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Department of Impresa e Management

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The Electric Vehicle market growth: the analysis of the Italian market.

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Academic Year 2021/2022

Summary

Introduction

The shape of the automotive industry is changing, new types of engines have been developed and the retention rate over the new technologies is rapidly growing. The main objective of most of the governments is to diminish the interdependences between the transportation systems and the fossil fuels. Many governments had the assets and the possibilities to fast forward this market transformation being the first in number of both matriculations of electric vehicles, hybrid vehicles and plug-in hybrid vehicles both in the size of charging network system. This paper wants to offer a framework of the growth of the electric vehicle market in Italy, to compare the different policies and incentives and the effectiveness of policies as market markers. There will be an analysis over the driving forces of the market, focusing the analysis over the singular commodities and their ability to generate economies of scale, the analysis of the commodities focused over the provenience of the mineral used for the lithium-ion electric batteries and the role of semiconductors in the variation of the volumes offered from the suppliers. The paper will end with a forecast analysis of the matriculation of electric, hybrid and plug-in hybrid vehicle in Italy, this analysis will give the suitable data to answer to the analysis question, how fast the electric vehicle market is growing in Italy? The analysis will take in consideration both the government incentives as the “ecobonus” and the “extrabonus” both the regional incentives and the reactiveness of the demand of each region over the time, analyzing the volume of matriculation of each type of fuel, Diesel, Fossil Fuel, Methane, HEV, BEV and PHEV.

Literature review:

The Electric Vehicles technology, a differentiated solution to the decarbonization of the transportation system.

Electric Vehicles are one of the most reliable solutions for a fast and efficient decarbonization of our transportation system. This process is aimed to minimize the interdependences between the fossil fuel and the automotive industry, to exploit an existing technology, to solve the urgent matter of the vehicle exhaust emission and the related environmental consequences, to create a sustainable development of a green transportation. The progressive saturation of the carbon fuel, the exceeds of demand characterizing the nowadays market has had an unpleasant effect on the price of carbon fuel, generating a negative direct effect on families and business assets, the decarbonization of the transportation system is a feasible solution for both families and enterprises to cut those interdependencies. The electric vehicle market is a differentiated market, offering suitable and tailored solutions to every need. The electric vehicles also known as EVs are automotives propelled by an electric engine rechargeable by battery, it differs from an internal combustion car in terms of structure of the engine and in terms of fuel. There are several types of electric vehicles, all differing on the type of engine; there are the Battery Electric Vehicle (BEV) using lithium-ion and lithium polymer batteries instead of internal combustion engines, the Hybrid Electric Vehicle (HEV), combining an electric propulsion system with an internal combustion engine and the Plug-in Hybrid Electric Vehicle (PHEV) combining an electric propulsion system whose battery pack can be recharged using a charging cable and last the internal combustion engine and Fuel Cell Electric Vehicles (FCEV) combining oxygen and compressed hydrogen to create electricity. Those are all the possible technologies developed in the last years, of those the most promising ones are the BEV or commonly known as the electric cars, leading the market

due to the success of the Tesla Automotive and the HEV and PHEV, suitable solutions for a more reticent to change type of customer. The FCEV did not find the same suitable environment to growth, due to a lower energy efficiency then competitors and unduly expensive cost for the development of the hydrogen recharging infrastructure. The differentiated offer of the electric vehicles had an unpredicted positive effect over the adoption of this innovation among the customers, as for any innovation the change aversion is a challenging risk to avoid that could increase the percentage of late adopters of the new technology, slowing the development of the technology itself, as for the electric vehicles the different typology of engine creates a suitable choice for any type of customer. The BEV, featured to be the most energy efficient offer from the market has some challenging features, the most critical is the range anxiety due to the difficulty and uncertainty to find a suitable supply equipment. This technology found a positive response from types of clients willing to take higher risks to be the first in line for an innovative technology, also known as the "early adopters". Those are the type of customers willing to sacrifice some elements of their routine to be the first to embrace a new technology. For a more cautious segment of the demand the market offer the PHEV and the HEV. The PHEV also known as the plug-in hybrid automotive need a charging station to properly function, having the same criticality of the HEV in terms of supply equipment but with a lower range anxiety due to a lower dependency from the frequency of recharging is the optimal solution for that kind of customer that usually take their tame in evaluating the new technology before embracing it, it gives a lower dependency from carbon fuel rather than the BEV still not being a completely electric car. The kind of customers selecting this kind of option are the ones willing to embrace the new typology of engine before most of the customers, known as "early adopters", they usually have an average higher risk propensity then the rest of the customers not being risk taker as the early adopters. The HEV, the mild hybrid electric

car has no need for a charging station, this characteristic drastically reducing the customer range anxiety. This is the most suitable solution for a kind of customer with a more skeptical approach at an innovation, not ready to completely embrace a new technology until it will be suitable for his specific needs. This peculiar type of electric vehicle responds to those specific needs of the "late majority" of customers, giving them the opportunity to slightly reduce their carbon fossil dependence, still having the benefit of an electric engine as a higher energy efficiency than a typical internal combustion engine. Along with the differentiation inside the segment of electric vehicle there is a further differentiation regarding the battery capability. To reduce the range anxiety adverse effects there are two major solutions, to develop a more suitable network of charging station or to exploit the battery efficiency. The outcome of a suitable solution would be a long-lasting capacity and a faster rechargeability. The typologies of batteries offered by the market are various and as for the typology of engine not all of them found a suitable environment for the mass production. When analyzing a battery there is an important aspect to consider, the energy density, the amount of energy that can be stored in a space. The energy density relies on two aspects; the size and the weight of the type of battery analyzed, a lighter weight will increase the specific energy density and a smaller size will increase a volumetric energy density both increasing the energy density of the battery analyzed. For the automotive industry the most reliable battery on the market is the lithium battery, having a high energy density and a lower weight. The lithium batteries offered on the market create a further offer differentiation based on battery capacity. The battery capacity enables customers to have a higher milage availability paying a premium price for a more efficient lithium battery, in 2020 the higher efficient batteries are offered by Mercedes, reaching with Mercedes EQS a energy density of 100 kW/h being able to function for over 485 miles (780,53 Km), a mileage sufficient to drive from Naples to Milan without needing for charging, this kind of

option is suitable for the kind of customer leaving in a county with a lower developed recharging infrastructure, needing a more reliable solution to their needs. At the other side of the segmentation there is the Smart EQ with a range of 58 miles (93,34 km), a mileage availability suitable for a more domestic use, for daily-life movements typical of city cars. In the between there are more offers tailored to each need and wallet possibility. This differentiation enables all types of consumers, even the most skeptical to find a suitable solution to their needs.[1]

The electric vehicle geographic market, Italy among the market big players.

The market of electric vehicles shows an increase in the volumes of industry supply and market demand, the volumes and the assets of importation and exportation of the automotive industry have strategic role in the economies of countries. To generate higher exportation rather than importation of this asset would be a strategic advance among the other countries. The presence of an efficient domestic production of electric vehicles is encouraged by in every country with governments' policies and financial benefits to help domestic automotive companies to compete in the market. In the automotive industry the more profitable companies in 2020 are Volkswagen group with 254.1 billion, followed by Toyota Motor with 249,4 billion, Daimler (Mercedes group) with 175.9 billion. Those numbers reflect a 2020 market where the electric vehicles sales among the total sales of the automotive industry, the electric vehicles percentage among the internal combustion engine automotive is still limited although growing fast, in 2015 being 0.6% of the market, in 2016 being 0.9% reaching 9% of the industry selling 6.6 million units in a year, more than double the volume than 2020.

[1] Electri Vehicles Worldwide, Statista 2021

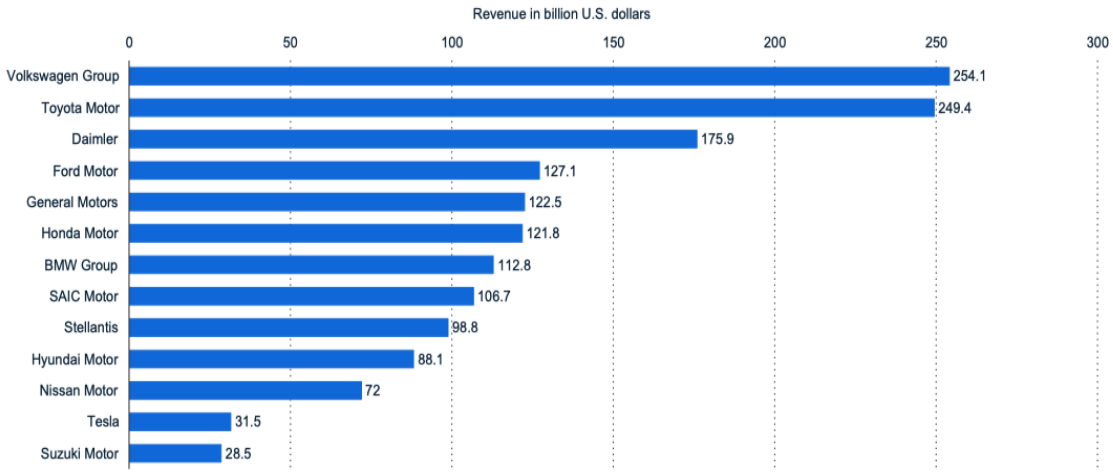

Figure 1-Revenue of leading automakers worldwide in 2020 - Statista

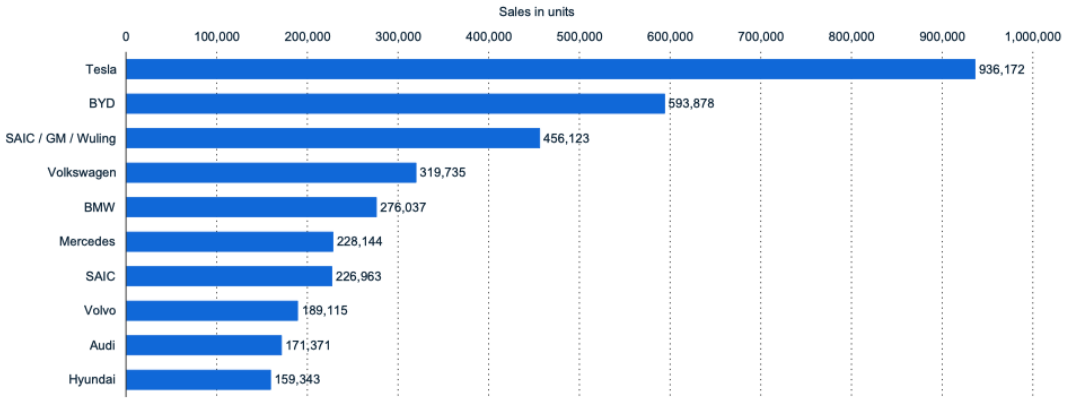

Figure 2-bestselling plug-in electric vehicle models worldwide in 2021 – Statista

Form statistical overviews the sales show a propension to buy BEV vehicles instead of plug-in hybrid electric, having 3.5 million unit of battery electric vehicles and 1.9 million unit sold of plug-in electric vehicles. The fast growth of the market share of electric vehicle among the automotive industry might reshape the leadership position of the automotive industry along with the trading power of the hosting countries. Tesla is the leader of the BEV electric vehicles, growing in revenues from 2015 to 2021 from 4,046 million annual revenues to 53,823 million having

quite reached the million unit sold worldwide in 2021, followed by the Chinese market leader prevalently sustaining the domestic demand along with the joint venture of SAIC, General Motors and Wuling based in Guangxi in China. From the prospect of the three geographic market leader of the electric vehicle is immediate to notice how the market power have been reshaped by the introduction of an innovative new segment in the market. The joint-venture strategy is a common Chinese strategy to fast develop know-how from a oversees company having the financial assets and facilities to develop an innovation[2]. China is now the leading country in the automotive market in terms of exportation, reaching a market growth of 155% in 2021 following North America with 96% and Europe with 66%. Willing to reach independence from the importation of his automotive fleet China started developing his automotive industry in 2008 going from importing 93% of the demand to a negative -11.4% in 2020, having 32,4% of the market share of the automotive industry[3]. Along with the automotive industry China is also leading the market for the electric vehicles, starting in 2014 with few hundreds unit sold and reaching in 2021 between 3.5 billion unit sold having 85,7% of battery electric vehicles and only 14,3% of plug-in hybrid electric vehicles. Those numbers differ from the rest of the market for some specificity, being able to build a network of facilities for the new arising technology in less than five years reaching 309 thousand accessible electric vehicle fast chargers from having just 9 thousand in 2014. China in 2023 will be able to produce around 13 million electric vehicles estimating to exceed the combined output of their competitors as United States, Germany, and Japan. In terms of exportation is easy to declare China as the top seller with SAIC, followed by United States with Tesla and Japan with Toyota. Instead, in terms of importation the most countries who import electric vehicles are European countries, having Norway as the one who import the most. In Norway in 2020 54,3% of the newly registered cars are electric, 20,44% are plug-in hybrid, 8.6% are hybrid and for the ICE automobiles, just 5,6% of diesel, and 7,97% of

[2] Electric vehicles in China, Statista, 2021
[3] Electric Vehicles Wordwide, Statista, 2021

gasoline. This phenomenon happened because of the government decision to minimize the greenhouse emissions via a progressive tax system aimed to create a gain for the consumer in purchasing an electric vehicle. In Norway is now cheaper to buy an electric car rather than an ICE automobile. Even with the marvelous example of Norway, Europe is the losing continent in the global competition, in 2021 the European electric vehicle market has grown only for 66%, doubled by China that shown a growth of 155% and North America with 96%, being last in the race to the electrification of the automotive transportation. For the leading position in the electric vehicle market the competition is fierce, the presence of a domestic company efficient in the competing among the others is fundamental to balance the importation exportation level. In Italy importations exceed exportations.

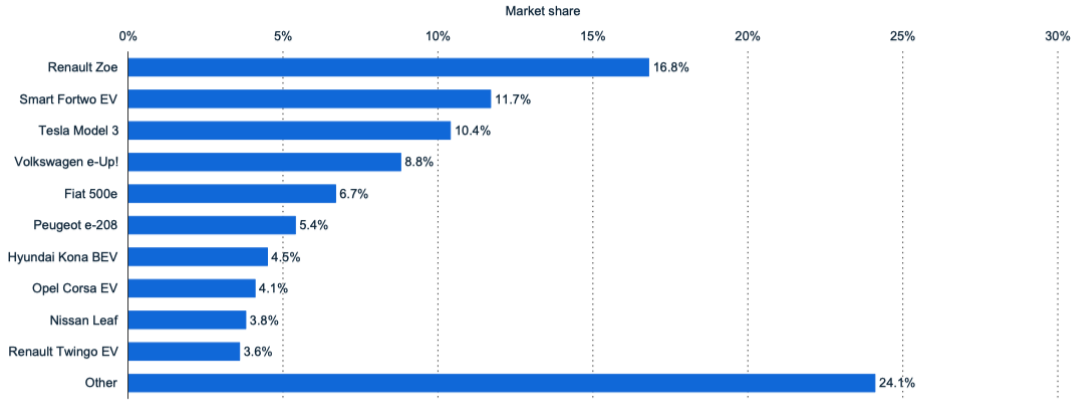

Figure 3 - Market share of battery electric vehicle in Italy in 2020 by model – Statista

Statistics shows that the Italian customer no longer relay to the Italian firms when to purchase an electric vehicle, the only Italian car in 2020 competing as top seller is the Fiat 500e being the fifth most purchase electric car in Italy, in the first positions there is France with the Renault Zoe, Germany with the Smart for two EV, North America with the Tesla model 3 and Germany again with the Volkswagen e-Up. Italians' customers are one of the most adverse purchasers of electric vehicle, in

2020 Italy had less then 5% of market share of electric vehicles, at the ninth position after Spain with 6% and UK with 11%, having Norway, Sweden and Netherlands leading the way. One of the reasons of this numbers are the poor developed infrastructure of the charging station, having just 1,679 public charging stations in 2015 and 12,150 public charging station in 2020 is easy to see why the Italian customer has an adverse position in the electric vehicle market transaction[4]. Italian government to avoid this trend tried the Norway way, to build a customer base thanks to government policies both on the ownership of the electric vehicle as the five-year exemption for the ownership tax from the date of first registration and a 75% reduction after this period and some purchases incentives as the Eco-bonus scheme, a one-off amount of max 6,000 euro for cars emitting less then 20 grams of C02/km and a price less then 50,000 euro, a malus up to 2,500 euro for cars emitting more than 290g C02/km additional incentive to buy BEVs or PHEVs of up to 2,000 euro or a contribution of 40% for households with an ISEE less then 30,000 euro buying a new electric car with less than 150kW/h and a list price mess then 30,000 euro and a special found with up to 8,000 euro per BEV and PHEV special car and light commercial vehicles. Regardless those data, and the skepticism of the Italian customers in regard the electric vehicles, according to the Roland Berger E-mobility index[5] Italy is ranked at the seventh place in term of electromobility implementation. The E-mobility index evaluate a competitive position comparing three key indicators: technology, industry, and market. Technology as government support in research and development of domestic production, Industry relying on the productive capacity and Market to the market sales. The Italian industry shows week in production the market sales are consistent, showing the big gap between Italian exportation and importation of electric vehicles.

