

The co-evolution of the climate change issue and the car industry in the EU: the case of Spain

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Abstract: This work aims to study the co-evolution of the climate change problem and its strategic responses from European automakers. This is done in two steps and at two levels. Firstly, by examining the co-evolution of the EU's position regarding climate change, its passenger car policies, and the (lobbying) responses of the industry. Here, it is observed how due to the relentless lobbying influence of automakers through powerful member states as Germany, the EU has historically avoided establishing policies to tackle carbon emissions from passenger cars. Secondly, and as a case study, Spain was selected for further socio-political research. For this purpose, system innovation studies are introduced and, particularly, the Dialectic Life Issue Cycle (DILC), a theoretical framework, developed by Penna and Geels (2012), is applied. Following this model, a mixed methodology with a quantitative socio-political analysis of various time-series and an in-depth qualitative study of primary sources is used. The application of this model served to analyse how technological transitions take place in several phases, alongside a pressing broad societal problem as climate change. As expected, the technological shift is slow and unwanted by automakers, which refrain from assuming any risks, and hence, take a long time to commit to alternative low-carbon emission technologies.

Keywords: climate change, car industry, technological innovation, DILC model

Table of contents

| | |
|---|----|
| List of abbreviations | 7 |
| Introduction | 8 |
| Research questions and structure..... | 12 |
| Societal relevance | 14 |
| Academic relevance | 14 |
| I. Theoretical framework and methodology | 15 |
| 1. Theoretical contextualization..... | 15 |
| 1.1 Innovation studies in relation to sustainable development | 16 |
| 1.2 Innovation of systems and wide-sociotechnical changes | 17 |
| 2. Theoretical model: an application of the Dialectical Issue Life-Cycle model to the case study..... | 19 |
| 3. Methodology, sources, objectives, and limitations | 21 |
| II. The European Union position on climate change and its policies regarding CO2 emissions of passenger cars..... | 24 |
| 1. The confirmation of the Climate Change theory and the development of International Environmental Politics..... | 24 |
| 2. European Union's 1997 Kyoto Protocol leadership and its impasse policy for passenger car CO2 emission standards | 26 |
| 3. European Union's 2009 Copenhagen Summit failure and its indulgent industry-led binding policy for passenger cars CO2 emission standards | 33 |
| 4. European Union's adaptive position at the 2015 Paris Summit and its new policy for passenger cars: a broad-scale fraud and the introduction of alternative vehicles..... | 37 |
| 5. European Union's passenger car policy towards Paris Agreement 1.5 ° objective. Tougher CO2 emission standards after the post- <i>Dieseltgate</i> era?..... | 44 |
| Main takeaways | 46 |
| III. The climate change issue and the slow reorientation of the car industry in Spain | 49 |
| 1. Emergence of climate change as an issue and lack of impact on the car industry (1995-2006) | 49 |
| 2. Increased public and political attention on climate change and hedged position by the car industry (2006-2010)..... | 51 |
| 3. Diminishing attention on climate change and the emergence of a wide range of alternative cars (2010-2016) | 54 |
| 4. Climate change as an emergency, the start of the end of the Diesel car, and the initial penetration in the market of alternative vehicles (2016-2021)..... | 58 |
| Pattern-matching the case of Spain with the DILC model | 63 |
| Final conclusions | 64 |
| Bibliography | 67 |

List of abbreviations

| | |
|-----------------|---|
| ACEA | European Automobile Manufacturers' Association |
| ANFAC | Spanish Association of Automobile and Truck Manufacturers |
| BEV | Battery electric vehicle |
| CNG | Compressed natural gas |
| COP | Conference of Parties |
| CO ₂ | Carbon dioxide |
| DILC | Dialectic Issue Life Cycle |
| EC | European Commission |
| ETS | Emission Trading System |
| EU | European Union |
| EV | Electric vehicle |
| EVI | Electric Vehicles Initiative |
| Flexi-fuel | Flexible fuel |
| GHG | Greenhouse gas |
| HEV | Hybrid electric vehicle |
| ICE | Internal combustion engine |
| IPCC | Intergovernmental Panel on Climate Change |
| LPG | Liquefied petroleum gas |
| NEDC | New European Driving Cycle |
| NGO | Non-governmental organization |
| NPF | National Policy Framework |
| PHEV | Plug-in hybrid electric vehicle |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VDA | German Association of the Automotive Industry |
| WMO | World Meteorological Organization |
| WTLP | Worldwide Harmonised Light Vehicles |

Introduction

During the first decades of the 20th century, the car industry experienced a shift from handmade production to the implementation of mass production techniques. In this context, in 1908 the Ford Model T was pioneered and introduced in the USA by Ford Motor Company. Built to be accessible and affordable for the general population, its production prompted a new type of mobility based on the internal combustion engine (ICE) and private transport.¹

However, at this point, oil fuel and its respective internal combustion engine were not the hegemonic technology. Multiple engine technologies (electric, steam, and combustion) and vehicles (electric tram, bicycle, horse-bus, and automobile) competed, coexisted, and endured for decades.² However, even if the electric vehicle was quiet and easy to operate, its range was limited by battery capacity. High steam pressures were as well ultimately disregarded, as steam engines required an expensive build and were difficult to maintain. Finally, in the 1930s the historical automotive Big Three (Ford, General Motors, and Chrysler) was already fully established and supplied the large majority of the American market with internal combustion motor vehicles.³

Ever since, and until present times, the global car industry has preserved and reinforced the same common technological trajectory: the internal combustion engine. It has not mattered that organizations like the Intergovernmental Panel for Climate Change (IPCC) have called to stop the combustion of fossil fuels since 1992.⁴ Thus, only towards the end of the 2010s, different disruptive low-carbon alternatives, primarily the electric engine, have become gradually but ultimately widely introduced.⁵ Until then, the oil industry and interests in favour of fuel cells pushed to create an unfavourable environment for electric vehicles.⁶ Since the 1990s there has been a tentative fruitless implementation of alternative novelties that faded away from the internal combustion

¹ See Geels, 2005, for a full explanation of the process in the USA from 1870 to 1930.

² Ibid.

³ Alan K. and Rae, John Bell, 2020.

⁴ Climate Change: The IPCC 1990 and 1992 Assessments. IPCC First Assessment Report Overview and Policymaker Summaries and 1992 IPCC Supplement. See: pp.9, and 53-56.:
https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report.pdf

⁵ IEA (2020), Tracking Transport 2020, IEA, Paris <https://www.iea.org/reports/tracking-transport-2020>

⁶ Martínez-Lao et al., 2017

engine.⁷ This failed transition can be explained, among other reasons, due to vested interests linked to sunk investments of the industry,⁸ and to the uncertainty of automakers of “betting on the wrong horse”.⁹ Thus, the lack of predictability of which would be the winning technological solution has delayed the greening of the industry.

Nowadays, the ICE car industry is one of the most important economic sectors in the EU. In 2017, the automotive sector accounted for 6.1% of all EU jobs, almost 14 million. It also represents the largest R&D sector in the EU, 28% of the total share. In Spain, 8.3% (157.610) of manufacturing jobs are in the automotive sector, and, in 2018, it accounted for 30 billion euros in tax revenue, 7.2% of the total country’s tax revenue.¹⁰

Accordingly, despite the socio-political change coming from the climate change issue, European automakers have not been pressured enough to provide alternatives to the ICE technology. The Spanish industry, owned by European automakers, has not been different. The first electric vehicle was commercialised in Spain as recently as 2013. Since then, three different and co-existing low-carbon options are sold: a) flexi-fuel cars,¹¹ which use compressed natural gas (CNG) or liquified petroleum gas (LPG) as fuel, and employ an ICE; b) electric cars (EV), which can be plug-in hybrid-electric cars (PHEV), combining an ICE and an electric engine, or battery electric cars (BEV), which only employ an electric engine; and, finally, c) hybrid-electric cars (HEV), which combine an ICE and with a smaller electric engine and are not pluggable.¹²

Boosted by the 1970s and 1980s foreign investment of General Motors and Ford Motor Company, in the 1990s, Spain became the third major automaker in Europe only after France, second, and Germany, first.¹³ The number of cars produced in Spain grew steadily until 1999 when the amount raised to 2.2 million units in that year.¹⁴ Moreover,

⁷ Dijk et al., 2016

⁸ P. 604 Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014).

⁹ Penna & Geels, 2015

¹⁰ ACEA, Pocket-guide, 2019-2020.

¹¹ Flexi-fuel stands for flexible fuel. This concept refers to an ICE based car that is able to function indistinctly with oil (diesel or gasoline) or with gas.

¹² HEV is not included neither in Figure 1 nor 2.

¹³ Ruiz, 2001

¹⁴ The number of cars produced by Spain has strongly fluctuated up and down around the 2 million number, with a ceiling of 2.4 in 2004, and a minimum of only 1.5 in 2012. See in: Expansión Datosmacro.com La producción de vehículos crece en España:

after the 2008 financial crisis, France decreased its production significantly, leaving Spain as the second major producer in Europe.¹⁵ However, this has not equated to the wide adoption of low-carbon cars in the country (Fig. 1).

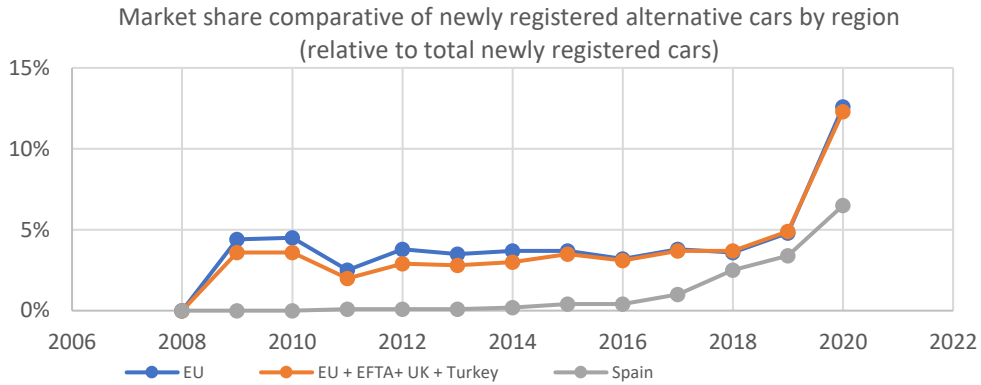


Figure 1 Market Share of alternative vehicles by region (EU, EU + EFTA + UK + Turkey, and Spain) from 2008 to 2020. Source: EAFO

Furthermore, the overall ownership level of alternative low-carbon of the largest three EU producers has remained low. It would only significantly rise from 2019 to 2020, when registrations of new alternative cars went from 3% to 14% in Germany, from 3% to 12% in France, and from 3% to 6.5% in Spain (Fig 2).

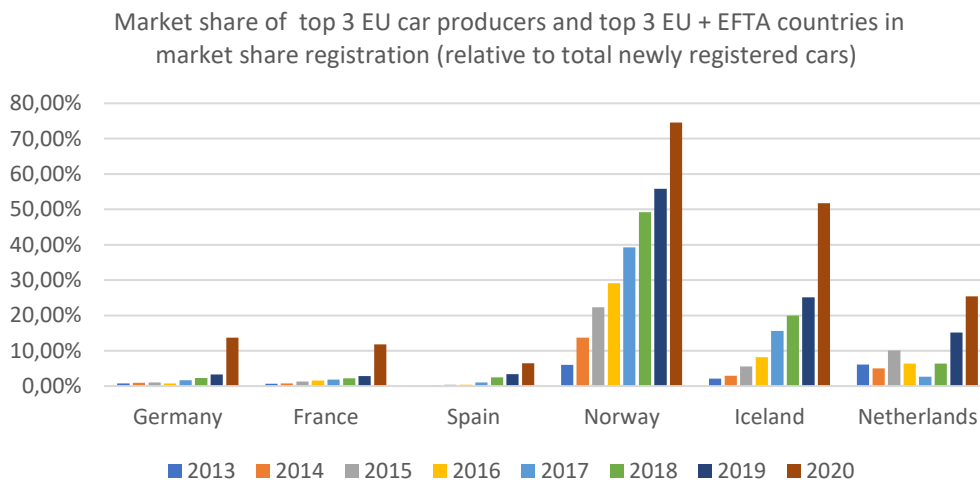


Figure 2 Market Share registration of top 3 countries of production in Europe (Germany, France, and Spain) and top 3 countries of registrations (Norway, Iceland, and the Netherlands). Source: EAFO.

Thus, despite the impact of the climate change issue, the industry's disruption through alternative drivetrains for cars has this far had slow results. The initiatives at alternative production have been wary and cautious. Consequently, the output of alternative cars

<https://datosmacro.expansion.com/negocios/produccionvehiculos/espana#:~:text=La%20producci%C3%B3n%20de%20veh%C3%ADculos%20crece,se%20fabricaron%202.764.067%20autom%C3%B3viles.>

¹⁵ See in OICA: <https://www.oica.net/category/production-statistics>

has been minimal relative to the total number produced. In 2019, Spain barely fabricated 78 thousand alternative vehicles out of 2,8 million - less than 2,8% of its total production (Fig.3).

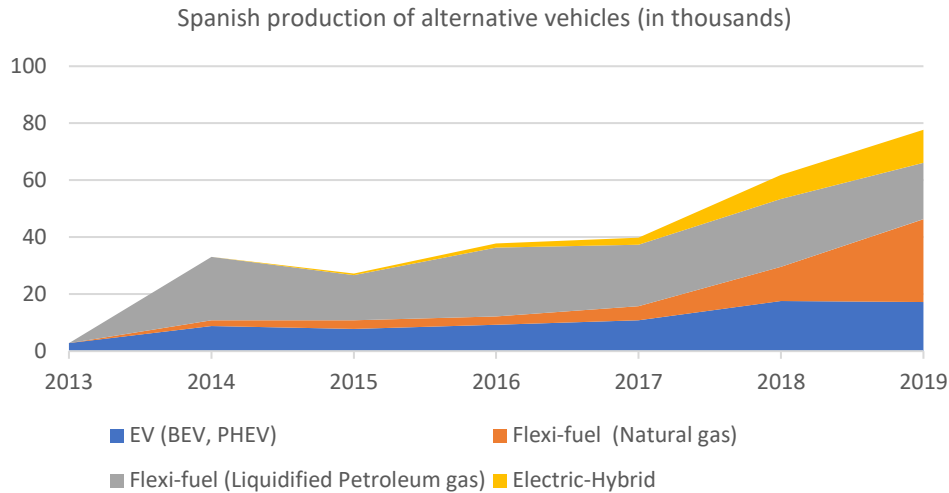


Figure 3 . Alternative vehicle production in Spain from 2013 to 2019. (including commercial and car passenger vehicles.) Source: ANFAC, 2019

The national production of electric vehicles only started in 2012, when Renault produced its mini-car quadricycle model, Renault Twizy, in Valladolid (Castilla y León).¹⁶ However, only in February 2020 did the firm group PSA start fabricating two electric passenger car models, the Opel Corsa–e, in Figueruelas (Zaragoza);¹⁷ and the Peugeot e-2008, in Vigo (Galicia).¹⁸ Previously, electric vehicle production was limited to commercial vehicles.¹⁹

On the other hand, since the 1990s, it is well known by the scientific community and policymakers that the transformation of the current ICE fleet of cars towards an

¹⁶“Así es la primera fábrica española de coches eléctricos”. Expansión.com: <https://www.expansion.com/2012/02/29/empresas/auto-industria/1330543389.html>. In 2018 the fabric would shift its production from cars to batteries, as car production was translated to South Korea. See in: Renault se lleva el Twizy de España para fabricar las baterías de sus coches híbridos enchufables: <https://www.hibridosyelectricos.com/articulo/sector/renault-lleva-espana-produccion-twizy-fabricar-baterias-hibridos-enchufables/20181011121507022399.html>

¹⁷ “Comienza la producción en serie del Corsa-e en España. La planta de PSA en Figueruelas será la primera planta del grupo en España en producir en serie un coche eléctrico”.: <https://www.carwow.es/blog/coches-hibridos-electricos-fabricados-espana>

¹⁸“Un Peugeot e-2008 eléctrico marca otro hito para Vigo”: https://www.cocheglobal.com/industria/peugeot-e-2008-electrico-marca-otro-hito-fabrica-vigo_370278_102.html#:~:text=Producci%C3%B3n%20del%20modelo%20el%C3%A9ctrico&text=La%20empresa%20inici%C3%B3n%20en%20febrero,se%20envi%C3%B3%20a%20otros%20pa%C3%ADses.

¹⁹ Until 2020 production has been centred in light-weight-duty commercial vehicles. In 2016 there were four models for commercial light duty vehicles. See in: ANFAC, Informe Anual, 2016.

alternative low carbon fleet is an elemental measure to mitigate climate change.²⁰ Faced with this situation, it is worth asking how and why it has been the rule to consume conventional cars until nowadays.

The theoretical context of this work is innovation studies and wide socio-technical systems. Innovation studies aim to study pre-existing technological trajectories breached by new technologies²¹. A technological trajectory can be defined as the pattern of normal or expected problem-solving activity on the ground of a technological paradigm.²² System innovation studies focus on broad socio-technical systems as a whole such as transport, food, or energy, where unsustainable practices and routines are ongoing. Thus, entire systems of production and consumption are part of their analytical scope.²³

Research questions and structure

The empirical point of departure of this work is that European car firms have refused to reorient their production of ICE cars towards alternative low carbon solutions. The central explanatory hypothesis is that this has been due to the lack of socio-political pressure exerted by EU policies, national regulations, and mass media. However, this is an expected characteristic of the process. Firms are hesitant to be proactive actors of change, as vested interests linked to sunk investments limit their incentives to pursue systemically low carbon solutions.²⁴

Hence, the main research question is: how have the pressures coming from the socio-political problematization of climate change affected the innovation of the car industry? In order to understand this process, the co-evolution of the climate change issue in relation to the socio-political context of the car industry will be analysed, along with the automaker responses. This is done in two steps and at two levels.

Firstly, by examining the co-evolution of the EU's position regarding climate change, its passenger car policies, and the (lobbying) responses of the industry. Secondly, and as a

²⁰ Climate Change: The IPCC 1990 and 1992 Assessments. IPCC First Assessment Report Overview and Policymaker Summaries and 1992 IPCC Supplement. See: 2. Impacts pp. 53-56: https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report.pdf

²¹ Vergragt, 1988.

²² Dosi, 1982.

