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**Driving Climate Breakdown: The barriers to decarbonising the automobile sector in the UK and Germany**

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**List of abbreviations**

**ACEA European Car Manufactures Association**

**AI Artificial Intelligence**

**BAFA Federal Office for Economic Affairs and Export Controls**

**BEIS Department for Business, Energy, and Industrial Strategy**

**BoE Bank of England**

**BMVI Federal Ministry of Transport and Digital Infrastructure**

**BMW Bayerische Motoren Werke AG**

**BMWi Federal Ministry for Economic Affairs and Climate Action**

**CAFÉ Corporate Average Fuel Economy**

**CCS Carbon Capture and Storage**

**CO2 Carbon Dioxide**

**CO2e Carbon dioxide equivalent**

**COP26 the 26th Conference of the Parties**

**DARP Recovery and Resilience Facility**

**DfT Department for Transport**

**ECB European Central Bank**

**EM Ecological Modernisation**

**ETS Emissions Trading Scheme**

**EV Electric vehicle/s**

**FCA Financial Conduct Authority**

**FCEV Fuel-cell vehicle**

**GND Green New Deal**

**GDP Gross Domestic Product**

**HD Hypothetico-deductive**

**HGV Heavy Goods Vehicle**

**ICE Internal Combustion Engine**

**IMF International Monetary Fund**

**IPCC Intergovernmental Panel on Climate Change**

**LGV Light Goods Vehicle**

**MLP Multi-level Perspective**

**NEDC New European Driving Cycle**

**NGFS Network for Greening the Financial System**

**NO2  Nitrogen Dioxide**

**NPE National Platform Elektromobiliät**

**OECD Organisation for Economic Co-Operation and Development**

**OLEV Office for Low Emission Vehicles**

**PHEV Plug-in Hybrid**

**PHV Private Hire Vehicle**

**QE Quantitative Easing**

**SDG Sustainable Development Goals**

**SMMT Society of Motor Manufactures and Traders**

**STT Socio-technical Transitions**

**SUV Sports Utility Vehicles**

**TCA Trade and Cooperation Agreement**

**TCFD Task Force on Climate-Related Financial Disclosures**

**ULEV Ultra-low emission vehicle**

**UK United Kingdom**

**UNCED United Nations Conference on Environmental and Development**

**UNFCCC United Nations Framework Convention on Climate Change**

**USA United States of America**

**VAT Value Added Tax**

**VED Vehicle Excise Duty**

**VoC Varieties of Capitalism**

**WLTP World Harmonized Light-duty Vehicles Test Procedure**

**WTO World Trade Organisation**

**WHO World Health Organisation**

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**Abstract**

Transport is the only sector in the global economy for which emissions continue to rise, with automobiles contributing substantially to this increase. Electric vehicles (EVs) have emerged as a key part of the strategy to address automobile emissions, becoming a central feature of the Paris Agreement. The transition to EVs and the barriers to decarbonising the automobile sector remain underexplored in the literature. To address this gap, I focus on the UK and Germany to examine the unique characteristics of their EV transitions, and how they compare. I develop a novel, synergistic theoretical framework that draws upon the Multi-level Perspective (MLP) from the Socio-Technical Transitions literature and Ecological Modernisation, to establish a robust theoretical framework in which to situate EV transitions. By combining these approaches, I reconceptualise the MLP by continuing its recent political turn. The work is underpinned by an original qualitative dataset of 65 semi-structured interviews and extensive primary and secondary documentary analysis. I argue that decarbonising the automobile sector requires a break from the orthodox neoliberal capitalist logic that has defined the state's role and capacity in the contemporary political economic paradigm since the 1980s. I show that the UK is attempting to couple the EV transition with a modernisation of its economy and industrial capacity. In contrast, I find that Germany, which is typically portrayed in the literature as a coordinated polity, has become markedly uncoordinated during the EV transition. Overall, the thesis contributes a detailed analysis of EV transitions in two national contexts, highlighting the political and economic tension that has been created by states pursuing environmental objectives whilst also attending to the economic interests of automobile manufacturers. The thesis identifies key barriers to decarbonising the automobile sector and suggests ways in which those barriers may be addressed.

# Chapter One

## Introduction

### 1.1: The politics of electric vehicles

This thesis examines the politics of decarbonising the automobile sector[[1]](#footnote-1) in both the United Kingdom (UK) and Germany as they transition to electric vehicles (EVs). It has been written amidst profound uncertainty over the future in the face of climate breakdown and the economic contraction of the global economy induced by COVID-19[[2]](#footnote-2). The thesis takes its lead from the Paris Agreement, which foregrounded EVs in the environmental debate to an unprecedented degree, promoting the technology as a crucial part in keeping global temperatures below 2**°** from pre-industrial levels under the United Nations Framework Convention on Climate Change (UNFCCC). This research is consequently a timely intervention into one of the most prominent, yet underdeveloped, features of the environmental politics literature in recent years. I address this pronounced gap by identifying some of the key barriers to the EV transition in two of the most developed capitalist states in the global economy, that have historically sought to portray themselves as environmental leaders.

After a total of 196 states ratified the Paris Agreement in 2015 it became the first-ever universal, legally binding global climate deal. The agreement identified the need to decarbonise the automobile sector from its dependence on internal combustion engine (ICE) vehicles. Whilst the agreement contained no mechanisms to enforce countries to set specific dates for phasing out ICEs (UN, 2015), countries nonetheless embarked upon their own transitionary pathways to EVs, referred to in this thesis as *electric vehicle development strategies*. Of the measures to have emerged from the Paris Agreement, the most ambitious was the intention to ban the sale of ICE vehicles. Subsequent deadlines for such bans were set in France for 2040, 2030 in the Netherlands, and 2025 in Norway, serving as benchmarks for the global EV transition.

Since the Paris Agreement, the imperative for transitioning to EVs has been intensified by the growing number of nation-states committing to carbon neutrality, or Net-Zero, by 2050. Rather than independent environmental objectives, Net-Zero has renewed the objective of keeping global emissions below the 2o outlined in Paris (IEA, 2021). It is also consistent with the pursuit of the United Nations’ (UN) Sustainable Development Goals (SDGs). EVs have been identified as a vital part of sustainable transport (UN, 2016) that will enable states to address the 3rd (healthy lives), 9th (resilient infrastructure) and 11th (sustainable cities) SDGs. And yet, despite this intense focus, EVs have on average accounted for only 2% of the automobile market, with a relatively recent increase to 10-15% meaning that the market remains dominated by carbon intensive vehicles (IEA, 2022).

Contrary to the focus EVs have attracted from policymakers, environmental politics and political economy scholars have paid relatively little attention to EV transitions, save a few exceptions (Lemphers et al., 2022; Debnath et al., 2021; Gjoen and Hard, 2002). EVs have instead often been one subject within broader analyses of climate politics (Marquardt and Nasiritousi, 2021; Stokes and Breetz, 2018; Schmidt and Sewerin, 2017). Where EVs have been the sole focus, it has tended to be with reference to a specific national context, such as Japan (Åhman, 2006), the USA (Sintov et al., 2020) and Norway (Cetkovic and Skjærseth, 2019) with few comparative analyses (Meckling and Nahm, 2018). Given that the transport sector continues to be the only sector in the global economy in which average emissions continue to rise (IEA, 2021), the EV transition leaves a significant gap in the literature with profound implications for the Paris Agreement. This thesis addresses this gap by engaging with the environmental politics literature, which has so far overlooked the EV transition (Cetkovic and Skjærseth, 2019), and the political economy literature, which has recently begun to consider the structural reorientation that polities will undergo in the process of transitioning (Christophers, 2021; Newell and Simms, 2021; Paterson, 2021).

This thesis uses a comparative case study of two key actors in the EV transitions, the UK and Germany, both signatories to the Paris Agreement, self-described environmental leaders and economies keen to capitalise on the EV transition. In this introductory chapter, I begin by establishing the scope of this thesis and so structure the chapter accordingly. I first outline the environmental impacts of transport emissions and provide a broad history of the policy mechanism introduced to address the issue. I demonstrate that the emergence of EVs can be considered a ‘technological fix’ to transport emissions. With EVs seen as the primary means to decouple transport emissions from automobile use, I also seek to provide a point of clarification, distinguishing EVs from a broader category of Ultra-low Emission Vehicles (ULEVs). I conclude this introduction by outlining the organisation of this thesis and a roadmap to the following chapters.

### 1.2 The impact of transport emissions: Driving climate breakdown

Society is orientated around different forms of energy for numerous purposes, such as food, entertainment, and transport (Heinberg, 2007). In the case of transport, oil, specifically petroleum and diesel, has come to be the standard form of energy used for car propulsion. Since transportation is a crucial facilitator of the global economy, attempts to predict the date of 'peak oil' have received gradually less attention since the 1970s (Claes, 2019; Atkinson, 2010; Parra, 2003). At the same time, the automobile sector’s emission output, or energy intensity, continues to be characterised by its level of oil consumption (Suarez et al., 2022). As a proportion of transport emissions, road transport accounts for three-quarters of total output, equal to 15% of global emissions, and more than that attributed to the output of the aviation sector at 11.6% (ibid).

Within the context of the Paris Agreement, current automobile emissions’ output represents an acute challenge, as the transport sector is the only one across the global economy in which emissions continue to rise (IEA, 2020). In the European Union (EU), where transport emissions account for 27% of total CO2 emissions (EEA, 2020), they have increased by a quarter between 1990 and 2017 as 95% of kilometres travelled by both passenger and freight in the EU rely on oil-based fuels (IEA, 2020; TERM report, 2014). Even during the contraction of the global economy during COVID-19, transport emissions rose by 0.5%, although this was down from an annual rise of 1.9% since 2000 (IEA, 2020). The Intergovernmental Panel on Climate Change (IPCC) has consequently identified the proliferation of automobiles as a key driver of global emissions, geographical desertification, ocean acidification and drought, amongst others (2018).

The environmental impact of automobile use is however not simply confined to CO2 emissions but is also linked to poor air quality. The World Health Organisation (WHO) attributes 'tailpipe emissions[[3]](#footnote-3)' from automobiles as the primary source of particulate matter (PM) and Nitrogen Dioxide (NO2). Associated health risks of these pollutants include the increased likelihood of strokes, heart disease, lung cancer and both chronic and acute respiratory diseases such as asthma, with 91% of the global population currently living in places that exceed air quality limits (WHO, 2021). Poor air quality is therefore ultimately estimated to have caused 4.2 million premature deaths in 2016 (ibid) and has even been more recently linked to higher COVID-19 fatalities (Ali and Islam, 2020).

Aside from the emissions associated with automobiles, they are also highly resource-intensive. To produce a car or van requires an exhaustive list of materials, such as steel, rubber, glass, plastics, paint, and many other material inputs. Of the average 24 tonnes of carbon dioxide equivalent (CO2e) a standard gasoline vehicle produces in its lifecycle, 5.6 tonnes are emitted during the production process (LCWP, 2015). While the material throughput for cars produces significant emissions, even before the automobile is ready to drive, they can, in theory, be offset by recycling end-of-life vehicles (Kaneria and Shallari, 2003). Indeed, recovery and recycling rates for the case study in question include the UK at around 92%, lower than their 95% target, with Germany at approximately 99%, reducing the environmental impact of automobiles, at least to a relative extent (Eurostat, 2015).

Such is the proliferation of automobiles in society that there has long been a reluctance to acknowledge their environmental impact (Whitmarsh and Koher, 2010). How best to reduce car emissions has been interpreted differently by the industry since the oil crises of the 1970s (Fridenson and Wada, 2019; Wadud and Ahmed, 2016; Moe, 2010). Primarily this came in the form of technological innovation in an automobile ‘fuel economy’ - the measure of a vehicle's fuel consumption over a certain distance. However, given the developments in the living standards of the Global South, particularly in China, demand for automobiles continues to rise across the global economy (Mattioli et al., 2020; Metz, 2013). The automobile sector has consequently proved to be a typical case of the Jevon’s paradox, (Jevons, 1866), whereby developments in fuel economy and alternative fuels have ultimately been negated due to the increase in the total number of vehicles in circulation (Fuglestvet et al., 2007).

In the act of driving an automobile, its environmental impact may appear abstract or tenuous, but has a profound impact on society's socio-ecological relations and keeping the economy within ecological limits (Craig, 2016). It is therefore not simply the emissions attributed to automobiles that are problematic, but it is the sheer volume of cars in contemporary society. As of 2021, data suggest that there are 1.4 billion cars in the world, which, on average, emit around 4.6 metric tons of CO2 per year (Chesterton, 2018; EPA, 2018).

Policy mechanisms have been implemented to limit the environmental impact of automobiles through harmonising the pollution standards for vehicles. In 2015, the United Nations Economic Commission for Europe (UNECE) introduced the world harmonised light-duty vehicle test procedure (WLTP) to replace the New European Driving Cycle (NEDC) designed to capture CO2 emissions and pollutants more accurately. Since its implementation in 2019, the WLTP was designed to deter manufacturers from passing on the cost of higher emitting vehicles to consumers by ensuring that vehicles must obtain official documentation to comply with the standards (Fernández-Yáñez, et al., 2016). The WLTP standards have consequently been the harmonisation standard adopted by the USA, China, Japan, India, the EU, and others, even though doubts remain about the stringency of the measure.

Previous attempts to decarbonise the automobile sector have proved problematic and sometimes contradictory. For example, to meet the Kyoto Protocol targets, in 2001, the UK government pursued a 'dieselisation' strategy to reduce CO2 emissions by stimulating demand for diesel vehicles (Rosenbaum, 2017; Young, 2000). This led to an increase in diesel vehicles from 3.45 million to 8.1 million (ibid). While it achieved its desired outcome of higher diesel demand, subsequent research suggested that as diesel vehicles produce more types of emissions than petrol alternatives, the measure inadvertently resulted in a larger environmental impact (Transport & Environment, 2020). Once dieselisation was found to contradict the original intention of the strategy, diesel vehicles have since been subjected to a series of 'diesel taxes' that ultimately devalued the same vehicles the government tried to incentivise consumers to buy.

It is against the backdrop of the previous shortfalls, and indeed failures, of past measures that the EV transition now unfolds. Different policies and technologies have therefore not altered the fact that the automobile sector needs to be decarbonised to achieve environmental objectives. For the purpose of this analysis, I use the term decarbonisation to refer to the broader objective of reducing emissions from ICE vehicles that use petrol or diesel as a means of propulsion. Therefore, a useful, albeit perhaps oversimplified, summary of the process of decarbonisation is to describe it as supplanting fossil fuel use from automobile propulsion with an electric alternative.

### 1.3 The technological fix to transport emissions?

Much of the discourse surrounding EVs describes the impending transition as a ‘revolution’ of the automobile industry, a new, innovative technology, or the inevitable transformation of the automobile sector (Thornhill, 2022; Stevens, 2021; Jones et al., 2020). As noted by Villarel (2011) however, such perceptions are merely a social construction of the EV transition thus far. The reality is that EVs have existed for over 100 years, emerging at the same time as gasoline and steam vehicles (Anderson and Anderson, 2010). In fact, when scholars have examined the history of EVs, they often tend to attribute the first instances of EVs to the end of the early 1900s[[4]](#footnote-4) (Bellis, 2019; Wakefield, 1994). So ill-considered have EVs been in the literature in both the environmental politics and political economy literature that an inaccurate framing surrounds the history of the technology.

EVs are therefore by no means a revolution of the automobile market, but one that has existed at the periphery of the automobile market for over a century. To establish a more accurate account of EVs would be to ask why EVs have emerged so prominently *now*. Matulka (2014) suggests that the previous iterations of EVs tended to emerge during disruptions to the automobile paradigm caused by shocks to fossil fuels. For example, the oil crisis in 1973 led to an interest in alternative fuels to avoid supply chain constraints in fossil fuels and similar gas shortages throughout the 1970s (ibid). Matulka’s account echoes that of scholars who have emphasised that alternatives to carbon intensive path dependencies emerge whenever there is difficulty harnessing natural reserves (Claes, 2018; Heinberg, 2007; Falola and Genova, 2005; Kirsch, 2000). Therefore, rather than a ‘revolution’ of the automobile sector, EVs are the recurring solution to challenges faced by the automobile sector for over a century.

Research and Development in alternative, non-fossil fuel vehicles have a long history despite the predominance of petrol and diesel vehicles. Attempts to potentially alter the dynamics of the automobile's relationship with the environment have, to varying degrees, been ongoing since the 1980s by exploring new, more environmentally friendly means of propulsion. Whitmarsh and Koher (2010) have noted that sector-wide trends in investment have been historically homogenous in the pursuit of such fuels, as focus shifted from EVs in the 1990s to fuel-cell and hybrid vehicles in the 2000s, to now returns to EVs in the 2010s and 2020s.

Since the discrediting of diesel, there is now a scientific consensus that petrol emissions also have little to no environmental benefit when compared to emerging technologies such as electric, and hydrogen (IPCC, 2018; ICCT, 2014). However, alternative fuels have not yet proved to be successful in displacing the dominance of fossil fuels. Instead, automobile manufacturers have had greater success in innovation in other forms of carbon-related fuels, such as liquid petroleum gas, ethanol, and propane (Whitmarsh & Köhler, 2010). The support for biofuels itself has often been linked to the economic motivations of the agriculture sector, as opposed to environmental goals (Songstad et al., 2009). The desire to transition to EVs does not, therefore, represent linear market trends, but rather environmental objectives pursued by governmental institutions (Caulfield et al., 2022)

In answer to the question of why now, I argue that EVs are being used as a technological fix to the issue of transport emissions. As I show in the following chapter, EVs serve the purpose of addressing automobile emissions whilst also maintaining the role of the automobile in society, causing the least disruption to the automobile paradigm (see Chapter 2). A technological fix is often considered to be a form of technology used to solve a human-related social problem (Dortman and Wallack, 2007). I have already outlined the significant environmental problem posed by automobiles and thus in this regard, the environmental benefit of EVs was first mooted in the 1990s. The rise of EVs therefore owes much to the Paris Agreement, with scholars stating that this inevitably makes the EV transition an objective of the nation-state across the global economy (Logan et al., 2020; Meckling and Nahm, 2019). Their commitments to the objectives of Paris consequently make the state the key unit of analysis for evaluating EV transitions, as states act as the arbiters and designers of the transition and are ultimately responsible for automobile decarbonisation.

### 1.4 Ultra-Low Emission Vehicles (ULEV): Relative and absolute decoupling

In the pursuit of a technological fix to transport emissions, a point of clarification needs to be made from the outset regarding EVs; insofar that they represent only one type of vehicle within the broader category of Ultra-Low Emission Vehicles (ULEVs). Rather than simply a focus on EVs, policymakers have tended to refer to ULEVs, a broad term with a significant degree of technical variation. Broadening the solution to climate breakdown consequently has implications for these policymakers as they seek to 'decouple’' automobiles from emissions (Jackson, 2016; Cleveland and Ruth, 2008).

The term decoupling has long been used as the process to determine whether growth in economic output or GDP can continue without a similar growth in CO2 emissions. Decoupling may itself be categorised as either (i) relative decoupling — whereby resource use declines per unit of economic output in any given sector/production process or account of material throughput, or (ii) absolute decoupling — resource use declines in absolute terms across all sectors within the economy (Jackson, 2016). For example, an important distinction between these types would be that an economy might relatively decouple its emissions from growth in the automobile sector, but still see an overall increase in domestic emissions as the economy grows.

Decoupling automobile use from emissions has been a subject of debate in recent years, as the automobile sector has witnessed a relative decoupling across the Organisation for Economic Co-operation and Development (OECD) countries (Gupta, 2015). This trend has frequently led to debates about whether automobiles can ever be 'greened' to achieve absolute decoupling (Mattioli et al., 2020; Li, 2011; Heinberg, 2007). To illustrate this point, I here outline the broad typology of ULEV, of which there are four principal categories.

**I. Battery electric vehicles (B/EV)** – sometimes referred to as 'pure' electric vehicles, these vehicles are powered by electricity alone. The vehicle is charged by an external power source and has the capacity for regenerative braking to aid in extending the battery range.

**II. Plug-in hybrid electric vehicle (PHEV)** – A combination of the electric drive motor and an internal combustion engine. Again, the vehicle can charge from an external power source, but its dominant mode of propulsion is petrol or diesel, which may then be switched to electricity during transit.

