ECOLOGICAL MARKET PRODUCTS FOCUSED ON ROAD TRANSPORT

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Abstract

Nowadays the evolution of road transport is turning into one ecological market products. Therefore, we have analysed the types of vehicles such as steam, gasoline, diesel, electric, hybrid, and the new hydrogen vehicles. Furthermore, we also took a note of one important fact, the technological improvements for the mitigation of greenhouse gases that involves one of the most important things in the research, the sector pollution. Also, we have asked to ourselves one question about how much each engine pollutes, therefore we have used the rule of three to solve it. Moreover, we had to be aware about the electric and internal combustion manufacturing process pollution because there are plenty of "fake news[1]". Besides we have studied the government's influence and the situation in Norway, Spain and two states of USA. Finally, we have analysed one econometric model related to new electric vehicles registered.

Keywords:

Manufacturing process pollution, road pollution, government policies, lithium battery cell, plug-in electric hybrid vehicle, electric, hydrogen, gasoline, and diesel.

JEL code:

Q55, Q56, Q58

[1] False news

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1 INTRODUCTION

The following research work is based on the study of the market of ecological products. Exactly, about the transport sector that these days is having the best change in its live.
Currently most of the people, if we talk about electric cars have not good information, overall due to their disinformation or ignorance. So, this could be one trouble to do not buy this type of vehicle or probably they could be right?
Due to, the manufacturing of an electric car and the bad charging of the vehicle; For instance, in Wyoming. Could pollute more than an internal combustion car.
In addition, we have reduced plenty of greenhouse gases emissions with solar roofs, wind wills, power walls, power packs, electric or hydrogen batteries for transportation or even hybrid cars. Nevertheless, all these incredible inventions are criticized by most people, because there are expensive, have not got green energy at all or even in the way that their production has caused a lot of pollution.
So, to achieve all these technologies we should have to be patient, humble and make a big effort as we did at the beginning of our history. So, when we said “at the beginning of our history” we were referring us about the transport history and their process or steps. ¡Therefore, everything comes!
However, the electric cars could be one more step in our history, because the hydrogen companies have begun to appear in the transport market and even in the electric system market to provide electricity to our houses also.
Currently, we have four Fuel Cell Vehicles (FCV), this name is referring to a hydrogen car. So, in our roads we have the HONDA FCX clarity, TOYOTA MIRAI, HYUNDAI NEXO and Mercedes GLC. All these companies work with one cell which is fed by the hydrogen battery. Furthermore, this energy is also made for trucks, trains, ships and for airplanes. But we are going to focus on vehicles because, there are more troubles for the use in cars than for all the last ones. Besides, we will see that there are also problems in how to obtain the hydrogen energy source and how to sell it in petrol stations.
Finally, we will develop and will make an objective study of these problems which the most important fact is ¡do not pollute anymore!

2 THEORETICAL FRAMEWORKS

2.1 THE EVOLUTION OF THE VEHICLE INDUSTRY

2.1.1 THE TYPES OF VEHICLE ENGINES

2.1.1.2 Steam vehicle

The history of the automobile and the evolution of technology have always gone hand to hand. There were a lot of technologies until arriving at the hydrogen electric battery. Nowadays it is unreal thinking about one steam car. However, Nicolas Joseph Cugnot would think the opposite.

In 1763 this French engineer created the first steam car in the world “cugnot car”. The idea was searching for a way to transport big artillery cannons. But as the famous proverb says, “The beginnings are always hard”, we saw how the cugnot car crashed into one house wall on the first test day.

Nevertheless, a British engineer whose name was James Watt, patented the “Firebomb” in 1769. Also, he improved in a better way. This British engineer discovered that coetaneous designs wasted a great amount of energy cooling and warming the cylinder faster. Therefore, James watt introduced one better design “the capacity condenses” due to cugnot car crashed.

Therefore, Great Britain nominated Richard Trevitthick as the first steam car inventor of our history because the car was completely an engineering achievement, for the reason that it could transport people and great issues for the military army without any problem. However, it only reached the speed of 15 km/h in 1801.

In American Continent the first steam car arrived in 1803 by the hand of the inventor and engineer of EEUU Oliver Evans.

Both inventors focused on the railway version because the steam train was invented before and they wanted a transport that would not only move on rail but also on road.

The first retail chain (Massive production) was built in 1873 by Amedee Bolle who made a school of selling steam cars as a dealer.

By the way, his first car was L'Obeissante[2] and already contained independent front suspension and gearbox[3]. Then De Dion Bouton (1883) Leon Serpollet (1887) and the famous French engineer Armand Peugeot (1889) arrived and followed the retail chain process of Amédée Bollée.

The first car racing in our history arrived in 1884 whose name was Paris Rouen, because of course it was celebrated in Paris. Besides, the participation was that only seven out of twenty-one cars had steam engines. However, various steam cars such as Leon Serpollet achieved the speed of 120 km/h. Also, the Stanley twins from north America achieved the maximum speed of 200 km/h.

Nevertheless, in 1889 without Leon Sepollet, was the end of the retail steam cars in Europe. But in the American continent, exactly in EEUU, Stanley and some partners of the steam engine continued to sell the steam car, approximately until 1902, with the last car produced by Stanley in the Locomobile fabric[4]. However, these famous twins continued producing cars, but he replaced the steam engine for petrol engines.

In 1960 plenty of brands studied the possibility of adopting steam engines again for simple reasons such as the cheap fuel, was quieter when it works, because of its combustion engine instead of explosion, and the emissions of gases, for the reason that the greenhouse gas emissions were less than gasoline cars. However, they stopped immediately, because the new inventions and projects in gasoline and diesel engines worked, so this fact made the age of oil begin.

Figure 1: Cugnot's Fardier steam car of 1769. Source: https://en.wikipedia.org/wiki/History_of_steam_road_vehicles

[2] Is the French name of the first steam road vehicle, built by Amédée Bollée

[3] Mechanical transmision

[4] Was an automobile manufacturer in the United States.

2.1.1.3 Gasoline and Diesel vehicle

The history of the internal combustion engine or the petrol engine began when the external combustion engine or steam engine arrived at the end.

Therefore, first, we should know how the gasoline engine works. In fact, we must be aware that the combination between air and gasoline inside the engine produces energy. However, the real process is pressing the spark plugs [5]until arriving at the explosion for creating energy to move the wheels.

In 1860 the first internal combustion engine was built by the hand of the Belgium Engineering Etienne Lenoir. This engine was fed by lightning gas, in other words, was fed by burning solid fossil fuels. However, it only produced three percent of energy. But this was the first step of evolution.

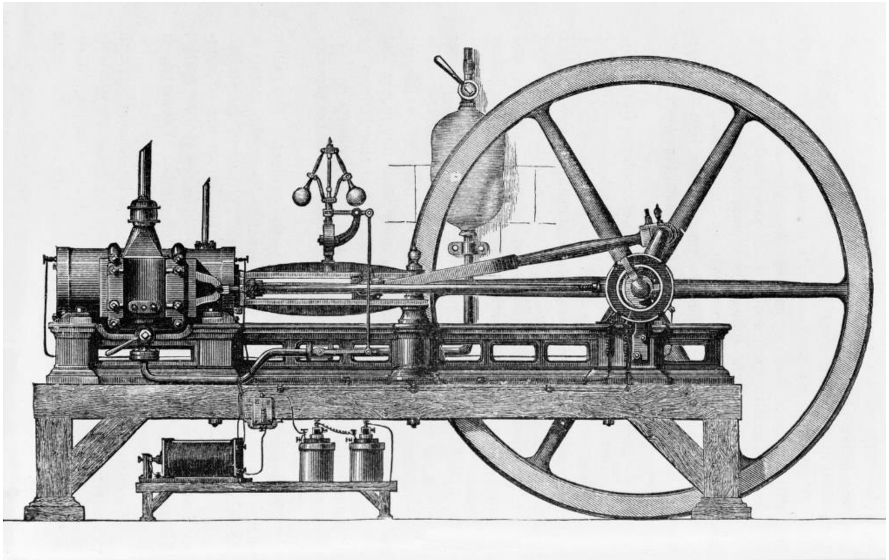


Figure 2: Internal combustion engine Etienne Lenoir (1896) Source: https://www.britannica.com/biography/Etienne-Lenoir

In addition, in 1876 arrived the great development of Nikolaus Otto, therefore he improved the energy power of the engine with a four-stroke cycle. Nevertheless, the engine was bigger for the size of a normal car, creating an impossible place to install.

By the way, this engine was patented by Otto, although everybody in the world knows it with the name of gasoline engine.

[5] Is a device that emits across a small gap creating the ignition for the combustion needed to start your vehicle.

Two years later, exactly in 1878, one invention appeared. This time with only two stroke cycles but was the satisfactory gasoline engine who all people were looking for. In fact, was made by the Scottish engineering Dugald Clerk. Therefore, we can say that this was the first achievement of the gasoline vehicle history.

On the other hand, people were focused on building the first car without any problem. However, to arrive at this point, we had to wait eight more years, exactly in 1886 by the hand of the famous German engineer Karl Benz.

This important person achieved the German patent number 37435, and this patent was the invention of the first gasoline vehicle in the world. By the way it contained three wheels, with tubular chassis powered off at ⅔ of 250 rpm (revolution power per minute) in other words, every time that the spark went up and down per minute.

However, a few months later the German engineer Gottlieb Daimler made the last invention to the internal combustion engine. Therefore, he built a gasoline vehicle powered by four wheels and two transmission speeds. The design was an open horse-drawn carriage with two sparks in one engine and was positioned in the centre of the vehicle.

Furthermore, in 1892 another German inventor whose name was Rudolf Diesel invented an auto-ignition propellant that worked on heavy fuels. Therefore, there are differences between gasoline and diesel engines. The fact is that the diesel is bigger and slower than gasoline, even though it is cost of production is higher.

Nevertheless, the first easy diesel engines were uncomfortable because of their noisy and their way of accelerating.

However, in 1923 the characteristics of the diesel technology engine were finally achieved. Due to the successful MAN[6] truck diesel engine test, which travelled from Munich (Germany) to Barcelona (Spain) without problems.

[6] MAN is a German company that manufactures trucks and buses.

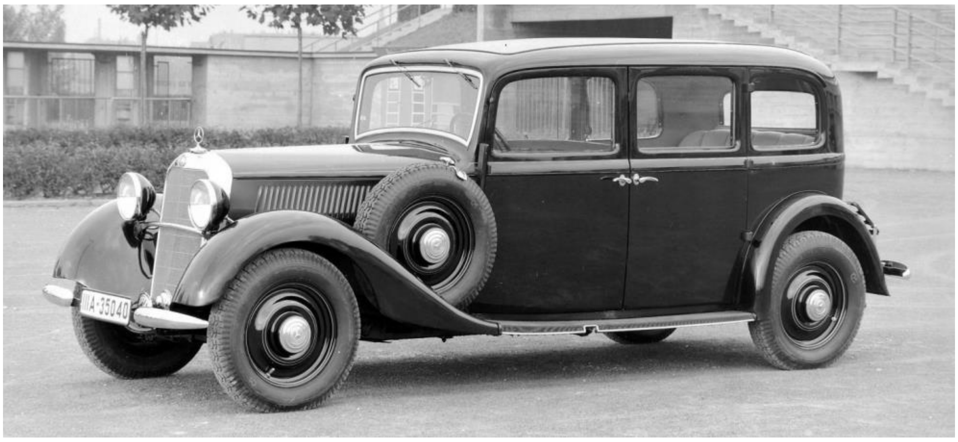


Figure 3 First diesel vehicle by Rudolf Diesel (1936) Source: https://www.diariomotor.com/noticia/primer-coche-diesel-historia/

2.1.1.4 Electric and Hybrid vehicle

In the history of the electric car there was no one who built the battery engine and the electric car at the same time. Therefore, was pretty much the same as the history of the internal combustion engine car as we have seen. The fact was that to build the electric car there were plenty of inventions, developments, and evolutions.
The first step was in 1828 by the hand of the engineer and inventor Anyos Jedlick from Hungary. He was the first man to use the first electricity cell battery. In fact, he built one small car module, as a toy car, moved by his electric engine. However, it was smallest for transport people and big issues of transportation, even it had problems in its battery exactly about charging their cells. For that reason, in 1834 Thomas Davenport and Robert Anderson from EEUU built another small electric vehicle. However, the difference was that this second one could work at least in a small circular circuit.
By the way, we have to say that in this period there were a few independent rechargeable power sources. Therefore, they had a limited usefulness as a means of transportation.
Finally, the world had to wait until 1859 by the hand of the French physicist Guston Plante who developed the lead battery, but it was not enough. So, in the meanwhile the technology was growing until 1881 with the help of another French engineer Camille Alphonse Faure who improved the capacity of cells. Therefore, this caused a massive battery engine production of industrial scale with a reliable and rechargeable energy source.
These were the first inventors, developments, and evolutions of the electric battery engine since nobody achieved the goal of putting the battery engine in a vehicle.

Nevertheless in 1867 people were celebrating the world exhibition of engines in Paris and Franz Kravogl, an engineer from Austria, presented his electric prototype car. The result was two electric wheels but not very reliable. However, this fact was the beginning of the evolution of the electric car. Therefore in 1884 the British inventor, Thomas Parker built the first electric car of production. Parker fed his car using a good size and a great capacity for rechargeable battery cells.

In American continent, exactly in EEUU by the hand of William Morrison de Des Moines developed one electric car for six passengers that raised the speed of 24 km/h.

Nevertheless, people were not interested in these types of electric engines. They were more vigorous with other engines like gasoline or steam.

However, it was a great era of technology and as we could see a few years later the interest of people in electric vehicles came back in 1900 and little by little his numbers of sales were growing until 2006. In fact, it was the boom year of the massive electric car production overall in EEUU and Europe by the hands of TESLA[7] and Toyota.

By the way, we have to be aware that in 1890 W.H.Patto had the idea to build a tram with hybrid power in series combining gas and electric engines.

In fact, the idea appeared because of the short autonomy of electric vehicles and the inconvenience of the weight.

Therefore, in 1896 the British H.J.Dowsing and L.Epstein patented the parallel hybridity. By the way, they turned the idea into one historical fact combining gasoline and electric engines in the Arnold Dinamo Vehicle and this was the first hybrid car in the world. So, the advantages were the combination of these engines, making the easy start of the gasoline engine and recharged batteries.

Therefore, we have made a video to explain the difference between plug-in hybrid electric and normal hybrid vehicle.

[7] Is a USA company that design, manufactures and sell electric vehicles, electric components and domestic batteries.

Figure 4 Plug-in electric hybrid vehicle & author of thesis (2021). Source: www.youtube.com/watch?v=EU742AtURnc&t=37s

(Here is the link to access to watch the video https://www.youtube.com/watch?v=EU742AtURnc&t=37s)

2.1.1.5 Hydrogen vehicle

The history of hydrogen vehicles seems very current. However, we must go back until 1966 for the reason that, General Motors [8]developed and researched for carrying out the world's first test of a hydrogen powered car, which name; Electrovan. In fact, it was a van because of the size of the vehicle allowed to install the hydrogen engine. By the way the test had two important inconvenient; the first one due to the expensive cost of making a car, in fact the issues, materials and the pieces of the battery were limited. Then the second one was the inefficient hydrogen stations.