[4] Public EVSE chargers by country and type, 2021, statista.
[5] E-mobility index, ROLAND BERGER, Advanced technology center FKA GMBH AACHEN, Dr. Wolfgang Bernhart, Stefan Riederle, Tim Hotz, Ingo Olschewski, Alexander Busse.

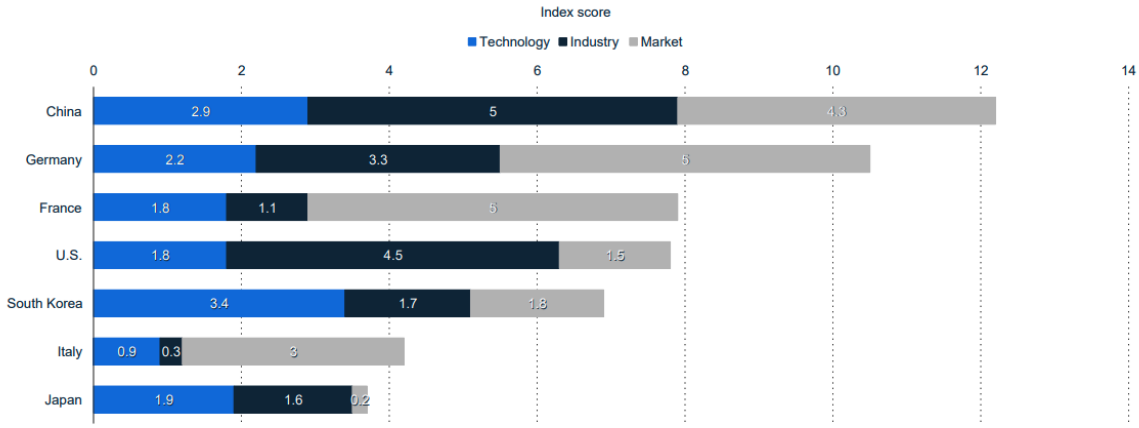

Figure 4 - Leading countries in the field of electromobility according to the Electric Vehicle Index 2021 – Statista

The fundamental role of the supply equipment in overcoming the range anxiety

The charging network is a fundamental driving factor for the growth of the electric vehicle demand, customers want to be able to relay on the availability of a charging network system before to purchase an electric vehicle. The absence of an efficient supply equipment creates some skepticism along the customers. A customer can rely on three types of charging stations: the residential charging stations, the public charging stations and the fast charge charging station. All of those can differ on three level of charging station; the level 1 charging, being able to provide only 1 to 1.5 kW/h, the level 2 charging stations providing 3.3 kW/h and the level 3 charging stations (fast charge charging stations) providing 45 kW/h for the level 1 to 120 kW/h for the level 2. The main difference between those types of charging stations is the price, having a fast-charging station level 2 as a residential charging is a service prohibitive for most of the customers of electric vehicle. [6]

[6] Public EVSE chargers by country and type, 2021, statista.

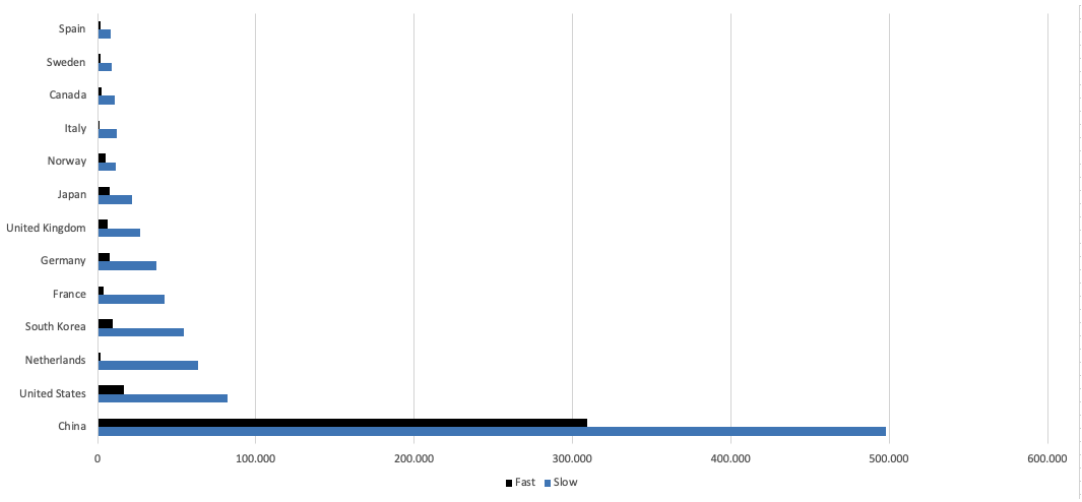

Figure 5 - Number of publicly available electric vehicle chargers (EVSE) in 2020, by major country and type – Statista

The market is although growing along the slope of the electric vehicle market. Just in Europe, the number of public chargers switched from 3 201 million in 2010 to 285.796 million in 2020 and as for the EV market growth also for the EVSE market growth the leading country is China with the incredible number of 498.000 million of slow public charging stations and 309.000 million of fast public charging stations, followed by the United States having 82.263 millions of slow public charging stations and 16.718 million fast charging stations.[7] In Italy the development of public available charging stations is developing. The Italian Government in 2022 is willing to spend 8.7 billion in Eco bonus incentives to be developed until 2030 and 741,3 million for charging station. The Italian government is deeply investing in the development of the EVSE to increase the internal demand of electric vehicles. [8]

[7] Smart grid worldwide, 2021, statista
[8] SMART MOBILITY REPORT 2021, La sostenibilità nei trasporti: le sfide per una mobilità sostenibile nello scenario post-Covid, 2021, Politencico di Milano, school of management.

Lithium-ion batteries economies of scale; the game changing factor of the market growth

The electric vehicle milage availability and the lithium-ion battery capacity have a significant influence both in the prices of electric vehicles than in the fluctuation of the demand. The average price for an electric vehicle having a high mileage availability of 485 miles and a battery capacity of 107.8 kWh is around 126,000$, list price for a Mercedes EQS, instead, the average price for a low segment electric vehicle is 25,000$ for a Smart EQ having 80 miles of availability and a battery capacity of 17.6 kWh[9]. The prices of the EVs arise as higher is the battery capacity and diminish when the battery capacity is lower, due to the steep growth valued by Statista forecast analysis the market offer of electric batteries should increase ten time more than 2020, making the prices less reactive to differences in battery capacity and a hypothetical price decrease of electric battery compared to the mileage availability. According to Statista forecasts the capacity of lithium-ion batteries entering in the global market in 2030 would reach 2,723 GWh, being of 242 GWh in 2020 and having a demand estimation of 1,500 GWh, showing how the market is well responding to the development of the electric batteries. The market size of the electric batteries is 40.5 billion forecasted more than double in five years should reach a market size of 80.17 billion of dollars[10]. Those data show how close the disruption of the internal combustion engine automotive is, the steep increase in the development of the electric lithium-ion batteries along with an implementation in the charging station network could change the features of the automotive industry as never before in less than a decade.

[9] Lithium batteries a statista dossier, 2021, statista
[10] Smart grid worldwide, 2021, statista

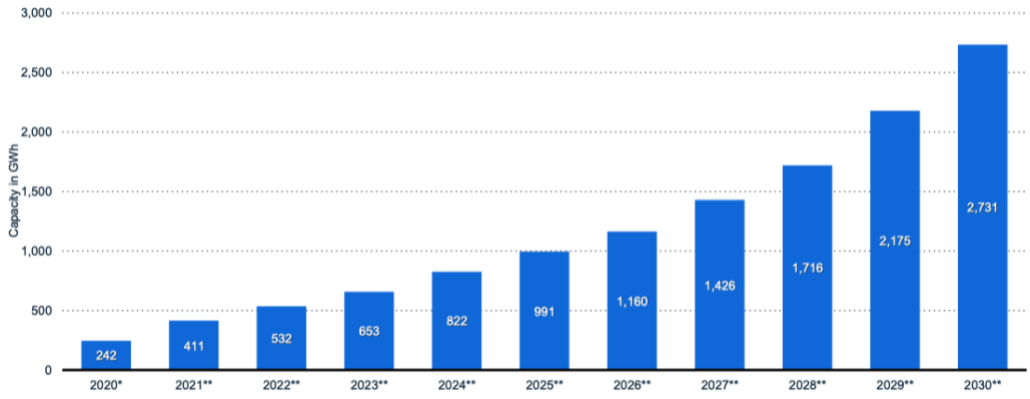

Figure 6 - Estimated capacity of lithium-ion batteries placed on the global market in 2020 with forecast in 2030 in gigawatt hours - Statista

The automotive industry has always been characterized for its economy of scale and the electric vehicles are not exception, the number productors of lithium-ion batteries along with Tesla's Gigafactories are increasing and the demand for the electric vehicles is rising, driving prices from being endogenous to be exogenous. In 2021 most of the producers are from Asian countries as China, South Korea, and Japan; for the 32,5% of the global production the leader of the market the Chinese factory CATL (Contemporary Amperex Technology Co, China), followed by LG Chem (South Korea) with the 21, 5%, then Panasonic (Japan) with the 14,7%.[11] Another important aspect of the production of lithium-ion batteries is the availability of the minerals needed for the development of the batteries, those are lithium, graphite and nickel, the price fluctuation of those minerals depends on the extraction sites and their availability along the mining sites, the forecasted demand for 2030 show us an increase for graphite nine times higher than lithium and for nickel five time higher than the lithium demand. Those mineral's price fluctuations will create a mirrored fluctuation in Lithium-io batteries' price and are very difficult to estimate. The major countries for the extraction of lithium during 2021 are Australia with 55,000 metric tons, followed by Chile with 26,000 metrics

[11] Lithium batteries a statista dossier, 2021, statista

tons and China with 14,000 metric tons. For graphite more than 90% [12]comes from China followed by Brazil and Mozambique for a minimum part and for nickel the main exporter countries are Indonesia, Philippines, and Russia. The extraction of those fundamental minerals is the negative side of the electric vehicle as an environmental solution, mining sites create negative externalities as water loss, ground destabilization, biodiversity loss, increased salinity of rivers, contaminated soil, and toxic waste. A possible solution to minimize the negative effect of mining minerals is the possibility to recycle and reuse the exhausted batteries. In waste management reuse has a higher economic value than recycle and a minor environmental impact.

The role of semiconductors in the worldwide mass production

The automotive market is reshaping his competitive advantages, once the leader on the market focused their investment on power and design, now the demand request safety, much like Apple on his security policy or the fintech PayPal with his fraud protection, consumers now want to feel safe. In the automotive industry this translates in electric vehicle and self-driving features. Both relying on a specific and important input; the semiconductors. The automotive industry is now one of the first industry for the semiconductor use, along with IoT (internet of things) market, this results in optical semiconductor for the estimation of object on the road or skidding, sensors and actuators for the radar functionalities, flash memories, digital signal processor and all the indispensable components of a self-driving experience. Semiconductors are also used for supplementary parts of electric vehicles as the EV charging stations. KPMG estimates the semiconductors market to reach 200$ billion worth

[12] Electric vehicle in China, 2021, statista

in the next 2 decades being now a market worth four times less.[13] The main use of those semiconductors is the development of self-driving features based on LiDAR radars that will increase the safeties of a vehicle. It is no doubts that the automotive industry will meet an increasing demand in semiconductors, the real question is, does the demand will find a suitable offer and if not, how the semiconductors will impact the price of the automotive industry? Worldwide the semiconductors market is shaped in an oligopolistic competition, just few industries have the know-how and the facilities to develop those complex technologies. In Taiwan the multinational company Taiwan semiconductor manufacturing company (TSMC) with 140 billion dollars of revenues in 2021 and UMC with 20 billion dollars made Taiwan the leading countries in the world for semiconductors production having the 65% of the revenues share worldwide, following by Samsung Electronics in South Korea with 18% and other small companies in China with Hua Hong Semi and other small companies reaching 5% of the revenues share worldwide.[14] The estimation of the semiconductor market size shows an increase of 200% from 2020 to 2030 going from 470 billion market size to 940 billion market size including smartphone, personal computer, consumer electronics, automotive, industrial electronics, wired and wireless infrastructure and servers, datacenters, and storage. The automotive forecast alone increasing from 39 billion in market size to 131 billion. Those forecasts are based on a linear proportional analysis not including possible declining factors as territorialism, supply chain disruption, talent risk, cyber security, lack of standards and regulations in new markets like IoT, autonomous vehicle, 5G and artificial intelligence. [15]

[13] McKinsey Electric Vehicle Index: Europe cushions a global plunge in EV sales, 2020
[14] Semiconductors sales worldwide, 2021, statista
[15] Semiconductors in Taiwan, 2021, statista

The Italian electric vehicle market growth

The effectiveness of the government incentives over the responsiveness of the domestic demand

In the last decade, several legislative measures, along with the European guidelines, were designed to encourage a different approach to mobility. The objective is to contribute to lowering the climate-altering emissions. The 13 July 2021 the European council approved the National Plan for Recovery and Resilience (PNRR), within the framework of "Mission 2: Green Revolution and Ecological Transition", includes the component (M2C2), "Renewable energy, hydrogen, network and sustainable mobility" with resources amounting to 23.78 billion euros. This component is divided into five areas of intervention, including the development of more sustainable local transport, with a total estimated expenditure of EUR 580 million and the testing of hydrogen for road transport and rail transport and the investment in electric buses, with an estimated expenditure of € 830 million.[16] The answer from the Italian parliament is the proposal for the Ecological Transition Plan (PTE), having as main objectives of Italy's environmental policies, the decarbonization of the transport sector using fuels with lower impact and from 2030 to achieve the goal of complete decarbonization, having at least 50% of engine to be electric. To reach the PTE's objective the Italian government developed the "ecobonus" in 2019 and the "extrabonus" in 2021.[17] The Decree-Law n° 73/2021 art 73-quinquies refinanced a total of 305 million for 2021 to cover eco-incentives for the purchase of new vehicles, regulating the allocation of resources and introducing new option of buying used cars. The government policy over the decarbonization of the Italian transportation system is based over five pillars. [18]

[16] SMART MOBILITY REPORT 2021, La sostenibilità nei trasporti: le sfide per una mobilità sostenibile nello scenario post-Covid, 2021, Politencico di Milano, school of management.