²³ Smith et al., 2010, p. 436

²⁴ Penna and Geels, 2015. p. 1030.

case study, Spain has been selected for further socio-political research. To this end, the Dialectic Life Issue Cycle (DILC), a theoretical framework developed by Penna and Geels is applied.²⁵ Following this model, several quantitative variables (public attention, political attention, automaker's attention, and patenting activity) are selected and used to organize the study period (1995-2021) in shorter coherent time frames. The sub-questions related to the aforementioned variables are:

- How intense has public attention been on climate change across time?²⁶
- How intense has political attention been on climate change across time?²⁷
- How intense has automaker's attention been on climate change across time?²⁸

The last sub-question is related to the technological responses presented by the Spanish auto industry. For this purpose, the patenting activity at the national level is tracked. It is also taken into account the new eco models implemented. Thus, there is one more sub-question to be answered:

- How has the national industry responded in terms of patenting activity and implementation of alternative low carbon cars?²⁹

The work is divided into three chapters. The first chapter, *Theoretical framework and methodology*, contextualizes and sets the base of the work. The second chapter, *The European Union's position on climate change and its policy regarding CO2 emissions of passenger cars*, aims to study the supranational political scenario. The third chapter, *The slow reorientation of the Spanish car industry*, dives into the socio-political transition process in a specific member state of the EU.

²⁵ Penna & Geels, 2012

²⁶ To this end, the number of articles citing "climate change" and "global warming" in *El País* and *El Mundo* newspapers is tracked.

²⁷ This is attained by examining the number of initiatives and oral interventions citing climate change at the National Congress.

²⁸ To this end, the number of articles citing "climate change", and alternative drivetrains in the *European Automotive News* ("electric", "hybrid", "natural gas", "liquified petroleum gas") are measured.

²⁹ For this purpose, patenting activity by the examination of reports of the OEPM is studied (Oficina Española de Patentes y Marcas).

Societal relevance

The transport sector is a central contributor to climate change. In 2012 on a worldwide scale, transport consumed 26% of the global energy, representing 23% of greenhouse gas (GHG) emissions. Furthermore, street traffic makes up 74% of the transport sector, of which automobiles have the most relevant impact due to their persistent presence across the world.³⁰ Environmental contamination impacts are already present in many people's daily life. Pollution in cities, which is produced mainly by transport,³¹ is responsible for the premature death of 400.000 citizens annually only in the EU.³²

As the 2014 IPCC report shows,³³ new technology-related practices are crucial to contribute to climate change mitigation in the transport sector. Accordingly, the International Agency of Energy has stated that deploying energy-efficient technologies is part of a critical near-term strategy to reduce transport emissions. Nonetheless, global transport sector energy intensity (measured by the total energy consumption per unit of GDP) must drop an average of 3.2% every year from 2020 to 2030 to put transport efficiency on track with the 2030 Sustainable Development Scenario.³⁴ Consequently, it is socially relevant to understand how this ongoing socio-technical process has been taking place in the last decades.

Academic relevance

This work aims to study a socio-technical transition in the EU from a socio-political and historical perspective, shifting away from an exclusively economic and market-based approach. Thanks to this perspective, it is observed how the deviation from technological trajectories gets regularly politically precluded, and, as a result, pre-existing technologies limit the emergence of clean alternatives.³⁵ Moreover, this approach acknowledges how shifts do not occur in vacuums, but within social and political contexts and environments.³⁶

³⁰ Helmers and Marx, 2012

³¹ 20/07/2016 - MEMO-16-2497 - A European Strategy for low-emission mobility

³² 15/02/2017 European Commission - Press release - Commission warns Germany, France, Spain, Italy and the United Kingdom of continued air pollution breaches

³³ Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014), p. 604.

³⁴ Tracking Transport 2020. IEA, 2020. <https://www.iea.org/reports/tracking-transport-2020>

³⁵ Dosi, 1982.

³⁶ Geels, 2004.

The study of the reorientation of the car industry in Spain through the DILC model serves the purpose of studying the evolution of a mobility sub-system in a specific territory. This type of research is embedded in the system innovation literature, which aims to study the change of broad societal systems from a multidimensional perspective.³⁷ It seeks to explain and jointly understand the concurrent evolution (co-evolution) of socio-political issues and industries.³⁸ Among this literature, there is plenty of theoretical and conceptual contributions but not many empirical studies. Thus, the objective is to contribute to the current literature by examining the passenger car socio-technical system from a socio-political perspective.

I. Theoretical framework and methodology

1. Theoretical contextualization

This work's area of study is wide-scale changes of socio-technical systems,³⁹ and it has as its background audience and inspiration system innovation and sustainable development studies. That said, to understand the EU socio-political context, this work has benefitted from a wide range of literature coming from global environmental governance and EU decision-making and regulatory processes. Thus, the second chapter aims to make a historical analysis of international relations at the EU level.

According to the systematic review of literature accomplished by Savaget et al. in 2019, a socio-technical system is a foundational notion used at five closely related research areas: innovation systems; innovation management; sustainable development; public understanding of science, technology and society; and system thinking and design. All these areas have in common a concern to the transitioning of socio-technical systems (food, water, transport, energy, housing...) towards sustainable directions. Despite their different approaches, it is agreed that the prevailing socio-technical systems are not easily changeable, as they are part of mutually reinforcing dynamics at every level.⁴⁰

³⁷ Geels, 2005.

³⁸ Smith et al., 2010.

³⁹ Savage et al., 2019. See: Table 2, p. 883. This work is part of the sixth category of this table: wide sociotechnical systems.

⁴⁰ Savaget et. al, 2019, p. 879.

Firstly, due to its direct theoretical connection with wide-scale changes, a brief introduction of innovation studies in relation to sustainable development will be made. Secondly, the expansion of innovation studies as system studies, and the notion of socio-technical systems will be presented.

1.1 Innovation studies in relation to sustainable development

Innovation studies is a field dedicated to studying how radical innovations breach pre-existing technological trajectories.⁴¹ A technological trajectory is the pattern of expected problem-solving activity on the ground of a technological paradigm. It constitutes a research program that embodies strong prescriptions on the directions of technical change to pursue and those to neglect.⁴² In this case, it refers to the paradigm of the ICE and its advancements. The ICE is a dominant design that provides a reference outlook for engineers, designers, and technologists,⁴³ while hindering other different feasible alternatives.⁴⁴

The contemporary concern regarding environmental sustainability arose in the 1970s. The publication of the report *Limits to Growth* by the Club of Rome ignited discussions about ecological limits.⁴⁵ Here, Meadows (1972) claimed that within the given economic system, the biophysical limits of the globe were about to be surpassed. Subsequently, this view was criticized for its Malthusianism, as innovation could stretch and redefine these limits, avoiding environmental and social collapse.⁴⁶

Later, the 1987 Brundtland report recognized the limits of environmental exploitation and proposed combining technological developments and social equity to face them.⁴⁷ Accordingly, sustainability became known as balanced integration of social inclusiveness, protection of the environment, and economic resilience for the benefit of current and future generations.⁴⁸ Thus, economic growth would be desirable only insofar as it improved people's quality of life, respecting equity and environmental

⁴¹ Vergragt, 1988.

⁴² Dosi, 1982.

⁴³ Utterback and Abernathy, 1975

⁴⁴ Kemp et al., 1998.

⁴⁵ Meadows, 1972.

⁴⁶ Freeman, 1979.

⁴⁷ This refers to the Report of the World Commission on Environment and Development in 1987.

⁴⁸ World Commission on Environment and Development, 1987:43.

protection.⁴⁹ This global environmental threat became widely understood in 1990 with the publication of the IPCC First Assessment Report,⁵⁰ which operated as the basis of the 1992 UNFCCC international environmental treaty.⁵¹ The IPCC, which serves as scientific authority in order to enhance climate change knowledge,⁵² warned in 1992 that the existing economic system and its development would have a potential disastrous environmental impact.⁵³

Up to this point, innovation academia studied the improvement of the environmental performance of individual technologies, going from more polluting to less polluting processes and products. This perspective promoted developing cleaner technologies but failed to take into account deeper problems, such as depletion of resources, climate change, hazardous wastes, etc.⁵⁴ However, when it became patent that incremental improvements could not address the inevitable challenges, a different approach had to begin.⁵⁵

1.2 Innovation of systems and wide-sociotechnical changes

To include sustainability, the broadening of the problem framing in innovation studies became necessary. This meant not only studying and promoting cleaner technical solutions but as well innovating entire systems of production and consumption. The focus shifted from examining specific artifacts or practices to analyse the transformation of entire technological regimes.⁵⁶ Consequently, the analytical dimension would grow too, going from a neo-classical environmental economics understanding of price signals inducing innovation towards a systemic perspective: the study of socio-technical systems.⁵⁷

⁴⁹ Zaccai, 2015.

⁵⁰ Intergovernmental Panel on Climate Change.

⁵¹ United Nations Framework Convention on Climate Change

⁵² See: Principles Governing the IPCC work: <https://www.ipcc.ch/site/assets/uploads/2018/09/ipcc-principles.pdf>

⁵³ Climate Change: The IPCC 1990 and 1992 Assessments. IPCC First Assessment Report Overview and Policymaker Summaries and 1992 IPCC Supplement. See: 2. Impacts pp. 53-56: https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report.pdf

⁵⁴ Berkhout et. al, 2004, p. 50.

⁵⁵ Evans et al., 2009.

⁵⁶ Berkhout et. al 2004, p. 50. Berkhout identified several labels regarding this new scholarship: regime shift, strategic niche management, systems innovation and transition management.

⁵⁷ Smith et al., 2010, p. 436.

This approach made the concept of “technology” much broader for transition management theorists. As Berkhout put it,⁵⁸ “(technologies) are seen as being formed by, and embedded within, particular economic, social, cultural and institutional structures and systems of beliefs (...) «socially shaped and society shaping (Hughes, 1987)⁵⁹». This sequence was led, among others, by the introduction of the theoretical notion of *sociotechnical configurations* by Rip and Kemp in 1998. These authors made explicit their ethical and normative concerns relating to global climate change and pledged to broaden the area of inquiry of technological change studies.⁶⁰ Up to that point, the literature on determinants of innovation had widely adopted a market point of view that ignored how other societal variables could affect innovation.⁶¹

Thus, a socio-technical system can be defined as one which encompasses production, diffusion and use of technology (...) the linkages between elements necessary to fulfil societal functions (e.g. mobility, communication, nutrition)”.⁶² Therefore, markets and users are not simply in a void out there, as policies, institutions, infrastructures, and cultural discourse also play a role.⁶³ This new approach was inspired by evolutionary and institutionalist economics, and it focuses on analysing the dynamics of the change process: its directionality, intensities, extents, and pressures. As a result, socio-technical systems and their transformations, are seen as a process of ongoing reproduction that incorporates cumulative, gradual, and self-reinforced characteristics. Therefore, innovations are not isolated events but co-evolving systems in which parts are interconnected.⁶⁴

⁵⁸ Berkhout, 2004, p. 51.

⁵⁹ Here, Berkhout cites Hughes, T. P. (1987). The evolution of large technological systems. The social construction of technological systems: New directions in the sociology and history of technology, 82.

⁶⁰ Rip and Kemp, 1998, p. 328: “Technology is implicated in global climate change in various ways—as a source of the problem, a possible solution, and an instrument of measurement and analysis”.

⁶¹ Ibid. p. 346. “this perspective is of the manager of a firm for whom the economic success of an innovation is crucial. As a consequence, the eventual shape of the technology can be considered a side effect, the main effect to be realized (by the manager) or explained (by the economist) being a successful firm (...) When firms are the focus, this coevolution is that of supply and demand. When technology is foregrounded, coevolution becomes a more complex phenomenon”.

⁶² Geels, 2004, p. 900.

⁶³ Ibid. p. 902

⁶⁴ Savaget et al., 2019, p. 884.

2. Theoretical model: an application of the Dialectical Issue Life-Cycle model to the case study

In order to study the Spanish evolution of the car system, a specific theoretical model will be applied: the DILC model. The DILC theoretical model proposes the multi-dimensional study of the longitudinal interaction between a problem stream and a solution stream.⁶⁵ This transitioning and reorientation process from a previous industry regime to a new one is usually full of tensions and struggles between the issue and the industry's interests, capacities, and perspectives.⁶⁶

Firstly elaborated in 2012,⁶⁷ it combines insights from lifecycle theory, -to conceptualize the dynamics of social problems- and systemic and multidimensional perspective innovation studies -to conceptualize the dynamics of technical solutions-.⁶⁸ The model builds upon a societal issue that demands an answer from incumbent industries.⁶⁹ Therefore, it studies the strategic decisions of firms-in-industries to develop and deploy technical solutions to these problems. Moreover, it is dialectic as it emphasizes the co-evolution between both of these dynamics, problems and solutions.⁷⁰ The point of departure is that firms are embedded in an organizational field, the Triple Embeddedness framework.⁷¹ According to this proposition, firm-in-industries face selection pressure from two dimensions: the economic environment -markets and suppliers- and the socio-political environment -pressures from social movements, public discourse, and policymakers who modify or implement new regulations-.

⁶⁵ As proposed by Kingdon, 1984.

⁶⁶ Penna & Geels, 2012.

⁶⁷ Ibid.

⁶⁸ Geels & Penna, 2015, p. 1030

⁶⁹ Ibid.: reference 1: "A social issue refers to a condition or state of affairs that certain actors perceive as undesirable or problematic. The meaning of issues is socially constructed. Views on causes, responsibility, seriousness and solutions are contested and develop over time".

⁷⁰ Kingdon, introduced the notion of the interaction among a problem stream and solution stream in 1984.

⁷¹ Geels, 2014

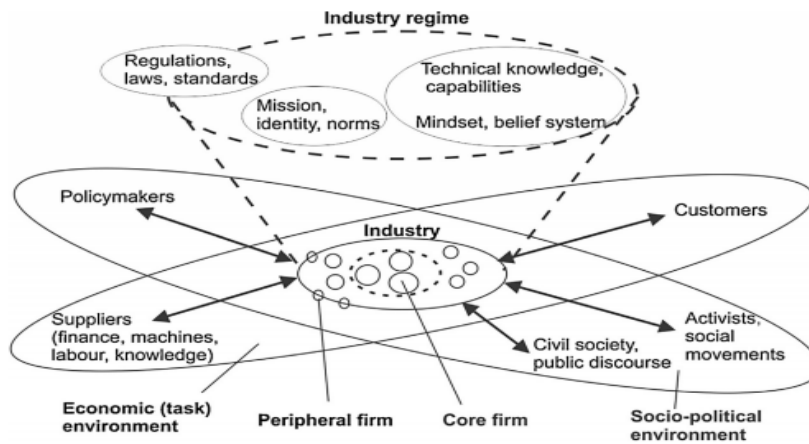


Figure 4 Triple Embeddedness framework of industries (Geels, 2014: 266)

The model describes and proposes how across years and decades, dynamics of societal pressure grow over time and align with each other, stimulating firm-in-industries to reorientate their activity (greening it). Ideally, firms subjected to enough pressure eventually adapt and reorientate their production.

If pressures are assumed to grow linearly, there are five progressive phases in the ideal sequence of the greening process.: (1) problem emergence and industry neglect, (2) raising public concern and defensive industry responses, (3) political debates, controversies and defensive hedging, (4) formation and implementation of substantive policy and industry diversification, and (5) spillovers to the task environment, and strategic reorientation.⁷² The first three phases characterize themselves by resistance to change and socio-political mobilization and defence. During this period, firms are expected to be locked into industry regimes, and thus, reluctant to make any substantial change to address the problem.⁷³ In this context, the socio-political and economic environments, constrain and limit the possibility for change.⁷⁴ The two later phases portray a new dynamic, as the problem starts to affect the economic environment. At this point, politicians may introduce radical legislation that can change the regime conditions (e.g., taxes, regulations, standards, subsidies, investments). Finally, mass consumer behaviour and preferences shift, creating demand for new technologies, and consolidating the transition process.⁷⁵

⁷² See further in Geels & Penna, 2015, p. 1032, Table 1.

⁷³ "Locked-in" means that firms are adapted and used to act accordingly to certain given norms, rules, standards, and procedures (Geels and Penna, 2015).

⁷⁴ See Figure 4 of this work.

⁷⁵ Geels & Penna, 2015, p. 1031.

3. Methodology, sources, objectives, and limitations

The overall objective of the work is to build a nuanced socio-political narrative of the historical transformation of the passenger car system at the European Union and Spanish levels. The time frame of the study goes from the 1990s up to 2020. The 1990s decade is the point of departure, as this was when climate change and GHG emissions became problematized.⁷⁶

The second chapter revolves around the EU institutional level and its decision-making processes helping to understand how i) climate change became politically problematized in the first place, ii) what has been the EU's role on this issue, and iii) how EU internal policies related to the reduction of CO₂ emissions of cars have been delayed and watered down by means of the car industry lobby. To this end, different primary and secondary sources have been used. Primary sources are mainly based on EU institution's official documents such as communications, press releases, and directives. Also, article newspapers and transport NGOs reports have been used. Secondary sources are based on environmental global governance and international relations literature, as well as on European Union decision-making, regulatory, and lobbying literature.

Building upon the findings of the second chapter, the third chapter aims to gain a deeper understanding of the socio-political process at a regional level. To this end, it aims to examine, i) how the climate change issue evolved politically and publicly inside the country, ii) how the government interacted with the car industry, and iii) how the industry responded. This will be done by combining quantitative analysis of proxy variables as rough indicators with the examination of primary sources. The quantitative variables of the study are:

a) Public attention, which is estimated by the number of newspaper articles that mention climate change or global warming. A liberal-conservative newspaper, *El Mundo*,

⁷⁶ See in this work, Chapter 2, subsection 2.

and a social-democrat one, *El País*, have been selected in order to provide a complete ideological overview.⁷⁷

b) Political attention, which is measured by regulatory bills and parliament's discussion at the National Congress level. This will be attained by examining the number of initiatives and oral interventions citing climate change⁷⁸

c) Automakers attention, which is based on the article count of the European edition of Automotive News, the most relevant magazine partnered with automakers at the European level. In this case, the number of articles citing "climate change", and alternative drivetrains ("electric", "hybrid", "natural gas", and "liquified petroleum gas") is measured. Since the privatization of the firm Seat in 1986 -sold to the German firm Volkswagen- and, as FASA-Renault, -Groupe Renault since 2000- has been historically controlled by the French firm Renault, there are not any national owned companies in the country. This means that Spanish companies' ownership has been distributed since the 1990s among foreign producers: Ford Motor Company, General Motors until 2017 - when it was bought by Groupe PSA-, Volkswagen, Groupe PSA, and Groupe Renault.⁷⁹ Consequently, the best way to track attention from automakers is from a European perspective.

