data from the “Waste management plan of Castilla-La Mancha”, elaborated by the Council of Agriculture, Environment and Rural Development, in 2014 <sup>xx</sup>there were produced 353269,37 tons of waste, of which 48025,98 were not recycled. This is the portion that will be useful for the project, as it has been considered that the usage of agrarian waste for compost-making purposes is an appropriate and sustainable method.

Taking into account that the province of Toledo has one fourth of the total area destined to primary sector activities, and that the area of study is roughly 30% of the area of the province, it could be said that 12% of the total waste is produced in the area. This means that 5763,12 tons of waste can be used to power up the micro-grid.

Considering a mean of 3200 kcal/kg of waste, following the same procedure as for SUW, a total of 2,45 MW of power is obtained from Agrarian Waste.

#### 4.2.4. Waste Compendium

In the area of study, three kinds of waste products have been observed, and will be considered for its usage in the micro-grid. They are grouped in the following table:

Waste Type	tons/yr	fraction of total (%)
SUW	26852,09	42,01
Forest residues	31298,316	48,97
Agrarian Waste	5763,12	9,02
<b>TOTAL</b>	<b>63913,526</b>	<b>-</b>

*Table 8: Types of residues and their contribution to the micro-grid. Own elaboration*

As the micro-grid requires a constant flow of fuel to provide manageable support to renewables, it does not seem accurate to rely fully on forest and agrarian residues, as they are often seasonal and irregular throughout the year. On the other hand, SUW appear as a constant and secure source able to take the responsibility to feed the system regularly. For the dimensioning of the waste products, it will then be considered the total amount of SUW and the 60% of the sum of the rest of the resources:

$$26852,09 + 22236,86 = 49088,95 \frac{t}{yr} = 134,49 \frac{t}{day}$$

As the flow of waste will be often higher and to round out to a closer market specification number, the rated flow of the plasma gasification plant will be fixed at 250 t/day.

### 4.3. Plasma

Plasma is the fourth state of aggregation of matter, where almost all atoms are ionized and there is a presence of free electrons. It is then a fluid formed by ions and electrons. It can be also defined as an ionized gas at a high temperature. Plasma is generated when gas molecules collide in high energy conditions resulting into charged particles. For this process it is necessary to provide an electric current or electromagnetic radiation. Plasma is the most abundant state in nature, as the majority of the Universe's visible matter (intergalactic plasma and stars) are in this state.

Plasma has a wide variety of applications in the industry and is present in many research areas, such as fusion power or enhanced oil recovery, but the most relevant one for the project are its waste-to-energy applications, such as plasma pyrolysis and plasma gasification.

#### 4.4. Plasma gasification technology features

The project proposes the possibility to convert waste products produced in proximity into a gas that could be used for power generation means. The chosen method is plasma gasification technology.

The process is carried out at a high temperature (5000 °C), the organic matter decomposes into its fundamental components, forming a high-energy gas mainly made-up of carbon monoxide and hydrogen. Its key advantage compared to other waste valorisation technologies is that char and dioxines are broken down. This synthesis gas can be used to produce energy in a clean and efficient way. In addition, all the inorganic matter is melted into a vitrified material that can be used as a material additive. <sup>xxi</sup>

#### 4.5. Direct Plasma Converter System

##### 4.5.1. PROCESS PHASES

The process's phases are described in the following figure:

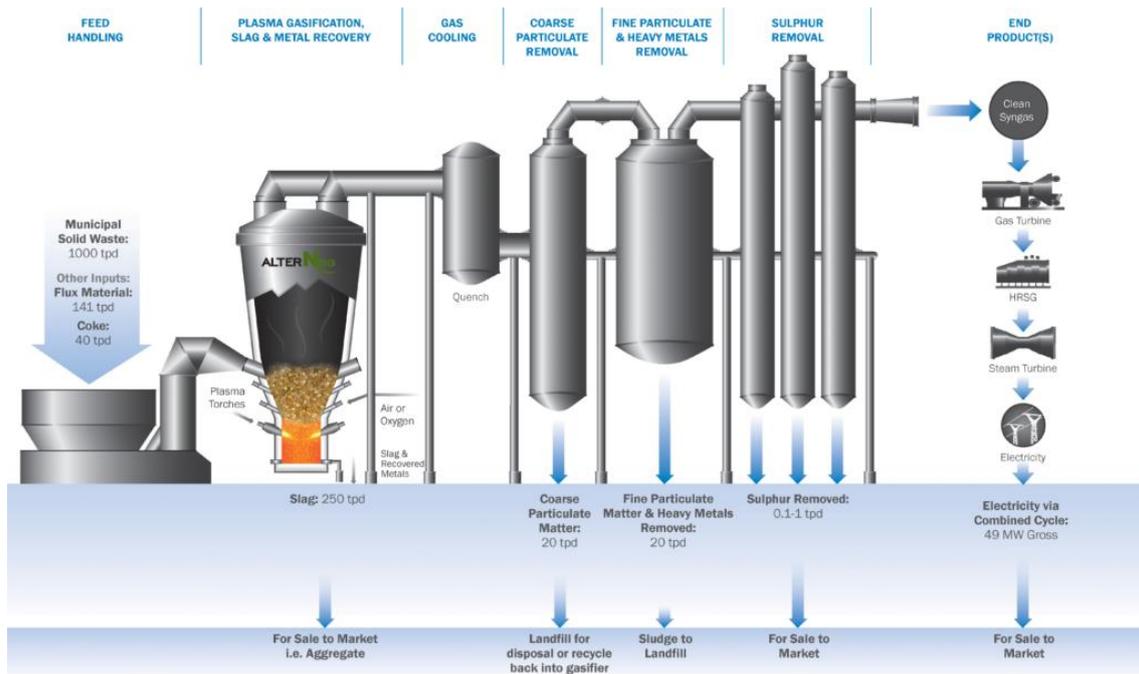


Figure 23: Plasma Gasification Phases for a 1000 tpd installation. Source: Alternrg

a) **Phase 1: Feed Handling**

Unlike other waste-to-energy processes, this technology can deal with a wide variety of residues, formed by different elements. In order to maximize efficiency, some pre-feeding treatments are carried out:

- **Size reduction:** This process makes it easier to introduce residues into the reactor, making the specific weight of the elements higher. Crushers and hammermills are utilised in this stage.
- **Separation:** By implementing this process, a more uniform syngas is achieved, its composition will not vary. The residue will be of better quality and more homogeneous. Optical, magnetic and ballistic separators are employed depending on the characteristics of the residue.
- **Compaction:** The goal of this stage is to increase the material’s density, ameliorating the residue’s transport and storage. The best option is the pelletization of the residues, facilitating waste storage for months without deteriorating.

- **Humidity reduction:** In this stage, the heat produced during the dissociation process is utilised to reduce humidity of the waste products, improving the efficiency of the process. Humidity reduces from 15% to 5%.
- **Feeding:** This last stage is performed via a line feeding. In this way, a continuous input of residues is assured. The system calculates as well the input flow in every moment, to guarantee that the optimal one is being provided.

Another fact to be taken into account is the feeding system, that is in charge of introducing the appropriate gases for the plasma process to take place. They are the following:

- **Oxygen gas:** Generates the necessary oxidizing atmosphere.
- **Plasmogen gas:** Feeds the torches towards the plasma formation.

#### b) Phase 2: Dissociation and slag & metal recovery

This process takes place inside the reactor, and achieves the dissociation of the input substances breaking molecular bonds. The voltage difference between two electrodes provokes the electric arc, resulting into a significant increase of the temperatures that allows the dissociation to take place. As a result of the process, a synthesis gas and vitrified slag are obtained.

The voltage difference is generated by the plasma torch, fed by a DC current generator. An oxygen gas is as well introduced in the reactor for the necessary oxidizing atmosphere to be created.

In the following figure the transformations that matter experience at a wide range of temperatures are shown. Dissociation is produced between 2700 and 5000°C. Then, 5000°C is the expected temperature for the matter to experience complete dissociation.

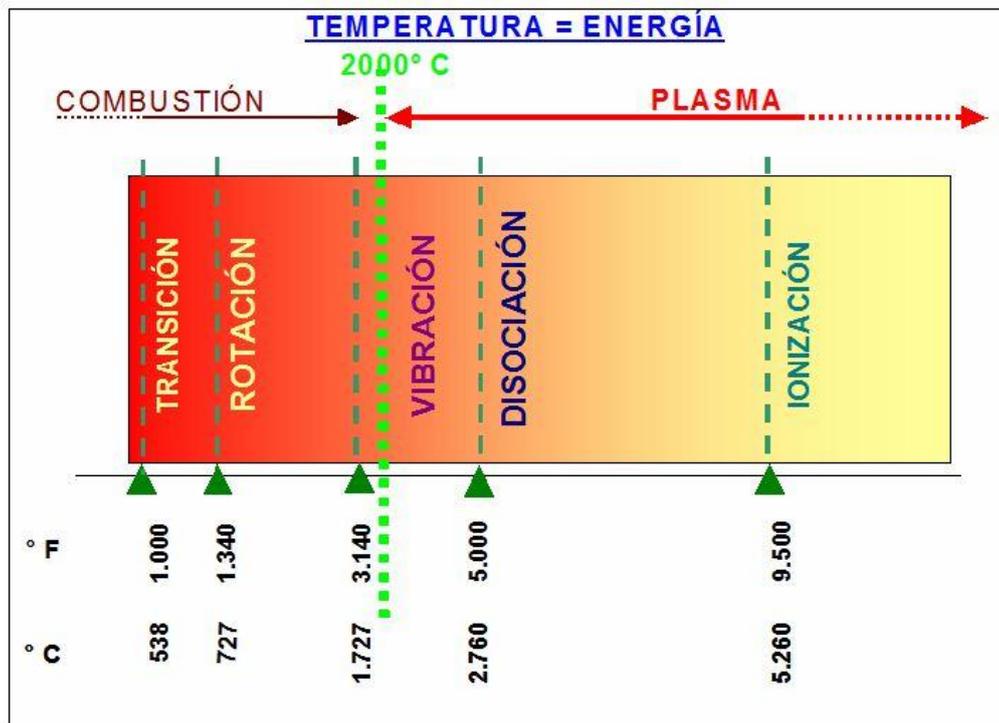
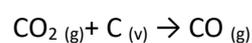
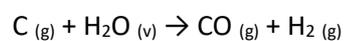


Figure 24: Range of temperatures for different matter transformations. Source: Acciona

Dissociation takes place in a reductive atmosphere and at a high temperature (2700-5000 °C). During this stage, the following process take place: <sup>xxii</sup>

1. **Thermal cracking:** Bigger molecules derive in lighter ones, forming hydrogen and hydrocarbon gases.
2. **Partial Oxidation:** It allows the formation of carbon monoxide through the oxidation of carbon atoms. Little amounts of carbon dioxide and water appear as a subproduct of the oxidation reactions, creating a negative impact on the calorific power of the syngas. It is then necessary to control the inlet of oxygen in the reactor.
3. **Reformation:** Primary elements are combined with the purpose of creating new molecules, specially hydrogen and carbon monoxide. The following chemical reactions occur:



The bottom of the reactor is covered with a bath of molten sand due to high temperatures. Thus, heavy inorganic material gets trapped in that silicon-rich sand. The result of this interaction is an innocuous non-dangerous silicate crystal that can be used in the construction industry. SUW residues are reduce at a 300:1 scale in dissociation.

The forthcoming tools are utilised in dissociation:

- **The reactor:**

It is the area where the dissociation takes place. It consists mainly of two differentiated parts: The body and a stainless-steel closing cap. It is essential that both parts are effectively sealed for the well-functioning of the process, and for that purpose the body will be operating at negative pressures, avoiding syngas leakages. In the figure, a scheme of a plasma reactor can be observed:

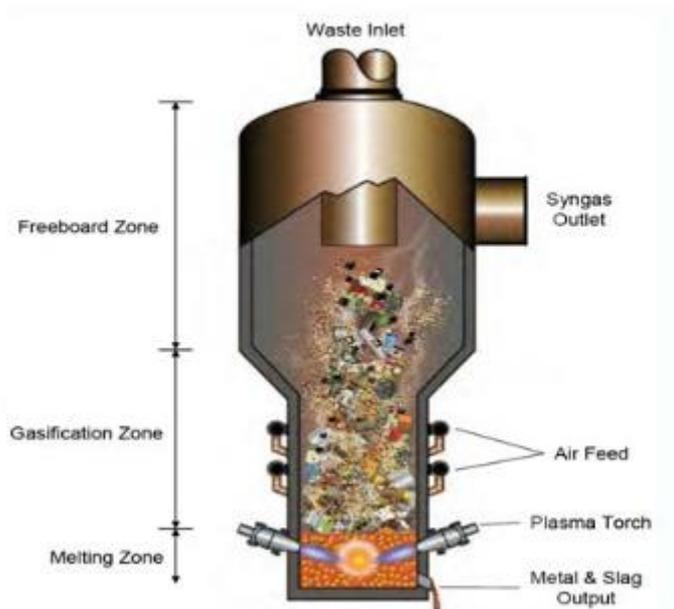


Figure 25: Plasma reactor scheme. Source Commonwealth Scientific Industrial Research Organisation (CSIRO)

In order to make the reactor more efficient, the walls of the body of the reactor are covered with refracting material. Temperatures inside the reactor are then kept over the limit for acid gas condensation, as its appearance in the syngas is not desired.

The temperatures along the reactor are shown in the upcoming figure. It can be observed that greater temperatures are achieved at the torch (6000°C), while at the rest of it they are considerably lower (1400°C on average).

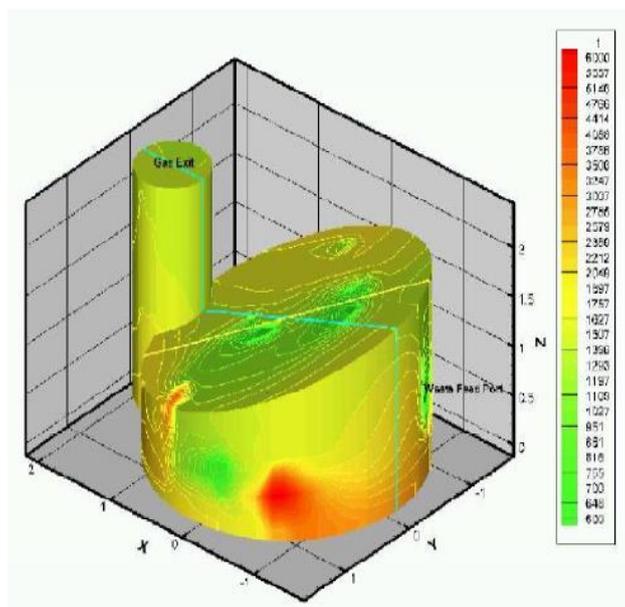


Figure 26: Temperature profile over the reactor. Source: Westinghouse

#### - The plasma torch:

This element is in charge of igniting the electric arc, generated by the voltage difference between the anode and the cathode. As it has been said it is the place

where higher temperatures (6000°C) are reached. The torch operation will require an electric generator and a refrigeration system.

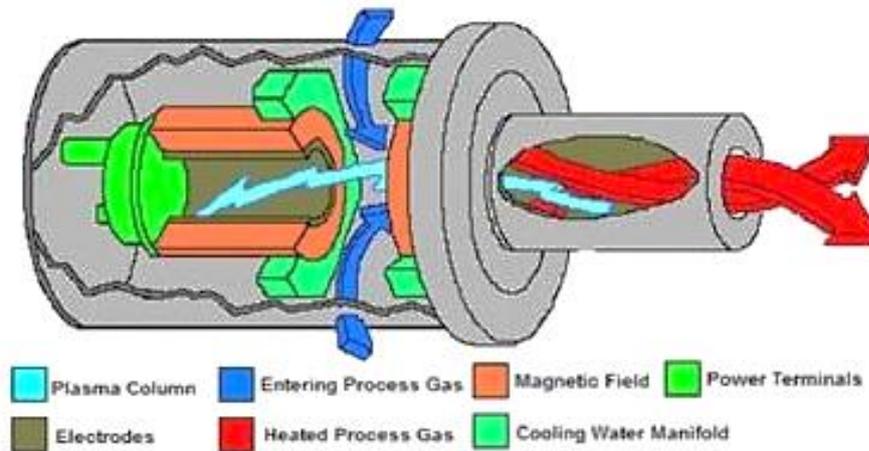


Figure 27: Scheme of a plasma torch. Source: Westinghouse

There exist two types of plasma torches:

- a) Transferred torch: In this case, the arc is generated by an anode situated in the in the torch, that needs to be replaced periodically, and a cathode placed in the base of the reactor. Heat is transferred by radiation, convection and conduction. This torch is suitable for situations where it is required to melt substances or for conducting materials.
- b) Non-transferred torch: For this element, both the anode and the cathode are placed at the torch. Energy is transferred via radiation. It is used both for conducting and non-conducting materials. This is the chosen technology for the project, as it is cheaper than the other one and good enough for its specifications.

- **DC current generator:**

This element is strictly necessary to be able to feed the plasma torch.

- **Refrigeration system:**

It is required in order to protect the device from the exposure to high temperatures and to extend its lifespan. Deionized water is employed for this process, pressurized in a closed circuit.

It consists of a heat exchanger with another water circuit that at the same time exchanges heat with an air flow.

- **Gas system**

A gas flow is required for the electric arc to be created. This plasmogen gas can be argon, helium, nitrogen, hydrogen or air, being the last one the most commonly used as it is the cheapest. Its flow rate is controlled by a control system.

- **Control system**

It consists of a PLC (Programmable Logic Controller) system. It is in charge of regulating the feeding rate of the process, the flow of plasmogen gas into the reactor, monitor and adjust the composition of the gas in real time and control of the DC current generator.

All is supervised from a central position by an IT system of human interface.

- **Vitrified material collection system**

Vitrified material collection can be carried out in two different ways:

- **Laterally by inclination:** In this case extraction is not continuous, although this fact is not required as the vitrified slag is not produced in large quantities. It is in fact the most common extraction technique.
- **By a mechanic extraction system:** Usually a worm drive. In this case the extraction is continuous.

In the case of the project, a worm drive seems to be the best option, as the accumulation of vitrified slag is avoided, leaving the material exit clear. After the extraction, the vitrified material will be cooled down by water. Thus, the material will form small fractions that can be easily manipulated.

c) **Phase 3: Gas Cooling**

The temperature of the syngas obtained at the end of the dissociation process rounds 1500 °C. It is highly recommendable to cool the gas down in order not to damage the rest of the components of the plant. Indeed, the heat obtained at this stage is utilised for energy production means in a Rankine cycle and to dry up residues at the first phase.

d) **Phase 4: Filtering**

The syngas obtained at the end of phase 3 is mainly composed of carbon monoxide and hydrogen, but it also contains other particles that diminish the quality of it. It is then required to filter the gas and purify it.

For this task, a cyclonic separator will be implemented. Its main working principle is the difference in density between solids and gases. The gas flux is forced to circulate following a helicoid. The centrifugal force makes the solid particles to collide with the device's walls, and then fall to the bottom due to the gravitational force. The resulting gas is extracted by a conduct situated at the top of the device:

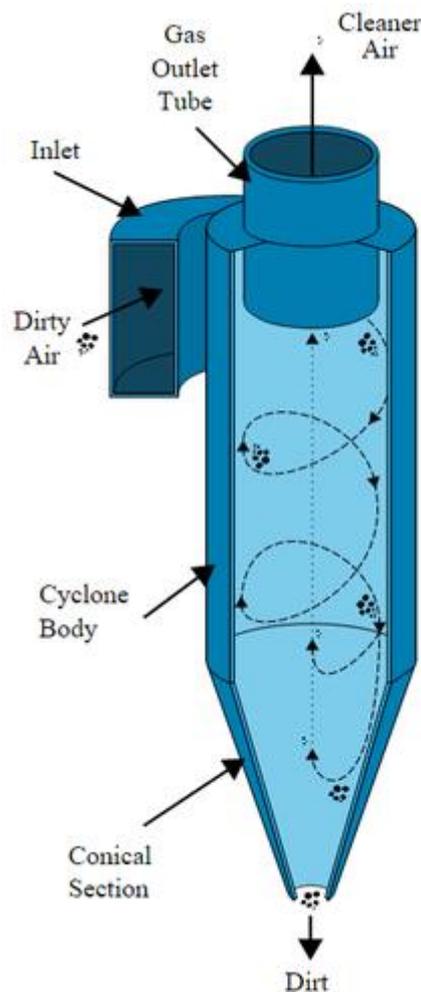


Figure 28: Cyclone separator scheme. Source: [energyeducation.ca](http://energyeducation.ca)

The overall efficiency of the process can be from 65 to 99%. Its cost is as well one of the main advantages, as its investment and running costs are significantly low. The main downside is that the efficiency decays when the process small particles.

e) **Phase 5: Sulphur Removal**

At this final stage, the syngas is going to be neutralised from halogenated components that still remain on the gas. A Scrubber & Quench combined system will be implemented for this purpose.

With this washing system, the gas will be “showered”, removing halides from the gas, and obtaining salt water as a subproduct. The output gas, still containing sulphurs, will pass through a high-efficiency HEPA filter (High Efficiency Particle Arresting), eliminating this components in the presence of active carbon.

The main scheme of the process is the following:



Figure 29: Washing System Scheme. Source: Plasma Gasification Material Julio Montes

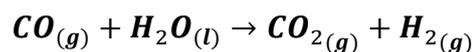
At the end of the process, a clean syngas at a temperature of 27 °C is obtained with the following composition:

Component:	Mass Fraction
Carbon Monoxide (CO)	77,6
Hydrogen (H <sub>2</sub> )	4,46
Nitrogen (N <sub>2</sub> )	7,11
Carbon Dioxide (CO <sub>2</sub> )	6,67
Water (H <sub>2</sub> O)	2,93
Argon (Ar)	1,22
Sulphuric Acid (H <sub>2</sub> S)	0
Methane (CH <sub>4</sub> )	0,01

*Table 9: Syngas composition at the end of phase 5*

The percentage of hydrogen existing in the syngas at the end of phase 5 is not as significant as the quantity of carbon monoxide. This problem will be sorted out with the following processes:

- **Shift reaction:** In this stage, the fraction of hydrogen present in the syngas will increase through a reaction of carbon monoxide and water that will result into carbon dioxide and hydrogen. An iron catalyst will be used to carry out the reaction:



- **Carbon Dioxide Capture:** This stage has the purpose of eliminating CO<sub>2</sub> from the syngas. CO<sub>2</sub> experiences a solvent bath.

## 4.5.2. Syngas characteristics

After all the processes, the syngas is mainly composed of hydrogen and carbon monoxide in volume (about 80% of the total volume). In addition to these gases, other ones appear in a smaller proportion:

Gas	% Volume
Carbon Monoxide	25-40
Hydrogen	40-60
Carbon Dioxide	3-5
Nitrogen	2-15
Hydrocarbons	1-5

Table 10: Syngas final composition. Source: Julio Montes Plasma Gasification Documents

One of the main advantages of this technology compared to other waste-to-energy technologies is the fact that the mass proportion of the syngas does not vary significantly regardless of the kind of residue introduced in the plant, although the volume one does. This phenomenon can be observed in the following graph, adding the fact that the total quantity of it changes noticeably:

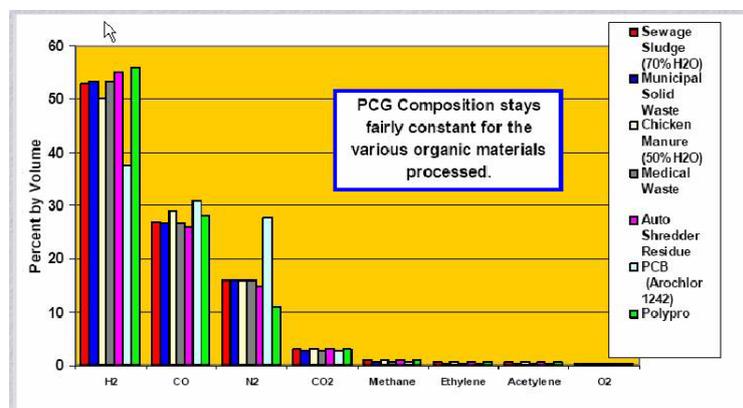


Figure 30: Gas fractions by residue.

### 4.5.3. Dimensioning of the plasma gasification plant

As it has been said, the rated waste capacity of the plant will be 250 t/ day. It was the closest waste capacity number available in the market, as the plants commercialised by *Materiales Renovados* allow up to 5,10,35,50,,125,250 t/day and the maximum flow calculated was 134,49 t/day.

SUW provides a constant amount of waste every day. Forest and agrarian residues, on the other hand, are seasonal. They will be stored when there is an excess of them so that they can be used when there is a lack of supply from these sources. Based on the existing forest areas, crops and farms in the area of study, the following collection profile is obtained:

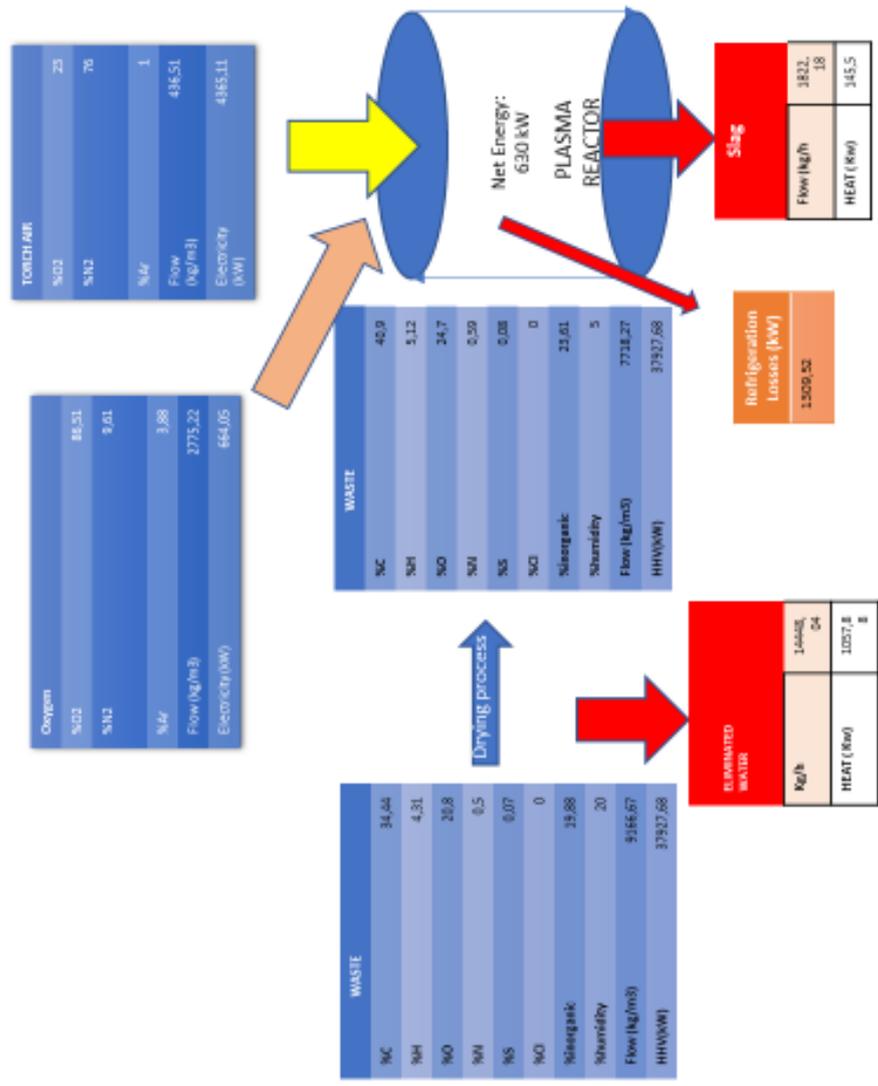
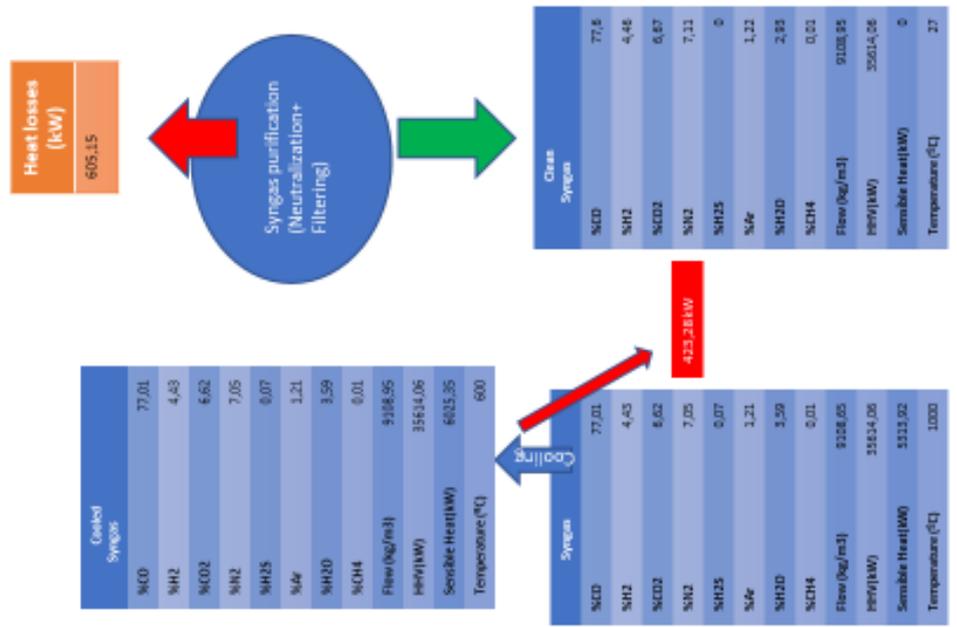
	Janu ary	Febru ary	Mar ch	Ap ril	M ay	Ju ne	Ju ly	Aug ust	Septe mber	Octo ber	Nove mber	Dece mber
SUW												
Fores t resid ues												
Agrar ian resid ues												

Table 11: Wste recollection profile in the area of study. Own elaboration

The fact that forest and agrarian waste can be stored and used later when needed, creates a power reserve system crucial for the plant's operation, avoiding having to oversize the plant's installations.