1. The “ecobonus” for the purchase of low-emission vehicles (electric and hybris)
2. The “extrabonus”, a state contribution for purchasing low-emission vehicles (electric and hybrid)
3. The state contribution for the replacement of vehicle before 2011 with new vehicles not less that Euro 6
4. The incentive to purchase electric vehicles for less well-off natural person

The ecobonus is a contribution in form of discount in price, for the purchase of a new electric or hybrid vehicle, it was introduced experimentally from 2019 to 2021. The amount of the ecobonus contribution is based on two emission bands: electric vehicle (0-20 gr/Km) and hybrid vehicles (21-60 gr/Km) giving in return a vehicle of the European category classes 0,1,2,3 or 4.

- For electric cars having 10-20 gr/km emissions the customer will have an incentive of EUR 6 000 with scrapping and 4 000 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 2 500 with scrapping and of 1 500 without scrapping.

The extrabonus, is an additional incentive, cumulative with the ecobonus, introduces a similar discount to the state contribution.

- EUR 2,000 in the case of scrapping of a vehicle approved in a class less then 6 euros, registered before 1 January 2011
- EUR 1,000 in the absence of scrapping.

The decree law refinanced EUR 305 million for 2021 to refund the extrabonus which last sees exhausted resources. For Euro 6 vehicles purchased before 2011 the state contribution for the replacement is EUR 1500 for the new vehicles purchased in 2021.[19] The government refinanced EUR 10 million the found for the granting of these

[19] SMART MOBILITY REPORT 2021, La sostenibilità nei trasporti: le sfide per una mobilità sostenibile nello scenario post-Covid, 2021, Politencico di Milano, school of management.

contributions. For the natural persons having an ISEE of less than EUR 30,000 who purchase even on financial lease a new motor vehicle of M1 category exclusively powered by electricity of less ten 150 kW with a list price less than EUR 30,000 will receive a contribution equal to 40% of the expenses incurred and remained at the expense of the buyer until 31 December 2021. [20]

The policies implemented found responsiveness over the Italian population, from 2017 the sales of Fuel and Diesel in Italy went from 628 306 to 435 611 in 2021 for fuel and from 1 112 742 to 322 826 for diesel, on the other end the sales of the electric and hybrid vehicles started to arise. In 2021 the number of electric vehicles reached the number of fuel cars with 423 520 units of HEV, and 436 611 unit of fuel cars and it exceeded the 322 826 unit sold of diesel car that year, in the chart below is possible to notice the interception between the HEV slope with the Diesel slope and how the growing HEV slope is reaching the volumes of the Fuel slope.[21]

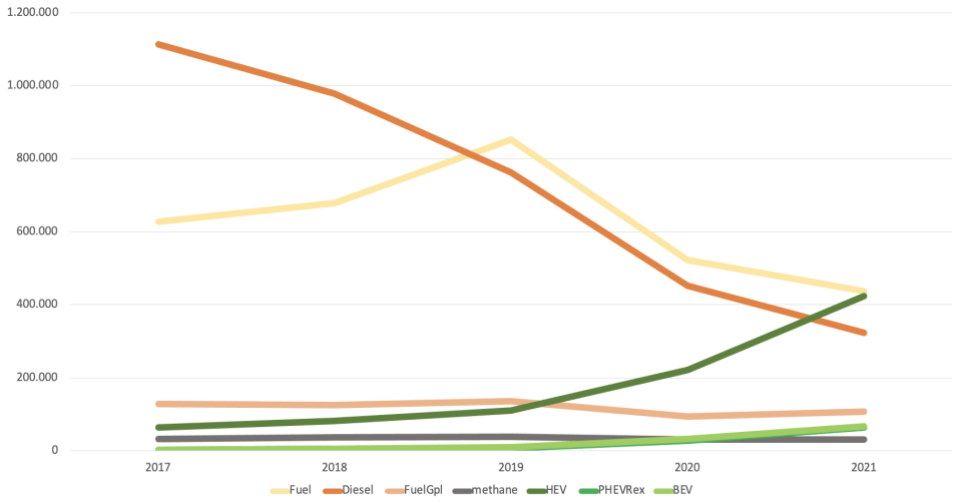

Figure 7- Matriculation in Italy from 2017 to 2021 - UNRAE reformulated data

The Italian regulation first objective is to have a harmonized framework with the European plans of zero-emission mobility. The European Commission started this journey in 2016 with the "European Strategy for

[20] DPCM, La mobilità sostenibile, Camera dei deputati, 19 maggio 2022
[21] Appendix B

Low-Emission mobility" and in May 2017 with "Europe on the Move" both oriented to a decarbonization of the transportation system and to stop the production of internal combustion engine by 2035 in each European member state. The 1 January 2020 the Regulation (EU) n° 2019/631 entered into force setting a target for the entire EU fleet of 95 g of CO2/km for the average emissions of new passenger cars. Along with the implementation of an electric transportation system, the European council had emended a directive for the implementation of the charging stations to be harmonized in the member states, the Directive 2014/94 on the construction of an infrastructure for alternative fuels (DAFI Directive), transposed into national legislation by Legislative Decree n° 257 of the 16 December 2016, aims to develop a large market of alternative fuels for transport as electricity, natural gas and hydrogen, the directive have the aim of sets the minimum requirements for the construction of infrastructure for alternative fuels, including recharging points for electric vehicles and natural gas and hydrogen refueling points to be implemented through Member States' National Policy frameworks. The implementation in the national framework started by the update of the 2014/94 PNire and merged into the National Strategic Framework provided by the Directive. The DPCM of the 1 February 2018 approved the program agreement for the construction of the infrastructure network for charging vehicles powered by electricity, aimed to enable programs prepared by the regions and the autonomous provinces for the construction of charging networks and for the implementation of special agreements between the Ministry of Infrastructure and Transport and the autonomous province. As regard for electric charging structures the article 4 of the legislative decree n° 257/2016 provides that member states shall ensure the creation of an adequate number of charging points accessible to public, to ensure that electric vehicles circulate at least in urban and suburban agglomerations and densely populated areas.

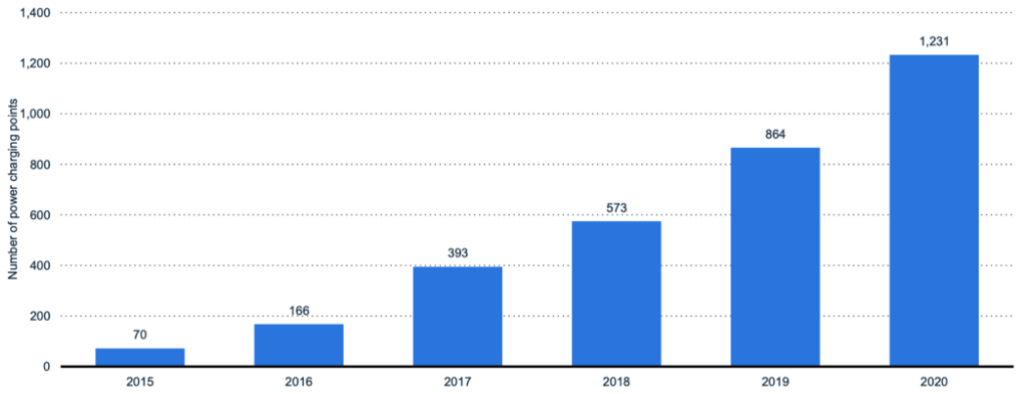

Figure 8 - Number of publicly accessible fast charging points for electric vehicles in Italy from 2015 to 2020 – Statista

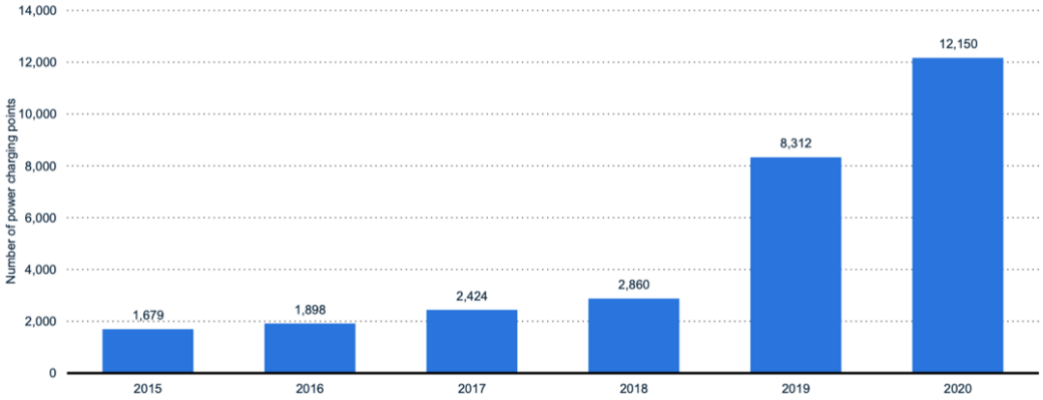

Figure 9 - Number of publicly accessible normal charging points for electric vehicles in Italy from 2015 to 2020 - Statista

The implementation of the European directive brought the publicity accessible fast charging points to go from 70 units to 1,231 units of public fast charging points and 12, 150 units for the normal charging points. The increase in demand of electric vehicle must take in account the collateral necessity of an adequate network of normal and fast charging stations to not create bottlenecks for the entire category. In 2020 the Italian government published two DCPM to support the Italian automotive industry that undergone over a difficult time due to the economic crisis of the Covid 19 epidemy.

- The “Decreto Rilancio”, DCPM n° 34 May/2020
- The “Decreto Agosto”, DCPM n°104 August/2020

Those incentives are based over the CO2 emissions of the type of electric care the customer is purchasing,

- For electric cars having 10-20 gr/km emissions the customer will have and incentive of EUR 10 000 with scrapping and 6 000 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 6 500 with scrapping and of 3 500 without scrapping.

The last government policy over the electric vehicle adoptions has been made the 6 of April 2022 by the Mario Draghi government, in this last DPCM the government from the publishing of the DPCM until the 31 of December of 2024

- For electric cars having 10-20 gr/km emissions the customer will have an incentive of EUR 3 000 with scrapping and 2 000 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 5 000 with scrapping and of 2 000 without scrapping.

The found for this incentive is of 650 million for each category. [22]

[22] DPCM, 6 aprile 2022, l Ministro dello sviluppo economico, di concerto con il Ministro dell’economia e delle finanze, del Ministro delle infrastrutture e della mobilità sostenibili e del Ministro della transizione ecologica.

The forecasted analysis of the domestic demand, what would be the new shape of the Italian automotive industry.

The analysis started by collecting the matriculation data of all the automotive vehicles bought in the domestic market from 2011 to 2021, gaining the data from the datasets of UNRAE, analyzing the visual data is possible to notice the decreasing trend of most of the fossil fuel engine automotive, having an increase in the demand of electric transportation solutions due to the implementation of government incentives and the havy investment in the creation of a charging station network in line with the volume demanded. Those characteristics and the progressive decrease in the price of the electric vehicle consequence of the economies of scope and scale of the automotive market brought in the situation showed in the graph below, the purchases of diesel automotive had a fast decrease followed by the fuel engine automotive numbers. Among all the different types of electric vehicles, the HEV is the one leading the way for the whole category, reaching the same volumes of Diesel and Fuel in 2021.

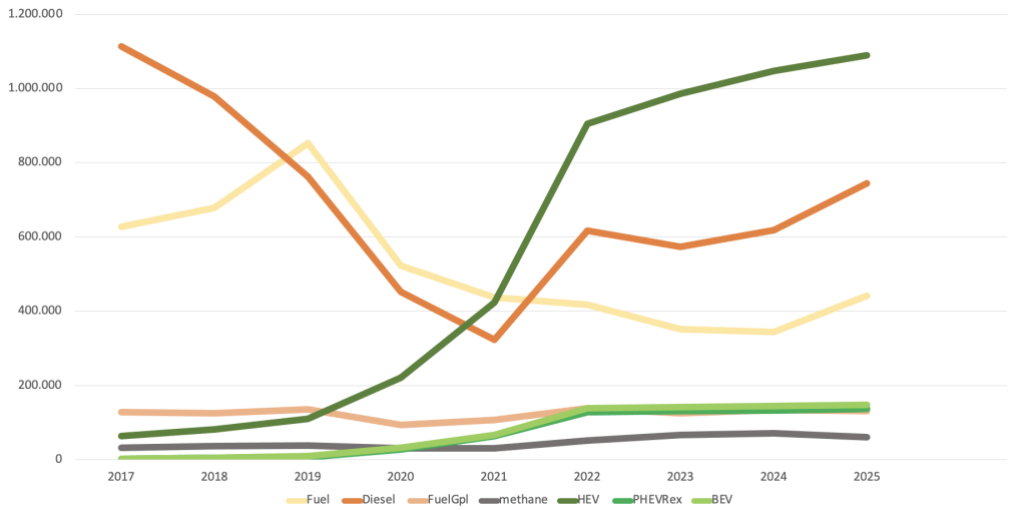

Figure 10 - Reformulated matriculation data from UNRAE

The question this work wants to answer to is, how does the automotive market will be reshaped from the introduction of the electric vehicles. A forecasted analysis taking in consideration just the trend of the market no not consider independent variables as the possible saturation of an essential input as the semiconductors of the lithium for the lithium-ion batteries, or at the other end the fluctuations of fossil oil price over the market. The forecast analysis has been made with a Holt-Winters with no trend methodology having as time variable the years between 2011 and 2021 and as value variables the types of fuel available on the market, respectively; Fuel, Diesel, Fuel GPL, Methane, HEV, PHEV and BEV. The analysis forecasted the trend of matriculation from 2022 to 2031, [23]taking in consideration just the first 3 years of forecast is it possible to notice the positive trend of the HEV technology growing along the small but consistent growth in matriculation of the PHEV and BEV automotive engine. The trend of the carbon fossil fuels shows an decreasing trend for the fuel engine automotive but still an important demand volume for Diesel and Fossil Fuel, for the forecast of those specific internal combustion engine an important characteristic was not included in the valuation, the European decision to block of the production of internal combustion engine by 2035, this European objective alone give a glimpse of the future trends of the market, hypnotizing an bigger decrease in the acquisition of both Fossil Fuel and Diesel.