Moreover, there is one variable to measure technical development by the auto industry in Spain: patenting activity (d). A patent is a government authority or license conferring a right or title for a set period, especially the sole right to exclude others from making, using, or selling an invention.⁸⁰ This patenting activity will be gathered by the examination of reports of the OEPM (Oficina Española de Patentes y Marcas).

Each time frame is characterized by the study of a wide range of primary sources coming from institutional observatories (EAFO), the Spanish National Congress, national and international newspaper articles, European automaker's (ACEA), national automaker's

⁷⁷ This data has been gathered from Lexis Nexis (1996-2000), and at the Media and Climate Change Observatory (2000-2020):

http://sciencepolicy.colorado.edu/icecaps/research/media_coverage/spain/index.html

⁷⁸ Pertinent oral interventions, initiatives and proposals are tracked by searching the keywords "climate change" in the search engine: <https://www.congreso.es/web/guest/busqueda-de-iniciativas>

⁷⁹ Other national vehicle producers like Nissan, Mercedes-Benz, and Iveco are not contemplated as they are dedicated to commercial vehicles.

⁸⁰ See in: Oxford Lexico: patent.

representatives (ANFAC), and the national automotive innovation platform (Move to Future).

The quantitative approach serves the purpose of providing an initial and overall overview of the process which facilitates the division of the period in shorter time-frames.⁸¹ As stated by Langley, temporal bracketing is a research strategy that aims to structure the description of events in phases. That said, it does not presume necessarily a progressive developmental logic. If these periods are chosen is because it can be identified a certain continuity in the activities within each period and there are certain discontinuities at its frontiers. However, the decomposition of data into successive adjacent periods enables the explicit examination of how actions of one period led to changes in the context that will affect action in subsequent periods.⁸²

However, as noted by Penna and Geels,⁸³ proxies for attention present certain limitations, such as not reflecting changes in the interpretation of the issue, size of articles, or intensity. Thus, temporal bracketing is merely a point of departure for the subsequent qualitative analysis based on primary sources. The combination of both approaches helps the construction of a narrative that focuses on contextual detail. This mixed approach does not attempt to create or prove neither a simple nor general theory, as it is meant to be high in accuracy and authenticity, and low in generality.⁸⁴

Limitations on the application of the DILC model

Even if the DILC-model enables comprehensive multi-dimensional analyses, the case study only revolves around climate change as a societal problem. In other words, it will observe the car industry concerning the climate change issue in its socio-political dimension. Thus, an analysis of the economic environment (customers and suppliers) is barely included. Additionally, the given reconstruction of the historical reorientation of the car industry cannot explain the impact of other related societal and environmental problems; such as pollution, depletion of resources, or ecological concerns; or external

⁸¹ The results of these quantitative findings will be introduced across the chapter in the form of charts in order to enable the flow of the narrative

⁸² Langley, A.1999. p. 703.

⁸³ Penna & Geels, 2015, see in reference 8.

⁸⁴ Langley, A. 1999, p. 695-697.

factors, such as financial or energy crises. Hence, it must be noted that picking climate change as an axis of study is only one of many suitable ways of proceeding.

II. The European Union position on climate change and its policies regarding CO₂ emissions of passenger cars

1. The confirmation of the Climate Change theory and the development of International Environmental Politics

In the 1970s global warming theory attained broad-scale interaction among the scientific and policy communities. Nonetheless, especially from the 1980s, climate change science and politics became closely intertwined and presented in combination in the public sphere (e.g. via energy policy).⁸⁵ In this context, 1988 can be considered the starting year in which the public attention of the Western countries was achieved. In the UK, Margaret Thatcher defended nuclear energy in the detriment of the carbon industry as a necessity to tackle climate change. In the USA, a NASA scientist warned the US Congress of the perils of climate change.⁸⁶ These events presented severe implications, representing a shift from policy for science towards science for policy, which would blur the boundaries between one and the other.⁸⁷

However, during the 1960s and 1970s evidence on climate change remained somewhat unclear, as from 1940 to 1970 data collected shown a cooling trend which prompted the hypothesis of human impact on global warming to be ignored or contested. The United Nations Conference on the Human Environment in 1972 in Stockholm was the first international conference dedicated specifically to address the global environment, creating the first precedent of a high-profile intergovernmental meeting on environmental politics. At this point, global warming was not a central part of the agenda.⁸⁸ It would take seven more years to establish international collaboration for

⁸⁵ Corfee-Morlot et. al, 2007. P. 2753 and 2754: "In 1983, two US government-sponsored science reports had conflicting conclusions about need for policy action to address climate change (...) by 1988 the US Congress was debating details of legislation to address climate change through the window of energy policy; by 1992 the Energy Policy Act was signed into law by President Bush (Sr)".

⁸⁶ Fernández Reyes et al., 2015

⁸⁷ Agrawala, 2000.

⁸⁸ Hart & Victor, 1993

monitoring and data collection of temperatures. Finally, in 1979 the World Meteorological Organization (WMO) staged the first World Climate Conference.⁸⁹

Thanks to this event, Climate Change as a scientific theory was empirically validated in the 1980s, when the beginning of a clear warming trend since 1981 was detected.⁹⁰ This evidence was gathered by surface and land-air temperature measurements from differently located measuring stations. Moreover, during these years, many developments in climate change science such as the ozone hole discovered in 1985 or palaeoclimatology discoveries on the melting of large sheets of ice finally disregarded theories about global cooling. By 1990, and despite critiques on the gathering of data and its interpretation, the international scientific community agreed overall that the global mean temperature of Earth, indeed, was warming up at an abnormal rate.⁹¹ Additionally, due to the alarming growth rate it was openly suggested that this could potentially lead to abrupt and dangerous changes.⁹² In 1992, further evidence raised when results from 14 different mathematic models pointed towards the same direction, corroborating human-induced global warming.⁹³

Meanwhile, during the 1980s a handful of experts and scientists had already been participating and working together consistently with policymakers at the Villach and Belagio conferences. These were international meetings organized by WMO, the United Nations Environment Programme, and the International Council for Science, to debate policy implications of climate change. These meetings would set the base for the subsequent creation of the IPCC in 1988.⁹⁴ Since its beginning, the IPCC has delivered what is considered the best science available on Climate Change, providing a series of periodical assessment reports in 1990, 1996, 2001, 2007, 2014 as well as a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels.⁹⁵ These reports have endorsed the causality between human activity and global warming and,

⁸⁹ Hecht & Tirpak, 1995

⁹⁰ Weart, 2008.

⁹¹ Maslin, 2004

⁹² Corfee-Morlot et al., 2007

⁹³ Weart, 2008.

⁹⁴ Haas & McCabe, 2001

⁹⁵ 2018 IPCC Special Report was ordered by Decision 1/CP.21, of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the 2015 Paris Agreement.

moreover, they have helped to provide a basis for political negotiations, mandating collaborative work between science and policy communities.⁹⁶

Starting in 1990, international negotiations were initiated under a United Nations General Assembly mandate (UNGA).⁹⁷ Thus, the UNGA created a self-standing Intergovernmental Negotiation Committee. These negotiations would lead to the signing of the United Nations Framework Convention on Climate Change (UNFCCC) at the Rio Earth Summit in 1992. This event constituted an international political landmark among developed and developing countries, in which local and global environmental issues became central to international relations.⁹⁸

Furthermore, this international political regime would be fully reinforced with the Third Conference of the Parties (COP) in Kyoto in 1997. This event prompted the creation of the Kyoto Protocol, signed by 186 countries and enforced in 2005. By this agreement, which operationalized the 1992 UNFCCC, industrialized countries committed to limit greenhouse gas emissions following agreed individual targets under the principle of “common but differentiated responsibility and respective capabilities”.⁹⁹

2. European Union’s 1997 Kyoto Protocol leadership and its impassive policy for passenger car CO₂ emission standards

The European Union became a leader in the global environmental arena in the 1990s, substituting the previous 1980s leadership of the US. If at the Vienna Framework Convention on Ozone (1985) hindered progress, and in the Montreal Protocol on Substances that Deplete the Ozone Layer (1987) participated as a secondary actor, in 1990, the EU aspired to become the leader on environmental politics.¹⁰⁰ Previously, climate change had not been relevant in the EU’s agenda. Climate change only became central in November 1990, just before the Second World Climate Conference. Here, the joint Council of Energy and Environment Ministers reached an innovative agreement,

⁹⁶ Hecht & Tirpak, 1995.

⁹⁷ UNGA Resolution 45/212 of 21 December 1990

⁹⁸ Corfee-Morlot et al., 2007

⁹⁹ Ibid.

¹⁰⁰ Sbragia & Damro, 1999

specifying that the EU would maintain the same amount of carbon dioxide emissions (CO₂) by 2000.¹⁰¹

Due to its institutional architectural structure, the EU had complications in functioning as an international actor in the environmental area. As an organization, it was dependent on member states for its representation, and *ad hoc* arrangements had to be characterized each time by the Presidency of the Council of Ministers speaking in the agreed position of member states. Nonetheless, even if the European Commission possessed legal competence since the Single European Act (1957), this competence would be only seriously strengthened by the Treaty of European Union of Maastricht (1992). The Maastricht Treaty represented a clear step forward in competencies as well as in content. As a result, the environment would become a direct responsibility of the Community.¹⁰² Accordingly, the EU as a unitary actor would become a full participant during the 1992 Rio Earth Summit. During this Summit, the Commission and member states failed to negotiate a reduction in CO₂ with the US Senior Bush administration.¹⁰³ It was not until the beginning of the 1997 Kyoto Protocol negotiations when the EU became a frontrunner leader. Up to this point, member states were more involved than the European Commission (EC) itself in negotiations.

In this context, the EC pledged for a global reduction of 15% of CO₂ emissions, among other GHG. However, in March 2001 the US Bush Junior administration decided to withdraw from the agreement. The US was the biggest GHG emission world's producer. This represented a definitive juncture for the EU, as it had been left alone in negotiations to convince the rest of industrialized countries on the unappealing task of reducing their own carbon emissions. Ultimately, in May 2002 a final agreement with the US Clinton administration for an 8% reduction of CO₂ -and of other five GHG gases related to global warming- was achieved.¹⁰⁴ Overall, and despite the introduction of flexibility mechanisms,¹⁰⁵ the 2005 ratification of the Kyoto Protocol was widely seen as a success

¹⁰¹ Delreux & Ohler, 2019

¹⁰² Schreurs & Tiberghien, 2007.

¹⁰³ Ibid.

¹⁰⁴ Schreurs & Tiberghien, 2007

¹⁰⁵ Rayner & Jordan, 2016, (p.5) "The Protocol's targets and timetables approach very much reflected the EU's traditional, regulatory approach to governing. But the Treaty also saw European negotiators swallow their opposition to "flexible mechanisms" -emissions trading, the Clean Development Mechanism, and Joint Implementation".

of the pluralistic multi-governance system of the EU, driven by key member states - namely Germany and the UK-, and the European Commission.¹⁰⁶ The main results were the burden-sharing agreement, which internally redistributed the reduction target among the member states,¹⁰⁷ and the Emission Trading System Directive (ETS) of 2003,¹⁰⁸ a cost-effective tool that covered 40% of total carbon emissions. Following the “polluter pays principle”, the ETS resulted favourably both for industries and for EU’s Kyoto target.¹⁰⁹

Despite the afore explained EU’s leading role in the Kyoto negotiations, the EU member states were reluctant to recognize the new systemic challenge that global warming represented. Nonetheless, as large consumers of fossil fuels, it meant the reshaping of their own domestic industrial systems.¹¹⁰ Hence, member states preserved a high degree of autonomy, limiting the European Commission’s competencies to propose new common policies in relation to key areas such as energy, taxation, and land-use planning.¹¹¹ For instance, in 1998 the EU’s Council of Energy Minister considered the Commission’s aim of 12% of renewable energy account by 2010 as simply indicative.¹¹² Thus, conversely to the ozone depletion issue -which was relatively costless for national economies of member states- measures to reduce CO₂ emissions that implicated major changes in national industries were not initially undertaken.¹¹³ Hence, it has been argued that, internally, the EU’s main objective of the Kyoto Protocol was simply placing climate change on its own agenda.¹¹⁴

¹⁰⁶ Schreurs & Tiberghien, 2007; Marklund, & Samakovlis, 2007; Rayner & Jordan, 2013.

¹⁰⁷ Rayner & Jordan, 2016, (p.5): “This arrangement allowed less developed Member states “headroom” to grow economically and increase their emissions, while quite substantial reductions were made by the richer, more environmentally progressive Member States (...)”.

¹⁰⁸ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003

¹⁰⁹ The ETS works as a (linear diminishing) cap and trade system, of which companies can profit from shrinking their emissions by selling their allowances to other companies. It has had three periods, from 2005 to 2007 (pilot programme), from 2008 to 2012, and from 2012 to 2020. See more in: https://ec.europa.eu/clima/policies/ets_en

¹¹⁰ Soroos, 1994

¹¹¹ Grubb & Gupta, 2000

¹¹² Sbragia & Damro, 1999

¹¹³ Collier, 1996

¹¹⁴ Oberthür & Pallemmaerts, 2010.

In this scenario, the lack of direct and mandatory measures affected one of the main areas of CO₂ emissions, car transport.¹¹⁵ What was happening with passenger car's CO₂ emissions inside the EU while the EU became a leader in climate change mitigation in the international arena? Overall, in the EU, CO₂ emissions from transport increased by 24% between 1990 and 2005,¹¹⁶ and, particularly, by 26% from road transport between 1990 and 2004.¹¹⁷ Regardless of the leadership shown by the EU in the 1992 Rio Earth Summit, CO₂ car emissions would only grow in the coming years.

The increase in car ownership and the distance travelled by owners surpassed the energy efficiency improvements -of 14% between 1995 and 2006- of the car fleet. Car ownership in the EU-27 grew by 22% (52 million cars) during this period.¹¹⁸ This dynamic has been denominated as the credibility gap. According to this critique, the EU pushed for overambitious targets during the 1997 Kyoto Protocol negotiations, creating a distance between its international discourse and position and its internal capabilities and domestic industrial policies.¹¹⁹ Road transport would become a paradigmatic case of this logic.

Initially, the Council of the EU called for a target of 120g CO₂/km for new registrations of passenger cars as early as 1992 without any success.¹²⁰ In 1994 the Environmental Council requested the Commission to attain a lowering of emissions of cars newly registered by 2005, which got the support of the European Parliament in 1995.¹²¹ It would be in this year when the EU Commission endeavoured to design and implement policies to reduce CO₂ emissions from passenger cars at the Community level.¹²²

¹¹⁵ CO₂ trading within the ETS did not include car emissions, but electricity and heat generation, energy-intensive industry sectors, and commercial aviation. See in: https://ec.europa.eu/clima/policies/ets_en

¹¹⁶ EEA (European Environment Agency). Annual European Community greenhouse gas inventory 1990–2005 and inventory report 2007. Technical Report No. 7/2007. Copenhagen; 2007

¹¹⁷ EC. 2007 (COM 2007/ 0019 final). Communication from the Commission to the Council and the European Parliament 6 Results of the review of the Community Strategy to reduce CO₂ emissions from passenger cars and light-commercial vehicles: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52007DC0019>

¹¹⁸ Ten Brink, 2010.

¹¹⁹ Afionis, 2011

¹²⁰ EEC 91/441. Council Directive calls for proposals to reduce CO₂ from passenger cars.

¹²¹ Ten Brink, 2010.

¹²² Ryan & Convery, 2009

This type of relevant measure usually follows a “trilogue” procedure, by which important decisions entail a triple dialogue and joint assessment by the Commission, Parliament, and Council (or their respective part for the matter under consideration).¹²³ In this political decision-making arena, transport policy reflects explicitly the clash between industry lobbyists willing to minimize the impact on their production on one side, and environmental organisations, willing to impose strict emission values and sanctions on the other. The former is based on the German automaker association (VDA),¹²⁴ and European industry interests (ACEA)¹²⁵, while the latter is based on the umbrella NGO Transport & Environment.¹²⁶ Nevertheless, VDA and ACEA have many successful lobbying mechanisms to which NGOs can barely have access, such as formal and informal meetings, European Commission expert groups, European Parliament intergroups, or even politicians that switch from public service to industry positions and vice versa.¹²⁷ This structural conditioned way of negotiation represents an imbalance in competitive relations, as it places the automotive industry and its influence above environmental lobbying capacities.¹²⁸

In 1995 carbon emissions from cars were rhetorically targeted as the main solution to the problem of climate change.¹²⁹ Accordingly, in 1995, the EC launched a Community Strategy, the main aims of which were to reach 120 g CO₂/Km for new passenger cars in 2012.¹³⁰ In this communication, the EC expressed its concern for road transport, as it

¹²³ According to Haas & Sander, 2019, the EU institutions implicated in transport policy are: at the European Commission, the DG Mobility and Transport (MOVE), the DG Internal Market, Industry and entrepreneurship and SMEs (GROW), the DG Environment (ENV), and since 2010, the DG Climate Action (CLIMA); at the Parliament, the Committee on Transport and Tourism (TRAN), the Committee on Environment, the Public Health and Food Safety (ENVI), and the Committee on Economic and Monetary Affairs (ECON); and at the Council the Transport, Telecommunications and Energy (TTE) Council, the Economic and Financial Affairs (ECOFIN) Council, and the Environment (ENVI) Council.

¹²⁴ VDA, (Verband der Automobilindustrie) is the German Association of the Automotive Industry. It includes: BMW, Daimler, VW Group, Opel and its suppliers Bosch, Continental and others.

¹²⁵ ACEA refers to the Association of European Car Manufacturers. It includes: BMW, Daimler, Fiat, Ford, GM, Porsche, PSA Peugeot Citroën, Renault, and VW Group.

¹²⁶ Haas & Sander, 2019.

¹²⁷ Haas & Sander, 2019; Katzemich, 2018

¹²⁸ Haas & Sander 2019, citing Nowack, F., & Sternkopf, B. (2015). *Lobbyismus in der Verkehrspolitik: Auswirkungen der Interessenvertretung auf nationaler und europäischer Ebene vor dem Hintergrund einer nachhaltigen Verkehrsentwicklung* (No. 2015 (2)). IVP-Discussion Paper.