#### 4.5.4. Energy balance

The energy balance of the process is shown below:



### 4.5.5. Heat recovery system

As it has been said before, when the syngas comes out of the reactor its temperature rounds 1000 °C. In order to increase the durability of the rest of the items implicated in the process afterwards, a cooling system is required.

The project will implement a Rankine cycle that will cool the gas down to 600°C, and will utilise that released heat to improve the plant's efficiency. More precisely, the cycle will:

- Take advantage of the heat released, introducing the gas in a turbine and producing power out of it. This electricity could be used to power up intermediate machines in the plant.
- Heat capture through a condenser, that will be used to dry up the input waste, improving the overall efficiency of the process. The humidity of the waste products will decrease from 20% to 5%.

The cycle's scheme is presented below:

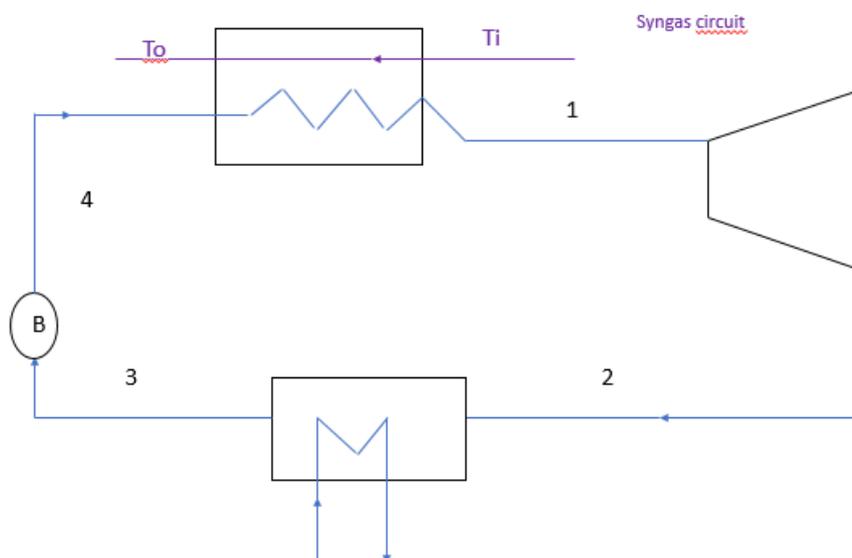


Figure 31: Rankine Cycle

The presentation and dimensioning of the different cycle components is presented below:

a) **Boiler:**

The boiler is basically a heat exchanger, whose function is cooling down a substance at a constant pressure at the expense of another one that is warmed up. In this boiler, the syngas experiences a decrease of temperature from 1000°C to 600°C at a constant pressure of 50 bar. There are two circuits:

- The syngas circuit, where heat is released to the water circuit. The amount of transferred heat is calculated below:

$$Q = \dot{m} \times C_p \times \Delta T;$$

Where  $\dot{m}$  is the syngas flow exiting of the reactor and  $C_p$  is the specific heat at a constant pressure coefficient ( the one of CO, as is the most abundant substance in the gas). Therefore:

$$Q = 2609,39 kW$$

- The water circuit, where water absorbs the heat released from the syngas, and is converted into gaseous vapor. Taking into account a 90% efficiency in the boiler, the transferred heat to the water circuit will be:

$$Q_{trans} = 2609,39 \times 0,9 = 2348,45 kW$$

Therefore, points 1 and four are determined:

Point	Temperature (°C)	Pressure (bar)	Enthalpy (kJ/kg)
4	49,25	50	192,65
1	500	50	3666,02

Table 12: Properties of the water circuit through the boiler.

b) **Turbine:**

Gaseous vapor enters the turbine, and experiences an isentropic expansion, with an efficiency of 85%. In this process, power is produced. The following calculations are made:

In 2:

$$P_2=0,08 \text{ bar} \quad s_{2s}=s_1$$

$$h_{2s}= 2285 \text{ kJ/kg}$$

$$\eta = \frac{h_1-h_2}{h_1-h_{2s}} = 0,85;$$

Given this, the following data is obtained:

Point	Temperature (°C)	Pressure (bar)	Enthalpy (kJ/kg)
1	500	50	3666,02
2	49,05	0,08	2492,15

Table 13: Properties of the water circuit through the turbine

Thus, work done by the turbine is calculated:

$$W_{turbine} = \dot{m} \times (h_1 - h_2) = 3600 \frac{kg}{h} \times \frac{1h}{3600s} \times (3666,02 - 2492,15) \frac{kJ}{kg} = 1173,87 \text{ kW}$$

If a mechanical efficiency of 90% is considered, then the effective work would be:

$$1173,87 \text{ kW} \times 0,9 = 1056,48 \text{ kW}$$

c) **Condenser**

The main function of the condenser is converting the gaseous vapor into water, as the bomb requires it in order to achieve maximum efficiency and to avoid cavitation, that could provoke damages in the device. In this process, heat will be released. Afterwards, it will be collected and utilised to dry up waste products before entering the reactor, improving overall efficiency of the process.

Calculations and properties of the process at this stage are resumed below:

Point	Temperature (°C)	Pressure (bar)	Enthalpy (kJ/kg)
2	49,05	0,08	2492,15
3	49,05	0,08	185,25

Table 14: Properties of the water circuit through the condenser

$$Q_{waste} = \dot{m} \times (h_2 - h_3) = 3600 \frac{\text{kg}}{\text{h}} \times \frac{1\text{h}}{3600\text{s}} \times (2492,15 - 185,25) \frac{\text{kJ}}{\text{kg}} = 2306,9 \text{ kJ}$$

Considering a 90% efficiency of the process, effective heat would be:

$$Q_{waste} = 0,9 \times 2306,9 \text{ kJ} = 2076,21 \text{ kJ}$$

d) **Hydraulic Bomb**

The hydraulic bomb has the function of compressing the fluid to the initial value of 50 bar. In that process, the bomb consumes energy.

The following table and calculations show the performance of the hydraulic bomb:

Point	Temperature (°C)	Pressure (bar)	Enthalpy (kJ/kg)
3	49,05	0,08	185,25
4	49,25	0,08	192,65

Table 15: Properties of the water circuit through the hydraulic bomb

$$W_{bomb} = \dot{m} \times (h_4 - h_3) = 3600 \frac{kg}{h} \times \frac{1h}{3600s} \times (192,65 - 185,25) \frac{kJ}{kg} = 7,4 kW$$

Considering a 90% mechanical efficiency of the device:

$$W_{bomb} = \frac{7,4}{0,9} = 8,2 kW$$

e) **Cycle's power and efficiency**

The amount of work that is used to produce energy is the one generated by the turbine minus the energy consumed by the bomb:

$$W_{total} = 1056,483 - 8,2 = 1048,283 kW$$

Thus, the efficiency of the process would be:

$$\eta = \frac{W_{net}}{Q_{sup}} = \frac{1048,283}{2348,45} = 44,64\%$$

Considering that this process is used to try to recover some energy from the process of cooling down the syngas, this efficiency is acceptable.

Through the year, the amount of energy produced is:

$$W_{year} = 1048,283 \text{ kW} \times 24 \times 365 \text{ h} = 9,182959 \text{ GWh}$$

#### 4.5.6. Waste drying through released heat

The goal of this phase is to dry up the waste products prior to its introduction in the reactor increasing the overall efficiency of the plant, decreasing humidity from 20% to 5%.

The heat that this operation requires is the following:

$$Q = \dot{m}_v \times L_{water} ;$$

where  $\dot{m}_v$  is the flow of the humidity that is going to be eliminated, and  $L_{water}$  the latent heat of water.

The humidity flow, considering that the waste input flow is 9108,65 kg/h, the input flow for eliminated humidity would be the 15% of that quantity:

$$9108,65 \text{ kg/h} \times (0,2 - 0,05) = 1366,3 \text{ kg/h} ;$$

The needed heat will then be:

$$Q = \frac{1366,3 \frac{kg}{h}}{3600} \times 2255 \frac{kJ}{kg} = 855,83 \text{ kW} ;$$

This heat will be obtained from the one released in the condenser. As the required heat is less than the one that the condenser produces, the goal of reducing the humidity from 20% to 5% is perfectly achievable, and as a result the project can dismiss the introduction of further drying systems, reducing investments and improving efficiency.

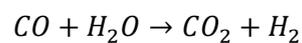
#### 4.5.7. Obtained Hydrogen

After the Scrubber neutralisation, the syngas has the following composition:

Substance:	Mass fraction (%)
H <sub>2</sub>	4,46
CO	77,6
Ar	1,22
H <sub>2</sub> S	0
H <sub>2</sub> O	2,93
CO <sub>2</sub>	6,67
N <sub>2</sub>	7,11
CH <sub>4</sub>	0,01

*Table 16: Syngas composition at the end of the Scrubber process.*

After this process, with the goal of increasing the hydrogen proportion of the syngas, a shift reaction is carried out. In this way, CO in the presence of water is converted into carbon dioxide and hydrogen:



The hydrogen produced by the reaction is the following:

$$m_{H_{2shift}} = m_{CO} \times \frac{MM_{H_2}}{MM_{CO}} = 9108,65 \times 0,776 \times \frac{2}{28} = 504,88 \frac{kg}{h}$$

The existing hydrogen before the reaction was:

$$m_{H_{2gas}} = m_{syngas} \times \%mass\ hydrogen = 9108,88 \times 0,0446 = 406,25 \frac{kg}{h}$$

Thus, a hydrogen flow of 911,13 kg/h of hydrogen can be extracted. For each 9108,65 kg/h of waste produced that are introduced, 911,13 kg/h of hydrogen is obtained.

#### 4.5.8. Gasification plant in numbers

As it has been stated, the basis of the plasma gasification plant's operation is the SUW produced in Talavera de la Reina. Seasonally, forest and agrarian waste result into an additional supply of fuel material for the gasification plant, being its storage possible for times when demand requires an extra amount of energy, or SUW collection struggles.

Below, the final data of the plant's operation is resumed:

<b>Mass flow of waste (kg/h):</b>	<b>Mass flow of hydrogen(kg/h):</b>	<b>Energy production of the Rankine Cycle (GWh):</b>
9166,67	911,13	9,1831

*Table 17: Resumed data of the gasification plant's operation*

## 5. Grid's backing and energy storage

### 5.1. Introduction

The plasma gasification process enables the system to transform waste products produced in the area of study into a hydrogen-rich syngas. This gas could be used for a wide variety of applications: It could be used in the chemistry industry, it can power up cars, generate electricity and many other things. In this project, the goal is to use that hydrogen to create a back-up system for the grid in order to improve its manageability.

There are many ways of transforming hydrogen into electricity. As the plant needs to react instantaneously to changes in the power supply or demand, quick transients and operability are required. Thus, technologies like internal combustion engines do not seem to be accurate for this task. On the other hand, fuel cells or hydrogen combined cycles could be an outstanding solution for the project's needs:

Fuel cells are able to provide a fast response to these demand and supply changes, they perform at a high efficiency and its gas and particles emission levels are almost zero. Combined cycles are also an outstanding solution. They are able to respond fast to demand and supply changes, and can provide a very similar efficiency to fuel cells. In addition, a hydrogen combined cycle would have zero emission levels.

Finally, the fuel cell system will be implemented, although a hydrogen combined cycle would also be an incredible solution. It will also be briefly explained later on.

### 5.2. Fuel cells: How they work

Fuel cells are electrochemical reactors that allow the chemical energy to transform into heat and electric energy. Fuel cells transform directly free available energy, and as there is no combustion process going on, Carnot cycle limitations do not apply for this process. Thus, higher efficiency than combustion process is expected.

The process needs a continuous flow of fuel (hydrogen) and an oxidant (oxygen). If this flow stops, the reaction is stopped and no further electricity is produced.

Fuel cells are formed by three main elements: Two electrodes, the anode and the cathode and an electrolyte material situated between them, that allows the flux of ions between them and acts as a catalyst of the reaction. Below, a basic scheme of a fuel cell can be observed:

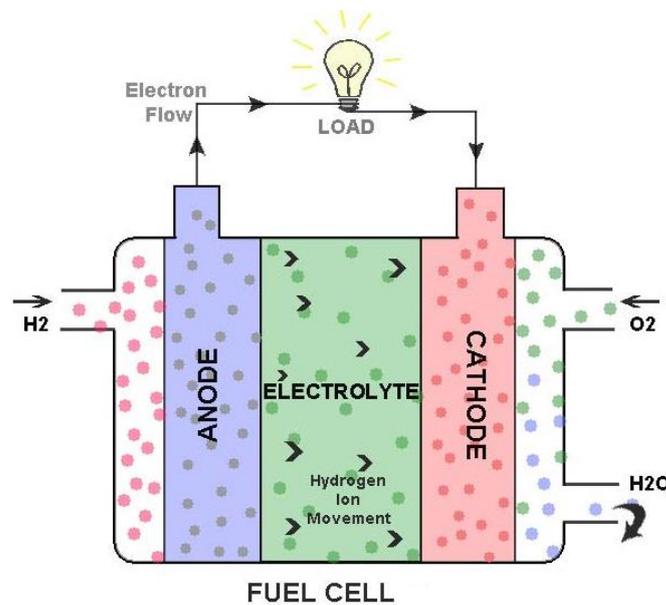
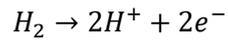
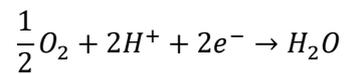


Figure 32: Fuel cell scheme. Source: Robot Platform

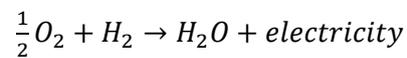
As it can be seen, hydrogen is introduced in the anode, and oxygen in the opposite pole (cathode). In the following chemical reaction, the electrons of the hydrogen atoms are separated:



In the cathode, oxygen atoms are combined with hydrogen ions that passed through the electrolyte. The reaction can be seen below:



These reactions combined make up the following one:



The role that the electrolyte plays in the process is crucial, as it should only let hydrogen ions go through and stop electrons, that could hinder the reaction.

The reaction's efficiency can be calculated using the Nernst equation:

$$E = E_o + R \times T \times \ln \frac{MM(H_2) + MM(2O_2)}{MM(H_2O)},$$

where:

- $E_o$  (1,229V) is the standard potential
- $R$  ( 8,31 KJ/mol) is the gas constant
- $T$  is the temperature in Kelvin

As it can be seen, all elements are constant parameters excluding temperature, that will be an key factor when designing fuel cells.

### 5.3. Fuel cell types

Fuel cells vary depending on the type of electrolyte and its temperature of operation range. As fuel cell technology is still in its infancy and has not been fully developed, only the most economically viable and the ones with more development capability will be considered.

Below, a table with the resumed information of each fuel cell technology can be found<sup>xxiii</sup>:

Type:	Electrolyte	Temperature of Operation (°C)	Applications	Pros	Cons
PEMFC	Solid Polimer	60-100	Laptops Vehicles Stationary generation	Low temperature Fast start. Solid Electrolyte, reduces corrosion and maintenance	Expensive catalyst. Sensitive to impurities in fuel.
AFC	Potassium hydroxide watery solution	90-100	Space and military industry	Fast cathodic reaction. Higher efficiency	Sensitive to impurities
PAFC	Phosphoric acid liquid	175-200	Stationary generation. Laptops	85% efficiency of heat and electricity cogeneration. Tolerates impure H <sub>2</sub>	Pt catalyst. Low power and current. Heavy and bulky.
MFCF	Lythium, sodium and potassium liquid solution	600-1000	Stationary generation	High temperature advantages: Greater efficiency and cheaper catalysts	Corrosion due to high temperatures. Short lifespan
SOFC	Solid Zr oxid with yttrium additions	600-1000	Stationary generation	High temperature and solid electrolyte advantages	Corrosion due to high temperatures. Short lifespan

*Table 18: Resumed information on considered fuel cell technologies*

### 5.3.1. PEMFC (Polymer Electrolyte Membrane Fuel Cell)

It is formed by a water-based acidic polymer membrane as electrolyte, and uses platinum-based electrodes. They perform well under low temperature conditions (below 100°C) and can tailor electrical output to meet dynamic power requirements. The main downsides of this technology are two:

- The usage of platinum-based electrodes has an effect on the price of the catalyst.
- The combination of low temperatures and metal based electrodes make the device specially sensitive to impurities in the input gas ( in this case, sensitivity to carbon monoxide)

On the other side, low temperatures allow fast start times and lengthen its lifespan. It can also deliver high power due to its high energy density.

They are currently a cutting-edge technology for light duty and materials handling vehicles. They are also used for stationary generation

### 5.3.2. PAFC (Phosphoric acid fuel cells)

They are formed by an anode and a cathode made of a disperse platinum catalyst on carbon and a silicon carbide structure that holds the phosphoric acid electrolyte. They tolerate well carbon monoxide impurities but usually have a lower efficiency than other technologies, but they can reach around 80% efficiency if cogeneration of heat and power is implemented. They operate at moderately high temperatures (180°C).

This kind of technology is commonly used for stationary generators, and its application in vehicles and buses is also being investigated. They are often heavy and bulky, and its platinum electrodes make the price more expensive.

### 5.3.3. MCFC (Molten Carbonate Fuel Cells)

They use a molten carbonate salt in a porous ceramic matrix as the electrolyte. Salts often include lithium carbonate, potassium carbonate and sodium carbonate.

They operate at high temperatures of around 650°C, which offers several advantages. Firstly, its high kinetic energy makes it needless to operate with precious metals, having a relevant effect on its price. This factor also makes the device more tolerant to impure input gases.

Its main disadvantages arise from the fact that the technology uses a liquid electrolyte rather than a solid one. This derives into higher corrosion and shorter lifespan, also shortened by high temperatures.

They are often used for stationary generation. They are commonly seen in fuel cells of megawatt capacity, as well as in Combined Heat and Power (CHP) and Combined Cooling and Power (CCP) plants. Its efficiency is around 60%, but it can make it to 80% in CCP and CHP applications where heat is utilised.

### 5.3.4. AFC (Alkaline Fuel Cells)

They were the first fuel cells to be developed, when NASA invented this system, that could provide power and water at the same time for astronauts at the spaceship. Although they are still used by NASA, they also have other applications in other industries.

AFC devices use potassium hydroxide in water and are often fuelled by pure hydrogen. At its infancy, they used to operate between 100°C and 250 °C, but they now operate at approximately 70°C. The usage of platinum electrodes is not necessary, other cheaper non-precious metals can be implemented as catalyts, being nickel the most common one.

They offer relatively high efficiencies of around 60%. Its main disadvantage is its low tolerance to carbon dioxide, which makes it necessary to filter hydrogen, making the process more expensive.

### 5.3.5. SOFC (Solid Oxide Fuel Cells)

They perform at considerably high temperatures ( 800-1000°C). In this kind of technologies, heat utilisation also improves greatly the overall efficiency, from 60% to about 80%. They use a solid ceramic electrolyte, zirconium oxide stabilised with yttrium oxide, instead of a liquid or membrane. They are widely used for stationary power generation.

Due to high temperatures, they are tolerant to hydrocarbons. They can also tolerate small amounts of sulphurs. Its high kinetics also make the need of using a metal catalyst completely redundant. On the other hand, its high operating temperatures make its start time greater.

## 5.4. Fuel cell type selection

This project requires a technology with an acceptable efficiency that can provide high power capacity and that can tolerate small impurities in the input fuel, as although the syngas will go through a Shift reaction, Carbon Monoxide is likely not to be completely eliminated sometimes. In addition, cost-effective technologies and with a greater lifespan will also be preferred.

Taking these considerations, PEMFC devices are seen as the best option possible. Its low operation temperatures lengthen its lifespan and shorten its running time, being able to

respond quickly to fast demand and supply changes specified for this project. In addition, its high energy density enables the system to provide high power.

The chosen supplier is Ballard. Its catalogue is included in the appendix. They offer 1MW cell units with an input flow of 63 kg/h of hydrogen and a 40% efficiency.

## 5.5. Hydrogen storage

Whenever the demand curve can be met with non-manageable power production or there is an excess of waste products, hydrogen produced can be stored and utilised when really needed.

For that purpose, it is necessary to implement a hydrogen storage system. Hydrogen can be stored in three ways, depending on the state of the substance: solid, liquid or gaseous.

### 5.5.1. Gaseous storage

Compressed gas storage is the easiest method. Hydrogen is compressed to pressures of about 200-700 bar. Energy densities are low, of about 12 MJ/m<sup>3</sup>.

It is an expensive system, and consumes a significant amount of power when the project involves big installations. It is widely used in portable installations, using high pressure tanks.

### 5.5.2. Liquid storage

For hydrogen to achieve a liquid state, it is necessary to stay at temperatures of 23 K. Cryogenic hydrogen is the obtained.

For this cooling process, several heat exchangers, compressors and other devices are needed, that consume a considerable amount of energy. Indeed, cryogenic tanks are needed for the hydrogen to maintain its temperature. These tanks are usually costly, increasing significantly its investment costs. Its main applications are the large-scale transport of gas, often used in transoceanic ships.

### 5.5.3. Solid storage

This storage method utilises metallic hydrides. It is the safest type of hydrogen storage. However, as the rest of the storage options, it is not cheap.

It consists of reversible covalent bonds between these metallic elements and hydrogen, that can be broken when heated releasing the hydrogen. These bonds are formed by applying a high hydrogen pressure on the metals.

This kind of storage is very attractive, as it is very safe and its qualities are very competitive. Many of these metals are rare earth elements, offering storage capacities of 1,4% of mass fraction, being more efficient in volume occupied than its direct storage competitors.

## 5.6. Hydrogen storage selection

Taking into account all features of the different technologies, solid storage is considered to be the most accurate one, as it is safest and most cost-efficient space-efficient option. In addition, when it comes to costs, no great difference between the different options is observed, so it would not be conditioning its choice.

HBond 700H model hydride tanks are then chosen, developed by ARIEMA, being able to store 700 L of hydrogen.

### 5.7. Fuel cell energy production and number of units

The plant produces 134,49 tons a day, which means that in an hour, the plant is able to produce 911,13 kg of hydrogen. The plasma gasification plant will be working permanently for electricity production and energy storage purposes. Fuel cells will be operating for a maximum of 15 hours so the other 9 will be used to store additional hydrogen. Considering that each fuel cell's rated flow is 63 kg/h, the optimal number of fuel cells will be:

$$\text{N}^{\circ} \text{ of fuel cells for regular hydrogen flow} = \frac{911,13 \frac{\text{kg}}{\text{h}}}{63 \frac{\text{kg}}{\text{h}}} = 14,46 \text{ fuel cells}$$

$$\text{N}^{\circ} \text{ of fuel cells for extra energy storage} = \frac{911,13 \frac{\text{kg}}{\text{h}} \times 9\text{h}}{15\text{h} \times 63 \frac{\text{kg}}{\text{h}}} = 8,677 \text{ fuel cells}$$

Those fuel cells together make a total of 23,14 fuel cells, so 24 units will then be necessary.

### 5.8. Possibility of implementing a hydrogen combined cycle plant

Hydrogen, as a carbon-free energy carrier, is likely to play an important role in a world with severe constraints on greenhouse gas emissions. In the power industry, its utilization as gas turbine fuel can be proposed under several possible scenarios. This project addresses the possibility to burn hydrogen in a large size, heavy-duty gas for a prompt application of the above general concepts, regardless of the process used to produce hydrogen and its integrations with the combined cycle.

As it has been said, there are many applications for hydrogen in the world of power production, and its combustion in turbines is one of them. Its direct combustion would result into lower efficiencies than those of fuel cells, but combining different cycles, such as a Brayton and a Rankine cycle utilising heat released would boost its efficiency to similar levels to those of fuel cells. The combustion process is indeed easier, but government aids are currently focusing more on fuel cells.

Moreover, the first hydrogen fuelled combined cycle was installed in 2010 in Fusina, Venice<sup>xxiv</sup>. This plant has a rated power of 16 MW and an overall efficiency of 42%, being able to transform 1,3 tons of hydrogen per hour. It has an emission rate of zero, and it is thought to avoid the emission of 7000 tonnes of CO<sub>2</sub>. It currently powers up houses for 20000 families. Its cost was estimated in about 50 million euros.



*Figure 33: Image of the hydrogen combined cycle of Fusina, Venice. Source: Hydrogen Park.*

Although being a medium-small power unit, this example shows the possibility of implementing these plants in a near future, achieving high efficiencies and zero emissions, being its implementation in the micro-grid a wonderful choice, given the project's needs and requirements. However, as the implementation of hydrogen in combined cycles is still in its infancy, there are still little data for the project to install and perform all the calculations for a hydrogen combined cycle. Thus, the project only mentions the possibility of implementing it given its characteristics, but does not get to size the plant and install it in the area of study.

## 6. Micro-grid's configuration

### 6.1. Introduction

At this point, micro-grid behaviour in different situations will be studied. As no specific information on Talavera de la Reina's demand profile has been provided, the project will consider the most unfavourable demand, which is a constant value of the maximum peak demand.

This chapter will cover different generation curve possibilities, depending on different weather conditions. Generation curves have been obtained from each technology's particular profile shown on chapter 3.

## 6.2. Micro-grid's configuration

### 6.2.1. Non-manageable technologies

As in the current Spanish power system configuration, this project will give priority to existing non-manageable technologies in the area of study. Thus, when those by themselves are able to satisfy demand with no further aid, hydrogen produced at the plasma gasification station will be stored for its utilisation when required, and in case of excess of non-manageable energy production, that power surplus would be injected to the conventional grid, obtaining possible revenues.

These technologies are solar PV plants, windfarms and small hydropower.

### 6.2.2. Manageable technologies: Plasma Gasification Plant

This technology is in charge of backing non-manageable power production in situations where it is not capable by itself to cover power demand. This technology is, then, responsible for acting fast when the situation requires it.

As a result, hydrogen produced permanently by the plasma gasification station will be stored when there is enough non-manageable generation and when generation does not satisfy demand but the price of electricity is low. Fuel cells will only be connected when demand requires it and the price of electricity is high.

### 6.2.3. Power exchanges with the conventional grid

An interconnection with the conventional grid is desired for situations in which the plasma gasification plant together with the non-manageable technologies installed in the area of study are not able to provide the necessary power to satisfy demand. Also, for situations in which non-manageable production exceeds demand and it is necessary to evacuate that power, transferring it to the conventional grid, stabilising the system and being able to obtain profits from it.

## 6.3. Possible scenarios

### 6.3.1. All non-manageable generation available:

In this case, all non-manageable generation is available. The scenario's generating profile is shown below, compared with a constant value representing maximum peak demand:

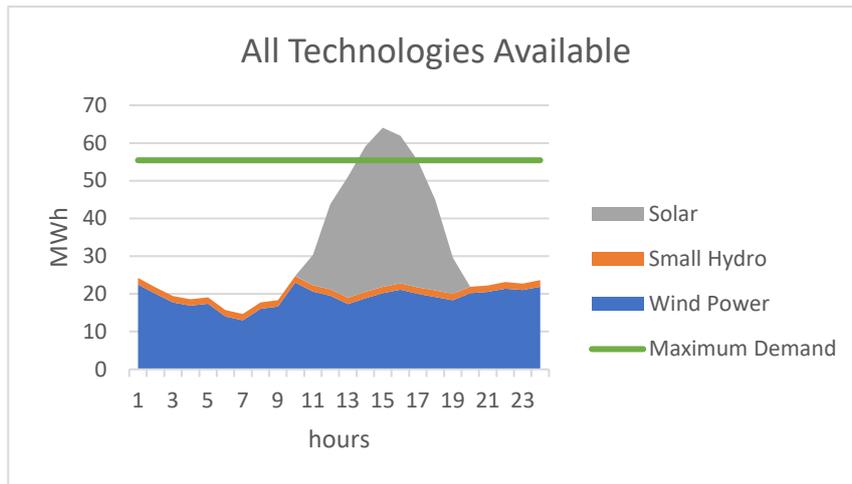


Figure 34 : Generation profile with all non-manageable technologies available. Own elaboration.

As it can be seen, existing non-manageable technologies are not able to cover maximum demand at most of the time. Maximum power demand is only exceeded by existing generation for approximately five hours. The system's power backings then likely to be used. Thus, it would be more interesting to compare it with a more realistic demand curve, being able to observe when demand tends not to be covered.

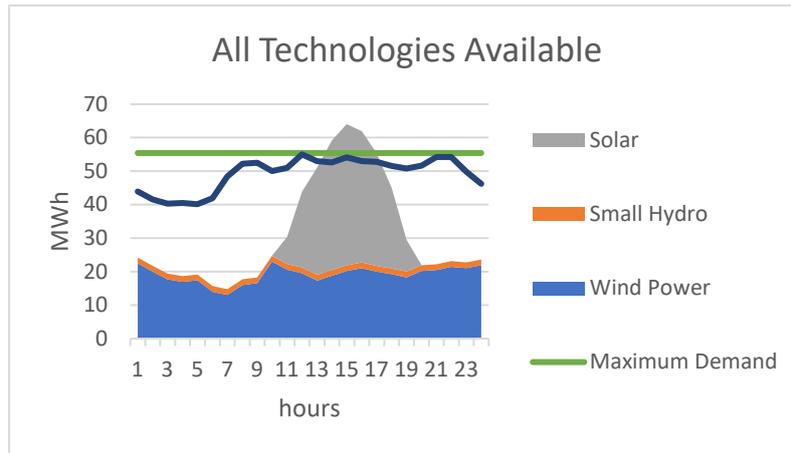


Figure 35: Generation profile with all non-manageable technologies available. Own elaboration.

