# <u>CIRO PROJECT</u>

# Sustainable Transport





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## 1. Abstract

The aim of this project is to develop possible changes that can be made in the city of Huelva, with the aim of creating a sustainable city, based mainly on hydrogen as a fuel and energy source. We will focus mainly on transport, which is one of the biggest problems facing Huelva today: most of its pollution is caused by traffic. We will see possible solutions, such as reducing the number of lanes, motivating people to use sustainable and public transport, and also the main engine of these proposals: hydrogen. Finally, we will look at the innovative aspects of our proposals, and offer a conclusion that we have reached during the realization of this project.

## 2. Introduction

Mutual interaction between transportation and the environment is a growing concern in today's world. The greenhouse effect and the reduction of the ozone layer are some of the examples that express this universal character. This is because of the increase in concentration of CO2 in the atmosphere due to the combustion of fuels that causes the average temperature of the Earth to rise, which can cause serious problems for humanity such as changing the weather or increasing the level of seas, droughts, human health itself and, of course, the development of the regions.

In order to stop this greenhouse effect and create a more sustainable world, we must take a number of measures such as: reducing the consumption of new vehicles, preferably using biofuels such as biodiesel and bioethanol, directing the market to lower-consumption vehicles and driving more efficiently.

On the other hand, pollutants are emitted in much smaller quantities than CO2, but, when accumulated in the atmosphere, they affect air quality, the health of living beings and

the soiling of the environment. The most detrimental pollutants are: carbon monoxide, hydrocarbons, nitrogen oxides and particles that cause the opacity of fumes.

In this work, we will analyse the impacts that the means of transport are causing on the environment and what solutions we can propose in our city to reduce pollution. Our solution is to improve the methods of transportation in our city, because it is a more serious problem than most people think.



## 3. Environmental Background

Huelva is a small city located in southwestern Spain. It belongs to the autonomous community of Andalusia, and it is the capital of the province of Huelva. In addition, Huelva borders the Atlantic Ocean, and it has 122 kilometers of beach. The city of Huelva has a beach called "Espigón" that is 2.5 km long. As well, this city is on a small peninsula in the estuary formed by the mouth of the rivers Tinto and Odiel.





Huelva has a Mediterranean climate along with influences from the Atlantic sea. Its temperature regime is of maritime type, being one of the warmest cities in Europe with an average of 19.2°C per year. July is the hottest month, exceeding 40°C, and January is the coldest month, averaging 16°C. Rainfall is scarce throughout the year, especially during the summer months, but it is the most abundant in late-early autumn. Furthermore, Huelva receives an average of about 3000 hours of sunshine per year, which would be equivalent to about 300 days with clear skies.

As for the geography of the city, it is a plain, with numerous hills covered by abundant vegetation. Many of them are still standing, but there are others that have disappeared due to human activity.

In Huelva, according to INE (Spanish Statistical Office) data, on January 1, 2020, there were a total of 143,837 inhabitants. Regarding its economy, it is the second Andalusian province in terms of GDP (the provincial GDP is 8415 million euros). One of the main incomes that the capital receives is thanks to the chemical pole, which was installed in the 1960s. However, it is one of the reasons why pollution has increased in the city, and also traffic. In this paper



we will discuss how we can solve these problems and achieve a sustainable city.

## 4. Detailed description and objectives

### 4.1 Replacement of lanes.

Transportation is necessary in our daily routine, especially for people who live far from the city center. For example, to commute to work, school or even shopping. But not all types of transport have the same effect on the environment. In cities, there is often a lot of traffic (mainly caused by cars), and that is something that greatly affects the environmental quality. Therefore, changing the type of transportation from the most polluting ones to others that are more environmentally friendly will help to improve the quality of the environment and reduce pollution.