¹²⁹ Gulbrandsen & Chritensen, 2014.

¹³⁰ EC (European Commission), 1995 (COM95/689) A Community Strategy to reduce CO₂ emissions from passenger cars and improve fuel economy: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:1995:0689:FIN:EN:PDF>

could potentially impair international agreements. Passenger car emissions itself accounted for nothing less than half of the transport's CO₂, about 12% of total CO₂ emissions in the EU.¹³¹

The concern of the Commission was centred around the lack of progress in fuel efficiency of cars which had not progressed since the middle of the 1980s. Paired with increased car ownership, this had led to widespread congestion problems associated with inefficiencies and raised fuel consumption. As a result, "the Council and the European Parliament have called on the Commission to present a proposal for a measure to reduce CO₂ emissions from cars (...) an average fuel consumption of 5 l/100km for petrol cars and of 4.5 l/100km for diesel cars (equivalent to 120g CO₂/km) has been mentioned by twelve Member States and the European Parliament as a target".¹³² Thus, a reduction in emissions based on improved fuel economy was presented. The initial target was to achieve the goal of 120g/Km by 2005 for new registrations, indicating a 35% reduction from past 1995 levels (186 g/km).¹³³ The objective was set in accordance with the Environment Council, which had specified that the strategy should be to achieve this goal by 2005.¹³⁴

In this context, the key proposal was a voluntary agreement with car manufacturers. These sort of agreements were widespread in the 1990s, used as means for environmental action. However, such agreements were not legally binding and, therefore, left it up to the industry whether to comply or not.¹³⁵ After two years of negotiations with automakers, in 1998, the Association of European Car Manufacturers (ACEA) agreed with the European Union the target of 140 g CO₂/ Km for new passenger cars in 2008, falling short of the initial proposal of 120g/km by 2005.¹³⁶ Hence, these targets were not imposed on the industry but formulated by the industry's interests,

¹³¹ EC. 1995 (COM95/ 689).

¹³² Ibid. Introduction. Paragraph 5.

¹³³ Ten Brink, 2010.

¹³⁴ Gulbrandsen & Chritensen, 2014.

¹³⁵ Ibid.

¹³⁶ The same type of agreement with equal objectives was signed with the Japanese (JAMA) and Korean (KAMA) automobile manufacturers association for 2008.

according to the extensive coordinative dynamics between industries and regulators that characterize many EU regulatory processes.¹³⁷

Even if the EU lessen its goals in favour of the car industry's desires,¹³⁸ the agreement would be qualified as the "most wide-ranging and most important environmental voluntary agreement with industry the EU had ever concluded".¹³⁹ The voluntary agreement was complemented by introducing labelling of car's polluting levels, and national (member state) vehicle taxes that favoured the consumption of fuel-efficient cars. That said, the outcome of this agreement was the utter overshoot of the agreed CO2 emissions. Hence, this agreement has been criticised for its lack of public transparency and participation in its making, weak targets, inadequate enforcement practices, and, overall, its poor result.¹⁴⁰

Time passed, and it became evident that EU policies had failed. The average emissions from new cars sold in the EU-15 fell only from 186g/km in 1995 to 163g/km in 2004.¹⁴¹ Thus, in the next three years, emissions would have had to fall more than they had done in the past nine. The 140g/km aim of the agreement turned to be far away from reality, and even further from the initial 120g/km mark of the 1995 Community Strategy. In 2003, Jürgen Trittin, German Minister of the Environment, had already called in solitary for EU regulation to obligate car manufacturers to reduce CO2 to the initial number of 120g/km by 2012.¹⁴² It was ignored until 2005 when the European Council and the Parliament supported this position.¹⁴³

Nevertheless, in 2006, the Commission concluded that automakers had "delivered a sizeable contribution to the EU strategy for reducing greenhouse gas emissions and to

¹³⁷ Mikler, 2010.

¹³⁸ Directive 98/69/EC of the European Parliament and of the Council of 13 October 1998 relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive. See: Statement by the European Parliament and the Council

¹³⁹ ENDS. (1998, October 6). *EU minister approve co2 from cars deal*. Retrieved from: <https://www.endseurope.com/article/1619146/eu-ministers-approve-co2-cars-deal>

¹⁴⁰ Volpi & Singer, 2002

¹⁴¹ Gulbrandsen & Christensen, 2014.

¹⁴² Ibid.

¹⁴³ EC (European Commission), 2007 (COM 2007/19, final). Communication from the Commission to the Council and the European Parliament 6 Results of the review of the Community Strategy to reduce CO2 emissions from passenger cars and light-commercial vehicles

its Kyoto reduction objectives”.¹⁴⁴ ACEA automakers in response affirmed that the focus on technology presented “seriously damage the future competitiveness and financial viability of the European car manufacturing industry and weaken the EU economy”.¹⁴⁵

In sum, automakers were reluctant to introduce any sort of radical changes in their technological drivetrains, leaving all responsibility to fiscal measures and consumer purchase choices. This was the case particularly for German automakers, whose segment based on heavy expensive, and fast diesel-based cars, was the most polluting.¹⁴⁶ Unsurprisingly, in 2007 the European Commission would announce that the only way forward was establishing mandatory regulation for automakers.¹⁴⁷

3. European Union’s 2009 Copenhagen Summit failure and its indulgent industry-led binding policy for passenger cars CO2 emission standards

In the 1990s and 2000s, the EU prevailed at the forefront of international efforts to address climate change. The UNFCCC and the Kyoto Protocol served as an opportunity to project EU leadership in the global political arena, enhance the integration of member states, and reinforce EU’s multi-level governance system.¹⁴⁸ Nevertheless, this was not initially accompanied by innovative policy options in the field of car emissions.¹⁴⁹ If the total sum of EU GHG emissions had declined in the 2000s was for unrelated reasons, particularly, the ETS and the economic restructuring of the German and UK energy systems.¹⁵⁰ Furthermore, the greening of the energy system provoked a division within the member states into two differentiated groups. One, advocating for ecological modernization –embodied in 2013 in the creation of the informal group *Green Growth Group Ministers*¹⁵¹ and another one composed primarily of Central and Eastern

¹⁴⁴ EC. 2006. (COM 2006/463, final). Conclusions: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52006DC0463>

¹⁴⁵ Ibid.

¹⁴⁶ Haas & Sander, 2019

¹⁴⁷ EC. 2007 (COM 2007/ 0019 final). Communication from the Commission to the Council and the European Parliament 6 Results of the review of the Community Strategy to reduce CO2 emissions from passenger cars and light-commercial vehicles. See in: 4.CONCLUSION: <https://eur-lex.europa.eu/legal->

¹⁴⁸ Schreurs & Tiberghien, 2007; Haug & Berkhout, 2010.

¹⁴⁹ Oberthür & Pallemmaerts, 2010.

¹⁵⁰ Meyer & Meyer, 2013

¹⁵¹ In 2014 this group of Ministers called for a reduction of at least 40% of CO2 emissions by 2030 in the *Joint statement 3rd March 2014 on a climate and energy framework for 2030.*: <https://www.government.nl/documents/discussion-documents/2014/03/03/joint-statement-green-growth-group-ministers-on-a-climate-and-energy-framework-for-2030>

European countries which were reluctant to abandon coal energy for economic reasons.¹⁵²

Following the signing of the Kyoto Protocol in 2005, the EU focused its efforts on complying with it, aiming unilaterally further to reduce emissions by 20% as well as boosting the share of renewable energy by 20% by 2020.¹⁵³ Accordingly, in 2005 the Second European Climate Change Programme was launched, exploring cost-effective options for reducing GHG emissions. At the March 2007 Kyoto Protocol Summit, the EU was the first party of the UNFCCC which proposed new GHG emission reductions beyond the expiration of Kyoto commitments in 2012. In October 2007, the European Council announced its aspiration of leading global action against climate change to 2020 and beyond.¹⁵⁴ Finally, in December 2008, the European Parliament sealed the *20 20 by 2020* EC proposal,¹⁵⁵ approving the first EU's Climate Change package.

Even so, the rhythm of CO₂ reduction related to car emissions was lower than the projected one and a set of alternative measures to the voluntary agreement with the car industry became necessary to confront the issue.¹⁵⁶ This was the time of the "integrated approach" of the EU car industry, developed by the Competitive Automotive Regulatory System for the 21st Century High Level Group (CARS21), and set up by the EC Directorate General of Enterprise and Industry in 2004.¹⁵⁷ This organism had the duty to review the role of carbon emissions as part of developing an overarching integrative policy for the automotive sector. However, this institution became an industry-led organism made up primarily of European and national industry representatives, which conflicted with the views of the Directorate General of Environment.¹⁵⁸ The aforementioned approach is coherent with an overall EU neoliberal environmental

¹⁵² Delreux & Ohler, 2019

¹⁵³ Going 12% further from the 8% established in the 2005 Kyoto Protocol for 2008-2012.

¹⁵⁴ Council of the European Union. 2007. Presidency Conclusions. Brussels. March 9.

¹⁵⁵ EC. 2008 (COM 2008/ 0030 final). *20 20 by 2020 Europe's climate change opportunity*. It referred to 20% reduction of GHG emissions, and 20% increase of renewable energy by 2020.

¹⁵⁶ Bampatsou & Zervas, 2011. See in: EU Regulation (EC) No. 715/2007

¹⁵⁷ A contribution to the EU's Growth and Jobs Strategy COM(2007) 22 final. Opinion of the European Economic and Social Committee on the Communication from the Commission to the European Parliament and Council — A Competitive Automotive Regulatory Framework for the 21st Century — Commission's position on the CARS 21 High Level Group Final Report

¹⁵⁸ Gulbrandsen & Chritensen, 2014; Haas & Sander, 2020 (p. 7): "corporate lobbyists had first-hand contact with Commissioners, while NGOs were excluded from agenda-setting phase"

policy, which had subordinated alternative policies to economic competitiveness.¹⁵⁹ Germany has been a clear example of this contradictory dynamic, as the European leader of climate change mitigation and, at the same time, a resolute advocate of its own high-carbon car industry.¹⁶⁰

In December 2007, the Commission would finally propose this industry-made draft. After a bilateral summit in June among Germany and France, in September 2008, the Parliament's industry committee voted to water down the Commission's proposal, gaining the votes of the environment committee a few weeks later. In December 2008, Member States and European Parliament representatives achieved an initial agreement.¹⁶¹ After long negotiations between primarily automaker countries such as France, Germany, Italy, and the UK, in April 2009 the European Parliament and the Council approved a binding regulation setting an upper limit to the exhaust CO₂ emitted from new passenger cars.¹⁶² As a result of the so-called Franco-German regulation, automakers were given the possibility to decrease gradually its emissions while keeping production of high emitter models, (as long as it was compensated with other low emitter car sales).¹⁶³ Once again, the car industry had achieved time to delay the transformation towards a cleaner car fleet.¹⁶⁴ The German and French automotive industry directly played the primary role in its formulation which mainly benefited the high-carbon German production.¹⁶⁵

Accordingly, CO₂ average emissions were limited to 130 g/km by 2015 for newly registered cars as an average of all manufacturers combined. Moreover, the heavier the average car's weight sold by a manufacturer, the higher the CO₂ level allowed. Hence,

¹⁵⁹ Zito et al., 2019

¹⁶⁰ Hey, 2010.

¹⁶¹ Anderton, 2017

¹⁶² Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO₂ emissions from light-duty vehicles

¹⁶³ Bampatsou & Zervas, 2011. See (p. 7801): "Using this pooling, car manufactures that produce extremely polluting cars (e.g. Ferrari and Maserati (of FIAT group) and Bentley, Bugatti and Lamborghini (of VW group)) are allowed to pool together with others without, in practice, a significant decrease of the emissions of their models."

¹⁶⁴ Ten Brink, 2010 (p. 194): "Overall, the move to the integrated approach can be seen on the one hand as necessary compromise to achieve legislative outcome, and on the other hand as a major lobbying victory for the industry".

¹⁶⁵ Lindloff, K. 2016; Haas & Sander, 2019

the German industry, the biggest automaker of large and heavy high-carbon cars, had succeeded.¹⁶⁶ Through informal networking at the EU and national level, Chancellor Merkel was able to push forward the interests of the German automotive industry achieving an effective lobbying action.¹⁶⁷ Consequently, the 130g/km average target was not applied immediately but gradually phased in time: limits applied to 65% of each manufacturer's new fleet in 2012, 75% by 2013, 80% by 2014, and 100% by 2015.¹⁶⁸

In sum, the new regulation combined overall reductions with flexibility for producers, benefitting heavy automobiles. Moreover, the regulation permitted the pooling of production among automakers. Thus, the 130 g/km goal only had to be reached collectively, without setting a limit for each specific passenger car type -as it had been the case only two years before-. The effect was the incentive to sell more cars overall, smaller vehicles, along with heavier ones, without effectively reducing emissions whatsoever.¹⁶⁹ The 2009 car emission regulation also suggested a broad aim to reduce CO2 emissions to 95g/Km by 2020 -although it did not implement any relative measure-, and a credit scheme for electric and plug-in hybrid cars. These "super-credits" allowed carmakers to sell 3.5 high-emitting cars for every electric vehicle sold and still reach the designated target.¹⁷⁰

However, despite the disappointing outcome of the new regulation -which would only led to more emissions- in April 2009, an "effort-sharing" EU Decision to reduce emissions from transport, housing, agriculture and waste was introduced. This Decision, determined on the basis of member state's GDP, would serve to establish reductions in those sectors that had not been included in the 2003 Emission Trading System.¹⁷¹

In the following months the 2009 Copenhagen Climate Change Conference was held. In the run up, the EU was willing to set a "comprehensive, ambitious, fair, science-based

¹⁶⁶ Gulbrandsen & Chritensen, 2014; Haas & Sander, 2020

¹⁶⁷ Haas & Sander, 2020 (p. 7): "The chief executives of VW, Daimler, BMW, and VDA made use of their close contacts to German Chancellor Angela Merkel and several of her ministers. Matthias Wissmann, former member of the German Bundestag and Federal Minister of Transportation (1993–1998), became president of the VDA in June 2007, since he had close personal ties to top-ranking officials, especially to his former cabinet colleague and fellow party member, Chancellor Merkel

¹⁶⁸ ICCT UPDATE, POLICY. Emission standards for passenger cars and light-commercial vehicles. *POLICY*, 2014.

¹⁶⁹ Ibid.

¹⁷⁰ Anderton, 2017.

¹⁷¹ Decision No. 406/2009/EC.

and legally binding global treaty".¹⁷² Accordingly, the EU called for large-scale GHG reductions, offering to raise its own 20% commitment and 8% Kyoto Protocol commitments to 30% below 1990 levels by 2020, and at least to 80% by 2050. However, the outcome differed blatantly from initial expectations as the EU became an unexpected, marginalized actor.¹⁷³ Negotiations failed, and the 2009 Copenhagen Summit resulted in a non-legally binding accord that would set global warming for more than 3°C in 2100.¹⁷⁴ The Summit also marked a shifting point in geopolitics. The EU and the US were not anymore the only relevant actors as it had happened during Kyoto negotiations. It clearly showed the power of emerging countries such as China and India, representing a shift towards a new multi-polar environmental world order.¹⁷⁵

4. European Union's adaptative position at the 2015 Paris Summit and its new policy for passenger cars: a broad-scale fraud and the introduction of alternative vehicles

Despite the 19% increase of carbon emissions in the passenger car and overall transport sector from 1990 to 2013,¹⁷⁶ the EU was able to reduce GHG emissions by 8% under the Kyoto Protocol First Commitment period (2008-2012) successfully. Even more, by 2015, levels had dropped by 23% from 1990.¹⁷⁷ Only one year before, in the run up of the 2015 Paris Summit, the European Council announced the *2030 Climate and Energy Policy Framework*. According to this plan, GHG emissions in the EU would be reduced at least by 40% from 1990 levels by 2030, and the share of renewable energy consumed and its efficiency by 27%.¹⁷⁸

¹⁷² European Commission, "Copenhagen Conference Must Produce Global, Ambitious and Comprehensive Agreement to Avert Dangerous Climate Change," press release (Brussels, 2 December 2009)

¹⁷³ Parker & Karlsson, 2010.

¹⁷⁴ Following Haug & Berkhout, (2010) the 2009 Summit was a visible failure for EU leaders (P. 24): "UK Prime Minister Gordon Brown described as "at best flawed and at worst chaotic, "provoked many bitter responses across Europe. Commission President Barroso called the Accord "a positive step but clearly below our ambitions." He also said: "I will not hide my disappointment. "Angela Merkel, the German Chancellor, echoed this by admitting that "the decision has been very difficult for me. We have done one step, we have hoped for several more".

¹⁷⁵ Ibid.

¹⁷⁶ CO2 emissions from cars: The facts April 2018. ICCT Report.

¹⁷⁷ EEA, 2015. *Trends and projections in Europe 2015: Tracking progress towards Europe's climate and energy targets for 2020*. EEA Report 4/2015. Copenhagen. European Environment Agency.

¹⁷⁸ European Council. Brussels, 24 October 2014. EUCO 169/14: <https://www.consilium.europa.eu/media/24561/145397.pdf>

Thus, regardless of the increasing road transport emissions, the EU ultimately demonstrated its leading-by-example model in the global environmental arena. After the 2009 Copenhagen debacle, the EU regained prestige in the post-COP17 2011 Durban Platform, where was accepted the target to limit global warming to 2°C by the parties.¹⁷⁹ In this context, the Commission issued in 2011 its *Roadmap for Moving to a Competitive Low Carbon Economy in 2050*.¹⁸⁰ This announcement promoted a holistic view, the idea of climate policy mainstreaming, which “means that actors whose main tasks are not directly concerned with (...) climate change also work to attain these goals”.¹⁸¹

Furthermore, the EU was able to build a coalition of countries called the “High Ambition Coalition”, unifying many developed and developing countries to pursue the common goal of applying pressure to large carbon emitters.¹⁸² In the run up of the 21 COP 2015 Paris Summit, 80 members led by the EU jointly supported an ambitious Paris agreement -which the US joined- based on long-term goals, 5 year reviews, and full transparency of measures and results.¹⁸³

The Paris Agreement set climate change mitigation to 1.5°C . This was achieved by leaving individual countries to determine how much they will contribute to the collective mitigation effort. The agreement deviated from the “targets and timetables” EU approach, but pushed global temperature reduction 0,5°C further, as a reduction of only 1.5°C would doom many Pacific islands. It represented a complete shift from the Kyoto top-down type of agreement, aiming for a decentralized, bottom-up process of voluntary pledges.¹⁸⁴ Without any type of timetable, the Paris Agreement simply called for “nationally determined contributions”, submitted and revised every five years. Thus, the resulted caps on emissions are not binding and, even if they were fully implemented, is estimated warming of more than 2,7°C. Compliance and progress would simply rely

¹⁷⁹ Rayner & Jordan, 2016.