As it can be seen, now generation exceeds demand in a similar way as the previous one, but the difference between demand and generation at other times is significantly diminished. As it has been said, fuel cells will only produce energy for 15 hours. 9 hours will be left for storing hydrogen. Thus, from 6h to 12h and from 18h to 1h, making it 10 hours of total operation. In this way, as the plasma gasification station produces 911,13 kg of hydrogen per hour, it will store: 8200,17 kg of H<sub>2</sub> in 14 hours. That quantity added to the one produced by the plant each hour that the fuel cells are working and the power generated by the Rankine cycle make it 24,19 MWh of extra energy generated by the fuel cells and the Rankine cycle during high price times:

$$23,14 + \frac{9183,1}{24 \times 365} = 24,19 \text{ MW each hour of extra energy}$$

Then, with the power generated by the plasma gasification station and the one obtained from the conventional grid, the power scenario finally looks like this:

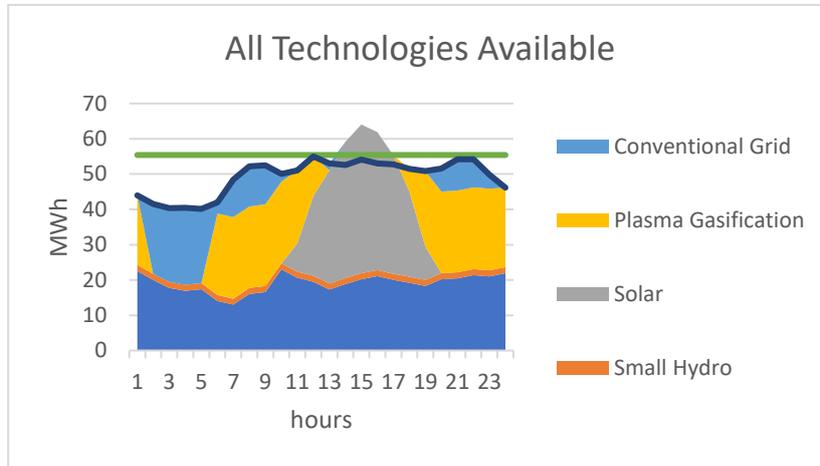


Figure 36: Final generation profile with all non-manageable technologies available. Own elaboration

The following graph shows the proportions of each source's contribution to demand:

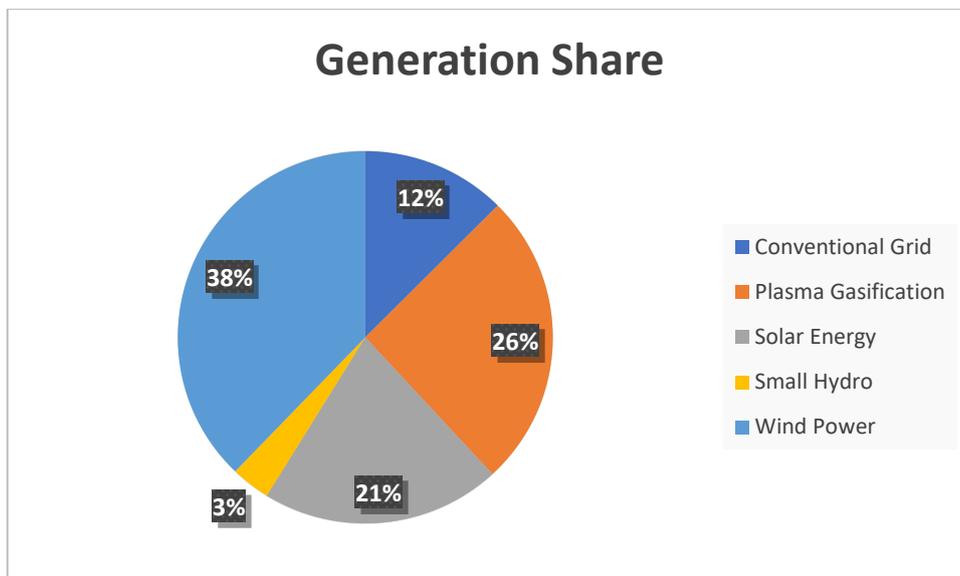


Figure 37: Generation share for all non-manageable technologies available. Source: Own elaboration.

It can be observed that under the most favourable conditions, energy import from the conventional grid adds up to 14%. Although solar PV is the technology with the highest installed capacity, its operating hours make wind the one with the highest share (38%). Fuel cells produced a very significant amount of energy, resulting into 26% of total generation.

### 6.3.2. Absence of one of the existing non-manageable sources:

At this stage, the project will study situations in which some non-manageable technologies do not make it into the supply curve. These situations can be provoked by a lack of wind, sun or severe droughts. Scenarios mentioned are resumed below:

- **Absence of solar generation:**

Solar energy is the one with more installed capacity, but it has the downside of having one of the shortest operation times. The generation profile is shown below:

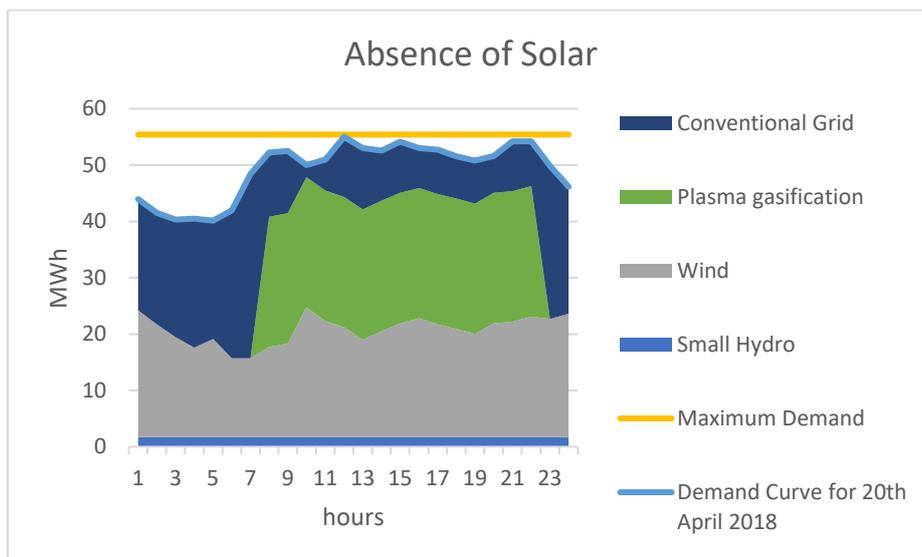


Figure 38: Generation Profile in the absence of solar power. Own Elaboration.

In this particular case, non-manageable power production never exceeds demand. Fuel cell energy production is decided to be switched on when demand is higher, because price then is expected to be high and more expensive to import from the conventional grid. As in the previous case, the plasma gasification plant will store hydrogen for 9 hours, and will be producing energy the 15 hours with higher demand. This is from 8 to 18h and 20-22h. In the following graph, the generation share of each technology operating in the micro-grid is shown:

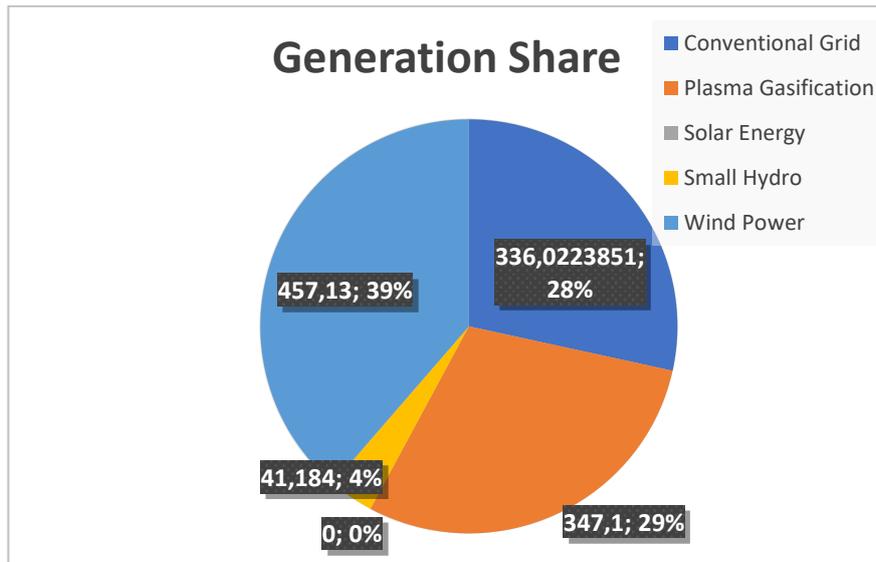


Figure 39: Generation share without solar energy. Own Elaboration.

In this case, wind power would represent 39% of the total production and energy from fuel cells will now represent 29% of the total generation. Imported energy will grow considerably as expected, and its share will now grow to 28%.

- **Absence of wind:**

This is the most critical situation, as the hourly production of small hydro is just 1,713 MWh. This means that during some hours when solar power does not produce any electricity it is the

grid that will supply almost all the power. The generation profile for this situation is presented below:

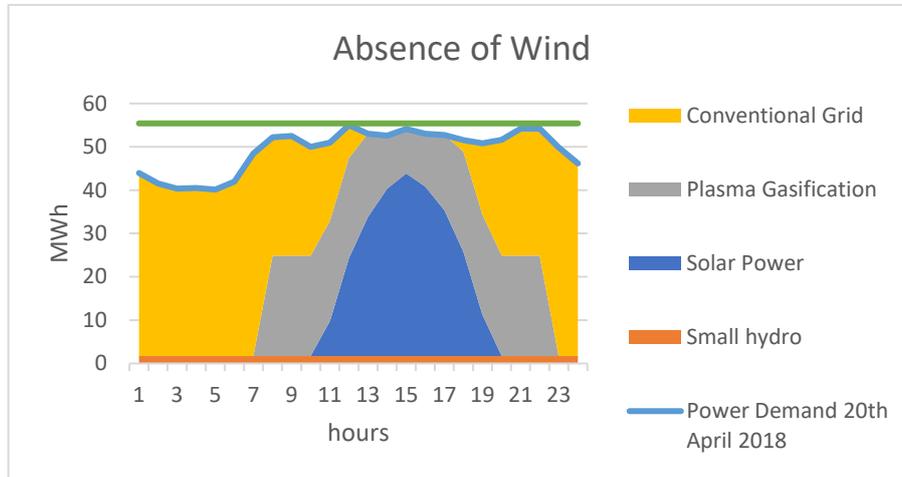


Figure 40: Power Generation profile in the absence of wind

As expected, non-manageable generation does not exceed at any time demand. In addition, the grid has to provide almost all the power to satisfy demand at night. Fuel cells help significantly to meet demand when it is working: 15 hours straight, from 8 to 22h. At midday, when solar power production is at its top production, no energy from the conventional grid is needed, as the contribution to demand from fuel cells adds a sufficient amount of power for four hours (from 13 to 17h). In the following graph the generation share is shown:

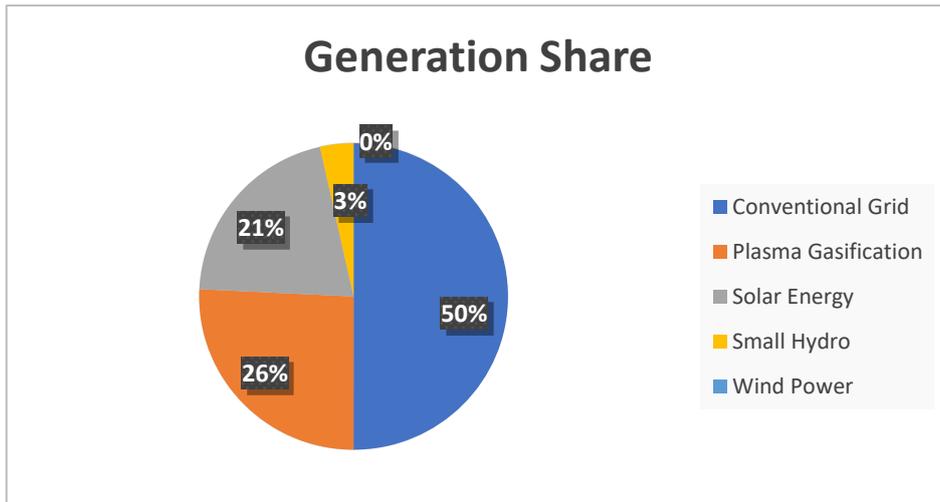


Figure 41: Generation share in the absence of wind. Own elaboration.

The graph shows that plasma gasification now provides 26% of the power generation, and the energy imports now make up the 50% of it. In fact, a 50% share of energy import can be seen as a very high percentage. It should be taken into consideration that a complete absence of wind during a long period of time is not very likely to happen very often. This situation is more prone to occur for short periods of time, and maybe will not happen at the same time in every windfarm. All in all, it could be said that 50% dependency on the conventional grid in a day is the maximum share that the grid will achieve, under very rare circumstances.

- **Absence of small hydro:**

As small hydro only means between 3 and 4% of total electricity generation, the absence of small hydro will be a very similar case to the one with all sources available. It could be said that small hydro production is almost residual.

#### 6.4. Analysis of results

After studying all the possible situations, it has been proved that the micro-grid's backing system in the form of fuel cells powered by a plasma gasification plant is a necessary element for its well-functioning. It has performed effectively, being able to reduce significantly the share of imported energy from the conventional grid. The technology's share rounds 27%, being the one of the imported energy always below 50% and often considerably under that limit.

As the existing non-manageable resources rarely reach the point of satisfying completely power demand, the strategy switching on fuel cells when the price of electricity is higher seems to be a good choice. Other configurations like producing backing power when supply is lower could be as well good alternatives, although the chosen one is apparently the most cost-effective.

As well, other backing solutions like hydrogen combined cycles would result into efficient and effective choices, that could even be combined with fuel cell production. Moreover, in order to maximize hydrogen production and boost fuel cell power production, hydrogen could be obtained as well from electrolysis or even natural gas. Another solution that would not involve hydrogen would be adding the hydropower supply's share to the micro-grid by connecting one or both of the big hydropower plants that exist near Talavera ( Azután and Castrejón), resulting into a much higher manageability of the micro-grid and a much lower dependency on the conventional grid.

## II. Economic Study

## 1. Economic Study of the different energy sources that take part in the micro-grid. Levelized costs of electricity.

At this point, it is the costs of the different generating technologies that inform the micro-grid that will be subject of study. For this task, all costs involved will be considered: Investment costs and operation and maintenance costs. The price of each technology per unit of power produced will then be obtained from that data.

In order to perform well the different calculations, the following assumptions have been made:

- The lifespan of each plant of every technology will be set to 25 years. This number will also be considered for the pay-off time.
- The project will consider as if the existing plants would have been built in the year 0 of the micro-grid, so that initial investment costs are accounted at the beginning of the grid's operation.
- For the operating costs calculations, a 2,1% value<sup>xxv</sup> for the CPI will be assumed as constant along the micro-grid's lifespan. In addition, a 1,6% reduction on the costs will be assumed from the 4<sup>th</sup> year, assuming an improvement on the process's learning curve.
- If real power production data from any plant is not known, it will be calculated given its equivalent operating hours, provided by IADE.

### 1.1. Economic Study for wind power

The following table resumes the information about the two planned windfarms that have been considered for the micro-grid. As no data was available on yearly energy production of these

windfarms, a theoretical value has been calculated based on 2300 hours of operation of this technology:

<b>Windfarm:</b>	<b>Rated Power (MW):</b>	<b>Yearly Energy Production (GWh):</b>
La Nava de Ricomalillo	15,3	35,19
Puerto de San Vicente	40	92
<b>TOTAL:</b>	<b>55,3</b>	<b>127,19</b>

*Table 19: Existing windfarm characteristics. Own elaboration*

### 1.1.1. Initial Investment Costs

For this technology, initial investments are mainly divided in windmill costs, electric equipment, civil work and others that depend on the characteristics of each project. Total investment cost of this type of plants result into 940 €/MW, following IDAE calculations for a 25 MW windfarm, and it will be the one used for the project's calculations. Each proportion of the total cost is provided by IDAE and it is presented below:

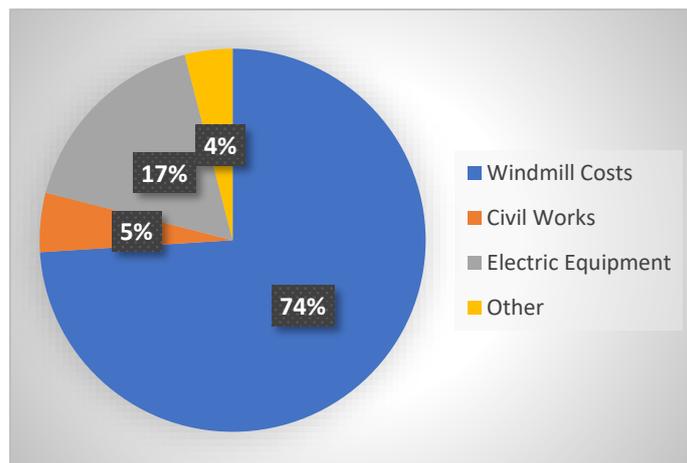


Figure 42: Initial investment costs distribution. Source: IDAE

Given the information above, the initial investment costs related to the installation of the existing windfarms in the area of study would be:

Windfarm:	Rated Power (MW)	Windmill Costs (M€)	Civil Works (M€)	Electric Equipment (M€)	Other (M€)	Total Investment Cost (M€)
La Nava de Ricomalillo	15,3	10,6412	0,719	2,4446	0,5752	14,38
Puerto de San Vicente	40	27,824	1,88	6,392	1,504	37,6
<b>TOTAL:</b>	-	38,4652	2,599	8,8366	2,0792	<b>51,98</b>

Table 20: Investment costs by windfarm. Own Elaboration.

In order to calculate the annual pay-off costs, an interest rate of 5% and a lifespan of 25 years will be considered. For this purpose, the following equation will be used:

$$P = I \times \frac{r \times (1+r)^n}{(1+r)^n - 1}$$

Where:

P= Annual pay-off cost

I= Total investment cost

n= Plant's lifespan

r= Interest Rate

It is then deducted that the total initial investment costs result into **51,98 M€** and its pay-off cost is **3,688 M€/yr.**

### 1.1.2. Running Costs

In addition to investment costs made at the beginning of the installation of the plant, there exist another type of costs that derive from the daily operation of it. The full amount of these costs is estimated in 20€/MWh by IDAE<sup>xxvi</sup>. They consist on operation and maintenance costs, insurances and taxes, management and administration and field rents:

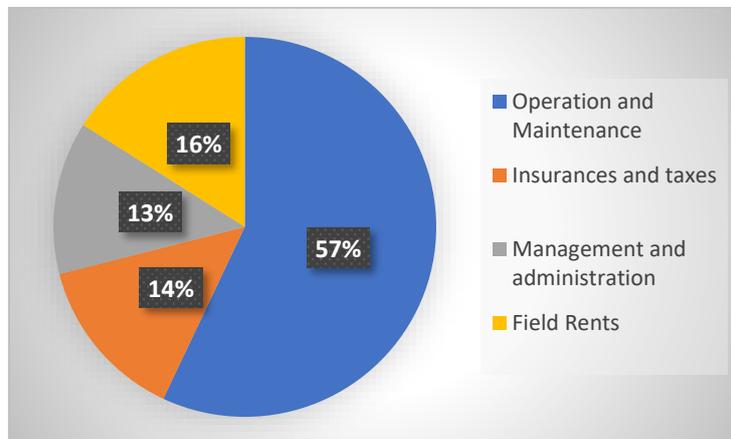


Figure 41: Running costs distribution in windfarms. Source: IDAE

Below, the running costs for the first year of operation can be observed:

<b>Windfarm:</b>	<b>Estimated Energy Produced (GWh)</b>	<b>Operation and Maintenance (€)</b>	<b>Insurances and taxes (€)</b>	<b>Management and administration (€)</b>	<b>Field Rents (M€)</b>	<b>Total Running Cost (M€)</b>
La Nava de Ricomalillo	35,19	401166	98532	91494	112608	0,7038
Puerto de San Vicente	92	1048800	257600	239200	294400	1,84
<b>TOTAL:</b>	-	1449966	356132	330694	407008	<b>2,5438</b>

*Table 21: Running costs distribution for windfarms. Own elaboration.*

This makes a total of 2,5438 M€ for the first year, that will be increased each year with the CPI, and since the fourth year it will decrease by the 1,6% improvement in the learning curve.

### 1.1.3. Electricity production final cost

Taking into account all factors that contribute to the costs associated with this technology and its annual energy production, it can be deducted the cost of producing a unit of energy from the existing power plants.

Hereby a table with the costs breakdown can be observed through all plant's years of operation, and a complete one can be found in the Annex:

<b>Year:</b>	<b>Running Costs/year (€)</b>	<b>Pay-off costs/year (€)</b>	<b>Energy production (GWh/year)</b>	<b>Electricity production cost (c€/kWh)</b>
Year 1	2543800	3688000	127,19	4,89959903
Year 5	2720985,65	3688000	127,19	5,03890687
Year 10	2789693,94	3688000	127,19	5,09292707
Year 15	2860137,21	3688000	127,19	5,14831136
Year 20	2932359,26	3688000	127,19	5,20509416
Year 25	3006405,01	3688000	127,19	5,2633108
<b>Total:</b>	<b>70590506,6</b>	<b>92200000</b>		

Table 21: Electricity production costs breakdown. Own elaboration

The mean electricity production cost obtained is 5,12 c€/kWh.

## 1.2. Economic Study for solar PV power plants

The following table collects all data from existing solar PV plants in the area of study. For the data on produced energy per year, the equivalent calculation has been made based on its operating hours per year (1250 h):

<b>Power Plant:</b>	<b>Rated Power (MW)</b>	<b>Energy Produced(GWh)</b>
Calzada de Oropesa	16	20
Los Navalmorales	8,12	10,15

Calera y Chozas	6	7,5
Alcolea de Tajo	4,4	5,5
Mejorada	4	5
San Martín de Pusa	2,8	3,5
Montearagón	1,8	2,25
La Pueblanueva	1,6	2
Erustes	1,5	1,875
Azután	1,1	1,375
San Bartolomé de Aliestas	1	1,25
Talavera	1	1,25
Segurilla	1	1,25
Carpio de Tajo	50	62,5
<b>TOTAL:</b>	<b>100,32</b>	<b>125,4</b>

*Table 22: Installed Solar PV power plants. Own elaboration*

### 1.2.1. Initial Investment Costs

For this case, the project will take the estimation that the NREL (National Renewable Energy Laboratory)<sup>1</sup> makes on the total investment costs of solar PV power plants, 1,85 \$ per installed watt, that in euros would be 1,587€ per watt. The total initial investment would then be **185,592 M€<sup>xxvii</sup>**.

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As for wind power plants, the project will consider a lifespan of 25 years and a fixed interest rate of 5%, obtaining a pay-off cost of **13,1682 M€** per year.

### 1.2.2. Running costs

In the case of running costs, the estimated number by IDAE is 0,03 € per kWh. For the first year, the total running costs add up 3,762 M€. For the next years, this number will be affected by the CPIc (2,01%) and also by the learning curve (1,6%) since the fourth year.

### 1.2.3. Electricity production final cost

In the following table, the cost breakdown throughout the 25 years of operation of the plant can be observed below. It can be seen how, with the complete data on investment and running costs, a final value on electricity production price per unit of energy is obtained:

Years:	Running Costs (€)	Investment Cost (€)	Annual Energy production (GWh)	Cost of electricity production(c€/kWh)
Year 1	3762000	13168208,5	125,4	13,5009637
Year 5	3941271,36	13168208,5	125,4	13,6439233
Year 10	4040793,4	13168208,5	125,4	13,723287
Year 15	4142828,49	13168208,5	125,4	13,8046547
Year 20	4247440,1	13168208,5	125,4	13,888077
Year 25	4354693,29	13168208,5	125,4	13,9736059
TOTAL:	102485408		Mean cost:	13,7700357

Table 23: Cost breakdown for Solar PV plants. Own elaboration.

It is noticeable that the mean value for the energy production cost is significantly higher than the one for wind power plants.

### 1.3. Economic Study for small-hydropower plants

Overall costs of a hydropower plant are very diverse, depending greatly on different factors. It is then needed to observe the different characteristics of the existing plants prior to make any consideration. Based on the information collected on the point 3.3.1 of the memoir, the existing plants characteristics are presented below. For the energy produced, 2300h of operation per year have been considered:

<b>Power Plant:</b>	<b>Rated Power (MW)</b>	<b>Energy Produced (GWh)</b>	<b>Hydropower plant type</b>
C.H. Talavera	2,854	6,56	Run-of-the- river
C.H. Palomarejo	1,96	4,51	Run-of-the- river
C.H. Montearagón	2,906	6,68	Run-of the- river
C.H. Cebolla	1,5	3,45	Run-of-the- river
<b>TOTAL:</b>	<b>9,22</b>	<b>21,2</b>	

*Table 24: Existing small-hydro plants nearby Talavera. Own Elaboration*

#### 1.3.1. Initial investment costs

For a run-of-the-river power plant, the initial investment is mainly divided into costs related to civil works, the turbo generator and electric equipment. Following the information provided by IDAE, a kW of installed capacity of this technology would result into 1500 € of investment costs, obtaining a total investment cost of **13,83M€**.

This value, considering a 5% interest rate and a 25-year lifespan, the pay-off cost per year for this technology is **981272,48 €**.

### 1.3.2. Running costs

IDAE has estimated that running costs for a 5 MW run-of-river power plant ascend to 225000 € per year. For this project, it is considered that this value is the same whatever it is the capacity of the plant. AS the number of power plants in the area of study is four, the running costs then add up to 900000 € for the first year. The next ones would be affected by the effect of the CPI (2,01%), and by the learning curve (1,6%) since the fourth year.

### 1.3.3. Electricity production final cost

The following table resumes the evolution of the cost of electricity per unit of power produced, and its cost breakdown. A mean value of 9,32 c€ per kWh is obtained through the 25 years of operation of the plant. More detailed data can be consulted in the Annex:

Years:	Running costs (€)	Investment Costs (€)	Annual Energy Production (GWh)	Electricity Production Cost (c€/kWh)
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Year 1	900000	981272,48	21,2	8,87392679
Year 5	957899,035	981272,48	21,2	9,14703545
Year 10	982087,186	981272,48	21,2	9,2611305
Year 15	1006886,12	981272,48	21,2	9,37810659
Year 20	1032311,25	981272,48	21,2	9,49803648
Year 25	1058378,41	981272,48	21,2	9,62099475
TOTAL:	24869248,8	981272,48	Mean cost:	9,32095486

Table 25: Cost breakdown for small-hydro technology. Own elaboration.

## 1.4. Economic Study for plasma technology devices

The plasma gasification power production process is divided into three well defined processes that will be evaluated separately. These processes are:

- Plasma gasification waste treatment
- Rankine Cycle
- Fuel cells

### 1.4.1. Plasma gasification waste treatment evaluation

As explained before, the waste products collected in the area of study taking into account solid urban waste, agrarian and forest residues ascend to 63913,526 tons per year. As the plant is in operation 8760 hours a year, the equivalent amount of waste per day is 134,49 tons.

The output of the plasma gasification process is a hydrogen-rich syngas, with a mass flow of 9108,65 kg/h. This hydrogen will be stored and then utilised to produce power in fuel cells later on. At this stage no electricity is produced yet, so no price per kWh will be obtained, but its running costs and investment costs will indeed be included for the global installation calculations.

The project will consider a lifespan of 25 years as for the rest of the micro-grid's plants, and it will utilise the information provided by *Materiales Renovados*<sup>xxviii</sup>. The economic data was obtained from Ángel Ramos Valle's TFG<sup>xxix</sup>.

- Initial Investment Costs:

These costs refer to those of the acquisition and installation of the feeding systems of the reactor, the reactor itself, the torch, the waste removal system and the control and removal system and the control and protection system.

These costs, for a 220 t/day plasma gasification plant are estimated in 35,37 M€, that will be paid out in a single payment and in the moment of the construction.

Under a 5% interest rate and a 25-year lifespan, the pay-off cost per year would be 2,5096 M€.

- Running costs:

These costs for the plasma gasification plant are divided in operation & maintenance and personnel costs.

In what personnel costs concern, there will be 3 operators available at any time, in 8-hour schedules, which will make a total of 9 operators. In addition, there will be three managers per working schedule. Running costs are resumed below:

<b>Operation and maintenance costs:</b>	<b>€ per ton</b>	<b>ton</b>	<b>Total (€)</b>	
Chemicals		9	63913,526	575221,73
Electrodes		5	63913,526	319567,63
Torches and refractory maintenance		6	63913,526	383481,156
General maintenance		7	63913,526	447394,682
<b>TOTAL:</b>				<b>1725665,198</b>

*Table 26: Operation & maintenance costs. Own elaboration.*

<b>Personnel Costs:</b>	<b>€ per person</b>	<b>Nº of Employees</b>	<b>Total (€)</b>
Operators	24000	9	216000
Managers	48000	3	144000
<b>TOTAL:</b>			<b>360000</b>

*Table 27: Personnel Costs. Own elaboration*

All of them together result into **2,085665 M€** the first year of operation. This result will be affected each year by the CPI and since the fourth year it will also be affected by the learning curve. The mean value for the yearly running costs will then be **2,315 M€**, that is **3,62 c€ per kg of waste**.

#### 1.4.2. Rankine cycle

As it was stated in previous chapters, the Rankine cycle produces 9,1831 GWh of energy a year.

This project bases its economic statements on the Rankine cycle in the study made by Ignacio Romero in his TFG<sup>xxx</sup>. Adapting those to the volume of waste existing in this project, the initial investment cost adds up to **8,56 M€**. These costs will be paid-off in 25 years, that matches up with the plant's lifespan. Taking into account a 5% interest rate, the annual pay-off cost will be **0,607 M€ per year**.

The associated costs to the daily operation of the plant during the first year will be 0,192 M€ in the first year. This value affected further on by the 2,01% CPI and the 1,6% learning curve since the fourth year. Thus, the mean value for running costs throughout the years will be **0,21442 M€ or 2,3 c€/kWh**.

### 1.4.3. Fuel cells

Fuel cells are from all the technologies included in the micro-grid the ones with the smaller technological development. The fact that this technology is still in its infancy is likely to have a significant impact in its price.

Although, the installation of these devices is crucial for the well-functioning of the micro-grid given the configuration chosen. It provides manageability for the micro-grid, and its operation offers a wide number of technological and environmental advantages. The calculations have been made using data provided by Ballard Power systems<sup>xxxi</sup>.