[23] Appendix A: forecast analysis with Datamining, Smoothing Holt-Winters no trend analysis

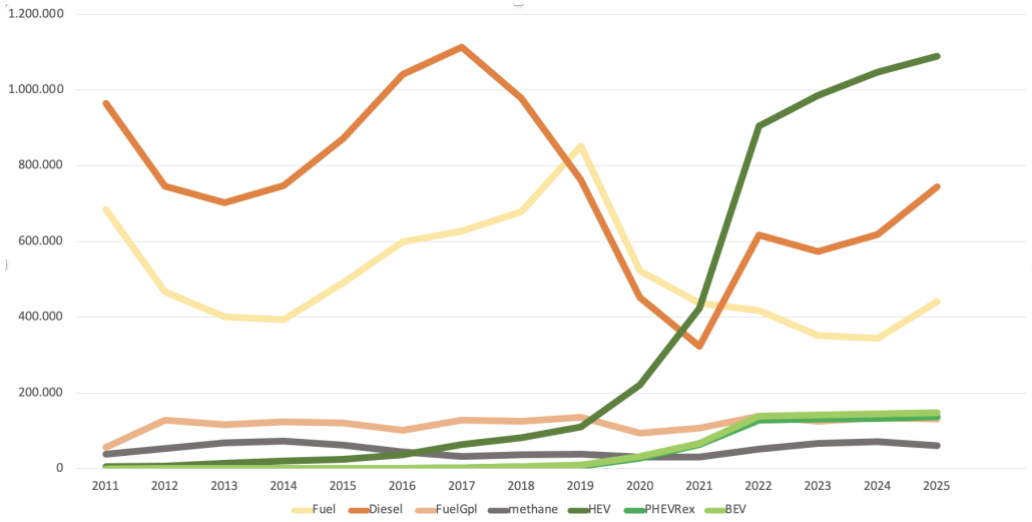

Figure 11 - Forecasted chart analysis of reformulated matriculation data from UNRAE

In this last chart is possible to notice the trend of each type of fuel over the time from 2011, when the electric vehicles were first introduced on the market to 2025, having the years from 2021 to 2025 forecasted. Italy has a long and solid history in the automotive sector, making the history of rally races with the Lancia Stratos of Scuderia Lancia, repositioning the automobile from a luxurious item to an affordable one with the Fiat 500 in 1957 and reshaping the idea of luxury cars with the Scuderia Ferrari and Scuderia Lamborghini. Italy has always had an important position in the automotive industry, at least with the ICE automotive industry. Statistics shows that the Italian customer no longer relay to the Italian firms when to purchase an electric vehicle, the only Italian car in 2020 competing as top seller is the Fiat 500e being the fifth most purchase electric car in Italy, in the first positions there is France with the Renault Zoe, Germany with the Smart for two EV, North America with the Tesla model 3 and Germany again with the Volkswagen e-Up. Italians' customers are one of the most adverse purchasers of electric vehicle, in 2020 Italy had less then 5% of market share of electric vehicles, at the ninth position after Spain with 6% and UK with 11%, having Norway, Sweden and Netherlands leading the

way.[24] One of the reasons of this numbers are the poor developed infrastructure of the charging station, having just 1,679 public charging stations in 2015 and 12,150 public charging station in 2020 is easy to see why the Italian customer has an adverse position in the electric vehicle market transaction. Italian government to avoid this trend tried the Norway way, to build a customer base thanks to government policies both on the ownership of the electric vehicle as the five-year exemption for the ownership tax from the date of first registration and a 75% reduction after this period and some purchases incentives as the Eco-bonus scheme, a one-off amount of max 6,000 euro for cars emitting less then 20 grams of C02/km and a price less then 50,000 euro, a malus up to 2,500 euro for cars emitting more than 290g C02/km additional incentive to buy BEVs or PHEVs of up to 2,000 euro or a contribution of 40% for households with an ISEE less then 30,000 euro buying a new electric car with less than 150kW/h and a list price mess then 30,000 euro and a special found with up to 8,000 euro per BEV and PHEV special car and light commercial vehicles.

[24] Appendix C : matriculations of total vehicle in Europe from 2016 to 2020, elaboration of ACEA's data report, vehicles in Europe 2022.

	Total Sales	BEV	PHEV	HEV
Austria	5,091,827	0.9 %	0.0 %	1.6 %
Belgium	5,827,195	0.5 %	1.2 %	1.5 %
Croatia	1,733,727	0.1 %	0.0 %	0.3 %
Cyprus	578,158	0.0 %	0.0 %	1.7 %
Czech Republic	6,129,874	0.1 %	0.1 %	0.5 %
Denmark	2,720,273	1.2 %	1.1 %	1.1 %
Estonia	808,689	0.2 %	0.0 %	1.6 %
Finland	2,748,448	0.4 %	1.7 %	0.0 %
France	38,346,266	0.6 %	0.4 %	1.7 %
Germany	48,248,584	0.6 %	0.6 %	1.5 %
Greece	5,315,875	0.0 %	0.0 %	0.7 %
Hungary	3,918,923	0.3 %	0.3 %	1.6 %
Ireland	2,215,127	0.6 %	0.6 %	2.7 %
Italy	39,717,874	0.1 %	1.4 %	0.0 %
Latvia	672,962	0.2 %	0.0 %	0.0 %
Lithuania	1,285,743	0.2 %	0.0 %	2.1 %
Luxemburg	435,989	1.0 %	1.1 %	2.0 %
Netherlands	9,049,959	2.0 %	1.1 %	3.0 %
Poland	25,113,862	0.1 %	0.0 %	1.0 %
Portugal	5,300,000	0.5 %	0.6 %	1.1 %
Romania	7,274,728	0.1 %	0.0 %	0.3 %
Slovakia	2,444,478	0.1 %	0.1 %	0.8 %
Slovenia	1,253,984	0.3 %	0.0 %	0.7 %
Spain	25,169,158	0.2 %	0.2 %	1.9 %
Sweden	4,944,067	1.1 %	2.5 %	2.6 %
Iceland	227,907	2.8 %	4.5 %	3.0 %
Norway	2,794,457	12.1 %	5.1 %	4.7 %
Switzerland	4,728,444	0.9 %	0.0 %	2.9 %
United Kingdom	5,141,909	0.5 %	0.6 %	2.0 %

Figure 12 - percentage of electric vehicles over the total sales of European countries member states - reformulated from ACEA

Fluctuation in regional domestic demand over the implementation of regional incentives and exemptions

To incentive the purchase of electric vehicles, along with the national policies of the "ecobonus" and the "extrabonus" there are also regional incentives, those incentives include exemptions from road tax "bollo auto" and free access to paid parking service and to restricted traffic areas, those incentives last for five years from the purchase of the vehicle but each regions has its autonomy in the development of the incentives of the circulation tax. There are two types of incentives for which regions have autonomy.

- The ownership ta (bollo auto) for the BEV automotive
- Founds that each region allocates following the government directive

For the ownership tax the regions gained autonomy after the DPCM n° 122 of 20 May 2019, following the government directive of giving a 5-year ownership tax exemption and being able to amplify this incentive but not to increase the fiscal pressure over the customers. Not every region adopted the additional incentives, other decide to offer additional years of tax ownership exemption and others to dismiss the tax for the vehicle lifetime for the BEV electric vehicle. [25]

- Piemonte and Lombardia are the only regions giving the exemption for the vehicle lifetime
- Val D'Aosta decided to give the ownership tax exemption of 8 years and for Campania 7 years

For the hybrid vehicles the ownership tax differs from region to region.

- Toscana, Friuli Venezia Giulia, Umbria, Sardegna, Basilicata and Sicilia do not offer any type of exemption for the hybrid vehicles
- Molise offer two years exception

[25] SMART MOBILITY REPORT 2021, La sostenibilità nei trasporti: le sfide per una mobilità sostenibile nello scenario post-Covid, 2021, Politencico di Milano, school of management

- Lombardia, Veneto, Trentino-Alto Adige, Emilia-Romagna, Lazio, Abbruzzo e Sicilia offer 3 years of exemption tax
- Val D'Aosta, Piemonte, Liguria, Marche, Puglia e Campania offer a 5-year ownership tax exemption.

Piemonte was one of the first region to adopt the possibility to increase the matriculation of electric vehicle and to decrease its fossil fuel dependency, was the first to introduce a lifetime exemption of ownership tax for the owner of an electric vehicle (BEV) and of 5 years for the owner of a hybrid vehicle.

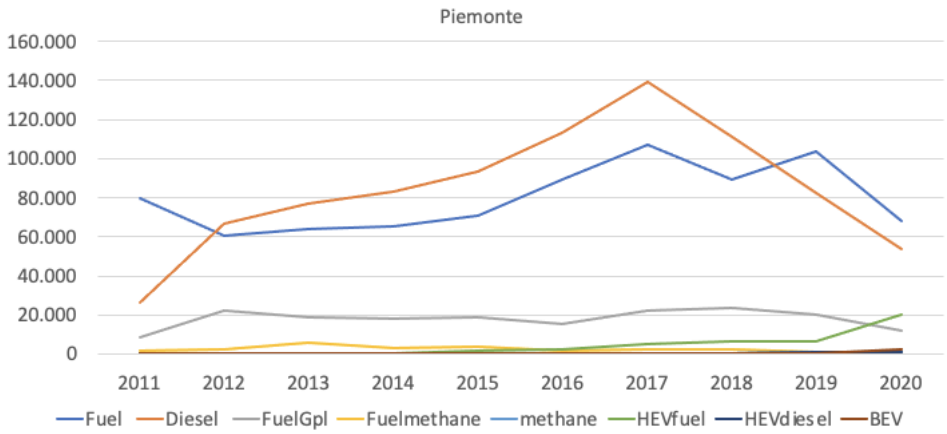

Figure 13 – Automotive matriculation divided by type in Piemonte from 2011 to 2020

The effect of the exemption from the ownership tax went along with a direct incentive to purchase BEV and PHEV vehicles.

- For electric cars having 10-20 gr/km emissions the customer will have an incentive of EUR 8 000 with scrapping and 6 000 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 6 000 with scrapping and of 4 000 without scrapping.

Those incentives found a responsive public, founding a decrease in the number of diesel and fossil fuel vehicles during the year in which the exemption and the incentives were implemented. The region Lombardia is the first in found rising for the incentives of electric and hybrid vehicles of EUR 26,5 million in 2019, those are offered in different cases, the incentive is from EUR 2 000 to EUR 8 000, and it depend by the quantity of emission of the vehicle owned and by the presence or not of scrapping of vehicles of lower energetic classes, those incentives are cumulable with the national incentives. Lombardia is the region with the higher volumes of vehicle matriculated of all the region of Italy and is the first as well for the implementation of electric and hybrid vehicle.

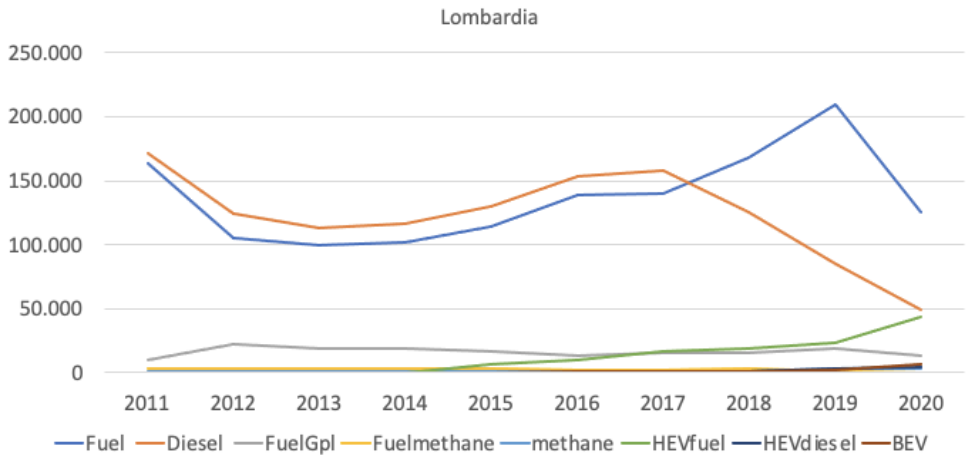

Figure 11 - – Automotive matriculation divided by type in Lombardia from 2011 to 2020

From the chart is effective the effect that the incentives and exemption have over the matriculation volumes of diesel vehicles and fossil fuel vehicles, especially for the fossil fuel vehicle went from an average range of 100.000 unit to 150.000 each tear to an average range of 50.000 to 100.000 units in 2019 and 2020. Another important example of an effective policy has been made by Friuli Venezia Giulia, the only one region giving an incentive also for the purchase of used vehicles.

- For new vehicles it gives EUR 3 000 for plug-in hybrid, EUR 4 000 for hybrid vehicle and EUR 5 000 for the electric vehicles.

- For used vehicles it gives EUR 1 500 for plug-in hybrid, EUR 2 000 for hybrid vehicle and EUR 2 500 for the electric vehicles.

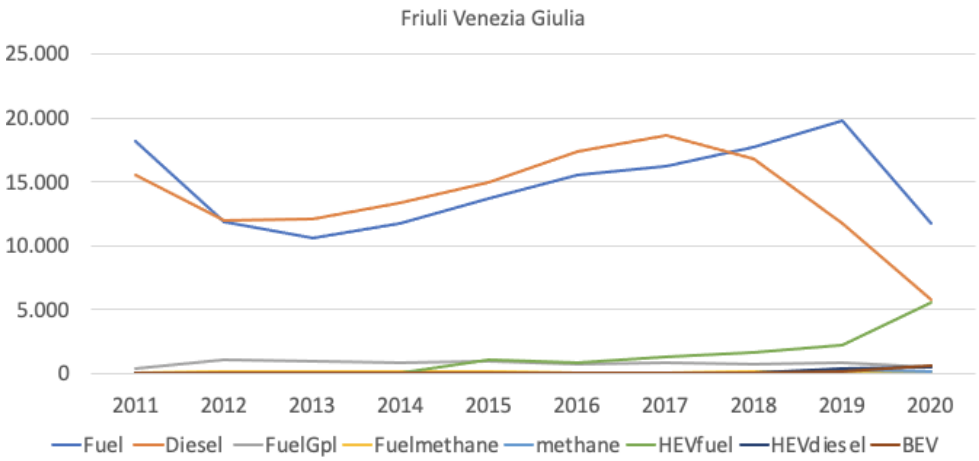

Figure 12 – Automotive matriculation divided by type in Friuli Venezia Giulia from 2011 to 2020

Friuli-Venezia Giulia, offering the contribution for both used and new electric, hybrid and plug.in hybrid electric cars, reached in 2020 to have the same number of units of HEV vehicles as the number of Diesel vehicles matriculated in 2020, including the used electric vehicles into the incentives was an effective incentive for the region. The autonomous provinces of Trento, offers a contribution to both individuals and companies, amounting to EUR 6 000 euros for BEV cars and EUR 4 000 euros for PHEV vehicles, the contribution can be combined with other incentives in the limit of 100% of the expenditure incurred for the purchase of the new car. For the region Valle D'Aosta the region has the objective to be fossil free by 2040, has allocated a found of 7 million for the incentives to customers. Criteria have also been set for incentives to purchase low-emission vehicles (which in addition to cars also include e-bikes and electric scooters). The contribution is € 6,000, while in the case of companies ranging from € 10,000 (for vehicles not related to the transport of people) to € 15,000 (for vehicles related to the transport of people). The incentives, which may increase in the case of the scrapping of vehicles of lower class than Euro 4, concern new or used vehicles

(bought in the dealership also with leasing and rental) with CO2 emissions of less than 70 g/km. For private individuals who are not owners of an activity, the total price of the car to buy must not exceed 60,000 euros, VAT excluded.