¹⁸⁰ EC 2011 (COM 2011/112, final). This included a plan to meet the long-term target of reducing domestic emissions by 80 to 95% by mid-century.

¹⁸¹ Anderton, 2017. See in:

¹⁸² Parkert et al, 2017.

¹⁸³ Ibid. See at: European Commission. 2015. EU and 79 African, Caribbean and Pacific Countries Join Forces for Ambitious Global Climate Deal. Press Release, http://ec.europa.eu/clima/news/articles/news_2015120802_en.htm

¹⁸⁴ Falkner, 2016

on transparency, peer pressure, and national accountability.¹⁸⁵ The EU shifted from the unilateral ideational-based leadership of the 2009 Copenhagen Summit, towards a more flexible and practical position, agreeing on a hybrid set up with bottom-up reduction pledges but with a top-down review of performance.¹⁸⁶ In few words, if “the Union came to Copenhagen with a strong normative agenda, unrealistic expectations, a miscalculation of the geopolitical context (...) It failed to forge any bridge-building coalitions”,¹⁸⁷ in Paris the EU adopted “a more realistic and pragmatic approach than it had done before”.¹⁸⁸

Internally, in 2018, the EC declared its willingness to reach climate neutrality (net-zero emissions) by 2050 at the communication *A Clean Planet for All*, as part of its long-term vision on ecological modernization.¹⁸⁹ Consequently, in this year the ETS and Effort-Sharing legislation was majorly reformed in order to achieve the defined mid and long term objectives.¹⁹⁰ That said, even with these reforms the EU is far away from being on track with its own 2050 objectives.¹⁹¹ Nonetheless, emission levels regarding the Effort-Share regulation sectors during the period 2015-2019 remained above 2014 levels, mostly due to increased emissions coming from the transport sector.¹⁹²

If there is any chance to limit global warming to 1.5 °C as stated in the Paris goals, it has been estimated that transport emissions should be reduced by 94% from 2005 levels to 2050,¹⁹³ and not to only 60% as proposed by the European Commission in its 2011

¹⁸⁵ Rayner & Jordan, 2016.

¹⁸⁶ Parkert et al, 2017.

¹⁸⁷ Bäckstrand & Elgström 2013

¹⁸⁸ Delreux & Ohler, 2019.

¹⁸⁹ EC 2018 (COM 2018/773 final). According to the press release, “The Commission presents strategy for a climate neutral Europe by 2050 – Questions and answers”, the EU’s approach regarding mobility include: (i) overall vehicle efficiency, low- and zero emission vehicles and infrastructure; (ii) a long-term switch to alternative and net-zero carbon fuels for transport; (iii) increased efficiency of the transport system.

¹⁹⁰ Delreux & Ohler, 2019.

¹⁹¹ EEA Report No 13/2020. Trends and projections in Europe 2020. Tracking progress towards Europe's climate and energy targets. p. 14: “the current EU-wide 2030 target of 40 % emission reductions compared with 1990 levels would put a greater burden on future generations to increase their emission reductions: the EU-27 would have to triple its annual average reductions from 2030 to 2050, compared with the average annual reductions that it achieved in the period 2005-2018”.

¹⁹² Ibid. (p. 18).

¹⁹³ T&E, Europe needs to slash its transport emissions by 94% by 2050 – Effort Sharing Regulation. 21/12/2016

Transport White Paper.¹⁹⁴ In this proposition, it was mentioned how the use of alternative fuels and electric vehicles is a mean to make transport cleaner and more efficient, without curving mobility. Thus, “the paramount goal of European transport policy is to help establish a system that underpins European economic progress, enhances competitiveness and offers high quality mobility services while using resources more efficiently”. Nevertheless, the ecological modernization discourse has been criticized for its depoliticization of environmental politics, as it emphasizes market rationality above any other criteria, blurring the scope for alternative substantial approaches.¹⁹⁵

It should once more be asked, what was happening with carbon emissions from passenger cars meanwhile the EU managed to recover its leading role in the international environmental arena? In 2014 the EU, responded in two complementary directions: setting new carbon regulations, and introducing the *Clean Power for Transport package*, a so-called long term strategy to promote alternative fuels for transport in Europe.

At the end of 2013, the EU Parliament and the Council of the EU reached an agreement regarding new mandatory carbon regulation of passenger cars.¹⁹⁶ In March 2014, new legislation amending the 2009 regulation was finally approved. A target value of 95g/km of CO₂ for 2020 newly registered cars was set. However, this would include a one-year phase-in period, requiring 95% of new sales to comply with the standard in 2020 and 100% from 2021 and on. Weight as a utility parameter was still retained, the heavier the manufacturers car fleet, the higher the CO₂ emission value is allowed by the regulation.¹⁹⁷ On the other hand, this regulation implied also a 95 euro fine for every 1g/km of CO₂ that a manufacturer exceeded in its average emissions target, multiplied

¹⁹⁴ European Commission, DG MOVE, White paper, Roadmap to a single European transport area, 2011

¹⁹⁵ Machin, 2019

¹⁹⁶ Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO₂ emissions from new passenger cars

¹⁹⁷ EU: LIGHT-DUTY: GHG EMISSIONS: <https://www.transportpolicy.net/standard/eu-light-duty-ghg-emissions/>

by its volume of new-car registrations in the previous year. Consequently, from 2021 and on automakers may expect to confront billionaire fines from the EU.¹⁹⁸

Just as it happened with the previous Directive 443/2009, the automotive industry intervened in the debate and decision-making of the Directive 333/2014. During 2012, after confidential meetings with VDA lobbyists, the German Minister of Economics contacted the Energy Commissioner, Günther Oettinger, a member of CDU (German conservative party). Meanwhile, Martin Winterkorn, chairman of the executive board of Volkswagen, wrote to Oettinger. As a result, Oettinger moved the Climate Commissioner, Connie Hedegaard, to make concessions in favour of the automotive industry.¹⁹⁹ In 2013, the 95g upper limit was introduced but along with the “super-credits” system, which would allow companies to double-count cars that emitted less than 50g/km. Initially, the European Council was meant to pass the legislation on 27th June 2013, however, Angela Merkel, led the President of the Council to remove this point from the agenda.²⁰⁰

In sum, despite the stricter 95 euro/km fine system introduced for 2021, Germany’s automotive industry managed a partial victory. Through its political representatives, it was able to slow down the approval of new passenger car carbon standards until February 2014 and managed to preserve car weight scale criteria. In 2013 the fleet average for new cars was already 127 g/km, falling below the 2015 standard of 130 g/km two years before planned by the 2009 regulation. However, this seemingly good news hid behind fraudulent tests. The EU’s car testing system suffered from a growing gap between laboratory test results and real on-road performance of cars.²⁰¹ The NGO Transport & Environment has estimated that the gap soared from 8% in 2001 to 28% in 2012 and 42% in 2016. According to this organization: “The primary cause, confirmed by the current emission cheating revelations, is carmakers manipulating the undemanding

¹⁹⁸ Carmakers face €20 billion in fines for exceeding CO2 targets – Part 2. 06 February 2020. Autovista Group

¹⁹⁹ Haas & Sander, 2020.

²⁰⁰ Damian Carrington, The Guardian. *Angela Merkel 'blocks' EU plan on limiting emissions from new cars*: <https://www.theguardian.com/environment/2013/jun/28/angela-merkel-eu-car-emissions>

²⁰¹ Paltsev et al. 2018

and poorly prescribed emissions tests; and choosing to fit technology to improve the efficiency of the car that works much better in the test than on the road”.²⁰²

Similarly, the International Council on Clean Transportation has estimated that the divergence grew from 8% in 2001 to 31% in 2013, which equals to a real-driving emission of 166 CO₂ g/km on average for new registered actual car emissions.²⁰³ Nonetheless, their estimations have revealed that the discrepancy between official measurements of vehicle efficiency and actual performance of new cars quadrupled from 2001 to 2017, getting up to 39%.²⁰⁴ Therefore, the 2009 testing procedure based on results obtained under laboratory conditions using the New European Driving Cycle (NEDC), significantly altered real emissions.²⁰⁵ This type of testing did not change either with the 2014 amendment on the 2009 regulation.

The laboratory NEDC test became a noticeable public problem in September 2015, when the United States Environmental Protection Agency accused Volkswagen of violating US emissions standards.²⁰⁶ Subsequently, Volkswagen Group admitted having implemented an illegal defeat device to beat the test cycle in their diesel cars. Better known as the *Dieseldate*, this global and political affair meant that the biggest European automaker had deliberately programmed (turbocharged direct injection) diesel engines to activate emission controls only during testing. Thus, carbon and, particularly, nitrogen oxide output emissions were up many times more in real-world driving than during tests in at least eleven million cars worldwide.²⁰⁷ Fortunately, in September 2018 a new emission test, the Worldwide Harmonised Light Vehicles Test Procedure (WLTP), was introduced assessing gas emissions. Even though the WLTP does not neither reproduce exactly real-driving emissions, it constitutes a major improvement from its obsolete precedent.²⁰⁸

²⁰² T&E, April 2018. CO₂ emissions from cars: The facts. See p.4: “the industry consistently fits technology to cars that will deflate emissions far more in the lab than on the road such as short range plug-in hybrids, stop-start and cylinder deactivation”.

²⁰³ ICCT, September 2014. FROM LABORATORY TO ROAD A 2014 UPDATE OF OFFICIAL AND “REAL-WORLD” FUEL CONSUMPTION AND CO₂ VALUES FOR PASSENGER CARS IN EUROPE.

²⁰⁴ ICCT, January 2019. FROM LABORATORY TO ROAD A 2018 UPDATE OF OFFICIAL AND “REAL-WORLD” FUEL CONSUMPTION AND CO₂ VALUES FOR PASSENGER CARS IN EUROPE

²⁰⁵ Paltsev et al. 2018; Ajanovic & Haas, 2017.

²⁰⁶ EPA. “Learn About Volkswagen Violations”.

²⁰⁷ Ajanovic & Haas, 2016; Klebaner, 2018

²⁰⁸ CO₂ emissions from cars: The facts April 2018. ICCT Report.

In the aftermath of *Dieselpgate*, automakers were under the spotlight of media and regulatory attention.²⁰⁹ Since the Voluntary Agreement was adopted in 1998, dieselization had been the main response of the car industry to reduce emissions. Accordingly, the share of diesel cars in Europe grew from 36% to 55% in 2011.²¹⁰ However, since the scandal arose in 2015, diesel shares of new car registrations have declined constantly in the European market, falling to a mere 30% of the market share in 2019.²¹¹ Now is widely known that diesel cars cannot be considered a low-carbon solution as the industry has been claiming since the 2000s.²¹² Due to their polluting emissions and their extra weight, they present no environmental benefits over petrol cars.²¹³ Meanwhile, low-carbon alternatives such as hybrid and plug-in hybrid electric cars have not been barely provided in the market until recently.²¹⁴

While the 2014 amendment on light-duty vehicles carbon standard was being negotiated, in 2013 the *Clean Power for Transport package* was introduced. Its objectives were the long-term substitution of oil as an energy source in all modes of transport,²¹⁵ and the deployment of alternative fuels recharging and refuelling infrastructure.²¹⁶ Even though since 2010 the EU started discussing and building up a policy framework related to this transition, it would only compromise itself in 2014 to set the infrastructure necessary for an alternative low-carbon type of mobility. The final Directive,²¹⁷ was adopted by the Parliament and the Council in September 2014, requiring the Member States to notify the European Commission of its own National Policy Frameworks (NPFs) regarding implementation. This policy would rely upon

²⁰⁹ 24 Nov 2020, 13:32 Edgar Meza. The diesel engine's days are numbered in Europe. <https://www.cleanenergywire.org/news/diesel-engines-days-are-numbered-europe-industry-analyst#:~:text=Diesel%20cars%20are%20now%20becoming,five%20percent%20in%20some%20countries.>

²¹⁰ The ICCT, European vehicle market statistics, Pocketbook 2017/18, 28/11/2017

²¹¹ See all types of fuels of new passenger cars in ACEA: [https://www.acea.be/statistics/tag/category/share-of-diesel-in-new-passenger-cars#:~:text=In%202019%2C%20almost%2060%25%20of,point%20more%20than%20in%202018\).](https://www.acea.be/statistics/tag/category/share-of-diesel-in-new-passenger-cars#:~:text=In%202019%2C%20almost%2060%25%20of,point%20more%20than%20in%202018).)

²¹² The ICCT, 2020-2030 CO2 standards for new cars and light-commercial vehicles in the European Union, 26/10/2017; Cames, & Helmers, 2013.

²¹³ EEA, Monitoring of CO2 emissions from new passenger cars and vans in 2016, Report n 19/2017, 18/01/2018

²¹⁴ T&E, Carmakers failing to hit their own goals for sales of electric cars, 05/09/2017

²¹⁵ EC (European Commission), 2013 (COM 2013/17)

²¹⁶ EC (European Commission), 2013 (COM 2013/18)

²¹⁷ Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure

member states, and private and public investment in alternative technology and infrastructure, without choosing any specific technology. Thus, the 2014 Directive advised that “technological neutrality should be ensured, and national policy frameworks should take due account of the requirement to support the commercial development of alternative fuels”. Internationally, in 2015 the Electric Vehicle Initiative (EVI), a multi-government policy forum dedicated to accelerating the adoption of electric vehicles,²¹⁸ presented a formal declaration in the COP 21 of the Paris Summit that pointed out the urgency of implementing electromobility.²¹⁹ This declaration would set a precedent for the later success of the electric vehicle as the primary substituting technology.

However, results have been heterogenous across member states, as each of them has been inclined for different technologies, and at different paces. Therefore, in 2019 results were much lower and fragmented than initially expected.²²⁰ Overall, as the own Directive’s 2019 Impact Assessment stated, up to 2019 it can be affirmed that NPFs presented by member states have “low ambition level (...) CO2 emissions from transport could be reduced by 0.4% by 2020 and 1.4% by 2030”. Hence, “action is needed to put the contribution of alternative fuels back on track for a meaningful impact on GHG emissions reductions from transport and minimising the EU's dependence on oil”.²²¹

5. European Union’s passenger car policy towards Paris Agreement 1.5 ° objective. Tougher CO2 emission standards after the post-*Dieseldgate* era?

If the 1998 Voluntary Agreement, and the 2009 regulation and its 2014 amendment were manifestly industry-led policies that prioritized short-term economic results of the

²¹⁸ As expressed in its website (<https://www.iea.org/programmes/electric-vehicles-initiative>), “EVI was launched under the Clean Energy Ministerial (CEM), a high-level dialogue among Energy Ministers from the world’s major economies. Fifteen countries are currently participating in EVI: Canada, Chile, China, Finland, France, Germany, India, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Sweden, and the United Kingdom.”

²¹⁹ *The Paris Declaration on Electro-Mobility and Climate Change and Call to Action* specified that “at least 20 percent of all road transport vehicles globally to be electrically driven by 2030 – if warming is to be limited to 2 degrees or less”. <https://unfccc.int/media/521376/paris-electro-mobility-declaration.pdf>

²²⁰ Commission Staff Working Document Impact Assessment accompanying the document Proposal for a Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure, SWD/2013/05 final

²²¹ COMMISSION STAFF WORKING DOCUMENT Report on the Assessment of the Member States National Policy Frameworks for the development of the market as regards alternative fuels in the transport sector and the deployment of the relevant infrastructure pursuant to Article 10 (2) of Directive 2014/94/EU

industry over climate change mitigation, the Directive 2019/361 would represent a moderate shift from this EU approach. This turn can be explained by increased pressure on EU institutions on climate change objectives, a loss of confidence in automakers, and the grown technological and market maturity of electric vehicles.²²²

Nonetheless, the *Dieseldgate* scandal represented a tipping-point, as it has shown not only that the automakers were openly deceiving GHG emission standards, but that EU institutions and even member states were aware and complicit in these practices. As the 2017 EU Parliament report noted, “the Commission lacked the political will and decisiveness to act upon the seriousness of the high NO_x emissions and to give priority to the protection of public health that was at stake”, and “Member States contravened their legal obligation to monitor and enforce the ban on defeat devices set out in Article 5(2) of Regulation (EC) No 715/2007. None of them found the defeat devices installed in the Volkswagen vehicles, in particular those Member States whose authorities type-approved those vehicles”.²²³ Moreover, these discrepancies among laboratory tests and real-world emissions “affect the vast majority of diesel cars and are not limited to the Volkswagen vehicles”.²²⁴

In November 2017, the Commission announced in a new draft the proposals for 2025 and 2030, planning to reduce CO₂ emissions by 15% and 30% respectively, and to make companies sell zero-emission vehicles (ZEVs) by these percentages too. However, through VDA pressure the Commission dismissed the fixed quota for electric cars and avoided introducing sanctions. Instead, the Commission proposed economic incentives to the companies to produce electric vehicles.²²⁵ In response, the European Parliament proposed that automakers should cut CO₂ emissions by 20% by 2025 and 40% by 2030; and ZEVs should account for 20% of sales in 2025 and 35 in 2030, while introducing sanctions for those who failed to meet the quota.

Here, France led a group in the European Council supporting the tougher Parliament measures, while Germany led the opposing group in favour of the softer Commission

²²² Haas & Sander, 2020.

²²³ Committee of Inquiry into Emission Measurements in the Automotive Sector. EU Parliament report (02/03/2017. Rapporteurs: Jens Gieseke, Gerben-Jan Gerbrandy

²²⁴ Ibid.

²²⁵ German lobbyists test EU on car emissions, A. Rettman, Brussels, 8. NOV 2017, 09:28

measures.²²⁶ The “trilogue” among the EU institutions would last until April 2019. Finally, it was agreed that CO₂ emissions of new cars should be reduced by 15% by 2025 and 37,5% by 2030, and that sales of zero-emission vehicles should account for 15% in 2025 and 35% in 2030. The forthcoming transformation to low-carbon vehicles has relied only on incentives, excluding any sanction mechanism for automakers that do not comply with the quotas.²²⁷ In the end, the outcome consisted of a middle ground agreement between the weak Commission proposal and the tougher Parliament plan.