[8] Opel's global partners automobile group

Nevertheless, the history of the hydrogen vehicle stopped in 1966, but it appeared again in 2012 with a lot of faster developments according to GM, Tesla, Honda, and Toyota. Due to its long autonomy as the gasoline and diesel engine besides because it did not pollute at all compared to other engines.

Therefore, the inconvenience of few hydrogen stations persists nowadays. Therefore, it costs plenty of money and time for governments even being a necessary fact to reduce the principal polluted sector in the world, the transport.

Nevertheless Toyota, Honda and Mercedes are betting on hydrogen vehicles, currently doing a great example to fight against the organisations and countries that never wanted to try to pollute less and signing important ecological deals such as Russia, China, India or EEUU.

Figure 5: First hydrogen vehicle (Electrovan) by GM (1966). Source: https://www.hydrogencarsnow.com/index.php/gm-electrovan/

2.1.2 TECHNOLOGICAL IMPROVEMENTS FOR THE MITIGATION OF GREENHOUSE GASES

2.1.2.1 Transport sector pollution

The pollution in the atmosphere is one of the biggest problems nowadays in our lives. Due to, is causing the worst problem of global warming. Therefore, the reduction of greenhouse gas emissions (CO_2) has become one of the most famous objectives currently in all over the world. Overall, for all Governments, Institutions and Organizations. As you know, it is the gas that pollutes more. However, there are others like sulphur dioxide, nitrogen dioxide or hydrogen peroxide, for that reason we are going to split first the pollutants and then describe them.

- Primary pollutants are the gases that have direct contact with the atmosphere such as CO_2, SO_2, NOX… They come from various sources like from traffic, industries, manufacturing processes etc. However, we cannot reduce it at all, despite some greenhouse gas emissions. For instance, including a filter in your car, or burners with few NOX emissions.
- Secondary pollutants are the gases that are made by physic-chemical processes around the atmosphere. Usually, these gases come from the primary pollutants. Therefore, the correct mitigation for these is reducing the greenhouse gas emissions of the primary pollutants exactly at the source. Due to the gas generation such as NO_2, HNO_3, H_2O_2, O_3 etc

We had to figure it out from where the greenhouse gas emissions came from to be aware that the world emits around 50 billion tonnes of carbon dioxide each year, due to 1,2 billion of vehicles. This was the first reason and the most important one. But there are plenty of others.

In fact, the CO_2 is the dioxide that pollutes more specially in transports and energy sectors. Nevertheless, we are going to focus on the pollution of the transport sector. Apart of being the highest second pollutant sector in general with 16,2% we must be aware that dividing into industry sections such as rail, shipping, or aviation, we could say that the road transportation or the automobile transportation is the industry section that has the highest percentage of greenhouse gas emissions from all industries with a number of 11,9%. In fact, this pollution is as we have mentioned at the beginning because of the burning of petrol and diesel. By the way we can split the emissions of sections, such as the 60% of road emissions coming from passenger travel and the remaining 40% from road freight instead of burning petrol and diesel to move the wheels. So, all automobile companies have created, since 2006 until nowadays, electric energy using batteries as engines, saving plenty of greenhouse gas emissions.

Then, the second industry sector that pollutes more exactly with 10,9% of pollution is the residential building. These emissions are correlated with the energy that is provided from the electricity companies and water companies such as Iberdrola and Facsa, both are in the Spanish country, but in some places are others. Therefore, these companies generate electricity for lighting, appliances, cooking, and heating at home. However, we can generate electricity by solar roofs or solar panels, for the reason that each of them can recharge one big electric battery cell that provides electricity from lightning, appliances and heating at home. But at least, the most important thing is that finally we reduce and save a lot of greenhouse gas emissions.

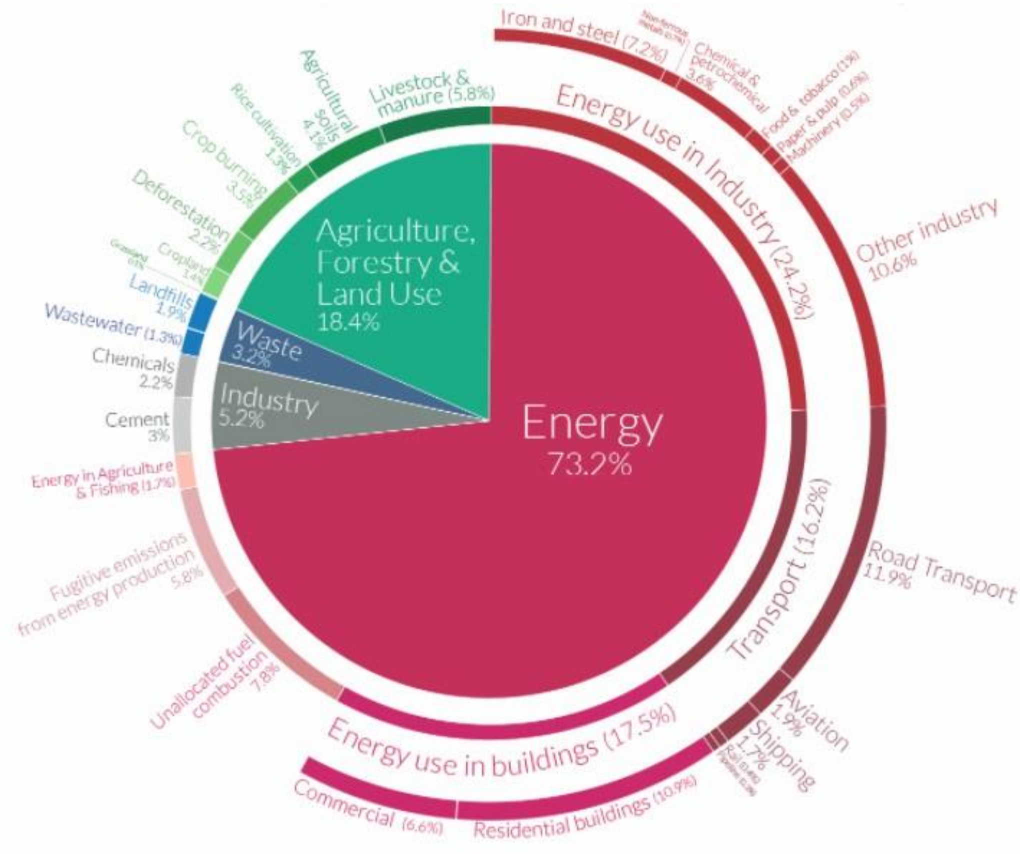


Figure 6: Global greenhouse gas emissions by sector (2016). Source: https://ourworldindata.org/emissions-by-sector

Therefore, as we have divided at the beginning. We must split two types of pollutants dioxide also that produce the transport sector.

- The first one as we all know is carbon dioxide because it is affecting global warming directly, due to the emissions that are immediately in contact with the atmosphere and causing greenhouse gases emissions.
- The others are more complex because they are harmful to human health such as nitrogen oxides (NOX), carbon monoxide CO) unburned hydrocarbons (HC), lead compounds, sulphur dioxide and solid particulates. Even these last ones have the worst consequences for people that are in big cities.

Nevertheless, nowadays these greenhouse gas emissions have decreased due to electric vehicles. Although they are still polluting carbon dioxide but in an indirect way to the atmosphere. Considering its manufacturing process of building electric batteries as a pollution generator. However, for sure less than gasoline, diesel, and hybrid emissions. For that reason, we are going to compare the greenhouse gas emissions between these types of vehicles that I show you in the table below.
However, there are a lot of inconveniences such as the size, weight, and revolutions per minute. Nevertheless, we have chosen plenty of vehicle models to be aware and to have an idea of how many emissions are emitted each model. Furthermore, some additional information to know about the median of carbon dioxide emissions in a gasoline vehicle is around 143 g/km. Therefore, compared to an electric vehicle the bad emissions are between 47% and 53% less than the gasoline vehicle. Then, compared to a hybrid vehicle the reduction of carbon dioxide emissions is 36% less. Besides, hybrid car pollution is 92 g/km of CO2. Finally, diesel vehicles pollute 120 g/km approximately 19% of Carbon dioxide emissions less than gasoline vehicles.

MODELO	CONSUMO (L/100KM)	EMISIÓN DE CO2 (G/KM)
SEAT Ibiza 1.0 75 CV Style 5v	4,9	112
Toyota Prius 125H Automático (e-CVT)	3,3	76
Audi A3 Cabrio 2.0 TFSI 190CV quattro S tronic	6,3	144
Peugeot 108 5 Puertas Active 1.0 VTi 68 CV ETG5	4,2	97
Citroën C3 Live BlueHDi 75 Manual 5v	3,5	92
Alfa Romeo Giulietta 1.6 Multijet 120 CV 6v	3,9	103
BMW X5 xDrive35i 306 CV Aut.	8,5	199
Volkswagen Passat Edition 1.4 TSI 125 CV 6v	5,3	123
Porsche Cayenne 3.0 V6 Diesel Tiptronic 262 CV	6,8	179
Land Rover Range Rover 4.4 SDV8 Autobiography 339 CV Aut.	8,4	219

Figure 7:Consume and emissions of co2 of some vehicle models. Source: https://www.motor.es/noticias/coche-electrico-contamina-201737700.html

Considering these databases from IDAE (Institute for energy saving and diversification) however, these capital letters are referring from the institute of Spain (Instituto para el Ahorro y la Diversificación de la Energía) So we can say that there are officials and easy to figure it out by people due to the information that are provided by the manufacturers.
Nevertheless, all people are aware about these databases in real life because these consumptions increase between 10 and 20% depending on the conditions of use. In fact, the real carbon dioxide emissions increase in all models, even until 20%. For that reason, this Seat Ibiza that has been made to fight against the bad emissions of diesel in 2015. Probably, are emitting 135g/km of carbon dioxide emissions, instead of 112% g/km officials.

2.1.2.1 How much does each engine pollute.

After looking for information about transport sector pollution on the road, we have realised that numbers of pollution can change in vehicles. Due to the size and weight of models, even because of how new the models are and how clean they are. Furthermore, we can say that depending on the state of the asphalt or pavement road conditions, one vehicle can pollute more or less. Therefore, we have checked it and exist plenty of sources to determine exactly the emissions that produce one specific vehicle during his journey.
Nevertheless, we are trying to compare the four engines in their total characteristics that we have analysed during the evolution of the vehicle industry, such as the autonomy, the cost of fuel and how much a vehicle pollutes.
By the way, we should focus on the same models of each engine to be in an equal way without advantages and disadvantages. But we know that there are not exist one identical model for each engine. Therefore, we are going to approximate the kilograms of vehicles.
For that reason, we have chosen as a pure electric vehicle a Tesla Model 3 Standard Plus RWD whose cost is 49.980€ and has a 4.694mm of length, 1.443mm of height, 1.849mm of width and 1.726kg of weight. Furthermore, this car has an electric power of 306 hp (horsepower) with a maximum speed of 225km/h and its acceleration from 0 to 100km/h is 56 seconds. A part of that the Tesla Model 3 Standard has an autonomy of 419km. Number that increase a little bit during the time, although this model had plenty of technological improvements. Moreover, another characteristic is how much the charge cost.

Therefore, currently in a supercharger station to charge a Tesla Model 3 Standard with his 419km. In fact, the total cost is 16.00€, exactly is the cost to travel from the University Jaume I (Castellon) to Las rozas (Madrid)
So, in other words the cost of 1 kilowatt per hour is 0,14€ of charging and the Tesla Model 3 standard consumes 28kwh per 100km. Therefore 28 · 0,14 = 3,99€/100km now we should multiply 3,99 · 4 = 16.00€ approximately. Furthermore, on the road a Tesla Model 3 Standard does not pollute any emissions of carbon dioxide or even bad health emissions such as nitrogen dioxide (NOX) if it is charge by renewable energy. To sum up, we could say that the electric vehicle has a short autonomy 419km and the charge is cheaper but slower. Therefore, you could spend 4 hours in your house charging or 30 min in superchargers[9], even though this is slower than the intern combustion engines.

Figure 8: Tesla Model 3 Standard Plus RWD. Source: https://www.km77.com/coches/tesla/model-3/2018/sedan/estandar/model-3-traccion-trasera-autonomia-estandar-plus/datos

Also, we can include the Hydrogen vehicle with the same characteristics as the Tesla Model 3 Standard such as Toyota Mirai Cell Fuel Hydrogen (FC) with 1850kg of weight, something more than the electric vehicle but pretty much the same in all his numbers. Besides, the vehicle emits zero emissions of carbon dioxide in all his processes and even in his rolling. Also, it has a long autonomy, and the time of the charge is faster like the intern combustion engines, exactly 5 minutes.

[9] Electric stations, where electric vehicles can stay between 30 min or 4 hours charging.

Figure 9:Toyota Mirai Cell Fuel Hydrogen (CFH). Source: https://www.km77.com/coches/toyota/mirai/2015/4-puertas/estandar/mirai-2015/imagenes

A plug-in hybrid electric vehicle (PHEV) with similar conditions could be Toyota Camry 220H Advance whose cost rose 38.450€, 10.000€ less than the electric vehicle. Furthermore, it has a maximum speed of 180km/h, therefore is slower than the electric, also it has a length of 4.605mm, a width of 1,845mm, a height of 1.675 and a weight of 1.670kg a little bit less heavy than the Tesla Model 3 standard. Besides, it combines two autonomies 1.146 (gasoline) and 50km (electric). A part of the charge time in superchargers is 30 min but at home the duration is 4 hours, and the cost is 0,15€ per kilowatt hour. Therefore, the Toyota Camry plug-in Hybrid electric vehicle 2020H Advance has a power of 152hp in terms of gasoline engine and 112kwh in terms of electric engine. So, the cost of 1 kilowatt per hour is 0,15€ in Spain as we have said, therefore if we multiply 112kwh per 0,15€ would be 16,8€. Furthermore, the median consume is 2 litres per 100km.

Internal combustion autonomy

2L ———— 100km

¿X? ———— 1146km

2 X 1146 / 100 = 22,92L X 1,304€/L = 29,79€

Equation 1: cos of refuelling the inter combustion of a PHEV.

Electric autonomy

0,15€/kwh ———— 1kwh

¿X? ———— 112kwh

0,15 X 112 / 1 = 16,8€

Equation 2: Cost of refuelling the electric part of a PHEV.

In addition, a plug-in hybrid electric vehicle as Toyota Camry 220H Advance with 1.670kg of weight pollutes 35 grams of carbon dioxide per 1 kilometre. So, if we have based the quantity of pollution according to the example that we talked that was the journey from the University of Jaume I (castellon) to Las rozas (Madrid) will be 35 · 418km = 14.630 grams of carbon dioxide will pollute this plug-in hybrid electric vehicle in Spain.
By the way I said Spain because depending on the electric energy supplied by each country it can cost and pollute.