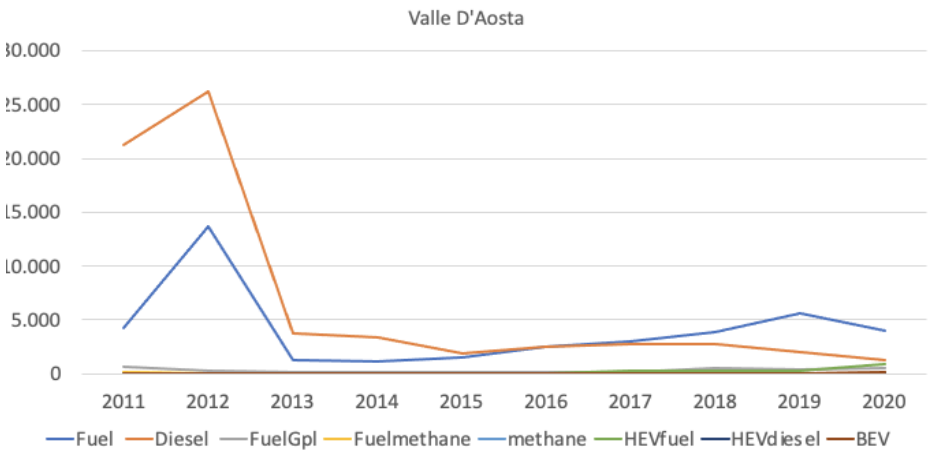

Figure 13 - Automotive matriculation divided by type in Valle D'Aosta from 2011 to 2020

After the implementation of the 2019 regional law, Val D'Aosta defined important objectives for 2020, 2021 and 2022, the region allocated EUR 7 million for the implementation of the matriculation of the electric and hybrid vehicles, those were allocated both for private customers and for individual companies operating in the Region, the contribution is of EUR 6 000 for the private customers, EUR 10 000 for the companies who transport people and EUR 15 000 for the company transporting goods. The incentive increase in case of scrapping of lower class than Euro 4.

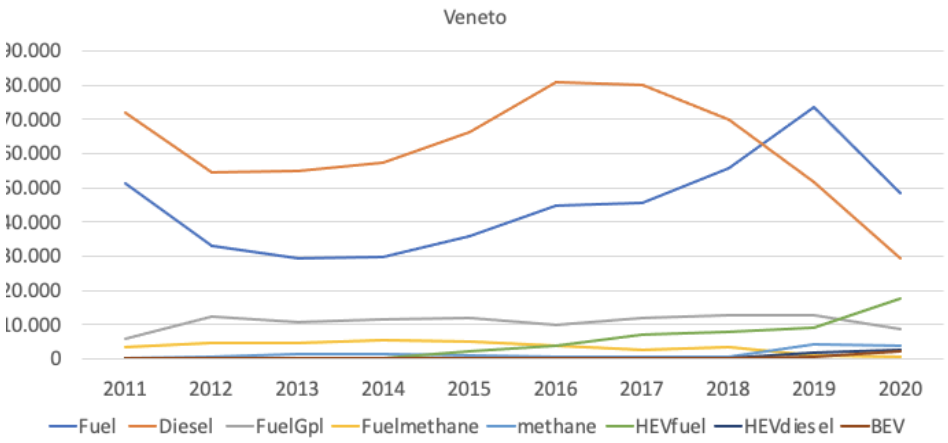

Figure 14 - Automotive matriculation divided by type in Veneto from 2011 to 2020

In the region of Veneto, the incentives available are for private citizens to grant a contribution from EUR 1 500 to 3 500 with the scrapping of highly polluting vehicles and simultaneous purchase of low impact environmental, the effect of the incentive was a little increase in matriculation of the electric (HEV) and an important decrease of number of Diesel and Fossil Fuel vehicles.

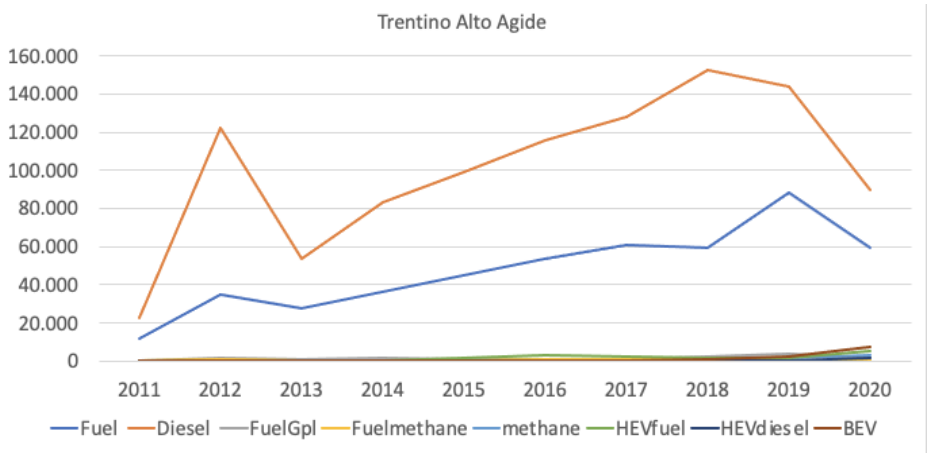

Figure 15 - Automotive matriculation divided by type in Trentino Alto Adige from 2011 to 2020

In Trentino Alto Adige, the autonomous region of Italy incentives available in 2019 only with scrapping of EUR 4 000 for the purchase of an electric car and 2 000 for the purchase of a hybrid car, incentive cumulable with the national incentives as the “ecobonus” and the “extrabonus”. As well as the other regions the pattern is similar also in Trentino Alto Adige were the number of matriculated Diesel and Fossil Fuel decreased and the number of electric vehicles HEV slightly increased.

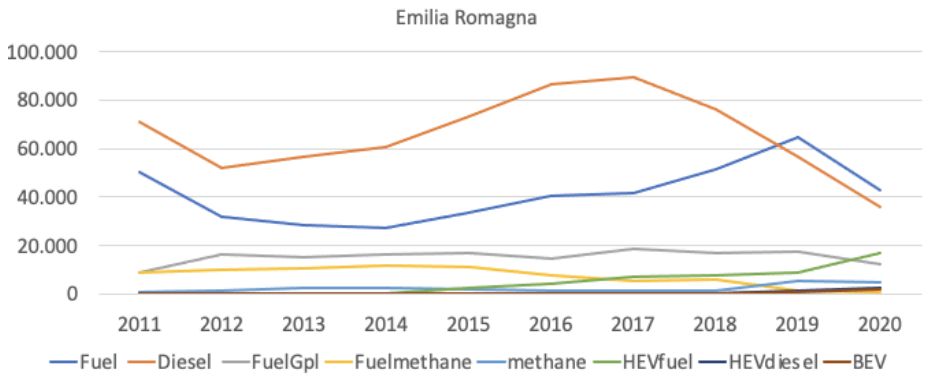

Figure 16 - - Automotive matriculation divided by type in Emilia Romagna from 2011 to 2020

For the Emilia Romagna the incentives are only for citizen having a ISEE lower than EUR 35 000 the contribution applied in 2019 offer up to EUR 10 000 for the companies who purchase an electric car, hybrid, methane, or GPL and up to EUR 3 000 for citizens who buy an electric car, hybrid, methane, or GPL. The effect of the incentives in Emilia Romagna is most visible for Fuel cars rather than Diesel cars, whose demand remain stable, is possible to notice an increase of HEV vehicles.

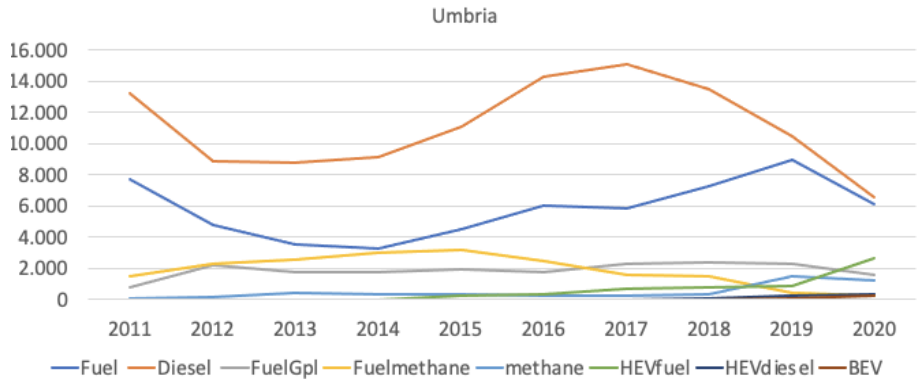

Figure 17 - Automotive matriculation divided by type in Umbria from 2011 to 2020

In the region of Umbria in 2019 EUR 4 million were offered to improve the air quality of the region, of this amount, EUR 680 000 were reserved for the contribution of the scrapping of old vehicles in favor of the electric or hybrid vehicles.

- EUR 4 000 for electric vehicles with scrapping EUR 3 000 for the hybrid vehicles with scrapping
- The incentives found a reactive demand, the matriculation of Fossil Fuel cars

The incentives found a responsive public, from the graph is easy to notice the effect of the incentives especially for the Fossil Fuel engine and a slight increase of the electric vehicles HEV.

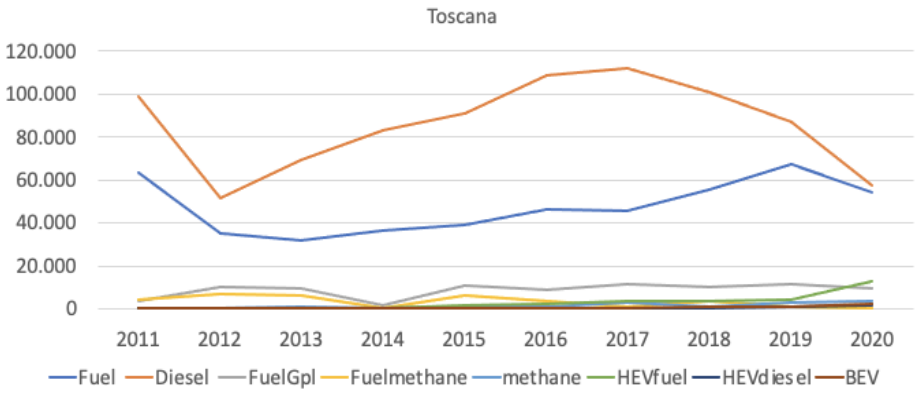

Figure 18 - Automotive matriculation divided by type in Toscana from 2011 to 2020

In Toscana the incentives are both for scrapping and without scrapping.

- For electric cars having 10-20 gr/km emissions the customer will have an incentive of EUR 6 000 with scrapping and 2 000 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 2 500 with scrapping and of 1 500 without scrapping.

The incentives found a response in the public having a decrease in both Diesel vehicles and Fuel vehicles and increase of more than double.

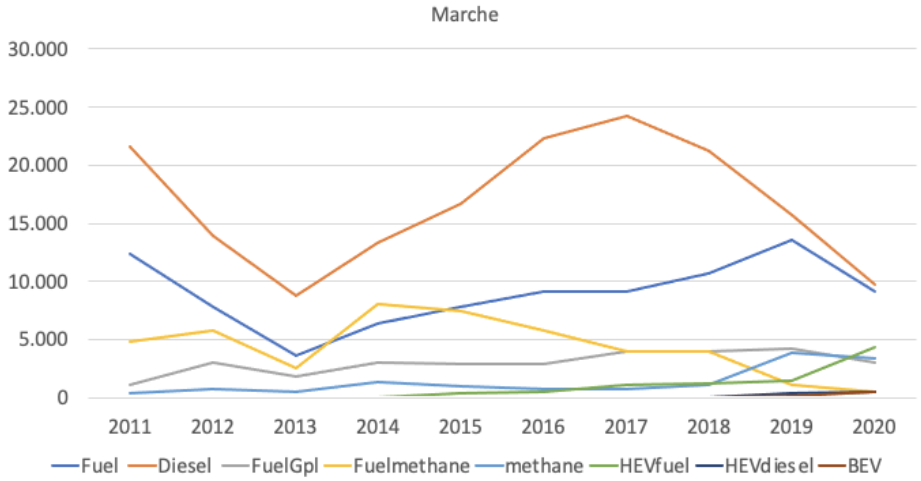

Figure 19 - Automotive matriculation divided by type in Marche from 2011 to 2020

The region of Marche creates a found of EUR 890 000 to finance cars, school buses and tourist shuttles. The region allows the purchase of electric and hybrid vehicles (cars, shuttles/ buses, school buses), both new but also

used with and without scrapping, the type of incentives depends over the amount of CO2/Km of each new vehicle. The incentives create an important decrease in the volume of matriculated Diesel and Fossil fuel and an increase in HEV fuel.

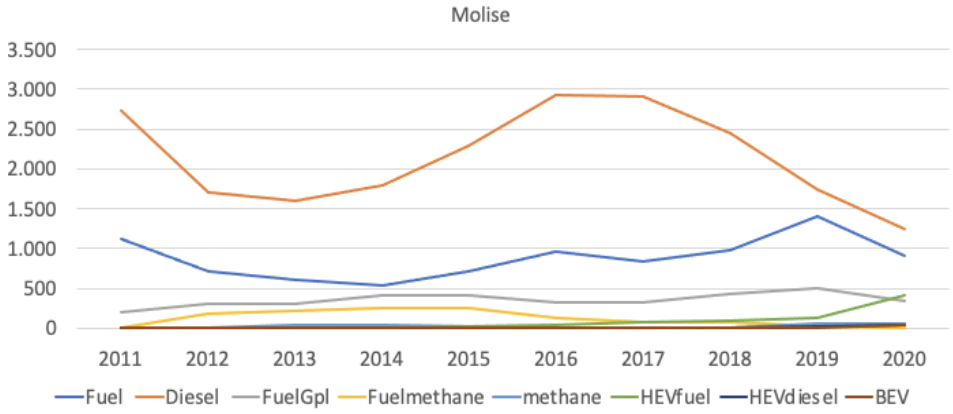

Figure 20 - Automotive matriculation divided by type in Molise from 2011 to 2020

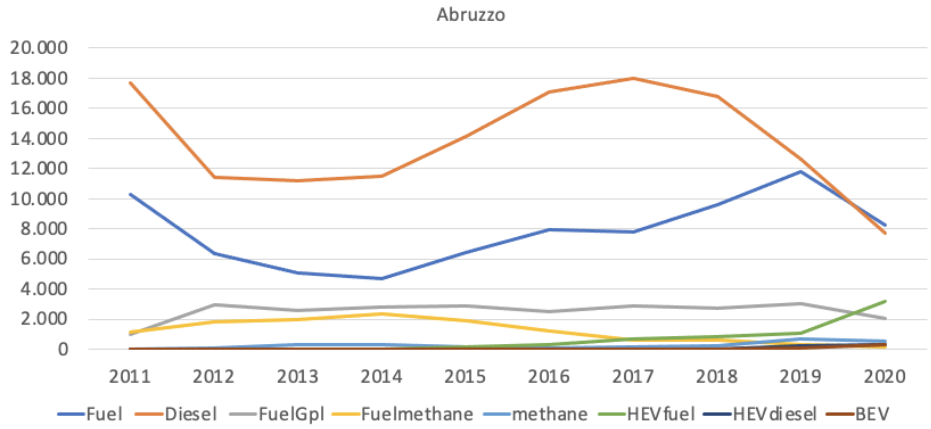

Figure 21 - Automotive matriculation divided by type in Abruzzo from 2011 to 2020

The regions of Molise and Abruzzo did not offer any type of incentives besides the exemption of the ownership tax and the exemption of the payable parking spots. Even without other types of incentives for both regions the HEV matriculation increased, and the matriculation of Diesel Fuel and Fossil Fuel decreased as well.