**III. Extended range vehicles (E-REV)** – Another vehicle with the capacity to draw upon electric and petrol/diesel. The electric motor drives the wheels with the petrol or diesel engine capacity acting as a generator.

**IV. Hydrogen fuel cell electric vehicle (FCEV)** – Unlike the previous three types, the method of propulsion is created by mixing hydrogen fuel and oxygen to produce electricity and produce only water as waste. The car is filled with hydrogen at a 'fuelling station' much like petrol or diesel. This technology is new, however and does not share the economies of scale or the product portfolio range of the three other types.

The term ULEV consequently captures a broad range of vehicles but tends to be used interchangeably in sustainable transport policy and discourse, despite the distinctly different attributes of each category (Lutsey, 2015; Dijk and Montalvo, 2009). The importance of unpacking the broad ULEV term becomes apparent once the range of the cars is considered, i.e., to what extent they require fossil fuels for propulsion. B/EVs are singularly powered by an electric motor, with mileage ranging between 100-500 miles. PHEVs have an average electric capacity of 10 to 40 miles, but also operate with a petrol or diesel engine. E-REVs too have an electric motor with a longer range than PHEVs, but also have a petrol or diesel engine (Energy Saving Trust, 2017).

Unlike the other types of ULEVs then, B/EVs emit no greenhouse gas emissions from the tailpipe, distinguishing it from both PHEVs and E-REVs (Funke et al., 2019, Bradley and Quinn, 2010). Conflating different types of vehicles under the ULEV umbrella is therefore misleading, as both PHEV and B-REV vehicles still rely on a fossil fuel engine for propulsion (Rigby, 2020). Such a distinction has led these latter vehicles to be referred to as a ‘wolf in sheep's clothing’ as significant doubt has been raised over their environmental credentials (Gatten, 2020; Transport and Environment, 2020; Hamada et al., 2015). The premise of this thesis is in keeping with the emerging consensus in the literature that the decarbonisation of the automobile sector through technology can only be achieved by a transition to B/EVs.

A final point of clarification that needs to be made is that the decarbonisation of the automobile sector is not solely contingent upon transitioning from ICE vehicles to EVs, but also requires the decarbonisation of a country's energy mix, as a low carbon transport sector simultaneously demands a low carbon energy sector. In this regard, any analysis of automobile decarbonisation must be sensitive to the concept known as 'well-to-wheel', which measures an EV's real environmental benefit compared to ICE vehicles, beyond a superficial comparison between fuels' respective energy intensity, though an extensive examination of this link is beyond the scope of this thesis.

### 1.5 Thesis structure and organisation

It is against the backdrop of achieving the 2o objective set out in the Paris Agreement while negotiating the economic crisis of COVID-19 that I situate this research. My focus is on the ascent of EVs up the policy agenda of national governments in recent years as the technological solution to automobile emissions and upon the development of the EV market. The main contribution of this research is to establish the principal barriers that prevent automobile sectors from making the transition to EVs in the UK and Germany, identifying the tension between economic and environmental imperatives, and the influence of state-business actors in each national context.

This research is motivated by the following three research questions:

(i) What are the barriers to decarbonising the automobile sector?

(ii) How can those barriers be overcome?

(iii) Are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?

To answer these questions, I focus on two developed capitalist economies, and proclaimed environmental leaders, to investigate how the transition to EVs has unfolded thus far (Dryzek et al., 2003). To that end, in the following chapters, I examine a neglected feature of environmental politics literature, examining the role of the states in setting their economies on an EV trajectory and the tensions that reside with the automobile paradigm. I subsequently contrast the attempts to achieve the objectives of the Paris Agreement with the interest in preserving fossil fuel path dependencies in the automobile sector. I therefore give the necessary attention to the environmental, political, and economic dynamics of the EV transition.

To navigate the central puzzle of this research, this thesis is structured as follows. Chapter 2 reviews the previous literature to establish a political economy account of the automobile sector. There I undertake a review of prior interdisciplinary perspectives of the automobile sector to establish a political economy account that conveys how, far from simply serving the function of a means of transportation, the automobile performs a crucial function in capital accumulation within the global economy. In Chapter 2, I position myself amidst the critical perspectives of the automobile paradigm due to the low rate of EV growth and the impact of the automobile on the environment that I have outlined here. I revisit elements of the literature that require examination considering the Paris Agreement, identify the key analytical subjects for the case studies of this research, namely the state and automobile manufacturers, and analyse the role these actors have played in producing the automobile paradigm. Far from simply being confined to these actors, I show the backward and forward linkages of the automobile sector to the oil sector and the financial market and lay the ground for the subsequent examination of the German and UK case studies. I show that the political economy literature alone is insufficient to provide a transitionary account of EVs, requiring a theoretical framework to address this gap in the subsequent chapter.

Chapter 3 outlines the synergistic theoretical framework I employ to examine automobile decarbonisation in the UK and Germany, one that provides a satisfactory account of the EV transition that is currently absent from the political economy literature. The chapter proceeds in several steps to establish a novel, synergistic framework for this research. First, I explain how the Socio-Technical Transitions literature provides a unique explanatory tool in the Multi-Level Perspective (MLP) to examine the EV transition (Geels 2014; 2005). I suggest two adjustments to the MLP framework for the purposes of this research. Initially, and in line with the recent 'political turn' of the STT literature, I extenuate the explicit political economy insights that can be used to refine the MLP. Thereafter, I propose a reconceptualisation of the MLP considering the insights drawn from the discipline of political economy to outline a sequential transitionary process. The second step is to synthesise the reinterpreted STT with insights from Ecological Modernisation, an approach that has influenced environmental politics for decades (Mol and Spaargaren, 2009; 2000). Using Ecological Modernisation, I develop a more robust theoretical understanding of the state to advance my analysis in subsequent chapters. In combining these approaches, I develop upon Meckling and Nahm's (2018) work to categorise potential transitory pathways. Taking lead from the authors’ initial heuristic of political competition and political coordination, I introduce a third category of political cultivation to categorise the potential pathways of the EV transition, which I empirically test in later chapters. I conclude this chapter by identifying the research questions that have guided this thesis.

Chapter 4 sets out the methodological design of this research and how it was implemented over the course of this research. As the thesis is based primarily upon a qualitative analysis of two case studies, it draws upon extensive novel interview data from 65 interviews with policymakers and stakeholders, and a documentary analysis. Chapter 4 also outlines the rationale of the case study selection, the philosophical approach underpinning the design of this research, and the changes made in response to the COVID-19 pandemic.

Chapter 5 is the first empirical chapter of this research, drawing upon the original data I gathered to identify many of the common barriers to the EV transition. This chapter is primarily informed by the interview data compiled across both the UK and Germany. It outlines how the ideological barrier rooted in the present neoliberal view of the EV transition presents an acute barrier to the ways in which the EV transition has been approached thus far. Likewise, it finds that there is an acute fiscal barrier that reveals both the consistent relationship between EV growth and fiscal policy, and also why this has been a problematic feature in the UK and Germany. Chapter 5’s final contribution to this thesis is that it identifies that administrative fragmentation has occurred in both the UK and Germany, with attendant challenges for EV transitions. By identifying three common barriers that exist across both case studies, Chapter 5 presents important findings that are consistent with the subsequent analyses of the UK in Chapter 6 and Germany in Chapter 7. So too do I provide an initial suite of measures that can, and indeed have, been used to overcome the barriers to EV growth.

Chapter 6 investigates the barriers unique to the UK, examining what I refer to as the political cultivation transition pathway as the UK attempts to capitalise on the transition to modernise the economy. I find that the barriers in the UK centre around its financialised political economy, particularly how investment is determined by the Treasury’s Green Book. I also show how Brexit has not only presented an acute barrier to the UK transition but is likely to continue to do so beyond the timeframe of this research. I show how both barriers are, in turn, linked to the absence of a developed automobile sector in the UK. In addition to identifying the barriers in the UK case, I outline how they can be overcome.

In Chapter 7, I examine the barriers found in the German case study as I show that the transition to EVs (or *e-mobility* in German) has seen Germany become markedly uncoordinated. I show that the revolving door between state and industry has formed a significant barrier to Germany’s EV transition. In addition, I find that aspects of Germany’s historic approach to fiscal policy, namely the Black Zero and the Debt Brake, have allowed Germany to run a fiscal surplus at the expense of an infrastructure deficit. The final barrier I identify is that of Tesla’s Giga-Berlin factory and how it threatens the longer-term objectives of Germany’s automobile manufacturers, and, by extension, its EV transition. Like the UK case study, I also examine how the barriers in Germany might be overcome, with the *Verkehrswende* (mobility transition) emerging as a key solution.

Chapter 8 concludes this thesis, outlining the answers to the research questions I pose in Chapter 3. It reiterates the key contributions made in this thesis (see below), identifies the potential future directions for the literature beyond the intervention made in this thesis before providing some closing remarks on the future of the literature and reflection on meeting the Paris Agreement.

In the following chapters, I make four principal academic contributions. First, I intervene in the environmental politics and political economy literature by providing an analytical account of the EV transition that uncovers the deeply political and contested nature of the transition. Whilst I focus on the UK and Germany, my findings have implications for the transition elsewhere. Second, I further the ‘political turn’ which has occurred in the Socio-Technical Transitions literature, reconceptualising the Multi-level Perspective (MLP), to establish a more precise framework through which to examine the EV transition. I employ the Socio-Technical Transitions approach as part of a synergistic theoretical framework alongside Ecological Modernisation which also challenges the assumptions made in the latter approach.

Third, I develop upon the work of Meckling and Nahm (2018) to show how the EV transition can be better understood through a clear categorisation of the transitionary pathways undertaken in the UK and Germany. The pathways I outline in this thesis provide a much-needed description of EV transition and how it has been shaped by the event of COVID-19. The final contribution of this thesis is that I utilise on an original data set that draws upon primary insights from policymakers, and documents from the case studies in question. This examination of automobile decarbonisation in the following chapters is, therefore, not simply an analysis of the actors who shape the transition, but also an account which is informed by them. To that end, the contributions of this thesis provide empirical, analytical, and theoretical insights into the study of the EV transition, not simply as an area of academic inquiry but as one with profound real-world implications.

# Chapter Two

## Situating the electric vehicle transition in the automobile paradigm: the political economy of the automobile sector

### 2.1 Introduction

Automobiles, and the automobile sector, have been the subject of interdisciplinary scholarship for decades, from social science, transport planning, transport economics to geography (Cowie, 2020; Franic and Hurdle, 2020; Spurling et al., 2019; Stanley and Spivak, 1993). As a result, automobiles are seen as more than merely a means of transportation, but as a contribution to economic indicators such as Gross Domestic Product (GDP), the balance of payments and employment, among others (Saberi, 2018; Lascher, 1999). To better understand the EV transition, I review the literature that has previously sought to identify the political and economic features of the automobile sector to situate the EV within the present automobile paradigm (Mattioli et al., 2020; Barry, 2006; Paterson, 2006). In this chapter, I outline how the disciplinary focus of political economy provides a basis from which to develop my analysis in the following chapters. However, I also demonstrate that this account alone is insufficient to provide a robust explanatory account of how the automobile sector transitions from its carbon-intensive form to one decarbonised through EVs.

Automobiles became a central feature of the global economy following the industrialisation of the Global North after the Second World War (Tolliday and Zeitlin, 1987). The various conceptualisations of the post-war global order common in the political economy literature, including the 'post-war consensus’ (Kerr, 2001), 'embedded liberalism' (Ruggie, 1982) and 'Keynesianism' (Clark, 2011; Kriesler and Sardoni, 1999) all pay attention to automobiles. In particular, they point to how states and their respective automobile sectors coordinate the industrial production of automobiles, such as the *Wirtschaftswunder* in Germany and the *Keijidōsha i*n Japan (Regan, 2020). Automobiles came to typify the Fordist mode of production from the mid-20th century[[5]](#footnote-5), as the industrialised and standardised mass production and consumption of automobiles saw it become the 'industry of industries' (Papatheodorou, 2007).

Automobiles perform an essential economic function in the development of economies, increasing domestic output and serving as an indication of national prosperity (Paterson, 2006). Not only are they important for nation-states, but also for individuals, who assign a significant degree of their social capital and identity to the economic value of vehicle ownership[[6]](#footnote-6) (McLeod, 2021). So fundamental have automobiles become to contemporary society that they have legitimised the ceaseless reconfiguration of urban-rural spatial dynamics, leading the natural environment to undergo even greater urbanisation to accommodate the automobile[[7]](#footnote-7) (Landes, 1969). It is this paradigmatic view of the automobile sector that the EV transition is situated, providing the means to "deconstruct [the] existing material arrangements and their accompanying ideologies to analyse them as products of particular political, economic, and social contexts" (Freund and Martin, 1993, p. 5-6). However, the political economy literature has paid limited attention to the transition that needs to be undertaken by the automobile sector to meet the Paris Agreement, a gap that this thesis seeks to address.

In the following review of the literature, I form the basis of my analysis, structuring this chapter as follows. I begin by providing an overview of the ideological/theoretical interpretations of the automobile sector in the political economy, locating this research amongst critical trends in the literature. I show that in addition to the typically macro focus adopted in the political economy literature, a micro level analysis is required for analysing this sector. Secondly, I show that because the present automobile paradigm has been designed by a discernible state-business arrangement, both the state and automobile manufacturers serve as two primary analytical subjects for this research, giving due attention to an important feature of this relationship. Finally, I find that a review of the literature demands sensitivity to the interconnectedness, or 'forward and backward linkages’, of the automobile sector, drawing into focus additional actors. I pay particular attention to the automobile sector’s ties to the oil sector and the financial market. I conclude this chapter by highlighting a gap in the literature, namely the absence of a transition framework that can explain and analyse the shift toward EVs.

### 2.2 The role of automobiles in the global political economy

Attempts to conceptualise the impact of automobiles on society have taken various forms in the literature, such as the 'automobilisation of society' (Sweezy, 1973; Baran and Sweezy, 1968) or similarly the 'automobilisation of societies' (Belzowski et al., 2014). These terms denote the structuring and restructuring of society in both developed and developing countries where the use of, and access to, automobiles is a fundamental tenet of modern society. It is thought to have produced a socio-political dependency, wherein a 'two-tier' society is formed between the 'modern' and 'underdeveloped' life, or between the car owners and the car-less (Newman, 2013). This tiering of the society reflects the automobile’s perceived utility as the ultimate means of transportation.

Such is the way in which polities across the global economy are then structurally determined to facilitate automobiles and by extension the automobile sector, that it has previously been viewed as a 'complex' within the literature. The notion of a complex began with the 'automobile industrial complex' (Sweezy, 1973) before subsequent reinterpretations in the form of the 'agroindustrial complex' (Sergi et al., 2019), and most recently as the 'political-automotive complex' (Haas and Sander, 2017). All these interpretations of the automobile complex are rooted within a political economy analysis of the automobile paradigm, essentially speaking to the demands made of polities to orient transport systems around embedding automobiles, lest they be considered underdeveloped or comparatively disadvantaged (Doner et al., 2021; Mattioli et al., 2020; Ugwueze et al., 2020; Niu, 2017). Furthermore, while these conceptualisations exhibit slight divergence in their framing of the automobile paradigm, they are nonetheless united in framing the automobile sector as far more than simply a means of transportation, but the key to capital accumulation (Deboard, 1995; Sweezy, 1973).

In much the same way as the automobile has become a common means by which to view the transport needs of society, the automobile sector is considered indicative of many of the themes within the International Political Economy literature, such as the concentration of ownership, globalised supply chains and a restructuring of production (Miller, 2008; Frieden and Lake, 1999). Rather than a monopolisation of the market, the sector resembles that of an oligopolistic entity, occupied by different actors across the global automobile market, including Ford, Chevrolet, and Chrysler in the USA; Volkswagen, BMW, and Daimler in Germany; Peugeot, Renault, and Citroen in France; and Toyota, Honda, and Nissan in Japan. Figure 1 illustrates the concentration of ownership in the automobile market, whereby 14 primary actors exert almost total control of the global industry.

**Figure 1: Concentration of vehicle ownership**

Chart

Description automatically generated

Source: Desjardins (2016).

Automobile manufacturers have subsequently proved to be a paradigmatic case of a globalised industry for political economy scholars who view the concentration of influence and capital as indicative of the shift in power from the state to the market since the 1980s (O'Brien and Williams, 2020; Cohen, 2019; Paterson, 2006). The economic growth of the sector witnessed over the 20th century, specifically since the 1950s/60s, has consequently seen the expansion of capital flows and international production to ever further reaches of the global economy, aided by the removal of many global trade barriers, allowing investment in both domestic and global markets (Bailey and De Propris, 2017; Dicken, 2003). During this time, the automobile sector has subsequently become a vehicle for both the individual and the development of capitalism since the mid-20th century.

In reviewing the literature, two initial trends emerge to provide the basis for a political economy account of the automobile sector. First, the different institutional formations have been the subject of comparative scholarship. For example, the Varieties of Capitalism (VoC) literature has sought to identify the heterogeneous elements of the automobile sector in the USA, Japan, and Germany instead of broader, homogenous analyses of the sector and its constituent actors (Mikler, 2009; Halls and Soskice, 2001). Secondly, analyses have moved beyond simply a focus on developed economies to developing countries, moving away from 'old core regions', and giving way to the emerging economies that offer advantageous fiscal incentives and lower labour costs, such as China, India, and Brazil (Cruz and Rolim, 2010).

Whilst the first strand focused on developed economies, providing a useful subject for comparative/political economy scholars, the latter focus on developing countries instead follows a more analytically precise line of enquiry. The expansion into developing countries, driven by the pursuit of capital, has seen the scale of automobile production expand to 73.4 million units (OICA, 2017) as the capital flows that underpin it reached an average turnover of €2.54 trillion in 2017 (ibid). Investment in the sector, in many cases, represents a significant proportion of GDP, including 14% in Germany and 12% in Japan in 2018 (Saberi, 2018). In terms of research and development (R&D) budgets, the automobile sector is also one of the three biggest sectors globally (PwC, 2016). The sector consequently offers an attractive investment opportunity with relatively little risk for financial actors, as it exhibits a capital multiplier of 1:3 (Saberi, 2018). The financial model underlying the automobile sector has therefore received greater attention than the automobiles themselves in recent years.

As scholars have observed the automobile paradigm taking shape, it has become the subject of contestation amongst different schools of thought within the political economy literature. Primarily, the sector is observed from a liberal perspective, wherein the automobile sector is thought to typify the dynamism of modern capitalism (Walks, 2014; Newman, 2013), as automobiles are thought to embody liberal values, with the agency and autonomy of the individual are ultimately realised through private mobility (Monbiot, 2016; Paterson, 2006; Bartlett and Seleny, 1998). Alternatively, the sector has long been viewed from a Mercantilist/Realist perspective as a typical case of developing a domestic industry to gain a comparative advantage over international competitors (Stern and Wennerlind, 2013; Abu-El-Haj, 2007; MacCharles and Wolf, 1982). Both interpretations are ultimately indicative of the neoclassical view of capitalism[[8]](#footnote-8), and the way in which to explain market dynamics, which have been commonplace in many disciplines, including political economy, for decades.

Contrary to both the liberal and Mercantilist interpretations, the automobile sector has also been the subject of critical scholarship, found in the Marxist and more latterly environmentalist literatures (Monbiot 2016; Bellamy Foster, 2000; Sweezy, 1973). Indeed, the very notion of an automobile complex outlined above is rooted in a critical view of the automobile sector, wherein its primary purpose is to drive capital accumulation at the expense of society and the environment (ibid). It is important to acknowledge these different ideological perspectives of the automobile paradigm for the purpose of situating this research. I accordingly follow the more critical strands in the literature, adopting such a position due to the slow development of the EV market, and the impact of the automobile on the environment outlined in Chapter 1.

Notwithstanding these ideological debates, and my position within it, all such positions are indicative of the macro framing typically adopted in the literature. Liberal, Mercantilist and critical scholars have all tended to analyse the automobile sector as a homogenous entity, affording little attention to the automobile manufacturers individually. The political economy literature has therefore largely neglected the macro/micro distinction often made by economic scholars to departmentalise case studies into more refined units of observation. Yet the micro level requires attention in the light of the Paris Agreement, to examine how the EV transition is not only unfolding at a broad/macro level, but also accounts for actions taken by the individual manufacturers. The following section outlines how the EV transition sits within a traditional macro framing, linking this analysis to recent trends in the political economy literature (see Chapter 1). I then seek to address the absence of a micro level analysis to provide scope to examine individual manufacturers in later chapters.