- Initial investment costs:

In this chapter, costs related to hydrogen storage are included. Investment costs related to this technology ascend to 2,61 M€/MW.

As the plant is formed by 24 fuel cells of 1MW each, the total investment costs will then be **62,64 M€**.

As the plant will be in operation for 25 years and a 5% interest rate will be considered, the pay-off cost per year for this technology will be **4,444 M€ per year**.

- Running costs:

Ballard estimates that operation & maintenance costs of their fuel cells are around 20\$ per MWh. Currently, 1€ is 1,157\$ so for the project's case these costs would result into approximately 17,29€ per MWh. As the 24 fuel cells produce 24 MWh of energy, running costs will ascend to **2,2719 M€ the first year**.

For the next years, running costs will be affected by the CPI and since the fourth year by the improvement in the learning curve. Thus, a mean value of **2,5218 M€ per year** is obtained for this technology's running costs.

#### 1.4.4. Conclusions on plasma technology total generation costs

After going through the different devices that inform this system, now it is time to calculate the total cost per kWh produced by the plasma technology.

The cost is defined as the related to fuel cells power production, adding the ones of the Rankine cycle, the fuel cells themselves and the plasma gasification plant.

The following table presents resumed information on the costs mentioned before:

<b>Device:</b>	<b>Total initial investment costs (M€)</b>	<b>Mean Annual Running costs (M€)</b>	<b>Annual Energy Production(GWh)</b>
Plasma gasification Plant	35,37	2,315	-
Rankine Cycle	8,56	0,21442	9,1831
Fuel Cells	62,64	2,5218	131,4

*Table 28: Cost breakdown of the technologies involving the plasma process. Own elaboration*

From the information in this table, adding all the costs it is possible to obtain concrete data on the cost breakdown of the whole system, and the cost per produced unit of power. It is presented below:

<b>Year:</b>	<b>Initial Investment Cost (M€)</b>	<b>Running Costs (€)</b>	<b>Annual energy production (GWh)</b>	<b>Electricity production cost (c€/kWh)</b>
Year 1	7,5606	4549565,198	140,5831	8,61423969
Year 5	7,5606	4865438,5	140,5831	8,838927652
Year 10	7,5606	4988296,919	140,5831	8,926319678
Year 15	7,5606	5114257,667	140,5831	9,015918462
Year 20	7,5606	5243399,082	140,5831	9,107779727
Year 25	7,5606	5375801,48	140,5831	9,201960605
	<b>Mean value:</b>	<b>5049118,8</b>		<b>8,96958371</b>

*Table 29: Plasma technology system cost breakdown. Own elaboration*

## 2. Economic Evaluation of the different energy sources that take part in the micro-grid

### 2.1. Resumed information on the power sources costs

Having studied all technologies that give shape to the micro-grid and its different generation costs, it is time to analyse and compare them, obtaining conclusions on which ones are the most competitive and which ones are the least.

The table below collects the information on the generation costs of each technology and its estimated annual energy production:

<b>Technology:</b>	<b>Mean Electricity production cost (c€/kWh)</b>	<b>Annual energy production (GWh)</b>
Wind Power	5,12	127,19
Solar PV	13,77	125,4
Small-hydro	9,32	21,2
Plasma gasification technology	8,97	140,5831

*Table 30: Resumed information on generation and costs of technologies. Own elaboration.*

As it can be seen, it is by far solar photovoltaic technology the one with the highest production costs. It is graphically represented in the following figure:

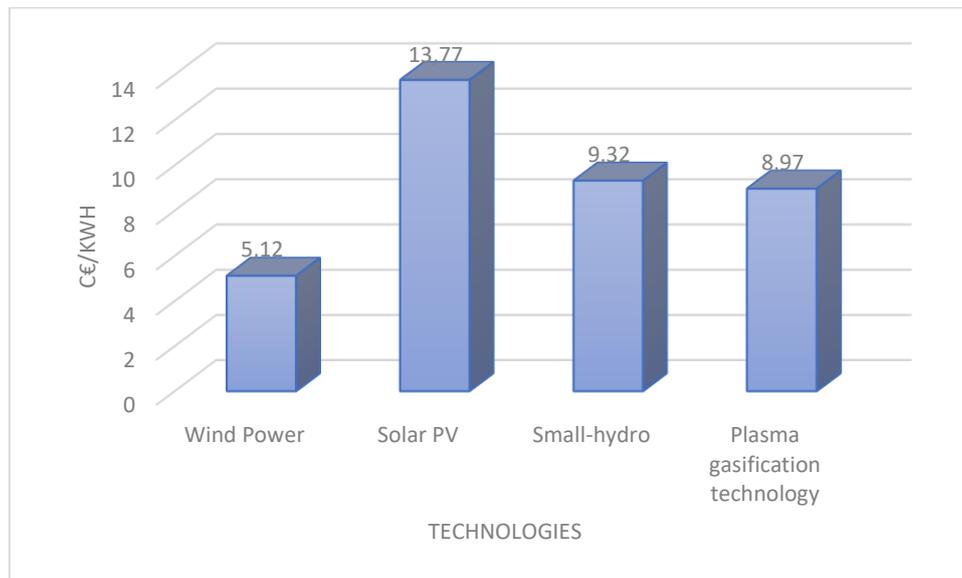


Figure 42: Production Costs Comparison. Own elaboration

It can be noticed that wind power is the most competitive option. Its low operation and maintenance costs make the difference. Small-hydro and plasma gasification technology are not far behind, being just about four cents per kWh more expensive. It is impressive how plasma gasification technology ends up being the second most competitive option, despite its low technological development in some of its devices. Its wide operability and the efficient and effective choice made when selecting the number of fuel cells have been decisive. On the other hand, solar PV technology is the most expensive technology, being more than two times costlier than the cheaper choice. That is because its short operability (it can only operate when there is daylight) and its still short technological development (although investment costs have experienced a significant fall).

Thus, it can be said that plasma technology ends up being an outstanding technology for the micro-grid's needs of a manageable power source. This technology transforms waste products into hydrogen, offering a sustainable and efficient solution for waste treatment. The Rankine cycle provides the process a positive energy balance, providing energy to various additional systems that take part in the process. Finally, fuel cells provide the necessary manageable backing for the micro-grid in an effective and efficient way.

## 2.2. Economic evaluation on the micro-grid as a whole

For the micro-grid to be economically competitive, it is necessary to prove that its costs are under the ones of the conventional power market. For this purpose, it is then necessary to introduce the concept of PVPC. PVPC (*Precio Voluntario para el Pequeño Consumidor*), previously known as TUR, is the existing tariff for small consumers of less than 10 kW and 1KV. This tariff is chosen to be compared with the prices of the micro-grid, as it has been considered that the majority of the consumers of the micro-grid are of this type. This tariff includes the cost of electricity generation, and a “toll tariff”, that includes a wide variety of factors that affect the price of electricity. All these factors are resumed below:

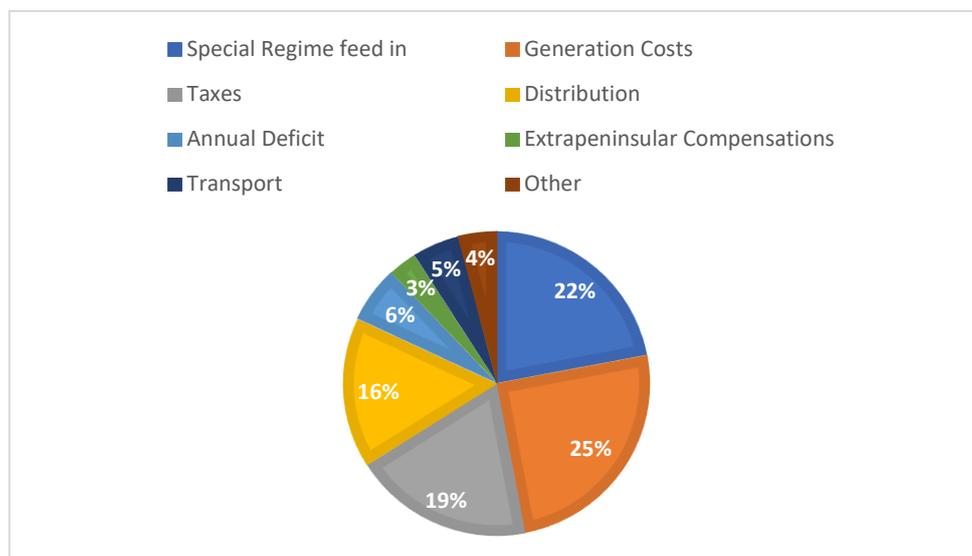


Figure 43: Cost breakdown of electricity in Spain. Source: IDAE

It is important to take into consideration that some of these costs will not account for the project's micro-grid. Feed-in costs, for instance, will not be included for the micro-grid, as no premiums will be paid for renewable production purposes. As the micro-grid's production will take place nearby its consumption point, transport costs will be reduced drastically, and will

not be considered for this case as well. In addition, extra peninsular compensations will not apply. All in all, a total 30% reduction will be considered for the comparison with the micro-grid.

The mean PVPC value for January 2017 was 0,13263 €/kWh, and it will be the reference value for the economic evaluation. It will be considered as constant throughout the year. As a 30% reduction will be achieved as explained, 0,039789 €/kWh would be saved just with the micro-grid's implementation.

The cost of the electricity in the micro-grid will be obtained through the weighted sum of each technology installed in the micro-grid concerning its generation share. Thus, a mean cost of 9,2588 c€/kWh the first year of operation of the micro-grid is obtained, being it significantly lower than the conventional grid's price of electricity for the same period. Indeed, it is in fact lower than the price of electricity excluding those costs that would not apply for the micro-grid.

All of this has been calculated for the micro-grid operating in island mode. This price will be altered in case that any exchange with the conventional grid is produced, typically when solar power production is at its peak, and there is an excess of power production, or when the micro-grid is not able to satisfy power demand. These exchanges will result into 60€/MWh for electricity import and 25 €/MWh for exports.

### 3. Cost-effectiveness of the micro-grid

In this last stage of the economic study, the spotlight is on the micro-grid affordability throughout the years. For this purpose, it has been considered the initial investment made on the micro-grid, its annual costs and its income. All of them are calculated for the 25-year lifespan of the micro-grid. The total initial investment of the micro-grid is **357,972 M€**, and it is distributed as in the figure below:

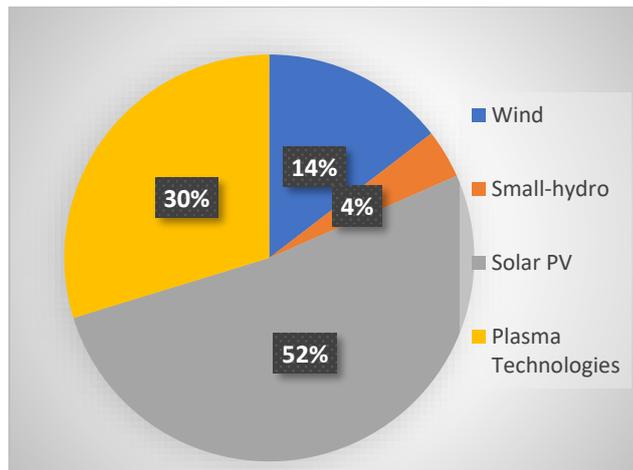


Figure 46: Investment costs share per technology. Own elaboration

Running costs are influenced throughout the years by the CPI (set to 2,01%). In this way, running costs vary from 11755365,2 € the first year to 14184903,64 € the 25<sup>th</sup>.

For these calculations, it has been considered as income the money that is being saved by not buying electricity from the conventional grid at its price of 0,13263 €/kWh ( the first year) and producing it in the plasma gasification plant (140,5831 GWh a year) added to difference in price of producing this energy at the micro-grid at a price of 9,2588 c€/kWh rather than the one of the conventional grid. All these calculations are carried out taking into account the CPI.

The project’s balance of profits and costs through the 25 -year lifespan of the micro-grid is shown in the following figure:

Year:	Costs(€)	Income (€)	Profits (€)	Accumulated Profits (€)
-------	----------	------------	-------------	-------------------------

Year 0	357972000	0	-357972000	-357972000
Year 1	11755365,2	24,7845351	13029169,9	-344942830
Year 2	12002227,9	25,3050103	13302782,5	-331640048
Year 3	12254274,7	25,8364156	13582140,9	-318057907
Year 4	12511614,4	26,3789803	13867365,9	-304190541
Year 5	12838230,1	26,9329389	14094708,8	-290095832
Year 6	12902421,2	27,4985306	14596109,4	-275499723
Year 7	12966933,3	28,0759997	15109066,4	-260390656
Year 8	13031768	28,6655957	15633827,7	-244756829
Year 9	13096926,9	29,2675732	16170646,4	-228586182
Year 10	13162411,5	29,8821923	16719780,8	-211866401
Year 11	13228223,5	30,5097183	17281494,8	-194584907
Year 12	13294364,7	31,1504224	17856057,7	-176728849
Year 13	13360836,5	31,8045813	18443744,8	-158285104
Year 14	13427640,7	32,4724775	19044836,8	-139240267
Year 15	13494778,9	33,1543995	19659620,6	-119580647
Year 16	13562252,8	33,8506419	20288389,1	-99292257,6
Year 17	13630064	34,5615054	20931441,3	-78360816,2
Year 18	13698214,4	35,287297	21589082,6	-56771733,6
Year 19	13766705,4	36,0283302	22261624,8	-34510108,8
Year 20	13835539	36,7849252	22949386,2	-11560722,6
Year 21	13904716,6	37,5574086	23652691,9	12091969,4
Year 22	13974240,2	38,3461142	24371873,9	36463843,3
Year 23	14044111,4	39,1513826	25107271,1	61571114,4
Year 24	14114332	39,9735616	25859229,6	87430344
Year 25	14184903,6	40,8130064	26628102,7	114058447

Figure 31: Profits and costs balance. Own elaboration

It can be seen how the micro-grid little by little overcomes the initial investment, and by the year 21 it starts to produce profits, accumulating a net profit by the year 25 of approximately 114 M€. It is then demonstrated the viability of the project also economically.

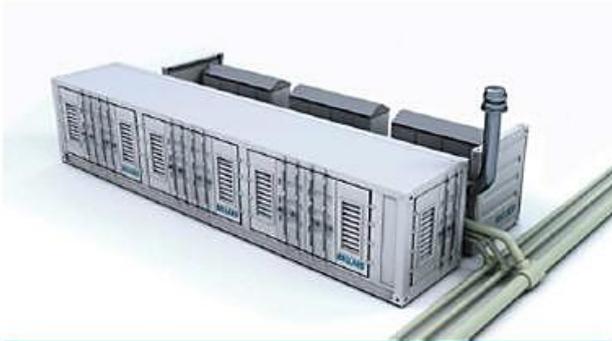
# Part III. Annex

## Annex A: Ballard Fuel Cell Catalogue:

**BALLARD®**

SMARTER SOLUTIONS FOR A CLEAN ENERGY FUTURE

**ClearGen®**  
SPECIFICATION SHEET



### ➤ Distributed Generation - 1MW

Ballard's ClearGen® fuel cell system is a complete turnkey solution, providing a supply of zero-emission power. The system can operate continuously for baseload power generation, or intermittently, providing peak power during times of high demand.

The self-contained power modules run on hydrogen fuel; customers range from utilities to chemical companies with available by-product hydrogen. The 1 MW modular units are completely scalable in 500 kW increments, enabling tailored solutions to meet each customer's needs.

Ballard's fuel cell stacks are at the core of this modular solution. Commercially available today, the fuel cells feature dynamic response, high efficiency, robust and reliable operation. Various annual service packages are available for the fuel cell system that include preventative and corrective maintenance, to support the product's 20-year lifetime.

Please contact us for product availability and pricing.

### ➤ PRODUCT SPECIFICATIONS

Type:	PEM (Proton Exchange Membrane) fuel cell generator	
Performance:	Net Power	1 MW
	Efficiency	40% (+2%) <sup>1</sup>
	Output voltage	380 – 480 V AC
	Output frequency	50 – 60 Hz
Physical Characteristics:	Fuel Cell Module: Dimensions (H x W x L) Weight	2.9 x 2.4 x 9 meters (x2) <40,000 kg
	Electrical Module: Dimensions (H x W x L) Weight	2.9 x 2.4 x 6.3 meters 15,000 kg
Fuel:	Hydrogen	>98% <sup>2</sup>
	Fuel consumption	63 kg/hr (700 m <sup>3</sup> /hour)
Available heat:	Output heat load	>950 kW <sup>3</sup>
	Available water temperature	60 – 65°C
Emissions:	Noise	<80db @ 7 M
	Pollutants	Zero emissions (no GHG or local air pollutants)

1. At beginning of life (BOL).

2. Ballard can work with customer to provide customized fuel purification system.

3. System interface cooling flow rate and rejection temperature to be determined.

Specifications and descriptions in this document were in effect at the time of publication. Ballard Power Systems, Inc. reserves the right to change specifications, product appearance or to discontinue products at any time (02/2012) GPC5103076-0E

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## Annex B: Power plants in Toledo province:

Nombre de Instalación	Municipio de la Instalación	Provincia de la Instalación	Potencia Instalada KW
TOLEDO PV	Puebla de Montalbán (La)	Toledo	1000
SALTO DE VILLAVERDE	Santa Cruz de la Zarza	Toledo	900
LAVADERO SAN BERNARDO	Toledo	Toledo	1500
HIGARES	Mocejón	Toledo	1600
MOLINO DEL CAÑAL (SAFONT)	Toledo	Toledo	1120
LA ALDEHUELA	Noblejas	Toledo	1400
CEBOLLA	Cebolla	Toledo	1500
BETICA DE COGENERACION	Yunclillos	Toledo	15000
ECOFRUIT DESIMPACTO	Quero	Toledo	10000
CARNICAS PRISAN	Lominchar	Toledo	508
MADERAS SAN RAFAEL	Villacañas	Toledo	2376
TRATAMIENTO DE PURINES DE GALVEZ	Gálvez	Toledo	15000
TRATAMIENTO DE PURINES DE LA PUEBLANUEVA	Pueblanueva (La)	Toledo	15000
TRATAMIENTO PURINES ALCAUDETE DE LA JARA	Alcaudete de la Jara	Toledo	1680
TRATAMIENTO PURINES CONSUEGRA	Consuegra	Toledo	16332
TRATAMIENTO DE PURINES DE POLAN	Polán	Toledo	16332
TRATAMIENTO DE PURINES GERINDOTE	Gerindote	Toledo	16300
TRATAMIENTO DE PURINES FUENSALIDA	Fuensalida	Toledo	16300
TRATAMIENTO DE PURINES EN MANZANEQUE	Manzaneque	Toledo	11652
TRATAMIENDO LODOS EN MADRIDEJOS	Madridejos	Toledo	9048
CERAMICA TECNICA DE ILLESCAS	Illescas	Toledo	3138
MAZARRON COGENERACION	Numancia de la Sagra	Toledo	2095
TRATAMIENTO DE PURINES EN BURUJON	Burujón	Toledo	15159
MONTECILLO	Toledo	Toledo	3600
PLANTA BIOMASA DE UNIENER	Ocaña	Toledo	100
PLANTA BIOMASA DE UNIENER	Ocaña	Toledo	700
PLANTA BIOMASA DE UNIENER	Ocaña	Toledo	1200
PLANTA DE PURINES EN MESEGAR DE TAJO	Mesegar de Tajo	Toledo	14940
PLANTA TRATAMIENTO DE BIOMASA EN VILLACAÑAS	Villacañas	Toledo	780
PLANTA TRATAMIENTO DE BIOMASA EN VILLACAÑAS	Villacañas	Toledo	2340
PLANTA TRATAMIENTO DE BIOMASA EN VILLACAÑAS	Villacañas	Toledo	1560
PLANTA TRATAMIENTO DE BIOMASA EN VILLACAÑAS	Villacañas	Toledo	3120

GRANJA AVICOLA VILLASECA	Villaseca de la Sagra	Toledo	14800
C.H. PEDRO ORTIZ RAMOS (ANTES SALTO DE MONTEARAGON)	Talavera de la Reina	Toledo	2906
ALCOHOLERA PUEBLA	Puebla de Almoradiel (La)	Toledo	2000
COGENERACION CAMPUS UNIVERSITARIO DE TOLEDO	Toledo	Toledo	814
PARQUE EOLICO LAS NAVAS	Nava de Ricomalillo (La)	Toledo	15300
P. E. LA PLATA	Villarrubia de Santiago	Toledo	21250
PARQUE EOLICO ALGODOR	Turleque	Toledo	44200
P. E. SIERRA DEL ROMERAL (ampliado 9/3/03)	Villacañas	Toledo	31450
COGENERACION	Madridejos	Toledo	2720
BIOMASA	Madridejos	Toledo	2780
PLANTA DE TRATAMIENTO DE PURINES	Manzanaque	Toledo	15000
P.E. CERRO DE LA OLIVA	Almonacid de Toledo	Toledo	9000
P.E. CERRO DEL PULGAR	Pulgar	Toledo	4500
P.E. CERRO MORENO	Villa de Don Fadrique (La)	Toledo	6000
P.E. CABEZA DEL CONDE	Madridejos	Toledo	8000
PARQUE 9-A	Villarrubia de Santiago	Toledo	36000
P.E. EL EMPERADOR	Yébenes (Los)	Toledo	20400
I.S.F. VICENTE MAQUEDA	Villa de Don Fadrique (La)	Toledo	5
I.F. VICENTE MAQUEDA	Villa de Don Fadrique (La)	Toledo	5
I.F. FRANCISCO COMENDADOR	Villa de Don Fadrique (La)	Toledo	5
I.F. M <sup>a</sup> VAL SANCHEZ	Mejorada	Toledo	2
I.F. LA GRANJA DE MANOLO	Ventas con Peña Aguilera (Las)	Toledo	5
I.S.F. EMILIANO PEREZAGUA	Sonseca	Toledo	4
P.E. LOS YEBENES I	Yébenes (Los)	Toledo	49500
P. E. YEPES I	Yepes	Toledo	38250
P. E. YEPES II	Yepes	Toledo	49300
P. E. SIERRA DE ALTAMIRA	Puerto de San Vicente	Toledo	40000
P.E. LOS YEBENES	Yébenes (Los)	Toledo	50000
I.F. MANUEL GARCIA ORELLANA	Ugena	Toledo	2,4
I.F. FRANCISCO COMENDADOR ROMERO	Villa de Don Fadrique (La)	Toledo	5
I.F. ANTONIO MANCEBO	Toledo	Toledo	5
I.F. CENTRO TERAPEUTICO L. PAVONI	Ugena	Toledo	5,76
I.F. VICTORIANO RONCO	Villa de Don Fadrique (La)	Toledo	5
I.F. AGUSTINA RONCO	Villa de Don Fadrique (La)	Toledo	5
I.F. FAUSTINO ORGANERO VILLAJOS	Villa de Don Fadrique (La)	Toledo	5
PLANTA DE ENERGÍA ELÉCTRICA - BIOGÁS - VERTEDERO	Toledo	Toledo	1048
PLANTA DE ENERGÍA ELÉCTRICA - BIOGÁS - VERTEDERO	Toledo	Toledo	1064

PLANTA DE ENERGÍA ELÉCTRICA - BIO-GÁS - VERTEDERO	Toledo	Toledo	1064
C.H. TALAVERA	Talavera de la Reina	Toledo	2854
C.H. PALOMAREJO	Talavera de la Reina	Toledo	1960
I.F. CP TOMAS ROMOJARO	Fuensalida	Toledo	2,5
COG. CERAMICA ESPIRITU SANTO, S.A.	Cobeja	Toledo	990
I.F. GLORIA DEL SEÑOR TOBOSO PICAZO	Romeral (El)	Toledo	5
I.EOLICA EN QUINTANAR DE LA ORDEN	Quintanar de la Orden	Toledo	300
I.EOLICA EN VILLA DE DON FADRIQUE	Villa de Don Fadrique (La)	Toledo	300
P.E. AMPLIACION CABEZA DEL CONDE HERA AMASA, S.A.	Madridijos	Toledo	4000
JUAN CARRASCO JOANIQUET	Sonseca	Toledo	10
JUAN CARRASCO JOANIQUET	Sonseca	Toledo	5
Mª OLVIDO MORENO CASTRO	Sonseca	Toledo	5
SANTA OLALLA-2	Santa Olalla	Toledo	5
SANTA OLALLA-2	Santa Olalla	Toledo	36,8
SANTA OLALLA-1	Santa Olalla	Toledo	5
JUAN ANTONIO GARCÍA BAÑÓN	Ocaña	Toledo	5
ANTONIO BALLESTEROS SANTIAGO	Ocaña	Toledo	5
MIGUEL ANGEL PALOMINO JIMÉNEZ	Ocaña	Toledo	5
DIRESA LA MANCHA, S.L.	Ocaña	Toledo	5
I.F. OTM	Ocaña	Toledo	5
GUSTAVO DÍAZ-REGAÑÓN ESQUINAS	Ocaña	Toledo	5
LA AURORA C.B.QUESERÍA	Urda	Toledo	5
LA AURORA C.B.GRANJA	Urda	Toledo	5
TOMÁS DE DIEGO MARTÍN	Yepes	Toledo	5
JOSÉ MANUEL CASADO GIL	Escalona	Toledo	5
ANA MARÍA DE VEGA CUESTA	Dosbarrios	Toledo	13,8
GONZALO MELGAR DE CORRAL	Argés	Toledo	3,5
ANA Mª BAUTISTA MARTIN	Cobisa	Toledo	5
ANGEL OLIVEROS ZAFRA	Villanueva de Alcardete	Toledo	5
JOSÉ ANGEL FERNÁNDEZ LIZCANO (ampl.7,5 kw-28/4/06)	Dosbarrios	Toledo	15
HIPICA ALMENARA	Toledo	Toledo	90
DESIDERIO GARCIA RODRIGUEZ	Urda	Toledo	5
DESIDERIO GARCIA RODRIGUEZ	Urda	Toledo	10
ANTONIO RAMOS VEGA	Aldeanueva de Barbarroya	Toledo	5
FRANCISCA SANTIAGO ORTIZ	Pelahustán	Toledo	5
GUADALUPE CASTELLANO PEREZ	San Román de los Montes	Toledo	5
JAVIER PAZ SIMON	Argés	Toledo	2,5
JAVIER PAZ SIMON	Argés	Toledo	5
	mar-01 Lagartera	Toledo	100
	mar-02 Lagartera	Toledo	100
ISF INES CARMEN DE LA PEÑA DE VEGA	Dosbarrios	Toledo	7,5
INSTALACIONES ELECTRICAS RETOR, SL	Polán	Toledo	15
SF VICENTE VALENTIN MORELLA NAVARRO	Ocaña	Toledo	5
MIGUEL ANGEL DIAZ GARRIDO	Pueblanueva (La)	Toledo	7,5

JOAQUIN DIAZ GARRIDO	Pueblanueva (La)	Toledo	7,5
JOAQUIN DIAZ GOMEZ	Pueblanueva (La)	Toledo	7,5
ANA BELEN DIAZ GARRIDO	Pueblanueva (La)	Toledo	7,5
ADELAIDA GARRIDO MARTINEZ	Pueblanueva (La)	Toledo	7,5
SF MIGUEL ANGEL MARTIN JIMENEZ	Sonseca	Toledo	5
LA ENCINILLA	San Bartolomé de las Abiertas	Toledo	100
LA ENCINILLA CB	San Bartolomé de las Abiertas	Toledo	100
FOTOVOLCENTRO TORRIJOS	Torrijos	Toledo	100
GEA	Villa de Don Fadrique (La)	Toledo	100
ANTONIO MARTINEZ TARDIEU	Villa de Don Fadrique (La)	Toledo	10
Mª ELOISA PEREGRINA PALOMINO	Villa de Don Fadrique (La)	Toledo	5
JAVIER CASTRO ORTIZ	Santa Cruz del Retamar	Toledo	4,6
DIRESA II	Ocaña	Toledo	9,9
ISF MARIA TERESA FERNANDEZ-GALINDO	Ocaña	Toledo	5
CERAMICA BARRASA	Mocejón	Toledo	960
CERAMICA MILLAS E HIJOS	Mora	Toledo	5190
FINCA BARCILES	Añoover de Tajo	Toledo	5826
NUEVA CERAMICA MODERNA	Pantoja	Toledo	2766
HERMANOS ORTIZ BRAVO I Y II	Pantoja	Toledo	2766
SANDARACA	Calzada de Oropesa	Toledo	98
MPC-1	Miguel Esteban	Toledo	10
MARIA ROSA MUÑOZ CUTILLAS	Torrijos	Toledo	55,2
MARIA JESUS FERNANDEZ ANTA	Belvís de la Jara	Toledo	3,5
INST. EOLICA FAYMASA	Novés	Toledo	7,2
JOSE LUIS-2006	Puente del Arzobispo (El)	Toledo	4,6
BEGOÑA-2006	Puente del Arzobispo (El)	Toledo	4,6
LUIS MARIANO	Fuensalida	Toledo	5
LUIS MARIANO	Fuensalida	Toledo	10
TAJO-1	Erustes	Toledo	45
TAJO-2	Erustes	Toledo	45
CARMELO GONZALEZ MORA	Villa de Don Fadrique (La)	Toledo	5
JUAN ANTONIO MENDOZA TOLEDO	Toboso (El)	Toledo	4,1
JOSE ANTONIO CABRERA LOARTE-1	Villa de Don Fadrique (La)	Toledo	5
JOSE ANTONIO CABRERA LOARTE-2	Villa de Don Fadrique (La)	Toledo	5
ANA CRISTINA REQUENA GALLEGO	Villa de Don Fadrique (La)	Toledo	5
SOLAR FOTOVOLTAICO	Ocaña	Toledo	5
MIGUEL ANGEL CABRERO RODRIGUEZ	Ocaña	Toledo	5
VICENTE CABRERO RODRIGUEZ	Ocaña	Toledo	5
ANTONIO GAMERO SERRANO	Cuerva	Toledo	100
RAFAEL DE LAS HERAS BALMASEDA	Cuerva	Toledo	100
HELIOS XXI	Cuerva	Toledo	100
I.B.M. PRODUCCIONES ENERGETICAS	Cuerva	Toledo	100