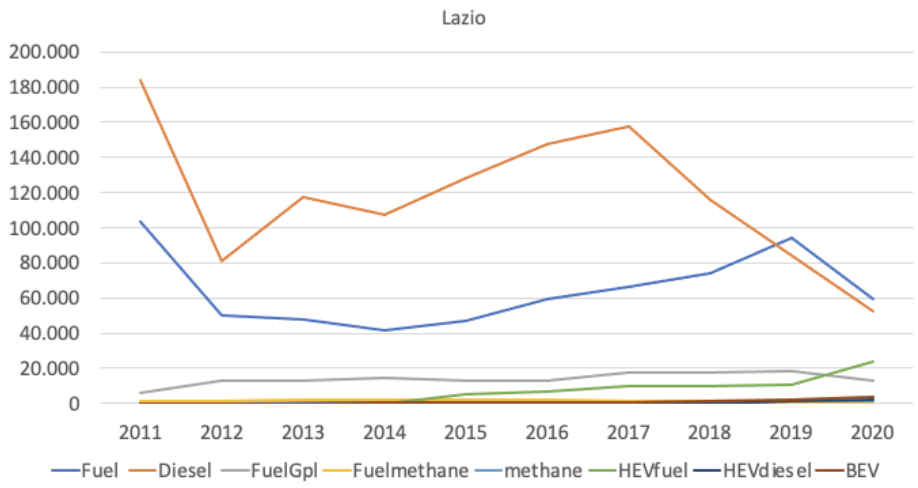

Figure 22 - Automotive matriculation divided by type in Lazio from 2011 to 2020

In the region of Lazio, the incentives are cumulative up to EUR 3 500 with the statal "ecobonus" meaning that if purchasing an electric car with scrapping the contribution comes to as much as EUR 13 500 and purchasing a vehicle having emission not exceeding 110 gr/km of CO2.

- EUR 3 500 for electric vehicles
- EUR 2 000 for hybrid vehicle
- EUR 1 000 for methane and hydrogen vehicles

The simultaneous scrapping must concern a motor vehicle for the transport of people, owned by the applicant (or his family member) for at least 6 months, with petrol power up to Euro 3 included or diesel up to Euro 5 included.

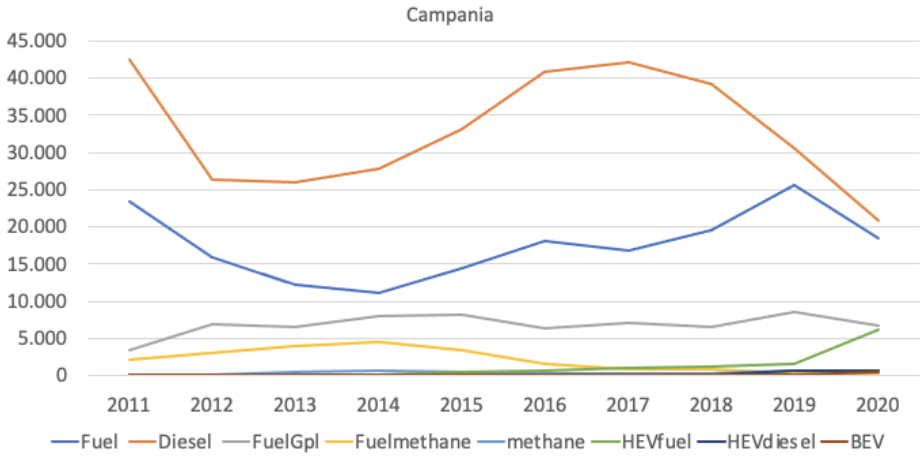

Figure 23 - Automotive matriculation divided by type in Campania from 2011 to 2020

The region of Campania offers incentives both for scrapping and without scrapping, the only condition for the customer purchasing a new electric vehicle with scrapping is having a vehicle of the same category approved in Euro classes 1, 2, 3 and 4.

- For electric cars having 10-20 gr/km emissions the customer will have an incentive of EUR 6 000 with scrapping and 2 500 without scrapping.
- For hybrid or hybrid plug-in having 21-60 gr/km emissions the customer will have an incentive of EUR 4 000 with scrapping and of 1 500 without scrapping.

The effect of the incentives was in line with the effect of the other regions, the amount of Diesel and Fossil Fuel started to decrease between 2018 and 2019 and from 2019 the amount of HEV increased of 5 thousand units.

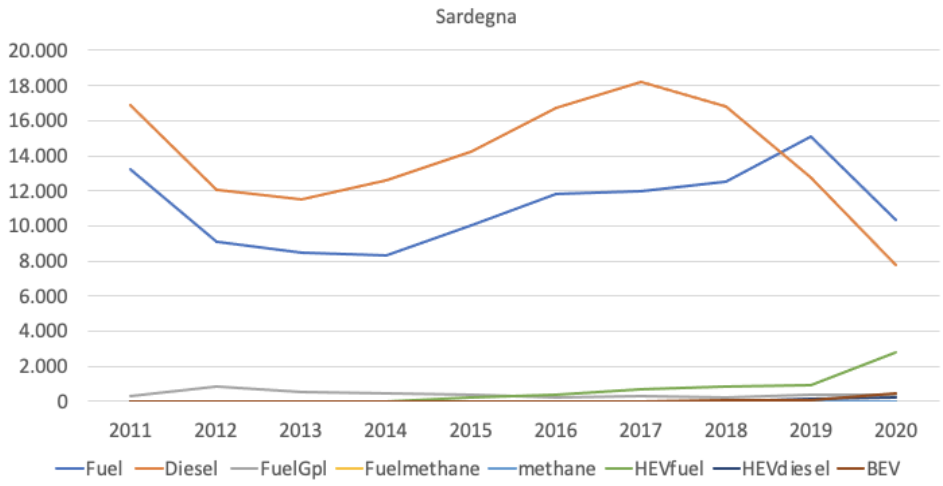

Figure 24 - Automotive matriculation divided by type in Sardegna from 2011 to 2020

The region has launched interesting initiatives in support of companies that want to switch to electric mobility already in 2019 allocating EUR 1.6 million for the incentives In Sardinia the contribution comes to 15,000 euros for the purchase of a car, 20,000 euros for the purchase of a van and 25,000 euros for the purchase of a van, the quantity of the incentive depend by the presence or not of scrapping and the amount of CO2 emitted by the purchased vehicle. The effect of the incentives was in line with the effect of most other regions, the amount of Diesel and Fossil Fuel started to decrease between 2018 and 2019 and from 2019 the amount of HEV increased of 2 thousand units.

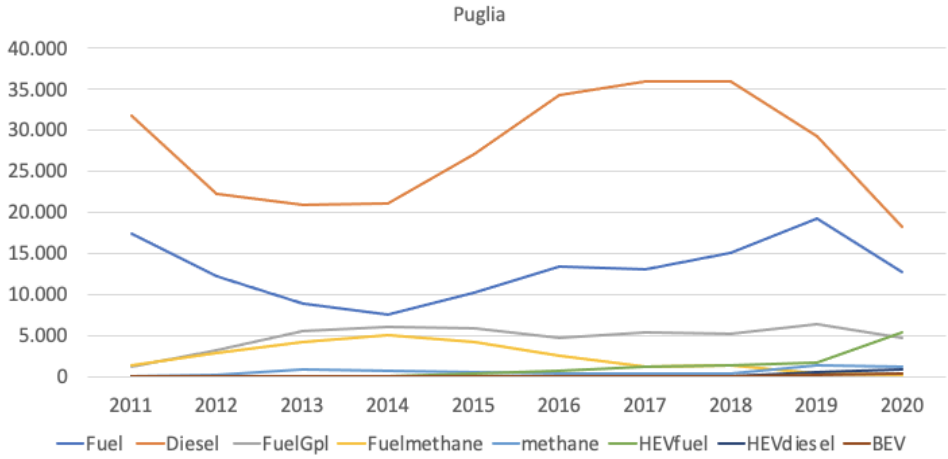

Figure 25 Automotive matriculation divided by type in Puglia from 2011 to 2020

The region of Puglia decided to have a different strategy, to offer an incentive not for the acquisition of a new electric or hybrid vehicle but to offer an incentive for the implementation of the charging station network, offering EUR 50 000 as found of this incentive, for each intervention the maximum incentive is of EUR 1 500, the offer is cumulative with other incentives, the application is allowed for the purchase and installation of a single charging station. The effect of the incentives was in line with the effect of the other regions, the amount of Diesel and Fossil Fuel started to decrease between 2018 and 2019 and from 2019 the amount of HEV increased of 5 thousand units.

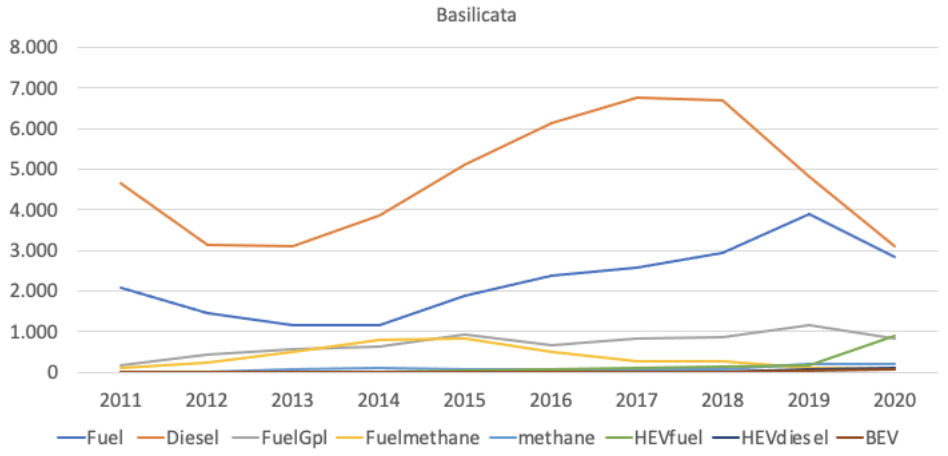

Figure 26 - Automotive matriculation divided by type in Basilicata from 2011 to 2020

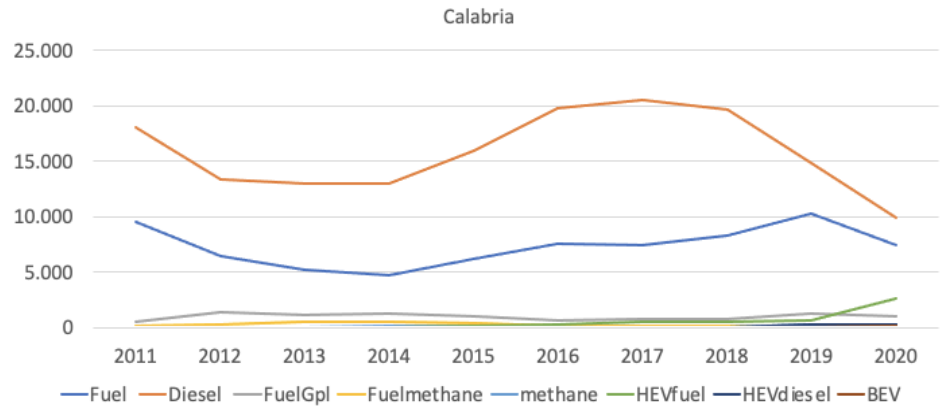

Figure 27 - Automotive matriculation divided by type in Calabria from 2011 to 2020

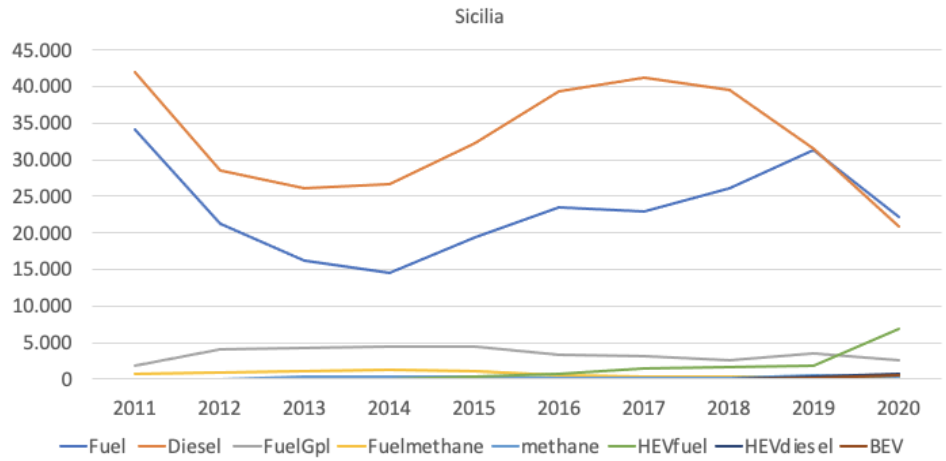

Figure 30 - Automotive matriculation divided by type in Sicilia from 2011 to 2020

As well as the regions of Abruzzo and Molise also the regions of Basilicata, Calabria and Sicilia did not offer any additional incentive to the "ecobonus" and "extrabonus". The regions show an increase in the matriculation of electric vehicles related to a more than proportional decrease of Diesel and Fossil Fuel vehicles. The analysis made over the amount and type of vehicles shows a reduction in volume in the matriculation of vehicles of any kind, a pattern that reflect the economic crisis in those years.

Conclusions

The paper demonstrated the downsize of the automotive industry in Italy over the years, the forecast analysis made from 2011 to 2022 shows how rapidly in the future the electric vehicles will substitute the internal combustion engines. The analysis shows a rapid increase in matriculated electric vehicles (BEV) after 2019, it also shows a less responsive increase in the adoption of hybrid (HEV) and plug-in hybrid (PHEV) vehicles. The data also shows a continuous decrease of the matriculated fossil fuel vehicles and a less responsive slope for the diesel vehicles. The forecast shows a recovery of diesel vehicles, mainly caused by the sine wave of the diesel vehicle over the time, the analysis has been made without taking in consideration independent variables as the changing prices of the oil over the years, the production capability of the industry, the availability of minerals as lithium and the availability of semiconductors over the market that will influence the price of the product or even the economic possibility of the customers and how it changes as inflation arise, the forecast reproduce the historical trend over ten years forecasting years from 2022 to 2025. The analysis over the regional matriculation size reflects the volumes in the national analysis. The citizens responsiveness in each different regions over the time shows how effective incentives and exemptions were and the ability of each region to implement a more sustainable transportation system. The economic differences in each region are reflected in the incentives possibilities and in the found offered, the region in the north of Italy were able to offer higher incentives rather than the region in the center of Italy and in the south, reporting higher volumes of vehicle matriculated. The region having the most matriculated electric vehicle is the region Lombardia having 54 000 electric, hybrid and plug-in hybrid vehicles matriculated in 2021. The analysis shows the effectiveness of policies as market maker and the responsiveness of the Italian citizens to national and regional incentives.