A good solution we have found to reduce pollution caused by heavy traffic is the replacement of roads with lanes for bicycles and electric scooters. Once cars are replaced by other individual types of transport, such as bicycles and scooters, some lanes or even roads will be changed to include bicycle lanes. The reason for this is that there will be fewer cars and more scooters and bicycles circulating in the city.



For example, in Huelva we could change Andalusia Avenue, which has currently four lanes: two on the right and the others on the left. These lanes could be reduced to just two (one on the right and one on the left), while the other two would be a safe place for people to move around with their individual ecological transport. As a result, we would have one road on each side, with two different lanes for different types of transport. The goal of this idea is to allow people to move around the city smoothly in their new types of transportation.

#### 4.2 Using hydrogen as a fuel.

Hydrogen is one of the most abundant gases in the universe in its molecular form. Obtaining hydrogen is not easy since it requires some chemical reactions. Moreover, natural gas is the most widely used compound to generate hydrogen, transforming it at high temperature using water vapor and catalysts. However, the water electrolysis process is the most studied process by which hydrogen is obtained to be used in automobiles. This new fuel would be effective because it virtually has unlimited reserves, a higher explosive power than gasoline, and, in addition, its reaction product is water steam.



H2 is also a key part of the energy transition because of its ability to be transformed into electricity, synthetic gas or heat. It has mainly industrial applications, but it can gradually be adapted to everyone's daily life. Depending on the sustainable value of hydrogen and its generation process, hydrogen is divided into three types: gray hydrogen, blue hydrogen and green hydrogen.

Gray hydrogen is the most commonly used form of hydrogen today in the chemical industry or in oil refineries. However, blue hydrogen requires fossil fuels, but it emits less carbon, given its sustainable value and generation process since it is removed by a method known as "catch and store".

Besides, there is green hydrogen, generated from renewable energies, which makes it a 100% sustainable alternative. However, it is the least used in the market and that is why we should start to use it more in everyday life to reduce pollution.

Regarding transportation, hydrogen is a source of energy for cars, with water being the only waste it produces. This type of vehicle has the zero emissions badge, which means they do not contribute to air pollution.

To sum up, we must use hydrogen as fuel, because it is an energy source combined with fuel molecules that do not create fumes, do not pollute with carbon dioxide or emit nitrous oxide. Moreover, it is more effective because it produces three times more energy than most fuels commonly used, and it reacts quickly with oxygen. We must also take into account that, unlike gasoline or natural gas, hydrogen has significant buoyancy in the atmospheric conditions, due to its low



density. Furthermore, any hydrogen leak will rise immediately and disperse, reducing the risk of ignition in the open air.

#### 4.3 Construction of hydropower plants.



The construction of hydropower plants is a very useful idea, though a bit dangerous. Hydrogen has a huge potential for energy storage, since it can be generated from the electrolysis of water, a chemical process that separates hydrogen and oxygen from water using any form of energy. If we use this energy that can be stored and transported, we will get available energy from H2 at any moment. The energy obtained would be very clean, enough to be used in electric heavy transport vehicles since they are always

moving on the roads and have their own gas stations. The idea would be to build hydro generators in the case of more special vehicles such as trucks or buses, since H2 is very dangerous. If we leave it at the disposal of any citizen, this could not give proper use and may cause an explosion. In addition, there are still cars and motorcycles of gasoline and diesel, but these would be in the car parks with shuttles.

#### 4.4 Parking with shuttles.

Parking with shuttles consists of building a parking lot with shuttles at the entrances of the city, which would not allow the entry of private vehicles of people who do not live in the city, unless they are using sustainable vehicles (those that use hydrogen or electric batteries). Apart from reducing traffic within the city, this would not increase pollution in the city so much.



The mechanism would be that, when arriving at one of the main entrances to Huelva by road, visitors will have the opportunity to leave their private vehicle in this car park. To get to the city, they would do it by taking a shuttle, which would leave every thirty minutes from this parking to different areas

of the city. Each person could get off at the place that they would want to. These shuttles would be free for anyone who makes use of the parking lot.

