



CIRO PROJECT

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Index:

Index:	2
ABSTRACT:	3
INTRODUCTION:	3
MAIN CAUSES OF GETAFE ENVIRONMENTAL PROBLEMS:	3
PROJECT DEVELOPMENT:	5
ENERGY SUPPLY OF HOUSING:	5
THE POWER OF RENEWABLE ENERGY SOURCES:	5
THE POWER OF HYDROGEN:	5
PASSIVE SOLAR ENERGY:	6
TREATMENT OF RESIDUES AND USE OF THESE AS FUEL:	6
A NEW LAW THAT WILL SUPPORT OUR PROJECT:	7
CONCLUSIONS:	8
Annexes:	9
BIBLIOGRAPHY:	11

ABSTRACT:

Our project aims to solve Getafe's environmental problems. To carry it out, our group has investigated the root causes of urban pollution by comparing the environmental data of this municipality with the rest of the Community of Madrid.

Our goal is to raise awareness among the authorities about municipal problems and introduce new methods for energy supply through renewable energy, as well as to promote the use of hydrogen.

Based on these facts, we will propose a sustainable city model by replacing polluting energies with green energy until Getafe is turned into a carbon-neutral city.

INTRODUCTION:

Getafe is a municipality and city in the south of the Community of Madrid, and one of the most industrialized in the metropolitan area of Madrid.

Getafe's proximity to the Spanish capital has led to a great industrial development throughout the twentieth century. Because of this factor, Getafe presents numerous environmental problems caused mainly by pollution from industries.

One of the main environmental problems of the municipality is the poor quality of its air, which has increased pollution levels in recent times. In almost half of what we've been through for the year, the city has recorded high levels of polluting particles.

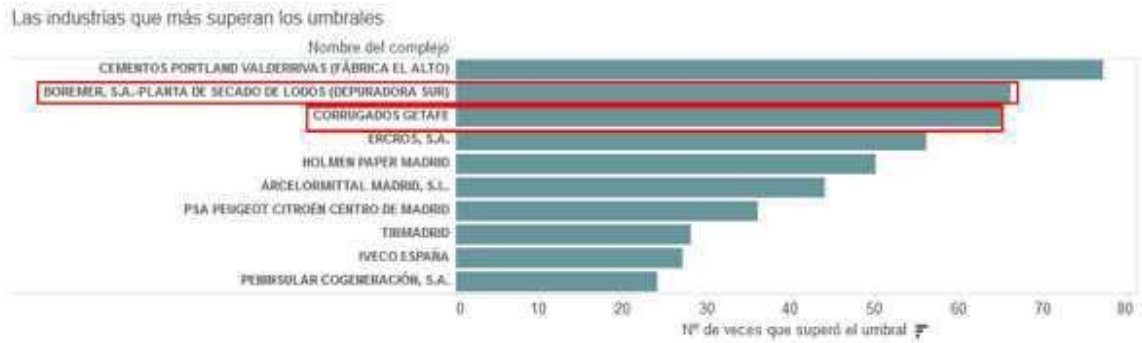
116 micrograms per cubic meter of nitrogen dioxide have been recorded, the maximum restricted value in the municipalities of the area, according to the Getafe Newspaper as defined in the report of the Air Quality Network, by the Community of Madrid.

Air quality has been poor these last few years in Getafe, with more than 50 micrograms per cubic meter, while in other locations such as Leganés the level is 41 micrograms, something not so good according to the map prepared by the Community of Madrid. In the case of Fuenlabrada and Valdemoro, although the levels are not low, the air quality is good. We can conclude that Getafe, is the locality whose air has the highest number of pollutants in the entire southern part of the Community of Madrid, which is a serious concern for the inhabitants of that municipality.

MAIN CAUSES OF GETAFE ENVIRONMENTAL PROBLEMS:

The main causes of the existence of pollutants in the air of our locality are the excessive use of fossil fuels, as well as the poor waste disposal and processing, the latter are burned instead of following a recycling protocol according to sustainable protocols, thus producing unnecessary emissions of CO₂ since we remember that to get rid of these wastes is carried out the combustion of these. Although the Ministry of the Interior has ensured that over the past 10-15 years waste processing techniques have improved, we agree that they are not yet as sustainable as they should and continue to harm the environment.