Figure 10: Toyota Camry 220H Advance.
Source: https://www.km77.com/coches/toyota/camry/2019/estandar/advance/camry-220h-advance/datos

On the other hand, a normal hybrid in this case we have chosen a BMW 520d berlina with similar autonomy, length, height, compared to the plug-in electric hybrid vehicle (Toyota Camry 220H Advance) and has a weight of approximately 1.670kg.
By the way, the first advantage is that it can spend less time refuelling, because refuelling a normal hybrid vehicle is the same as refuelling an internal combustion vehicle such as gasoline or diesel. Therefore, the cost of refuelling his 950km of gasoline autonomy would be taking the reference in Spain of the cost per 1 litre of gasoline that is 1,30€ and taking the median consume of the vehicle per 100km which is 5,3L.
Therefore, we will calculate a rule of three to know how much cost refuelling the entire container of a normal hybrid vehicle.

5,3L ——— 100km

XL ——— 950km

5,3 X 950 / 100 = 50,35L X 1,30€/L = 65,455€

Equation 3: Total cost of refuelling a normal hybrid (1700kg)

Nevertheless, a normal hybrid vehicle has a combination of gasoline and electric engine. Therefore, this electric engine helps to save autonomy and combustion for the car. Since when the vehicle is stopped and when it is accelerating for the first time. Then it changed to a normal gasoline vehicle.

So, this is the principal reason why these types of vehicles have the stick of ECO vehicles and not the stick of 0% emissions, therefore this is an important disadvantage with respect to the plug-in hybrid electric vehicle.

Moreover, talking about carbon dioxide emissions per kilometre this vehicle pollutes exactly 119kg/CO2 per kilometre. Therefore, if we use our example from the University of Jaume I to Las Rozas with 418km. We will know how much a normal hybrid vehicle pollute. So, if we multiply the km of the journey per the grams of CO2 that pollutes the car, we will achieve the result, therefore 119 · 418 = 49.742 grams of carbon dioxide, however we must be aware that is not an exact number due to, the help of its small battery. Therefore, could be between 35.000 and 45.000 grams of co2.

Figure 11: BMW 520d Berlina. Source: https://www.km77.com/coches/bmw/serie-5/2017/berlina/estandar/520d-berlina3/datos

On the other hand, the diesel vehicle with similar conditions and characteristics that we have chosen is a Volkswagen Tiguan 2.0 TDI 110kw (150hp). This diesel vehicle has a cost of 27.700€ and with this price we could say that is the cheapest one. However, it has a maximum speed of 204km/h pretty much the same as the others. Also, we could confirm that it has similar length 4.486mm, wide 1.839mm, high 1.654mm and similar weight 1.677kg. Furthermore, the car has an acceleration from 0 to 100km/h of 9,5 seconds, due to his power of 150hp. Moreover, to be exact the vehicle has between 3.500 and 4.000 revolutions per minute. Besides, the Volkswagen Tiguan 2.0 TDI 110kw (150hp) has a consumption of 4,7L/100km. So, if the autonomy of the vehicle is 1.059km, the total consume will be 4,7 · 10,59 = 49,773L therefore if the price per 1 litre of diesel today (29/03/2021) is 1,184€/L the cost of refuelling the diesel container will be 49,773 x 1,184 = 58,93€

4,7L ——— 100km

¿X? ——— 1.059km

4,7 X 1.059 / 100 = 49,773L X 1,184€/L = 58,93€

Equation 4: Total cost of refuelling a diesel vehicle (1700kg)

Nevertheless, the impact of carbon dioxide in the atmosphere is 123 grams of CO2 per Kilometre is a lot. But diesel vehicles have polluted even more in nitrogen oxides, which is harmful for the health of people, with a number per kilometre of 165 grams of NOX.
Moreover, in terms of carbon dioxide emissions and sticking to our example from Castellon to Madrid (418km) a diesel with 1677kg pollute exactly 123 · 418 = 51.474 grams of CO2 in this total journey.

Figure 12: Volkswagen Tiguan 2.0 TDI 110kw (150hp).
Source: https://www.km77.com/coches/volkswagen/tiguan/2016/estandar/edition/tiguan-2016/datos

The last but not at least, we have analysed the gasoline vehicle with similar qualities. In this case we have chosen a BMW x4 drive 20I as a reference to compare it with a Tesla model 3 Standard with 1700kg as we did with the diesel, plug-in hybrid electric vehicle, normal hybrid vehicle and the hydrogen vehicle. Therefore, this diesel car has similar skills and characteristics such as the length with 4.752mm, the width with 1.918mm, the weight with 1.621mm and the weight 1795kg. However, the price of the BMW x4 drive 20I is a little bit more expensive than the others with a cost of 53.000€. Furthermore, it has a maximum speed of 214km/h and his acceleration from 0 to 100km/h is in 8,3 seconds. Besides his autonomy is 915km due to his media consumption of 7,1L/100km. Therefore, if the cost of 1 litre of gasoline today (29/03/2021) is 1,304€ the cost of refuelling the entire container will be: 915km per 7,1L/100km is equal to 6.496,5 then divide this amount by 100km and the result is 64,96L/915km finally multiply 64,96L per 1,304€/1L of gasoline and the result would be 84,714€

7,1L ——— 100km

¿X? ——— 915km

7,1 X 915 / 100 = 64,96L X 1,304€/L = 84,71€

Equation 5: Total cost of refuelling a gasoline vehicle (1700kg)

On the other hand, we must be aware about how much a vehicle that has more than 320 years in our roads pollutes. Therefore, this vehicle specially pollutes 163 grams of CO2 per 1km. So according to our example from the University Jaume I to Las rozas (418km) we can calculate that in this journey this vehicle could pollute 163 · 418 = 68.134 grams of carbon dioxide.

Figure 13: a BMW x4 drive 20I. Source: https://www.km77.com/coches/bmw/x4/2018/estandar/estandar/x4-xdrive20i/datos

2.1.2.2 Internal combustion manufacturing process pollution

All people must be aware that a part of carbon dioxide emissions carried out by vehicles, also exist the pollution of the manufacturing process, exactly in how to subtract the crude and how it turns into oil. This refers to an internal combustion vehicle as diesel or gasoline. Nevertheless, there is another bad part of how to subtract the lithium and how this material turns into a battery cell combined with cobalt.

In this case we are referring to electric vehicles or plug-in hybrid vehicles (PHV). That combines the bad of both parts but not with the same intensity of pollution as a total internal combustion or a normal hybrid vehicle.

Nevertheless, there is no pollution in the manufacturing process to produce containers of hydrogen fuel cells. It is not the same cells with lithium as we have seen with electric vehicles.

However, we should know how and how much we pollute directly or indirectly to the atmosphere. Therefore, all began when human people preferred vehicles powered by internal combustion engines instead of steam or battery cells.

According to the first step of the Internal combustion vehicle manufacturing process is: subtracting crude oil that is in 1800m underground or also it can be subtracting under the seabed. Therefore, exist suckers rod pumps [10]that work with an electricity network energy in the underground but with diesel or gasoline engines in offshore platforms. This last energy pollutes a lot because it is working plenty of hours during the day. So, this sucker rod pump needs exactly 332kwh per day or 9.960kwh per month.

An important fact is that in EEUU there are 435.000 oil wells that use sucker rod pumps, and they have a consumption of 4.300-gigawatt hour per month.

On the other hand, the first process in deep waters is subtracting with oil platforms crude oil and transporting it to refineries. Furthermore, these refineries where the crude is turned into oil, require a high temperature to burn the crude oil. Besides they achieved it with an electricity grid energy or internal combustion engine. An important fact is that a sucker rod pump on the high seas consumes 20 or 30 tons of diesel per day.

Therefore, imagine a Ford Fiesta vehicle with a diesel combustion engine which has 1.200kg. Well, suppose that this type of car makes one trip per day of 60km. According to my experience it is a normal trip to go and come back from my town La Vall D'uixo to my University Jaume I of Castellon.

So, the consumption is 5 litres of diesel and during the journey polluted 90 grams of CO2 per kilometre. Therefore, the pollution per day is 90gco2k/km · 60km = 5.400 grams of CO2. So according to the consumption of a sucker rod pump per day we could calculate the pollution of it that moves a dynamic plunger per day by an internal combustion diesel engine.

As we expected is an autogenous due to if we turn into the 25 tons of diesel, that consume a sucker rod pump per day to litres. So, we will obtain with a rule of three and knowing that 1 litre of diesel is 0,85 kilograms that.

$$1L \text{ ——— } 0{,}85kg$$

$$¿X? \text{ ——— } 25.000kg$$

$$1 \text{ X } 25.000 / 0{,}85 = 29.411{,}76L$$

Aquation 6: Total kg per day that consume a sucker road pump.

[10] It is a tool for extracting crude oil from the ground.

So, the journey is moving the dynamic plunger which weights around 300kg, up and down stroke of 5,00 metres. So, with a rule of three we can calculate how much a sucker rod pump pollute every time that goes up and down (0,005km · 22,5gco2/km / 1km = 0,1125 grams of CO2). The number of 22,5 is the grams of co2 per 1 kilometre that a dynamic plunger of 300kg pollute. Consequently (300kg x 90gco2 / 1200kg = 22,5 gco2/km)

1km ——— 22,5gco2/km

0,005km ——— ¿X?

$$0{,}005 \times 22{,}5 / 1 = 0{,}1125\text{gco2}$$

Equation 7: How much a sucker road pump pollutes during its journey going up and down (0,005km)

1200kg ——— 90gco2

300kg ——— ¿X?

$$300 \times 90 / 1200 = 22{,}5\text{gco2}$$

Equation 8: How much a sucker road pump pollutes according to its weight.

Therefore, if in 1 minute the sucker rod pump move its dynamic plunger 65 times, we can calculate the distance and the pollution in 1 minute 0,005km · 65 = 0,325km multiplied by 22,5g/co2 per km = 7,31gCO2 this number is with a weight reference of 300kg that is the dynamic plunger. By the way, the number 90 is the pollution of a diesel car of 1200kg.

So, in a day will be 93.600 times (24h x 3.900times of 1h = 93.600 times of 24h) that it goes up and down therefore we should multiply this by the km of 1 time 93.600 · 0,005 = 468km and then by 22,5 and we will obtain a pollution of 10.530 grams of CO2 per day the same as diesel vehicles with a journey of 60km per day.

One important fact that we should say is that, in the world there are 1.470 oil wells in deep waters generating 6.191.640 grams of CO2 per day.

A part of subtracting the crude oil in oil wells and oil platforms, we must be aware that the next step of the manufacturing process is to transport the crude oil with boats and trucks to refineries. This step also causes pollution due to transport powered by diesel combustion. Even they use the heaviest diesel because there are limited rules of transport pollution in the sea. Furthermore, catastrophes caused by these types of transports and failures of engine oil platforms are harmful for wildlife and the environment. The catastrophes are oil spills in the ocean and oil platforms explosions and burnings.

Also, instead of transporting the crude in diesel ships or diesel trucks, we can transport the crude by pipelines. These ducts are regenerated by electric grid energy.

By the way, one important fact is that in the maritime transport its pollution is 1.000.000.000 tons of carbon dioxide per year and 10% of that is contributing to the transport.

Due to these ships that pollute so much, there are some countries that do not allow work near its coastal area. Finally, they must be towed by boats, to transport the barrels of crude to the refineries,

The process of oil refining requires plenty of energy. Therefore, the manufacturing of oil processes pollution even more. Due to burning crude oil until 420 degrees Celsius.

An important fact is that they are refining by electric grid power and internal combustion energy and this causes pollution also.

Then the next step, after the crude oil refining, is to deliver it by tanker truck also powered by an internal combustion engine until arriving at petrol stations there are oil tanks refuelled by these tanker trucks of oil crude refining to finally give oil combustion to every vehicle in the world.

Nevertheless, we must be aware about building an internal combustion vehicle. In this case building the parts of a gasoline or diesel car will be less polluting than building an electric vehicle.

Even it could be 70% less polluting because the problem as we have analysed is the way of how to subtract the combustion but not the manufacturing process of building the vehicle with all the parts with its interior and bodywork, overall, in building the lead battery.

Consequently, is because the engine of the combustion car is made of strong metals such as steel and cast aluminium. For that reason, achieving all these metals pollutes a lot. But less than an electric vehicle, obviously with the same size and weight.

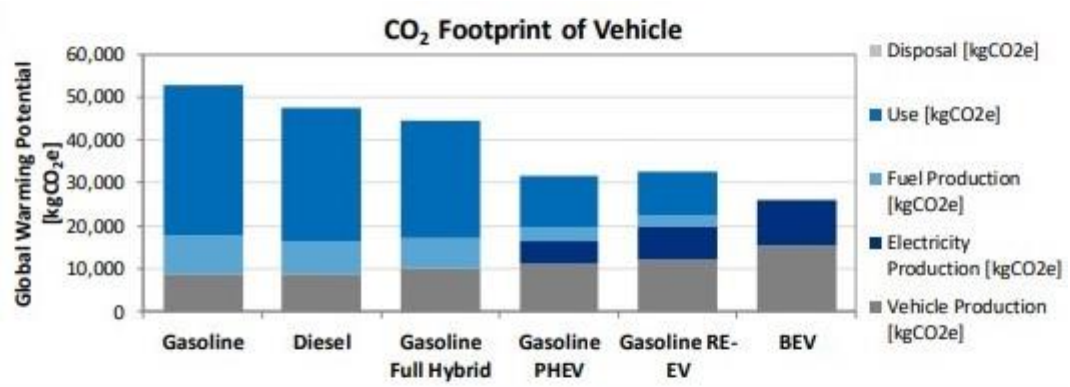


Figure 14: Lifecycle of vehicle pollution (150.000km).
Source: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

2.1.2.3 Electric manufacturing processes pollution

We have mentioned at the beginning that an electric vehicle cannot pollute the road, and this is not 100% true. We must be aware of the energy of a battery, exactly If a battery of an electric vehicle is recharged by coal, oil, or nuclear energy. This will have bad consequences of polluting directly to the atmosphere emitting carbon dioxide emissions during its journey.

However, if the energy batteries are recharged by renewable energy sources such as solar, wind, biomass, or hydroelectric energy, we can say that the electric vehicle will not pollute anymore on the road.

So, depends on countries and their power plants because the process is the same as recharging a computer in your house. If the power plant is recharged by clean energy your computer will not pollute. However, if your country uses polluting energy in its power plants your computer will pollute.

Nevertheless, even an electric car recharged in whatever country will pollute less than a gasoline or diesel combustion vehicle in general. For instance, in occidental Europe countries is 500 grams of carbon dioxide per kwh and obviously that in this case an electric car will pollute less but if we manufactured in China exactly in Shanghai where the first energy source is coal with 80.4%, we can see that even like this, an electric car will pollute less than an internal combustion.