BENEDICTO XVI - 1	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 2	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 3	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 4	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 5	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 6	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI 7	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI 8	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI 9	Villarrubia de Santiago	Toledo	80
I.S.F. BENEDICTO XVI - 10	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI 11	Villarrubia de Santiago	Toledo	80
I.S.F. BENEDICTO XVI - 15	Villarrubia de Santiago	Toledo	80
TECNICAS CONSTRUCTIVAS	Cuerva	Toledo	100
ROSA MARIA GUERRERO CALVO	Cuerva	Toledo	100
GOMEZ MOTA	Cuerva	Toledo	100
GAMERO ENERGIAS ALTERNATIVAS 3	Cuerva	Toledo	100
CMA SOLAR	Cuerva	Toledo	100
ALTERNATIVA ENERGÉTICA (CUERVA SOLAR)	Cuerva	Toledo	100
IGNACIO GAMERO SERRANO	Cuerva	Toledo	100
JUAN JESUS CARRASCAL GARCIA	Santa Cruz del Retamar	Toledo	4,6
I.S.F.	Cuerva	Toledo	100
DAPASA SERVICIOS E INVERSIONES	Cuerva	Toledo	100
HORTI SOLAR	Cuerva	Toledo	100
AÑO VER PV	Calera y Chozas	Toledo	100
CALERA ENERGIAS RENOVABLES, SL	Calera y Chozas	Toledo	100
BARCILES ENERGIAS RENOVABLES	Calera y Chozas	Toledo	100
ALBERCHE ENERGIAS RENOVABLES	Calera y Chozas	Toledo	100
ALBERCHE SOLAR FOTOVOLTAICA	Calera y Chozas	Toledo	100
MARFLET VACACIONES	Calera y Chozas	Toledo	100
LINGEGAS B.V.	Calera y Chozas	Toledo	100
BARCILES SOLAR FOTOVOLTAICA	Calera y Chozas	Toledo	100
CALERA SOLAR FOTOVOLTAICA	Calera y Chozas	Toledo	100
MARFLET	Calera y Chozas	Toledo	100
GESTION DE RECURSOS ENERGETICOS AIZPURUA, SL	Nombela	Toledo	5
CASTRO HERAS 1	Alcolea de Tajo	Toledo	4,6
JOSE ANTONIO CABRERA LOARTE	Villa de Don Fadrique (La)	Toledo	20
BENEDICTO XVI-13	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI-14	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI-12	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI-16	Villarrubia de Santiago	Toledo	80
BALTEUS FORUM	Nombela	Toledo	20
GREGORIO	Fuensalida	Toledo	5
GREGORIO	Fuensalida	Toledo	10
MAVE ENERGIA FOTOVOLTAICA, S.L.	Villaminaya	Toledo	100
INGESOLAR, SL	Villaminaya	Toledo	100
ENSOLER ENERGIA FOTOVOLTAICA, SL	Villaminaya	Toledo	100
SANDANCOS D. SOPENA, SL	Villaminaya	Toledo	100
FASANCER ENERGIA SOLAR, SL	Villaminaya	Toledo	100

SANCHEZ MARCOS SOLAR, SL	Villaminaya	Toledo	100
LOURDES GREGORIO-1	Alcaudete de la Jara	Toledo	5
ISIDRO CALDERON 1	Alcaudete de la Jara	Toledo	5
SONIA ACOSTA SANCHEZ	Villa de Don Fadrique (La)	Toledo	10
I.S.F.	Villa de Don Fadrique (La)	Toledo	10
FRANCISCO CARPINTERO TELLO	Villa de Don Fadrique (La)	Toledo	18
LAS PALOMERAS	Estrella (La)	Toledo	40
CULTIVOS DIAZ	Pueblanueva (La)	Toledo	30
ANA BELEN DIAZ GARRIDO	Pueblanueva (La)	Toledo	40
JOAQUIN DIAZ GARRIDO	Pueblanueva (La)	Toledo	40
MIGUEL ANGEL DIAZ GARRIDO	Pueblanueva (La)	Toledo	40
ADELAIDA GARRIDO MARTINEZ	Pueblanueva (La)	Toledo	40
JOAQUIN DIAZ GOMEZ	Pueblanueva (La)	Toledo	39
VEGA 3	Cobisa	Toledo	5
PRODUCTOS CERAMICOS MORA, S.L.	Illescas	Toledo	100
LA ABUELA JULIA	Villaminaya	Toledo	100
DIONISIO GALAN DELGADO	Madridejos	Toledo	29,7
LILLO SOLAR, SL	Corral de Almaguer	Toledo	96
CRISTOBAL SILVAN SEN	Almorox	Toledo	10,5
DALPES	Illescas	Toledo	50
ALBERTO CONTRERAS AFUERA	Huerta de Valdecarábanos	Toledo	7,5
JENARO JOSE E. NORIEGA MUÑIZ	Huerta de Valdecarábanos	Toledo	7,5
PEDRO LORENZO GIL	Huerta de Valdecarábanos	Toledo	7,5
DOLORES MARIA DEL PILAR DIAZ CANO	Huerta de Valdecarábanos	Toledo	7,5
AYUNTAMIENTO HUERTA DE VAL-DECARABANOS	Huerta de Valdecarábanos	Toledo	7,5
JOSE ILLANA GISMERA	Huerta de Valdecarábanos	Toledo	30
MARIA ROSA BARCENILLA GALLEG0	Huerta de Valdecarábanos	Toledo	7,5
SANTIAGO MAZARRO MOZOS	Huerta de Valdecarábanos	Toledo	7,5
LUCIO MOYA MUÑOZ	Huerta de Valdecarábanos	Toledo	7,5
Mª ISABEL BARRASUS HERNANDO	Huerta de Valdecarábanos	Toledo	7,5
JOAQUIN MIGUEL MIGUEL	Huerta de Valdecarábanos	Toledo	7,5
JOSE RAMON PASCUAL CASTELLOR	Huerta de Valdecarábanos	Toledo	7,5
MARIA PILAR PASCUAL CASTELLOR	Huerta de Valdecarábanos	Toledo	7,5
JOSE LUIS PERERA SOLER	Huerta de Valdecarábanos	Toledo	7,5
SOCIEDAD DE CARTERA 2R & 2 M, SL	Huerta de Valdecarábanos	Toledo	30
DECURSO, S.A.	Huerta de Valdecarábanos	Toledo	7,5
VASSILIOS MORFAKIDIS	Huerta de Valdecarábanos	Toledo	7,5

Mª DOLORES MARTIN SANCHEZ	Huerta de Valdecarábanos	Toledo	7,5
LUIS MONTOLIU ESPAÑA	Huerta de Valdecarábanos	Toledo	7,5
AGUSTIN ALFAYA RODRIGUEZ	Huerta de Valdecarábanos	Toledo	7,5
BLANCA MUÑOZ DELGADO	Huerta de Valdecarábanos	Toledo	7,5
CONCILIA, SL	Huerta de Valdecarábanos	Toledo	30
HUERTA DE VALDECARÁBANOS 40	Huerta de Valdecarábanos	Toledo	7,5
FLORA BALLESTEROS APARICIO	Huerta de Valdecarábanos	Toledo	7,5
RAMON VIÑUALES GARCIA	Huerta de Valdecarábanos	Toledo	7,5
JUAN FCO GARCIA CONDE	Huerta de Valdecarábanos	Toledo	7,5
MARIA TERESA MAYOR MONTES	Huerta de Valdecarábanos	Toledo	7,5
CESAR LUIS MIRAVALLES GUTIERREZ	Huerta de Valdecarábanos	Toledo	7,5
MONICA MOYA MARTINEZ	Huerta de Valdecarábanos	Toledo	7,5
EUGENIA SERRANO CASTELLOR	Huerta de Valdecarábanos	Toledo	7,5
MARIA CONSUELO BARRASUS HERNANDO	Huerta de Valdecarábanos	Toledo	7,5
SUSANA BARCENILLA PAZ	Huerta de Valdecarábanos	Toledo	7,5
LUIS BARCENILLA GALLEGO	Huerta de Valdecarábanos	Toledo	7,5
NURIA CONTRERAS AFUERA	Huerta de Valdecarábanos	Toledo	7,5
ANTONIA SERRANO CASTLLOR	Huerta de Valdecarábanos	Toledo	7,5
Mª AMPARO MAZARRO FERNANDEZ	Huerta de Valdecarábanos	Toledo	7,5
RAFAEL CONTRERAS AYAS	Huerta de Valdecarábanos	Toledo	22,5
MARGA RIOJA, SL	Huerta de Valdecarábanos	Toledo	15
CAROLINA SANTAELLA VALLEJO	Huerta de Valdecarábanos	Toledo	7,5
BEGOÑA DEL CARMEN MARTIN MORENO	Huerta de Valdecarábanos	Toledo	7,5
Mª DEL MAR SAEZ CAÑO	Huerta de Valdecarábanos	Toledo	15
JOSE IGNACIO CERRO ARROYO	Huerta de Valdecarábanos	Toledo	7,5
HUERTA DE VALDECARABANOS	Huerta de Valdecarábanos	Toledo	7,5
GONZALO LORENZO SANCHEZ	Huerta de Valdecarábanos	Toledo	7,5
BENITO ADAN GARCIA DEL RINCON	Huerta de Valdecarábanos	Toledo	7,5
MUEBLES FERMIN DE LA ROSA, SL	Huerta de Valdecarábanos	Toledo	7,5

SONIA BARBA MUÑOZ	Huerta de Valdecarábanos	Toledo	7,5
JUAN ADAN GARCIA DEL RINCON	Huerta de Valdecarábanos	Toledo	7,5
HUERTA DE VALDECARABANOS	Huerta de Valdecarábanos	Toledo	7,5
ALICIA CONTRERAS AFUERA	Huerta de Valdecarábanos	Toledo	7,5
DANIEL ROJO ROMO	Yébenes (Los)	Toledo	7,5
Mª LOS ANGELES RECUERO AFUERA	Huerta de Valdecarábanos	Toledo	7,5
Mª PILAR ENTRENA MORATIEL	Huerta de Valdecarábanos	Toledo	7,5
ANGEL ALFREDO RUBIO FERNANDEZ	Huerta de Valdecarábanos	Toledo	7,5
ENRIQUE SEBASTIAN ACHUTEGUI	Huerta de Valdecarábanos	Toledo	7,5
Mª CLARA REVUELTA REVIEJO	Huerta de Valdecarábanos	Toledo	5
Mª LOS ANGELES REVUELTA REVIEJO	Huerta de Valdecarábanos	Toledo	5
Mª BERNARDA TRENADO RAMIREZ	Huerta de Valdecarábanos	Toledo	7,5
TEODORO SANZ MARTIN	Huerta de Valdecarábanos	Toledo	7,5
Mª PILAR ESCOBAR RODRIGUEZ	Huerta de Valdecarábanos	Toledo	7,5
ARANCHA EGUIGUREN SANCHEZ	Huerta de Valdecarábanos	Toledo	7,5
JUANA DUQUE VICARIA	Huerta de Valdecarábanos	Toledo	7,5
JUAN IGNACIO VALLEJO ROSELL	Huerta de Valdecarábanos	Toledo	7,5
MARIA JESUS MUÑOZ DELGADO	Huerta de Valdecarábanos	Toledo	7,5
Mª PILAR PERALTA JUAREZ	Huerta de Valdecarábanos	Toledo	7,5
PEREZ NAVARRO FOTOVOALTAICA, C.B.	Huerta de Valdecarábanos	Toledo	7,5
RAQUEL RECUERO AFUERA	Huerta de Valdecarábanos	Toledo	7,5
MIQUELMITA FERNANDEZ RODRIGUEZ	Huerta de Valdecarábanos	Toledo	7,5
JUAN GIL NAVAS	Huerta de Valdecarábanos	Toledo	7,5
BEATRIZ PAREDES GARCIA	Huerta de Valdecarábanos	Toledo	7,5
Mª ANGELES GARCIA MERINO	Huerta de Valdecarábanos	Toledo	7,5
JOSE RECUERO AFUERA	Huerta de Valdecarábanos	Toledo	15
OSCAR SANCHEZ REY PEREA	Huerta de Valdecarábanos	Toledo	7,5
JUAN SALVADOR ORTIGOSA MARMOL	Huerta de Valdecarábanos	Toledo	7,5
SANTIAGO PEREZ RECIO	Huerta de Valdecarábanos	Toledo	7,5
DAVID SANTIAGO PEREZ BARRASUS	Huerta de Valdecarábanos	Toledo	7,5

OLAF PALLE GARCIA POHL	Huerta de Valdecarábanos	Toledo	7,5
ELENA GIMENO CASTILLAZUELO	Huerta de Valdecarábanos	Toledo	7,5
LUIS GARCIA ALONSO	Huerta de Valdecarábanos	Toledo	7,5
Mª ANA GONZALEZ SANTIS	Huerta de Valdecarábanos	Toledo	7,5
DAVID SAAVEDRA YUSTE	Huerta de Valdecarábanos	Toledo	7,5
ANTONIO SANTOS ORTIGOSA	Huerta de Valdecarábanos	Toledo	7,5
DELIA MARIA TORAÑO VALLINA	Huerta de Valdecarábanos	Toledo	7,5
HUERTA DE VALDECARÁBANOS 72	Huerta de Valdecarábanos	Toledo	7,5
DAVID MATEO RUEDA	Huerta de Valdecarábanos	Toledo	7,5
JOSE ANTONIO DE LA FLOR GARCIA	Huerta de Valdecarábanos	Toledo	7,5
SUSANA FERNANDEZ SALGADO	Huerta de Valdecarábanos	Toledo	7,5
FRANCISCO RODRIGO DIAZ CRIADO	Huerta de Valdecarábanos	Toledo	7,5
MIGUEL ANGEL VILLARRUBIA DIAZ	Mora	Toledo	5
FRANCISCO P. DE LA FLOR GARCIA	Huerta de Valdecarábanos	Toledo	30
Mª TERESA FERNANDEZ DEL VILLAR	Huerta de Valdecarábanos	Toledo	7,5
JOSE ANGEL PEREZ NAVARRO	Huerta de Valdecarábanos	Toledo	7,5
FU2	Fuensalida	Toledo	18,4
IGNACIO RODRIGUEZ-NOVAS SANCHEZ-DIEZMA	Huerta de Valdecarábanos	Toledo	7,5
JOAQUIN GOMEZ NAVARRO	Huerta de Valdecarábanos	Toledo	7,5
PURIFICACION PECES CANTERO	Huerta de Valdecarábanos	Toledo	7,5
PABLO HERNANDEZ GARRIDO	Burguillos de Toledo	Toledo	5
ALEJANDRA RAMIREZ DE CARTAGENA LOSADA	Huerta de Valdecarábanos	Toledo	7,5
Mª DEL MAR SANCHEZ MARTINEZ	Huerta de Valdecarábanos	Toledo	7,5
DE LA ROSA NIÑO INVERSIONES, SL	Huerta de Valdecarábanos	Toledo	7,5
Mª ANGELES DE LA ROSA NIÑO	Huerta de Valdecarábanos	Toledo	7,5
FERMIN DE LA ROSA URDIALES	Huerta de Valdecarábanos	Toledo	30
ROSA MARIA DIEZ PICO	Huerta de Valdecarábanos	Toledo	7,5
EUGENIO DE LA ROSA NIÑO	Huerta de Valdecarábanos	Toledo	7,5
JORGE DE LA ROSA NIÑO	Huerta de Valdecarábanos	Toledo	7,5
MARCOS ROMERO GOMEZ	Huerta de Valdecarábanos	Toledo	7,5

FRANCISCO JAVIER COLASTRA GARCIA DEL RINCON	Huerta de Valdecarábanos	Toledo	7,5
JOSE IGNACIO EGUIGUREN SANCHEZ	Huerta de Valdecarábanos	Toledo	15
LUIS RECUERO AFUERA	Huerta de Valdecarábanos	Toledo	75
JOSE ANTONIO MUÑOZ JIMENEZ	Huerta de Valdecarábanos	Toledo	15
HUGO FERNANDEZ GARCIA	Huerta de Valdecarábanos	Toledo	15
MAR VALLEJO ROSELL	Huerta de Valdecarábanos	Toledo	75
MODULO 1 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 2 PARQUE SOLAR FV DE TOTANES	Totanés	Toledo	100
MODULO 3 PARQUE SOLAR FV DE TOTANES	Totanés	Toledo	100
MODULO 4 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 5 PARQUE SOLAR FV DE TOTANES	Totanés	Toledo	100
MODULO 6 PARQUE SOLAR FV DE TOTANES	Totanés	Toledo	100
MODULO 7 PARQUE SOLAR FV DE TOTANES	Totanés	Toledo	100
MODULO 8 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 9 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 10 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 11 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 12 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 13 AYUNT. DE TOTANES	Totanés	Toledo	100
MODULO 14 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 15 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 16 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 17 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
MODULO 18 PARQUE SOLAR FV. DE TOTANES	Totanés	Toledo	100
AZUTAN III	Azután	Toledo	93,9
AZUTAN II	Azután	Toledo	93,9
AZUTAN IV	Azután	Toledo	99
AZUTAN V	Azután	Toledo	99
AZUTAN VI	Azután	Toledo	99
AZUTAN VII	Azután	Toledo	99
AZUTAN VIII	Azután	Toledo	99
AZUTAN X	Azután	Toledo	99
AZUTAN I	Azután	Toledo	93,9
AZUTAN IX	Azután	Toledo	99

AZUTAN XI	Azután	Toledo	21
AZUTAN XI	Azután	Toledo	7,5
I.F.	Casarrubios del Monte	Toledo	49,5
ISF	Talavera de la Reina	Toledo	5
PEDRO FUENTES GARCIA	Méntrida	Toledo	5
YOLANDA MONTALVO GARCIA	Méntrida	Toledo	5
MARIA DEL CARMEN GANDIA RAMOS	Puebla de Almoradiel (La)	Toledo	15
ALCOLEA 1	Alcolea de Tajo	Toledo	100
ALCOLEA 2	Alcolea de Tajo	Toledo	100
ALCOLEA 3	Alcolea de Tajo	Toledo	100
ALCOLEA 4	Alcolea de Tajo	Toledo	100
ALCOLEA 5	Alcolea de Tajo	Toledo	100
ALCOLEA 6	Alcolea de Tajo	Toledo	100
ALCOLEA 7	Alcolea de Tajo	Toledo	100
ALCOLEA 8	Alcolea de Tajo	Toledo	100
ALCOLEA 9	Alcolea de Tajo	Toledo	100
ALCOLEA 10	Alcolea de Tajo	Toledo	100
ALCOLEA 11	Alcolea de Tajo	Toledo	100
ALCOLEA 12	Alcolea de Tajo	Toledo	100
JUSTINO RODRIGUEZ-MALO GALLEGO	Sonseca	Toledo	24
JOSE BARBERO JIMENEZ	Orgaz	Toledo	24
SAN JULIAN I	Ventas de San Julián (Las)	Toledo	99
SAN JULIAN III	Ventas de San Julián (Las)	Toledo	99
SAN JULIAN IV	Ventas de San Julián (Las)	Toledo	99
HERRERUELA DE OROPESA I	Herreruela de Oropesa	Toledo	100
HERRERUELA DE OROPESA II	Herreruela de Oropesa	Toledo	100
SAN JULIAN V	Ventas de San Julián (Las)	Toledo	99
LA MOHEDA 1	Corral de Almaguer	Toledo	100
LA MOHEDA 2	Corral de Almaguer	Toledo	100
LA MOHEDA 3	Corral de Almaguer	Toledo	100
LA MOHEDA 4	Corral de Almaguer	Toledo	100
LA MOHEDA 5	Corral de Almaguer	Toledo	100
LA MOHEDA 6	Corral de Almaguer	Toledo	100
LA MOHEDA 7	Corral de Almaguer	Toledo	100
LA MOHEDA 8	Corral de Almaguer	Toledo	100
LA MOHEDA 9	Corral de Almaguer	Toledo	100
LA MOHEDA 10	Corral de Almaguer	Toledo	100
LA MOHEDA 11	Corral de Almaguer	Toledo	100
LA MOHEDA 12	Corral de Almaguer	Toledo	100
LA MOHEDA 13	Corral de Almaguer	Toledo	100
LA MOHEDA 14	Corral de Almaguer	Toledo	100
QUINTANAR 32	Quintanar de la Orden	Toledo	32
QUINTANAR 64	Quintanar de la Orden	Toledo	64
JUAN PABLO II Nº 9	Ocaña	Toledo	5
JUAN PABLO II Nº 2	Ocaña	Toledo	5
JUAN PABLO II Nº 33	Ocaña	Toledo	9,9
JUAN PABLO II Nº 31	Ocaña	Toledo	9,9
JUAN PABLO II Nº 6	Ocaña	Toledo	5

JUAN PABLO II Nº 4	Ocaña	Toledo	5
JUAN PABLO II Nº 40	Ocaña	Toledo	9,9
JUAN PABLO II, Nº 54	Ocaña	Toledo	9,9
JUAN PABLO II Nº 25	Ocaña	Toledo	9,9
JUAN PABLO II Nº 49	Ocaña	Toledo	9,9
JUAN PABLO II Nº 42	Ocaña	Toledo	9,9
JUAN PABLO II Nº 32	Ocaña	Toledo	9,9
JUAN PABLO II Nº 24	Ocaña	Toledo	9,9
JUAN PABLO II Nº 44	Ocaña	Toledo	9,9
JUAN PABLO II Nº 35	Ocaña	Toledo	9,9
JUAN PABLO II Nº 36	Ocaña	Toledo	9,9
JUAN PABLO II Nº 37	Ocaña	Toledo	9,9
JUAN PABLO II N1 52	Ocaña	Toledo	9,9
JUAN PABLO II Nº 22	Ocaña	Toledo	9,9
JUAN PABLO II Nº 21	Ocaña	Toledo	9,9
JUAN PABLO II Nº 8	Ocaña	Toledo	5
JUAN PABLO II Nº 48	Ocaña	Toledo	9,9
JUAN PABLO II Nº 30	Ocaña	Toledo	9,9
JUAN PABLO II Nº 41	Ocaña	Toledo	9,9
JUAN PABLO II Nº 45	Ocaña	Toledo	9,9
JUAN PABLO II Nº 38	Ocaña	Toledo	9,9
JUAN PABLO II Nº 11	Ocaña	Toledo	5
JUAN PABLO II Nº 23	Ocaña	Toledo	9,9
JUAN PABLO II Nº 26	Ocaña	Toledo	9,9
JUAN PABLO II Nº 10	Ocaña	Toledo	5
JUAN PABLO II Nº 28	Ocaña	Toledo	9,9
JUAN PABLO II Nº 29	Ocaña	Toledo	9,9
JUAN PABLO II Nº 3	Ocaña	Toledo	5
ISF	Torrijos	Toledo	72,6
SAN JULIAN II	Ventas de San Julián (Las)	Toledo	99
ISF	Totanés	Toledo	100
HUERTASOLAR DE ALDEANUEVA DE BARBARROYA D	Aldeanueva de Barbarroya	Toledo	75
HUERTASOLAR DE ALDEANUEVA DE BARBARROYA E	Aldeanueva de Barbarroya	Toledo	90
HUERTASOLAR DE ALDEANUEVA DE BARBARROYA B	Aldeanueva de Barbarroya	Toledo	90
HUERTASOLAR DE ALDEANUEVA DE BARBARROYA A	Aldeanueva de Barbarroya	Toledo	75
HUERTASOLAR DE ALDEANUEVA DE BARBARROYA C	Aldeanueva de Barbarroya	Toledo	60
AZUTÁN XII	Azután	Toledo	99
JULIO INOCENTE GARCIA-MORENO RODRIGUEZ	Madridejos	Toledo	100
JOSE ANTONIO GARCIA-MORENO RODRIGUEZ	Madridejos	Toledo	100
FOTOVOLTAICA CUERVA 1	Cuerva	Toledo	100
CARMEN-1	Sonseca	Toledo	9,9
SAN JULIAN VI	Ventas de San Julián (Las)	Toledo	99
SAN JULIAN VII	Ventas de San Julián (Las)	Toledo	99
AZUTAN XIII	Azután	Toledo	99

AZUTÁN XIV	Azután	Toledo	99
SAN JULIAN VIII	Ventas de San Julián (Las)	Toledo	99
PUNGIA SOLAR 29	Villa de Don Fadrique (La)	Toledo	45
DACRIS SOLAR	Casar de Escalona (El)	Toledo	29
GLOSAN SOLAR	Casar de Escalona (El)	Toledo	29
SANDAN SOLAR	Casar de Escalona (El)	Toledo	29
ANGEL GARCIA RODRIGUEZ	Urda	Toledo	10
ROGAMAR BUSINESS	Marjaliza	Toledo	20
ANGEL LUIS TOLEDO CARIPNTERO	Dosbarrios	Toledo	2,5
ANGEL LUIS TOLEDO CARIPNTERO	Dosbarrios	Toledo	2,5
KHOBAR GENERATION, S.L.	Casarrubios del Monte	Toledo	100
PUNGIA SOLAR 27	Villa de Don Fadrique (La)	Toledo	100
CRISTOBAL SILVAN SEN	Almorox	Toledo	13,8
PREFABRICADOS LA MANCHA	Borox	Toledo	90
CONSTRUCCIONES MENCHERO	Borox	Toledo	90
JUAN PABLO II Nº 27	Ocaña	Toledo	9,9
JUAN PABLO II Nº 46	Ocaña	Toledo	9,9
JUAN PABLO II Nº 47	Ocaña	Toledo	9,9
JUAN PABLO II Nº 13	Ocaña	Toledo	5
JUAN PABLO II Nº 12	Ocaña	Toledo	5
JUAN PABLO II Nº 57	Ocaña	Toledo	25
JUAN PABLO II Nº 14	Ocaña	Toledo	5
JUAN PABLO II Nº 15	Ocaña	Toledo	5
JUAN PABLO II Nº 16	Ocaña	Toledo	5
JUAN PABLO II Nº 17	Ocaña	Toledo	5
JUAN PABLO II Nº 56	Ocaña	Toledo	25
JUAN PABLO II 5	Ocaña	Toledo	5
PANGIA 1	Villa de Don Fadrique (La)	Toledo	15
PUNGIA SOLAR 36	Villa de Don Fadrique (La)	Toledo	60
PUNGIA SOLAR 33	Villa de Don Fadrique (La)	Toledo	5
PUNGIA SOLAR 32	Villa de Don Fadrique (La)	Toledo	5
I.S.F.	Villa de Don Fadrique (La)	Toledo	10
PUNGIA SOLAR 31	Villa de Don Fadrique (La)	Toledo	5
JUAN PABLO II Nº19	Ocaña	Toledo	5
JUAN PABLO II 18	Ocaña	Toledo	5
JUAN PABLO II Nº 7	Ocaña	Toledo	5
JUAN PABLO II Nº 1	Ocaña	Toledo	5
I.S.F. PANGIA SOLAR 35	Villa de Don Fadrique (La)	Toledo	5
PUNGIA SOLAR 34	Villa de Don Fadrique (La)	Toledo	9
PUNGIA SOLAR 34	Villa de Don Fadrique (La)	Toledo	9
BENEDICTO XVI - 17	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 18	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 19	Villarrubia de Santiago	Toledo	80

BENEDICTO XVI - 20	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 21	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 22	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 23	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 24	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 25	Villarrubia de Santiago	Toledo	80
TALAUTO	Cazalegas	Toledo	100
TALINVERS	Cazalegas	Toledo	100
TALGONPER	Cazalegas	Toledo	100
I.S.F. JUAN PABLO II Nº 27	Ocaña	Toledo	9,9
JUAN PABLO II 34	Ocaña	Toledo	9,9
JUAN PABLO II 39	Ocaña	Toledo	9,9
I.S.F. PARQUE SOLAR EL GRANDE 50	Ocaña	Toledo	9,9
JUAN PABLO II 51	Ocaña	Toledo	9,9
ALFERGLASS	Casarrubios del Monte	Toledo	100
ISF	Hormigos	Toledo	21
ISF	Mohedas de la Jara	Toledo	5
JUAN PABLO II Nº 20	Ocaña	Toledo	5
JUAN PABLO II 55	Ocaña	Toledo	9,9
SAN BARTOLOME 1	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 5	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 6	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 7	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 8	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 9	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 2	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 3	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 4	San Bartolomé de las Abiertas	Toledo	100
SAN BARTOLOME 10	San Bartolomé de las Abiertas	Toledo	100
TRES CRUCES - 2007/1	Puente del Arzobispo (El)	Toledo	20
TRES CRUCES - 2007/2	Puente del Arzobispo (El)	Toledo	20
CASIOPEA INSTALACION FOTOVOLTAICA	Mora	Toledo	90
ANDERSON INSTALACION FOTOVOLTAICA	Mora	Toledo	90
FREIXO INSTALACION FOTOVOLTAICA	Mora	Toledo	90
GALE INSTALACION FOTOVOLTAICA	Mora	Toledo	90
PANDORA INSTALACION FOTOVOLTAICA	Mora	Toledo	90
LOVAS INSTALACION FOTOVOLTAICA	Mora	Toledo	90
GICLAS INSTALACION FOTOVOLTAICA	Mora	Toledo	90
BRORSEN INSTALACION FOTOVOLTAICA	Mora	Toledo	90