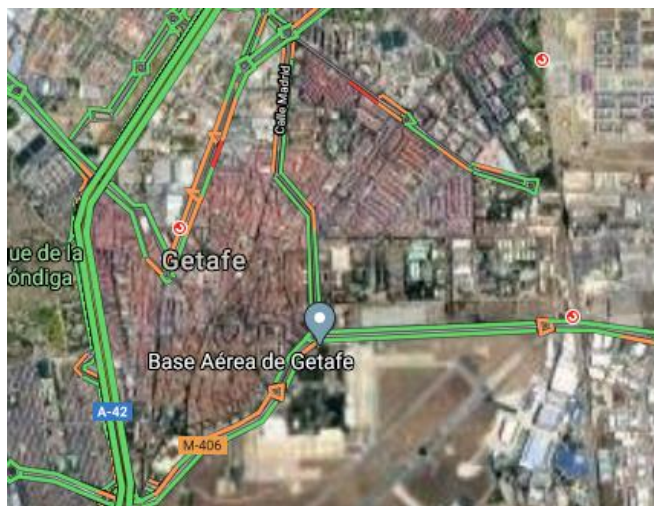
As we see in the graph below, one of the main causes of pollution in our municipality is the production of waste generated by the local factories. Considering the source of PRTR, two of the most polluting industries in the community are located in the southern part of Madrid. These factories exceed more than 60 times the threshold set by the Community.



Fuente: PRTR

Gráfico: María Quintán Maza y Daniel González Capas

However, in Getafe, the leading cause of the ranking of polluting sources, far exceeding industrial air conditioning systems and waste processing, among others, is road traffic, which is the highest producer of nitrogen oxide in our municipality. Nitrogen oxides have harmful effects on both residents' health and the environment.



As we can see in the image, the center of the municipality is very busy by polluting vehicles, a fact that undoubtedly favors the emission of harmful particles into the air of the city.

PROJECT DEVELOPMENT:

ENERGY SUPPLY OF HOUSING:

We have devised an innovative project, based on measures taken by other municipalities in Madrid consisting of an energy distribution network that runs through the urban route, which allows homes the possibility of having sanitary hot water and heating, being the energy to obtain these resources of renewable origin. Its energy is obtained from renewable sources, such as biomass and solar energy concentration among other sources of clean energy, replacing non-renewable sources for the supply of basic resources of our municipality's homes.

Here comes one of the fundamental ideas of our project, we propose to provide energy to all the inhabitants of Getafe, using the guidelines of this project thus ensuring that our municipality uses energy from renewable origin, such as wind energy or solar energy to reduce pollution by committing to sustainability. Of course, in existing neighbourhoods it would be a very costly change, but in all future construction neighbourhoods, the use of such measures will be indispensable.

Thanks to this sustainable project, we will reduce our municipality's dependence on non-renewable energy sources, committing ourselves to improving the air quality of our municipality and sustainability.

THE POWER OF RENEWABLE ENERGY SOURCES:

Looking at the problems mentioned above and contrasting the possible solutions, we have concluded that introducing renewable energy sources in our municipality is a great help in reducing air pollution in the city, improving air quality and taking care of the health of our neighbours.

Having taken into account that Getafe has an area of 78.34 km², of which we could only use 30%, since the rest of the area is occupied and that the annual consumption of the municipality is 13.35 * 10⁻⁶ KW, we have carried out the following experiments.

EXPERIMENT 1. Wind turbines:

According to the calculations in the annex, it is not possible to make Getafe a city supplied only by wind turbines. Wind power would not be sufficient to guarantee the supply of energy to all our inhabitants, as we do not have enough space to establish such machinery.

EXPERIMENT 2. PHOTOVOLTAIC PLATES:

According to the calculations in the Annex, 1 021 000 photovoltaic plates would be necessary, which would occupy 1.74 km². Considering that Getafe is an extensive municipality and that certain parts of the territory do not host housing or fields, the use of solar energy as the main source of supply in our municipality would be feasible. However, the area of these areas would have to be calculated to ensure a correct supply of energy.