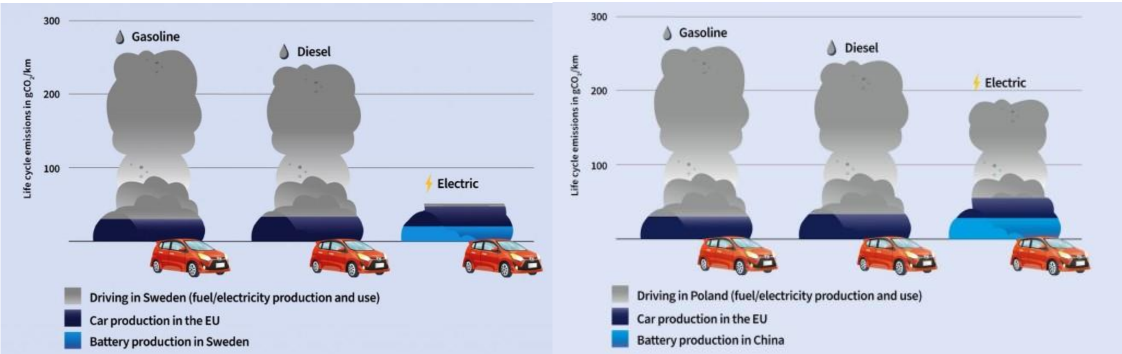


Figure 15: Lifecycle of electric vehicle manufactured and drived in EU and Lifecycle of electric vehicle manufactured in China and drived in EU.
Source:
https://www.transportenvironment.org/sites/te/files/downloads/T%26E%E2%80%99s%20EV%20life%20cycle%20analysis%20LCA.pdf

However, we are focusing on the electric manufacturing process pollution of electric vehicle. The simple fact of building is polluting between 15 and 20 tons of CO2, depending on the models due to its size and weight can change the quantity of emissions.

In fact, it pollutes a little bit more since the electric engine is made of strong metals such as steel and cast aluminium like an internal combustion engine.

But this is not the important fact due to exist other metals savings in cells of an electric battery, whose name is Ions of lithium, anode, that is a circuit of metal oxide and cathode, that it could be graphite or maybe the new chemical element that is silicon, moreover there are a liquid whose name is electro lithium that splitting the anode and cathode. Both combined, anode and cathode, show that the battery can work positively, consuming and boosting a vehicle or negatively recharging the battery, when the driver comes to brake the car.

These metals do not pollute anymore when it comes to work if they are recharged by a renewable energy source. Otherwise during its manufacturing process of subtracting the lithium, of course these metals pollute directly to the atmosphere. Therefore, an electric vehicle can pollute more during its manufacturing process. Although it depends on size and weights of the battery cells you want to install for the vehicle, because it can obtain lithium inside the battery and it can pollute to the environment.

An important fact is that a Tesla model 3 Standard with a weight of 1700kg generates 65 kilograms of lithium in his battery cells.

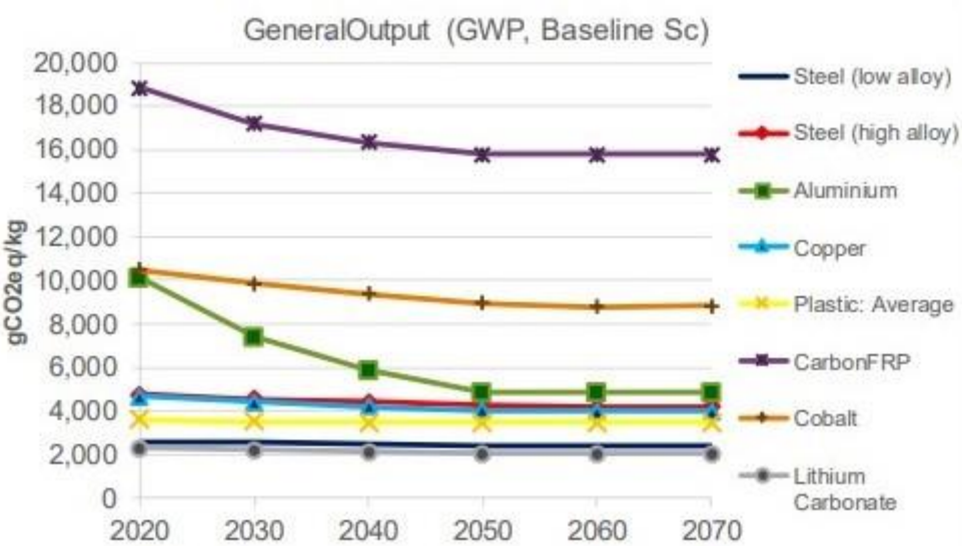


Figure 16: Battery metals for manufacturing an electric vehicle. Source:
https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

Moreover, to know about the production of an electric car, we must be aware that an electric vehicle requires more energy to manufacture it. Due to the great capacity of lithium batteries that they have under the body.

So, it is evidence that one company spends more energy to build one electric, because they do not share components as an internal combustion vehicle does. For instance, Porsche, Volvo, Volkswagen, and Jaguar have the same platform to share these components and reduce costs of manufacturing, cost of energy and therefore they pollute less in the manufacturing process.

Nevertheless, little by little we could say that the electric vehicle will cover most of the manufacturing process in industries and will pollute less. Because also electric companies can share components by making deals between electric brands that work with the same materials and platforms.

But currently, we must be aware that an electric vehicle and plug-in hybrid electric vehicles are the principal cars that pollute more in the manufacturing process between 15kg of CO2 and 20kg of CO2. Then exist the normal hybrid and the internal combustion vehicle that pollutes less between 10kg of carbon dioxide and 15kg of carbon dioxide. However, we have not included the subtracting of lithium.

By the way the manufacturing process of an electric vehicle is subtracting the reactive metal (Lithium) that is necessary for the use of every battery in the world. Therefore, this process pollutes in two parts. The first one is because of the environment, including deforestation and the second one is because it pollutes in direct contact with the atmosphere.

Furthermore, this reactive metal is very well cared for because it reacts in a bad way with the oxygen and the water. However, it is transported to big factories and laboratories to manufacture electric battery cells and subsequently all the components of an electric vehicle.

The good news is that instead of an internal combustion that lost all the combustion. The components of batteries cell are recycling.

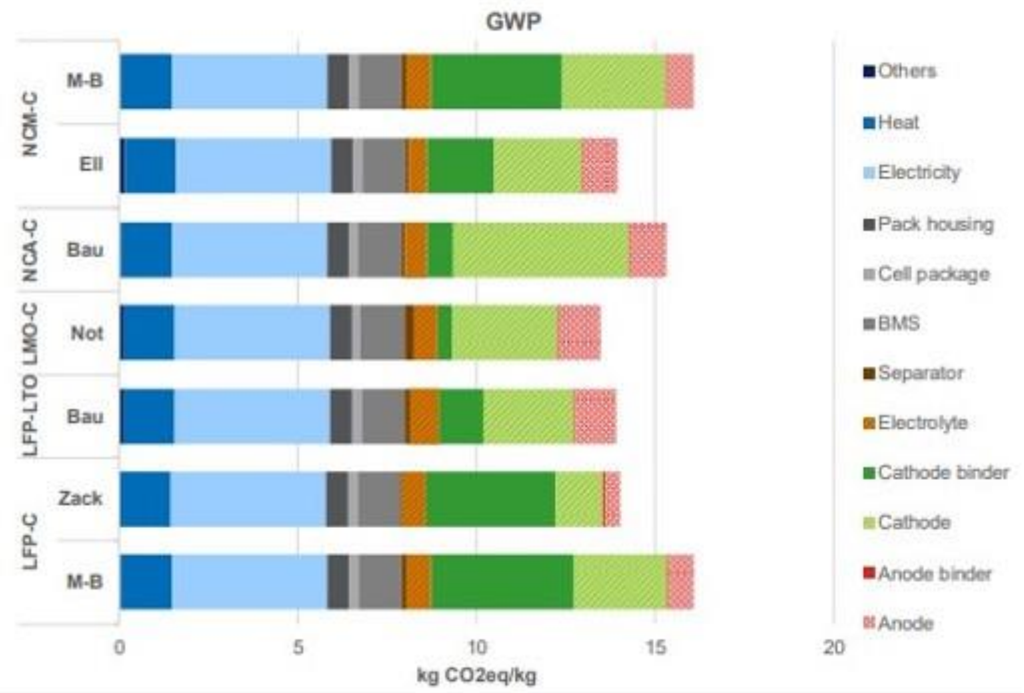


Figure 17: Components of a lithium battery. Source:
https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

According to Ricardo's consulting Life Cycle Assessment informs of CO2 emissions for a vehicle production by vehicle system and overall life cycle impact. We could say that gasoline and diesel vehicles are the most polluting cars in a 150.000km of life. Otherwise, an electric vehicle and a plug-in hybrid Electric Vehicle are the others that pollute less directly to the atmosphere. Due to the 70% of the combustion of gasoline or diesel vehicles expire and only the 30% is used for power. However, electric vehicles use 95% of the energy consumed by the battery. Overall depending on which country, the car is charged. It could pollute, so according to this information Ricardo's consulting is based on United Kingdom energy sources. Therefore, an electric vehicle in the UK can pollute 300 grams CO2 per kwh.

Otherwise, if we talk about the carbon dioxide emissions in vehicle production, we note that they are the internal combustion vehicles that emit less CO2 emissions to the atmosphere. Manufacturing an electric car costs a lot of energy as we have mentioned.

By the way another fact, depending on where the company is located, will also pollute depending on the energy sources of the country.

Consequently, the source of Ricardo's consulting is a great example to identify that manufacturing a battery is very difficult and expensive. That's the reason why an electric vehicle is in the top pollutants in the manufacturing process phase, however in general it turns into the lowest one.

3 THE GOVERNMENT'S INFLUENCE IN THE AUTOMOBILE INDUSTRY

3.1 CURRENTLY ANALYSES OF SITUATION

The automobile industry is going to support the best change in the era of the transport until today. Therefore, the governments and big companies must take measures and protect their profits, otherwise they will not be able to avoid many losses.

According to big markets such as the United States of America, European Union, and China, we must be aware that between them there is a deal to not cross the line. For instance, imagine that China, the country in which most of the batteries are manufactured, goes to the European Union to sell its batteries, and install its charging stations. For that reason, the government of the EU has the power to avoid these types of actions.

Moreover, an oligopoly market exists between companies of each government such as Ford and Tesla from the USA, Toyota from China and BMW and Volkswagen from the European Union. These are the big companies that have relevant weights inside the government. Even though these companies have a golden share, this means that it is impossible to buy Volkswagen because Battenberg has the special action to control the power of the German companies.

Therefore, this is one of the biggest deals in the world to not be attacked. due to the business of the automobile industry is not like the photography business or beer business.

So, the next policies and deals are the national government of countries therefore will depend on energy sources and charging stations. Moreover, we are going to analyse them in terms of the automobile industry in Norway, Spain and two states of the USA, that are Wyoming and California. This last one has similar energy sources as Spain but a different percentage of habitants with electric cars and that is the reason why we decided to investigate and compare California with Spain.

3.1.1 The government's influence in Norway

Everyone thinks that Norway is a role country model, in other words, is a country to follow. due to its amazing or radical change from internal combustion vehicles to electrics or plug-in hybrid electric vehicles.

However, it's not logical to compare it to other countries, because it is not a great example to represent the expansion of electric cars. Furthermore, Norway has plenty of quality of life in the world and has the highest per capita income. moreover, has the largest sovereign wealth fund on the planet.

At the beginning of the 20th century Norway was an exportation country of petrol and its government knew how to manage the economic resources. Such as selling oil and providing great social coverage to each citizen.

As we mentioned Norway is one of the richest countries. therefore, we have subtracted the media of each GDP and demography in the last five years. so, the result was that Norway has a median GDP of 475.895,6€ in 5.079.623 citizens.

Now focusing on the electric cars in Norway, first we must be aware that the prices of the cars before the arrival of the electric ones were very expensive compared to the other countries. Even in some cases the cars cost three times more than in Poland. By the way Poland has a median GDP of 497.899,7€ in 38.033.123 citizens. To sum up, Norway is 7,6 times richer than Poland therefore it has a high salary. Moreover, Norwegian awareness of car ownership is a top quality, in other words, it is not an essential good for living, such as, in Spain, therefore the good of having vehicles in Norway comes with taxes. Since 1900 the government of Norway has started to collect the first pollution taxes on vehicles therefore was the first country in Europe to introduce this fee. Apart from collecting the municipal taxes for having the vehicles outside or for driving on the roads. Also, the horsepower taxes and the tax of weight of the car. Consequently, having a car in Norway is almost very difficult to maintain, for instance having one Chevrolet Camaro, a sportive vehicle with gasoline engine and a big horsepower has a maintenance cost of 120.000$ of taxes per year. So less than its own price of 89.000$.

So how has Norway encouraged the development of electric cars? Giving money or giving support to the citizens?

No, the opposite, doing nothing, therefore if the citizens buy electric cars, they will save the tax of pollution and the horsepower. An electric vehicle, as we know, does not pollute anything on the road if it was rechargeable by renewable energy and its power is by kilometres per hour. by the way the only support of the government was deleting or cancelling the tax of weight. Furthermore, an electric vehicle weighs more than the internal combustion car and may was the reason why they deleted.

To sum up, the Norway citizens change their political tax that the government applied at the beginning of the 90 eras by themselves, buying electric cars.

Therefore, more than 50% of people buy plug-in hybrid electric vehicles and electric cars. Apart from now the government has changed its own vehicles tax policy, due to a plug-in hybrid vehicle can also pollute its road traffic. Therefore, this type of vehicle has specific taxes, in other words, Norway has a fiscal advantage compared to other countries. Even more, the electric cars in Norway compared with the same model as an internal combustion cost less.

Furthermore, the most important tax due to its highest cost is value added tax with 25%. So, the Norway fiscal government also deleted it. This means that Norway has a strong government which has a large capacity difference with other taxes and can afford to not collect the value added taxes of 25%. Apart from the vehicles tax cancelation has another advantage, the incentive for electric vehicles uses. Until 2017 many important things were supported for electric cars such as in the public vehicle parks recharging was free and on the road with superchargers. Overall, one important fact in Norway is that the country has plenty of lakes and there are many of them and it is mandatory to cross by ferry, so until 2017 was totally free using this support for electric vehicles. However not for the internal combustion since they had to pay a fee every time that they wanted to cross the lake.