VESUBIO INSTALACION FOTOVOLTAICA	Mora	Toledo	90
MORTIMER INSTALACION FOTOVOLTAICA	Mora	Toledo	90
FINLAY INSTALACION FOTOVOLTAICA	Mora	Toledo	90
WIRTANEN INSTALACION FOTOVOLTAICA	Mora	Toledo	90
GALLIANO INSTALACION FOTOVOLTAICA	Mora	Toledo	90
TAYLOR INSTALACION FOTOVOLTAICA	Mora	Toledo	90
VARGAS INSTALACION FOTOVOLTAICA	Mora	Toledo	90
KOWAL INSTALACION FOTOVOLTAICA	Mora	Toledo	90
KOJIMAL INSTALACION FOTOVOLTAICA	Mora	Toledo	90
ISF	Añover de Tajo	Toledo	2,5
CASIOPEA INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
ANDERSON INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
FREIXO INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
GALE INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
PANDORA INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
LOVAS INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
GICLAS INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
BRORSEN INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
VESUBIO INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
MORTIMER INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
FINLAY INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
WIRTANEN INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
GALLIANO INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
TAYLOR INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
VARGAS INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
KOWAL INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
KOJIMA INSTALACION FOTOVOLTAICA	Manzanaque	Toledo	90
ISF	Madridejos	Toledo	100
ISF	Madridejos	Toledo	100
ISF	Madridejos	Toledo	100
ISF	Madridejos	Toledo	100
ISF	Huerta de Valdecarábanos	Toledo	7,5
AHIJADO IV	Pepino	Toledo	89,1
AHIJADO V	Pepino	Toledo	89,1
AHIJADO I	Pepino	Toledo	89,1
AHIJADO II	Pepino	Toledo	89,1
AHIJADO III	Pepino	Toledo	89,1
GALUA HIJOS	Calera y Chozas	Toledo	96
ISF	Seseña	Toledo	5
ANTONIO CASTILLO SELVA	Layos	Toledo	20
ESMALTES CERAMICOS DE CASTILLA-2007	Alcolea de Tajo	Toledo	40

ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
ISF	Yébenes (Los)	Toledo	100
JUAN PABLO II Nº 43	Ocaña	Toledo	9,9
ISF	Madridejos	Toledo	100
CONSULTORIA TECNOENERGETICA-1	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-2	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-3	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-4	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-5	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-6	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-7	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-8	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-9	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-10	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-11	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-12	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-13	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-14	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGÉTICA - 15	Pueblanueva (La)	Toledo	99,9
CONSULTORIA TECNOENERGETICA-16	Pueblanueva (La)	Toledo	99,9
P.E. AMPLIACION LA PLATA	Villarrubia de Santiago	Toledo	6800
TEMBLEQUE PV 1	Tembleque	Toledo	5
TEMBLEQUE PV 2	Tembleque	Toledo	5
TEMBLEQUE PV 3	Tembleque	Toledo	5
TEMBLEQUE PV 4	Tembleque	Toledo	5
TEMBLEQUE PV 5	Tembleque	Toledo	5
TEMBLEQUE PV 6	Tembleque	Toledo	5
TEMBLEQUE PV 7	Tembleque	Toledo	5
TEMBLEQUE PV 8	Tembleque	Toledo	5
TEMBLEQUE PV 9	Tembleque	Toledo	5
TEMBLEQUE PV 10	Tembleque	Toledo	5
BENEDICTO XVI - 26	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 27	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 28	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 29	Villarrubia de Santiago	Toledo	80
BENEDICTO XVI - 30	Villarrubia de Santiago	Toledo	80
UNO ERUSTES SOLAR	Erustes	Toledo	100
NUEVE ERUSTES SOLAR	Erustes	Toledo	100
DIEZ ERUSTES SOLAR	Erustes	Toledo	100
ONCE ERUSTES SOLAR	Erustes	Toledo	100
DOCE ERUSTES SOLAR	Erustes	Toledo	100
TRECE ERUSTES SOLAR	Erustes	Toledo	100

QUINCE ERUSTES SOLAR	Erustes	Toledo	100
DIECISEIS ERUSTES SOLAR	Erustes	Toledo	100
INVERSORA FOTOVOLTAICA-ERUSTES 2007, SL	Erustes	Toledo	100
BARBAZAS	Erustes	Toledo	100
CIERALIA AARHUS	Erustes	Toledo	100
FAMER	Erustes	Toledo	100
ROD	Erustes	Toledo	100
ROSEDY	Erustes	Toledo	100
BENEDICTO XVI - 31	Villarrubia de Santiago	Toledo	80
JULIA SANCHEZ-VALVERDE GARCIA	Villa de Don Fadrique (La)	Toledo	36,6
ISF	Navamorcuende	Toledo	5
PRODUCTOS CERAMICOS MORA	Illescas	Toledo	960
LOMINCHAR	Lominchar	Toledo	1460
COGENERACION - PUEBLA ALMORA-DIEL	Puebla de Almoradiel (La)	Toledo	10000
ISABEL SAEZ	Carpio de Tajo (El)	Toledo	70
PANGIA SOLAR 41	Villa de Don Fadrique (La)	Toledo	5
PANGIA SOLAR 42	Villa de Don Fadrique (La)	Toledo	5
ISF	Chueca	Toledo	15
ISF	Chueca	Toledo	15
ISF	Layos	Toledo	15
MODULO 1 CUERVA	Cuerva	Toledo	100
MODULO 2 CUERVA	Cuerva	Toledo	100
MODULO 3 CUERVA	Cuerva	Toledo	100
MODULO 4 CUERVA	Cuerva	Toledo	100
MODULO 5 CUERVA	Cuerva	Toledo	100
MODULO 6 CUERVA	Cuerva	Toledo	100
MODULO 7 CUERVA	Cuerva	Toledo	100
MODULO 8 CUERVA	Cuerva	Toledo	100
MODULO 9 CUERVA	Cuerva	Toledo	100
MODULO 10 CUERVA	Cuerva	Toledo	100
MODULO 11 CUERVA	Cuerva	Toledo	100
ROBERTO ROBLES BERMUDEZ	Gálvez	Toledo	100
LUIS ALVAREZ RODRIGUEZ	Madrideos	Toledo	29,7
BRICO BLOCK	Villacañas	Toledo	99
GAR SPORT	Fuensalida	Toledo	60
APOLO II - 2	Escalona	Toledo	100
APOLO II - 3	Escalona	Toledo	100
APOLO II - 5	Escalona	Toledo	100
APOLO II - 6	Escalona	Toledo	100
APOLO II - 8	Escalona	Toledo	100
ISF	Pueblanueva (La)	Toledo	50
ISF	Pueblanueva (La)	Toledo	50
ISF	Pueblanueva (La)	Toledo	100
LADRILLOS MORA, S.L.	Illescas	Toledo	20
COGENERACION CERATRES	Pantoja	Toledo	2934
I.S.F. ALCOLEA 1	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 3	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 4	Alcolea de Tajo	Toledo	100

I.S.F. ALCOLEA 5	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 6	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 7	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 8	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 9	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 11	Alcolea de Tajo	Toledo	100
I.S.F. ALCOLEA 12	Alcolea de Tajo	Toledo	100
I.S.F.	San Pablo de los Montes	Toledo	100
I.S.F. ALBERCHE SOLAR BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. MARFLET VACACIONES BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. LINGEGAS BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. MARFLET BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. CALERA ENERGÍAS BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. CALERA BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. BARCILES ENERGÍAS PV	Añover de Tajo	Toledo	100
I.S.F. ALBERCHE BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. AÑOVER BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. ALBERCHE RENOVABLES BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. GRAVELINAS BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. BREDA BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. LEPANTO BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. RONCESVALLES BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. PAVIA BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. CERIÑOLA BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. SAN QUINTÍN BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. NORDLINGEN BARCILES PV	Añover de Tajo	Toledo	100
I.S.F. CARELLANO BARCILES PV	Añover de Tajo	Toledo	100
I.S.F.	Escalona	Toledo	96
I.S.F. CAPEVI SOLAR	Mora	Toledo	50
I.S.F. INSTALACIONES IDESA	Ontígola	Toledo	22,5
FERNANDO ROMERO	Quintanar de la Orden	Toledo	5
EL EJIDO DE ORITRANCA	Alcañizo	Toledo	10
ALCNAT 1	Alcolea de Tajo	Toledo	100
ALCNAT 2	Alcolea de Tajo	Toledo	100
ALCNAT 3	Alcolea de Tajo	Toledo	100
ALCNAT 4	Alcolea de Tajo	Toledo	100
ALCNAT 5	Alcolea de Tajo	Toledo	100
ALCNAT 6	Alcolea de Tajo	Toledo	100
ALCNAT 7	Alcolea de Tajo	Toledo	100
ALCNAT 8	Alcolea de Tajo	Toledo	100
ALCNAT 9	Alcolea de Tajo	Toledo	100
ALCNAT 10	Alcolea de Tajo	Toledo	100
LA PUEBLA 1	Puebla de Montalbán (La)	Toledo	25
LA PUEBLA 2	Puebla de Montalbán (La)	Toledo	25
LA PUEBLA 3	Puebla de Montalbán (La)	Toledo	25
LA PUEBLA 4	Puebla de Montalbán (La)	Toledo	25

TOMAS HERRERO	Romeral (El)	Toledo	5
ISF	Polán	Toledo	50
ENRIQUE	Nambroca	Toledo	7,5
DANIEL DIAZ-MAROTO	Villa de Don Fadrique (La)	Toledo	5
JESUS TELLO	Villa de Don Fadrique (La)	Toledo	19,8
FARELO	Villaluenga de la Sagra	Toledo	9,9
JESUS DIAZ	Villaluenga de la Sagra	Toledo	9,9
JESUS TELLO 2	Puebla de Almoradiel (La)	Toledo	19,8
MARIA VICTORIA	Urda	Toledo	8,3
MARIA VICTORIA	Urda	Toledo	9,1
CALZADA 2003	Calzada de Oropesa	Toledo	98,8
CALZADA 2006	Calzada de Oropesa	Toledo	98,8
CALZADA 2005	Calzada de Oropesa	Toledo	98,8
CALZADA 2002	Calzada de Oropesa	Toledo	98,8
CALZADA 2001	Calzada de Oropesa	Toledo	98,8
CALZADA 2010	Calzada de Oropesa	Toledo	98,8
CALZADA 2008	Calzada de Oropesa	Toledo	98,8
CALZADA 2007	Calzada de Oropesa	Toledo	98,8
CALZADA 2004	Calzada de Oropesa	Toledo	98,8
CALZADA 2009	Calzada de Oropesa	Toledo	98,8
ALCOLEA-1	Alcolea de Tajo	Toledo	100
ALCOLEA-2	Alcolea de Tajo	Toledo	100
ALCOLEA-3	Alcolea de Tajo	Toledo	100
ALCOLEA-4	Alcolea de Tajo	Toledo	100
ALCOLEA-5	Alcolea de Tajo	Toledo	100
ALCOLEA-6	Alcolea de Tajo	Toledo	100
ALCOLEA-7	Alcolea de Tajo	Toledo	100
ALCOLEA-8	Alcolea de Tajo	Toledo	100
ALCOLEA-9	Alcolea de Tajo	Toledo	100
ALCOLEA-10	Alcolea de Tajo	Toledo	100
ALCOLEA-11	Alcolea de Tajo	Toledo	100
ALCOLEA-12	Alcolea de Tajo	Toledo	100
GRAYGLO	Mora	Toledo	20
AZULARA	Miguel Esteban	Toledo	50
PANGIA SOLAR 38	Villa de Don Fadrique (La)	Toledo	100
PANGIA SOLAR 40	Villa de Don Fadrique (La)	Toledo	60
PANGIA SOLAR 37	Villa de Don Fadrique (La)	Toledo	100
ALBARREAL DE TAJO MÓDULO 1	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 2	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 3	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 4	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 5	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 6	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 7	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 8	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 9	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 10	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 11	Albarreal de Tajo	Toledo	100

ALBARREAL DE TAJO MÓDULO 12	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 13	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 14	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 15	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 16	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 17	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 18	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 19	Albarreal de Tajo	Toledo	100
ALBARREAL DE TAJO MÓDULO 20	Albarreal de Tajo	Toledo	100
MENASOLAR 1	Menasalbas	Toledo	100
MENASOLAR 2	Menasalbas	Toledo	100
MENASALBAS 1	Menasalbas	Toledo	100
PROMOCIONES JEROFERNA	Menasalbas	Toledo	100
BARGAS SOLAR 1	Bargas	Toledo	100
BARGAS SOLAR 2	Bargas	Toledo	100
BARGAS SOLAR 3	Bargas	Toledo	100
BARGAS SOLAR 4	Bargas	Toledo	100
BARGAS SOLAR 5	Bargas	Toledo	100
BARGAS SOLAR 6	Bargas	Toledo	100
BARGAS SOLAR 7	Bargas	Toledo	100
BARGAS SOLAR 8	Bargas	Toledo	100
BARGAS SOLAR 9	Bargas	Toledo	100
BARGAS SOLAR 10	Bargas	Toledo	100
BARGAS SOLAR 11	Bargas	Toledo	100
BARGAS SOLAR 12	Bargas	Toledo	100
BARGAS SOLAR 13	Bargas	Toledo	100
BARGAS SOLAR 14	Bargas	Toledo	100
BARGAS SOLAR 15	Bargas	Toledo	100
BARGAS SOLAR 16	Bargas	Toledo	100
BARGAS SOLAR 17	Bargas	Toledo	100
BARGAS SOLAR 18	Bargas	Toledo	100
BARGAS SOLAR 19	Bargas	Toledo	100
BARGAS SOLAR 20	Bargas	Toledo	100
BARGAS SOLAR 21	Bargas	Toledo	100
BARGAS SOLAR 22	Bargas	Toledo	100
BARGAS SOLAR 23	Bargas	Toledo	100
BARGAS SOLAR 24	Bargas	Toledo	100
BARGAS SOLAR 25	Bargas	Toledo	100
BARGAS SOLAR 26	Bargas	Toledo	100
BARGAS SOLAR 27	Bargas	Toledo	100
BARGAS SOLAR 28	Bargas	Toledo	100
BARGAS SOLAR 29	Bargas	Toledo	100
BARGAS SOLAR 30	Bargas	Toledo	100
BARGAS SOLAR 31	Bargas	Toledo	100
BARGAS SOLAR 32	Bargas	Toledo	100
BARGAS SOLAR 33	Bargas	Toledo	100
BARGAS SOLAR 34	Bargas	Toledo	100
BARGAS SOLAR 35	Bargas	Toledo	100
BARGAS SOLAR 36	Bargas	Toledo	100
BARGAS SOLAR 37	Bargas	Toledo	100
BARGAS SOLAR 38	Bargas	Toledo	100
BARGAS SOLAR 39	Bargas	Toledo	100

BARGAS SOLAR 40	Bargas	Toledo	100
BARGAS SOLAR 41	Bargas	Toledo	100
BARGAS SOLAR 42	Bargas	Toledo	100
BARGAS SOLAR 43	Bargas	Toledo	100
BARGAS SOLAR 44	Bargas	Toledo	100
BARGAS SOLAR 45	Bargas	Toledo	100
BARGAS SOLAR 46	Bargas	Toledo	100
BARGAS SOLAR 47	Bargas	Toledo	100
BARGAS SOLAR 48	Bargas	Toledo	100
BARGAS SOLAR 49	Bargas	Toledo	100
BARGAS SOLAR 50	Bargas	Toledo	100
BURUJON 1	Burujón	Toledo	100
BURUJON 2	Burujón	Toledo	100
BURUJON 3	Burujón	Toledo	100
BURUJON 4	Burujón	Toledo	100
BURUJON 5	Burujón	Toledo	100
BURUJON 6	Burujón	Toledo	100
BURUJON 7	Burujón	Toledo	100
GSI OCTOSOL	Villa de Don Fadrique (La)	Toledo	80
MONTENUEVO	Talavera de la Reina	Toledo	100
PEDRO CALDERON	Noblejas	Toledo	5
FERNANDO MEDINA	Cuerva	Toledo	100
ULPIANA	Cuerva	Toledo	100
PARQUE SOLAR APOLO II-1	Escalona	Toledo	100
PARQUE SOLAR APOLO II-4	Escalona	Toledo	100
PARQUE SOLAR APOLO II-7	Escalona	Toledo	100
PARQUE SOLAR APOLO II-9	Escalona	Toledo	100
PARQUE SOLAR APOLO II-10	Escalona	Toledo	100
PARQUE SOLAR APOLO II-11	Escalona	Toledo	100
PARQUE SOLAR APOLO II-12	Escalona	Toledo	100
PARQUE SOLAR APOLO II-13	Escalona	Toledo	100
PARQUE SOLAR APOLO II-14	Escalona	Toledo	100
PARQUE SOLAR APOLO II-15	Escalona	Toledo	100
PARQUE SOLAR APOLO II-16	Escalona	Toledo	100
PARQUE SOLAR APOLO II-17	Escalona	Toledo	100
PARQUE SOLAR APOLO II-18	Escalona	Toledo	100
PARQUE SOLAR APOLO II-19	Escalona	Toledo	100
PARQUE SOLAR APOLO II-20	Escalona	Toledo	100
FV 1	Orgaz	Toledo	90
FV 2	Orgaz	Toledo	90
FV 3	Orgaz	Toledo	90
FV 4	Orgaz	Toledo	90
FV 5	Orgaz	Toledo	90
FV 6	Orgaz	Toledo	90
FV 7	Orgaz	Toledo	90
FV 8	Orgaz	Toledo	90
FV 9	Orgaz	Toledo	90
FV 10	Orgaz	Toledo	90
FV 11	Orgaz	Toledo	90
FV 12	Orgaz	Toledo	90
FV 13	Orgaz	Toledo	90
FV 14	Orgaz	Toledo	90

FV 15	Orgaz	Toledo	90
FV 16	Orgaz	Toledo	90
FV 17	Orgaz	Toledo	90
MODULO 1 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 2 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 3 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 4 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 5 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 6 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 7 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 8 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 9 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 10 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 11 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 12 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 13 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 14 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
MODULO 15 LOS NAVALMORALES	Navalmorales (Los)	Toledo	100
SAN ANTONIO	Oropesa	Toledo	90
BURUJON VIII	Burujón	Toledo	100
BURUJON IX	Burujón	Toledo	100
BURUJON X	Burujón	Toledo	100
BURUJON XI	Burujón	Toledo	100
BURUJON XII	Burujón	Toledo	100
BURUJON XIII	Burujón	Toledo	100
BURUJON XIV	Burujón	Toledo	100
BURUJON XV	Burujón	Toledo	100
BURUJON XVI	Burujón	Toledo	100
BURUJON XVII	Burujón	Toledo	100
BURUJON XVIII	Burujón	Toledo	90
BURUJON XIX	Burujón	Toledo	36
RAFAEL GAMERO MORALES	Cuerva	Toledo	100
IGNACIA GAMERO SERRANO	Cuerva	Toledo	100
ESTHER GAMERO GAMERO	Cuerva	Toledo	100
HIPER HIERROS	Borox	Toledo	100
VIÑASOLAR	Quero	Toledo	100
BELVIS	Belvís de la Jara	Toledo	9,9
LAS VENTAS DE RETAMOSA	Ventas de Retamosa (Las)	Toledo	20
JIMÉNEZ BELINCHÓN, S.A.	Ocaña	Toledo	99
CASTMODA BQ	Quintanar de la Orden	Toledo	40
CORRAL DE ALMAGUER 1	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 2	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 3	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 4	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 5	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 6	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 7	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 8	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 9	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 10	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 11	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 12	Corral de Almaguer	Toledo	100

CORRAL DE ALMAGUER 13	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 14	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 15	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 16	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 17	Corral de Almaguer	Toledo	100
CORRAL DE ALMAGUER 18	Corral de Almaguer	Toledo	75
CORRAL DE ALMAGUER 19	Corral de Almaguer	Toledo	75
CORRAL DE ALMAGUER 20	Corral de Almaguer	Toledo	75
CORRAL DE ALMAGUER 21	Corral de Almaguer	Toledo	75
HUERTA A	Talavera de la Reina	Toledo	100
HUERTA I	Talavera de la Reina	Toledo	90
HUERTA H	Talavera de la Reina	Toledo	90
HUERTA G	Talavera de la Reina	Toledo	90
HUERTA F	Talavera de la Reina	Toledo	90
HUERTA E	Talavera de la Reina	Toledo	90
HUERTA D	Talavera de la Reina	Toledo	90
HUERTA C	Talavera de la Reina	Toledo	90
HUERTA B	Talavera de la Reina	Toledo	90
HUERTA J	Talavera de la Reina	Toledo	90
HUERTA K	Talavera de la Reina	Toledo	90
AUXILIAR DE OBRAS VD	Villasequilla	Toledo	40
ISIDRO CALDERÓN 2	Alcaudete de la Jara	Toledo	9,9
LOURDES GREGORIO 2	Alcaudete de la Jara	Toledo	9,9
19.11 VALDECARÁBANOS	Huerta de Valdecarábanos	Toledo	40
19.12 VALDECARÁBANOS	Huerta de Valdecarábanos	Toledo	40
PARQUE SOLAR MESA DE OCAÑA, PLANTA 1	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 2	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 3	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 4	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 5	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 6	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 7	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 8	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 9	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 10	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 11	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 12	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 13	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 14	Ocaña	Toledo	80

PARQUE SOLAR MESA DE OCAÑA, PLANTA 15	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 16	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 17	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 18	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 19	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 20	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 21	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 22	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 23	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 24	Ocaña	Toledo	80
PARQUE SOLAR MESA DE OCAÑA, PLANTA 25	Ocaña	Toledo	80
HOYA ARRUÑA	Yébenes (Los)	Toledo	100
PEDRIZA LARGA	Yébenes (Los)	Toledo	100
CERRO DE LA MONAGUILLA	Yébenes (Los)	Toledo	100
HOYA GARABATO	Yébenes (Los)	Toledo	100
HOYA DE LOS VENADOS	Yébenes (Los)	Toledo	100
MARIA ASUNCIÓN MONTEAGUDO NOGUEIRA	Escalona	Toledo	5
MARIA BEGOÑA MONTEAGUDO NOGUEIRA	Escalona	Toledo	5
JOSE LUIS BARQUILLO SERRANO	Escalona	Toledo	5
GABRIEL MUÑOZ PÉREZ	Escalona	Toledo	5
IGNACIO DOMAICA VADILLO	Escalona	Toledo	5
IGNACIO DOMAICA VADILLO	Escalona	Toledo	30
ANA MARÍA VADILLO DOMAICA	Escalona	Toledo	20
ELMINE	Escalona	Toledo	25
BORJA VILLAR CÁCERES	Escalona	Toledo	5
ARIADNA DE ARQUITECTURA	Escalona	Toledo	95
MARISOL MENDIETA SORIANO	Escalona	Toledo	10
JOSE MANUEL DOÑATE PERIS	Escalona	Toledo	5
MERCEDES MORENO DOMENE	Escalona	Toledo	5
SANTIAGO VILLAVERDE GÓMEZ	Escalona	Toledo	30
GUSTAVO GARROTE BENITEZ	Escalona	Toledo	5
ZAR SIGLO XXI	Ocaña	Toledo	50
ESQUINAS CANDENAS	Ocaña	Toledo	50
ABALEKUN	Ocaña	Toledo	50
DEMETRIO ESQUINAS	Ocaña	Toledo	50
JOSE IGNACIO ESQUINAS	Ocaña	Toledo	50
DIRESA SOLAR	Ocaña	Toledo	30
DIRESA SOLAR 1	Ocaña	Toledo	80
DIRESA SOLAR 2	Ocaña	Toledo	80
DIRESA SOLAR 3-1	Ocaña	Toledo	50
DIRESA SOLAR 3-2	Ocaña	Toledo	50
SPANIEN 0311	Ocaña	Toledo	80

SPANIEN 0310	Ocaña	Toledo	80
SPANIEN 0309	Ocaña	Toledo	80
SPANIEN 0308	Ocaña	Toledo	80
SPANIEN 0307	Ocaña	Toledo	80
SPANIEN 0306	Ocaña	Toledo	80
SPANIEN 0305	Ocaña	Toledo	80
SPANIEN 0304	Ocaña	Toledo	100
SPANIEN 0303	Ocaña	Toledo	100
SPANIEN 0302	Ocaña	Toledo	100
SPANIEN 0301	Ocaña	Toledo	100
ABAFOTO - 1	Montearagón	Toledo	100
ABAFOTO - 2	Montearagón	Toledo	100
ABAFOTO - 3	Montearagón	Toledo	100
ABAFOTO - 4	Montearagón	Toledo	100
ABAFOTO - 5	Montearagón	Toledo	100
ABAFOTO - 6	Montearagón	Toledo	100
ABAFOTO - 7	Montearagón	Toledo	100
ABAFOTO - 8	Montearagón	Toledo	100
ABAFOTO - 9	Montearagón	Toledo	100
ABAFOTO - 10	Montearagón	Toledo	100
ABAFOTO - 11	Montearagón	Toledo	100
ABAFOTO - 12	Montearagón	Toledo	100
P1	Puebla de Almoradiel (La)	Toledo	100
P2	Puebla de Almoradiel (La)	Toledo	100
P3	Puebla de Almoradiel (La)	Toledo	100
P4	Puebla de Almoradiel (La)	Toledo	100
P5	Puebla de Almoradiel (La)	Toledo	100
P6	Puebla de Almoradiel (La)	Toledo	100
P7	Puebla de Almoradiel (La)	Toledo	100
P8	Puebla de Almoradiel (La)	Toledo	100
P9	Puebla de Almoradiel (La)	Toledo	100
P10	Puebla de Almoradiel (La)	Toledo	100
P11	Puebla de Almoradiel (La)	Toledo	100
P12	Puebla de Almoradiel (La)	Toledo	100
P13	Puebla de Almoradiel (La)	Toledo	100
P14	Puebla de Almoradiel (La)	Toledo	100
P15	Puebla de Almoradiel (La)	Toledo	100
P16	Puebla de Almoradiel (La)	Toledo	100
P17	Puebla de Almoradiel (La)	Toledo	100

P18	Puebla de Almoradiel (La)	Toledo	100
P19	Puebla de Almoradiel (La)	Toledo	100
P20	Puebla de Almoradiel (La)	Toledo	100
P21	Puebla de Almoradiel (La)	Toledo	100
P22	Puebla de Almoradiel (La)	Toledo	100
P23	Puebla de Almoradiel (La)	Toledo	100
P24	Puebla de Almoradiel (La)	Toledo	100
P25	Puebla de Almoradiel (La)	Toledo	100
P26	Puebla de Almoradiel (La)	Toledo	100
P27	Puebla de Almoradiel (La)	Toledo	100
P28	Puebla de Almoradiel (La)	Toledo	100
P29	Puebla de Almoradiel (La)	Toledo	100
P30	Puebla de Almoradiel (La)	Toledo	100
P31	Puebla de Almoradiel (La)	Toledo	100
P32	Puebla de Almoradiel (La)	Toledo	100
P33	Puebla de Almoradiel (La)	Toledo	100
P34	Puebla de Almoradiel (La)	Toledo	100
P35	Puebla de Almoradiel (La)	Toledo	100
P36	Puebla de Almoradiel (La)	Toledo	100
P37	Puebla de Almoradiel (La)	Toledo	100
P38	Puebla de Almoradiel (La)	Toledo	100
P39	Puebla de Almoradiel (La)	Toledo	100
P40	Puebla de Almoradiel (La)	Toledo	100
P41	Puebla de Almoradiel (La)	Toledo	100
P42	Puebla de Almoradiel (La)	Toledo	100
P43	Puebla de Almoradiel (La)	Toledo	100
P44	Puebla de Almoradiel (La)	Toledo	100
P45	Puebla de Almoradiel (La)	Toledo	100
P46	Puebla de Almoradiel (La)	Toledo	100

P47	Puebla de Almoradiel (La)	Toledo	100
P48	Puebla de Almoradiel (La)	Toledo	100
P49	Puebla de Almoradiel (La)	Toledo	100
P50	Puebla de Almoradiel (La)	Toledo	100
P51	Puebla de Almoradiel (La)	Toledo	100
P52	Puebla de Almoradiel (La)	Toledo	100
P53	Puebla de Almoradiel (La)	Toledo	100
P54	Puebla de Almoradiel (La)	Toledo	100
P55	Puebla de Almoradiel (La)	Toledo	100
P56	Puebla de Almoradiel (La)	Toledo	100
P57	Puebla de Almoradiel (La)	Toledo	100
P58	Puebla de Almoradiel (La)	Toledo	100
P59	Puebla de Almoradiel (La)	Toledo	100
P60	Puebla de Almoradiel (La)	Toledo	100
P61	Puebla de Almoradiel (La)	Toledo	100
P62	Puebla de Almoradiel (La)	Toledo	100
P63	Puebla de Almoradiel (La)	Toledo	100
P64	Puebla de Almoradiel (La)	Toledo	100
P65	Puebla de Almoradiel (La)	Toledo	100
P66	Puebla de Almoradiel (La)	Toledo	100
P67	Puebla de Almoradiel (La)	Toledo	100
P68	Puebla de Almoradiel (La)	Toledo	100
P69	Puebla de Almoradiel (La)	Toledo	100
P70	Puebla de Almoradiel (La)	Toledo	100
P71	Puebla de Almoradiel (La)	Toledo	100
P72	Puebla de Almoradiel (La)	Toledo	100
P73	Puebla de Almoradiel (La)	Toledo	100
P74	Puebla de Almoradiel (La)	Toledo	100
P75	Puebla de Almoradiel (La)	Toledo	100

P76	Puebla de Almoradiel (La)	Toledo	100
P77	Puebla de Almoradiel (La)	Toledo	100
P78	Puebla de Almoradiel (La)	Toledo	100
P79	Puebla de Almoradiel (La)	Toledo	100
P80	Puebla de Almoradiel (La)	Toledo	100
P81	Puebla de Almoradiel (La)	Toledo	100
P82	Puebla de Almoradiel (La)	Toledo	100
P83	Puebla de Almoradiel (La)	Toledo	100
P84	Puebla de Almoradiel (La)	Toledo	100
P85	Puebla de Almoradiel (La)	Toledo	100
P86	Puebla de Almoradiel (La)	Toledo	100
P87	Puebla de Almoradiel (La)	Toledo	100
P88	Puebla de Almoradiel (La)	Toledo	100
P89	Puebla de Almoradiel (La)	Toledo	100
P90	Puebla de Almoradiel (La)	Toledo	100
P91	Puebla de Almoradiel (La)	Toledo	100
P92	Puebla de Almoradiel (La)	Toledo	100
P93	Puebla de Almoradiel (La)	Toledo	100
P94	Puebla de Almoradiel (La)	Toledo	100
P95	Puebla de Almoradiel (La)	Toledo	100
P96	Puebla de Almoradiel (La)	Toledo	100
P97	Puebla de Almoradiel (La)	Toledo	100
P98	Puebla de Almoradiel (La)	Toledo	100
P99	Puebla de Almoradiel (La)	Toledo	100
P100	Puebla de Almoradiel (La)	Toledo	100
NOBLEJAS 1	Noblejas	Toledo	100
NOBLEJAS 2	Noblejas	Toledo	100
NOBLEJAS 3	Noblejas	Toledo	100
NOBLEJAS 4	Noblejas	Toledo	100
NOBLEJAS 5	Noblejas	Toledo	100
NOBLEJAS 6	Noblejas	Toledo	100
NOBLEJAS 7	Noblejas	Toledo	100
NOBLEJAS 8	Noblejas	Toledo	100