That said, even the initial Parliament proposal was still far behind the Paris Agreement objectives to limit global warming to 1.5°C.²²⁸ Nonetheless, these EU policies have already had a deep impact in many member states. As stated by the International Energy Agency, by 2030 in member states such as the UK, Denmark, Iceland, or the Netherlands only zero-emission vehicles will be sold.²²⁹

Main takeaways

In this chapter four key takeaways are identified. Firstly, as illustrated in Table 1,²³⁰ the EU has acted as a clear-cut leader in the intricate and challenging construction and development of the international climate change regime. The political configuration of the EU as an aggregation of individual states with different governing institutions has not been an obstacle for its leadership as a unit. Conversely, despite the impulse and willingness presented by the EU, climate change as a global political matter is a complex issue to tackle. Therefore, outcomes are slow, fragile, and uncertain, as they rely upon the coordination of other powers with different interests. Moreover, it is exposed to setbacks, as happened in the 2009 Copenhagen Summit. Here it became patent that the EU is no longer capable of leading the process by itself as it did before.

Secondly, there has been a blatant political dissonance inside the EU between climate change policy and passenger car policy. On the one hand, the climate change problem

²²⁶ Haas & Sander, 2020

²²⁷ Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO₂ emission performance standards for new passenger cars and for new light commercial vehicles, and repealing Regulations (EC) No 443/2009 and (EU) No 510/2011

²²⁸ T&E. Parliament sends a clear signal to Ministers: more ambition needed to cut car CO₂. 2018.

²²⁹ IEA, 2021. Global EV Outlook, 2021, p. 47. China and Japan also plan to have 100% electrified sales by 2035.

²³⁰ See two pages below.

has been a priority on the EU's public agenda since the 1990s. Hence, the EU became a frontrunner at the Kyoto Protocol in 1997, and ever since, pledged for the sharpest GHG emission reductions. Accordingly, in 2003 it implemented the ETS to tackle emissions of different industries and successfully achieved the desired reduction of GHG emissions. On the other hand, although since 1992 the Council of the European Union was aware of the impact of passenger car emissions, the EU institutions over time showed political neglect and reluctance to confront the increasing emissions of road transport. As a result, until the approval of the 2019 binding regulation, the EU has made broad concessions to the car industry. This dynamic is even more paradoxical when it is acknowledged that its primary cause has been Germany's pressure, one of the assumed leading countries in the fight against climate change within the EU.

Thirdly, this dissonance was caused through the co-optation of the EU institutions by the industry. As exposed during this chapter, EU institutions operated in a corporatist way, guided mainly by the automaker's economic interests. These had a prioritized position during the decision-making processes. Even if the EU shifted its approach in 2007 after the failure of the 1998 Voluntary Agreement, the European and German lobbying action successfully watered down the 2009 and 2014 subsequent agreements. Additionally, after the *Dieseldgate* scandal saw light in 2015, it became further clarified how automakers had purposefully defeated test emissions with the consent of the EU institutions and its member states. Hence, the regulatory standards were only a mere number that did not appropriately reflect real-driving emissions.

Lastly, the industry-led policy delayed the implementation of alternative drivetrain technologies. For a long time, the EU's exclusive approach towards CO₂ emissions reduction relied on the agreed improvement of fuel efficiency by ICE cars, leading to increased sales of diesel fuel cars. Thus, alternative technologies were not a foreseeable solution until the 2013 approval of the *Clean Transport Package*. On the other hand, as showed in the 2018 EC communication *A Clean Planet for All*, it must be noted that the EU's solution is a techno-optimist strategy, which does not attempt to curb or limit mobility but transform it through technological and behavioural changes. Accordingly, *ex-ante* private automobile mobility will not necessarily be reduced but only transformed mainly through electric engines.

| Key political climate change events and EU's role and GHG emission reduction policies | Key EU's passenger car policies |
|---|--|
| Creation of the IPCC, 1988 - First IPCC assessment, 1990 - EU pledge to maintain emissions of CO2 emissions in 1990 by 2000, 1990 | Lack of agreement for CO2 car reductions by the Council of the EU, 1992 |
| UNFCCC and Rio Earth Summit 1992 - Growing international role of the EU as unitary actor - Failure of a reduction agreement due to US dropout | Community Strategy, 1995 - 120g CO2/Km by 2012 as initial objective |
| Kyoto Protocol Summit 1997 - EU as a frontrunner and solitary leader - EU 15% pledge reduction of GHG emissions from 1990 - First European Climate Change Programme, 2000 | Voluntary Agreement, 1998 - 140g CO2/km by 2008 objective - Industry led agreement - Lack of enforcement and effectiveness - Beginning of the "integrated approach" by CARS21 group, 2004 |
| Kyoto Protocol ratification, 2002 - EU achievement of an 8% binding reduction of GHG emissions - Introduction of the Emission Trade System, 2003 | New Community Strategy, 2007 - Open recognition of failed policies - Announcement of monitoring of emissions and future binding CO2 standards |
| Kyoto Protocol implementation, 2005 - Second European Climate Change Programme, 2005 - <i>20 20 by 2020 Europe's climate change opportunity</i> , 2008 - Introduction of the Effort-Sharing regulation, 2009 | First binding regulation on CO2 emissions, 2009 - "Integrated approach" realization by CARS21 group - 130 g CO2/km by 2015 objective - Watered down agreement, introduction of minor fines and phased in time limits from 2012 to 2015 - Industry-led regulation by Germany and Italy automakers - Introduction of the NECD testing system, 2009 |
| | Transport White Paper, 2011 - Announcement of low-carbon and competitive mobility - Mention to alternative vehicles as a key element |
| | Clean Power for Transport package, 2013 - Implementation of alternative vehicle infrastructure - Technological neutrality between different alternatives |
| Copenhagen Summit 2009 - EU loss of leadership and failure of its top-down "targets and regulation" approach - <i>EU 2030 Climate and Energy Policy Framework</i> , 2014 - EU regain of international prestige in and after the Durban Platform, 2011 - <i>Roadmap for Moving to a Competitive Low Carbon Economy in 2050</i> , 2011 | 2014 Amendment to the 2009 regulation, 2014 - Target value 95 g CO2/km by 2020 - Introduction of 95 euro per gram per car above the average fine by 2021 - Partial victory of the industry |
| Paris Summit, 2015 - EU "leading-by-example" realistic comeback with 23% drop of GHG emissions from 1990, 2015 - <i>Dieselgate</i> discovery, 2015 - <i>A Clean Planet for All</i> EU announcement, 2018 | New binding regulation on CO2 emissions, 2019 - Ambitious techno-optimist ecological turn for the future - Further reduction of CO2 emissions and introduction of a stricter testing procedure (WTLP), 2018 - Lack of zero-emission EVs quotas |

Table 1 Chronological summary of key events at the global climate change arena and EU's role, and policies regarding GHG emissions (left), and EU's passenger car policies (right)

III. The climate change issue and the slow reorientation of the car industry in Spain

1. Emergence of climate change as an issue and lack of impact on the car industry (1995-2006)

Climate change and socio-political environment

As seen in the second chapter of this work, internationally, climate change had already gained significant scientific and political attention in the 1980s.²³¹ However, as in many other regions, the issue would take one more decade to appear in the public sphere in Spain.²³² Thus, it would not be until the 1990s when it attracted some attention from the media. This attention would follow the major international landmarks, such as the Kyoto Protocol (1997), the Third IPCC report (2001), and the ratification of the Kyoto Protocol (2005). That said, this set of events did not become exceptionally popular, having moderate or even low press coverage. However, it was already a main topic at specialized environmental magazines.²³³

Political attention on the issue at the Spanish Congress remained minor also. The attention given would come hand by hand with the outcome of the Kyoto Protocol Summit in 1997 and its ratification in 2002 (Fig. 5). Both events would prompt oral interventions and initiatives which revolved around discussions on the Spanish position towards Kyoto Protocol and its objectives.

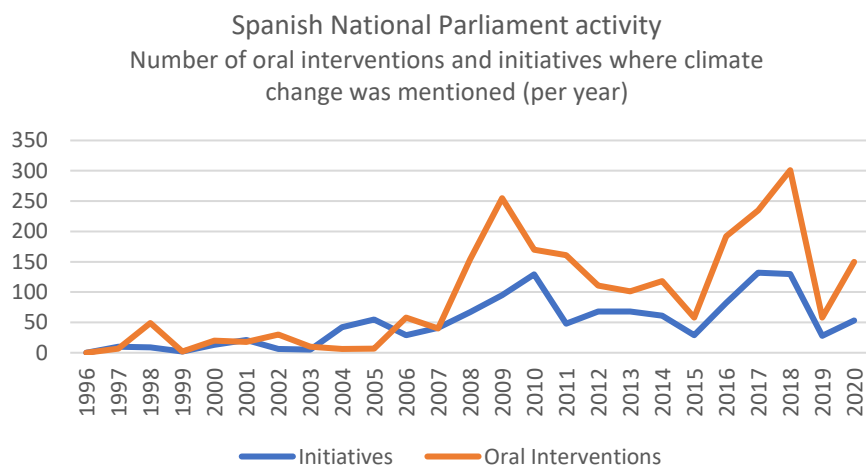


Figure 5 Spanish National Congress evolution of activity in terms of oral interventions and initiatives (1996-2020). Source: Spanish National Congress search engine

²³¹ Corfee-Morlot et al., 2007

²³² Fernández Reyes, 2010

²³³ Ibid.

Correspondingly, during this phase, two policy-making institutions associated with the Ministry of Environment were established.²³⁴ The National Climate Council, created in 1998,²³⁵ and the Spanish Climate Change Office, created in 2001.²³⁶ Additionally, in 2005 the Climate Change Commission was formed to implement the EU Emission Trading System.²³⁷

Meanwhile, supranational regulatory pressure regarding car emissions was non-existent. In 1994 the Spanish government decided to subsidize the conventional industry by financing the ownership of new cars for those buyers whose vehicle had more than ten years. From 1994 to 1997, new acquisitions were supported by means of the *Renove* Plan, and from 1997 up to 2007, by means of the *Prever* Plan. During these years, the administration helped the industry with a total of 1.745 euro million.²³⁸ Hence, innovation pressure towards radical technologies remained non-existent. After all, in 1998 the European industry had managed to attain a voluntary agreement with the EU which would only boost further diesel vehicles.

Car industry responses

As the Spanish government started financing the industry, its representatives focused on campaigning against the vehicle registration tax. In 1995 the Spanish association of automakers, ANFAC, pushed to reduce it. The communicative strategy applied by ANFAC worked in three steps.²³⁹ Firstly, the risk of a sharp reduction of production was announced.²⁴⁰ Then, fiscal reductions were explicitly requested.²⁴¹ Lastly, the industry warned the government of investment losses and collective dismissals of workers.²⁴²

²³⁴ See: "Organismos e Instituciones implicadas en la lucha contra el Cambio Climático a nivel Nacional", Ministerio para la transición ecológica y el reto demográfico.: <https://www.miteco.gob.es/es/cambio-climatico/temas/organismos-e-instituciones-implicados-en-la-lucha-contra-el-cambio-climatico-a-nivel-nacional/>

²³⁵ Real Decreto 177/1998, de 16 de febrero,

²³⁶ Real Decreto 376/2001, de 6 de abril

²³⁷ Ley 1/2005, de 9 de marzo, por la que se regula el régimen del comercio de derechos de emisión de gases de efecto invernadero

²³⁸ "El lobby del automóvil se cuele en La Moncloa" (Civio, 1 de febrero, 2014)

²³⁹ Esparcia, 2006

²⁴⁰ "Las ventas de coches caerán un 3% en el primer semestre, según la patronal" (El País, 30 de junio, 1995)

²⁴¹ "Los fabricantes de coches piden bajar la tasa de matriculación y no el IVA" (El País, 17 de mayo, 1995)

²⁴² "Caen las ventas de coches y Anfac anuncia regulaciones de empleo si no hay ayudas fiscales" (ABC, 7 de junio, 1995)

This would remain a topic across time, as industry representants unceasingly kept asking for its reduction or suppression.²⁴³ Nevertheless, this tax did not impede the growth of the industry, whose production of conventional cars had the highest-ever growing tendency during this period up until 2008 when the global financial crisis started.²⁴⁴ Accordingly, the agreed policy between the national government and the industry was based on incremental changes, encouraging the sales of diesel based cars which presented increased efficiency.²⁴⁵

2. Increased public and political attention on climate change and hedged position by the car industry (2006-2010)

Climate change and socio-political environment

It would be in 2007 when climate change irrupted as it had not before in the public sphere. The presentation of the Fourth IPCC report, in combination with Al Gore´s figure and documentary *An inconvenient truth*, catapulted climate change to the forefront of national newspapers (Fig. 6). A similar peak of attention only was achieved at the 2009 Copenhagen Summit.²⁴⁶

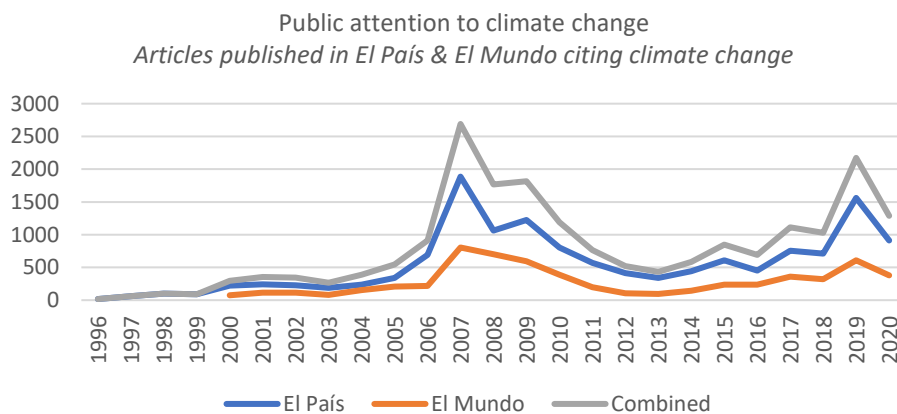


Figure 6 Spanish newspaper coverage of climate change by number of articles citing Climate change (El Mundo & El País) Source: MeCCO, Media and Climate Change Observatory

Political attention at the national Congress increased significantly (Fig. 5). Moreover, in 2007 a national strategy for climate change and clean energy was announced.²⁴⁷

²⁴³ “El sector discrepa sobre el traspaso del impuesto de Matriculación”, (El Mundo, 20 de mayo, 2001).

²⁴⁴ España - Producción de vehículos: <https://datosmacro.expansion.com/negocios/produccion-vehiculos/espana>. España - Matriculaciones de vehículos nuevos: <https://datosmacro.expansion.com/negocios/matriculaciones-vehiculos/espana>

²⁴⁵ “Turbo-sobrealimentación, más potencia para su motor” (Evolution, 30 de noviembre, 2006).

²⁴⁶ Fernández-Reyes et al., 2015

²⁴⁷ Estrategia española de cambio climático y energía limpia, horizonte 2007-2012-2020

Viernes 20 de julio de 2007: <https://www.lamoncloa.gob.es/Paginas/archivo/200707-estrategia.aspx>

However, despite the presence of the topic at parliamentary discussions in the form of oral and written questions, inquiries, and government appearances, only one bill would be passed referring directly to climate change, the 2010 update of the previous national adaptation of the EU Emission Trading System.²⁴⁸

Meanwhile, European automakers increased their attention on climate change and new drivetrain technologies, as both issues became widely relevant and popular at the automaker magazine *Automotive News Europe*. Climate change attention skyrocketed after the 2005 implementation of the Kyoto Protocol (Fig. 7 a). Meanwhile, attention on alternative drivetrains increased significantly correlating with the announcement of the EU community car strategy in 2007 and the launch of the 2009 CO₂ emission binding standards. Hence, this period shows a clear step forward, as it enhanced the awareness and visibility of the problem among automakers, which had to make prospects on the introduction of alternative low-carbon cars.