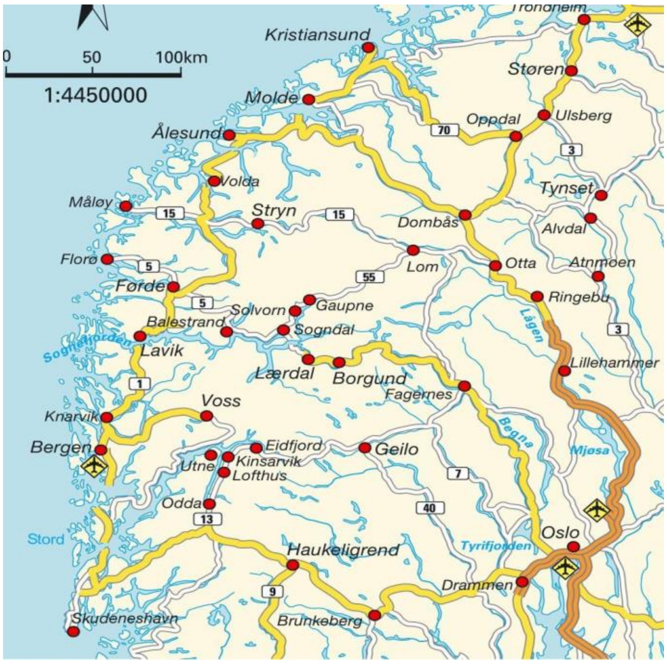


Figure 18: Norway road map. Source: https://www.ilovemaps.co.uk/products/norway-road-map

Moreover, the electric vehicles could drive on the bus lane or high-load lanes. Also, they did not have to pay anything when they had to suddenly pass the toll [11]on highways.

In contrast with all these advantages of the electric vehicle, we must be aware that the citizens of Norway have more houses than flats and this is a big important thing to change your car in your garage. Also, the roads of Norway compared to Germany or Spain are

[11] A government system installed in highways to control citizens and collect money of them.

pitiful. It has few roads because the majority roads are against direction and only allow driving until 90 km per hour. Therefore, electric vehicles adapt to these measures because of their few autonomy and rechargeability during their break. Finally, we should also say that Norway must take advantage of its big renewable energy sources. For that reason, is the pioneer when we talk about pollution.

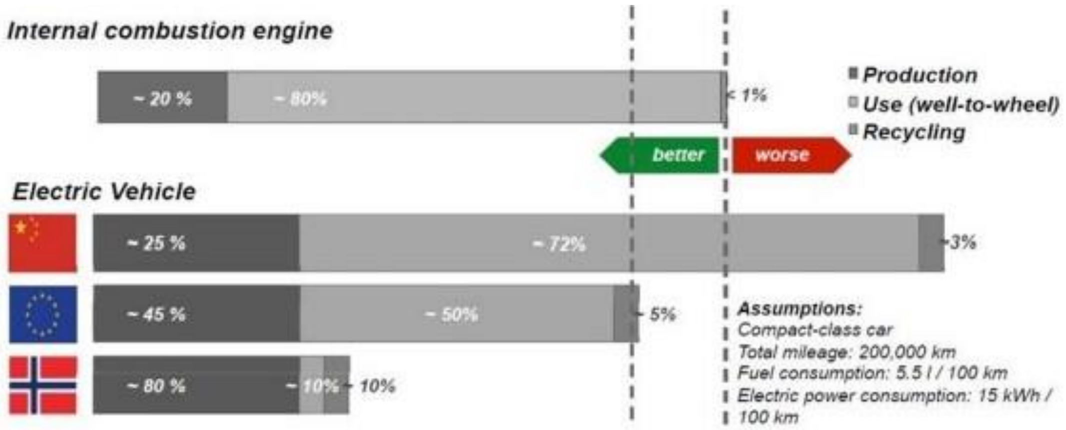


Figure 19: Manufacturing an electric vehicle in Norway comparing China and EU. Source: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

3.1.2 The hypothetical case in Spain

First, we must be aware that we are always talking about a hypothetical case where everyone is going to have an electric car in the future.

Therefore, the case of Spain is simple, due to the density of habitants is 92 ha/km2. If we must analyse it, we should say that Spain has 500.000 km2 of area. In sociological words we suppose that a country that has more area should have more habitants. But this assumption is wrong due to our data and compared to Italy we should know in a simple view that our country is divided.

In addition, the density of Italy is 200h/km2 because it has 60 million in a 300.000 km2 of area. So, in Europe there are only 33 areas that live more than 40.000 habitants per km2 according to the database of Eurostat. Therefore 10 are in France and 23 in Spain. However, this is an assumption that we have referred about the habitants per km2 where people are living currently. The case of Spain would be focusing on big cities. According to this formula that we have calculated previously.

$$\frac{\text{nº of habitants}}{\text{Area}} = \text{Population density}$$

Moreover, this formula has a phenomenon, and we must look at the Spain map because it shows us the distribution of our population density. Therefore, there are plenty of areas painted in white referring to the problem that we have mentioned at the beginning, the rural depopulation. In addition, all is focused on Madrid, Barcelona, Valencia, Sevilla, and Bilbao, in other words, all is focused on big cities and their metropolitan areas.

Figure 20: Population density of Spain. Source: https://en.wikipedia.org/wiki/Demographics_of_Spain

Nevertheless, all of this has consequences. First, if plenty of Spanish people are living in big cities and therefore, they have the major percentage in Europe of population density per km2 in urban cities is due to the huge buildings for living.

According to INE[12], 65% of people live in buildings and the rest 35% live in houses. So, there is no country in central Europe that has almost 65% of their population living in buildings.

According to Eurostat[13], France has a distribution of 30% of the people living in buildings and 70% in houses. Also, in United Kingdom that has more population density the numbers increase in houses (15% living in buildings and 85% in houses)

Therefore, the idea of installing solar panels and recharging electric cars in garages has no sense in the distribution of Spain, due to most of the population having buildings and without a garage. So, this idea is better to apply it to the United Kingdom or France. Otherwise in Spain studying the case it could affect us but not for the majority. So, we are going to see how the border between rich and poor increases. In addition, according

[12] Spanish National Institute of Statistics
[13] European Statistics Explained

to ASESGA[14], we have a mobile park of 78,9% of vehicles and only the 21,1% sleep in the garage.
One important fact is that Tesla had the best expansion of the electric car in California due to there being 93% of houses and 7% of flats in the region. Therefore, they have the possibility to install solar panels in their houses and recharge the electric cars. So, Elon Musk wants to replay this situation all over the world, but this case is not relevant for every country such as Spain.
Another important fact is that in Spain the 40% of registered vehicles are in the province of Madrid and Barcelona due to the phenomenal rural depopulation. For this reason, it is impossible to turn the California phenomenon into a Spanish country.
So, what will happen with Spain?
There are plenty of solutions, turn the old buildings into the new ones that sound almost impossible but could be.
Another would be sharing the garage to people that do not have them.
And finally, the fastest solution would be using rental electric vehicles by minutes or days, overall, in big cities.

3.1.3 The situation of USA and its energy sources

The USA is the role model country for everyone, however, exist a lot of states that are not as evolved as California or Washington. So, when we are talking about evolution, we must be aware that we are referring to the renewable energy source. Therefore, the pioneer state which has more than 80% of renewable energy is Washington. In addition, these states have plenty of houses as we mentioned, even in their metropolitan areas of San Jose, San Francisco, Los Angeles, or San Diego.
So, we have compared the fourth types of vehicles, using Washington state energy sources as a reference.

[14] Spanish Association of parking's and garage

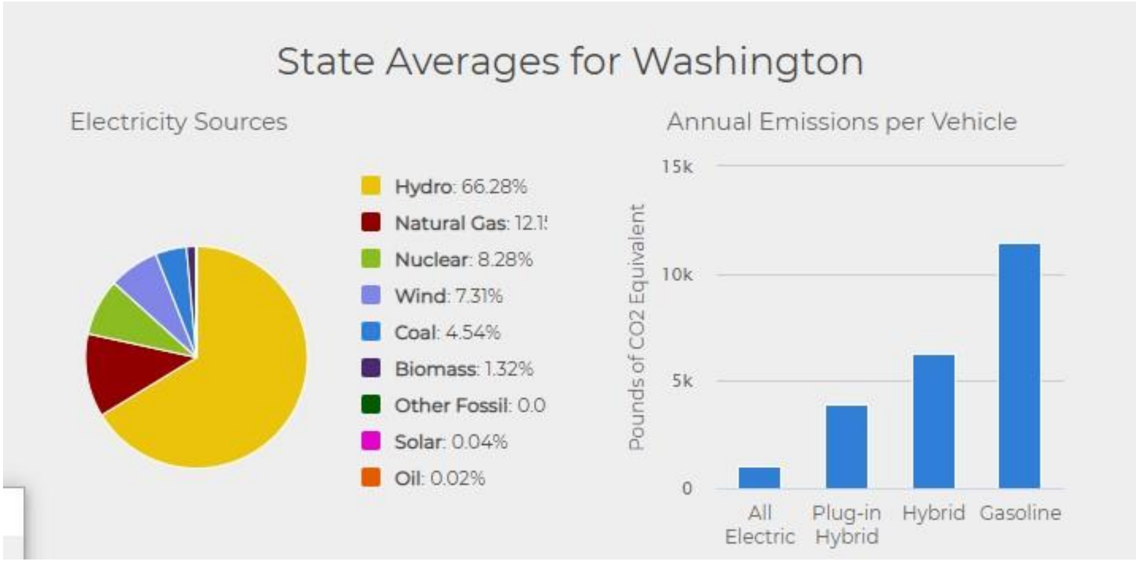


Figure 21: Washington energy sources that influence in the pollution of vehicles. Source: http://afdc.energy.gov/vehicles/electric_emissions.html

Otherwise, as we said there are other states that have problems with the renewable energy supplies, and this is the case of Wyoming that has 80,76% of coal in all its energy. Therefore, an electric vehicle will pollute the same as an internal combustion car during its road traffic in one year.

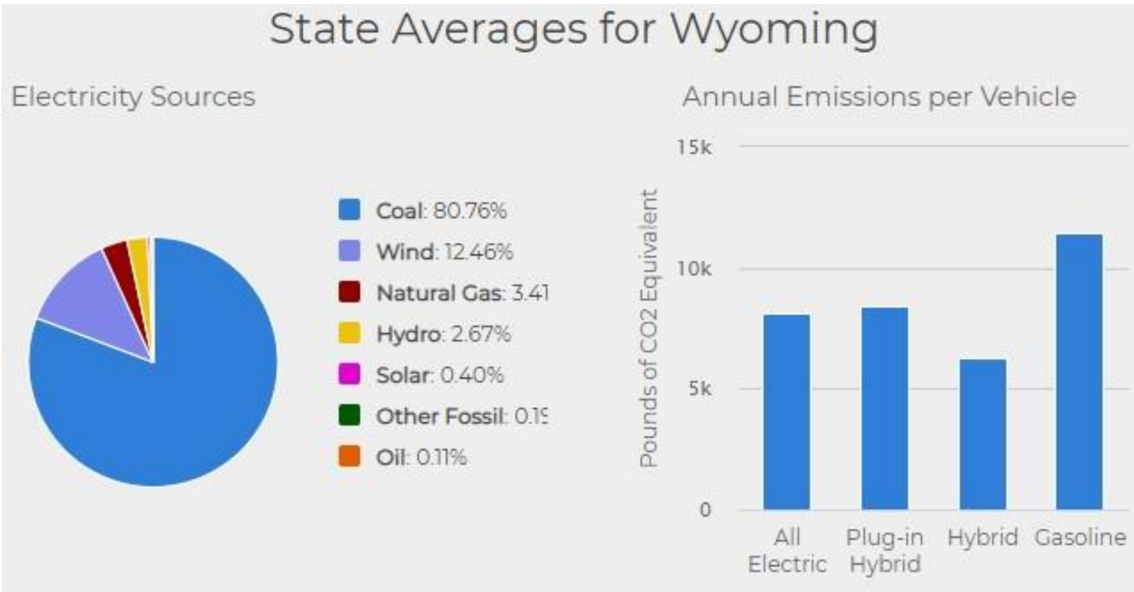


Figure 22: Wyoming energy sources that influence in the pollution of vehicles Source: https://afdc.energy.gov/vehicles/electric_emissions.html.

4 ECONOMETRIC MODEL

First for making the econometric model, we have made a survey with 20 people about the study of the new electric vehicle registered in Castellon province. The survey had 5 questions such as how important is the environment for you? How many times do you drive per month? How many kilometres do you do when you drive? Do you have a garage? And how much do you earn per year?

Consequently, the answers were between 0 and 10 in the same cases and others between 20km and 100km. nevertheless the data base of the dependent variable (new electric vehicles registered) was impossible to look for.

Therefore, we were looking for the same variable but in all around Spain. However, the survey as you remembered was in the province of Castellon and not from all around Spain so the econometric model could be totally wrong.

Finally, we have decided to look for new electric vehicles registered in the same countries of Europe and change the independent variables that explain the econometric model.

so, we looked on Eurostat, the European Statistic web page and we discovered many independent variables such as the house's price, expenditure energy, demography, environmental income taxes, the air pollution, the annual net earnings, and new petrol vehicles registered. This last one we supposed that in one year would change its database and could be the opposite of the new electric vehicles registered for that reason. Both variables could have relation in order to translate them in the model. However, the econometric model showed us another result, but we should say that our database begins in 2013 and ends in 2019. So, during this period we have also grown.

According to this example that we have spoken about, there were plenty of mistakes. Therefore, we have changed the variables: air pollution, expenditure energy for housing and gross domestic product, all of these had good R squared and the Durbin-Watson index. Moreover, they had good linear graphs in the scatter plot with the dependent variable. However, they also had multicollinearity.

So finally in order to complete an econometric model we have decided to exclude the variable Air Pollution and include only two independent variables: Gross Domestic Product and Expenditure Energy for housing.

Therefore, the first step to study the econometric model is: having a structure of the dataset in excel. So, our database is referring to panel data with stacked time series. Therefore, we have 7 numbers of time periods from 2013 to 2019 and 8 numbers of cross-section units, representing the selected countries from Spain to Romania.

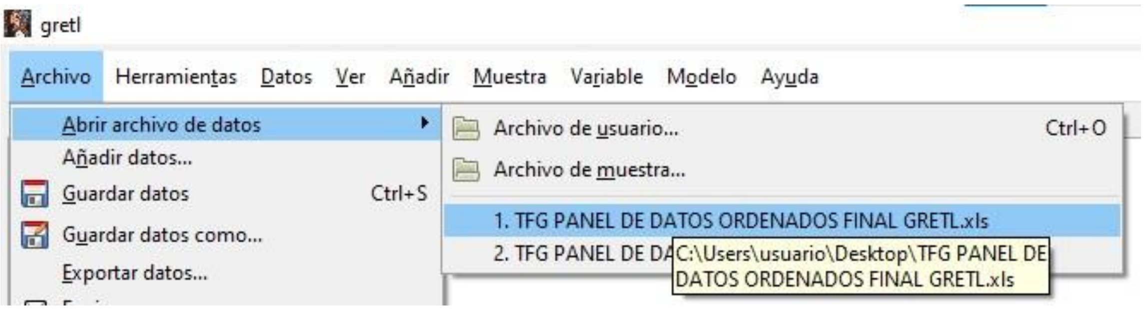


Figure 23: Econometric model (1 step)

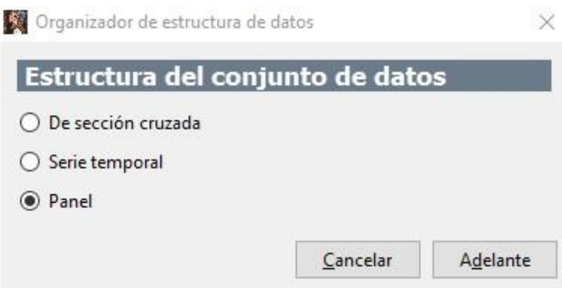


Figure 24: Econometric model (2 step)

Figure 25: Econometric model (3 step)

Figure 26: Econometric model (4 step)

Our econometric model of panel data includes a sample of economic actors or stakeholders such as individuals, companies, banks, cities, countries, etc. for exactly one type of period. For that reason, we could say that panel data combine both types of data temporal and structural dimension.