NOBLEJAS 9	Noblejas	Toledo	100
NOBLEJAS 10	Noblejas	Toledo	100
NOBLEJAS 11	Noblejas	Toledo	100
NOBLEJAS 12	Noblejas	Toledo	100
NOBLEJAS 13	Noblejas	Toledo	100
NOBLEJAS 14	Noblejas	Toledo	100
NOBLEJAS 15	Noblejas	Toledo	100
NOBLEJAS 16	Noblejas	Toledo	100
NOBLEJAS 17	Noblejas	Toledo	100
NOBLEJAS 18	Noblejas	Toledo	100
NOBLEJAS 19	Noblejas	Toledo	100
NOBLEJAS 20	Noblejas	Toledo	100
NOBLEJAS 21	Noblejas	Toledo	100
NOBLEJAS 22	Noblejas	Toledo	100
NOBLEJAS 23	Noblejas	Toledo	100
NOBLEJAS 24	Noblejas	Toledo	100
NOBLEJAS 25	Noblejas	Toledo	100
NOBLEJAS 26	Noblejas	Toledo	100
NOBLEJAS 27	Noblejas	Toledo	100
NOBLEJAS 28	Noblejas	Toledo	100
NOBLEJAS 29	Noblejas	Toledo	100
NOBLEJAS 30	Noblejas	Toledo	100
NOBLEJAS 31	Noblejas	Toledo	100
NOBLEJAS 32	Noblejas	Toledo	100
NOBLEJAS 33	Noblejas	Toledo	100
NOBLEJAS 34	Noblejas	Toledo	100
NOBLEJAS 35	Noblejas	Toledo	100
NOBLEJAS 36	Noblejas	Toledo	100
NOBLEJAS 37	Noblejas	Toledo	100
NOBLEJAS 38	Noblejas	Toledo	100
NOBLEJAS 39	Noblejas	Toledo	100
NOBLEJAS 40	Noblejas	Toledo	100
PUERTAS ARTEVI	Villacañas	Toledo	100
GRUPO 1	Tembleque	Toledo	100
GRUPO 2	Tembleque	Toledo	100
GRUPO 3	Tembleque	Toledo	100
GRUPO 4	Tembleque	Toledo	100
GRUPO 5	Tembleque	Toledo	100
GRUPO 6	Tembleque	Toledo	100
GRUPO 7	Tembleque	Toledo	100
GRUPO 8	Tembleque	Toledo	100
SONSECA SOLAR LOS CORBETORES	Orgaz	Toledo	100
SONSECA SOLAR EL VISO	Orgaz	Toledo	100
SONSECA SOLAR LA TABLADA	Orgaz	Toledo	100
SONSECA SOLAR LA CERCA	Orgaz	Toledo	100
SONSECA SOLAR EL ESPINO	Orgaz	Toledo	100
SONSECA SOLAR LA LAGUNILLA	Orgaz	Toledo	100
SONSECA SOLAR MAJADA	Orgaz	Toledo	100
SONSECA SOLAR LA REGUERA	Orgaz	Toledo	100
VARILLA ROSCADA	Orgaz	Toledo	100
VAROSA INMUEBLES	Orgaz	Toledo	100
SONSECA SOLAR LA MINA	Orgaz	Toledo	100

SONSECA SOLAR LA SOTA	Orgaz	Toledo	100
SONSECA SOLAR LOS OBISPOS	Orgaz	Toledo	100
SONSECA SOLAR EL MANGUITO	Orgaz	Toledo	100
SONSECA SOLAR EL CORNEJO	Orgaz	Toledo	100
SONSECA SOLAR CAPELLANIA	Orgaz	Toledo	100
SONSECA SOLAR EL BATAL	Orgaz	Toledo	100
SONSECA SOLAR RAPOSO	Orgaz	Toledo	100
SONSECA SOLAR TORREJON	Orgaz	Toledo	100
SONSECA SOLAR LA SOLANA	Orgaz	Toledo	100
SONSECA SOLAR LAS CRUCES	Orgaz	Toledo	100
SONSECA SOLAR CUARTILLEJOS	Orgaz	Toledo	100
SOLJESÚS	Menasalbas	Toledo	60
INSTALACIÓN 1	Montearagón	Toledo	40
INSTALACIÓN 2	Montearagón	Toledo	40
INSTALACIÓN 3	Montearagón	Toledo	40
INSTALACIÓN 4	Montearagón	Toledo	40
INSTALACIÓN 5	Montearagón	Toledo	40
INSTALACIÓN 6	Montearagón	Toledo	40
INSTALACIÓN 7	Montearagón	Toledo	40
INSTALACIÓN 8	Montearagón	Toledo	40
INSTALACIÓN 9	Montearagón	Toledo	40
INSTALACIÓN 10	Montearagón	Toledo	40
INSTALACIÓN 11	Montearagón	Toledo	40
INSTALACIÓN 12	Montearagón	Toledo	40
INSTALACIÓN 13	Montearagón	Toledo	40
INSTALACIÓN 14	Montearagón	Toledo	40
INSTALACIÓN 15	Montearagón	Toledo	50
PARQUE SOLAR APOLO II - 21	Escalona	Toledo	100
PARQUE SOLAR APOLO II - 22	Escalona	Toledo	100
PARQUE SOLAR APOLO II - 23	Escalona	Toledo	100
PARQUE SOLAR APOLO II - 24	Escalona	Toledo	100
PARQUE SOLAR APOLO II - 25	Escalona	Toledo	100
PARQUE SOLAR APOLO II - 26	Escalona	Toledo	100
SERVIGESCAR	Borox	Toledo	99
SONSECA SOLAR LA MANILLA	Orgaz	Toledo	100
SONSECA SOLAR LA TEJERA	Orgaz	Toledo	100
SUN 2019	Orgaz	Toledo	100
SONSECA SOLAR PEÑAONZA	Orgaz	Toledo	100
SONSECA SOLAR EL ARMEZ	Orgaz	Toledo	100
SONSECA SOLAR LOS ARAÑALES	Orgaz	Toledo	100
INICIATIVAS DE CAPITAL SOCIOAMBI- ENTAL	Orgaz	Toledo	100
MARIO CALVO HERCE	Orgaz	Toledo	100
PLANIFICACIÓN GESTIÓN Y EJECUCIÓN	Orgaz	Toledo	100
OKETA PROYECT	Orgaz	Toledo	100
SONSECA SOLAR LA PALETINA	Orgaz	Toledo	100
SONSECA SOLAR LAS GAVIAS	Orgaz	Toledo	100
DEMICARA	Orgaz	Toledo	100
SONSECA SOLAR AJONJERAL	Orgaz	Toledo	100
SONSECA SOLAR EL CALDERÓN	Orgaz	Toledo	100
SONSECA SOLAR EL HORQUILLO	Orgaz	Toledo	100
SONSECA SOLAR LAS CAÑADAS	Orgaz	Toledo	100

SONSECA SOLAR VALLEHERMOSO	Orgaz	Toledo	100
HIDROSOLAR INVERSIONES ENER- GÉTICAS	Orgaz	Toledo	100
KUIPER CONSULTORIA E INVERSIONES	Orgaz	Toledo	100
SONSECA SOLAR EL CUARTILLERO	Orgaz	Toledo	100
SONSECA SOLAR VIÑAS VIEJAS	Orgaz	Toledo	100
INTI-ENERGY	Orgaz	Toledo	100
VIÑARESOL	Orgaz	Toledo	100
SONSECA SOLAR LA ZAHONDA	Orgaz	Toledo	100
SONSECA SOLAR LA PRADILLA	Orgaz	Toledo	100
TRUCALASOLAR	Orgaz	Toledo	100
SONSECA SOLAR CUNA ANCHA	Orgaz	Toledo	100
LAS CUMBRES 1	Villarejo de Montalbán	Toledo	100
LAS CUMBRES 2	Villarejo de Montalbán	Toledo	100
LAS CUMBRES 3	Villarejo de Montalbán	Toledo	100
LAS CUMBRES 4	Villarejo de Montalbán	Toledo	100
LAS CUMBRES 5	Villarejo de Montalbán	Toledo	100
LAS CUMBRES 6	Villarejo de Montalbán	Toledo	100
MIGUEL ANGEL DE LOS REYES GARCÍA	Polán	Toledo	50
DIAZ LOPEZ INVERSIONES	Polán	Toledo	20
MALPICA - OXIMINOR	Malpica de Tajo	Toledo	90
MALPICA - INAESA	Malpica de Tajo	Toledo	90
MALPICA - MARTINECAL	Malpica de Tajo	Toledo	90
MALPICA - ARITOSA	Malpica de Tajo	Toledo	90
MALPICA - JNG	Malpica de Tajo	Toledo	90
MALPICA - AHICA	Malpica de Tajo	Toledo	90
MALPICA - LARGREDOS	Malpica de Tajo	Toledo	90
MALPICA - ECONISA	Malpica de Tajo	Toledo	90
MALPICA - LCL	Malpica de Tajo	Toledo	90
MALPICA - DEPGE	Malpica de Tajo	Toledo	90
JOSÉ JAVIER DÍAZ JIMÉNEZ	Nombela	Toledo	100
LA ALBERIZA ENERGÍA SOLAR	Huecas	Toledo	96
ENERBUR FOTOVOLTAICA	Huecas	Toledo	96
FOTOVOLTAICA DOPER	Huecas	Toledo	96
FAORSE FOTOVOLTAICA	Huecas	Toledo	96
FOTOVOLTAICA TRISOL	Huecas	Toledo	96
HUECAS LAS CALERAS	Huecas	Toledo	96
NECAEMA FOTOVOLTAICA	Huecas	Toledo	96
SELDON BAS	Huecas	Toledo	96
FÉLIX ADRIÁN DÍEZ	Huecas	Toledo	96
ENERGÍAS RETAMAR	Huecas	Toledo	96
PEÑA CARDIN	Escalona	Toledo	400
VALORES LÍQUIDOS EXCELENTES	Yuncler	Toledo	100
INSTALACIÓN 1	San Martín de Pusa	Toledo	100
INSTALACIÓN 2	San Martín de Pusa	Toledo	100
INSTALACIÓN 3	San Martín de Pusa	Toledo	100
INSTALACIÓN 4	San Martín de Pusa	Toledo	100
INSTALACIÓN 5	San Martín de Pusa	Toledo	100
INSTALACIÓN 6	San Martín de Pusa	Toledo	100
INSTALACIÓN 7	San Martín de Pusa	Toledo	100
INSTALACIÓN 8	San Martín de Pusa	Toledo	100
INSTALACIÓN 9	San Martín de Pusa	Toledo	100
INSTALACIÓN 10	San Martín de Pusa	Toledo	100

INSTALACIÓN 11	San Martín de Pusa	Toledo	100
INSTALACIÓN 12	San Martín de Pusa	Toledo	100
INSTALACIÓN 13	San Martín de Pusa	Toledo	100
INSTALACIÓN 14	San Martín de Pusa	Toledo	100
INSTALACIÓN 15	San Martín de Pusa	Toledo	100
INSTALACIÓN 16	San Martín de Pusa	Toledo	100
INSTALACIÓN 17	San Martín de Pusa	Toledo	100
INSTALACIÓN 18	San Martín de Pusa	Toledo	100
INSTALACIÓN 19	San Martín de Pusa	Toledo	100
INSTALACIÓN 20	San Martín de Pusa	Toledo	100
INSTALACIÓN 21	San Martín de Pusa	Toledo	100
INSTALACIÓN 22	San Martín de Pusa	Toledo	100
INSTALACIÓN 23	San Martín de Pusa	Toledo	100
HUERTO SOLAR	Quero	Toledo	25
INSTALACIONES ANTONIO DE LOS REYES	Toledo	Toledo	50
TRASDOS	Corral de Almaguer	Toledo	40
VILLARDETE 1	Villanueva de Alcardete	Toledo	100
VILLARDETE 2	Villanueva de Alcardete	Toledo	100
VILLARDETE 3	Villanueva de Alcardete	Toledo	100
VILLARDETE 4	Villanueva de Alcardete	Toledo	100
VILLARDETE 5	Villanueva de Alcardete	Toledo	100
VILLARDETE 6	Villanueva de Alcardete	Toledo	100
VILLARDETE 7	Villanueva de Alcardete	Toledo	100
VILLARDETE 8	Villanueva de Alcardete	Toledo	100
VILLARDETE 9	Villanueva de Alcardete	Toledo	100
VILLARDETE 10	Villanueva de Alcardete	Toledo	100
VILLARDETE 11	Villanueva de Alcardete	Toledo	100
VILLARDETE 12	Villanueva de Alcardete	Toledo	100
VILLARDETE 13	Villanueva de Alcardete	Toledo	100
VILLARDETE 14	Villanueva de Alcardete	Toledo	100
VILLARDETE 15	Villanueva de Alcardete	Toledo	100
VILLARDETE 16	Villanueva de Alcardete	Toledo	100
VILLARDETE 17	Villanueva de Alcardete	Toledo	100
VILLARDETE 18	Villanueva de Alcardete	Toledo	100
VILLARDETE 19	Villanueva de Alcardete	Toledo	100
VILLARDETE 20	Villanueva de Alcardete	Toledo	100
SOLFUTURE S-1	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-2	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-3	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-4	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-5	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-6	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-7	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-8	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-9	Puebla de Almoradiel (La)	Toledo	100

SOLFUTURE S-10	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-11	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-12	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-13	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-14	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-15	Puebla de Almoradiel (La)	Toledo	100
SOLFUTURE S-16	Puebla de Almoradiel (La)	Toledo	100
UPA - 1	Albarreal de Tajo	Toledo	100
UPA - 2	Albarreal de Tajo	Toledo	100
UPA - 3	Albarreal de Tajo	Toledo	100
UPA - 4	Albarreal de Tajo	Toledo	100
UPA - 5	Albarreal de Tajo	Toledo	100
UPA - 6	Albarreal de Tajo	Toledo	100
UPA - 7	Albarreal de Tajo	Toledo	100
UPA - 8	Albarreal de Tajo	Toledo	100
UPA - 9	Albarreal de Tajo	Toledo	100
UPA - 10	Albarreal de Tajo	Toledo	100
INGHELIOS	Erustes	Toledo	50
ENERGÍAS RENOVABLES SEMAIN	Erustes	Toledo	50
PARQUE SOLAR ALMOCAFRES	Erustes	Toledo	100
AGROPECUARIA SAN SEBASTIÁN	Erustes	Toledo	100
ARKNOVÉS	Erustes	Toledo	50
ÁLVAREZ PICASSO COMPAÑÍA DE AR- RENDAMIENTOS	Erustes	Toledo	50
SILOS PV PLANTA 1	Calera y Chozas	Toledo	100
SILOS PV PLANTA 2	Calera y Chozas	Toledo	100
SILOS PV PLANTA 3	Calera y Chozas	Toledo	100
SILOS PV PLANTA 4	Calera y Chozas	Toledo	100
SILOS PV PLANTA 5	Calera y Chozas	Toledo	100
SILOS PV PLANTA 6	Calera y Chozas	Toledo	100
SILOS PV PLANTA 7	Calera y Chozas	Toledo	100
SILOS PV PLANTA 8	Calera y Chozas	Toledo	100
SILOS PV PLANTA 9	Calera y Chozas	Toledo	100
SILOS PV PLANTA 10	Calera y Chozas	Toledo	100
PUSA 1	San Martín de Pusa	Toledo	100
PUSA 2	San Martín de Pusa	Toledo	100
PUSA 3	San Martín de Pusa	Toledo	100
PUSA 4	San Martín de Pusa	Toledo	100
PUSA 5	San Martín de Pusa	Toledo	100
PUSA 6	San Martín de Pusa	Toledo	100
INSTALACIÓN 1A	Calera y Chozas	Toledo	25
INSTALACIÓN 1B	Calera y Chozas	Toledo	25
INSTALACIÓN 1C	Calera y Chozas	Toledo	25
INSTALACIÓN 1D	Calera y Chozas	Toledo	25
INSTALACIÓN 2A	Calera y Chozas	Toledo	25
INSTALACIÓN 2B	Calera y Chozas	Toledo	25
INSTALACIÓN 2C	Calera y Chozas	Toledo	25

INSTALACIÓN 2D	Calera y Chozas	Toledo	25
INSTALACIÓN 3A	Calera y Chozas	Toledo	25
INSTALACIÓN 3B	Calera y Chozas	Toledo	25
INSTALACIÓN 3C	Calera y Chozas	Toledo	50
INSTALACIÓN 4A	Calera y Chozas	Toledo	25
INSTALACIÓN 4B	Calera y Chozas	Toledo	25
INSTALACIÓN 4C	Calera y Chozas	Toledo	25
INSTALACIÓN 4D	Calera y Chozas	Toledo	25
INSTALACIÓN 5A	Calera y Chozas	Toledo	25
INSTALACIÓN 5B	Calera y Chozas	Toledo	25
INSTALACIÓN 5C	Calera y Chozas	Toledo	25
INSTALACIÓN 5D	Calera y Chozas	Toledo	25
INSTALACIÓN 6A	Calera y Chozas	Toledo	100
INSTALACIÓN 7A	Calera y Chozas	Toledo	100
INSTALACIÓN 8A	Calera y Chozas	Toledo	100
INSTALACIÓN 9A	Calera y Chozas	Toledo	50
INSTALACIÓN 9B	Calera y Chozas	Toledo	50
INSTALACIÓN 10A	Calera y Chozas	Toledo	25
INSTALACIÓN 10B	Calera y Chozas	Toledo	25
INSTALACIÓN 10C	Calera y Chozas	Toledo	25
INSTALACIÓN 10D	Calera y Chozas	Toledo	25
INSTALACIÓN 11A	Calera y Chozas	Toledo	50
INSTALACIÓN 11B	Calera y Chozas	Toledo	50
INSTALACIÓN 12A	Calera y Chozas	Toledo	50
INSTALACIÓN 12B	Calera y Chozas	Toledo	50
INSTALACIÓN 13A	Calera y Chozas	Toledo	100
INSTALACIÓN 14A	Calera y Chozas	Toledo	100
INSTALACIÓN 15A	Calera y Chozas	Toledo	100
INSTALACIÓN 16A	Calera y Chozas	Toledo	25
INSTALACIÓN 16B	Calera y Chozas	Toledo	25
INSTALACIÓN 16C	Calera y Chozas	Toledo	25
INSTALACIÓN 16D	Calera y Chozas	Toledo	25
INSTALACIÓN 17A	Calera y Chozas	Toledo	25
INSTALACIÓN 17B	Calera y Chozas	Toledo	25
INSTALACIÓN 17C	Calera y Chozas	Toledo	25
INSTALACIÓN 17D	Calera y Chozas	Toledo	25
INSTALACIÓN 18A	Calera y Chozas	Toledo	25
INSTALACIÓN 18B	Calera y Chozas	Toledo	25
INSTALACIÓN 18C	Calera y Chozas	Toledo	25
INSTALACIÓN 18D	Calera y Chozas	Toledo	25
INSTALACIÓN 19A	Calera y Chozas	Toledo	100
INSTALACIÓN 20A	Calera y Chozas	Toledo	25
INSTALACIÓN 20B	Calera y Chozas	Toledo	25
INSTALACIÓN 20C	Calera y Chozas	Toledo	25
INSTALACIÓN 20D	Calera y Chozas	Toledo	25
INSTALACIÓN 1	Villa de Don Fadrique (La)	Toledo	100
INSTALACIÓN 2	Villa de Don Fadrique (La)	Toledo	100
INSTALACIÓN 3	Villa de Don Fadrique (La)	Toledo	9,2
INSTALACIÓN 4	Villa de Don Fadrique (La)	Toledo	9,2

INSTALACIÓN 5	Villa de Don Fadrique (La)	Toledo	13,8
INSTALACIÓN 6	Villa de Don Fadrique (La)	Toledo	4,6
INSTALACIÓN 7	Villa de Don Fadrique (La)	Toledo	4,6
INSTALACIÓN 8	Villa de Don Fadrique (La)	Toledo	4,6
INSTALACIÓN 9	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 10	Villa de Don Fadrique (La)	Toledo	4,6
INSTALACIÓN 11	Villa de Don Fadrique (La)	Toledo	4,6
INSTALACIÓN 12	Villa de Don Fadrique (La)	Toledo	13,8
INSTALACIÓN 13	Villa de Don Fadrique (La)	Toledo	9,2
INSTALACIÓN 14	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 15	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 16	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 17	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 18	Villa de Don Fadrique (La)	Toledo	33,25
INSTALACIÓN 19	Villa de Don Fadrique (La)	Toledo	9,2
INSTALACIÓN 20	Villa de Don Fadrique (La)	Toledo	9,2
INSTALACIÓN 21	Villa de Don Fadrique (La)	Toledo	9,2
INSTALACIÓN 22	Villa de Don Fadrique (La)	Toledo	19,95
INSTALACIÓN 23	Villa de Don Fadrique (La)	Toledo	27,6
INSTALACIÓN 24	Villa de Don Fadrique (La)	Toledo	100
INSTALACIÓN 25	Villa de Don Fadrique (La)	Toledo	11,25
JULIA	Layos	Toledo	15
MANUEL	Layos	Toledo	15
PEDRO	Layos	Toledo	15
CHERJOS	Puebla de Almoradiel (La)	Toledo	10
INSTALACIONES ANTONIO DE LOS REYES	Toledo	Toledo	50
IMTO ENVASES	Mascaraque	Toledo	600
FELIPE MORENO RICO 1	Yepes	Toledo	100
FELIPE MORENO RICO 2	Yepes	Toledo	100
SERAPIA GUTIÉRREZ MARTÍN	Yepes	Toledo	100
ANGEL LARA GAROZ 1	Yepes	Toledo	100
ANGEL LARA GAROZ 2	Yepes	Toledo	100
Mª DEL CARMEN JIMÉNEZ PASTRANA	Yepes	Toledo	100
BEATRIZ ALBARRÁN PÉREZ 1	Yepes	Toledo	100
BEATRIZ ALBARRÁN PÉREZ 2	Yepes	Toledo	100

BEGOÑA TOMÉ LANDA 1	Yepes	Toledo	100
BEGOÑA TOMÉ LANDA 2	Yepes	Toledo	100
PAULINO TELLO MAESO 1	Yepes	Toledo	100
PAULINO TELLO MAESO 2	Yepes	Toledo	100
INÉS CANO DÍAZ 1	Yepes	Toledo	100
INÉS CANO DÍAZ 2	Yepes	Toledo	100
MARÍA DEL PRADO TELLO CANO	Yepes	Toledo	100
MARÍA INÉS TELLO CANO	Yepes	Toledo	100
ISABEL TELLO CANO	Yepes	Toledo	100
PAULINO TELLO CANO	Yepes	Toledo	100
FOTOVOLTAICA RENOVABLE	Yepes	Toledo	100
PETRA BERLANAS GIL	Yepes	Toledo	100
FOTOVOLTAICA RENOVABLE 3	Yepes	Toledo	100
ACACIA INSTALACIONES FOTOVOL- TAICAS	Madridejos	Toledo	8000
ING SOLAR DEL TIETAR	Gerindote	Toledo	100
PEREZ HOME Y ASOCIADOS	Gerindote	Toledo	100
ING SOLAR DEL TIETAR	Gerindote	Toledo	100
PEREZ HOME Y ASOCIADOS	Gerindote	Toledo	100
ING SOLAR DEL TIETAR	Gerindote	Toledo	100
PEREZ HOME Y ASOCIADOS	Gerindote	Toledo	100
ING SOLAR DEL TIETAR	Gerindote	Toledo	100
FOTOVOLCENTRO	Gerindote	Toledo	100
CABANILLAS INGENIEROS	Gerindote	Toledo	100
CARLAUTO	Fuensalida	Toledo	15
FOTOVOLTAICA E. PALMERO	Seseña	Toledo	3,3
FRAILE Y NUÑEZ-2008	Oropesa	Toledo	80
AGUIFOT	Nambroca	Toledo	100
NOEZ 1	Noez	Toledo	100
NOEZ 2	Noez	Toledo	100
NOEZ 3	Noez	Toledo	100
NOEZ 4	Noez	Toledo	100
NOEZ 5	Noez	Toledo	100
NOEZ 6	Noez	Toledo	100
NOEZ 7	Noez	Toledo	100
NOEZ 8	Noez	Toledo	100
NOEZ 9	Noez	Toledo	100
NOEZ 10	Noez	Toledo	100
NOEZ 11	Noez	Toledo	100
NOEZ 12	Noez	Toledo	100
NOEZ 13	Noez	Toledo	100
NOEZ 14	Noez	Toledo	100
PEJUBE	Huerta de Val- decarábanos	Toledo	35
MARMOLES LA UNIÓN	Yuncos	Toledo	20
MAZARAMBROZ 1	Mazarambroz	Toledo	100
MAZARAMBROZ 2	Mazarambroz	Toledo	100
MAZARAMBROZ 3	Mazarambroz	Toledo	100
MAZARAMBROZ 4	Mazarambroz	Toledo	100
MAZARAMBROZ 5	Mazarambroz	Toledo	100
MAZARAMBROZ 6	Mazarambroz	Toledo	100
MAZARAMBROZ 7	Mazarambroz	Toledo	100
MAZARAMBROZ 8	Mazarambroz	Toledo	100

MAZARAMBROZ 9	Mazarambroz	Toledo	100
MAZARAMBROZ 10	Mazarambroz	Toledo	100
MAZARAMBROZ 11	Mazarambroz	Toledo	100
MAZARAMBROZ 12	Mazarambroz	Toledo	100
MAZARAMBROZ 13	Mazarambroz	Toledo	100
MAZARAMBROZ 14	Mazarambroz	Toledo	100
MAZARAMBROZ 15	Mazarambroz	Toledo	100
MAZARAMBROZ 16	Mazarambroz	Toledo	100
MAZARAMBROZ 17	Mazarambroz	Toledo	100
MAZARAMBROZ 18	Mazarambroz	Toledo	100
MAZARAMBROZ 19	Mazarambroz	Toledo	100
MAZARAMBROZ 20	Mazarambroz	Toledo	100
MAZARAMBROZ 21	Mazarambroz	Toledo	100
ISF GRUPO 1	Ocaña	Toledo	100
ISF GRUPO 2	Ocaña	Toledo	100
ISF GRUPO 3	Ocaña	Toledo	100
ISF GRUPO 4	Ocaña	Toledo	100
ISF GRUPO 5	Ocaña	Toledo	100
ISF GRUPO 6	Ocaña	Toledo	100
ISF GRUPO 7	Ocaña	Toledo	100
ISF GRUPO 8	Ocaña	Toledo	100
ISF GRUPO 9	Ocaña	Toledo	100
ISF GRUPO 10	Ocaña	Toledo	100
ISF GRUPO 11	Ocaña	Toledo	100
ISF GRUPO 12	Ocaña	Toledo	100
ISF GRUPO 13	Ocaña	Toledo	100
ISF GRUPO 14	Ocaña	Toledo	100
ISF GRUPO 15	Ocaña	Toledo	100
ISF GRUPO 16	Ocaña	Toledo	100
ISF GRUPO 17	Ocaña	Toledo	100
ISF GRUPO 18	Ocaña	Toledo	100
ISF GRUPO 19	Ocaña	Toledo	100
ISF GRUPO 20	Ocaña	Toledo	100
ISF GRUPO 21	Ocaña	Toledo	100
ISF GRUPO 22	Ocaña	Toledo	100
ISF GRUPO 23	Ocaña	Toledo	100
ISF GRUPO 24	Ocaña	Toledo	100
ISF GRUPO 25	Ocaña	Toledo	100
ISF GRUPO 26	Ocaña	Toledo	100
ISF GRUPO 27	Ocaña	Toledo	100
ISF GRUPO 28	Ocaña	Toledo	100
ISF GRUPO 29	Ocaña	Toledo	100
ISF GRUPO 30	Ocaña	Toledo	100
PLANTA I	Pulgar	Toledo	100
PLANTA II	Pulgar	Toledo	100
PLANTA III	Pulgar	Toledo	100
PLANTA IV	Pulgar	Toledo	100
PLANTA V	Pulgar	Toledo	100
PLANTA VI	Pulgar	Toledo	100
PLANTA VII	Pulgar	Toledo	100
PLANTA VIII	Pulgar	Toledo	100
PLANTA IX	Pulgar	Toledo	100