#### 2.2.1 Macro

As the largest manufacturing sector in the world, it has been estimated that if the automobile sector were considered a country, it would be the sixth-largest in the world in terms of GDP (OICA, 2020). In 2021, *Fortune* noted that 10 automobile companies were still in the top 500 companies globally, 20 when considering automobile retailing and services (Fortune, 2021). A macro-level understanding of the automobile paradigm might then consider the automobile sector's relationship to growth and GDP (Hill et al., 2010), interest rates (Ahmed, 2020), output (Saberi, 2018) and employment (Cairns and Harmer, 2011; Soron, 2009). By way of its macroeconomic implications, various indicators, including value-added, exports, employment, and the exchange rate could be used to analyse the sector (OECD, 2011). Those countries with a burgeoning automobile sector, such as Germany and Japan, are already synonymous with their automobile industries, which are used as a proxy for how their economies are performing as a whole (Mattioli, 2016; Bouzarovski and Petrova, 2015).

A macro level analysis of the automobile paradigm ties the automobile sector to both the booms and downturns of the business cycle. Owing to the globalisation of automobile value chains, parts and components are produced in different countries amongst different firms at numerous stages in the supply chain (Hess and Coe, 2006), making the automobile sector acutely susceptible to economic crises. I show later in this thesis how the Financial Crisis of 2008 and the COVID-19 pandemic had a material impact on the sector's operation (Deloitte, 2019). Shocks to the industry, such as lowering demand, supply chain disruptions or labour disputes, therefore, have far-reaching implications for the global economy (OECD, 2011).

I emphasise the importance of analysing the automobile sector at a macro level because it reveals that despite the reorganisation of the global economy with the emergence of tech companies, the expansion of the banking sector and the turn towards the financial system, the largest economies in the world by GDP still heavily rely on a burgeoning national automobile industry (World Bank, 2019). As outlined in Chapter 1, this focus allows the research to contribute to the political economy literature that has recently begun to consider the potential structural reorientation required to facilitate low carbon transitions. This allows for a better understanding of the role played by automobiles in the national economy of the UK and Germany, and how the economic crises such as the Financial Crisis, Eurozone Crisis, Brexit, and COVID-19 have shaped the EV transition within the case studies. Therefore, by accounting for macro-level changes the EV transition can be understood as part of a broader economic change, wherein the transition presents both opportunity and risks to the UK and Germany in equal measure.

#### 2.2.2 Micro

In addition to the macro level framing, I adopt here, I seek to address the pronounced absence of a micro level analysis. It should be acknowledged that some attention has been given to a 'regionalist' understanding of the automobile sector, wherein the focus has tended to be on 'auto-valleys' or industrial cores (Klier and Rubenstein, 2010; Sutcliffe and Glyn, 2003). In some cases, this has helped give rise to the focus on developing or emerging economies I noted above (Cruz and Rolim, 2010). The individual manufacturers, of which there are many from countries such as the USA, Germany, and Japan, have seldom been the focus of scholars, however. Instead, the manufacturers located in each country have historically been considered part of the broader/macro national whole.

This research must avoid this common oversight in the political economy literature, however, not least due to Germany serving as one of two case studies for this research. Germany alone is home to individual manufacturers, such as Volkswagen, BMW, Daimler, and other associated manufacturers (see Figure 1). But as I show in later chapters, this research needs to be sensitive to the rise of emergent automobile manufacturers, including Tesla, Build Your Dream, Polestar and Byton, to name just a few. Accounting for individual manufacturers allows this research to consider how the EV transition might produce variation in the national context. It also affords the research scope to examine the manufacturer’s relationship with other actors, such as its ties with national governments and its competitors (Lall, 2004). A micro level analysis of the automobile sector is consequently an important analytical addition to this thesis.

### 2.3 The automobile paradigm state-business relations

Central to previous accounts of the automobile paradigm in the literature is how it has been shaped by a relationship between the state and the automobile sector. The focus of the literature is comfortably within the focus of this research, since, as noted in Chapter 1, it was nation-states who signed the Paris Agreement. The state is therefore a key analytical subject alongside automobile manufacturers for this research. As noted by Hay et al., (2005) however, defining the state is difficult given that it is subject to a plurality of perspectives. For this thesis, I use the state to denote the central government institution in the economy, made up of the pertinent departments/ministries, such as the financial and transport ministry, and sub-departments related to the automobile sector. The relationship between state and the automobile sector has been the subject of significant scholarship, explored through the prism of national competitiveness (Nagy and Jambor, 2018; Vosta and Kocourek, 2017) and the structural power of business (Mattioli et al., 2020). This relationship has subsequently been described by some scholars as one which exhibits a dynamic comparable to that of 'corporatism' (Desai and Habib, 1997; Martin, 1997) and 'neo-corporatism' (Anner, 2003; Kurekova, 2012; Pavlinek, 2012), depending on the degree of agency one affords to the state relative to business in the economy[[9]](#footnote-9).

The magnitude of the global automobile market, as outlined previously in this chapter, compels governments to support their domestic automobile sector on account of a performing automobile sector tending to be electorally beneficial (Saberia, 2018; Rajan, 1996). National automobile sectors tend to be an evocative political subject given that they remain one of the few sectors, particularly amongst developed economies, that have avoided the trend of dematerialisation of the ‘real economy’[[10]](#footnote-10) (Goodall, 2012). Moreover, states often tend to be the largest consumer of new vehicles in the national economy, which is crucial in channelling vehicles to the second-hand market (IEA, 2021). So important is the sector to the economy that, as seen during the Financial Crisis and more latterly COVID-19, manufacturers can rely on the state during economic downturns to provide them with stimulants, or bailouts (Terzo, 2019).

All too aware of their role in the economy's prosperity, manufacturers have previously used their role to influence prior environmental policies, using economic arguments to oppose or weaken regulation. For example, the German automobile industry has previously argued that stringent regulation on CO2 emissions threatens the existence of Germany as a 'car building nation', with consequences for jobs and industrial output (Reuters, 2018). The industry’s influence also extends to the European Union, where, in 2006, the European Car Manufacturers Association responded to proposals by the European Commission to introduce binding targets for CO2 emissions, stating it was 'technically unrealisable' and would constitute 'an industrial political intervention at the expense of the entire European, and especially German automobile industry' (CEO, 2018). The argument that regulation would result in 65,000 workers losing their job in Sindelfingen, Untertürkheim and Bremen led the then-German Chancellor Angela Merkel to argue that the German government would not be responsible for a 'general reduction' in automobile output (Bundresregierung, 2007).

Parallels may be drawn with manufacturers in the USA, where the automobile sector strongly opposed the increased stringency of regulations, known as the corporate average fuel economy (CAFE) standards, from the 1970s onwards (Paterson, 2006). Again, economic arguments were deployed as a riposte to possible environmental standards, as manufacturers stated that increased standards would raise production costs, meaning the price of vehicles would increase, thus leading to lower total sales and lower demand (Shove, 2010; Raven 2004). Manufacturers in Europe and the USA have attempted to couch alternative fuel vehicles, such as EVs, in economic arguments largely associated with a neoclassical perspective noted above, insofar as they claim that the state should not intervene in the market, for the market is the ultimate allocator of resources (see 2.1).

Having proven themselves averse to stronger regulatory frameworks, this research needs to consider the previous suggestion that the automobile lobby seeks to establish a set of state-business relations wherein the state that overburdens them with regulation (Baker, 2006). The literature indicates that manufacturers have tended to contest the state policy decisions, as they perceive them to be a threat to their incumbency and accumulation strategies (Smith et al., 2009). How business exerts influence over state capacity to formulate policy has, again, been the subject of scholarship in the (international/global) political economy literature (Barry-Jones, 2021; Cohen, 2019; 2008; Oatley, 2018; O' Brien and Williams, 2016; Palan, 2012) over the past decades. Within the context of the Paris Agreement then, and particularly the ban on ICE vehicles, the literature would suggest that the EV transition is an inevitably contested process, atypical of the ways in which state-business relations have historically been conducted.

The degree to which the EV transition is a contested process is, of course, a matter for later chapters. Before this however, I refer in the following section to two important features of the state’s relationship with the automobile sector previously highlighted in the literature. I do so to assist in developing a more analytically robust understanding of the state’s role in shaping the automobile paradigm, as previously observed by scholars, and to also highlight mechanisms by which the state may reshape the paradigm as it transitions to EVs. I give particular focus to the (i) fiscal framework designed around automobiles that provides the state with a budgetary surplus and (ii) subsidisation/prioritisation of the automobile sector. I focus on these features specifically to allow for an empirical investigation as to how, or if, the state is facilitating the EV transition in the following empirical investigation.

#### 2.3.1 Fiscal framework

No other element of the automobile state-business relationship is more important than fiscal policy. Indeed, it is the fiscal policy erected around the automobile sector that ties the state and automobile manufacturers together. Fiscal policy here takes many forms, including acting as an alternative to regulation (ICCT, 2011), a means to incentivise foreign investment (Ma et al., 2019), and stimulating the economy during economic downturns in the form of scrappage schemes (Böckers et al., 2012). The automobile sector is also influenced by monetary policy, with central banks determining the interest rates that are payable on the financial model associated with the automobile sector and, more recently, on the bond purchasing, particularly of corporate bonds, under the Quantitative Easing (QE) undertaken after the Financial Crisis (Galema and Lugo, 2021; Ballew et al., 1994). However, in this analysis, I focus on the fiscal policy implications of the automobile sector which, as will be seen, are intimately tied to the environmental policies identified in later chapters.

The fiscal framework erected around automobiles tends to be made up of three categories: i) Vehicle Excise Duty (VED), ii) Fuel tax/duty, and iii) Value Added Tax (VAT). VED, also known as road tax, or car tax, comprises two features: the first is a tax leveraged on CO2 emissions linked to the new Worldwide Harmonised Light Vehicle Test Procedure (WLTP), also known as the 'on-the-road' performance. The second rate is an annual fee, again contingent on the car's fuel, that rises with inflation. Fuel duty[[11]](#footnote-11), by contrast, is levied on the fuel (petrol/diesel), making it variable on the type of fuel and size of the engine, but it serves as the automobile sector's direct carbon tax. The value-added tax, also referred to as goods and services tax is levied on the producer of a product or service at each production stage, distribution, and sale to consumers. Beyond these three primary levies, other taxes are applied differently in each context, including provincial, stamp, gross revenue, and supplemental taxes, to name a few.

Amidst the pluralistic, diverse, often convoluted, taxation frameworks employed by different countries, automobile taxes contribute considerably to government budgets. For example, automobile related tax income in 2020 for France is €86.4bn, €76.3bn in Italy, €99.9bn in Germany, and €398.4bn across the entire EU as of 2021 (ACEA, 2021). Regarding the European Union, transport also accounts for 4.4% of the average public expenditure of member states[[12]](#footnote-12) (European Commission, 2020). On average, automobiles in Europe are taxed twice as much as the government spends per capita (ibid). The total can be even greater. For example, in 2016, the UK generated £33.81bn from vehicle taxation, only to invest £9.77bn back into the sector, primarily through road building and repair, which, when adjusted for inflation, meant automobile expenditure accounted for just 27.7% of road taxation (RAC, 2018). In providing such fiscal space, the rate of automobile income has been used to counter the need for EVs, as the tax incentives for EVs not only cost the state money but would also lead to a reduced taxable income (Inman and Wearden, 2021).

The automobile sector can consequently produce a budgetary surplus for governments, wherein the revenue produced from taxes exceeds the expenditure on road building and maintenance, producing 'spill-over effects' to compensate for budgetary shortfalls. Automobiles are thus the target of fiscal mechanisms to address budgetary deficits elsewhere in the economy, such as health and social care and defence. The fiscal frameworks around automobiles also exhibit a particularly novel feature, insofar as automobile travel constitutes a form of induced/latent demand, whereby the expansion of transport systems often leads to greater transport demand. Building roads, then, leads to greater automobile use and avenues for taxation, making automobiles a unique return on investment (Duranton and Turner, 2010; Stanley and Spivak, 1993). Rather than discourage automobile use, then, there is an inherent incentive to expand the road network continuously.

It is important to consider the fiscal policy of the automobile sector as not simply a way to reflect the environmental impact of automobile. Rather, what is of equal importance is that when considered within the context of fiscal austerity since the Financial Crisis, automobiles become a means to alleviate budgetary concerns, particularly as states across the global economy have 'fetishised' the fiscal deficit since 2010 (Bailey, 2018). As this analysis is conducted amid a similar economic contraction in the form of COVID-19, the implications for this research are that the EV transition, whether directly or indirectly, is intimately tied to the ways in which the UK and Germany respond to the COVID crisis. Therefore, the fiscal framework erected around the automobile sector, perhaps more than any other feature of the automobile paradigm, ensures that the EV transition cannot be divorced from the broader political and economic context I have outlined here, but is an important feature of it.

#### 2.3.2 State prioritisation/subsidisation

As noted in Chapter 1, this research analyses the transition to EVs, which represent the most viable means to decarbonise transport emissions in the short term. The fiscal framework that surrounds the automobile sector has served to prioritise, or as argued by scholars, subsidise the sector (Transport & Environment, 2020; Ma et al., 2019; Robinson, 2019). This prioritisation takes the form of both direct and indirect subsidies. Indirect subsidies arising from the tax framework from the automobile sector have benefitted (see above). Recent examples of indirect subsidies include €32bn of reductions in the rate of VAT and depreciation write-offs across the UK and EU (Jolly, 2020), or the flatlining (freeze) in fuel duty to prevent any dis-incentivisation of automobile use (Johnson et al., 2012). Moreover, the health impact of poor air quality and the impact of transport emissions on the climate is not passed on to manufacturers. Indeed, evidence suggests that despite vehicle taxation to capture the environmental impact, much of the cost remains largely 'externalised’ (WHO, 2019). This charge is not unique to automobiles, but also applies to other forms of transport, including aviation and maritime (Begg and Haig, 2018) as fiscal policies can serve as a proxy for state priorities.

In terms of direct subsidy, states have provided scrappage schemes for automobile manufacturers, such as those introduced following the Financial Crisis. States here subsidised automobile manufacturers to mitigate against a downturn in the business cycle. In theory, the purpose of the subsidy is to establish a 'payback effect', in which manufacturers return the subsidy in the medium term (Donovan and Hanney, 2011). But analytical accounts of the post-crisis subsidy suggest that prioritising automobiles in this manner ultimately harmed the state’s economic recovery, for it incurs a 'crowding-out effect', whereby incentivising consumers to invest in the automobile market takes away from consumption of other goods and services in aggregate terms (Marin and Zoboli, 2020; Jiang et al., 2018).

Outside of economic downturns, state prioritisation of the automobile sector manifests in a multiplicity of ways, from road building and repair (Paterson, 2007), to planning housing and retail outlets around the automobile, reorganising the environment to accommodate it at the expense of other modal alternatives (Newman & Kenworthy, 2006; Small et al., 1989) and ceding the operation of many public transport alternatives to the private sector (Petrovic et al., 2001; Stiglitz, 1998; Vickers and Yarrow, 1991). As Rajan (1996) argues, by prioritising the automobile sector, the state has assisted the automobile into becoming an 'institution' in and of itself, and so the sector is not merely an adjunct to the state but part of its broader institutional apparatus.

Scholars have been divided on the normative legitimacy of subsidising the automobile sector. On the one hand, some suggest that it discounts model alternatives; on the other, some claim such subsidies are a natural function of the state (Wall, 1999; Wood, 1996). The pervasiveness of automobiles often seems to serve as tacit legitimacy for state intervention (Dennis and Urry, 2009). As noted in the previous chapter, state imperatives have narrowed the framing of transport emissions to one centred around the automobile sector, with many policymakers and scholars determined to cause the least disruption to the automobile paradigm as possible (see Chapter 1). However, to align with the Paris Agreement, how the paradigm is disrupted, in what way, and by what means, makes the EV transition no less politicised than if the state had (re) prioritised a modal alternative. The extent to which the state then priorities EVs, and, in turn, (de)priorities ICE vehicle serves as an important feature of the literature that requires investigation in this thesis.

### 2.4 Forward and backward linkages

The final aspect of the literature I seek to highlight in this chapter is the global interconnectedness of the automobile sector, as it draws into focus other actors beyond the state and manufacturers. The interconnectedness of the sector has been thought of in many ways in the literature, including 'supply chain analyses' (Braese, 2003), 'lock-in mechanisms' (Erickson et al., 2015; Unruh, 2000), 'sectoral value chains' (Spatz and Nunnenkamp, 2002), and the 'motoring sector matrix' (Froud et al., 2002). I here refer to Paterson (2006), who defines these links as forward and backward linkages of the automobile sector. Backward linkages refer to those actors and goods required to produce the final vehicle, including manufacturers of rubber, glass, steel, and more recently, satellite navigation technology and artificial intelligence. Traditionally, backward linkages have been considered the stage at which the environment is 'added into' production through the waste disposal and recycling of redundant cars (Bailey and de Ruyter, 2015). Forward linkages, by contrast, refer to the goods and services, including wholesalers, garage and repair facilities, and insurance companies that are a product of automobile consumption.

The extent to which the automobile paradigm reduces analyses of the automobile sector to the trade and capital flows that move the final vehicle around the global economy might be considered indicative of the typical macro framing in the literature. However, by including consideration of forward and backward linkages, a broader examination is possible that encompasses the various elements of production and consumption that envelop numerous raw materials and actors around the automobile, of which the automobile industry is but one actor within an industrial ecosystem. To understand the full implications of the EV transition, this analyses need take account of the forward and backward linkages, which will consequently draw into focus actors often overlooked in the automobile sector, but who themselves have played no small part in producing the automobile paradigm (Freund and Martin, 1993).

I seek to capture the interconnectedness of the automobile sector not merely as a descriptive exercise but for analytical reasons, as this analysis must be sensitive to actors who shape the automobile paradigm beyond the state and business as outlined above. This interconnectedness speaks to one of the more ill-considered elements of the 'the Jevons Paradox' or 'rebound effect' outlined in Chapter 1, whereby altering one aspect of the extraction-production-consumption cycle alters the patterns of accumulation that have established an efficient and profitable enterprise (Berners-Lee and Clark, 2013; Jevons, 2008; York, 2006). By disrupting the economic patterns associated with the combustion engine, then, the knock-on effects may have direct, albeit inadvertent, consequences for jobs or production. The very prospect of economic disruption brings environmental policies into opposition with economic imperatives, allowing manufacturers to frame such policies as having an adverse impact on the economy, from employment to mobility (Paterson, 2008).

In the following section, I draw particular attention to two of the forward linkages within the intricate web of interdependent links within the automobile sector, whose role in 'locking-in' automobiles to the process of capital accumulation is often neglected (Unruh, 2006; Pereira and de Frutos, 1999). Much of the literature has consequently focused on the value created through the backward linkages that precede the final vehicle, leaving many forward linkages ill-developed (Mattioli et al., 2016; Unruh and Carrillo-Hermosilla, 2006). While it is beyond the scope of this chapter to outline all the constituent features of the automobile sector, the chapter focuses here on, i) the oil/fossil fuel sector and ii) the financial market, for the purposes of illustrating how the EV transition will have profound effects on the wider economic status quo.

#### 2.4.1 Forward linkage: (i) Oil

As already outlined in Chapter 1, it is the oil dependency of the automobile sector that made it a contested subject under the Paris Agreement. Oil accounts for the highest proportion of an automobile’s environmental impact. Both conventional petrol and diesel fuels are refined from mineral oil, the process that accounts for the combustive element in combustion engine vehicles. Aside from a means of propulsion, the automobile and oil sectors share an acute economic relationship, insofar as the price of oil determines the use of automobiles (van den Hove et al., 2002). That is to say that this relationship exhibits a ‘multiplier effect[[13]](#footnote-13)’, whereby the decreased cost of oil is reflected in the disposable income of vehicle owners, allowing them to spend on other goods and services elsewhere in the economy, producing a positive or negative net effect (Krugman, 2008; Blanchard and Jordi, 2007). Conversely, higher oil prices produce an overall reduction in aggregate demand in the economy as a higher proportion of income is spent on the ‘individual’ demand for fuel (Brown, 2006; Tatom, 1987). Fluctuations in the supply of oil are therefore thought to exert inflationary pressures on the economy (Sill, 2007; Hooker, 2002), pressures that are partly realised and manifested in the use of automobiles.