THE POWER OF HYDROGEN:

As we have said before, the main cause of pollution is road traffic, so our proposal will be to encourage the use of hydrogen-powered vehicles. These vehicles use hydrogen in two ways: combustion and conversion of the hydrogen stack. In the first, hydrogen is burned in an explosion engine just like a gasoline engine. In conversion, the hydrogen is oxidized from the

fuel cell and the electrons it loses make electric current that will circulate through fuel cells that move electric motors as if they were a battery.

The basic concept is simple: print kinetic energy on the wheels using diatomic hydrogen (H₂) as fuel. To achieve this end, an intermediate process called electrolysis is necessary: the elements of a chemical compound are separated by electricity, where there is time of reduction (electrons are released) and oxidation (electrons are captured).

These vehicles are considered zero emissions, because the only by-product of hydrogen is water vapor, which as we already know is not a polluting agent. While a common diesel vehicle emits about 106g/km of CO₂, a hydrogen-driven vehicle does not emit CO₂, so this alternative to traditional vehicles is clean and in line with project objectives.

In order to carry out this proposal, it is necessary to provide the city with hydrogen stations capable of supplying the vehicles with the necessary fuel to operate.

The operation of these vehicles is explained and developed in the annex.

PASSIVE SOLAR ENERGY:

Another way to produce energy that we propose to include in our city, is passive solar energy.

This is a technique that harness energy coming from the sun directly without having to transform it. We will implement this energy in order to provide heating to the houses.

This technique is used in buildings that are designed with windows and walls that collect, store, and distribute solar energy in the form of heat in winter and reject solar heat in summer. The key to this system will be to take advantage of the local climate.

The facility would consist of putting on the roof collectors or collecting plates whose operation is based on the greenhouse effect and the photovoltaic effect, a storage tank, a control system to control the temperature and an energy reserve system for when there is more production that demands, when it occurs.

TREATMENT OF RESIDUES AND USE OF THESE AS FUEL:

Countries such as Norway have developed an innovative method capable of converting waste into fuel. This process is simple, the waste, ton by ton, falls into an incinerator. The temperature rises to 850 degrees, burning most waste.

Not everything burns, as there are residues left that are then recycled, as well as heat. The heat is used to turn water into steam which drives a turbine that produces electricity and the excess boiling water is channeled out of the plant, to houses and public schools throughout Oslo.

With full capacity the plant will provide heat and electricity to all Oslo schools and heat to 56,000 households, figures that would certainly be enough to supply Getafe with electricity in a more sustainable way.

Although it would be ideal to reduce the amount of waste in our municipality, there is no doubt that this procedure would significantly reduce the use of non-renewable sources to supply our city with energy.

A NEW LAW THAT WILL SUPPORT OUR PROJECT:

On the draft Climate Change and Energy Transition in Spain.

The first draft of this Law was introduced in 2019, and it managed to enter congress last May 2020. Already in October more than 700 possible changes were presented, the amendments. Recently, on 8th of April, the draft Climate Change and Energy Transition was approved by the Lower House of Parliament and submitted to the Upper House.

This law appears in line with different climate policies at European level, such as the Paris agreement, proposing to avoid rising global temperatures by more than 2 degrees Celsius. With current policies we are still far from this goal, increasing temperatures by 3 degrees by the end of the century.

To achieve this, this new draft aims, among others, to make Spain a zero carbon-emissions power by 2050, before that it seeks to achieve by 2030 the reduction of the carbon footprint a minimum of 20% over that of 1990, which is a very ambitious goal, although it would allow to comply with the Paris agreement, but more slowly. If we want the effects of climate change to be as smooth as possible, we must seek a much faster reduction.

The increase in renewable energy production, especially hydropower, will be sought with the use of reversible hydroelectric plants to achieve a constant electricity supply. In addition, the use of hydrogen is also contemplated, but being a technology of difficult logistical application, its use is not yet entirely possible.

As for nuclear power, it will be sought for complete elimination by 2035.

On the other hand, the consumption of renewable gases such as biogas, which on paper is a neutral carbon energy, will be encouraged, although in practice, because of its processing and transport this is not the case.

As regards transport, the vehicle network will be sought not to emit carbon directly. In addition, in municipalities of more than 50,000 inhabitants, the establishment of a low-emission zone will be mandatory. Electric car charging areas will then be strategically available at different petrol stations.

All this will be attempted through a fair transition for all countries and companies, with the addition of respect for biodiversity protection laws.