Summary

The automotive industry in the last decade has had many changes, the transformation of this sector generates new technologies to be mass produced, as the electric vehicles (BEV), the hybrid electric vehicles (HEV) and the plug-in hybrid electric vehicle (PHEV). The introduction of an innovation in the automotive industry found their early adopters and late laggers, the main skepticism in adopting a new technology is the range anxiety, meaning the fear to not be able to find a suitable charging network framework efficient enough to substitute the benefits that internal combustion engines use to give to the consumers. One of the main driving forces of the electric vehicle automotive market is the development rate of the service related with the innovation, the development of the charging stations has a different adoption rate in each countries, some governments decided to invest more than others in the implementation of public fast and slow charging stations, first of them is the government of China, being the first country in the world both for the development of the fast and slow public charging station, both for the number of matriculated electric and hybrid vehicles in total, the number showed in the analysis are relative numbers and in evaluating those rankings is important to take in considerations factors as the different volumes of population of each county and their economic situation. Another important driving factor of the analysis are the lithium-ion batteries, the lithium battery is the main element characterizing the price of the product, the economies of scale that companies can generate from the production of lithium battery are able to create a significant decrease in price of the electric and hybrid vehicles, generating a higher demand from the public, the main productors of lithium-ion batteries. The prices of the electric vehicles are very elastic to the different volumes of battery capacity and from the forecast analysis of the battery capacity over the years made by Statista before the end of 2030 the battery capacity of the future types of lithium-ion batteries will be well over the market demand, generating a price decrease of electric batteries

and an implementation of the km available per recharge influencing the range anxiety. Another driving factor influencing the future fluctuation of the electric vehicle price are the semiconductors, the availability of semiconductors is fundamental to produce all kind of vehicle over the automotive industry itself, those are needed to produce vehicles electric systems, vehicles road mapping systems, vehicles security systems and over all are fundamental to produce the electric part of an electric engine. Those semiconductors are mainly produced by few companies based in Taiwan, South Korea, and China, having most of their facilities in Taiwan. An example of the importance of those assets is in Taiwan is when due to a wrong demand forecasting during the first period of the Covid pandemic, the major producers of semiconductors heavily downsized their production, as the demand of electric vehicle surprisingly increased the absence of semiconductors brought most automotive companies to not have enough supplies to meet the market, many industries increase the waiting period, other increased the price of the product. The paper than analyze the government policy framework over the incentives and exemptions that the European Council made to be harmonized in the member states, the main objective of the European Union is to reach the decarbonization imposing the impossibility to produce internal combustion engine vehicles no longer than 2035, to meet this objective the main incentives and investments that governments made were to develop and adequate charging station network and to offer a financial support to the citizen when scrapping an old internal combustion engine vehicle with an electric vehicle. The forecast analysis made over the matriculated vehicles by type in Italy from 2011 to 2025 shows an increase in the adoption of electric vehicles (BEV) related to a more than proportional decrease of Diesel and Fossil Fuel vehicles. The analysis also shows a downsize of the automotive market in Italy, reflecting the economic crisis of the last decade.

Appendix A: forecast analysis with Datamining, Smoothing Holt-Winters no trend analysis

Error Measures: Training

Record ID	Value
SSE	2627097024
MSE	238827002
MAPE	12,5168115
MAD	11540,9734
CFE	29590,8322
MFE	2690,07565
TSE	2,56398063

Fitted

Record ID	year	FuelGpl	Fitted: FuelGpl	Residual
Record 1	2011	55889	79002	-23113
Record 2	2012	128879	124368,4	4510,6
Record 3	2013	115947	116686,52	-739,52
Record 4	2014	124498	126475,616	-1977,616
Record 5	2015	120762	103017,0928	17744,9072
Record 6	2016	102115	77131,42424	24983,5758
Record 7	2017	129103	133498,3194	-4395,3194
Record 8	2018	124867	123772,7495	1094,25049
Record 9	2019	136190	133866,6948	2323,30519
Record 10	2020	93800	112254,482	-18454,482
Record 11	2021	107105	79490,86903	27614,131

Forecast

Record ID	Forecast: FuelGpl	StdDev	LCI	UCI
2022	1349149,30	15454,0287	104625,591	165204,2701
2023	1263429,03	15760,0788	95453,7162	157232,0897
2024	1362794,51	16060,2977	104801,846	167757,056
2025	1131636,88	16355,0066	81108,4637	145218,9117
2026	863944,02	16644,4983	53771,7846	119017,0189

Error Measures: Training

Record ID	Value
SSE	2,3816E+11
MSE	2,1651E+10
MAPE	23,8628679
MAD	124796,52
CFE	-32526,363
MFE	-2956,9421
TSE	-0,2606352

Fitted

Record ID	year	Fuel	Fitted: Fuel	Residual
Record 1	2011	683881	641507,5	42373,5
Record 2	2012	467594	556424,7	-88830,7
Record 3	2013	401802	530631,56	-128829,56
Record 4	2014	394022	587925,148	-193903,15
Record 5	2015	491745	433204,0184	58540,9816
Record 6	2016	599134	581496,3897	17637,6103
Record 7	2017	628306	484906,2018	143399,798
Record 8	2018	678044	503559,2184	174484,782
Record 9	2019	851943	618261,9953	233681,005
Record 10	2020	522339	561679,9027	-39340,903
Record 11	2021	436611	688350,7286	-251739,73

Forecast

Record ID	Forecast: Fuel	StdDev	LCI	UCI
2022	5441731,82	147141,205	255781,72	832564,6443
2023	5357004,88	150055,175	241597,75	829803,2269
2024	6184661,20	152913,626	318760,921	918171,319
2025	5014967,31	155719,614	196291,896	806701,5668
2026	6254157,96	158475,928	314808,686	936022,9069

Error Measures: Training

Record ID	Value
SSE	6,9693E+11
MSE	6,3357E+10
MAPE	35,2087276
MAD	177904,763
CFE	-689061,52
MFE	-62641,957
TSE	-3,8732045

Fitted

Record ID	year	Diesel	Fitted: Diesel	Residual
Record 1	2011	965485	1003032,5	-37547,5
Record 2	2012	745416	921569,5	-176153,5
Record 3	2013	702739	797931,3	-95192,3
Record 4	2014	746991	693212,84	53778,16
Record 5	2015	872548	611277,472	261270,528
Record 6	2016	1040580	1002386,203	38193,7974
Record 7	2017	1112742	929141,1621	183600,838
Record 8	2018	978604	881501,8897	97102,1103
Record 9	2019	762992	822690,8347	-59698,835
Record 10	2020	452053	728434,6862	-276381,69
Record 11	2021	322826	1000859,137	-678033,14

Forecast

Record ID	Forecast: Diesel	StdDev	LCI	UCI
2022	7916390,62	251709,14	298298,214	1284979,91
2023	7029546,86	256693,963	199843,763	1206065,608
2024	6168831,61	261583,811	104188,313	1129578,01
2025	5237326,37	266383,914	1629,75898	1045835,515
2026	8313508,53	271099,04	300006,499	1362695,208

Error Measures: Training

Record ID	Value
SSE	4583619877
MSE	416692716
MAPE	246,255303
MAD	10996,6325
CFE	78415,1734
MFE	7128,65213
TSE	7,13083514

Fitted

Record ID	year	BEV	Fitted: BEV	Residual
Record 1	2011	307	842	-535
Record 2	2012	524	1165	-641
Record 3	2013	864	2695,8	-1831,8
Record 4	2014	1100	5283,94	-4183,94
Record 5	2015	1452	15534,152	-14082,15
Record 6	2016	1377	-3439,5284	4816,5284
Record 7	2017	2020	-2051,52272	4071,5227
Record 8	2018	4998	362,241824	4635,7582
Record 9	2019	10671	4126,286459	6544,7135
Record 10	2020	32493	16027,31857	16465,681
Record 11	2021	67263	4108,138874	63154,861

Forecast

Record ID	Forecast: BEV	StdDev	LCI	UCI
2022	171265,61	20413,053	-22882,29	57135,40871
2023	187542,33	20817,311	-22046,95	59555,41181
2024	216865,73	21213,867	-19891,84	63264,98774
2025	327747,11	21603,144	-9566,674	75116,09586
2026	198968,54	21985,53	-23193,99	62987,70209

Error Measures: Training

Record ID	Value
SSE	4146875335
MSE	376988667
MAPE	413,664237
MAD	10067,0124
CFE	74094,546
MFE	6735,86782
TSE	7,36013259

Fitted

Record ID	year	PHEVRex	Fitted: PHEVRex	Residual
Record 1	2011	0	722	-722
Record 2	2012	0	1300,1	-1300,1
Record 3	2013	200	2202,58	-2002,58
Record 4	2014	369	2649,064	-2280,064
Record 5	2015	890	12906,5512	-12016,551
Record 6	2016	1444	-2978,35904	4422,35904
Record 7	2017	2889	-1400,292232	4289,29223
Record 8	2018	5014	584,9422144	4429,05779
Record 9	2019	6539	2303,879572	4235,12043
Record 10	2020	27445	13377,5793	14067,4207
Record 11	2021	64504	3531,40895	60972,5911

Forecast

Record ID	Forecast: PHEVRex	StdDev	LCI	UCI
2022	164128,69	19416,196	-21642,176	54467,91368
2023	175472,33	19800,7124	-21261,45	56355,91637
2024	183706,62	20177,9028	-21177,301	57918,62474
2025	290889,53	20548,1704	-11184,721	69362,62662
2026	187745,57	20911,8831	-22211,981	59761,09438

Error Measures: Training

Record ID	Value
SSE	1,695E+11
MSE	1,5409E+10
MAPE	160,755848
MAD	77581,8355
CFE	500884,608
MFE	45534,9644
TSE	6,45620982

Fitted

Record ID	year	HEV	Fitted: HEV	Residual
Record 1	2011	5162	21204	-16042
Record 2	2012	6836	31946,6	-25110,6
Record 3	2013	14956	40121,98	-25165,98
Record 4	2014	21120	52236,784	-31116,784
Record 5	2015	25279	104101,4272	-78822,427
Record 6	2016	37246	-14849,65824	52095,6582
Record 7	2017	63474	9067,043408	54406,9566
Record 8	2018	81749	33143,16573	48605,8343
Record 9	2019	109881	59714,79238	50166,2076
Record 10	2020	221898	125450,7517	96447,2483
Record 11	2021	423520	48099,50567	375420,494

Forecast

Record ID	Forecast: HEV	StdDev	LCI	UCI
2022	1367967,39	124132,742	-106498,96	380092,4424
2023	1497014,14	126591,054	-98412,493	397815,3218
2024	1666298,93	129002,529	-86210,419	419470,2041
2025	2246466,63	131369,746	-32833,307	482126,6327
2026	1419546,29	133695,054	-120082,86	403992,1208

Error Measures: Training

Record ID	Value
SSE	1779933863
MSE	161812169
MAPE	26,8612912
MAD	11416,9036
CFE	-33719,029
MFE	-3065,3663
TSE	-2,9534303

Fitted

Record ID	year	methane	Fitted: methane	Residual
Record 1	2011	38308	41051	-2743
Record 2	2012	53695	42672,4	11022,6
Record 3	2013	68042	54397,92	13644,08
Record 4	2014	72389	59897,736	12491,264
Record 5	2015	62942	54166,4888	8775,5112
Record 6	2016	43794	49551,94104	-5757,941
Record 7	2017	32747	51258,63283	-18511,633
Record 8	2018	37442	57208,38027	-19766,38
Record 9	2019	38637	55968,46341	-17331,463
Record 10	2020	31625	44086,88309	-12461,883
Record 11	2021	31418	34498,18386	-3080,1839

Forecast

Record ID	Forecast: methane	StdDev	LCI	UCI
2022	361027,42	12720,5412	11170,9398	61034,54518
2023	456920,79	12972,4576	20266,5294	71117,62881
2024	485271,84	13219,5742	22617,2948	74437,07356
2025	403553,76	13462,1555	13970,0357	66740,7154
2026	337281,38	13700,4422	6875,76461	60580,51118

Appendix B: matriculations of vehicles by type in Italian regions from 2011 to 2020, elaboration of UNRAE data from the 2020 statistical analysis.

	year	Fuel	Diesel	FuelGpl	Fuelmethane	methane	HEVfuel	HEVdiesel	BEV
Valle D'Aosta	2011	4.235	21.225	692	156	8	0	0	3
Valle D'Aosta	2012	13.720	26.215	239	74	8	0	0	5
Valle D'Aosta	2013	1.214	3.729	200	34	3	0	0	3
Valle D'Aosta	2014	1.206	3.431	119	26	5	0	0	1
Valle D'Aosta	2015	1.498	1.909	109	13	3	40	0	0
Valle D'Aosta	2016	2.456	2.460	99	9	2	89	2	8
Valle D'Aosta	2017	3.058	2.751	185	9	0	242	0	8
Valle D'Aosta	2018	3.901	2.767	502	16	1	300		2
Valle D'Aosta	2019	5.581	1.969	460	25	6	340	34	30
Valle D'Aosta	2020	4.029	1.289	479	3	8	839	53	141
Piemonte	2011	79.659	26.215	8.792	1.872	57	0	0	6
Piemonte	2012	60.468	66.661	22.453	2.242	129	0	0	22
Piemonte	2013	63.881	77.196	19.039	5.875	296	0	0	50
Piemonte	2014	65.349	82.821	18.276	3.409	360	0	0	44
Piemonte	2015	70.985	93.376	18.542	3.476	179	1.443	31	46
Piemonte	2016	89.226	113.492	15.097	1.840	97	2.073	19	37
Piemonte	2017	107.166	139.249	22.396	2.590	136	5.066	16	74
Piemonte	2018	89.308	111.340	23.681	2.172	181	6.643	120	210
Piemonte	2019	103.559	82.353	20.247	901	940	6.692	876	503
Piemonte	2020	68.231	53.788	11.841	283	940	20.362	1.295	2.483
Lombardia	2011	164.055	171.824	9.953	2.709	497	0	0	95
Lombardia	2012	105.440	124.656	22.619	3.562	832	0	0	144
Lombardia	2013	99.180	113.008	18.977	3.586	1.420	0	0	179
Lombardia	2014	101.840	116.140	19.158	3.684	1.344	0	0	216
Lombardia	2015	114.472	129.637	16.793	3.236	857	6.888	139	233
Lombardia	2016	138.574	152.849	13.065	2.357	569	10.012	171	344
Lombardia	2017	139.823	158.005	15.863	1.859	494	16.494	45	422
Lombardia	2018	168.173	125.865	14.944	2.620	598	19.317	321	665
Lombardia	2019	209.969	85.543	18.485	476	3.417	22.834	2.631	1.947
Lombardia	2020	125.816	48.554	12.847	150	2.724	43.665	3.965	6.394
Veneto	2011	51.094	71.972	5.780	3.466	393	0	0	15
Veneto	2012	33.080	54.688	12.383	4.518	794	0	0	12
Veneto	2013	29.330	54.811	10.926	4.749	1.609	0	0	62
Veneto	2014	29.901	57.518	11.709	5.476	1.406	0	0	75
Veneto	2015	36.001	66.264	12.067	5.046	1.043	2.291	64	77
Veneto	2016	44.634	80.886	9.917	3.736	723	3.792	27	130
Veneto	2017	45.691	80.239	11.983	2.654	700	6.917	32	159
Veneto	2018	55.950	69.866	12.671	3.604	780	7.801	244	285
Veneto	2019	73.614	51.876	12.579	1.067	4203	9.010	1.709	800
Veneto	2020	**48.551**	**29.515**	**8.645**	**433**	**3761**	**17.578**	**2.564**	**2.296**
Trentino Alto Adige	2011	11.453	22.390	453	157	28	0	0	13
Trentino Alto Adige	2012	34.755	121.986	1.761	593	201	0	0	95
Trentino Alto Adige	2013	3.561	8.772	1.766	2.586	445	0	0	13
Trentino Alto Adige	2014	36.167	83.162	1.442	263	176	0	0	114
Trentino Alto Adige	2015	44.802	99.104	1.138	255	113	1.367	16	150
Trentino Alto Adige	2016	53.417	115.718	1.012	976	117	2.872	39	160
Trentino Alto Adige	2017	60.857	128.352	940	905	90	2.131	36	170
Trentino Alto Adige	2018	59.374	152.374	2.125	1.476	109	1.319	40	934
Trentino Alto Adige	2019	88.509	143.919	3.612	90	1.887	1.611	463	2.011
Trentino Alto Adige	2020	59.762	89.846	1.701	215	3.357	5.036	1.543	7.083
Friuli Venezia Giulia	2011	18.209	15.564	425	89	10	0	0	3
Friuli Venezia Giulia	2012	11.879	11.966	1.088	122	26	0	0	4
Friuli Venezia Giulia	2013	10.614	12.063	974	137	67	0	0	13
Friuli Venezia Giulia	2014	11.799	13.418	870	169	52	0	0	7
Friuli Venezia Giulia	2015	13.731	14.953	924	137	35	1.143	5	42
Friuli Venezia Giulia	2016	15.588	17.333	734	109	19	861	5	27
Friuli Venezia Giulia	2017	16.235	18.586	818	96	21	1.310	6	47
Friuli Venezia Giulia	2018	17.734	16.812	712	134	32	1.687	31	53
Friuli Venezia Giulia	2019	19.743	11.779	822	52	301	2.254	413	210
Friuli Venezia Giulia	2020	11.773	5.797	551	21	181	5.613	488	671