Cognisant of this fact, governments attempt to stabilise petrol and diesel prices to avoid fluctuations in consumer prices and stabilise the business cycle by controlling fuel duty prices (Wappelhorst et al., 2018). Governments adjust the price of oil using some of the fiscal mechanisms outlined above to overt potentially inflationary impact on the economy (IMF, 2014). Given that automobile use can stimulate oil demand, and vice versa, fuel duty has become a key fiscal tool (ibid). However, it is an economic policy for governments and businesses alike. The forward link to oil is so important that it leads priorities between these actors to diverge, where governments may, on the one hand, focus on EVs to address environmental emissions, and manufacturers, on the other, prioritise their competitiveness in the national market through a continuation of their current product range.

Aside from automobiles, oil permeates throughout other spheres of production. As well as serving as fuel for heavy goods vehicles (HGVs) to aeroplanes, by-products of oil refining are used in the production of plastics and chemicals, for lubricants, waxes and tars, and are used in many pesticides and fertilisers (World Economic Forum, 2016; OPEC, 2013). As with the automobile sector, the oil sector is characterised by a high concentration of ownership. Of the 94.1 million barrels of oil produced per day in 2020, over half of the production was concentrated in five countries, including the USA (20%), Saudi Arabia (11%), Russia (11%), Canada (6%) and China (5%) (EIA, 2021). Some of the largest oil companies operate within these countries, including Saudi Aramco (Saudi Arabia), China National Petroleum Corporation (China), BP (UK), Gazprom, Lukoik and Rosneft (Russia), and Exxon Mobil, Chevron Corporation and Verlo Energy (USA) to name a few.

The prospect of the EV transition consequently has potentially profound implications for the automobile paradigms current forward linkages, as the transition is inevitably antithetical to the interests of the oil sector. There is extensive literature on the ways in which oil companies have previously sought to combat environmental policies (Bach, 2019; van den Hove et al., 2002). Such strategies include the attempts to push environmental policies to the periphery of political debate, such as automobile fuel economy improvements, recycling and turning off house lights (Mann, 2021), to casting doubt over scientific evidence, creating ‘scientific uncertainty’ that delegitimises environmental policies (Leggest, 1999), and laundering (mis)information on the credentials of alternatives (Lee, 2003). For example, ExxonMobil spent $16 million funding advocacy organisations to manufacture uncertainty about the climate science[[14]](#footnote-14) between 1998-2008 (UCS, 2007), to protect what Malm (2016) refers to as ‘fossil capital’.

The automobile and oil sectors have indeed worked together before to preserve the automobile paradigm. For example, the Global Road Safety Partnership brought the two together to emphasise educational campaigns and driver training rather than speed limits which could disincentivise certain types of automobiles (Roberts et al., 2006). Oil companies will lobby on behalf of automobile manufacturers, by casting the prospect of EVs, and indeed any emission controls, as akin to self-imposed economic impact (Levy and Rothenberg, 2002; Hamilton, 1998). Tesla owner Elon Musk has even accused the oil industry of spreading misinformation about climate science to undermine electric vehicles (Vaughan, 2013), before ExxonMobil and Koch lobbied the US Congress to remove EV subsidies and the installation of EV infrastructure (Bade, 2019). It is thus unavoidable to account for the role of the oil sector when analysing automobiles, for they have significant capacity to influence policy. This element of the current automobile paradigm is, however, only further accentuated by the transition to EVs, wherein the fruition of the transition can only be at the expense of oil.

#### 2.4.2 Forward linkage: (ii) Financial markets

Far less considered in the literature than those who inhabit the fossil fuel sector is the role that financial markets perform in financing the operations of the automobile sector. Indeed, while one might assume that the profits yielded by the automobile manufacturers are (re)invested back into further production, the reality is that manufacturers depend upon access to credit from the financial market before refinancing their accrued debt, by issuing corporate bonds onto the primary bond market (Kaczmarczyk, 2021). Access to and subsequent servicing of debt is therefore crucial to the manufacturers' operations, to the extent that domestic manufacturers' indebtedness can be used as a proxy for the overall economic conditions of a country. For example, the creditworthiness of Italy's automobile manufacturers was used as a proxy for the recessionary pressures on the economy during the Eurozone crisis (Zeneli, 2021)[[15]](#footnote-15). Financial markets also reflect the embeddedness of fossil capital in the global economy, as many pension and hedge investments made on asset classes are shares and bonds in the fossil fuel sector.

The financial market assesses the performance and creditworthiness of manufacturers through the ratio of return on capital employed, which determines each actor's profitability based on the performance of different market segments (Froud et al., 2002). Manufacturers are therefore highly leveraged, debt-dependent actors, who, when measured by debt-to-equity ratios[[16]](#footnote-16), tend to exhibit a ratio higher than 1 (Kallstrom, 2015). While borrowing costs can, to a certain extent, be offset by providing their lending services to intermediaries and consumers in the market (see below), longer-term considerations, such as the transition to EVs, are outweighed by short-term capital demands to ensure future access to financial markets.

Automobile manufacturers began to be traded on the stock exchange in the 20th century and continue to be appealing to investors, despite the bankruptcies, such as Saab, Saturn and Aptera Motors over the past decade (Terzo, 2019). Like oil, the automobile sector shares a close relationship with the financial system, as illustrated during economic crises when contracted economic activity leads financial markets to become illiquid the demand for credit from manufacturers contracts in turn (Pavlinek, 2012; Martin 2011). Yet, while automobile companies account for a small proportion of assets exchanged on the financial markets, their corporate bonds remain a reliable asset class (Inderst, 2010). The financial model underpinning the automobile sector is not simply confined to the manufacturers and their creditors but is a financial ecosystem inhabited by four primary actors.

First, financial actors provide the credit that makes the automobile sector's capital requirements more intense, as manufacturers remain dependent on access to ensure their competitiveness and operations. In many instances, manufacturers can often access credit more cheaply than governments, as seen recently by the different maturity rates tied to the issuance of three separate bonds from Volkswagen of 0.0, 0.375 and 0.625% (Volkswagen, 2021). Such financial arrangements make manufacturers acutely susceptible to corporate bond yields, increases in interest rates and inflationary pressures. Secondly, manufacturers accordingly look to offset their debt requirements by performing the role of creditors through their banks (including BMW Bank) or securing future lending against vehicles leased to dealerships and consumers.

Third, the financial actors and manufacturers, and between the producers and consumers of automobiles, reside many intermediaries, from suppliers to insurers (Opsahl, 2021). Principal among them are the showrooms, retailers, dealerships, which buy, lease vehicles from manufacturers to sell to consumers. Intermediaries look to imitate manufacturers by offsetting their interest payments through setting their own interest rates for consumers (Sowers, 2021). In many instances, dealerships are sub-divisions of the manufacturers (Deloitte, 2019). In others, dealerships act independently, providing many of the services associated with automobiles, such as servicing and MOTs, which tend to yield higher margins than the actual sale of vehicles. They also have unique access to both primary and secondary automobile markets (new and used vehicles) through auctions, vehicle parts and trade-ins where the residual (resale) values of vehicles can yield higher returns than a vehicle sale. Fourth in the financial ecosystem are consumers, who rely on a suite of financial instruments to procure automobiles. Typically, such measures are departmentalised into the following three categories:

**I Hire Purchase:** a structured payment option consisting of a deposit (typically 10%), followed by the requirement that consumers pay the principal cost and interest payments of the vehicle in instalments until the value of the vehicle is met.

**II Personal Contract Purchase:** based upon a 'minimum guaranteed future value' (model, requiring a deposit and monthly financial package with a final lump sum/balloon payment to purchase the vehicle *if* desired.

**III Personal Leasing/Contract Hire**: like the previous personal contract purchase arrangement, but without the option to buy the vehicle (Porter, 2021).

These different options attribute value and risk to the vehicle and lie beyond this chapter's scope. However, the costs to consumers, whether that be the cost or interest payment of the vehicle, ultimately return to the financial market. Figure 2 provides an overview of the financial ecosystem of automobile finance, though additional costs can vary in different national contexts.

**Figure 2: Automobile sector financial ecosystem**

**Financial Market –**

Where manufacturers access credit and allocate their corporate bonds. Also, the site of credit default swaps and derivative trading on automobiles.

**Income:**

Interest + principal on credit

**Costs:**

Losses related to defaults or stranded assets

**Consumer –**

Where automobiles are ultimately consumed.

**Income:**

Wage + trade-in

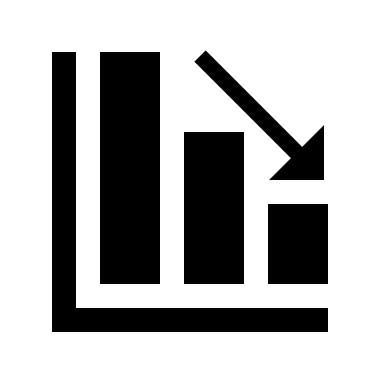
**Costs:**

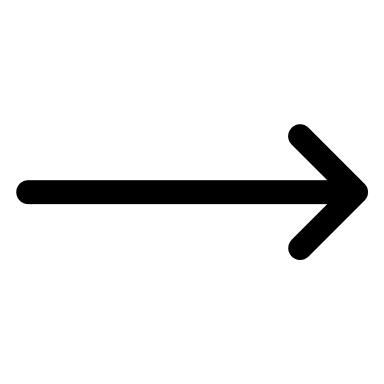
Principal + interest paid on:

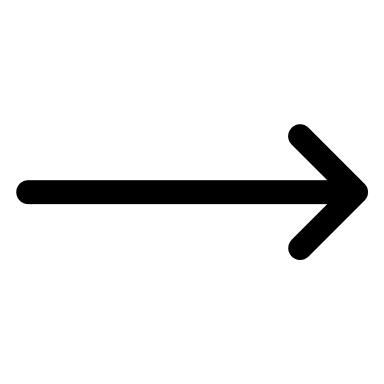
I)Hire Purchase – interest leveraged on vehicles cost

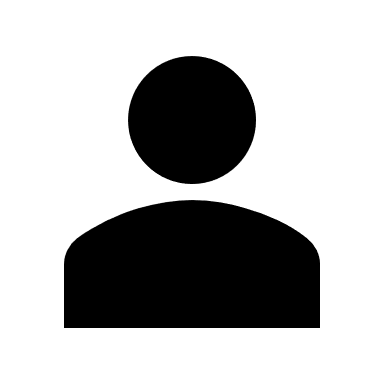
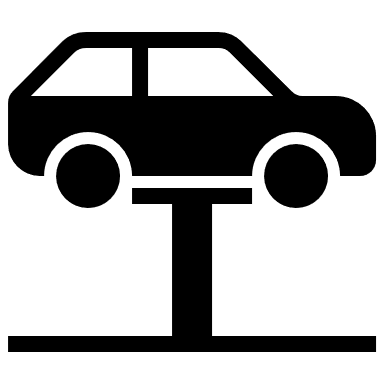
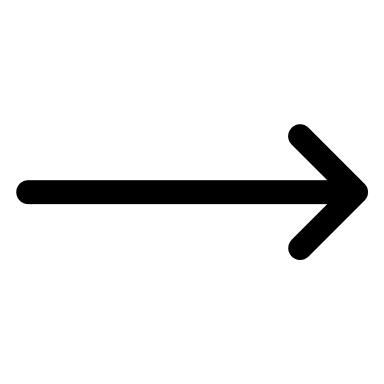
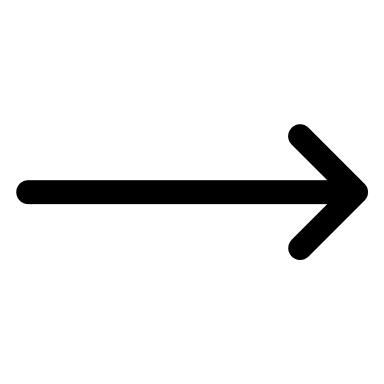
ii) Personal contract purchase –

iii)– Personal leasing (contract hire) – Deposit

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**Manufacturer –**

Producers of automobile.

**Income:**

Price of vehicle + interest on leasing arrangement to both dealerships and consumers.

**Costs:**

Credit + credit to financial markets + ‘hold back money’ – capital paid to dealership for selling the vehicle

**Dealership –**

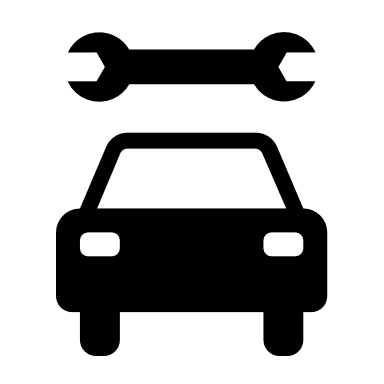
Intermediary in automobile ecosystem.

**Income:**

Financial arrangement with consumer + primary/secondary markets.

**Costs:**

Credit + principal to manufacturers.

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Author’s graphic

Financial markets, unlike the oil sector, are an ill-considered element of the automobile sector, but they are equally important because they underpin the automobile sector’s economic model. The Finance and Leasing Association, like the oil sector, has historically lobbied against any disruptions to the sector’s financial flows, as it would affect its relative reliability as a sector to invest in. What makes this forward linkages important to this analysis is that they illustrate what ecological economists have increasingly come to refer to as the 'transitional risks' associated with low carbon transitions and environmental policy (Jackson and Jackson, 2021; Reoberedo and Otero, 2021). Transitional risks refer to the adverse economic impacts of transitions to alternatives to business-as-usual (ibid). By supplanting the internal combustion engine, and the related investments made by manufacturers in their production, research and supply, the EV transition inevitably presents transitional risks to the automobile sector and, by extension, the financial market. EVs, while therefore an opportunity to address climate breakdown, are a risk to the financial system.

Whilst I have gained important insights this in chapter, a political economy analysis of the automobile sector offers only an analytical-descriptive account of the automobile paradigm. Reviewing the literature therefore serves to position my analysis within the literature and highlight key analytical subjects and their relationship to each other, a prominent gap remains insofar as the literature has yet to consider how the sector transitions from its present form. The historic macro-level framing of the sector, the state-business relations that define it, and the linkages it has to actors elsewhere in the global economy therefore all capture the ways in which the automobile paradigm drives capitalist accumulation, but consider less that, above all else, it is a carbon-intensive enterprise. This limitation of the literature was highlighted in the introduction to this chapter (see above). However, in the context of the Paris Agreement, it is clear this research needs a robust theoretical framework to address this gap, one that explains how the sector transitions from its carbon-intensive form to a decarbonised state. Given that is the subject of inquiry for this research, I seek to address this gap in the following chapter.

### 2.5 Conclusion

In this chapter, I have undertaken a review of the literature to identify the key features of the automobile paradigm. This chapter has situated the EV transitions amidst the automobile paradigm, identifying some of the features that stand to be altered by the transition to EVs. In the process, I have situated this thesis amongst critical trends in political economy scholarship. I adopt a critical position for this because of the slow growth in the EV market I outlined in Chapter 1. I have shown how the literature had tended to simply adopt a macro-level understanding of the automobile and how it fits within the broader global political economy. I built upon this formative analytical frame by introducing a micro-level dimension able to analyse individual automobile companies. I did so for the purpose of examining incumbent automobile manufacturers, particularly German manufacturers Volkswagen, BMW, and Daimler, as well as emergent EV manufacturers such as Tesla, who need to be considered later in this research. Adding the micro-level understanding to the significant macro analysis established in the political economy literature allows for a more nuanced analysis of the EV transition, one able to distinguish between the automobile sector as a whole and the actions made by individual actors.

I have also identified the key analytical subjects of this research. Primarily, this chapter has emphasised the state's role in designing the automobile paradigm through the fiscal framework and its prioritisation of the automobile. The state’s relationship with automobile manufacturers within the case studies selected for this research will therefore inevitably serve as an important feature of the EV transition. Rather than simply isolate this analysis to focus this research on the state-business relations that characterise the present automobile paradigm, I outlined how the backward and forward linkages of the automobile sector draw other actors into the purview of this analysis. I drew attention to the oil sector and the financial market as two of the more ill-considered linkages to the automobile sector. These links demand this research is sensitive to the role of pertinent actors, such as the European Union, and national central banks and public-private organisations in subsequent chapters.

For all these formative insights I have drawn from the political economy literature in this chapter, I have shown that a political economy account alone is insufficient to provide an adequate understanding of the transitionary process. The literature has yet to adequately consider how the automobile paradigm transitions away from its present form to one decarbonised by growth in the EV market. In other words, scholars have sought to provide a descriptive account of what the automobile sector *is*, rather than conceptualise what it *could be*. I therefore seek to build upon this initial understanding of the automobile paradigm by providing a theoretical framework capable of framing the EV transition and addressing this gap in the literature. To address this lingering gap, I turn in the following chapter to the question of the transition, and how it may be understood. I accordingly build upon the disciplinary focus of this research outlined here to develop a robust theoretical framework that allows this research to examine the decarbonisation of the automobile sector.

# Chapter Three

## A theoretical framing the electric vehicle transition: Forming a synergistic framework

### 3.1 Introduction

Following a review of the literature that formed the basis of this research, I turn here to the gap identified in the previous chapter. I here seek to provide a theoretical framework through which to examine the automobile sector's transition to EVs. As Chapter 2 demonstrated, a political economy analysis of the automobile paradigm provides a useful means by which to establish the political and economic dynamics of the automobile sector but lacks a robust understanding of the transitory process. The sustainable transitions literature offers important analytical and conceptual leverage to address this gap. In this chapter, I develop a robust transitions approach, developing a novel, synergistic theoretical lens that draws upon Socio-Technical Transitions and the Ecological Modernisation approaches, to examine the EV transition in the chosen case studies.

The transition literature, particularly sustainable transitions, has become a burgeoning area of scholarship in recent years (Rogge and Reichardt, 2016; Farla et al., 2012; Markard et al., 2012). The emerging politics of sustainable transitions literature has already provided important insights into the inherently political nature of low carbon transitions. Several features of sustainable transitions accordingly draw useful parallels with elements of this research highlighted in previous chapters, such as that powerful actors seek to maintain unsustainable path dependencies (Meadowcroft, 2011); that the accumulation of capital motivates actors to reproduce, rather than transition away from, dominant economic paradigms (Newell, 2008); and how political actors must envisage the end goal of transitions to develop robust policy (Gaede & Meadowcroft, 2015). The preceding chapters have already outlined how the EV transition might be consistent with these characteristics. Indeed, as I noted in Chapter 1, decarbonising the automobile sector to meet the Paris Agreement serves as a clear end goal, just as Chapter 2 showed how the automobile sector is occupied by powerful actors seeking to maintain the automobile paradigm in its present form.

To address the gap in the political economy literature identified in Chapter 2, the purpose of this chapter is to develop a theoretical framework that can capture the multi-faceted and contingent nature of decarbonising the automobile sector. To do so I employ the Socio-Technical Transitions (STT) approach, the preeminent sustainable transition theory to have emerged from the literature in recent times (Geels, 2011; Smith et al., 2010). I then combine the STT approach with Ecological Modernisation (EM), a school of thought which has served as the key policy paradigm of environmental politics since the 1980s (Brand, 2010; Cohen, 1999). Due to the extensive contributions made to the Social-Technical Transitions and Ecological Modernisation literature by countless scholars, I show in the following chapter how together they can form the basis of a useful theoretical framework. I also demonstrate how the framework outlines a sequential transitionary process that can be used to identify empirical barriers to decarbonising the automobile sector in subsequent chapters.

To establish the foundations of the framework, I structure this chapter accordingly. I begin by outlining the key conceptual insights of the Socio-Technical Transition literature, particularly its key analytical heuristic known as the Multi-level Perspective (MLP), to provide a conceptualisation of the transition process currently absent from this research. In identifying the important contributions STT can make to the analysis of EVs, I also propose a reconceptualisation of the MLP, informed by the discipline of political economy outlined in the previous chapter. Whilst I seek to refine each level of the MLP, my most significant reconceptualisation is the focus I afford to the regime level, continuing the STT literature’s recent political turn by offering an abridgment with a political economy analysis. I combine my reconceptualised account of the MLP with Ecological Modernisation to develop a robust conceptual understanding of the state, that can be empirically tested in later chapters. I show how a weak, techno-corporatist interpretation of Ecological Modernisation provides a useful framing to examine the EV transition empirically. I conclude this chapter by outlining a categorisation of the EV transition pathways, building on the work of Meckling and Nahm (2018), that can be applied to the UK and German case studies. I conclude by identifying the three research questions that guide this thesis.