In short, it is a law that gives us a move towards a better future, also good support for science. On the other hand, it has poor objectives, below European level, so it will still be necessary to make upward changes to them.

CONCLUSIONS:

Taking into account all the aspects analyzed in the project and according to the calculations carried out, we believe that it is really possible to create a completely sustainable city, or at least carbon neutral, committed to the environment and the development of energies of renewable origin. To achieve this project, only an economic investment is needed large enough to be able to carry out the necessary processes and make Getafe a municipality committed to development.

Annexes:

CORRUGADOS GETAFE:



OPERATION OF AEROGENERATORS:

One of our proposals to reduce pollution and turn our city into a clean and sustainable city lies in the wind turbines, whose operation is explained in this video:

<https://youtu.be/gPT5DkFEO2Y>

OPERATION OF PHOTOVOLTAIC PLATES:

Another of the fundamental pieces in our project is the use of photovoltaic plates to improve the air of our municipality and reduce polluting emissions and the volume of non-renewable energies. The operation of photovoltaic boards is explained in this video:

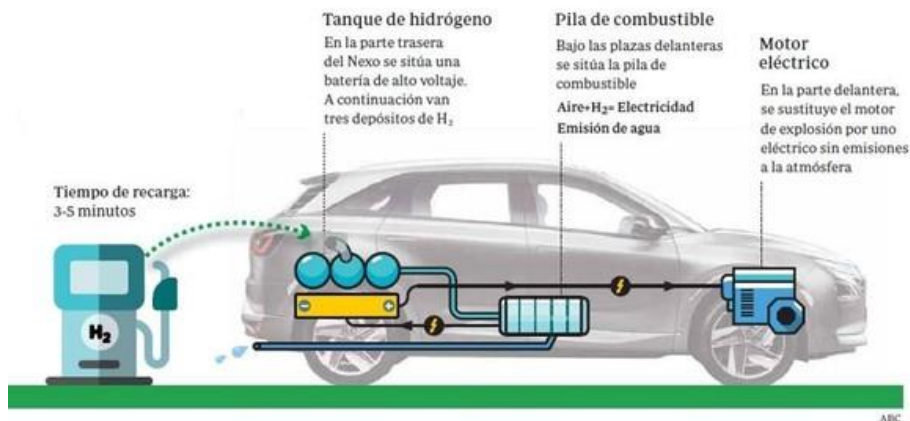
<https://youtu.be/q5bMAz4NK0c>

OPERATION OF HYDROGEN VEHICLES:

Our project aims to promote the use of hydrogen vehicles to reduce pollution created by emissions produced by conventional vehicles. How these work is explained in this video:

https://youtu.be/T3-bNe_qAxQ

STRUCTURE OF HYDROGEN VEHICLES:



WHAT IS PASSIVE SOLAR ENERGY?

It is a technique that takes care of the energy coming from the sun directly without having to transform it. Our project aims to implement this technique in newly built buildings to reduce the energy costs of housing thanks to this innovative technique.

<https://youtu.be/nakc27580tA>

CALCULATIONS EXPERIMENT 1:

Data:

Power 330 KW

Production 376710 KW/ m²

Consumption 681 million KWh

Getafe population: 180,747

Getafe area: 78.74 km²

Results:

Average Getafe Consumption :681000000kw/h

Production by kW/km² of a wind turbine:376710kw/km²

681000000/376710=1807km².so there is not enough space.

CALCULATIONS EXPERIMENT 2:

Data:

Power of photovoltaic plates used: 330W.

Photovoltaic plate area: 1.71m²

Annual production per photovoltaic plate: 670 KWh.

Getafe population: 180,747.

Average energy used per person: 3768.12 KWh.

Total energy required: 681 million KWh.

Results:

A solar plate: P= 330 W, E= 667 kwh annually produced

Average Getafe Consumption: 681000000 kwh

681000000/667=1021450 solar panels

A plate occupies:1.71m²

1021450*1.71= 1746677.7 m²= 1.74km²

1021450 plates occupy a space of 1.74km²

1 021 000 photovoltaic plates will be needed, which would occupy 1.74 km². Considering that Getafe is an extensive municipality and that certain parts of the territory do not host housing or croplands, the use of solar energy as the main source of supply in our municipality would be feasible. However, these areas would have to be calculated to ensure a correct supply of energy.

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