Therefore, the first objective that we must study with our panel data is knowing how to capture the collinearity, the heterogeneity, and the heteroscedasticity. Due to this assumption cannot be detected and studied by time series and cross-section.

The general specification of a regression model with panel data is:

$$Xit = ait + b1xit + b2xit + \ldots bkxkit + Uit$$

With i = 1…n and t = 1… r

Where (i) is referring to the unit of study (cross-section) and (t) is referring to dimension of time.

(a) It's the constant or vector of intercepts that is compound between 1 and n+t parameters.

(b) It is a vector of K parameters.

(Xit) is the observation at the moment t for K variables in other words the data that refers to the variable in the exact moment.

4.1- Normality

Nevertheless, we have deleted one country in our econometric model due to its influence between the other countries with the same independent variables. Therefore, this is the case of Norway, the country that we have decided to disappear, because its numbers were out of control such as 62.510 miles of tonnes of CO2 in sector pollution variable or 25.068 euros per year in Annual net earnings.

So, this was the great problem of our model previously due to if we want to compare one independent variable with another variable, at least dependent or independent variable with another variable. We would see that the scatter plot may would has problems. Due to it could be an uncorrelation graph, or low negative or low positive correlation graph. Therefore, we must analyse the database with and without Norway.

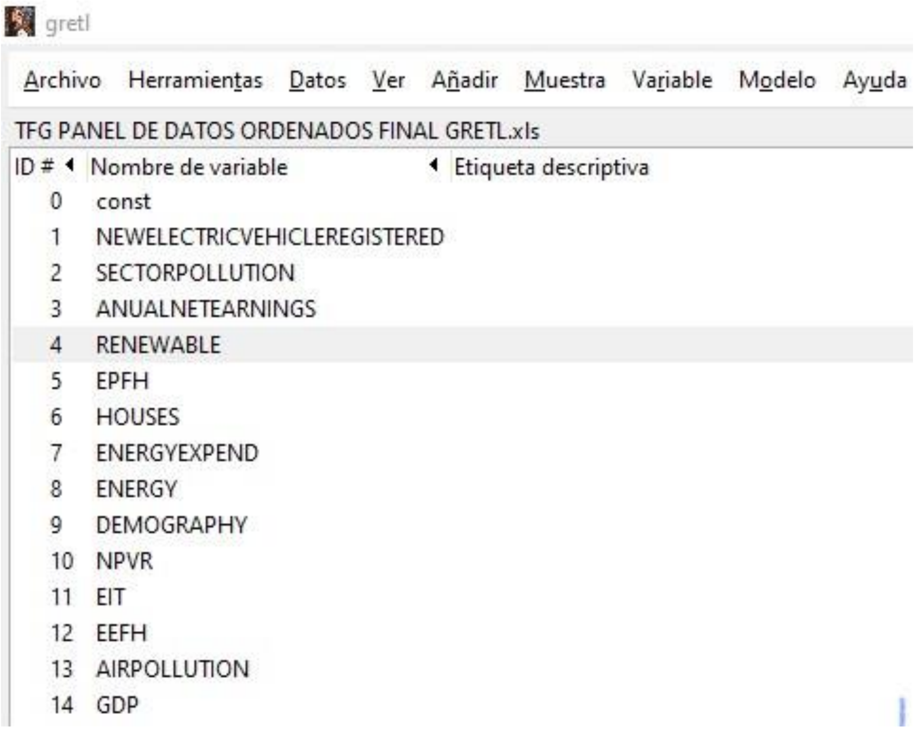


Figure 27: Econometric model (5 step)

Table 1: panel data base with Norway

COUNTRY	NEVR	SECTORP	EPFH	HOUS	ENERGY	EEFH	GDP
SPAIN 2019	14029	352208	0,0663	34%	134155	8894,4765	1244772
SPAIN 2018	11209	357364	0,0955	33%	137564	13137,362	1204241
SPAIN 2017	7175	342728	0,0879	34%	137451	12081,9429	1161867
SPAIN 2016	3414	352473	0,0898	34%	131746	11830,7908	1113840
SPAIN 2015	2634	340543	0,0907	34%	130297	11817,9379	1077590
SPAIN 2014	1181	337898	0,0891	35%	125967	11223,6597	1032158
SPAIN 2013	94	364061	0,0884	35%	127851	11302,0284	1020348
FRANCE 2019	42262	462798	0,0574	67%	253115	14528,801	2425708
FRANCE 2018	30945	480931	0,0567	68%	256613	14549,9571	2360687
FRANCE 2017	24910	475829	0,0544	68%	257333	13998,9152	2297242
FRANCE 2016	21758	474962	0,0553	68%	257145	14220,1185	2234129
FRANCE 2015	17269	470141	0,0556	67%	261797	14555,9132	2198432
FRANCE 2014	10567	501009	0,0557	66%	257699	14353,8343	2149765
FRANCE 2013	8781	500033	0,0539	66%	268184	14455,1176	2117189
GERMANY 2019	63281	888718	0,0698	44%	306973	21426,7154	3449050
GERMANY 2018	36062	923767	0,0689	42%	316743	21823,5927	3356410
GERMANY 2017	25056	935789	0,0693	41%	324280	22472,604	3259860
GERMANY 2016	11410	931044	0,0692	42%	322845	22340,874	3134740
GERMANY 2015	12363	927146	0,0714	42%	320515	22884,771	3026180
GERMANY 2014	8522	967357	0,0714	42%	318861	22766,6754	2927430
GERMANY 2013	6051	949425	0,0745	42%	333067	24813,4915	2811350
UNITED KIGNDO	16018	498745	0,0842	85%	184967	15574,2214	2526615
UNITED KIGNDO	15579	507693	0,0935	85%	188474	17622,319	2420897
UNITED KIGNDO	13727	516325	0,0891	84%	188732	16816,0212	2359789
UNITED KIGNDO	10544	541747	0,0763	85%	191122	14582,6086	2434119
UNITED KIGNDO	10063	558960	0,0672	85%	193599	13009,8528	2644716
UNITED KIGNDO	9726	598957	0,0687	85%	190352	13077,1824	2311080
UNITED KIGNDO	6873	612397	0,0741	84%	201320	14917,812	2096338
FINLAND 2019	1897	439263	0,0503	66%	158086	7951,7258	240261
FINLAND 2018	776	442575	0,0448	66%	159710	7155,008	233696
FINLAND 2017	502	446472	0,0454	66%	161815	7346,401	226301
FINLAND 2016	223	449083	0,0451	65%	156490	7057,699	217518
FINLAND 2015	243	435597	0,0466	65%	157629	7345,5114	211385
FINLAND 2014	183	456024	0,0454	65%	151758	6889,8132	206897
FINLAND 2013	50	491371	0,0446	65%	160570	7161,422	204321
NETHERLANDS 2	61547	200458	0,0677	77%	87880	5949,476	810247
NETHERLANDS 2	23985	205445	0,0597	77%	88641	5291,8677	773987
NETHERLANDS 2	7958	207217	0,0574	76%	90540	5196,996	738146
NETHERLANDS 2	3988	207351	0,0598	76%	89904	5376,2592	708337
NETHERLANDS 2	3193	198532	0,063	76%	88388	5568,444	690008
NETHERLANDS 2	2597	205848	0,0662	75%	87933	5821,1646	671560
NETHERLANDS 2	2381	206023	0,0679	75%	92239	6263,0281	660463
SWEDEN 2019	15795	10278887	0,0653	55%	15436	1007,9708	474550
SWEDEN 2018	7147	10175214	0,0653	55%	15545	1015,0885	470673
SWEDEN 2017	4359	10057698	0,0641	55%	15763	1010,4083	480025
SWEDEN 2016	2993	9923085	0,0624	55%	15452	964,2048	466266
SWEDEN 2015	2916	9799186	0,0596	55%	14833	884,0468	455494
SWEDEN 2014	1266	9696110	0,0614	54%	13374	821,1636	438833
SWEDEN 2013	452	9600379	0,0671	53%	14949	1003,0779	441850
NORWAY 2019	66481	53769	0,0656	81%	29098	1908,8288	362242
NORWAY 2018	57990	54063	0,0659	81%	31574	2080,7266	370294
NORWAY 2017	41583	55054	0,0575	81%	30748	1768,01	353316
NORWAY 2016	28965	56019	0,0543	80%	29481	1600,8183	333471
NORWAY 2015	21997	55706	0,0531	79%	30672	1628,6832	347632
NORWAY 2014	21153	55648	0,0588	78%	29991	1763,4708	375947
NORWAY 2013	9970	55637	0,0671	78%	34328	2303,4088	393408
ROMANIA 2019	8973	116531	0,0593	62%	33141	1965,2613	222997
ROMANIA 2018	4449	117890	0,0554	63%	33610	1861,994	204496
ROMANIA 2017	2321	115166	0,0528	62%	33562	1772,0736	187772
ROMANIA 2016	1169	117142	0,0509	64%	31826	1619,9434	170063
ROMANIA 2015	479	116839	0,0508	66%	31917	1621,3836	160149
ROMANIA 2014	254	116501	0,0531	67%	31665	1681,4115	150708
ROMANIA 2013	247	126041	0,0547	67%	31909	1745,4223	143690

Table 2: Panel data base without Norway

COUNT	NEW EL	SECTOR	EPFH	HOUSE'	ENERGY
SPAIN 2019	14029	352208	0,0663	34%	134155
SPAIN 2018	11209	357364	0,0955	33%	137564
SPAIN 2017	7175	342728	0,0879	34%	137451
SPAIN 2016	3414	352473	0,0898	34%	131746
SPAIN 2015	2634	340543	0,0907	34%	130297
SPAIN 2014	1181	337898	0,0891	35%	125967
SPAIN 2013	94	364061	0,0884	35%	127851
FRANCE 2019	42262	462798	0,0574	67%	253115
FRANCE 2018	30945	480931	0,0567	68%	256613
FRANCE 2017	24910	475829	0,0544	68%	257333
FRANCE 2016	21758	474962	0,0553	68%	257145
FRANCE 2015	17269	470141	0,0556	67%	261797
FRANCE 2014	10567	501009	0,0557	66%	257699
FRANCE 2013	8781	500033	0,0539	66%	268184
GERMANY 20	63281	888718	0,0698	44%	306973
GERMANY 20	36062	923767	0,0689	42%	316743
GERMANY 20	25056	935789	0,0693	41%	324280
GERMANY 20	11410	931044	0,0692	42%	322845
GERMANY 20	12363	927146	0,0714	42%	320515
GERMANY 20	8522	967357	0,0714	42%	318861
GERMANY 20	6051	949425	0,0745	42%	333067
UNITED KING	16018	498745	0,0842	85%	184967
UNITED KING	15579	507693	0,0935	85%	188474
UNITED KING	13727	516325	0,0891	84%	188732
UNITED KING	10544	541747	0,0763	85%	191122
UNITED KING	10063	558960	0,0672	85%	193599
UNITED KING	9726	598957	0,0687	85%	190352
UNITED KING	6873	612397	0,0741	84%	201320
FINLAND 201	1897	439263	0,0503	66%	158086
FINLAND 201	776	442575	0,0448	66%	159710
FINLAND 201	502	446472	0,0454	66%	161815
FINLAND 201	223	449083	0,0451	65%	156490
FINLAND 201	243	435597	0,0466	65%	157629
FINLAND 201	183	456024	0,0454	65%	151758
FINLAND 201	50	491371	0,0446	65%	160570
NETHERLAND	61547	200458	0,0677	77%	87880
NETHERLAND	23985	205445	0,0597	77%	88641
NETHERLAND	7958	207217	0,0574	76%	90540
NETHERLAND	3988	207351	0,0598	76%	89904
NETHERLAND	3193	198532	0,063	76%	88388
NETHERLAND	2597	205848	0,0662	75%	87933
NETHERLAND	2381	206023	0,0679	75%	92239
SWEDEN 201	15795	59489	0,0653	55%	15436
SWEDEN 201	7147	57879	0,0653	55%	15545
SWEDEN 201	4359	56146	0,0641	55%	15763
SWEDEN 201	2993	55937	0,0624	55%	15452
SWEDEN 201	2916	55848	0,0596	55%	14833
SWEDEN 201	1266	55506	0,0614	54%	13374
SWEDEN 201	452	54605	0,0671	53%	14949
ROMANIA 20	8973	116531	0,0593	62%	33141
ROMANIA 20	4449	117890	0,0554	63%	33610
ROMANIA 20	2321	115166	0,0528	62%	33562
ROMANIA 20	1169	117142	0,0509	64%	31826
ROMANIA 20	479	116839	0,0508	66%	31917
ROMANIA 20	254	116501	0,0531	67%	31665
ROMANIA 20	247	126041	0,0547	67%	31909

Apart we must be aware that all the independent variables are significative. This means that all independent variables have small t-statistic and p-value less than 0,05. Therefore, these control variables have direct effect with the response variable (new electric vehicle registered). For that reason, we have clicked the new model and selected ordinary least square. Then, we have seen the econometric model with our variables that we have chosen.