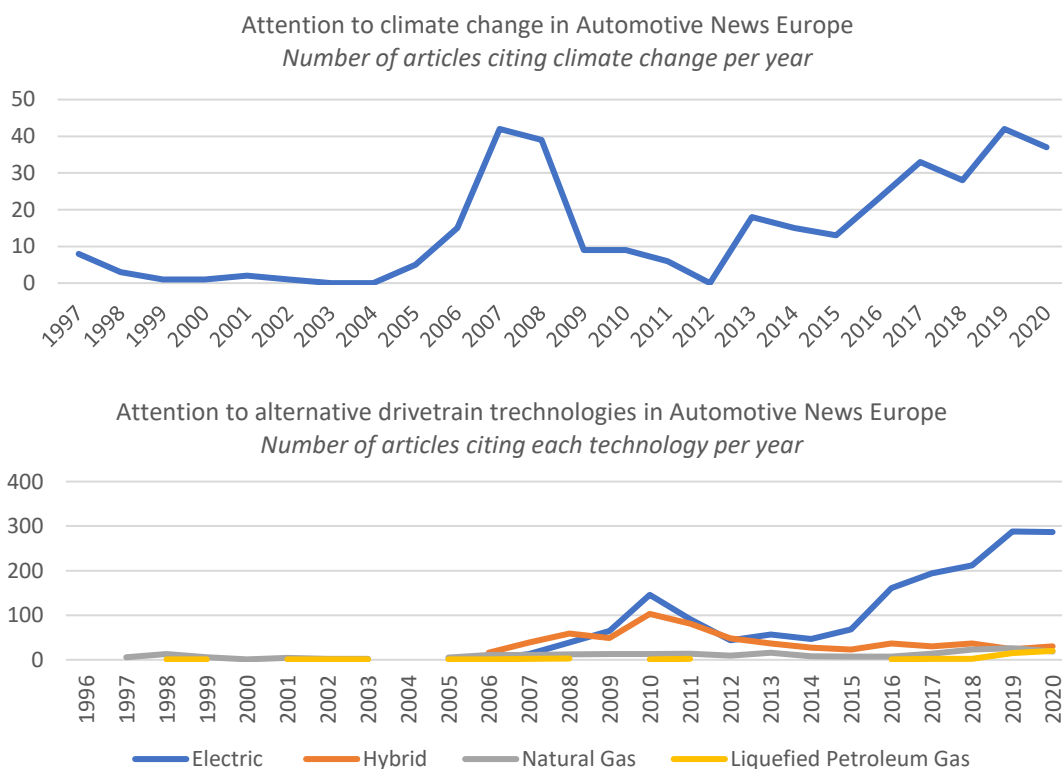


Figure 7 (a, b, top-down) Attention to climate change (a) and to alternative drivetrain technologies (b) by automaker's magazine *Automotive News Europe*. Source: *Automotive News Europe*

²⁴⁸ Ley 13/2010, de 5 de julio, por la que se modifica la Ley 1/2005, de 9 de marzo, por la que se regula el régimen del comercio de derechos de emisión de gases de efecto invernadero

Car industry responses

As abovementioned, the European and national industry had to face some regulatory supranational changes during these years. In this regard it is noteworthy how in 2007 ACEA and ANFAC, asked the Spanish government to actively help the industry at the EU level, going against the implementation of the 120g CO₂/km standard regulation. Particularly, the general secretary of ACEA, Ivan Hodac, pointed that Brussels standards were utopic and unrealistic. Moreover, he warned Spain to step in negotiations at the EU level if it did not want production to be relocated to other regions.²⁴⁹

Besides, ACEA complained about the EU labelling system, which made pollutant cars be identified as such.²⁵⁰ Meanwhile, national ecologist groups pushed the initial EU's proposal of 120g CO₂/km as an emission standard for 2012.²⁵¹ However, the industry still wanted to benefit from the sale of relatively low-carbon (diesel-based) cars, which presented less CO₂ emissions but not as low as the EU proposed standard. Accordingly, in 2007 ANFAC criticized the ending of the government funding programme *Prever Plan*. On this occasion, national automakers expressed their environmental concern, arguing that 23% of the Spanish fleet was outdated and contaminating, and, therefore, new sales were needed.²⁵²

Next year the government would lean towards the industry desires by means of the *Vive Plan* (2008-2010), which would boost sales by providing loans on favourable terms to buyers. The Ministry of Industry spent 1.200 million euros in this occasion.²⁵³ Additionally, the *2000e Plan* (2008-2010) was also implemented, providing 100 extra million euros per year to subsidize low-carbon sales. For ANFAC, these would be clear examples of positive support for a key national industry suffering a global crisis.²⁵⁴

²⁴⁹ "Los fabricantes europeos de coches solicitan 'ayuda activa' al Gobierno español" (26 de junio, 2007, Cinco Días).

²⁵⁰ "Bruselas pretende que los anuncios resalten lo que contamina un coche" (28 de julio, 2008, El país).

²⁵¹ "Organizaciones ecologistas lanzan una campaña para reducir las emisiones de CO₂ de los coches" (15 de julio, 2008, Ambientum)

²⁵² "Acaba el Plan Prever entre peticiones de prórroga por la 'alarmante' situación del parque español" (31 de diciembre, 2007, El Mundo).

²⁵³ "El lobby del automóvil se cuele en La Moncloa" (Civio, 1 de febrero, 2014)

²⁵⁴ Situación de la industria de automoción en España. Ante la era post- petróleo (2010). García Sanz, Presidente ANFAC.

As a result, automakers helped by the government increased their diesel-based car sales, which by then, were promoted as a clean alternative to gasoline. Hence, during this phase and the next one (2006-2015), diesel sales astonishingly rose. Despite its polluting harmful effects, as much as 70% of new car registrations and 60% of the total cars in use were diesel-based over these years.²⁵⁵ As explained by the Spanish Technology Platform of Components of the Automotive sector in their 2008 Strategic Research Agenda, automakers did not present any innovative activity.²⁵⁶ As “factories located in Spain focus exclusively on manufacturing (...), vehicle constructors do not have decision centres in Spain and all the R&D activity takes place beyond our borders”. Thus, “electric vehicles are still not ready to conquer the automobile market. The main reason lies in the batteries and their limitations; the energy supplied is simply not enough for long journey”.²⁵⁷ In conclusion, the national industry had not and could not provide by itself any sort of low-carbon alternatives, and European R&D centres, namely, Germany and France, had not used its capability to implement alternative drivetrains.²⁵⁸

3. Diminishing attention on climate change and the emergence of a wide range of alternative cars (2010-2016)

Climate change and socio-political environment

Since the 2009 Copenhagen Summit the climate change issue significantly lost the attention of the media. This would only be temporarily recovered in 2015 when the Paris Summit was held (Fig 6.). However, even if the issue lost somewhat political attention in terms of oral interventions (Fig 5), ten draft bills referring to climate change were discussed at the parliament. These bills protected different environmental areas such as national parks, biodiversity, or the coasts.

²⁵⁵ El País, “La venta de coches de gasolina supera al diésel por primera vez en 20 años” (07-07-2018)

²⁵⁶ This is a broad platform associated to the Spanish Ministry of Science and Innovation, “a meeting point for the technology stakeholders from all vehicle-related sectors” (Strategic Research Agenda, 2012). It was created in 2005 and is comprised by component suppliers but also by automakers and its representants, as well as by research institutes. See more at: <https://www.move2future.es/quienes-somos>

²⁵⁷Strategic Research Agenda. November 2008, Move to Future.

²⁵⁸ According to ACEA, Pocket-guide 2019-2020, the automotive patents by country in 2018 was distributed in the following way: Germany 2.988 patents, France 980, Sweden 444, Italy 403, the UK 340, and the rest of the EU 693.

Correspondently, during this period the public administration turned to subsidize both conventional and alternative cars. In 2010 the Ministry of Industry, Energy and Tourism initiated a strategy to finance the electric vehicle through the *Movele* Plan. The objective of this plan was to achieve 250.000 electric vehicles for 2014. However, only 10 million euros per year were dedicated, and, understandably, the lack of charging infrastructures paired with higher prices equalled to only 10.000 registrations of electric cars by the end of 2014.²⁵⁹

Meanwhile, in 2012 the *Pive* Plan was introduced, which mainly would serve to incentivize conventional efficient vehicles. It would be extended several times over the years, adding up to a total of 1.115 million of spending in 2016.²⁶⁰ The private gains of the industry through these programmes were justified in terms of public benefit, as the renovation of the fleet, aimed for a (slight) reduction of oil consumption and, therefore, of CO₂ emissions too.²⁶¹ However, this can be also explained by economic reasons, as the introduction of incentives based on the sale of relatively low-carbon ICE cars, turned beneficial for both automakers and the public administration. Nonetheless, public governmental investment at these plans had a multiplied return of four times via value-added taxes.²⁶²

At the EU level, it is noticeable how automaker's attention on climate change and alternative drivetrains diminished significantly until 2014 (Fig. 7). After the EU 2009 watered-down binding agreement, automakers had space to keep working on incremental improvements of ICE fuel consumption for diesel cars. Thus, radical alternative innovations were not necessarily crucial or imminent. Attention on both dimensions would grow back considerably when the regulatory environment changed. In 2014 the EU introduced an ambitious amendment on carbon emissions, which designated a 95g CO₂/km goal for 2021.²⁶³ Moreover, according to the Directive 2014/94/EU on Alternative Fuels Infrastructure, member states were obliged to develop their alternative vehicle structure for this year too. Spain did not join the EVI initiative

²⁵⁹ Mapa Tecnológico de Movilidad Eléctrica, Observatorio Tecnológico de la Energía jueves, 12 de enero de 2012. IDAE

²⁶⁰ "Gráfico: Evolución del plan PIVE" (Sur, 23 de julio, 2016)

²⁶¹ Elguero, 2018

²⁶² Ibid.

²⁶³ Ibid.

at the 2015 COP 21 of the Paris Summit but presented a National Strategy to Impulse Alternative vehicles.²⁶⁴ Finally, in 2016 it introduced its *New Energy Vehicle* policy transposing the EU's Directive.²⁶⁵

Car industry responses

If the first period (1995-2006) was characterized by the total neglect of the industry and policymakers, and the second one (2006-2010) by increasing visibility of the issue and awareness of the industry, this one opened a window for alternative drivetrain technologies. Accordingly, this was reflected in the car market where there was a meaningful increase in alternative vehicle sales. However, the majority of these were still inside the ICE paradigm, such as the alternative fuel ICE cars (LPG and CNG) and, foremost, HEVs (Fig. 8 a). Thus, sales from electric vehicles (BEVs and PHEVs) remained minimal, representing only 0,3% of the total amount of sales (Fig. 8 b)

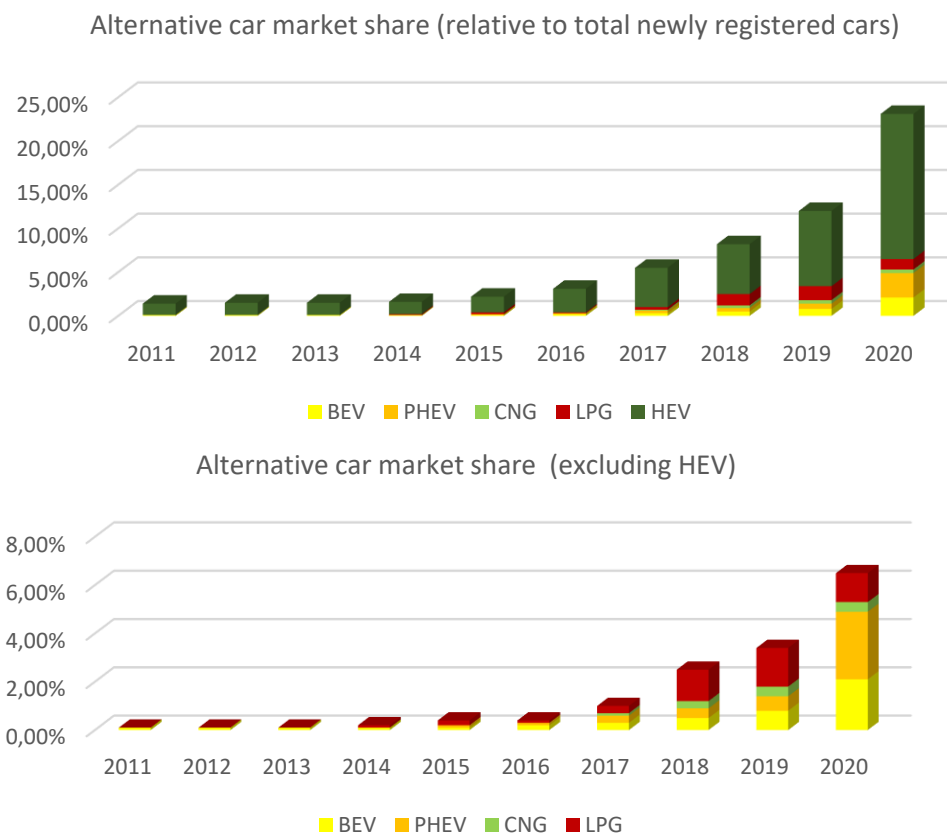


Figure 8. (a, b, top-down) Market share of alternative cars BEV, PHEV, CNG, LPG, HEV (a), and market share of alternative car excluding HEV (b). Sources: a) EAFO, ANFAC, STATISTA b) EAFO.

²⁶⁴ Estrategia de Impulso del Vehículo con Energías Alternativas: <https://industria.gob.es/es-es/Servicios/estrategia-impulso-vehiculo-energias-alternativas/Paginas/estrategia-vea.aspx>

²⁶⁵ Real-Decreto, 639/2016 de 9 de diciembre

The national production of alternative passenger cars only started in 2014 based on flexi-fuels cars. This refers to a vehicle that can function alternatively with gas (natural or petroleum gas) or conventional gasoline. In 2014, Opel -owned by General Motors until 2017, and from then on by the French firm PSA Groupe- and Seat -owned by the German firm Volkswagen- would start producing this type of flexi fuel passenger car.²⁶⁶, That said, there were not any electric passenger vehicles produced, and only one Hybrid, the Ford Mondeo Hybrid.²⁶⁷ However, commercial electric vehicles, indeed, were already being produced, and ANFAC claimed that the *Movele* Plan, along with future incentives, would transform Spain into a major electric vehicle producer.²⁶⁸

In contrast with Spanish representatives, European automakers remained sceptical and doubtful towards the electric car. In 2013, the general secretary of ACEA, Ivan Hodac, stated that due to high investment costs, lack of incentives and infrastructure, electric cars were doomed to failure.²⁶⁹ In 2015, its successor, Erik Jonnaert, extended this ominous narrative: “on climate change, we are at a crossroads. And as we move forward in the discussion about CO2 and climate change, we want to ensure we don’t undermine the sector”. Furthermore, regarding electric cars it expressed that “electrification is going to be an option worthwhile exploring for passenger transport, but it is not going to be *the* solution”, and hence, “we continue working on optimising combustion engines”.²⁷⁰

However, the patenting activity of electric and hybrid technology in Spain increased significantly, showing the potential of an emerging technological shift (Fig. 9). This innovation was developed mainly by other stakeholders, such as universities,

²⁶⁶ During these years, Opel produced three models of petroleum gas (Meriva, Corsa, Mokka), and Seat one (Leon). See in: ANFAC, 2014, Informe Anual.

²⁶⁷ Anfac 2016, Informe Anual.

²⁶⁸ According to, “Anfac presenta un plan para el desarrollo del vehículo eléctrico en España” (Energías Renovables, 10 de septiembre de 2014), up to 2014 16.000 electric vehicles (which none of them were cars) had been produced. There were four commercial vehicle models (Citroen Berlingo E, Peugeot Partner E, Mercedes Vito E, and Nissan e-Nv 200), and one micro-car (Renault Twizy).

²⁶⁹ “El coche eléctrico va directo al fracaso según los fabricantes europeos”, Car and Driver, (08/01/2013).

²⁷⁰ “ACEA boss: Even a zero-emission target will fail to address car CO2” EURACTIV.com 29 may 2015

component suppliers, and energy companies, which shown an interest in the implementation of electric cars.²⁷¹

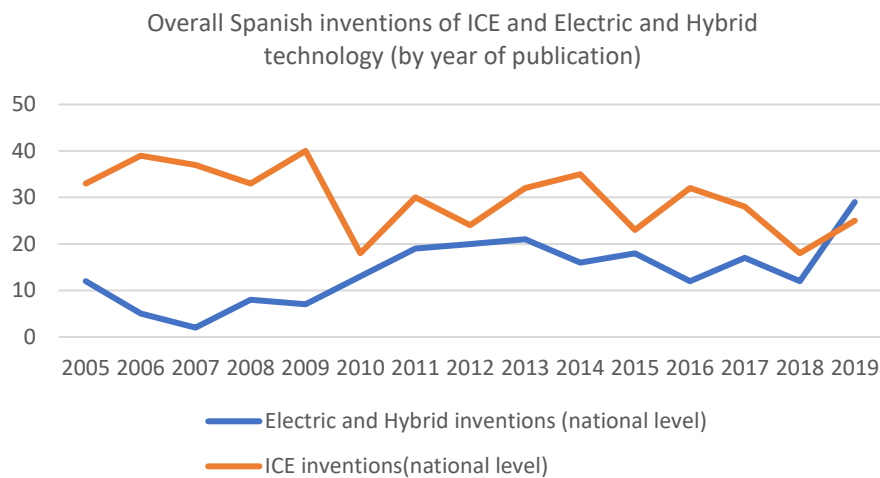


Figure 9 Overall Spanish inventions of ICE and electric and hybrid technology from 2005 to 2019 .Source: Oficina Española de Patentes y Marcas, (OEPM).

Echoing this tendency, the Spanish Technology Platform pointed out in 2012 that “we are witnessing important technological restructuring in vehicle propulsion systems and transmission. This is due to factors such as the Kyoto Protocol, directives on reducing CO2 emissions and recycling end-of-life vehicles (...) Clearly, this means research needs to be done on alternative fuels and the electrification of vehicles and infrastructures”.²⁷²

4. Climate change as an emergency, the start of the end of the Diesel car, and the initial penetration in the market of alternative vehicles (2016-2021)

Climate change socio-political environment

This period represents a partial but definitive cultural and technological shift. The introduction of a national policy framework would significantly increase pressure on automakers, and at the same time, facilitate adequate conditions for further market penetration of alternative cars. Following the publication of the 2018 IPCC report, public attention on climate change raised to the level acquired back in 2007 (Fig. 6). Additionally, the expressions used to communicate its effects had deeper connotations,

²⁷¹ Solicitudes publicadas de invenciones (patentes y modelos utilidad) relacionadas con el coche eléctrico, 2006-2014. Unidad de Apoyo Dirección General. Servicio de Estadísticas y Estudios, OEPM.

²⁷² Spanish Technology Platform of Components of the Automotive sector, Strategic Research Agenda, 2012.

as then terms such as “climate emergence” and “climate crisis” became central in *El Mundo* and *El País* newspaper agendas.²⁷³ A parallel process occurred at the National Congress, where political attention grew considerably (Fig. 5). In 2018, the newly appointed social-democrat government turned substantially into the community strategy against climate change, aligning the country with those countries which had the most ambitious policies.²⁷⁴ Accordingly, the Ministry for Ecological Transition and the Climate change and Energy Commission were created. Next year, the COP 25 Summit took place in Madrid. Despite its disappointing outcomes,²⁷⁵ the initiative of the Spanish government hosting this meeting consolidated the country’s compromise towards the ecological transition. Correspondently, the council of ministers accorded a strategic frame for this purpose.

During this period, different policies prompted a favourable environment for alternative cars. Every year different purchase incentive plans were introduced, such as the 2017 *Movea* Plan (with 14 million euros), the 2017 *Movolt* Plan (with 20 million euros), and 2018, 2019, and 2021 *Moves* Plan I, II, and III (with 45, 100, 400 million euros respectively).²⁷⁶ Other incentives accompanied such as suppression of registration taxes, road tax exemptions, toll exemptions on regional highways, free parking in selected cities, reserved traffic lanes for EVs.²⁷⁷ Likewise, charging infrastructure extended significantly in this period for electric, natural gas, and LPG cars, for which considerable infrastructure was already in place in 2019.²⁷⁸ However, charging infrastructure remained insufficient, and chargers would have to dramatically rise from 8.000 in 2020 to 110.000 in 2025 for electric cars to reach the required market share to decarbonize transport.²⁷⁹ These measures certified the death of the diesel-based system that had decayed since 2015 when the *Dieseltgate* scandal took place.