### 3.2 Socio-technical Transitions (STT)

The Socio-Technical Transitions approach has emerged across many disciplines in recent years, including geography (Calvert et al., 2017), health policy (Shaw and Donia, 2021) and ecology (Tapsoba et al., 2020), as it has become established as an indispensable tool in examining transition processes. ‘Transitions theories’ are a broad conceptual umbrella under which several approaches, including Technological Innovation Systems (TIS), Strategic Niche Management (SNM) and Transition Management reside (Hegger et al., 2007). There is therefore no single ‘transition theory’, but the Socio-Technical Transitions approach has risen to the forefront of the research agenda because, in contrast to its predecessors, its analytical focus is to examine the multi-dimensional struggle between niche innovations, such as EVs, and the incumbent system such as the automobile paradigm[[17]](#footnote-17) (Geels, 2019). The approach seeks to provide analytical-descriptive accounts of sustainable transitions to identify the patterns and relationships that form the transition process (Brand, 2016; Feola, 2015).

Key to the allure of the Socio-Technical Transitions approach is the Multi-Level Perspective (MLP). As the name implies, the MLP consists of several levels, which interact to determine the outcome of sustainable transitions. Known as the ‘nested hierarchy’, the levels within the MLP are the landscape (macro) level, regime (meso) level, and niche (micro) level (Geels and Schot, 2007; Geels, 2002). The MLP serves as an analytical heuristic, or prism, for the Socio-Technical Transitions literature that perceives sustainable transitions to be the result of multi-dimensional interactions between government, industry, technology, and the market, among other analytical subjects (Geels and Schot 2007). The MLP has even been employed independently of the Socio-Technical Transitions literature in recognition of its explanatory power (Hausknost and Haas, 2019; Burton-Jones and Gallivan, 2007). In Figure 3, I provide an overview of the traditional MLP framework[[18]](#footnote-18).

**Figure 3: Original MLP framework**

Text

Description automatically generated

Source: Geels (2011).

In Figure 3, Geels (2011) argues that this illustration captures each level of the MLP. It shows that transitions are brought to bear through the alignment of heterogeneous levels. The alignment of these levels, as argued by Geels, is not a linear process but requires the interplay of each analytical level to bring about socio-technical change. As I outline further below, the basic principles of the framework purport to show how landscape developments but pressure on existing regimes, opening windows of opportunity. In turn, niche innovations are in the learning process of becoming aligned with the MLP until the point at which they take advantage of the windows of opportunity as they occur. Meanwhile, the regime is a ‘dynamically stable’ level that monitors the ongoing processes at both the landscape and regime level. I discuss each level in more detail below.

Prior contributions to the Socio-Technical Transitions literature provide two initial insights into how the EV transition may function within the MLP framework. The first is proposed by Geels (2019; 2016), the key scholar in the Socio-Technical Transitions literature, who has previously examined how the automobile emerged as the dominant mode of transport during the early 20th century, displacing the horse-drawn carriage (Geels 2005). Geels suggested that the gasoline powered car exhibited its technological credentials by not only displacing the horse and carriage, but also steam and electric-powered alternatives by fulfilling a useful social niche amongst racing and touring groups. Geels subsequently challenged the notion of simple technological substitution by observing that the emergence of innovative technology became linked to a broader social function.

Geels (ibid) also suggests the emergence of the gasoline car was by no means a linear, uncontested process. Rather, it was the culmination of struggles between groups pursuing different ends all seeking to avoid potential disruptions to the status quo (ibid). More specifically, the antagonisms which marked the rise of the automobile, then itself an alternative technology, centred around the automobile’s infrastructure requirements, and dangers associated with the unprecedented speeds at which automobiles could travel (ibid). Gasoline automobiles’ ultimate rise to prominence, however, relied on the highway union to embed the automobile through a vast programme of road building in the 1930s rather than simply a technological innovation. The result was that this transition created what the STT literature refers to as the ‘lock-in’ of automobiles in contemporary social and political structures (Klitkou et al., 2015; Nelson, 2008). I have previously outlined this in further detail in Chapter 2.

The second insight of the STT literature is provided by Zhang et al., (2021) and Berkeley et al (2017), who have previously situated the EV transition within the MLP. Rather than simply try to predict the ‘tipping point’ at which EVs might achieve price parity with petrol and diesel alternatives (Nykvist and Nilsson, 2015), the authors use the MLP to show that regime actors play a key role in addressing the unaffordability of EVs or the cost of batteries (Zhang et al., 2021; Tsang et al., 2012) and that new actors would find it difficult to penetrate the automobile market (Berkely, 2017). However, neither Zhang et al., nor Berkeley et al., acknowledged the problematic features of the MLP that I address below.

What can be gleaned from the previous application of the MLP to the automobile sector is twofold. Firstly, it states that electric vehicles are not a new technology in the traditional sense[[19]](#footnote-19) (Berkeley et al., 2017). As previously noted in Chapter 1, electric vehicles are not a new technology but proved popular in the early 20th century until they became uncompetitive with the first mass-produced gasoline alternatives.  The second is that the transition to automobiles did not occur in isolation, nor unaided, but was linked to a broader social purpose (Geels, 2005; ibid). Therefore, while gasoline vehicles have long been an incumbent technology, it was only possible due to existing petrol infrastructure, and existing maintenance networks and repair skills outside of major cities (Geels, 2005; Unruh, 2000). Obvious links can therefore be drawn with the focus of this research, with EVs emerging as a focus of environmental policy to fulfil the broader social purpose of the Paris Agreement.

Despite these initial insights, however, I propose that the traditional iteration of the MLP does not offer a completely clear analytical guide to examine the EV transition, due to the obfuscated conceptual levels. As highlighted in Chapter 1, states played a key role in identifying EVs as a solution to climate breakdown by signing up to the Paris Agreement. Yet the level of the MLP at which states resides is unclear. Chapter 2 highlighted several other key analytical subjects in the political economy literature, such as automobile manufacturers, and the financial actors, that also sit uncomfortably within a typical framing of the MLP. In the following section, I outline a reconceptualised interpretation of MLP, which helps to address the gap identified in the previous chapter. This reconceptualisation continues the ‘political turn’ taken by the Socio-Technical Transitions literature by further drawing upon the discipline of political economy. Below each level of the MLP is reviewed in turn, examining the traditional framing of the niche, regime, and landscape levels before proposing a conceptual readjustment of each level.

#### 3.2.1 Niche

By virtue of the niche level serving as the object of much of the STT literature, it serves as a useful entry point in which to begin an examination of the MLP (Johnston and Newell, 2018; Geels, 2011). Within the framework, sustainable transitions are frequently presented as bottom-up processes, contingent on the displacement of technology with an emergent, low-carbon alternative. The technologies in question are referred to as ‘niches’ because they are innovations that exist at the periphery of existing systems until actors find a way to integrate them into the incumbent sector or market (Schot and Geels, 2008). Examples of niches include innovations such as the carbon-intensive automobile, or indeed EVs as shown above, but also alternative foods, and decentralised energy production (Geels and Schot, 2007). Foregrounding innovative or ‘green’ technology is not unique to the STT approach. Rather, it reflects a broader ‘technocentric’ trend in the sustainable transitions literature which is also prominent in Technological Innovation Systems (TIS) (Web and Truffer, 2017; Markard et al., 2012) and Strategic Niche Management (SNM) amongst others (Schot and Geels, 2008). But this focus is a useful framework to examine the EV which, as I have already outlined in Chapter 1, is a technological fix to an environmental problem.

However, a prominent feature of the STT approach is the niche-regime dynamic. I develop the regime level in greater detail below, but initially, the regime can be understood as a sphere of public-private actors that influence the trajectory of transitions. Different accounts of the niche-regime dynamic conceive of the relationship in different ways. For example, some consider the innovations at the niche level to be the result of a concerted effort by actors at the regime level dedicated to bringing about the transition in question (Kemp et al., 1998).  Others argue that transitions are the result of a ‘trickling down’ of resources to test the compatibility of new products/technologies with the existing infrastructure (Smith et al., 2005). What ultimately distinguishes these two accounts is the level of resources and focus afforded to the transitions by actors at the regime level.

However, as noted, the position of many STT scholars in the literature is that transitions are bottom-up processes. Indeed, this focus has been articulated in several rhetorical forms, from the notion that niches ‘bubble from below’ (Smith et al., 2005, p. 886) to more descriptive terms, which see the niche level as ‘incubation rooms’ for an impending transition (Geels, 2011). Again, both assume a different role for regime actors, with the latter prescribing a level of ‘nurtured development’ from incumbents that is absent from the former (Savaget et al., 2019, p. 886). Both however speak to the precarity of niches insofar as they must prove incorporable into the regime. While regime actors are conceived of in different ways, for niche innovations to emerge, the niche-regime dynamic must nonetheless combine to create ‘configurations that work’ (Rip and Kemp, 1998, p. 387).

Whether transitions come to fruition is contingent upon the interaction of the entire MLP, requiring the niche-regime to respond to landscape pressures (Farla et al., 2012; Geels, 2004). By way of summarising this complex dynamic, transitions begin as niche innovations, emerging at the fringe of the regime. Incumbents must then decide whether to embark on a series of ‘learning processes’, including matching niches to the existing technological incumbents based on price and performance before incorporating them into the regime. As changes at the landscape level put pressure on the regime, ‘windows of opportunity’ are created for niches to emerge (Geels and Shot, 2007). Such a process can last for decades for the layers of the MLP to align before a breakthrough is made and a transition takes place (Geels, 2005; Freeman and Preze, 1998).

Here the MLP provides a useful conceptualisation of how transitions occur, albeit operating at a distinct level of abstraction since, as I show in this chapter, each level has been subject to different interpretations from scholars, limiting the MLP’s empirical precision (Tyfield, 2014). What is also clear is that the STT approach reflects the normative assumptions of the orthodox neoclassical approach to economic development (see Chapter 2). In particular, the STT literature perceives transitions as being determined ultimately by the price and performance of the niche in question (Geels, 2005). This suggests that the interactions between levels of the MLP are guided by a market logic that determines the viability of a transition not only by its social function.

I propose that such an interpretation as to how transitions unfold is often ill-defined in the STT literature. I refer here to Mazzucato’s (2018) analysis of the iPhone, a commodity often perceived to typify the dynamism of market forces to which STT scholars refer. First released in 2007 in an industry then dominated by Nokia and Blackberry, the iPhone brought with it a full-size touch screen when ‘flip phones’ with a split keyboard and screen were the norm (Aljafari, 2016). A typical interpretation of the emergence of the iPhone 3G, and Apple more broadly, in the Socio-Technical Transitions literature might then attribute its success to its technological innovation and its price, costing $199 in a market where $400 phones were common (Cecere et al., 2015; Business Insider, 2011).

However, placing the success of the iPhone simply at the door of an innovative touch screen or lower price is too simplistic. A more accurate application of the MLP would also need to account for the emergence of the iPhone amidst the landscape pressures in the form of the internet and 3G connectivity. It would also need to account for the role of other actors, such as Nokia or Blackberry, who were unable to respond to the ‘mobile internet’ landscape pressures in the same way (Ishii, 2004). Indeed, Apple was only able to do so because of an exclusive partnership with the established phone market incumbent AT&T[[20]](#footnote-20) (Business Insider, 2012). Only by first establishing the factors preceding the niche’s introduction to the market can the success of the iPhone be understood. Rather than simply being a case of market dynamics, transitions are also contingent upon actors internalising landscape pressures in different ways.

The iPhone nonetheless serves to illustrate the potential utility of the MLP whilst simultaneously revealing some of its more pronounced limitations. These shortcomings can be addressed by making the first tentative links to the discipline of political economy. By taking a broader view of the political and economic environment, a political economy analysis can be used to determine Apple’s role within the global economy. Viewed accordingly, the iPhone might then be understood as not simply a niche innovation, but rather the most recent innovation of Apple, an incumbent in the computer market since the 1980s[[21]](#footnote-21) (Business Insider, 2012). As an incumbent in the telecommunications sector, a political economy analysis of Apple would suggest it is able to exert a significant influence over other markets.[[22]](#footnote-22) Absent from much of the STT literature is a sensitivity to the fact that the ability of niches to penetrate markets can be determined by the size of actors. In other words, Apple’s capacity to diversify its asset portfolio into other markets through the iPad, iWatch, iMac, and most recently AppleTV (Kenny and Pon, 2011) is made possible by the capital accumulated, supply chains established, and economic power gained in other sectors.

The STT literature has often failed to recognise that niche technology may simply be the most recent venture of incumbents behind the veneer of innovation. I argue the literature would subsequently benefit from distinguishing between *new fringe actors* and *incumbents at the fringe of new markets*. This distinction is particularly pertinent to Chapter 7, where I examine the automobile sector in Germany, which is home to entrenched incumbents, such as Volkswagen, Daimler AG, and BMW, and Tesla, which could be classified as a seemingly typical niche actor in the Socio-Technical Transitions literature (see Chapter 7). However, as I outline in the chapter, Tesla’s success can be attributed to its part in a wider corporate entity. The power of transnational corporations (TNCs) to influence the EV transition has incidentally already been highlighted in Chapter 2 as an observation made by political economists since the 1980s (Blakely, 2019; O'Brien & Williams, 2016). Such clarifications, however, assist in developing the MLP beyond an abstract heuristic to an analytically precise framework.

The niche level requires the least attention in this chapter, as its technological focus already sits comfortably within the focus of this research. The focus of this chapter incidentally follows a recognition in the STT literature that one of the limitations of the MLP is that it had become too niche focused (Turnheim and Geels, 2013; Smith and Stirling, 2010). Coincidentally, this recognition has, in part, been linked to the growing influence of political science in developing the regime level (see below), but there is nonetheless an acknowledgement that previous niche-centric accounts of sustainable transitions belie the complexity of the niche-regime dynamic (Hermwille, 2015; Smith et al., 2005). Because of the growing recognition of the MLP’s niche centrism, I hereafter shift the focus of my reconceptualised account of the regime level. That is not to say that the niche level loses any value, but that it serves a different purpose within the MLP.

#### 3.2.2 Regime

The niche-centric framing that has dominated the MLP (Turnhem and Geels, 2013; Smith et al., 2005) is partly a consequence of an ill-defined regime level. Whilst accounts of the niche tend to be relatively detailed, accounts of the regime have by contrast been vague and rudimentary (van Rijnsoever and Leednderste, 2020; Geels et al., 2017). This is in large part due to prior contributions to the literature applying the regime in too broad a fashion. Briefly, the regime has been used as a term to denote a sphere of policy (Geels, 2011), to describe technology, science (Geels, 2002), cultural meanings (Rip and Kemp, 1998), infrastructure, and industry (Geels, 2006). Elsewhere, other scholars have applied it to all too different units of analysis, including users (Schot et al., 2016), civil society (Smith, 2007), and firms (Farla et al., 2012), rendering the regime level an obfuscated analytical subject.

Amidst such a fluid understanding of the regime level, there are several common features in the literature. The first is that the regime level is subject to landscape pressures which create windows of opportunities for the niche to emerge (Geels, 2012; 2011). The second is that niches can ‘reinforce’ or ‘weaken’ the regime (Kivimma and Kern, 2016). Lastly, scholars also agree that the regime is the ‘systemic dimension’ of the MLP, mediating between stability and change (Köhler et al., 2019). All such features inadvertently highlight the crucial, yet neglected, function of the regime level in the Socio-Technical Transitions literature. Tying together these common features, I therefore propose that rather than a niche-centred framing, the utility of the MLP would be better served orientating around a regime-centrist framing.

At times, the STT has seemingly acknowledged the pre-eminence of the regime level when stating the landscape and niche levels are ‘derived concepts’ of the regime, as its transitions are defined by regime change (Geels, 2011, p. 26). Adopting a regime-centred framing remains problematic however by virtue of the diverse descriptive interpretations attributed to the analytical level and the inconsistent conceptual iterations in the literature. One need only attempt to accommodate prior definitions of the regime level with its proposed function in the MLP to illustrate this point. For example, how technology could destabilise cultural meanings, science and users is unclear (Kern et al., 2014). Likewise, framing the regime as a particular infrastructure or meaning embedded within socio-cultural relations demands two wholly different analytical and methodological subjects. Such diverse accounts obfuscate the explanatory power of the MLP due to these subjects bearing little resemblance to each other. The profound empirical and analytical challenges presented by this ambiguous conceptualisation of the regime level (Köhler et al., 2019) require redress before further developing the MLP.

For the purpose of this research, I suggest the regime level can be most clearly conceptualised as the political and economic sphere of state-business relations, reflecting the automobile paradigm I outlined in Chapter 2. The regime is of course not solely attributable to the automobile sector, but a flexible conceptual space able to account for any number of state-business relations, and one that as I have shown throughout this thesis thus far, must always retain a focus on the state following its role in shaping the trajectory of the transition, and the socio-technical system in which the transition takes place (see Chapters 1 and 2). Previous accounts of the regime have employed the state to these ends, but often only in reference to the regulatory role of niches (Smith et al., 2013). More recent contributions have also highlighted the role of government arrangements in introducing policies, such as in the case of the German *Energieweinde* (Kuzemko et al., 2016). However, the state has too often played only an ancillary role in the STT literature. So glaring is this omission, that scholars outside the STT approach have attributed its limited understanding of the state to a lack of engagement with the discipline of political science (Johnston and Newell, 2018; Meadowcroft, 2009).

The reconceptualisation of the MLP I propose here responds to a decade-long call within the transitions literature to pay greater attention to the discipline of political science (Smith and Stirling, 2010; 2007; 2004; Walker and Shove, 2007). The reason for the omission of politics from STT and MLP analyses is unclear. Some consider it to reflect the narrow boundaries of political action typically considered permissible within the context of sustainable transitions (Scrase and Smith, 2009). Others blame the previous ontological assumption that transitional processes are rooted in socio-human realities with artefacts, without considering how governing regimes shape those material arrangements (Köhler, 2019). Greater attention to political science thus also reflects the calls for the literature to move beyond a socio-material to politico-material ontology (Avelino et al., 2017).

In response, the STT approach has taken a ‘political turn’ in recent years (Argyriou and Barry, 2021; Johnstone and Newell, 2018; Turnheim and Geels, 2013). Prior to this turn, Meadowcroft (2011) had asserted that “politics is the constant companion of Socio-Technical Transitions, serving alternatively (and often simultaneously) as context, arena, obstacle, enabler, arbiter, and manager” (p. 71). This turn is neatly tied into how the debate has shifted to the politics of sustainable transitions (Scrase and Smith, 2009; Meadowcroft, 2006). As political scholars have contributed to the STT literature, the analysis has soon moved beyond simply the content *of* policies to *how* policies are shaped (Hess, 2014), drawing on insights from political science to further strengthen the Socio-Technical Transitions approach.

The ways in which policies are shaped, who shapes them, and what levers of power they use to exert their influence have also led the STT literature to previously draw on insights from the political economy literature. Geels (2014) has previously employed a political economy approach to account for the relationship between policymakers and incumbents who band together to form a ‘Core Alliance’. Rather than disrupting the regime, the alliance attempts to incorporate niche innovations into the status quo, leading some to refer to it as the ‘historical bloc’ (Johnstone and Newell, 2018; Levy and Newell, 2002), the basis for arrangement formed around ‘carbon capital’ (Urry, 2013) or ‘carbon lock-ins’ (Unruh, 2000). The Core Alliance subsequently echoes the idea of a ‘fossil fuel historical bloc’ (Phelan et al., 2012) suggesting that the regime is made up of reciprocal state-business relations based on fossil fuels. Clearly, then, the automobile paradigm serves as a fossil fuel historical bloc, just as the state and automobile manufacturers as the Core Alliance. More broadly, this useful intervention by Geels thus draws the STT approach closer to the disciplinary focus of this research I established in the previous chapter.

Far more parallels can be drawn between the STT literature and political economy once the regime level is understood as a sphere of state-business relations. Indeed, the very concept of the Core Alliance echoes that of Corporatism common in political science (Rein, 2016; Clarke et al., 2001), and has been attributed to the automobile sector (see Chapter 2). To build upon these initial links of state-business relations, and to understand the regime’s Core Alliance analytically, Newell and Paterson (1998) suggest that businesses rely on the state to ensure property rights, regulation, standards and, where required, financial support. In return, states rely on business to drive economic growth upon which they can build their electoral victory. By working in the interest of capital, business is, by extension, afforded a degree of structural power or ‘soft’ power over policy and therefore sustainable transitions (ibid). To a lesser extent, Barley (2010) suggests that soft power is also exercised by other public and private actors, such as government advisory committees, government offices, think tanks and industry lobby groups, which again, speaks to the backward and forward linkages identified in Chapter 2.