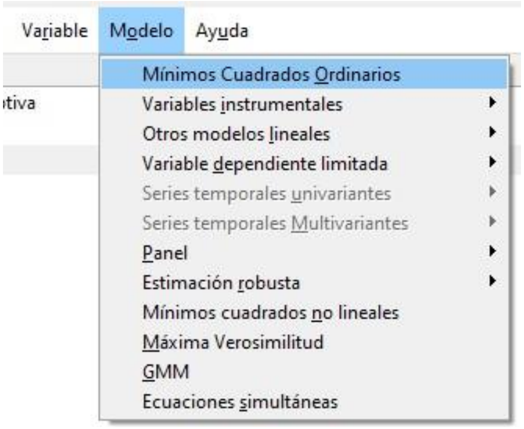
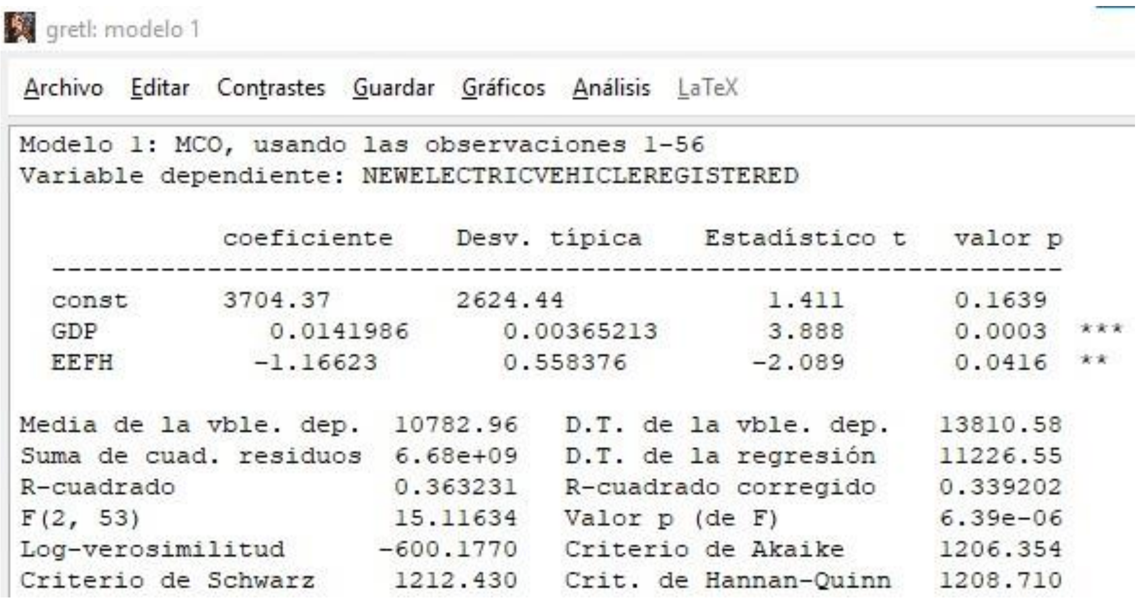


Figure 28: Econometric model (6 step)




```
Modelo 1: MCO, usando las observaciones 1-56
Variable dependiente: NEWELECTRICVEHICLEREGISTERED

             coeficiente    Desv. típica   Estadístico t   valor p
  ------------------------------------------------------------------
  const      3704.37        2624.44             1.411       0.1639
  GDP           0.0141986      0.00365213       3.888       0.0003  ***
  EEFH         -1.16623        0.558376        -2.089       0.0416  **

Media de la vble. dep.  10782.96   D.T. de la vble. dep.   13810.58
Suma de cuad. residuos  6.68e+09   D.T. de la regresión    11226.55
R-cuadrado              0.363231   R-cuadrado corregido    0.339202
F(2, 53)                15.11634   Valor p (de F)          6.39e-06
Log-verosimilitud      -600.1770   Criterio de Akaike      1206.354
Criterio de Schwarz     1212.430   Crit. de Hannan-Quinn   1208.710
```

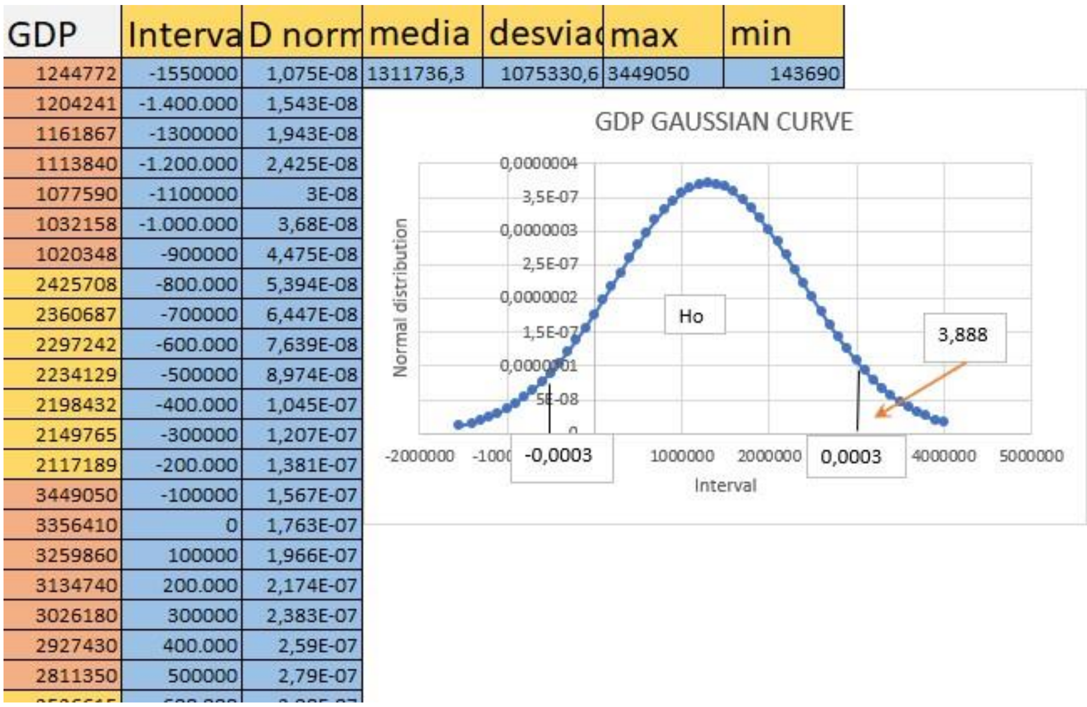
Figure 29: Econometric model (7 step)

The most important things in whatever econometric model are the R square, due to represents how many percentages explains the model. Therefore, according to our econometrical model we have an R square of 36.3%. This means that all these variables that we have chosen, such as Gross Domestic Product and Expenditure Energy for Housing, answer to ourselves with a probability of 36.3% the question of, why there are more electric vehicles registered every year? Or How much effect have these two variables respect to the new electric vehicle registered?

In a simple view, we have seen that our econometric model has a small number of Durbin-Watson Index, exactly 0.456377. Therefore, our explication could have autocorrelation between independent variables. Due to, this index refers that more than 1.00 unit or even 1.00 unit exactly could have not autocorrelation.

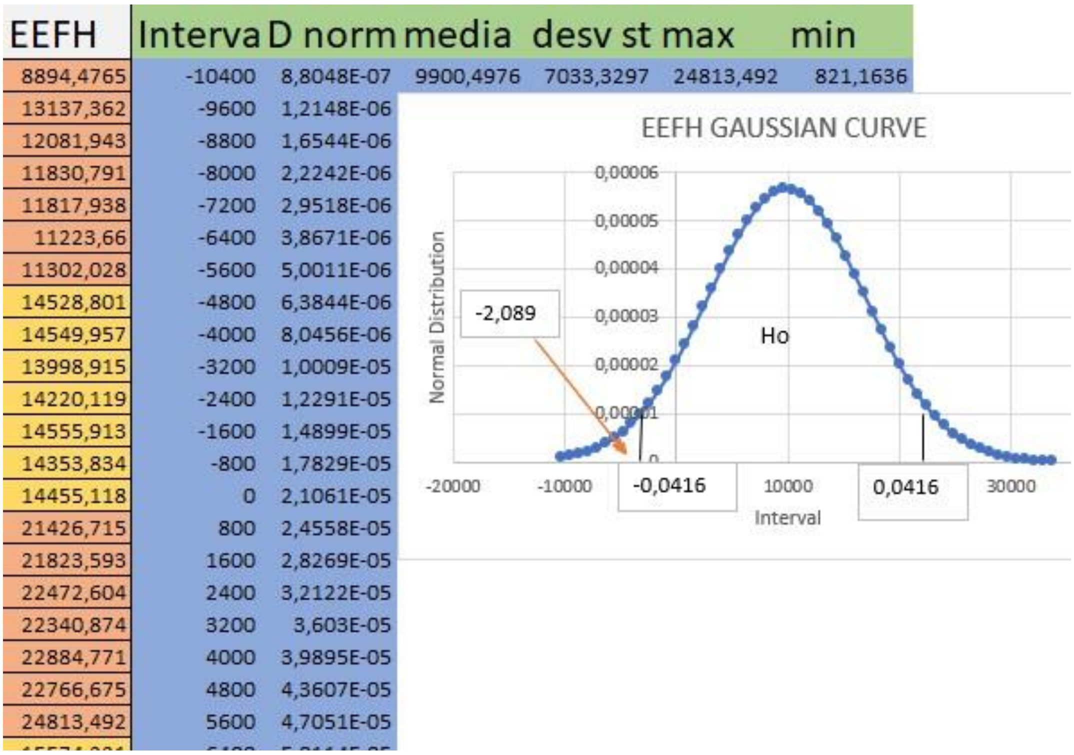
The typical deviation shows as the proportion between the mean variation, and we must be aware that is very few. For that reason, we have anywise a normal database.

Furthermore, our t-statistic is very small consequently it could be a good number to calculate the non-rejection area (3,888 and 2,089). Therefore, our p-value of Gross Domestic Product is 0,0003 < 0,01 this means that there are a lot of correlation between this independent variable with new electric vehicle registered. Also, the p-value of expenditure energy for housing is 0,0416 < 0,005 therefore has a relation with our response variable.



GDP	Interva	D norm	media	desviac	max	min
1244772	-1550000	1,075E-08	1311736,3	1075330,6	3449050	143690
1204241	-1.400.000	1,543E-08				
1161867	-1300000	1,943E-08				
1113840	-1.200.000	2,425E-08				
1077590	-1100000	3E-08				
1032158	-1.000.000	3,68E-08				
1020348	-900000	4,475E-08				
2425708	-800.000	5,394E-08				
2360687	-700000	6,447E-08				
2297242	-600.000	7,639E-08				
2234129	-500000	8,974E-08				
2198432	-400.000	1,045E-07				
2149765	-300000	1,207E-07				
2117189	-200.000	1,381E-07				
3449050	-100000	1,567E-07				
3356410	0	1,763E-07				
3259860	100000	1,966E-07				
3134740	200.000	2,174E-07				
3026180	300000	2,383E-07				
2927430	400.000	2,59E-07				
2811350	500000	2,79E-07				

Figure 30: GDP Gaussian curve



EEFH	Interva	D norm	media	desv st	max	min
8894,4765	-10400	8,8048E-07	9900,4976	7033,3297	24813,492	821,1636
13137,362	-9600	1,2148E-06				
12081,943	-8800	1,6544E-06				
11830,791	-8000	2,2242E-06				
11817,938	-7200	2,9518E-06				
11223,66	-6400	3,8671E-06				
11302,028	-5600	5,0011E-06				
14528,801	-4800	6,3844E-06				
14549,957	-4000	8,0456E-06				
13998,915	-3200	1,0009E-05				
14220,119	-2400	1,2291E-05				
14555,913	-1600	1,4899E-05				
14353,834	-800	1,7829E-05				
14455,118	0	2,1061E-05				
21426,715	800	2,4558E-05				
21823,593	1600	2,8269E-05				
22472,604	2400	3,2122E-05				
22340,874	3200	3,603E-05				
22884,771	4000	3,9895E-05				
22766,675	4800	4,3607E-05				
24813,492	5600	4,7051E-05				

Figure 31: EEFH Gaussian curve

4.2- Multi collinearity

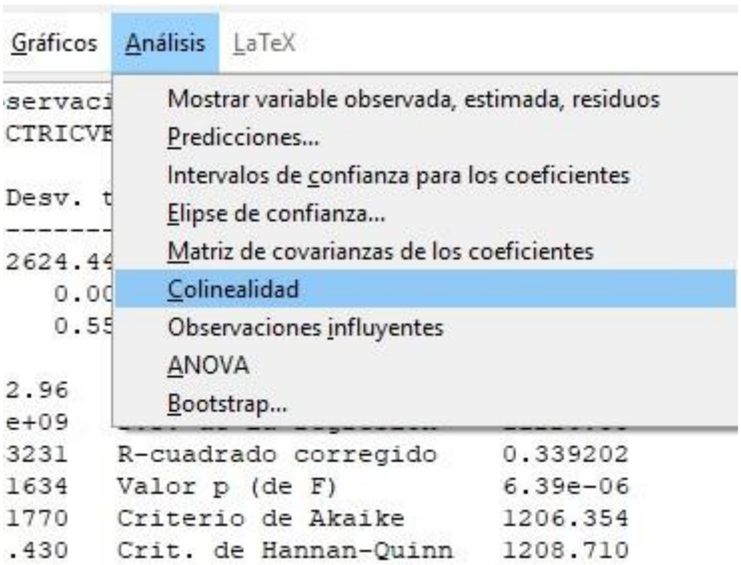
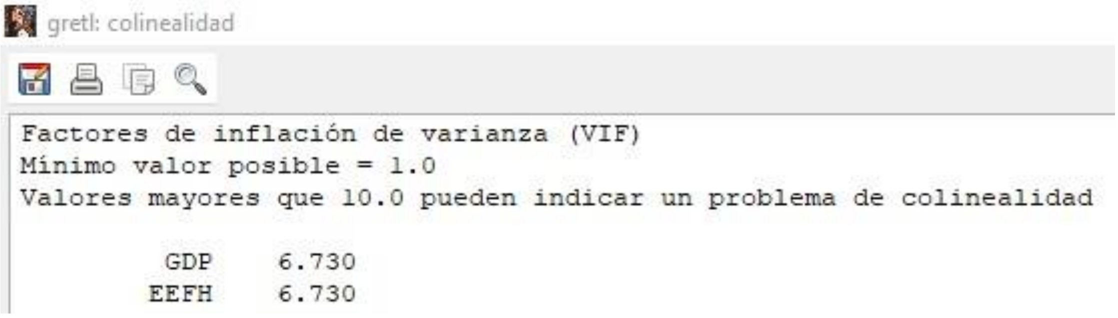


Figure 32: Econometric model (8 step)


gretl: colinealidad

```
Factores de inflación de varianza (VIF)
Mínimo valor posible = 1.0
Valores mayores que 10.0 pueden indicar un problema de colinealidad

        GDP    6.730
       EEFH    6.730
```

Figure 33: Econometric model (9 step)

Besides, with the variance inflation factors (VIF) we could calculate and know another assumption whose name is collinearity. This assumption is the most common mistake in whatever econometric model, due to one more independent variable can suddenly affect to the others in a bad way, making a mistake. For instance, in our econometric model, we have collinearity of (6,73) but is less than (10). Therefore, according to the variance inflation factors (VIF) we should suppose that they do not have it. However, exist a hight collinearity, because we have only two independent variables and they have a hight value of collinearity. Consequently, when more gross domestic product more expenditure energy for housing, but we do not know the intensity of this effect.
Therefore, our econometric model would be:

NEVR = Const + GDPx1 – EEFHx2

Y = 3704.37 + 0,014 X1 – 1,166X2

4.3- Homoscedasticity

This assumption is the opposite of heteroscedasticity also both words came from the Greek language and if we try to rot it, we observe that “homo” is equal and “cedasticity” means scattering. So, if we unify both meanings, we have equal scattering, also we must be aware about the scatter plot graph, due to if we obtain a linear scatter plot, that means that we will have a great econometric model. But if we have a low negative or positive scatter plot, we will have worst econometric model.