²⁷³ Erviti, 2020

²⁷⁴ Jiménez-Sánchez, 2020.

²⁷⁵ “Failure In Madrid As COP25 Climate Summit Ends In Disarray”, Dave Keating, 15-12-2019

²⁷⁶ Observatorio del Vehículo Eléctrico y Movilidad Sostenible de la Universidad Pontificia Comillas. Legislación e incentivos: <https://evobservatory.iit.comillas.edu/legislacion-y-normativa>

²⁷⁷ EAFO. Country detail incentives: <https://www.eafo.eu/countries/spain/1754/incentives>

²⁷⁸ Report on the Assessment of the Member States National Policy Frameworks for the development of the market as regards alternative fuels in the transport sector and the deployment of the relevant infrastructure pursuant to Article 10 (2) of Directive 2014/94/EU

²⁷⁹ ANFAC Automoción 2020-40

Noticeably, the percentage of Diesel sales diminished from 60% in 2015 to 37% in 2018 and barely 27% in 2020.²⁸⁰

Reasonably, given the accumulated socio-political pressure of this period, automakers had to shift their attention towards the alternative car trend. Consequently, attention on climate change (Fig. 7 a), and attention on electric drivetrains by these (Fig. 7 b), raised and peaked as they had not before.

Finally, in May 2021, a bill was passed regarding climate change mitigation and clean energy for the next decades.²⁸¹ Following the impulse of the 95g CO₂/km EU standard, the aforementioned law certified the death of the ICE car. By 2040 it has been determined a total ban of ICE car sales. By 2050 it is expected that no cars emitting CO₂ will be circulating the roads. Thus, the phase-out of the ICE car has become a foreseeable reality in the mid-term.²⁸² Among other measures, all municipalities with over 50.000 inhabitants will have to establish a low-emission area. Moreover, every gas station is designated to implement electric charging points. Thus, it is already set the path for a future without ICE cars.

Car industry responses

In every year of this period, the market share of alternative cars constantly grew (Fig. 8). Alternative cars expanded in many of their variants, particularly regarding HEVs which reached 16.6% of total sales in 2020. Thus, the ICE technology is persistent and intends to accompany the transition process. That said, electric, gas natural, and LPG cars slowly but surely increased their sales. Actually, despite the irruption of the Covid-19 in 2020, sales of this type of cars only soared. In sum, the electric car market share reached 4,8% this year. Natural gas and LPG sales remained lower, with only 0,4% and 1,2% growth.

Meanwhile, European automakers overviewed the whole process with scepticism and contempt. In 2018, ACEA strongly criticized the EU CO₂ objectives, pointing that “the severe lack and unbalanced distribution of charging points is putting consumers off buying electric cars”. Thus, automaker’s representatives denounced the unequal

²⁸⁰ El País, “Las restricciones al diésel fuerzan a los vendedores a rebajas de precio”, 22-10-2018

²⁸¹ Ley 7/2021, de 20 de mayo, de cambio climático y transición energética.

²⁸² “Las medidas más importantes de la nueva ley de cambio climático”, El País, 08-06-2021. See more in *Table 3* at the end of this subsection.

development of charging infrastructure among EU member states, arguing that “although the EU’s Directive on Alternative Fuel Infrastructure set out objectives for member states in 2014, its implementation has been poor so far”.²⁸³ Moreover, Europe Automaker's magazine claimed that “from the auto companies' perspective, it's clear that switching to electric is largely a response to legislation rather than consumer demand”. Accordingly, “for many automakers, the word "electrified" encompasses mild hybrids, which gives standard combustion engines a small electric boost for an equally small decrease in CO2 emissions”.²⁸⁴ As proof of the distrust of automakers, it is noticeable how on average less than 2% of total advertisement spending was conceived to promote zero-emission cars.²⁸⁵ In the same sense, in 2020, ACEA kept denouncing the lack of appropriate charging infrastructure despite its growth.²⁸⁶ As a response, in 2020, ANFAC signed an agreement with AELEC²⁸⁷ to further develop the charging infrastructure.²⁸⁸

Regardless of the doubts of European automakers, in Spain, 2019 was registered as the first year when electric and hybrid inventions were ahead of ICE ones (Fig. 9). That said, The Spanish Technology Platform announced in its 2019 report that in the short term, investment and research are needed and expected for both technologies, advanced ICEs, and electric engines.²⁸⁹ In this context, imports of electric cars have soared, and national producers have finally introduced electric car models. In 2020, Opel and Peugeot each produced an electric model, Ford produced two hybrids, and Seat fabricated three natural gas models (Table 2).²⁹⁰ Overall, the change is incipient, and the majority of the car fleet is still diesel-based (Table 3). In 2020, 22% of total sales came from alternative cars, but only 0,7% of the Spanish passenger car fleet was formed

²⁸³ “Electric cars: unrealistic CO2 targets proposed by EU Parliament ignore lack of charging points”, ACEA, press release, 5th of July 2018.

²⁸⁴ “EU electrified car push is driven by rules, not market demand”, Automotive News Europe, 22-09-2018.

²⁸⁵ T&E, 2018. Carmakers STILL failing to hit their own goals for sales of electric cars

²⁸⁶ “Charging points: Growth not keeping pace with rising demand for electric vehicles, new data show”, ACEA, press release, 28th October 2020.

²⁸⁷ Spanish association of electric energy companies

²⁸⁸ “Las eléctricas y las marcas de coches se unen para impulsar el coche eléctrico”, El País, 20-07-2020

²⁸⁹ Evolución APE de I+D+i del sector de automoción – 2019, Move to the Future.

²⁹⁰ ANFAC, Annual Report, 2019; “Estos han sido los coches eléctricos más vendidos en España durante 2020”, 04-01-2021, Hibridosyelectricos.com

by these, way below the 5,8% average of the EU.²⁹¹ Moreover, Spain ranked 17th out of 29th European countries in terms of plug-in electric car market share in 2019.²⁹²

| Spanish production of alternative passenger car models in 2020 | | | Five most sold models of electric cars in 2020 | |
|--|------------------|------------|--|-------|
| PHEV | Battery Electric | CNG | Model | Units |
| Ford Mondeo Hybrid | Peugeot e-208 | Seat Ibiza | Renault Zoe | 2.403 |
| Ford Nuevo Kuga | Opel Corsa -e | Seat Arona | Hyundai Kona | 1.793 |
| | | Seat Leon | Peugeot n-208 | 1.249 |
| | | | Tesla model 3 | 1.202 |
| | | | Volkswagen ID.3 | 1.017 |

Table 2. Spanish production of alternative passenger car models in 2020 (left) and five most sold electric models in Spain in 2020 (right) Source: ANFAC (2019) and Hibridoselectricos.com

| Cars in use by type in 2019 (units and percentage) | | |
|--|------------|-------|
| Gasoline | 10.939.069 | 44,5% |
| Diesel | 13.510.143 | 55,0% |
| Alternative (HEV, BEV, PHEV, CNG, LPG) | 108914 | 0,4% |

| Car sales by type in 2019 and 2020 (percentage) | | |
|---|--------|--------|
| | 2019 | 2020 |
| Gasoline | 60,10% | 49,80% |
| Diesel | 27,90% | 27,70% |
| Alternative (HEV, BEV, PHEV, CNG, LPG) | 12% | 22% |

Table 3 Total cars in use by type in 2019 in Spain (top) and car sales by type in 2019 and 2020 in Spain (bot) Source: DGT and Statista

In sum, this period represents a decisive turn from an innovative and socio-technical standpoint. The socio-political environment has substantially evolved, and policy regulations have set a new scenario suitable for alternative cars. Nevertheless, as observed across this chapter, it is also clear that the ICE drivetrain based on conventional fuels, natural gas, and liquified petroleum gas is meant to remain on the roads and co-exist with electric cars for the next decades.

²⁹¹ See in EAFO: <https://www.eafo.eu/vehicles-and-fleet/m1#>

²⁹² European Countries Listed By Plug-In Electric Car Market Share In Q1-Q4 2020 by INSIDE EVs: <https://insideevs.com/news/489169/european-countries-plugin-market-share-q1q4-2020/>

Pattern-matching the case of Spain with the DILC model

To provide a further explanation of the transition process in Spain now is performed a pattern-matching analysis, which compares the core dynamics in the four selected temporal periods²⁹³ with those predicted by the DILC model for different conceptual phases.²⁹⁴

The first period (1995-2006) matches well with DILC's phase 1, presenting little attention by newspapers and a lack of responses by the industry. In this time frame, only the scientific community and the national environmental magazines acknowledged the relevance of the topic. Accordingly, even if the government created institutions to monitor climate change, firms did not experiment any pressure whatsoever. Hence, politicians only reacted to the topic to discuss and follow the EU's position at the Kyoto Protocol.

The second period (2006-2010) portrayed dynamics of the DILC's phase 2, such as raising public concern and symbolical political action, and 3, such as defensive hedging by the industry. Echoing the effects of the 2007 IPCC Report, public and political attention on climate change skyrocketed nationally. Accordingly, newspapers adopted climate change as a priority, and the National Congress increased its awareness, as demonstrated by the rise of discussions and the announcement in 2007 of a National Strategy for climate change. However, even if the attention on alternative drivetrains soared by the industry, alternative cars were not part of the political agenda. Hence, the government financially supported the ICE diesel-based technology and its further production. Accordingly, as the EU did not require any further measures, the government did not attempt to promote any innovation. Thus, it remained preferable economically to secure and extend the production of ICE cars.

The third period (2010-2016) combined dynamics of the DILC's phase 3, such as the continued defensive position of the industry, and phase 4, such as the formation of

²⁹³ 1995-2006, 2006-2010, 2010-2016, 2016-2020.

²⁹⁴ As explained in the second chapter of this work at the subsection "2. Theoretical model: an application of the Dialectical Issue Life-Cycle model", the phases of the DILC model are: (1) problem emergence and industry neglect, (2) raising public concern and defensive industry responses, (3) political debates, controversies and defensive hedging, (4) formation and implementation of substantive policy and industry diversification, and (5) spillovers to the task environment, and strategic reorientation. See further in: Geels & Penna, 2015, p. 1032, Table 1.

substantial innovative policy. At the same time, an unexpected regression in the attention on climate change occurred during this period. Despite this, the political inertia prompted by the EU *White Paper on Transport* (2011) and *Clean Package* (2013) facilitated the introduction of national policies preparing the eventual implementation of alternative cars. At the same time, the government kept greatly financing the renewal of the ICE car fleet with more ICE cars. Thus, the advancement of ICE technology, rather than alternative ones, remained the priority for both the government and automakers.

Lastly, the fourth phase (2016-2021) displayed the dynamics of phase 4, such as the further implementation of substantial policy and industry diversification, and somewhat of phase 5, such as (incipient) strategic reorientation and consumer behaviour change. At this stage, pressure from the socio-political environment has aligned and accumulated. Many relevant stakeholders become in favour of a slow but steady transition: the EU institutions, the national government, ANFAC, and component suppliers. Internationally, the EU designated a new alternative path for automakers after the approval of the 2019 binding agreement. Nationally, climate change became known as an emergency. In 2018 the government created the Ministry for Ecological Transition, which led to the announcement of a climate change mitigation strategy in 2019, and its final approval in 2021. The new favourable context provoked reactions both in terms of inventions and models. Remarkably, during this period, national electric and hybrid inventions surpassed the number of ICE inventions. Moreover, automakers finally developed new models and started the production of electric passenger cars in 2019 and 2020. Consequently, in 2020, consumers began slowly leaning towards alternative cars, which finally become a visible reality.

Final conclusions

The present work has analysed how climate change socio-political pressures have fostered a technological transition in the European and Spanish car industry. The historical parallelism between the first decades of the twentieth century and the present one is remarkable. As it happened once during the creation of the car industry, where electric, steam, and oil-based vehicles competed, we are currently heading into a new era where different technologies are meant to co-exist for a prolonged period.

As predicted by the DILC model, the industry's struggle against alternative drivetrains was present at all phases, slowing down its impact as long as possible. Until climate change pressures did not align in the last years, the effective implementation of alternative cars has not been viable. Hence, the application of this theoretical model served to prove and explain how deep societal problems, like climate change, take a hard and long time to confront pre-existent technologies, from the moment the issue gains public awareness until real solutions, such as electric cars, become implemented. Even though these are not a unique and definitive solution to the problem, as stated by the IPCC and transport environmental NGOs, they constitute a necessary short-term measure to mitigate climate change.

At the EU level, this work showed how the EU became a leader in the climate change global regime, while its institutions acted jointly with the car industry to define their own policies. Even if the EU confronted climate change in other areas through the ETS, road transport became an untouchable area. For a long time, the transition became blocked by the lobbying action. Member state economic interests and, specifically, German political representatives, effectively protected the profits of their domestic industries. Additionally, it also illustrated the inherently complex character of a broad systematic transition that is full of uncertainty. Despite the recent popularity of electric cars, the EU's commitment to technological neutrality shows how all existing technologies -including incremental advancements of the ICE- are considered part of the solution. Nevertheless, regardless of the technology, it became clear that a charging infrastructure and state driven economic incentives at all levels are necessary conditions for change.

The study of Spain showed the case of a member state with a high production output but without any innovation capacity or relevant influence at the EU decision-making process. Its national government depended on foreign companies to sustain one of its main economic sectors in terms of tax revenue and employment. Hence, it facilitated as much as possible the development and incremental advancement of the ICE car industry. Resembling the EU political guidelines, despite 2007's peak of popularity of climate change, Spain did not take any specific measures against the ICE car industry until recently. That said, the last years have prepared the scenario for a gradual but

dramatic change in the car mobility system. In the next decade, it is expected that alternative cars, and especially electric cars, penetrate the market, significantly increasing their share and prompting national automakers to increase their production of these sorts of vehicles. However, until its final phase-out in 2040, the ICE technology will also be part of this process in its conventional form -using diesel or gasoline-, in Flexi-fuel cars -using CNG or LPG- and in combination with the electric engine -in the form of HEVs and PHEVs-.

In sum, all over Europe, the private automobile vehicle will gradually substitute its pre-existent ICE technology for low-carbon based alternatives, reinforcing at the same time the car's position as a primary way of mobility. Only time will judge if this EU's techno-optimist approach, also extended in other regions of the world, will be enough to maintain global warming below the 1.5°C mark, and avoid forthcoming dreadful climate change-caused catastrophes.

Finally, it should be reflected that this work presents some limitations. Firstly, this study only selected one of the many drivers of change for the car industry, climate change. However, the same co-evolving process in relation to other relevant issues could have been studied, namely, economic and financial crises, the EU's dependency on foreign oil, or the harmful impact of pollution. Thus, this work solely explained the process partly, as it only engaged with climate change as a source of pressure to the industry. Secondly, this work has not taken into account the impact that relevant non-European carmakers, such as Hyundai or Toyota, may have also had in the process.

For further research, it would be worthwhile to focus on the case of member states with high production levels, high patenting levels, and local firms as these could directly show automaker's reactions. This selection would render fruitful analysis, as it could allow for a better appreciation of where technology innovation efforts are placed. The most prominent case by far is the German one. Germany is the leading country in production and technological innovation, but also in the EU's climate change policy. That said, the French and Italian cases would also be interesting comparatively, as due to the lighter weight of their vehicles, they are producers with opposing, or at least different, interests from Germany.

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PLAGIARISM RULES AWARENESS STATEMENT

Fraud and Plagiarism

Scientific integrity is the foundation of academic life. Utrecht University considers any form of scientific deception to be an extremely serious infraction. Utrecht University therefore expects every student to be aware of, and to abide by, the norms and values regarding scientific integrity.

The most important forms of deception that affect this integrity are fraud and plagiarism. Plagiarism is the copying of another person's work without proper acknowledgement, and it is a form of fraud. The following is a detailed explanation of what is considered to be fraud and plagiarism, with a few concrete examples. Please note that this is not a comprehensive list!

If fraud or plagiarism is detected, the study programme's Examination Committee may decide to impose sanctions. The most serious sanction that the committee can impose is to submit a request to the Executive Board of the University to expel the student from the study programme.

Plagiarism

Plagiarism is the copying of another person's documents, ideas or lines of thought and presenting it as one's own work. You must always accurately indicate from whom you obtained ideas and insights, and you must constantly be aware of the difference between citing, paraphrasing and plagiarising. Students and staff must be very careful in citing sources; this concerns not only printed sources, but also information obtained from the Internet.

The following issues will always be considered to be plagiarism:

- cutting and pasting text from digital sources, such as an encyclopaedia or digital periodicals, without quotation marks and footnotes;
- cutting and pasting text from the Internet without quotation marks and footnotes;
- copying printed materials, such as books, magazines or encyclopaedias, without quotation marks or footnotes;
- including a translation of one of the sources named above without quotation marks or footnotes;
- paraphrasing (parts of) the texts listed above without proper references: paraphrasing must be marked as such, by expressly mentioning the original author in the text or in a footnote, so that you do not give the impression that it is your own idea;
- copying sound, video or test materials from others without references, and presenting it as one's own work;
- submitting work done previously by the student without reference to the original paper, and presenting it as original work done in the context of the course, without the express permission of the course lecturer;
- copying the work of another student and presenting it as one's own work. If this is done with the consent of the other student, then he or she is also complicit in the plagiarism;
- when one of the authors of a group paper commits plagiarism, then the other co-authors are also complicit in plagiarism if they could or should have known that the person was committing plagiarism;
- submitting papers acquired from a commercial institution, such as an Internet site with summaries or papers, that were written by another person, whether or not that other person received payment for the work.


The rules for plagiarism also apply to rough drafts of papers or (parts of) theses sent to a lecturer for feedback, to the extent that submitting rough drafts for feedback is mentioned in the course handbook or the thesis regulations.

The Education and Examination Regulations (Article 5.15) describe the formal procedure in case of suspicion of fraud and/or plagiarism, and the sanctions that can be imposed.

Ignorance of these rules is not an excuse. Each individual is responsible for their own behaviour. Utrecht University assumes that each student or staff member knows what fraud and plagiarism



entail. For its part, Utrecht University works to ensure that students are informed of the principles of scientific practice, which are taught as early as possible in the curriculum, and that students are informed of the institution's criteria for fraud and plagiarism, so that every student knows which norms they must abide by.

| | |
|---|--|
| I hereby declare that I have read and understood the above. | |
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Failure to submit or sign this form does not mean that no sanctions can be imposed if it appears that plagiarism has been committed in the paper.