Through greater engagement with political economy, the MLP gains a significant degree of analytical precision of the state-business relations previously absent from the STT literature. The STT literature can then in turn begin to address the absence of a transitionary process in the political economy literature I outlined in Chapter 2. For the purposes of this chapter, I turn then to how transitions are shaped by regime actors. Here, many insights may be gleaned from scholars who have previously addressed this question. Chin (2019) states that governments have played a key role in the development of computers, jets, planes, civilian nuclear energy lasers and more. Developing on this initial assertion, Bastani (2019) likewise argues that without government assistance in the form of capital, regulation and dedicated government bodies, the internet, automobiles, planes, and many others would likely have never developed. By way of attempts to quantify the state’s impact, Block and Keller (2011) found that between 1971 and 2006, 88% of innovations were funded by governments at some stage in the development of niche innovations. Transitions, by this understanding, are then not simply possible through the price and performance of the niche, as typically assumed, but the resources, nurturing, and ultimate purpose that the state affords to it (see above).

To further illustrate the impact of the state, I return to the example of Apple I referred to above (see 3.2.1). Mazzucato (2018) has subsequently provided a thorough account of Apple’s relationship with the US government. There Mazzucato states Apple has been the benefactor of government aid in the form of tax credits, ensuring intellectual property rights, investing in GPS systems and their SIRI system, to name a few. To take this example further, the landscape pressure on which Apple capitalised (see above) was enabled by the ‘computer development hub’ nurtured by the US government funding the ‘internet California Gold Rush’ or ‘Silicon Gold Rush’ (Kenney, 2013). Silicon Valley is also itself, in part, the result of government spending for military, university and industry purposes since the Cold War (Guzman and Stern, 2015).

By drawing on insights from political scholars, it becomes clear that the regime level plays a central role in determining the outcome of transitions within the MLP framework. Moreover, it shows that the state is *the* key actor at the regime level, alongside its partners in the Core Alliance. How these actors negotiate the EV transition is a matter of empirical investigation, one which I address in the following chapters. But, as noted previously, the STT literature has tended to frame transitions as processes that occur once the regime is destabilised by emerging actors responding to landscape pressures. This has tended to frame the regime as a rigid dichotomy made up of new entrants and radical innovations versus resistant incumbents (Johnstone and Newell, 2018) or framing regimes as monolithic structures resisting change (Geels, 2014). I have already shown that the STT would benefit from greater attention to different actors but reducing the transitions to this rigid dichotomy might be linked to the literature tending to focus on *how* transitions occur as opposed to *why*.

Failing to determine the cause of transitions can be linked to the MLP’s tendency to view the regime not as one entity, but as a ‘patchwork of regimes’ (Geels, 2002). This suggests that the regime level can be divided into an incalculable number of regimes, made up of entirely different actors, all operating in accordance with their own unique logic. Yet elsewhere the STT literature has tentatively acknowledged the neoclassical view of transitions as contingent upon the price and performance of emergent technology. And whilst I have already shown that this process is more complex, it nonetheless speaks to a singular, identifiable logic at the regime level, namely the accumulation of capital, also outlined in Chapter 2. Viewed in this way, a more coherent understanding of transitions in the STT literature would be gained by acknowledging the single motivating logic referred to in the political economy literature as the ‘regime of accumulation’ (Paterson and Laberge, 2018). Why transitions occur can therefore also be linked to the disruption of the very same patterns of capital accumulation, as the arrangement upon which the regime’s core alliance is formed becomes destabilised. I further outline how this is brought to bear in the following section (see 3.2.3).

Whilst the purpose of this framework is to address the gap identified in the political economy literature, it is clear that the political economy discipline still offers important insights that, in turn, develop the regime level of the MLP. And whilst there are clear overlaps between these perspectives, whether the regime is ultimately destabilised by exogenous forces, or whether incumbent actors destabilise it from within, remains absent from my analysis, and thus requires an examination of the landscape level. Due to the focus of the STT being one that has focused on the niche-regime dynamic, the role played by the landscape level in determining the outcome of sustainable transitions has often been neglected in the literature. I turn, then, to the regime-landscape dynamic to undertake a thorough review of the MLP.

#### 3.2.3 Landscape

Nowhere has the tendency of the MLP to operate a distinct level of abstraction been more obvious than in the case of the landscape level. Previously the landscape level has been considered to form a ‘gradient’ that is beyond the direct influence of actors to change (Geels, 2005). Translating this into a coherent analytical subject for STT scholars has proved problematic, in much the same way as at the regime level. Prior contributions have subsequently coupled the landscape level with material and spatial arrangements of cities, highways, and electricity infrastructure (Rip and Kemp, 1998). Elsewhere, other scholars have conceived of the landscape in many ways, including demographics, ideologies, geographies and more (Geels et al., 2017). At the MLP’s more familiar abstract level, the landscape has even been considered to comprise social, cultural, and economic factors (Geels, 2004; Rip and Kemp, 1998). The inconsistent application of the landscape level has thus made it a problematic conceptual element of the MLP.

One common feature which can be gleaned from such obscurity is that the landscape is the macro level of the MLP, representing the material aspects of society (Rip & Kemp, 1998). In the absence of a clear descriptive framing, however, one must instead question the function of the landscape to gain a clearer understanding of what role it serves in the MLP. As noted, previous contributions to the literature state that the landscape provides a ‘landscape shock’, in which windows of opportunity are created (Van Bree et al., 2010; Verbong and Geels, 2010), exerting a ‘downward’ pressure on the levels below (Berkhout et al., 2011).

To refine the landscape level for the purpose of this research, I propose a useful (and apposite for sustainable transitions) conceptualisation of the landscape as the natural/ecological environment. As rudimentary as that may first appear, the environment has been notably absent from Socio-Technical analyses of sustainable transitions. The environment is, however, an appropriate accessory to the landscape level. Not least because it allows for a distinction to be made between sustainable and technological transitions. At a conceptual level, the environment sits comfortably on top of the ‘nested hierarchy’ of the MLP (Geels, 2005; 2004). Far from being an all-encompassing concept, however, the environment is an umbrella under which several variables, traditionally referred to as *environmental* or *negative externalities,* may exist as units of analysis[[23]](#footnote-23) (OECD, 2019). Framed in this way, water or air pollution, CO2 emissions, water or land use, food security and resource extraction, all have the capacity to serve as landscape pressures in MLP analyses (Jenkins et al., 2018).

Negative externalities have been long since been a focus of the environmental politics and political economy literatures, but noticeable absentees from the Socio-Technical Transitions literature (Carter, 2007). Yet, once negative externalities are seen through the prism of landscape pressures, sustainable transitions become relatively linear processes within the MLP. For example, the pressure of the landscape is exerted on the regime, producing a tension between the Core Alliance that, when left unaddressed, can have a destabilising effect on the relationship as features of the arrangement become problematic, whether that be politically, economically, or socially. In other words, when the Core Alliance is formed around a carbon intensive enterprise, such as the automobile sector, its associated impacts on the environment return to the Core Alliance as landscape pressures. To then diffuse the tension, the regime seeks niche solutions to address landscape pressures such as CO2 emissions. Therefore, the main purpose of the niche is to address the negative externalities that produce landscape pressures. Recent developments in the STT scholarship accordingly consider niches to be ‘niche-fixes’ within the MLP (Geels, 2014; 2002), echoing that of EVs as a technological fix, outlined in Chapter 1.

What distinguishes the regime-landscape dynamic then is the co-constituent flow of negative externalities between the regime and landscape level. More specifically, it is because regime state-business relations have tended to be formed around a fossil fuel historic bloc that landscape pressures are ultimately a result of activity at the regime level. The same landscape pressures that are then exerted on the regime are a product of the Core Alliance’s fossil fuel dependent state-business relations. Just as landscape pressures are produced by patterns of capital accumulation at the regime level, then, sustainable transitions must, by extension, disrupt the very same patterns of accumulation. This consequently brings sustainable transitions into opposition with the economic status quo.

Acknowledging the political and economic features of sustainable transitions is thus vital to understanding why landscape pressures are alone not sufficient to bring about a transition. For example, ocean pollutants do not necessarily preclude the clearing of oceans, nor address the health effects associated with petrol and diesel cars. Landscape pressures, then, do not inevitably compel regime actors to address them. It is only when these pressures are left unaddressed that landscape cracks can destabilise existing regimes (Fuenfschilling and Binz, 2018). As noted by Geels & Schot (2010), the destabilisation of the regime occurs when the landscape pressures begin to de-legitimise industrial processes and technologies. The authors indicate that this again inevitably calls into question the role of the state as the formal political structure in society.

It is because of the focus on the niche-regime dynamic in the STT literature that the regime-landscape dynamic has been left underdeveloped. By coupling the landscape level with an understanding of the natural environment, I seek to address several important interrelated, yet neglected, conceptual features of sustainable transitions. Firstly, such a framing of the landscape level inverts the MLP, from a top-down beginning with the landscape level as opposed to bottom-up framing of sustainable transitions beginning at the niche level. Secondly, once landscape pressures begin to pressure the regime, regime actors must mediate between the landscape pressures and attempt to find solutions at the niche level. The result is the ‘social trajectory’ or timeline of sustainable transitions, is determined by the regime (Verbong and Geels, 2010; Geels, 2005; 2004). An obvious example of a social trajectory could again be considered the objectives of the Paris Agreement.

This revised framing addresses some of the more lingering analytical gaps in the MLP, not least in that it presents landscape cracks as the result of negative externalities occurring because of the Core Alliance’s economic arrangement. The focus of this research, as I outlined in Chapter 1, accordingly sits comfortably within such a framing. By also indicating that unaddressed landscape cracks require sustainable transitions to depart from what was once ‘business as usual’ for the regime, this conceptual framing helps to contextualise the problematic elements of sustainable transition examined later in this thesis.

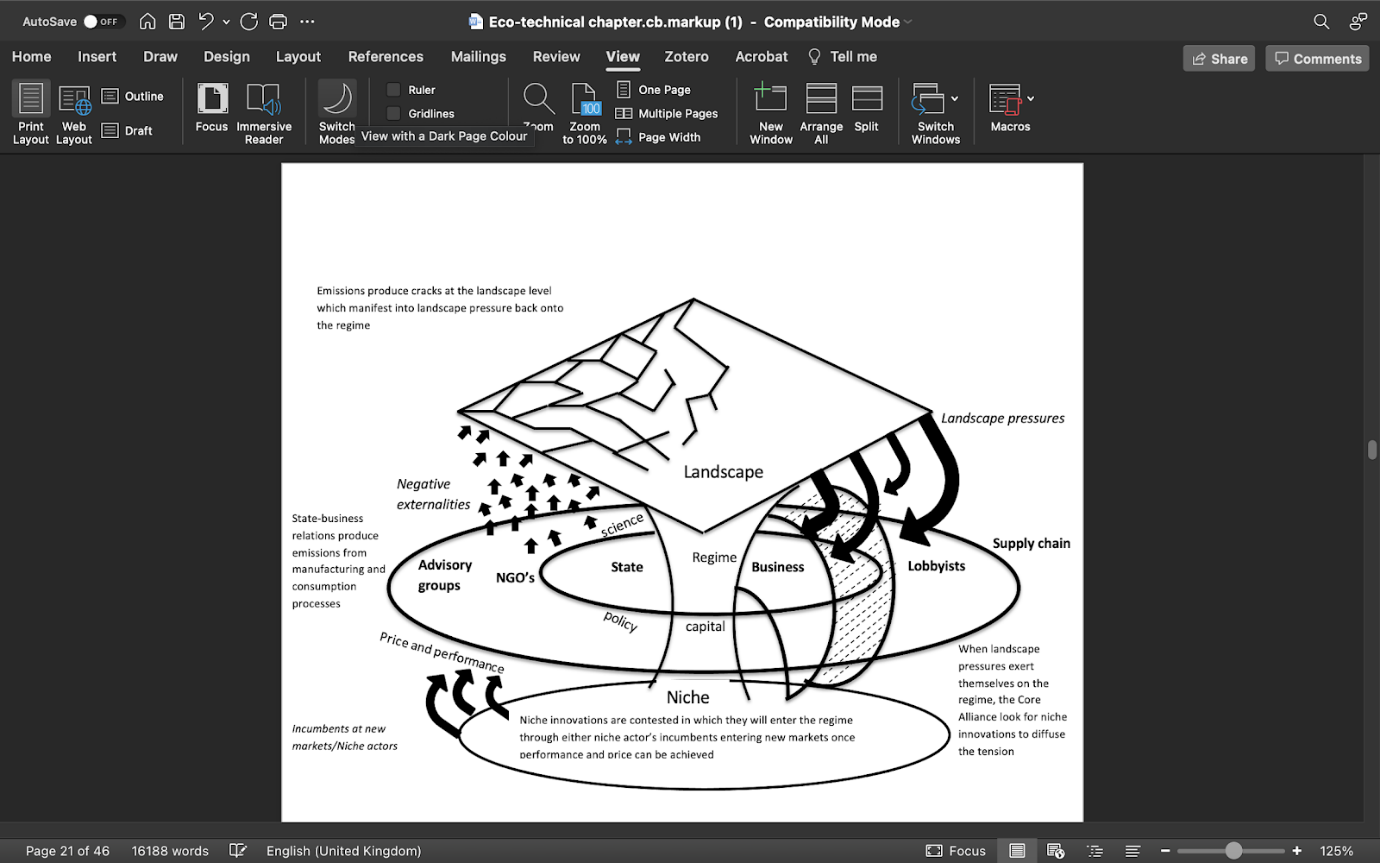
The conceptualisation of the landscape level proposed here is broadly in keeping with the vast body of contributions made to the literature that sees the landscape level as the macro level of the MLP. However, (re)characterising it as the natural environment represents a significant departure from previous understanding of the landscape level, whilst bringing the analysis firmly within the environmental focus of this research. While defining the landscape level this way may appear an (over)simplification, it adds a level of clarity previously absent from the MLP.

### 3.2.4 Reconceptualising the MLP: Furthering the political turn

The reconceptualised account I have proposed here seeks to further the MLP’s political turn, coupling the MLP with the political economy literature to form a more analytically robust account of the approach than has typically been utilised in the Socio-Technical Transitions literature. My intervention follows the call from political scholars, who have for some time stated that the MLP would benefit from greater engagement with political analysis (Johnstone and Newell, 2018; Meadowcroft, 2011). The STT approach, through the MLP, has however helped to address the gap identified in the political economy literature, providing an important theoretical framework to frame the EV transition.

By continuing the political turn, I have refined several features of the Socio-Technical Transitions literature. Firstly, I have proposed more robust analytical accounts of the regime and landscape level. The reinterpretation of these levels is an attempt to provide a much-needed degree of clarity for the MLP’s analytical framing. Secondly, I have contested that the niche-centric bias has produced an uneasy application of the MLP, arguing instead for a regime-centric focus (Turnheim et al., 2015; Smith and Stirling, 2010). Thirdly, I have sought to reveal a more complex transitionary process than previously proposed in the STT literature, inverting the MLP’s analytical framing. Consequently, the transitional causality of sustainable transitions now filters down from the landscape, as opposed to bubbling up from the niche, as had previously been suggested in the literature. My reconceptualisation of the MLP is accordingly summarised in Figure 4. This can be contrasted with Figure 3 (see above).

**Figure 4: Reconceptualised MLP framework**



**Author’s graphic**

As shown in Figure 4, my reconceptualised account of the MLP significantly reinterprets how a sustainable transition unfolds, inverting it from a bottom-up to a top-down process. The figure shows the co-constitutive relationship between the landscape and regime level I highlighted above, to show how the operations of regime actors produce negative externalities which, in turn, create cracks at the landscape level and returns to the regime level in the form of landscape pressures (See 3.2.2 and 3.2.3). Figure 4 also shows that regime actors use niche innovations to address these landscape pressures, though reconciling these tensions remains contingent upon the niche achieving a required level of price and performance (See 3.2.1). Most importantly, by drawing upon the insights previously established in Chapter 2, I have provided a more substantial account of the regime level, which actors inhabit it, and the purpose it serves in the MLP.

This reconceptualised account of the MLP provides a more analytically precise account of each level. There nonetheless remains one further feature of in the STT approach that requires amendment for the purpose of analysing the EV transition. This returns to the central focus of this chapter, being concerned with how to accurately conceptualise the EV transition. On this subject, the Socio-Technical Transitions literature has again historically suffered from an overly broad conceptual understanding of transition pathways, with typologies varying widely amongst scholars (Geels, 2014; 2011; Kern et al., 2014; Marletto, 2014). STT scholars have previously addressed this question and have contributed to it becoming a diverse conceptual terrain (see Rosenbloom and Meadowcroft, 2014; Elzen and Hofman, 2007). Geels and Schot (2007) provide the most refined accounts of STT typologies, taking one of (i) transformation, (ii) reconfiguration, (iii) technological substitution or (iv) de-alignment and re-alignment. And while I have sought to refine many of the elements of the STT approach, it is still important to account for pathway categories to capture the nuances which occur across different case studies.

Having already integrated the STT literature with political economy to reconceptualise the MLP, the rare instance in which the EV transition has been a feature of the political economy literature incidentally offers a useful categorisation of transition pathways to refine an understanding of transitionary pathways. For that purpose, I refer to the work of Meckling and Nahm (2018), whose work on EVs has already categorised two distinct pathways for EV transitions in their analysis of the USA and Germany, but also indicative of the inadequate account of the transitory process from the political economy literature (hence my intervention in this chapter), but nonetheless provides a useful categorisation. The authors identify two potential pathways: (i) *Political coordination* – whereby government and industry strike an accord that prioritises the interest of incumbent actors and technology and (ii) *Political competition* – in which policy makers form coalitions around technologies to challenge incumbents. Meckling and Nahm’s pathways, therefore, offer a useful categorisation of transition pathways for this research absent from the STT. I develop upon this initial heuristic further in section 3.5 below.

In summary, the STT literature, through the MLP, provides a useful way in which to address the gap in the political economy literature, albeit with a reconceptualised account of the MLP that itself draws upon the influence of political economy. No other feature of the MLP has required greater reconceptualisation than the regime level to better understand sustainable transitions. This continues an analytical thread of this research, developed in both Chapters 1 and 2, that the state’s role in sustainable transitions, particularly the EV transition, is of fundamental importance. However, if the state is the most important actor in the transition, what tools does it have at its disposal to shape this transition? This question remains outstanding in this thesis so far. To address this acute analytical shortcoming, I combine my reconceptualised MLP with Ecological Modernisation to form a synergistic framework able to investigate EV transition.

### 3.3 Ecological Modernisation

Ecological Modernisation is often considered the preeminent school of thought in environmental politics (Mol, Sonnenfeld and Spaargaren, 2009; Mol & Spaargaren, 2000a). It is a theory concerning the way in which the economy is brought into greater harmony with the environment, though precisely how is subject to debate (Mol, Sonnenfeld and Spaargaren, 2009). Unlike the STT approach, Ecological Modernisation has for a long time been the site of much political scholarship, making it well placed to address the conceptual limitations I highlighted above. Ecological Modernisation has by virtue of its extensive contributions from political scholars also had greater engagement with the political economy literature than STT. I consequently employ Ecological Modernisation as part of a synergistic framework to further develop an understanding of the state, and its relationship with business in the EV transition. The importance of the state has been a consistent theme in this thesis so far, prominent as a signatory to the Paris Agreement in Chapter 1, and a significant influence on the automobile paradigm in Chapter 2. I consequently employ Ecological Modernisation to form a conceptual understanding of the state that can be empirically examined in later chapters.

Historically, Ecological Modernisation has been employed in several ways by different scholars. Firstly, as a concept, it has been used to describe the modernisation of important institutions in the pursuit of environmental endeavours (Mol, 1995; 1994).  Second, as a political programme, it constitutes a move away from a hierarchical state-centred ‘command and control’ policy style to a decentralised, self-regulating use of market instruments, within legal boundaries (Mol and Spaargaren, 2000b; Boons, 1997; Jänicke, 1997). Finally, as a discourse, it has been used to advance the ‘polluter pays principle[[24]](#footnote-24)’ often considered to be the normative basis for Ecological Modernisation (Berger et al., 2010; Mol and Spaargaren, 2000b).