NAVE INSTALACIONES ALCAZAR	Consuegra	Toledo	45
CARMEN 2	Sonseca	Toledo	9,9
BENISA 1	Sonseca	Toledo	5
JESUS MORA DIAZ	Toledo	Toledo	100
ESBRASE - 2008	Alcolea de Tajo	Toledo	23,7
GALUA FOTOVOLTAICA	Calera y Chozas	Toledo	40
INNOVACIONES AGRÍCOLAS Y ENER- GÉTICAS DE LA VEGA	Casarrubios del Monte	Toledo	100
FOTOV. AGUSTIN GARCIA PECES	Sonseca	Toledo	96
FOTOV. AGUSTIN GARCIA	Sonseca	Toledo	96
GRUPO LEADER TOLEDO	Oliás del Rey	Toledo	100
SOLEA 4	Illescas	Toledo	5
SOLEA 1	Illescas	Toledo	5
SOLEA 2	Illescas	Toledo	2,5
SOLEA 3	Illescas	Toledo	5
LORENZO-1	Alcaudete de la Jara	Toledo	50
PERFORACIONES CAPTAGUA	Guadamur	Toledo	99
PEÑUELAS INVERSIONES	Ocaña	Toledo	20
GRAYGLO II	Cazalegas	Toledo	36
GEA SOLAR HUECAS	Huecas	Toledo	600
EXCAVACIONES FUENLABRADA	Illescas	Toledo	5
BOROX 70	Borox	Toledo	68,4
CT 11 STELERGY 1	Ontígola	Toledo	100
CT 17 STELERGY 2	Ontígola	Toledo	100
CT 16 STELERGY 3	Ontígola	Toledo	100
CT 15 STELERGY 4	Ontígola	Toledo	100
CT 14 STELERGY 5	Ontígola	Toledo	100
CT 11 NATURAL ELECTRIC 1	Ontígola	Toledo	100
CT 16 NATURAL ELECTRIC 2	Ontígola	Toledo	100
CT 15 NATURAL ELECTRIC 3	Ontígola	Toledo	100
CT 13 NATURAL ELECTRIC 4	Ontígola	Toledo	100
CT 14 NATURAL ELECTRIC 5	Ontígola	Toledo	100
RIOFISA 1	Ontígola	Toledo	50
LOS NAVALMORALES	Navalmorales (Los)	Toledo	6624
BURUJON 1	Burujón	Toledo	100
BURUJON 2	Burujón	Toledo	100
BURUJON 3	Burujón	Toledo	100
BURUJON 4	Burujón	Toledo	100
BURUJON 5	Burujón	Toledo	100
JUSTINO MAGAN	Burujón	Toledo	100
ANSACONS CB	Quismondo	Toledo	45
LOPEZ DE LA ALBERCA	Tembleque	Toledo	9
PUNZIA SOLAR Nº3	Mejorada	Toledo	1500
LA TERCIA	Villa de Don Fadrique (La)	Toledo	9
CARPINTERIA G. COMENDADOR	Villa de Don Fadrique (La)	Toledo	9
CARPINTERO AROCO	Villa de Don Fadrique (La)	Toledo	9
ECONOMIA	Erustes	Toledo	25
ENERGIA PRACTICA	Erustes	Toledo	9,9
ENERGIA Y BIENESTAR	Erustes	Toledo	9,9

DESARROLLOS ENERGÉTICOS DEL SUR	Erustes	Toledo	9,9
MARIA SOLEDAD	Erustes	Toledo	9,9
SISTEMAS	Erustes	Toledo	9,9
METODOS	Erustes	Toledo	25
TAJO I	Erustes	Toledo	9,9
AREMAR	Quero	Toledo	100
VILLACAÑAS 1	Villacañas	Toledo	50
VILLACAÑAS 2	Villacañas	Toledo	50
TEMBLEQUE PV II - 1	Tembleque	Toledo	5
TEMBLEQUE PV II - 2	Tembleque	Toledo	5
TEMBLEQUE PV II - 3	Tembleque	Toledo	5
TEMBLEQUE PV II - 4	Tembleque	Toledo	5
TEMBLEQUE PV II - 5	Tembleque	Toledo	5
TEMBLEQUE PV II - 6	Tembleque	Toledo	5
TEMBLEQUE PV II - 7	Tembleque	Toledo	5
TEMBLEQUE PV II - 8	Tembleque	Toledo	5
TEMBLEQUE PV II - 9	Tembleque	Toledo	5
TEMBLEQUE PV II - 10	Tembleque	Toledo	5
DON TOLEDO 1	Calzada de Oropesa	Toledo	100
DON TOLEDO 2	Calzada de Oropesa	Toledo	100
DON TOLEDO 3	Calzada de Oropesa	Toledo	100
DON TOLEDO 4	Calzada de Oropesa	Toledo	100
DON TOLEDO 5	Calzada de Oropesa	Toledo	100
DON TOLEDO 6	Calzada de Oropesa	Toledo	100
DON TOLEDO 7	Calzada de Oropesa	Toledo	100
DON TOLEDO 8	Calzada de Oropesa	Toledo	100
DON TOLEDO 9	Calzada de Oropesa	Toledo	100
DON TOLEDO 10	Calzada de Oropesa	Toledo	100
DON TOLEDO 11	Calzada de Oropesa	Toledo	100
DON TOLEDO 12	Calzada de Oropesa	Toledo	100
DON TOLEDO 13	Calzada de Oropesa	Toledo	100
DON TOLEDO 14	Calzada de Oropesa	Toledo	100
DON TOLEDO 15	Calzada de Oropesa	Toledo	100
DON TOLEDO 16	Calzada de Oropesa	Toledo	100
DON TOLEDO 17	Calzada de Oropesa	Toledo	100
DON TOLEDO 18	Calzada de Oropesa	Toledo	100
DON TOLEDO 19	Calzada de Oropesa	Toledo	100
DON TOLEDO 20	Calzada de Oropesa	Toledo	100
DON TOLEDO 21	Calzada de Oropesa	Toledo	100
DON TOLEDO 22	Calzada de Oropesa	Toledo	100
DON TOLEDO 23	Calzada de Oropesa	Toledo	100
DON TOLEDO 24	Calzada de Oropesa	Toledo	100
DON TOLEDO 25	Calzada de Oropesa	Toledo	100
DON TOLEDO 26	Calzada de Oropesa	Toledo	100
DON TOLEDO 27	Calzada de Oropesa	Toledo	100
DON TOLEDO 28	Calzada de Oropesa	Toledo	100
DON TOLEDO 29	Calzada de Oropesa	Toledo	100
DON TOLEDO 30	Calzada de Oropesa	Toledo	100
DON TOLEDO 31	Calzada de Oropesa	Toledo	100
DON TOLEDO 32	Calzada de Oropesa	Toledo	100
DON TOLEDO 33	Calzada de Oropesa	Toledo	100
DON TOLEDO 34	Calzada de Oropesa	Toledo	100





DON TOLEDO 139	Calzada de Oropesa	Toledo	100
DON TOLEDO 140	Calzada de Oropesa	Toledo	100
DON TOLEDO 141	Calzada de Oropesa	Toledo	100
DON TOLEDO 142	Calzada de Oropesa	Toledo	100
DON TOLEDO 143	Calzada de Oropesa	Toledo	100
DON TOLEDO 144	Calzada de Oropesa	Toledo	100
DON TOLEDO 145	Calzada de Oropesa	Toledo	100
DON TOLEDO 146	Calzada de Oropesa	Toledo	100
DON TOLEDO 147	Calzada de Oropesa	Toledo	100
DON TOLEDO 148	Calzada de Oropesa	Toledo	100
DON TOLEDO 149	Calzada de Oropesa	Toledo	100
DON TOLEDO 150	Calzada de Oropesa	Toledo	100
I.S.F.	Villaminaya	Toledo	100
I.S.F.	Villaminaya	Toledo	100
I.S.F.	Villaminaya	Toledo	100
CERAMICA J.RUIZ E HIJOS	Talavera de la Reina	Toledo	990
LA GAMONOSA	Mejorada	Toledo	1900
GSI NEROSOL	Mejorada	Toledo	600
FOTOV. FOT. GFM-I	Villacañas	Toledo	100
FOTOV. FOT. GFM-II	Villacañas	Toledo	99
FOTOV. FOT. GFM-III	Villacañas	Toledo	99
FOTOV. ARTEVI II	Villacañas	Toledo	100
GONZALEZ DEL BOSQUE	Escalona	Toledo	7,5
HONTANA AYUNTAMIENTO	Hontanar	Toledo	5
TEPE Y BIGOER	Illescas	Toledo	99
JOSE CARLOS RODRIGUEZ	Burujón	Toledo	90
DEL TAJÓ	Burujón	Toledo	90
CERAMICA PEÑO	Talavera de la Reina	Toledo	990
ZAR SIGLO XXI	Borox	Toledo	30
VALPUREN BAÑUELO	Polán	Toledo	1500
VALPUREN BAÑUELO	Polán	Toledo	15000
VALPUREN COMATUR	Consuegra	Toledo	1500
VALPUREN COMATUR	Consuegra	Toledo	15000
TORRALBA DE OROPESA 1	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 2	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 3	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 4	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 5	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 6	Torralba de Oropesa	Toledo	90
TORRALBA DE OROPESA 7	Torralba de Oropesa	Toledo	90
JUAN CARLOS VILLALTA GONZÁLEZ	Nambroca	Toledo	40
SEDE ARQUINVER	Torrijos	Toledo	10
QUINTO MORA	Mazarambroz	Toledo	17,3
CERÁMICA MILLAS E HIJOS I	Mora	Toledo	990
CONDEMIOS	Villaseca de la Sagra	Toledo	59,85
I.S.F. PANGIA SOLAR 5	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGIA SOLAR 7	Villa de Don Fadrique (La)	Toledo	5
NEPTUNO 34	Cobisa	Toledo	7,5
MARIA ANGELES MENDOZA	Villa de Don Fadrique (La)	Toledo	9,9
MMG	Camuñas	Toledo	19,8

ALMAGUESOL	Corral de Almaguer	Toledo	9,9
I.S.F. PANGÍA SOLAR 15	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 22	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 9	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 2	Villa de Don Fadrique (La)	Toledo	5
I.S.F.	Santa Cruz del Retamar	Toledo	5
I.S.F.	Santa Cruz del Retamar	Toledo	5
I.S.F.	Santa Cruz del Retamar	Toledo	5
I.S.F. PANGIA SOLAR 11	Villa de Don Fadrique (La)	Toledo	5
I.S.F.	Santa Cruz del Retamar	Toledo	5
I.S.F. PANGIA SOLAR 13	Villa de Don Fadrique (La)	Toledo	5
CALERA 1	Calera y Chozas	Toledo	100
CALERA 2	Calera y Chozas	Toledo	100
CALERA 3	Calera y Chozas	Toledo	100
CALERA 4	Calera y Chozas	Toledo	100
CALERA 5	Calera y Chozas	Toledo	100
CALERA 6	Calera y Chozas	Toledo	100
CALERA 7	Calera y Chozas	Toledo	100
CALERA 8	Calera y Chozas	Toledo	100
CALERA 9	Calera y Chozas	Toledo	100
CALERA 10	Calera y Chozas	Toledo	100
GUADAMUR 1	Guadamur	Toledo	100
GUADAMUR 2	Guadamur	Toledo	100
GUADAMUR 3	Guadamur	Toledo	100
GUADAMUR 5	Guadamur	Toledo	100
GUADAMUR 6	Guadamur	Toledo	100
GUADAMUR 4	Guadamur	Toledo	100
GUADAMUR 7	Guadamur	Toledo	100
GUADAMUR 8	Guadamur	Toledo	100
GUADAMUR 9	Guadamur	Toledo	100
ERNESTO SANCHEZ CADIZ	Palomeque	Toledo	5
KANGAROOS	Fuensalida	Toledo	40
EL TEJAR NEGOCIOS E INVERSIONES	Layos	Toledo	20
NAVAHERMOSA 1	Navahermosa	Toledo	100
NAVAHERMOSA 2	Navahermosa	Toledo	100
NAVAHERMOSA 3	Navahermosa	Toledo	100
NAVAHERMOSA 4	Navahermosa	Toledo	100
NAVAHERMOSA 5	Navahermosa	Toledo	100
I.S.F. PANGÍA SOLAR 4	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 17	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 21	Villa de Don Fadrique (La)	Toledo	5

I.S.F. PANGÍA SOLAR 16	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 6	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 12	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 8	Villa de Don Fadrique (La)	Toledo	5
I.S.F. PANGÍA SOLAR 3	Villa de Don Fadrique (La)	Toledo	5
CASFER 92	Nava de Ricomalillo (La)	Toledo	19,8
PULGAR GANADEROS	Pulgar	Toledo	100
ONTIGOLA	Ontígola	Toledo	30
FERVIPAL	Yébenes (Los)	Toledo	20
VALSER	Añoover de Tajo	Toledo	5
EP CLIMATIZACION	Mocejón	Toledo	20
GUADAMUR	Guadamur	Toledo	20
PERSONALIA-13,2	Sonseca	Toledo	13,2
NAVALUCILLOS-20	Navalucillos (Los)	Toledo	19,95
ASICOR	Urda	Toledo	49,5
FRANCISCO JAVIER 20	Villacañas	Toledo	20
EL BARRO RENOVABLES	Camarena	Toledo	64,85
LUIS ALVAREZ RODRIGUEZ II	Madridejos	Toledo	20
COLASTRA PV 30	Yepes	Toledo	30
ANTONA PECES	Orgaz	Toledo	90
M.Y.T. SAEZ FV	Yepes	Toledo	59,85
AGUSTIN GARCIA GARCIA_2	Orgaz	Toledo	80
EMCC COBEJA	Cobeja	Toledo	60
EMCC OLIAS DEL REY	Oliás del Rey	Toledo	70
EMCC GUADAMUR	Guadamur	Toledo	70
EMCC HUERTA DE VALDECARABANOS	Huerta de Val-decarábanos	Toledo	60
FRANCISCO CASERO	Navalmorales (Los)	Toledo	35
CERAMICAS MILLAS E HIJOS II	Mora	Toledo	990
PUERTAS TEMBLEQUE 1	Tembleque	Toledo	79,2
PLASEX	Numancia de la Sagra	Toledo	99
AYUNTAMIENTO HONTANAR	Hontanar	Toledo	10
JOSE MARIA SANABRIA	Illescas	Toledo	20
LOS ENEBRALES	Almorox	Toledo	20
VALMONTE_1	Escalona	Toledo	10
MIGUEL ANGEL SANCHEZ	Sonseca	Toledo	16
PROYECTO NAVES L	Borox	Toledo	896
PROYECTO NAVES M11	Borox	Toledo	1394
VALMONTE_2	Almorox	Toledo	10
PEDRO ABAD	Villanueva de Alcardete	Toledo	10
CERRAJERIAS GUTIERREZ-90	Yébenes (Los)	Toledo	90
NEUMATICOS MORON	Yuncos	Toledo	20
SOLESON_1	Orgaz	Toledo	20
IMMODO ORGAZ_1	Orgaz	Toledo	80
VILLACAÑAS	Villacañas	Toledo	60
IMMODO ORGAZ_2	Orgaz	Toledo	70
PROYECTO NAVES VWB	Borox	Toledo	1137
PROYECTO NAVES M10	Borox	Toledo	1394

BEZARES	Casarrubios del Monte	Toledo	400
ESTACION CRUCE DE CEDILLO	Cedillo del Condado	Toledo	54,9
TONELEROS RENOVABLES	Torrijos	Toledo	19,95
PIVELLON 1	Polán	Toledo	20
PIVELLON 2	Polán	Toledo	20
PIVELLON 3	Polán	Toledo	20
PIVELLON 4	Polán	Toledo	20
PIVELLON 5	Polán	Toledo	20
PIVELLON 6	Polán	Toledo	20
PIVELLON 7	Polán	Toledo	20
PIVELLON 8	Polán	Toledo	10
CEIP VILLA DE YUNCOS	Yuncos	Toledo	10
I.S.F.	Ajofrín	Toledo	5
I.S.F. CODIABE 1	Ajofrín	Toledo	25
I.S.F. CORPORACIÓN DAESPA, S.L.	Ajofrín	Toledo	100
I.S.F. CUBIERTA NAVE IND.	Ajofrín	Toledo	5,2
I.S.F. CUBIERTA NAVE IND.	Ajofrín	Toledo	5,2
I.S.F. CUBIERTA NAVE IND.	Ajofrín	Toledo	5
I.S.F. CUBIERTA NAVE IND.	Ajofrín	Toledo	5
I.S.F.	Ajofrín	Toledo	3,2
I.S.F.	Ajofrín	Toledo	5
I.S.F. PAULA GAMERO GAMERO	Ajofrín	Toledo	100
I.S.F.	Ajofrín	Toledo	15
I.S.F.	Ajofrín	Toledo	100
I.S.F.	Ajofrín	Toledo	25
I.S.F.	Ajofrín	Toledo	5
JUAN PABLO II 53	Ajofrín	Toledo	9,9
NOBLEJAS SOLAR	Ajofrín	Toledo	500
TRASDOS	Corral de Almaguer	Toledo	20
UBALDO BERMEJO	Escalona	Toledo	20
FERGAR FV 20	Illescas	Toledo	19,95
INAEL ELECTRICAL SYSTEMS	Toledo	Toledo	300
MIGUEL DELIBES	Viso de San Juan (El)	Toledo	10
SESEÑA FOTOVOLTAICA	Seseña	Toledo	80
QUINTANAR ALPHA 15	Quintanar de la Orden	Toledo	100
POLIDEPORTIVO LAYOS	Layos	Toledo	72
SOL10_005	Sonseca	Toledo	50
PORCELANITE FV-TOLEDO	Villaluenga de la Sagra	Toledo	100
MEJORIGAR YELES I	Yeles	Toledo	45
FAMMSA	Yébenes (Los)	Toledo	999
MANUELA MARTINEZ FERNANDEZ	Santa Cruz del Retamar	Toledo	5
VILLACAÑAS II	Villacañas	Toledo	19,95
LINGEGAS 2	Calera y Chozas	Toledo	1000
CEIP EL GRECO	Illescas	Toledo	12
JULIAN I	Nava de Ricomalillo (La)	Toledo	9,9
VILLACAÑAS III	Villacañas	Toledo	36
VILLACAÑAS IV	Villacañas	Toledo	100
VILLACAÑAS V	Villacañas	Toledo	85
JMM VILLARRUBIA DE SANTIAGO 20 KW	Villarrubia de Santiago	Toledo	20
SOL-10-11	Almorox	Toledo	20

SOL-10-10	Almorox	Toledo	20
EL MESON	Torrijos	Toledo	20
CLIMAMOTOR RENOVABLES	Villacañas	Toledo	20
PEDRO ABAD 2 / INST. FOT. 4 KW C/ CUENCA	Villanueva de Alcardete	Toledo	4
CASARRUBIOS 2 FRUSANGAR	Casarrubios del Monte	Toledo	72
PLANTA SOLAR FV APOLONIO MARTIN	Segurilla	Toledo	1000
I. F. GUITARRAS MANUEL RODRIGUEZ AND SONS	Esquivias	Toledo	50
PEDRO ABAD 3 / INST. FOT. 10 KW C/ MAYOR	Villanueva de Alcardete	Toledo	10
CASARRUBIOS 1 ISOLPE	Casarrubios del Monte	Toledo	79,8
FOTOVOLTAICA EL PRADO	Talavera de la Reina	Toledo	90
PASEO DE LA ROSA	Toledo	Toledo	15
JUMISA 1	Yuncler	Toledo	1000
IFV ZAHORI 21 - YUNCOS	Yuncos	Toledo	0
SOL10_12	Santa Cruz del Retamar	Toledo	20
HIERROS Y TRANSFORMADOS, S.A.	Quintanar de la Orden	Toledo	1500
TOLEDO SOLAR PISCINA CUBIERTA	Toledo	Toledo	50
TOLEDO SOLAR COLEGIO EUROPA	Toledo	Toledo	70
ISFV GFM SL	Villa de Don Fadrique (La)	Toledo	70
MOLGAS COGENERACION GRAINTO	Portillo de Toledo	Toledo	1000
SAN ANTÓN	Lillo	Toledo	7200
TOLEDO SOLAR CENTRO CIVICO	Toledo	Toledo	75
FOTOVOLTAICA DE 20 KW EN CUBIERTA POLIDEPORTIVO	Layos	Toledo	20
100 KW INSTALAKUNTZA	Urda	Toledo	99
INS. T. SOLAR FOTOV. DE 20 KW SOBRE CUBIERTA C/ LEON FELIPE 16	Orgaz	Toledo	20
INSTALACION SOLAR FOTOVOLTAICA OTERO	Otero	Toledo	700
FV MOHEDAS I	Mohedas de la Jara	Toledo	10
SOL11_001	Toledo	Toledo	70
TOLEDO SOLAR CP LA CANDELARIA	Toledo	Toledo	45
TOLEDO SOLAR CP VALPARAISO	Toledo	Toledo	55
TOLEDO SOLAR CP ALBERTO SANCHEZ	Toledo	Toledo	75
ONTIGOLA SOLAR	Ontígola	Toledo	990
TOLEDO SOLAR CP PABELLON POLIGONO	Toledo	Toledo	75
TOLEDO SOLAR COLEGIO ALFONSO VI	Toledo	Toledo	70
TOLEDO SOLAR COLEGIO ALFONSO VI	Toledo	Toledo	70
EXTRUSIONES TOLEDO	Toledo	Toledo	1200
PLANTA SOLAR FOTOVOLTAICA ARCI-COLLAR	Arcicóllar	Toledo	10000
POYATOS	Toledo	Toledo	500
MARIA SAGRARIO VERBO BERNAL	Orgaz	Toledo	9,9
INST. FOTOV. 1600 KW SESEÑA	Seseña	Toledo	1600
IMPORT LAMP - 1	Toledo	Toledo	400
VICENTE CORDERO 192 KW	Yeles	Toledo	192
FOT. M. CARMEN GALAN	Urda	Toledo	5
RECRIA DE GANADO TESTADO	Camarenilla	Toledo	50

AMPLIACION HUERTO SOLAR	Quero	Toledo	25
FOT. MERCADO MUNICIPAL DE ABASTOS	Corral de Almaguer	Toledo	8,28
TOYOTA	Illescas	Toledo	26,79
FOTOVOLTAICA CENTRO JOVEN	Illescas	Toledo	5,61
FOTOVOLTAICA AYUNTAMIENTO NUEVO	Illescas	Toledo	5,52
FOTOVOLTAICA CUARTEL POLICIA LOCAL	Illescas	Toledo	2,8
BIOMASA EMTE	Navalmorales (Los)	Toledo	4800
BIOMASA EMTE	Navalmorales (Los)	Toledo	3200
I.F. ANUNCIACION GARCIA VILLALOBOS	Romeral (El)	Toledo	5
CERAMICA HERMANOS JEREZ	Numancia de la Sagra	Toledo	979
LADRILLERIA ROSO	Illescas	Toledo	858
VALDAJOS	Villarrubia de Santiago	Toledo	1440
CERAMICA EL PARAISO	Pantoja	Toledo	979
CERAMICA ZAMORA	Talavera de la Reina	Toledo	532
LADRILLOS MORA	Illescas	Toledo	960
LA PALOMA	Pantoja	Toledo	979
CERAMICA SAN JAVIER	Pantoja	Toledo	922
TECAMASA	Pantoja	Toledo	922
COGENERACION HERMANOS DIAZ REDONDO	Cobeja	Toledo	999
COGENERACION INCEDISA	Cobeja	Toledo	977
CERAMICA J.RUIZ E HIJOS	Talavera de la Reina	Toledo	850
LINGEGAS	Calera y Chozas	Toledo	3120

## I. Annex C: Running Costs per technology:

### C.1. Wind Power Running Costs

Year:	Running Costs/year (€)	Pay-off costs/year (€)	Energy production (GWh/year)	Electricity production cost (c€/kWh)
Year 1	2543800	3688000	127,19	4,899599025
Year 2	2597219,8	3688000	127,19	4,941599025

Year 3	2651761,416	3688000	127,19	4,984481025
Year 4	2707448,406	3688000	127,19	5,028263547
Year 5	2720985,648	3688000	127,19	5,03890687
Year 6	2734590,576	3688000	127,19	5,049603409
Year 7	2748263,529	3688000	127,19	5,060353431
Year 8	2762004,846	3688000	127,19	5,071157203
Year 9	2775814,871	3688000	127,19	5,082014994
Year 10	2789693,945	3688000	127,19	5,092927074
Year 11	2803642,415	3688000	127,19	5,103893714
Year 12	2817660,627	3688000	127,19	5,114915187
Year 13	2831748,93	3688000	127,19	5,125991768
Year 14	2845907,674	3688000	127,19	5,137123732
Year 15	2860137,213	3688000	127,19	5,148311355
Year 16	2874437,899	3688000	127,19	5,159554917
Year 17	2888810,088	3688000	127,19	5,170854696
Year 18	2903254,139	3688000	127,19	5,182210975
Year 19	2917770,41	3688000	127,19	5,193624035
Year 20	2932359,262	3688000	127,19	5,20509416
Year 21	2947021,058	3688000	127,19	5,216621635
Year 22	2961756,163	3688000	127,19	5,228206748
Year 23	2976564,944	3688000	127,19	5,239849787
Year 24	2991447,769	3688000	127,19	5,251551041
Year 25	3006405,008	3688000	127,19	5,263310801
Total:	70590506,63	92200000		5,119600806

## C.2. Solar PV Running Costs

Year:	Costs(€)	Income (€)	Profits (€)	Accumu- lated Prof- its (€)
Year				-
0	357972000	0	357972000	357972000
Year				-
1	11755365,2	24,7845351	13029169,9	344942830
Year				-
2	12002227,9	25,3050103	13302782,5	331640048
Year				-
3	12254274,7	25,8364156	13582140,9	318057907
Year				-
4	12511614,4	26,3789803	13867365,9	304190541

Year				-
5	12838230,1	26,9329389	14094708,8	290095832
Year				-
6	12902421,2	27,4985306	14596109,4	275499723
Year				-
7	12966933,3	28,0759997	15109066,4	260390656
Year				-
8	13031768	28,6655957	15633827,7	244756829
Year				-
9	13096926,9	29,2675732	16170646,4	228586182
Year				-
10	13162411,5	29,8821923	16719780,8	211866401
Year				-
11	13228223,5	30,5097183	17281494,8	194584907
Year				-
12	13294364,7	31,1504224	17856057,7	176728849
Year				-
13	13360836,5	31,8045813	18443744,8	158285104
Year				-
14	13427640,7	32,4724775	19044836,8	139240267
Year				-
15	13494778,9	33,1543995	19659620,6	119580647
Year				-
16	13562252,8	33,8506419	20288389,1	99292257,6
Year				-
17	13630064	34,5615054	20931441,3	78360816,2
Year				-
18	13698214,4	35,287297	21589082,6	56771733,6
Year				-
19	13766705,4	36,0283302	22261624,8	34510108,8
Year				-
20	13835539	36,7849252	22949386,2	11560722,6
Year				-
21	13904716,6	37,5574086	23652691,9	12091969,4
Year				-
22	13974240,2	38,3461142	24371873,9	36463843,3
Year				-
23	14044111,4	39,1513826	25107271,1	61571114,4
Year				-
24	14114332	39,9735616	25859229,6	87430344
Year				-
25	14184903,6	40,8130064	26628102,7	114058447

## C.2. Small-hydro Running Costs

<b>Years:</b>	<b>Running costs (€)</b>	<b>Investment Costs (€)</b>	<b>Annual Energy Production (GWh)</b>	<b>Electricity Production Cost (c€/kWh)</b>
Year 1	900000	981272,48	21,2	8,873926792
Year 2	918900	981272,48	21,2	8,963077736
Year 3	938196,9	981272,48	21,2	9,054100849
Year 4	957899,0349	981272,48	21,2	9,147035448
Year 5	957899,035	981272,48	21,2	9,147035448
Year 6	962688,5302	981272,48	21,2	9,169627406
Year 7	967501,9728	981272,48	21,2	9,192332325
Year 8	972339,4827	981272,48	21,2	9,215150767
Year 9	977201,1801	981272,48	21,2	9,238083302
Year 10	982087,186	981272,48	21,2	9,2611305
Year 11	986997,6219	981272,48	21,2	9,284292934
Year 12	991932,61	981272,48	21,2	9,307571179
Year 13	996892,2731	981272,48	21,2	9,330965816
Year 14	1001876,734	981272,48	21,2	9,354477427
Year 15	1006886,118	981272,48	21,2	9,378106595
Year 16	1011920,549	981272,48	21,2	9,401853909
Year 17	1016980,151	981272,48	21,2	9,42571996
Year 18	1022065,052	981272,48	21,2	9,449705341
Year 19	1027175,377	981272,48	21,2	9,473810649
Year 20	1032311,254	981272,48	21,2	9,498036483
Year 21	1037472,811	981272,48	21,2	9,522383446
Year 22	1042660,175	981272,48	21,2	9,546852145
Year 23	1047873,476	981272,48	21,2	9,571443187
Year 24	1053112,843	981272,48	21,2	9,596157184
Year 25	1058378,407	981272,48	21,2	9,620994751
<b>TOTAL:</b>	<b>24869248,77</b>		<b>Mean cost:</b>	<b>9,320954863</b>

### C.3. Plasma Gasification Technology

<b>Years:</b>	<b>Initial Investment Cost (M€)</b>	<b>Running Costs (€)</b>	<b>Annual Energy Production (GWh)</b>	<b>Cost of Electricity Production (c€/kWh)</b>
Year 1	7,5606	4549565,198	140,5831	8,61423969
Year 2	7,5606	4645106,067	140,5831	8,682200113
Year 3	7,5606	4742653,295	140,5831	8,751587705
Year 4	7,5606	4842249,014	140,5831	8,822432436

Year 5	7,5606	4865438,5	140,5831	8,838927652
Year 6	7,5606	4889765,692	140,5831	8,856232145
Year 7	7,5606	4914214,521	140,5831	8,87362316
Year 8	7,5606	4938785,593	140,5831	8,891101131
Year 9	7,5606	4963479,521	140,5831	8,908666491
Year 10	7,5606	4988296,919	140,5831	8,926319678
Year 11	7,5606	5013238,404	140,5831	8,944061131
Year 12	7,5606	5038304,596	140,5831	8,961891291
Year 13	7,5606	5063496,119	140,5831	8,979810602
Year 14	7,5606	5088813,599	140,5831	8,99781951
Year 15	7,5606	5114257,667	140,5831	9,015918462
Year 16	7,5606	5139828,956	140,5831	9,034107909
Year 17	7,5606	5165528,1	140,5831	9,052388303
Year 18	7,5606	5191355,741	140,5831	9,070760099
Year 19	7,5606	5217312,519	140,5831	9,089223754
Year 20	7,5606	5243399,082	140,5831	9,107779727
Year 21	7,5606	5269616,077	140,5831	9,126428481
Year 22	7,5606	5295964,158	140,5831	9,145170478
Year 23	7,5606	5322443,979	140,5831	9,164006185
Year 24	7,5606	5349056,199	140,5831	9,18293607
Year 25	7,5606	5375801,48	140,5831	9,201960605
Total:		5049118,84	Mean:	8,969583712

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