Thus, in addition, visits to Huelva would be increased. Not only would these shuttles connect the city center with the car parks, but they would also be connected to the nearest towns, such as San Juan del Puerto or Corrales (among others), from which many people leave to work or to educational centres daily. Therefore, apart from offering benefits to the

environment, we would be also offering help to citizens who would not have to worry about their transportation.

#### 4.5 Rental system for mobility.



As we have seen during the project, the main idea is to have more sustainable means of transport in Huelva. We will achieve this by using vehicles that run on hydrogen, reducing traffic in the city (for example, allowing only mobility in the city of Huelva and with individual sustainable vehicles), and, most importantly, encouraging the population to use public transport and other types of private transport, such as scooters and electric bicycles.

It has been proven by science that using this type of transport can be a great solution to reduce carbon dioxide emissions. In addition to being totally clean, electric scooters have other advantages. Firstly, they are quite fast as they can reach a speed of 25 km/h. Secondly, they do not use much energy. Thirdly, they are easy to use, so the people of all ages can use them because no license is necessary. Fourthly, they are affordable and easy

to maintain. And, finally, it's a fun way to move around the city. Consequently, thanks to their usage, the traffic can be reduced.

So that everyone has the opportunity to use these sustainable means of transport, there will be a rental system. The rental system will work through a mobile app that everyone will be able to download (people from Huelva and foreigners). First, they should register and activate their location. When this is done, they will have at their disposal a map in which they will be able to see



which scooter is the closest one. Once they have finished with the service, they can leave the scooter and the application will then read the disposable scooters back into the application. It will be cheap, and, if in any case there are damages, the next user should report the case in the application and the person who caused the damage will be fined.

## 5. Innovative aspects

Thanks to the improvement proposals, we will achieve a clean city. Even though it looks a bit complicated, we would all get used to the new situation and respect the new rules. It would be a much more ecological city, mainly because the energy would come from renewable sources, would be more controlled and would improve our society on an economical level thanks to the energy saving.

In relation to the innovations that would take place in Huelva, the most remarkable one would be the use of hydrogen as the new energy source for transportation throughout the city. Another innovative aspect would be to give the city a new and totally different essence: clean and with much less traffic. Thanks to the new laws and the elimination of certain lanes, a new, greener landscape can finally give the city a new atmosphere with more people in the streets.

New technologies and developments such as Powerpaste can help to improve in this way, and even make the use of hydrogen easier in small devices. Powerpaste is made up of magnesium hydride (created when magnesium powder is combined with hydrogen), an ester and a metal salt. A plunger pushes the paste out of its container, water is added and hydrogen is released. Half of the hydrogen is released from the magnesium hydride and the other half comes from the water. The resulting hydrogen can then be used to generate electricity using a fuel cell.



### 6. Conclusion

As we have seen during this project, over traffic is one of the main factors that negatively affects the environment and creates negative consequences such as the constant greenhouse effect gases emissions that do not only damage the environment, but also affect our health with the toxic gases that are emitted. Pollution increases carbon dioxide in the atmosphere which warms the bottom atmosphere layer, the troposphere, and causes what is known as climate change.

In this project, we have focused on Huelva, which earns most of its money thanks to the chemical pole. However, that is one of the main causes of the increase of pollution in the city. As a possible solution, we have planned this project with the objective of reaching a sustainable city. To reach this objective, we have planned and developed different ideas. With the purpose of diminishing the CO2 and greenhouse effect gases emission, we have thought on the substitution of lanes, the creation of a parking lot with shuttles, and even a renting mobility system.

In conclusion, thanks to the elaboration of this project, we have seen that even though we have to work hard so that Huelva can be a sustainable city, this project does not require a big difficulty. We just need information and investigation about new energy solutions in order to propose new ideas that have the same purpose, and also to raise awareness among citizens of all these proposals to be a reality.

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