Liguria	2011	18.820	18.374	753	438	16	0	0	1
Liguria	2012	12.164	14.244	1.890	770	22	0	0	3
Liguria	2013	10.900	14.884	1.716	704	122	0	0	22
Liguria	2014	10.858	15.101	1.957	633	115	0	0	5
Liguria	2015	12.941	17.591	1.767	496	70	417	2	10
Liguria	2016	14.879	19.529	1.335	356	66	649	1	5
Liguria	2017	14.714	19.736	1.637	290	59	1.322	4	22
Liguria	2018	17.260	15.540	1.553	358	69	1.581	22	58
Liguria	2019	21.934	11.177	1.827	98	242	1.981	269	162
Liguria	2020	13.949	6.301	1.245	47	265	6.209	404	399
Emilia Romagna	2011	50.333	71.077	8.871	9.073	785	0	0	21
Emilia Romagna	2012	32.069	52.009	16.640	10.213	1.504	0	0	31
Emilia Romagna	2013	28.460	56.628	15.031	10.542	2.514	0	0	82
Emilia Romagna	2014	27.600	60.582	16.231	11.783	2.379	0	0	172
Emilia Romagna	2015	33.479	73.271	16.769	11.005	1.829	2.717	59	85
Emilia Romagna	2016	40.783	86.502	14.691	7.839	1.309	4.337	32	87
Emilia Romagna	2017	41.576	89.180	18.435	5.459	1.193	6.986	27	123
Emilia Romagna	2018	51.751	76.384	17.159	6.125	1.424	7.897	185	358
Emilia Romagna	2019	64.496	56.921	17.779	1.689	5.273	8.882	1.698	64.496
Emilia Romagna	2020	43.040	36.051	12.151	620	4.836	17.231	2.505	1.950
Toscana	2011	63.051	98.503	3.491	4.366	188	0	0	22
Toscana	2012	35.403	51.752	9.950	7.021	397	0	0	15
Toscana	2013	31.606	69.549	9.432	6.441	1.254	0	0	57
Toscana	2014	36.167	83.162	1.442	263	176	0	0	114
Toscana	2015	39.335	90.589	11.064	6.518	974	1.702	71	200
Toscana	2016	46.135	108.755	8.997	3.911	701	2.456	35	76
Toscana	2017	45.397	112.152	11.561	685	2.716	3.522	13	216
Toscana	2018	55.401	100.988	10.299	3.650	756	3.541	106	938
Toscana	2019	67.451	86.708	11.604	812	3.083	4.547	1.112	1.190
Toscana	2020	54.008	57.657	9.245	334	3.291	12.594	1.632	2.508
Umbria	2011	7.744	13.253	757	1.538	82	0	0	0
Umbria	2012	4.743	8.876	2.247	2.270	166	0	0	4
Umbria	2013	3.561	8.772	1.766	2.586	445	0	0	13
Umbria	2014	3.314	9.145	1.795	2.974	375	0	0	25
Umbria	2015	4.475	11.111	1.952	3.199	331	267	28	14
Umbria	2016	6.063	14.253	1.781	2.434	271	338	3	13
Umbria	2017	5.873	15.119	2.335	1.549	260	700	3	15
Umbria	2018	7.223	13.514	2.349	1.510	375	772	30	26
Umbria	2019	8.948	10.447	2.299	431	1.496	880	271	77
Umbria	2020	6.082	6.581	1.570	294	1.270	2.669	296	224
Marche	2011	12.346	21.544	1.120	4.864	409	0	0	1
Marche	2012	7.846	13.946	3.062	5.834	697	0	0	8
Marche	2013	3.561	8.772	1.766	2.586	445	0	0	13
Marche	2014	6.432	13.343	3.010	8.087	1.393	0	0	16
Marche	2015	7.754	16.691	2.923	7.464	942	351	3	17
Marche	2016	9.087	22.295	2.922	5.817	751	445	3	16
Marche	2017	9.177	24.231	4.012	3.960	794	1.073	3	13
Marche	2018	10.660	21.277	4.025	3.948	1.109	1.263	68	36
Marche	2019	13.623	15.744	4.273	1.094	3.869	1.517	412	112
Marche	2020	9.190	9.784	3.043	480	3.363	4.360	547	481
Abbruzzo	2011	10.312	17.723	962	1.124	35	0	0	2
Abbruzzo	2012	6.374	11.439	2.979	1.834	97	0	0	3
Abbruzzo	2013	5.075	11.198	2.602	1.963	322	0	0	13
Abbruzzo	2014	4.665	11.505	2.820	2.371	344	0	0	5
Abbruzzo	2015	6.455	14.164	2.859	1.869	192	171	7	10
Abbruzzo	2016	7.944	17.121	2.534	1.200	108	285	4	3
Abbruzzo	2017	7.806	17.991	2.918	626	148	715	2	8
Abbruzzo	2018	9.614	16.815	2.771	652	227	877	19	21
Abbruzzo	2019	11.798	12.667	3.013	299	714	1.076	269	75
Abbruzzo	2020	8.247	7.704	2.059	166	571	3.177	315	287

Lazio	2011	103.403	184.233	5.975	1.219	60	0	0	130
Lazio	2012	50.147	81.282	12.746	1.515	127	0	0	156
Lazio	2013	48.155	117.760	12.787	2.029	569	0	0	198
Lazio	2014	41.471	107.359	14.245	2.163	667	0	0	287
Lazio	2015	47.334	127.915	12.761	1.894	449	4.947	147	479
Lazio	2016	59.125	147.752	13.092	1.860	317	6.819	80	409
Lazio	2017	66.102	157.302	17.865	1.392	348	9.791	14	534
Lazio	2018	74.358	115.782	17.353	1.408	405	10.113	76	1.183
Lazio	2019	93.971	83.952	18.456	245	1.552	10.999	1.191	2.023
Lazio	2020	59.690	52.129	13.272	120	1.344	23.831	1.807	4.043
Sadegna	2011	13.251	16.914	335	17	1	0	0	3
Sadegna	2012	9.062	12.040	861	11	1	0	0	8
Sadegna	2013	8.482	11.497	524	10	2	0	0	13
Sadegna	2014	8.297	12.587	439	13	2	0	0	13
Sadegna	2015	10.069	14.214	375	8	1	211	2	18
Sadegna	2016	11.814	16.693	236	5	1	342	0	22
Sadegna	2017	11.949	18.190	308	1	1	685	1	15
Sadegna	2018	12.496	16.771	235	6	0	835	13	32
Sadegna	2019	15.072	12.758	403	0	5	931	162	93
Sadegna	2020	10.306	7.746	345	1	2	2.811	182	435
Campania	2011	23.428	42.423	3.328	2.176	47	0	0	2
Campania	2012	15.836	26.328	6.966	3.106	91	0	0	6
Campania	2013	12.200	26.001	6.455	3.955	456	0	0	17
Campania	2014	11.037	27.787	7.907	4.428	617	0	0	14
Campania	2015	14.360	33.172	8.189	3.426	368	457	8	18
Campania	2016	18.117	40.917	6.359	1.628	208	605	4	12
Campania	2017	16.812	42.133	7.025	749	234	1.020	2	15
Campania	2018	19.579	39.242	6.537	780	184	1.176	47	36
Campania	2019	25.650	30.484	8.602	284	631	1.587	653	129
Campania	2020	18.416	20.847	6.742	205	623	6.228	691	448
Puglia	2011	17.467	62	1.118	1.379	0	0	0	0
Puglia	2012	12.209	22.261	3.230	2.815	183	0	0	5
Puglia	2013	8.860	20.935	5.506	4.149	787	0	0	20
Puglia	2014	7.520	21.090	6.082	5.026	772	0	0	13
Puglia	2015	10.144	27.005	5.820	4.195	529	385	8	20
Puglia	2016	13.438	34.313	4.744	2.458	373	626	6	9
Puglia	2017	13.002	35.943	5.418	1.252	358	1.121	2	20
Puglia	2018	15.101	35.888	5.284	1.332	368	1.299	73	33
Puglia	2019	19.253	29.185	6.294	412	1.338	1.652	587	160
Puglia	2020	12.758	18.198	4.652	269	1.254	5.310	813	426
Basilicata	2011	2.095	4.646	175	114	4	0	0	1
Basilicata	2012	1.464	3.126	449	251	10	0	0	2
Basilicata	2013	1.158	3.098	556	508	70	0	0	1
Basilicata	2014	1.174	3.860	638	788	106	0	0	3
Basilicata	2015	1.886	5.126	913	820	71	45	1	0
Basilicata	2016	2.388	6.140	654	484	62	59	3	2
Basilicata	2017	2.579	6.765	823	268	74	93	1	3
Basilicata	2018	2.950	6.693	853	253	57	144	6	6
Basilicata	2019	3.891	4.828	1.173	94	218	161	78	22
Basilicata	2020	2.834	3.088	836	72	193	905	89	79
Calabria	2011	9.533	18.012	472	102	2	0	0	1
Calabria	2012	6.438	13.357	1.345	325	14	0	0	2
Calabria	2013	5.182	12.974	1.187	522	74	0	0	13
Calabria	2014	4.731	13.007	1.246	557	86	0	0	5
Calabria	2015	6.211	16.020	991	380	87	189	3	4
Calabria	2016	7.615	19.803	651	173	31	247	0	2
Calabria	2017	7.413	20.554	726	131	52	537	1	8
Calabria	2018	8.331	19.623	758	161	33	565	38	18
Calabria	2019	10.264	14.851	1.283	42	217	640	225	41
Calabria	2020	7.499	9.924	989	21	233	2.625	300	191

Molise	**2011**	1.124	2.734	197	0	4	0	0	0
Molise	**2012**	722	1.714	314	179	1.714	0	0	0
Molise	**2013**	612	1.595	307	214	47	0	0	0
Molise	**2014**	534	1.801	418	253	44	0	0	0
Molise	**2015**	712	2.284	421	259	18	26	0	0
Molise	**2016**	972	2.930	335	126	**7**	50	0	2
Molise	**2017**	839	2.916	332	83	12	78	0	1
Molise	**2018**	984	2.457	437	75	15	95	3	2
Molise	**2019**	1.406	1.750	510	22	60	125	27	8
Molise	**2020**	904	1.242	352	10	68	423	41	38
Sicilia	**2011**	34.064	41.936	1.909	625	7	0	0	0
Sicilia	**2012**	21.253	0	4.098	967	0	0	0	5
Sicilia	**2013**	16.194	26.023	4.245	1.104	279	0	0	20
Sicilia	**2014**	14.590	26.617	4.496	1.215	402	0	0	18
Sicilia	**2015**	19.444	32.312	4.427	1.062	249	429	2	44
Sicilia	**2016**	23.386	39.306	3.355	579	174	711	2	13
Sicilia	**2017**	22.894	41.235	3.205	311	108	1.449	5	25
Sicilia	**2018**	26.007	39.471	2.581	332	93	1.571	57	47
Sicilia	**2019**	31.386	31.404	3.463	132	454	1.917	432	135
Sicilia	**2020**	22.095	20.814	2.605	68	416	6.855	664	567

Appendix C: matriculations of total vehicle in Europe from 2016 to 2020, elaboration of ACEA's data report, vehicles in Europe 2022.

	2016	2017	2018	2019	2020	BHEV	PHEV	HEV
Austria	4,821,557	4,898,578	4,978,852	5,039,548	5,091,827	0.9 %	0.0 %	1.6 %
Belgium	5,669,766	5,735,280	5,782,684	5,813,771	5,827,195	0.5 %	1.2 %	1.5 %
Croatia	1,528,119	1,567,883	1,665,391	1,728,911	1,733,727	0.1 %	0.0 %	0.3 %
Cyprus	508,284	526,617	550,695	572,501	578,158	0.0 %	0.0 %	1.7 %
Czech Republic	5,368,660	5,592,738	5,802,520	5,989,538	6,129,874	0.1 %	0.1 %	0.5 %
Denmark	2,465,956	2,529,979	2,593,589	2,650,227	2,720,273	1.2 %	1.1 %	1.1 %
Estonia	703,151	725,944	746,464	794,926	808,689	0.2 %	0.0 %	1.6 %
Finland	2,629,432	2,668,930	2,696,334	2,720,307	2,748,448	0.4 %	1.7 %	0.0 %
France	37,586,724	38,086,586	38,253,851	38,467,190	38,346,266	0.6 %	0.4 %	1.7 %
Germany	45,803,560	46,474,594	47,095,784	47,715,977	48,248,584	0.6 %	0.6 %	1.5 %
Greece	5,126,024	5,169,026	5,164,183	5,247,295	5,315,875	0.0 %	0.0 %	0.7 %
Hungary	3,308,495	3,467,861	3,638,374	3,809,670	3,918,923	0.3 %	0.3 %	1.6 %
Ireland	2,089,419	2,064,020	2,104,060	2,172,098	2,215,127	0.6 %	0.6 %	2.7 %
Italy	37,876,138	38,520,321	39,018,170	39,545,232	39,717,874	0.1 %	1.4 %	0.0 %
Latvia	594,295	617,791	636,671	656,875	672,962	0.2 %	0.0 %	0.0 %
Lithuania	1,190,146	1,212,154	1,238,119	1,264,084	1,285,743	0.2 %	0.0 %	2.1 %
Luxemburg	390,933	403,258	415,128	426,324	435,989	1.0 %	1.1 %	2.0 %
Netherlands	8,439,318	8,594,600	8,787,283	8,938,572	9,049,959	2.0 %	1.1 %	3.0 %
Poland	21,675,388	22,503,579	23,429,016	24,360,166	25,113,862	0.1 %	0.0 %	1.0 %
Portugal	4,600,000	4,800,000	5,015,000	5,205,000	5,300,000	0.5 %	0.6 %	1.1 %
Romania	5,470,578	5,996,377	6,450,750	6,901,236	7,274,728	0.1 %	0.0 %	0.3 %
Slovakia	2,124,972	2,228,118	2,326,787	2,326,787	2,444,478	0.1 %	0.1 %	0.8 %
Slovenia	1,143,218	1,192,358	1,220,814	1,249,364	1,253,984	0.3 %	0.0 %	0.7 %
Spain	23,320,290	23,942,022	24,520,287	25,008,222	25,169,158	0.2 %	0.2 %	1.9 %
Sweden	4,768,060	4,845,609	4,870,783	4,887,904	4,944,067	1.1 %	2.5 %	2.6 %
Iceland	211,456	214,045	222,729	223,999	227,907	2.8 %	4.5 %	3.0 %
Norway	2,639,245	2,693,021	2,720,013	2,768,990	2,794,457	12.1 %	5.1 %	4.7 %
Switzerland	4,571,994	4,620,630	4,665,390	4,572,188	4,728,444	0.9 %	0.0 %	2.9 %
United Kingdom	34,378,386	34,686,328	34,887,915	35,168,259	5,141,909	0.5 %	0.6 %	2.0 %

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