4.4. Heteroscedasticity

Heteroscedasticity, as we mentioned in the before assumption is the opposite of homoscedasticity. So, if we study the word “hetero” that means different or plenty of options and the word “cedasticity” as we said is scattering.

Therefore, this means that the variances of our errors in the independent variable are not constant.

Besides, to know the variances of our independent variable that affect to the dependent variables we should see the relation of the scattering in the plot. So, in both graphs we can see that exists a little bit heteroscedasticity and homoscedasticity. But it is not the best example due to in our econometric model do not exists a high variance percentage to show graphically these assumptions. However, we could say that the country Netherlands with the variance of each independent variable, show us a little bit of heteroscedasticity. To sum up, the mistake of the delated country “Norway” was its high variance and that’s create heteroscedasticity.

According to my econometric knowledge I suppose that is very simple, because only explain the 36% of the model. This means that our independent variables show us a high correlation between the dependent variables.

Therefore, we could say that if we have more expenditure energy for housing, it will suppose, according to this negative signal that we will obtain a smaller number of new electric vehicles registered.

Furthermore, if we suppose that we have more gross domestic product we will obtain more new electric vehicles registered.

By the way if we split both independent variables, we have from EEFH to NEVR that follow a correlation:

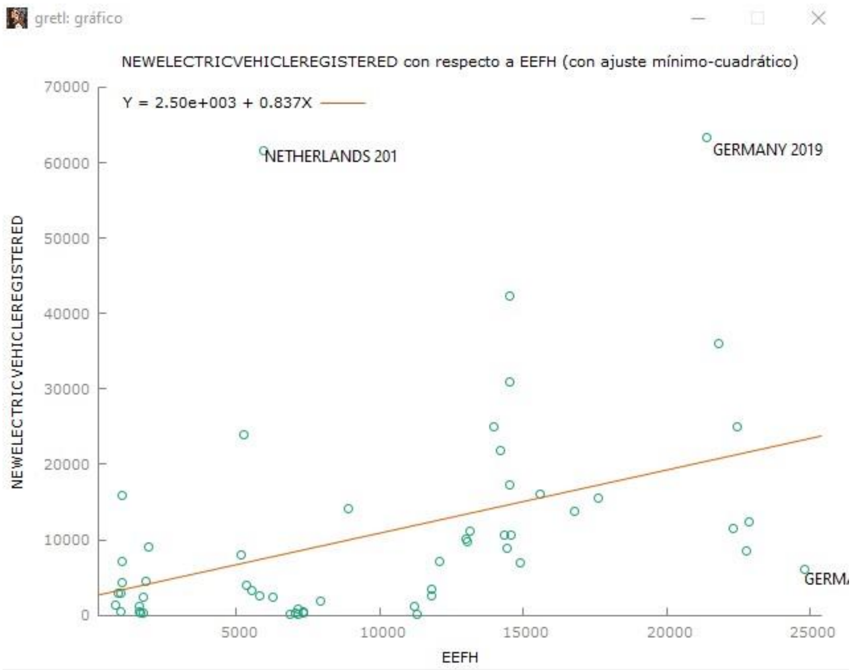


Figure 34: Econometric model (10 step)

So, it has a little bit less slope than the GDP, therefore that means probably that the independent variable (expenditure energy for housing) has more variances of error and for that reason can create a little bit more heteroscedasticity. However, we could not affirm 100% that, so we have to calculate the test Leven.

By the way the correlation between gross domestic product and the response variable is.

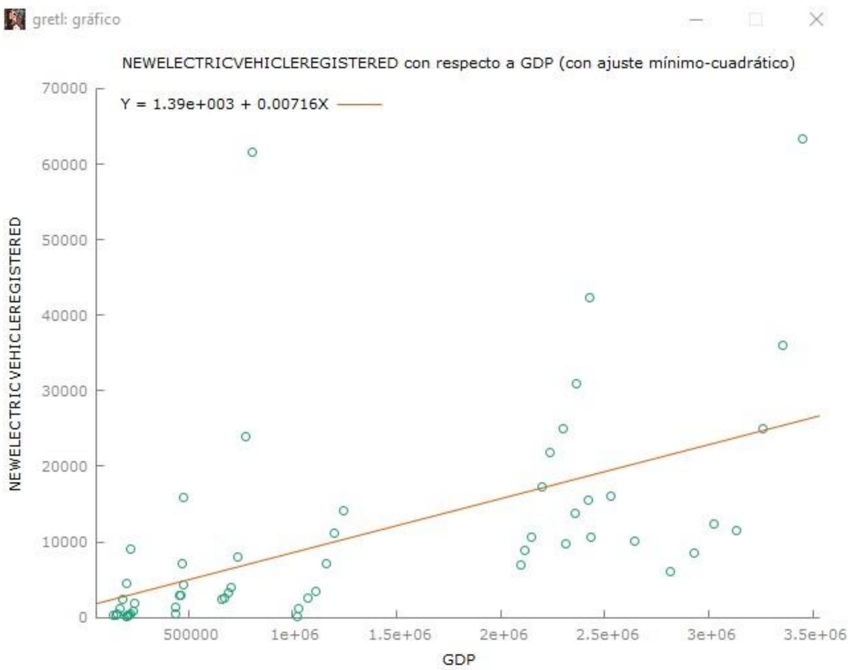


Figure 35: Econometric model (11 step)

5 CONCLUSIONS

5.1 THEORY CONCLUSION

Regarding to this research, we have discomposed and studied one of the most important "fake news"; How much an electric vehicle pollute. Consequently, we have discovered it due to the information collected in the manufacturing process of electric and internal combustion vehicle. Moreover, this research showed as the worst face of the internal combustion vehicle, exactly the way of subtracting the crude. Due to it seems that we are destroying the world.

Personally, if anybody read this research could notice about the exorbitant numbers of pollution and the catastrophes that we have done.

Nevertheless, there are still people complaining and demonstrating, saying that the electric vehicle pollutes equally or even more than an internal combustion vehicle.

By the way, I will understand the people that complains about the price of the electric car and the method of charging the vehicle, because he/she does not have garage, but not the denialists.

Therefore, the government will have to do economic policies to help this type of citizens that unfortunately is the majority of the country.

However, according to this information a part of electric vehicles the other future car will be (FCV) hydrogen vehicle.

Finally, studying the case of our country, we have to take advantage of the research information of Spain to know that we have to wait more years to buy an electric vehicle and see the real change.

When I said "real change" I was referring me that currently few people could buy and charge an electric or plug-in electric hybris vehicle in their house. But the "real change" will be when all people will change their internal combustion vehicle for an electric or hydrogen one.

However, Spain as we mentioned has few houses compare to other countries, consequently we must be aware that the price in superchargers is more expensive than charging it in house. Therefore, there are very few electric stations in Spain and even less of hydrogen stations.

Not all countries can follow the model of California.

Therefore, a hypothetical case of this research of our country could be a balance of houses and buildings, but how? Recovering the great depopulation of rural houses. Also, the government of Spain could make economic policies to reactive the economical situation, overall, for helping people who do not have garage, for example, reducing the taxes of energy prices in the electric stations. The last hypothetical case according to the research could be encouraging the rental electric vehicle and increasing the taxes of internal combustion vehicles.

5.1 ECONOMETRIC MODEL CONCLUSION

Before arriving to this econometric model, we already did a lot of changes because the problem of our model was the constant; due to it was not significative.
For that reason, we could have aleatory or casualty results overall when the independent variable will be zero. Due to its higher p-value (0.7 < 0.163).
However, we have a consistent and realistic model although it seems simple.
By the way, it should be realised that a part of these two independent variables that complete a perfect model. Previously we have tried to create other variable with logarithms because of the hight quantity of numbers. However, the econometric model (level-log) did not work perfectly, due to the autocorrelation.
Even more, we have thought about another variable that could affect the dependent variable, such as price for housing. Consequently, if a house has garage the cost would be more expensive. Therefore, according to this logical thought to charge an electric car, you need a garage.
So, if there are an increase of new electric vehicle registered every year and the house pricing is increasing too, we would think that it could be a relation. However, the econometric model did not realise it, due to the intensity of the error variances in the scatter plot.
Also, there are other variables in our database from (Eurostat) that we have used, for instance: air pollution and expenditure energy which have collinearity.
Since we spend more energy, we pollute more, for that reason, we have thought about renewable energy variable because there is not collinearity between itself and air pollution, but of course it has with expenditure energy for housing.
Finally, as we have seen in the econometric model, we have decided between expenditure energy for housing and gross domestic product, as independent variables. Both have a little bit of correlation of 6.74, Therefore this quantity could show us aleatory or casualty results in the model and it could not specify exactly the correlation.
In addition, in a simple view of the econometric model if the GDP increase, we should spend more energy.

Depends on two things, firstly if it is based on our database will be around 90% reliable. Secondly, looking into the percentage of our R squared in this case 36%. show us, a hight relevant number for the explication of the econometric model.

Therefore, is very difficult to identify the perfect independent variables for the ideal econometric model that explains the new electric vehicle registered, but we have searched both variables that has totally good influence and any problem with the assumptions and the autocorrelation.

6- REFRENCES

afdc.energy.gov. (2009, 02 29). Retrieved from afdc.energy.gov: https://afdc.energy.gov/vehicles/electric_emissions.html

Asesga. (2020, 08 16). Retrieved from Asesga: http://www.asesga.org/asociarme.php

britannica. (2019, 03 25). Retrieved from britannica: https://www.britannica.com/technology/manufacturing

britannica. (2020, 04 22). Retrieved from britannica: https://www.britannica.com/biography/Etienne-Lenoir

daimler. (2018, 07 23). Retrieved from daimler: https://www.daimler.com/company/tradition/company-history/1885-1886.html

datarade.ai. (2017, 02 16). Retrieved from datarade.ai: https://datarade.ai/data-categories/electric-vehicle-charging-stations-data

ec.europa.eu. (2019, 17 05). Retrieved from ec.europa.eu: https://ec.europa.eu/transport/facts-fundings/scoreboard/compare/energy-union-innovation/ev-charging-points_en#2016

ee.ricardo. (2019, 10 27). *Energy & Invironment*. Retrieved from Energy & Invironment: https://ee.ricardo.com/sustainability/life-cycle-assessment

Elperiodico. (2018, 06 13). Retrieved from Elperiodico: https://www.elperiodico.com/es/economia/20200614/el-gobierno-anuncia-plan-automocion-renovacion-parque-vehiculos-7999025

Energy Information and Administration . (2017, 06 19). Retrieved from Energy Information and Administration : https://www.eia.gov/electricity/data/state/

España Exportacion e Inversiones (ICEX). (2018, 05 23). Retrieved from España Exportacion e Inversiones (ICEX): https://www.icex.es/icex/es/pagina-no-encontrada/index.html

European Alternative Fuels Observatory. (2020, 06 01). Retrieved from European Alternative Fuels Observatory: https://www.eafo.eu/electric-vehicle-charging-infrastructure

eurostat. (2020, 09 15). Retrieved from eurostat: https://appsso.eurostat.ec.europa.eu/nui/submitModifiedQuery.do

Galt energy. (2019, 08 13). Retrieved from Galt energy: https://blog.galt.mx/por-que-las-baterias-le-hacen-dano-al-medio-ambiente

hydrogencarsnow. (2019, 10 02). Retrieved from hydrogencarsnow: https://www.hydrogencarsnow.com/index.php/gm-electrovan/

ilovemaps. (2004, 08 19). Retrieved from ilovemaps: https://www.ilovemaps.co.uk/products/norway-road-map

Km77. (2016-2018, 09 11). Retrieved from Km77: https://www.km77.com/coches/volkswagen/tiguan/2016/estandar/edition/tiguan-2016/datos

Km77. (2018-2019, 05 02). Retrieved from Km77: https://www.km77.com/coches/bmw/x4/2018/estandar/estandar/x4-xdrive20i/datos

Km77. (2018-2019, 02 16). Retrieved from Km77: https://www.km77.com/coches/toyota/camry/2019/estandar/advance/camry-220h-advance/datos

km77. (2019-2020, 5 2). Retrieved from km77: https://www.km77.com/coches/tesla/model-3/2018/sedan/estandar/model-3-traccion-trasera-autonomia-estandar-plus/datos

Km77. (2019-2020, 04 12). Retrieved from Km77: https://www.km77.com/coches/tesla/model-3/2018/sedan/estandar/model-3-traccion-trasera-autonomia-estandar-plus/datos

motorgiga. (2016, 04 15). Retrieved from motorgiga: https://motorgiga.com/bmw/5-series/540i-xdrive-berlina/2017/precio-ficha-tecnica

movilidadelectrica. (2019, 04 27). Retrieved from movilidadelectrica: https://movilidadelectrica.com/volkswagen-baterias/

ourworldindata. (2019, 03 12). Retrieved from ourworldindata: https://ourworldindata.org/emissions-by-sector

Ricardo. (2020, 07 13). *ec.europa.eu*. Retrieved from ec.europa.eu: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/2020_study_main_report_en.pdf

statista. (2019, 04 18). Retrieved from statista: https://www.statista.com/statistics/955443/number-of-electric-vehicle-charging-stations-in-europe/

statssos. (2016, 11 07). Retrieved from statssos: https://statssos.online/2015/03/18/gonzalo-apoya-la-aditividad-los-4-supuestos-de-la-regresion-lineal/

The International Council On Clean Transportation (TICOCT). (2020, 06 17). Retrieved from The International Council On Clean Transportation (TICOCT): https://theicct.org/sites/default/files/publications/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf

transportationhistory. (2019, 07 14). Retrieved from transportationhistory: https://transportationhistory.org/2020/08/04/a-pioneering-developer-of-the-internal-combustion-engine-completes-his-lifes-journey/

transportenvironment. (2020, 4 12). Retrieved from transportenvironment: https://www.transportenvironment.org/sites/te/files/downloads/T%26E%E2%80%99s%20EV%20life%20cycle%20analysis%20LCA.pdf

wikipedia. (2009, 04 17). Retrieved from wikipedia: https://en.wikipedia.org/wiki/Demographics_of_Spain *wikipedia*. (2009, 05 26). Retrieved from wikipedia: https://en.wikipedia.org/wiki/Durbin%E2%80%93Watson_statistic

Wikipedia. (2018, 10 07). Retrieved from Wikipedia: https://en.wikipedia.org/wiki/History_of_steam_road_vehicles

worldenergy. (2008, 10 08). Retrieved from worldenergy: https://www.worldenergy.org/assets/downloads/PUB_Energy_and_urban_innovation_Case_Study_Shanghai_2010_WEC.pdf