Beginning with the pollution controls in West Germany, the theory of Ecological Modernisation was attributed to various developed capitalist economies across OECD countries from the 1980s onwards (Mol and Sonnenfeld, 2014), becoming enshrined within the EU’s Fifth Environmental Action Programme (Castree, 2002). So much so that the model has become increasingly incorporated into Asian economies (Sonnenfeld and Mol, 2006) and other developing countries (Castree, 2002). Having been applied to such varied case studies, exponents of Ecological Modernisation claim it is the practical means to frame environmental politics without drifting into the realms of theoretical or normative assertions of what the relationship between the environment and economy should be (Haas, 2021; Gendron, 2011).

The emergence of Ecological Modernisation signalled the move away from the critique of capitalism known as the ‘Limits to Growth’ perspective common in the 1970s toward a view of Sustainable Development[[25]](#footnote-25) (Mol and Spaargaren, 2000b). Ecological Modernisation is therefore often perceived to be a departure from the eco-radicalism of the mid-20th century towards the notion that ecological crisis *can* be avoided without root and branch structural change[[26]](#footnote-26) (Jänicke, 1985). Capitalism, it is argued, can instead be brought into an ‘environmental equilibrium’ by addressing the ‘design faults’ within the economy (Mol et al., 2000). Such a view of capitalism has consequently been credited with emboldening the ecological consciousness in the policy decisions across the global economy (Sonnenfeld and Mol, 2006). This view of environmental-economic relations is consequently often framed by advocates of Ecological Modernisation as a *positive-sum* scenario rather than the irreconcilable tension presented by critical scholars (Mol et al., 2000).

There are some clear overlaps in the definitions outlined above, so much so that the three offer some potential for a conceptual harmonisation. Hajer (1996) has indeed previously made a similar observation, stating that Ecological Modernisation operates at both the level of policy programme and prominent discourse. Some scholars have subsequently come to regard Ecological Modernisation as a belief system or ‘ideology’ (Mol and Sonnenfeld, 2014). Alternatively, Ecological Modernisation has been defined as a form of ‘political modernisation’ (Jänicke, 1990) or ‘the new politics of pollution’ coinciding with the advent of neoliberalism (ibid). I subsequently employ the term Ecological Modernisation to refer to an ideological approach to an environmental politics, prescribing a role for both the state and business within a capitalist political economy.

It is because Ecological Modernisation has a long intellectual tradition in the environmental politics literature that it is an appropriate addition to develop the regime level, for it assumes that sustainable transitions are processes that do not put burdens on the economy but are a potential source for growth (Langhelle, 2000; Gouldson and Murphy, 1997). It also helps to frame state-business relations as a cooperative endeavour, in which sustainable transitions are couched in the ‘language of business’ (Berger et al., 2001). The Core Alliance of state-business relations established in the STT literature, then, work together to achieve what Huber (1985) refers to as the ‘ecological switchover’ by i) the reorientation of production and consumption to decouple economic development with emissions by reducing resource inputs, ii) ‘economising ecology’ by placing an economic value on nature and iii) integrating environmental policy into other policy areas. Huber’s notion of an ecological switchover can thus capture how the Core Alliance approach the design of sustainable transitions.

In the following section, I outline how the main advantage of employing Ecological Modernisation is to develop a more analytically robust account of the regime level, a remnant from the conceptual shortfalls in the STT literature. To that point, Ecological Modernisation scholars have long asserted that the role of the state is not to ‘row’ the economy through ‘command and control measures’, but simply ‘steer’ it through a series of predominantly supply-side market-based instruments (Hajer, 1995). This ideological prescription has the capacity to provide a deeper understanding of how regime actors mediate between the niche and landscape levels, albeit itself requires a degree of clarification. I hereafter turn to the various strands of Ecological Modernisation in the literature to clarify the precise application of the state used in this research addressing (i) the weak and strong variants of Ecological Modernisation alongside (ii) the techno-corporatist and Reflexive modernisation strands of the literature.

#### 3.3.1 Policies of Ecological Modernisation: Weak or Strong?

The first debate on Ecological Modernisation I seek to clarify is which variant of the approach I am using for this analysis. Rather than simply a descriptive typology, the form of Ecological Modernisation subsequently has implications for the role of the state in the economy and the stringency of its policy. This debate has roots in Christoff’s (1996) distinction between two forms of Ecological Modernisation, namely ‘weak’ or ‘strong’. Here Weak Ecological Modernisation refers to a technocratic national project focused on technological substitution through familiar economic means (Christoff, 1996). By contrast, Strong Ecological Modernisation is a democratic, international version premised upon ecological objectives, broadening in scope to implementing wide ranging changes to society’s institutional structure (Dryzek et al., 2009). See Figure 5 for a full list.

**Figure 5: Ecological Modernisation as categorised by Christoff (1996)**

|  |  |
| --- | --- |
| **Weak EM** | **Strong EM** |
| Economistic  Technological  Instrumental  Technocratic/neo-corporatist  National  Unitary | Ecological  Institutional/systemic  Communicative  Deliberative democratic/open  International  Diversifying |

Source: Christoff (1996)

One could be forgiven for thinking that weak and strong EM represent dichotomous positions on environmental policy. Christoff’s framework, however, speaks to a spectrum of Ecological Modernisation rather than a rigid polarisation. States might then be weak or strong but also incorporate elements of both strands. Subsequent developments of Christoff’s framework have attempted to emphasise that weak or strong should not be seen as synonymous of ‘good’ and ‘bad’ policy, as both variants are intended to deliver environmental improvements, rather than absolute sustainability (Mol, 2000). Likewise, neither weak nor strong strands guarantee environmental outcomes (Toke, 2011).  It is also important to note that Christoff himself did not advocate one of the variants but stated that environmental politics, as may be observed empirically, is ultimately characterised by weak Ecological Modernisation (Toke, 2011; Christoff, 1996).

It is the weak variant of Ecological Modernisation that is also attributed to the initial success of ‘environmental policy integration’ into the economy from the 1980s (Jänicke, 2008). Despite weak EM being clearly reflected in environmental policy making, there nonetheless remains advocates of the stronger variant in the literature, as ideological debates persist between normative ideals and their intended outcomes (Spaargaren et al., 2009). To bridge this divide, some theorists have sought to find a ‘middle ground’ within the literature. Yet, as valiant as that endeavour may be, scholars still accuse others of inevitably leaning towards ‘weak’ forms of EM (Meadowcroft, 2006) or ‘strong’ forms (Jänicke, 2008; Dryzek, 2003).

The initial distinction between weak and strong has undergone review and (re)categorisation since Christoff’s foundational work. Howes et als (2010) subsequent development of the weak and strong dichotomy again asserts the hegemonic influence of ‘weak’ Ecological Modernisation (see Figure 6). Howes et als intervention is also echoed by other scholars in the literature who likewise emphasise, the influence of the weak variant on the analytical framing of Ecological Modernisation (Duru and Therond, 2015; Dryzek et al., 2009). Such is the prevalence of weak Ecological Modernisation, that the empirical examination of the state in the EV transition I undertake in the following chapters must accordingly acknowledge these normative perceptions, for they shape its analytical function in both case studies.

**Figure 6: Ecological Modernisation as categorised by Howes et al., (2010)**

|  |  |  |
| --- | --- | --- |
|  | **Weak EM** | **Strong EM** |
| View of the environment  Role of the state  Policy Approach  Decision-making style  Scale of focus  EM strategy | Economist and utilitarian  Market facilitation, minimal state intervention  Instrumental  Technocratic/closed decision-making by economic and political elites  National Focus  Hegemonic | Ecological  Sustainable state intervention, institutional restructuring  Communicative  Deliberative democratic/open    International  Diversifying |

Source: Howes et al., (2010)

Howes et als categorisation further helps to develop a more analytically robust account of the state that further refines the regime level (see 3.2.2). A review of the literature would then indicate that the most accurate view of the state, and its policy toolkit, is to view it through a weak Ecological Modernisation lens. An initial policy toolkit may accordingly be thought to include metrics for Green GDP, environmental auditing, environmental productivity metrics, and other market-based instruments for supply and demand side measures (Mol and Spaargaren, 2000b). When viewed through an Ecological Modernisation lens, the state’s capacity to intervene in sustainable transitions is often viewed as relatively weak, deferring instead to market-based solutions to environmental, or in the context of this research, landscape problems.

#### 3.3.3 Modernisation: Reflexive or techno-corporatist?

The second prominent debate in the Ecological Modernisation literature centres around what type of ‘modernisation’ is being referred to. Previously great emphasis has been placed on the value of science, technology, industry, capitalism, and a more modern form of governance, to achieve what has been referred to as ‘simple modernisation’ (Langhelle, 2000). Alternatively, the scale of Ecological Modernisation is thought to be far more extensive, in that while science and technology offer great benefits in resolving the tensions in economic-environmental relations, truly remedying this tension requires a process of ‘superindustrialisation’ (Hajer, 1995). As was prominent in the weak variant of Ecological Modernisation, neither simple nor super modernisation are necessarily oriented around the ‘greening of capitalism’ per se, but rather of the greening of capitalist industrialisation (ibid).

Much like the debates around weak and strong Ecological Modernisation, this notion of modernisation has manifested into two distinct variants. This dividing line has been drawn by Hajer (1995) who proposed that Ecological Modernisation can be apportioned into: *Techno-corporatist Ecological Modernisation* — in large part an administrative affair in which technology is employed to diffuse the areas of tension between the economy and the environment. Second is *Reflexive Ecological Modernisation —* which entails a more fundamental revaluation of social practices and institutional arrangement. Whereas the Techno-Corporatist strand exhibits faith in technology to ultimately solve environmental ills, Reflexive Ecological Modernisation emphasises the actions of individuals in the political arena.

As noted, Christoff’s conclusion of weak EM was that it frequently aligned with the ‘techno-corporatist’ approach, sharing common philosophical principles (see above). Both approaches place great faith in the ‘economisation of nature’ through the emergence and diffusion of technology and the technocratic governance style made up of elite actors (Berger et al., 2010). Scholars have previously likened the state’s capacity to design and implement environmental policy under this approach to a form of ‘collective environmental management’ (Barry, 1999). Consequently, Techno-corporatist modernisation, like weak EM, is thought to have become *the* established iteration, having been employed to examine the pollution control measures in Germany and the Netherlands since the 1980s.

Again, much like weak EM, the EV transition undoubtedly sits comfortably within the techno-corporatist framing. A techno-corporatist perspective also affords this research a level of analytical precision largely absent from Reflexive Modernisation (Sonnenfeld and Mol, 2006; Mol and Spaargaren, 2000a). This framing is useful for this analysis due not least to the fact that, as I outlined in Chapter 1, the very nature of the EV transition is one of a technological fix to transport emissions. It also draws clear parallels with the niche from the STT literature. So too does the corporatist element of the approach speak to the Core Alliance or state-business relations in the EV transition, positioning the state as an administrative entity alongside business, as opposed to an interventionist one.

### 3.4 Weak Techno-Corporatism: The state-business regime

By reviewing the various conceptual strands of Ecological Modernisation, I have established that the literature would assume that most states can be defined as exemplifying characteristics associated with weak, techno-corporatist Ecological Modernisation. Such a portrayal may be understood as the most analytically precise account of the state as observed by environmental scholars since the 1980s, as opposed to a solely normative or conceptual application (Dryzek et al., 2009; Christoff, 1996). But a weak, techno-corporatist framing is also in keeping with the neoclassical assumptions of the Socio-Technical Transition approach, which have tended to overlook the role of the state in the EV transitions thus far. This understanding of the state will then be empirically tested in the following chapters, examining the weakness, and indeed strength, of the state. Because of the critical presupposition of this research, I identified in Chapter 2, this understanding of the state will be empirically tested in the examination of the barriers to the EV transition.

Despite the assertation of Ecological Modernisation scholars that the state is ultimately a weak institution, the following analysis must remain sensitive to the empirical context within which this research is undertaken. That is to say that while the state is a nominally weak institution, it is nonetheless an institution that retains the capacity to achieve unparalleled change (Meadowcroft, 2011). Indeed, the 2008 Financial Crisis led many scholars to revisit the role of the state in the economy, perceived to be the arbiter of ‘green new deals’, ‘green stimulants’ and designer of a ‘green economy’ (Tienharra, 2013). Given that this research is undertaken amid the profound economic crisis in the form of the COVID-19 pandemic, it is therefore important to leave this conceptualisation of the state open to change.

### 3.5 A synergistic framework: Framing the EV transition

Having established the key conceptual contributions of the Socio-Technical Transitions approach and Ecological Modernisation to this research, I hereby propose a novel framework that utilises the strengths of both literature to form a synergistic theoretical framework. By combining these theoretical approaches, I have addressed the gap identified in Chapter 2 as to the absence of a satisfactory understanding of how the automobile paradigm may transition from its carbon-intensive form to a decarbonised state, whilst also providing a robust analytical account of the state in the transition. The framework I propose here is designed to address the gap in the political economy literature by establishing a sequential transitionary process and identifying the actors located within it. In the following chapters, I utilise this framework by examining the EV transition in the UK and Germany, identify the barriers to decarbonising the automobile sector, whilst also investigating how such barriers may be overcome.

As noted above, the Socio-Technical Literature has long since attempted to propose transition pathways to account for the different processes that unfold across case studies. To begin to apply this framework empirically, I advanced an initial set of pathways, building upon the work of Meckling and Nahm’s (2018) heuristic outlined above in Section 3.2.4 as a means to categorise the EV transition in the UK and Germany (see above). To reiterate, Meckling and Nahm’s initial framing outlined two potential pathways: (i) *political coordination* – whereby government and industry strike an accord that prioritises the interest of incumbent actors and technology, and (ii) *political competition* – in which policy makers form coalitions around technologies to challenge incumbents. The latter of these pathways was in reference to Germany, providing an initial category for the later chapters.

Before investigating these pathways, I propose a moderate expansion of Meckling and Nahm’s initial heuristic for the purposes of this analysis. The author's initial heuristic was proposed in relation to the USA and Germany, which both have significant automobile manufacturing capacity. This discounts the potential for countries to purposely develop an automobile sector, orientated around EVs, in light of the Paris Agreement. To address this shortfall, I propose that the heuristic would benefit from a third pathway category; (iii) *political cultivation* – a process of industrial development to capitalise on emergent technologies as policy makers seek to guide the market into areas of industrial development. As I show in Chapters 5 and 6, accounting for such a pathway is acutely important to examine the EV transition in China and importantly in the UK.

Notwithstanding these possibilities, it is important to first identify the pathway in question in both the UK and Germany. As noted by Meckling and Nahm, the pathway is determined by the distinct features of the country's accumulation strategy, the composition of state-business relations, and the size of the automobile industry. As I have previously stated, due to Meckling and Nahm’s initial work having already categorised the pathway in Germany as politically *coordinated,* I take lead from the authors on this subject. In the case of the UK, I have already argued that a political *cultivation* pathway is required for the purpose of analysing this case study. Determining the accuracy of both these categories is a subject of inquiry for this research, but they nonetheless serve as a useful conceptual basis from which to develop a robust methodology in the next chapter.

### 3.6 Conclusion and Research Questions

In this chapter, I have proposed the novel, synergistic framework designed to account for both the process by which sustainable transitions unfold and the key analytical subjects that shape them. In combining the Socio-Technical Transitions approach with Ecological Modernisation, this framework is not constrained by many of the conceptual shortcomings of either approach, but instead draws upon some of their key strengths to examine the EV transition. Importantly, this framework is also able to address the gap in the political economy literature, all the while utilising key disciplinary insights from political economy to reconceptualise the MLP. The theoretical framework I advance in this chapter accordingly acts as a lens through which to examine the EV transition in the UK and Germany.

The framework outlines a relatively sequential transitionary process from which barriers can be identified by virtue of them inhibiting this process. As stated here, the sequential process by which transitions unfold begins at the landscape level of the MLP, as pressures are exerted on regime actors, destabilising the Core Alliance of state-business actors. These same actors then search for niche solutions to these pressures, revealing how the political and economic nature of the transition brings the fossil fuel historical bloc into the debate. I have shown in this chapter how the CO2 emissions produced by the present automobile state-business actors outlined in Chapter 2, and the EV transition outlined in Chapter 1, serve as clear analytical objects within the MLP. The aim of the following chapters is therefore to determine what prevents the niches (EVs) being incorporated into the regime (state-business relations in the UK and Germany). I have shown here that while the state is of primary importance, its capacity, and limitations to mediate between landscape pressures and niche solutions, can be best understood once seen through a weak, techno-corporatist Ecological Modernisation framing.

From the synthesisation of these approaches, I identify three research questions that can be viewed through this framework as a guide to the empirical contributions of this research. To that end, the subsequent chapters of this thesis are motivated by answering the following research questions mentioned previously in this thesis (see Chapter 1). Once again, these research questions are:

*(i) What are the barriers to decarbonising the automobile sector?*

*(ii) How can those barriers be overcome?*

*(iii) Are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?*

The framework proposed here offers important theoretical leverage to address these questions. To take these questions in turn, the first research question is intended to empirically identify the barriers in both the UK and Germany and is the primary purpose of this research. This question is, essentially, motivated by the central puzzle of this thesis identified in Chapter 1, that being given EVs have been identified as the technological fix to meeting the Paris Agreement, why has EV growth remained so low? This question is posed to provide such an explanatory account. By outlining how transitions are brought to bear through an interaction of three levels, as per the MLP, the framework aids in answering this question by understanding barriers as the obstacles to the harmonisation of these levels.

The second question is a clear development on the first, attempting to identify, where possible, how these barriers may be overcome. The second question thus seeks to develop upon the first by moving this analysis simply beyond the identification of the barriers to the EV transition but affording greater attention to what, if any, actions are being taken to overcome these barriers. Asking how the barriers can be overcome also demands that this research ventures into empirical and analytical territory as yet uncovered. Because this research is conducted amidst the COVID-19 pandemic, through this question I can investigate whether the assumptions made in the literature examined in both this chapter and Chapter 2 still hold true.

The final question proposed here gets to the heart of the comparative case studies of this research, ultimately attempting to determine which, if any, of the UK and Germany has exhibited greater success in their EV transition. Answering this question is consequently contingent upon the answers to the previous two research questions, as the barriers identified in, and the ways in which they are overcome, serve as important indicators of the success, or lack thereof, in undertaking the transition. I will only be able to provide a tentative answer to this question, as it is unlikely the automobile sector will be decarbonised within the timeframe of this research. However, addressing these questions has important implications not only for the literature, but for also meeting the objectives of the Paris Agreement.

Determining the answers to these questions is, of course, not simply achievable through theoretical means alone. Instead, it requires a robust methodological approach in which to utilise the theoretical framework now in place. That being the case, I promptly turn in the following chapter to establish such an approach, outlining the design, implementation, and initial results of my methodology. In the following chapter, then, I outline my methodology and data gathering strategy for addressing these questions.

# Chapter Four

## Methodology

### 4.1 Introduction

In this chapter, I outline the methodological approach of this thesis to develop the theoretical framework established in the previous chapter. To empirically investigate the research questions identified in Chapter 3, I employ a predominantly qualitative analysis of the EV transition in the two case studies, informed by document analysis and semi-structured interview data with policy stakeholders, research organisations, and industrial actors. To outline my methodology, this chapter is structured as follows. I begin by outlining the critical realist epistemology which underpins this research as I conducted it using the hypothetico-deductive model to make for an efficient data collection process. I then outline how the case studies of the UK and Germany fit within a comparative case study method in advance of setting out the rationale for my methods, and how they were undertaken. I conclude by identifying the practical issues encountered during the data collection process and the adjustments made in the wake of the COVID-19 pandemic.

### 4.2 A Critical Realist Research Philosophy

My methodological approach to this research is based on a critical realist epistemology.  Critical realism was first proposed by Bhaskar (1975) to produce a scientific body of knowledge that is a branch of philosophy distinguishing between the 'real' world and the 'observable' one (Archer et al., 1998). By making this distinction, the approach seeks to move beyond the positivist or constructivist 'paradigm wars' of the 1980s by combining facets of both to produce a markedly different approach (Denzin and Lincoln, 2017; Onwegbuzie and Leech, 2005). What distinguishes this approach from the traditional dichotomy is that it asserts that a 'real world' exists independent of human perception (realist ontology) but that providing an account of the 'observable world' is the task of a robust methodological design (constructivist epistemology). To that end, critical realism seeks to uncover and capture the nature of causation, agency, structure, and the constitutive relations therein (Archer et al., 1998).

Combining a realist ontology with a constructivist epistemology allows empirical observations to proceed in three stages (Bhaskar, 1998). The first is at the empirical level, at which subjects experience the world through ongoing events. How these events are experienced relies upon the ideas, meaning and decisions that we construct. The second is the level at which events occur independently of observation (ibid). This level sits between the empirical and the theoretical and is otherwise referred to as 'the actual'. The last level is the one of structure and causation. This is the meta-theoretical level bearing on our account of the social world but does not necessarily determine how it is investigated (Price and Heila, 2015; Sayer, 2000).

As will become apparent in the following discussion, by not privileging a particular methodological approach over another, instead of seeing the merits in both qualitative and quantitative methods, critical realism is an accommodating epistemological approach. While it acknowledges that there are limits to the extent to which we may discover the world, it asserts that attempting discovery is a worthwhile endeavour. Aside from its epistemological assumptions, the point remains that utilising tools from both qualitative and quantitative methods allows for a robust research strategy. The influence of a critical realist approach was accordingly operationalised through a hypothetico-deductive and comparative case study approach.

### 4.3 Hypothetico-deductive Model

In Chapter 1, I posited that EVs were a technological fix to transport emissions identified by the state to achieve the objectives of the Paris Agreement. To probe this claim, I employed a hypothetico-deductive (HD) approach to this research to determine its accuracy. In contrast to inductive approaches, such as grounded theory, hypothetico-deductivism allows the researcher to test hypotheses rigorously through a scientific and empirical procedure that is otherwise impossible through induction (Mesly, 2015).

Far from being the subject of a theoretical straitjacket, the hypothetico-deductive model is a scientific practice designed to uncover new data (Blackburn, 2008). By virtue of this objective, this model possesses several practical advantages. Firstly, the method flows seamlessly from the scientific method, utilised by professionals in biology, physics and chemistry (Tariq, 2015). The hypothetico-deductive model aligns the basic inferences of scientific reasoning, argument, and discovery (Lawson, 2009). Not to be confused with a static methodological approach, the model follows a cyclical pattern of reasoning and observation to generate or test explanations of complex and puzzling phenomena (Lawson, 2015). A significant advantage of this method, then, is its reflexivity, allowing previous assumptions to be revisited to adjust one's analytical position.

Second, the hypothetico-deductive model is also rooted in the discipline of political economy[[27]](#footnote-27), having been employed by many of the discipline’s earliest proponents (Martini, 2017). More recently, it has been enlisted by scholars in the neoclassical economic tradition who seek to test the viability of growth models (Bresser-Pereira, 2009). Despite HD's popularity amongst many disciplines, detractors have criticised it for a propensity to focus on future events, often in contrast to the historical-deductive approach which takes a more retrospective perspective (Cristiano, 2009). Of course, Historical-Deductivist accounts can provide invaluable insights, but such an approach is inevitably limited when faced with ongoing and upcoming phenomena.

Thirdly, the model's deductive element does not predetermine a methodological design to test hypotheses but complements the multi-method approach employed in this research. The experimental stage of the HD model affords the research a significant degree of flexibility in design and then redesign where necessary, allowing the researcher's methodological approach to account for new, perhaps unforeseen, information (Lewis-Beck & Liao, 2004). The HD model's usability is that Lawson (2015) stated that it has two general developmentally based levels of thesis testing, capable of testing both observable and unobservable phenomena. While the latter is sometimes viewed as an accessory to the primary objective, the capacity to do so is central to Critical Realism.

Finally, the HD model was employed for the same purpose as designing the synergistic framework outlined in Chapter 3, insofar as they emphasise making a novel contribution to the field of political science. Indeed, advocates of the HD model attest to its epistemological success in finding data rather than affixing ad hoc theory to the data (Sprenger, 2011; Hitchcock and Sober, 2004). Therefore, the HD model was an appropriate accompaniment to my approach, since as the name suggests, the hypothetico-deductive model is deployed in two parts (Nola, 2014). Once my theoretical approach produced three testable research questions, the deductive methodology was deployed to test them. The third and most important element of the model is to unveil the research findings.

Ultimately, the key advantage of the hypothetico-deductive model for this research is that, like critical realism, it follows a phased approach to the methodological investigation (Taleb, 2007; Bynum & Porter, 2005; Calaprice, 2005). The application of the model typically proceeds as follows:

1. Observe - make empirical observations to consider a potential problem
2. Form hypotheses
3. Predict – design a methodology to test
4. Test - conduct the 'experiment' to affirm or falsify a hypothesis
5. Evaluate - Report result

The precise stages of this process have been subject to some revisions by scholars adding or reinterpreting certain elements, but the core principles remain ever-present, as many scholars consider a robust methodological approach as one that requires a staged approach (Lawson, 2009). True, then, to the sequential HD model, the observation stage was outlined in Chapter 1 as being the slow adoption of EVs in the UK and Germany following the Paris Agreement, as was the hypothesis stage noted above. I accordingly turn in the following section to the prediction stage, in which I establish the methodological design of this research before outlining the test and evaluation stage in the subsequent chapters.

### 4.4 Comparative Case study method

As discussed in Chapters 1, 2 and 3, the state is the primary unit of analysis in this research, as it is they who have determined EVs are the solution to transport emissions. In Chapter 3, I clarified that the policies pertaining to the development of EVs need also to take account of state-business actors, with each influencing policies in line with their political and economic interests. According to the hypothetico-deductive model, a comparative case study method was employed across two case studies to test whether it was indeed the state who were key to the EV transition (Bartlett and Vavrus, 2017; Goodrick, 2014).

Case studies have been defined as a research strategy that allows an empirical investigation of real-world phenomena (Geddes, 2003). Nation-states serve as a useful unit of analysis, as they confine observable phenomena to specific geography (Clark, 2010). By choosing the UK and Germany, the research is characterised as a 'most similar systems' rather than a 'most different system' comparison (Gerring, 2005) as the UK and Germany share more discernible dependent variables. For example, both are developed capitalist economies, environmental leaders in the EU[[28]](#footnote-28), members of the G7 and, most importantly, have committed to net zero emissions by 2050. But, at least in the context of this research, they differ in their capacity to manufacture automobiles, making for unique national contexts. Accounting for these dependent variables was, however, factored into the theoretical framework (see Chapter 3). As noted by Burns (1997), case studies are best utilised when applied to a 'bounded system' or entity to discover idiosyncratic complexity instead of generalised findings.

The central government's transport departments were the primary subject, particularly the Department for Transport (DfT/UK), Federal Ministry for Transport and Digital Infrastructure (BMVI/GER), and any additional sub-departments. Given that the UK and Germany have markedly different automobile sectors, there is a significant difference observable in their respective state-business relations in both composition and scale. Because its automobile sector is more developed, the German case offered more in subject matter than the UK. Beyond this relatively narrow sample, any countervailing perspectives on the issue of automobile decarbonisation were accounted for by drawing on insights from advisory or lobbyist groups, those in the emergent sectors, such as charging infrastructure, and academia, so as to provide alternative accounts to government departments.

When conducting comparative research, it is often assumed that comparisons contain some level of 'commensurable' or arbitrary equivalence (Pickvance, 2001). As noted above, the UK and Germany share an objective equivalent in developed capitalist economies that have assumed environmental leadership roles. Typical comparative case studies have followed the HD data collection model to both large and small case studies (Caramani, 2011). A frequently referenced strength of the comparative study is its ability to isolate independent variables. Once the dependent variables (automobile decarbonisation through EV growth) were established, the independent variables could be identified (government policy, political-economic composition), tested and evaluated against each case (Landman, 2008). Isolating these variables is essential in identifying key differences or similarities across the sample (Guy, 2011). The task was made easier by refining the sample of this research to simply focusing on two cases.

Such is the utility of analysing multiple countries at once that it has been referred to as the closest replication of the experimental method used in the natural sciences available to the social sciences (Lim, 2010). Moreover, it is claimed that by avoiding the selection biases that run through single-study cases, the risk of invalidity is reduced by not solely relying on one case to validate the research questions (Stafford, 2013). Comparisons between multinational factors are therefore thought to increase plausibility and transferability beyond a single case (Keman, 2011). Case studies also allow for a flexible and open-ended data collection process, allowing the researcher to utilise a multi-method approach made more manageable by adhering to the phases of the hypothetico-deductive model, in keeping with Critical Realist philosophy (Guy, 2011; 1988).

The comparative study provided a platform for fruitful and critical discussion and allowed me to dive deeper into the intricate details, along with a broader sample than could be otherwise undertaken in a single case study (Krehl and Weck, 2019). Refining the scope of comparative research to smaller cases has proved increasingly popular in political science as it is easier to make a novel inference once the unit of analysis is limited to a manageable 'empirical universe' (Goodin, 2011). By establishing a demarcation point at different transitionary pathways (see Chapter 3), this analysis proposed a 'case-orientated approach' in which the UK and Germany's historical conditions produce different outcomes (Ragin and Becker, 1992).

As is common with all methodological approaches however, inevitable limitations must be acknowledged and mitigated where possible. Perhaps the most rudimentary of the critiques levelled at the case study method is that practitioners are not forthright in their methodological rationale, suggesting that the method is not sufficiently stringent (Ragin and Becker, 1992). Criticism of case study models argue that it lacks control, and is arbitrary and atheoretical (Kaarbo and Beasley, 2002). These critiques of the comparative method appear outdated or unjust, given that the method continues to prove a common feature of political science that makes for a rigorous methodological aptitude. Contrary to arbitrary criticism, I outlined that this research is due to events following the Paris Agreement in 2015.

Comparative case study methods have also been criticised for a tendency to match estimators and assumptions based on prior choices, making the result a quasi-experimental procedure (Campell, 1988; Rubin, 1974). Two points can be made in response to this charge: the critique was made against large heterogeneous case studies claiming to find homogeneity. Since such time, comparative research has tended to make explicit its focus on smaller case samples concerned with difference (Large N) or similarities (Small N) from the outset (Goodin, 2011). Second, all research contains an element of arbitrary predetermination. No research, or indeed researcher, is free of some element of bias, preference, or subjectivity, which inevitably occurs at the preliminary stage of research, known as the 'pre-analytical phase' (Lippi et al., 2019; Raworth, 2017).

### 4.5 Data Collection

Before undertaking the data collection stage of this research, the undertaking of this methodological approach was subject to an approved ethics application and confirmation review at the University of Sheffield Politics and International Relations department. The data collection stage of this research took place over nine months between March and December 2020. Several adjustments had to be made due to the outbreak of COVID-19, as both the UK and Germany went into lockdown in March 2020.

Three methods were used as part of the data collection: document analysis, semi-structured interviews, and data analysis. The three methods were combined to provide a diverse data set representing a broad range of information. Each method was chosen on the merit of its potential to contribute to the research. The advantages and weaknesses of each method will be discussed below, along with the measures used to corroborate information. The process of overcoming each method's weaknesses is often referred to as triangulation, specifically methodological triangulation (Denzin, 2006). In essence, triangulation 'gives a more detailed and balanced picture of the situation' (Altrichter et al., 2008, p. 147), compensating for any one method’s shortcomings (see 4.6).

In collecting the data, it is worth noting here that almost all respondents showed little, if any knowledge, of the power of automobile manufacturers, or the political and economic function automobiles serve in the global economy. However, the questions were not designed to discuss the automobile paradigm specifically, nor were interviewees requested to familiarise themselves with the term. Nonetheless, the structural power of automobile incumbents was widely acknowledged, whether conscious of literature or otherwise. Those interviewed in government departments (see 4.5.3) did not always consider the tension between environmental and economic policy as stated in the literature (see Chapter 2).

Nothing in the data collection stage caused a re-evaluation of the design of this research, however. Rather, the data, by and large, confirmed and reflected a consistent theme in this research, insofar as the state was not only the key actor in the EV transition, but that it, in many instances, would be required to further intervene in the economy. I outline the findings of this research further in the following chapters. As the fieldwork was undertaken, it became clear that this research design was appropriate for testing the state’s role in the EV transition (Lawson, 2009; Jaksic, 1981). As confirmation holism*[[29]](#footnote-29)* dictates, in outlining the methods of this research, I cannot claim that the research findings are definitive or unfalsifiable (Votsis, 2014), but that the methodological approach employed for this thesis had practical benefits.

#### 4.5.1 Adjustments made for COVID-19

My initial plan to spend a period of six weeks between the University of Heidelberg and Technical University Munich (TUM) was prevented by COVID-19. To address the restrictions in travel I moved my planned face-to-face interviews online and conducted them via several video conferencing apps, including Google Meets, Skype and Zoom. Aside from not conducting the interviews in person, the adjustments made for COVID presented little in the way of problems in undertaking this fieldwork, though they may have lacked the personal element often attributed to interviews. However, what the interviews lacked in in-person interaction, they gained in the availability of interviewees, as many noted that they had greater availability due to having no travel commitments.

#### 4.5.2 Document analysis

The main documents analysed were policy/strategic documents (mainly those from the UK DfT and Department for Business, Energy, and Industrial Strategy and the BMVI in Germany), as well as annual corporate documents from automobile manufacturers, including Volkswagen, BMW, Daimler, and Tesla. The benefit of primary documents was that they were produced by key actors for automobile decarbonisation and the political, economic, and technological context within which they operate (Bowen, 2009). In providing these authoritative and original accounts of decarbonisation, the documents served a crucial function in allowing this research to provide novel insights for this thesis (Lowry, 2015).

All the analysed documents were publicly available. Whereas the UK government had a centralised archiving platform (https://www.gov.uk/), documents from the German government tended to be listed via specific departments (inc https://www.bmu.de/en/ and https://www.bmvi.de/EN/Home/home.html). The documents used for analysing the automobile manufacturers were annual reports published in line with their corporate and stakeholder guidelines. As is often referenced as an important benefit of document analysis, the review of primary documents subsequently uncovered less influential but important actors in the decarbonisation transition (Goldstein and Reiboldt, 2004). In the case of this research, the documents led to subsequent analysis of materials published by and interviews with representatives of the EV taskforce in the UK and the Nationale Plattform Elektromobilität (NPE) in Germany.

The documents provided specific details on the national context of the UK and German automobile decarbonisation process, largely absent from secondary accounts in the academic literature. Likewise, the documents comprehensively captured the relevant information, sometimes called 'social facts', such as government strategies or manufacturers’ annual reports (Atkinson and Coffey, 1997, pg. 47). The potential weakness is that the documents contain an insufficient level of detail into the shortcomings of government and corporate strategies. In other words, the documents are produced for somebody, by somebody, for a purpose other than the research (Bowen, 2009). The bulk of the documents analysed were those produced by actors who tended to adopt an uncritical, almost casual, approach to the prospect of automobile decarbonisation, with little acknowledgement of potential challenges. For this reason, the authenticity of the document has sometimes been called into question due to what is, but more importantly, what is not listed in them (Mason, 2002).

Given that I adopted a broadly critical approach to this research, these weaknesses were mitigated by treating the contents of documents critically and not relying on them to provide all relevant information but instead as a building block for later methods. Indeed, the documents provided a platform for the subsequent interviewees to engage with (see 4.5.3). The interviewees representing government departments tended to display a 'biased selectivity', adopting an uncritical stance, often referencing only their organisation's documents in their answers (Frey, 2018, Yin, 1994). When the same questions were asked of non-government representatives, the answers tended to be far more critical. Interestingly, interviewees from automobile manufactures were, unsurprisingly, positive about the EV transition, but did not display the same biased selectivity as government representatives.

Notwithstanding these practical issues, the document analysis avoided the 'low retrievability' problem, which sometimes limits the method (Yin, 1994). Because the documents were publicly available, government interviewees may have felt duty-bound to repeat what was listed in them. Notwithstanding, the document analysis provided an invaluable function in providing the foundations for an operational methodology. It allowed for a more robust interview process by establishing common ground between interviewer and interviewee (Connell, Lynch, and Waring, 2001) that allowed the research to answer research questions (Goldstein and Reiboldt, 2004).

#### 4.5.3 Semi-structured Interviews

Semi-structured interviews allowed me to blend closed and open-ended questions to clarify the *how* and *why* in relation to automobile decarbonisation (Adams, 2015). As semi-structured interviews have sometimes been otherwise referred to as 'elite interviews' (Dexter, 1970), it is important to note that the respondents who took part in this research were not simply the highest-paid or most senior members of their organisation, but included respondents from several backgrounds. Having a diverse but considered pool of interviewees helped the research reach a requisite level of empirical depth (Adams, 2015), yielding much of the thesis's primary data (Blaikie, 2000). As previously stated, interviews were conducted with government representatives and the automobile sector. This method was not limited to these groups, as further interviews were conducted with charging infrastructure providers, local authorities, think tanks, and more (see Appendix A for a list).

I approached potential interviewees through publicly available web addresses, LinkedIn and Twitter, based on their expertise in the EV transition or the UK and German environmental policy. As stated in Section 4.5.1, all the interviews were conducted online due to COVID-19. From the perspective of myself and the interviewee, this inadvertently proved broadly advantageous regarding their enhanced availability and removing the need to travel. Disadvantages were, however, also experienced in the form of occasionally poor audio quality, making the interviewee sometimes difficult to hear, a problem which became more acute during the transcribing process. Due to the relatively large sample, data saturation was reached at around 20-25 interviewees in both samples. Although there was a good variety of views expressed in the interviews, interviewees from sectors/professions tended to express homogeneous views with little deviation in responses amongst professions.

In total, I conducted 65 interviews (34 in the UK and 31 in Germany), compared to the original plan of conducting 60 interviews in total with a 50/50 split of 30 interviews in both the UK and Germany. Aside from representatives at the German government and Tesla, who responded to my inquiry by stating that their organisation's policy is not to participate in this kind of research, interviews were conducted with all other relevant and identified parties. Due to the German government and Tesla's reluctance to participate, interviewees from German universities were sought to compensate for government respondents. Tesla, on the other hand, were not vital to the research as their Giga Berlin factory is yet to be operational. Interviews were conducted with the key German manufacturers, including Volkswagen and Daimler. The interviews were supplemented by unrecorded and informal talks and attendance at conferences, including the 2020 EV Summit. Interviewees were contacted through either email or LinkedIn to establish their willingness to participate, and were asked a broadly similar base of questions with scope to respond to the answers given (see Appendix D for examples of questions). Nearly all participants were asked if they would rather recommend a colleague to participate in the process before conducting the interview.

Having previously worked in local government, I had a previous professional relationship with several of the interviewees. While this offered practical benefits in accessing useful interviewees in important organisations, there was also a potential for selection bias. In acknowledgement of this fact, two points should be made. Firstly, having worked alongside these individuals on projects previously, I was confident that their expertise would benefit this research, which proved to be the case. Second, given the resources available to local governments for EVs, these individuals were almost always the only people who worked on EVs at these organisations. Therefore, any perceived disadvantages of this selection bias were outweighed by the fact that without prior experience, many of the interviewees would have been inaccessible.

Responses from different groups of interviewees incidentally tended to express a different view on the EV transition; government officers, and those situated in public institutions tended to exhibit uncritical/technical perspectives, echoing much of the content of government documents. By contrast, charging infrastructure providers were slightly more critical, particularly on government interventions, but also tended to focus more on the technical details of EV as opposed to the political. Interviewees from academia or think tanks were, however, very critical of the prospect and details of the transition. Therefore, they provided a good analytical account of the decarbonisation of the automobile sector, but sometimes lacked technical detail from practitioners (e.g., policymakers and charging infrastructure staff). In reaching a point of data saturation amongst such a diverse sample, the interviews incidentally performed the required function of ascertaining key empirical and practical data from those familiar with the subject of study (Adams, 2015).

As it is often considered the 'gold standard’ of qualitative research (Barbour, 2003), the interviews undoubtedly yielded original data for this research. The key strength of interviews was that it helped to uncover information absent from the documents, enhancing the originality and substantiality of this thesis (Exley and Letherby, 2001). Nevertheless, potential limitations inevitably lie in the form of having asked the right questions to tease out the required information, which can be an art form as much as a science (Barbour, 2003). After reaching a point of data saturation, I assumed the questions asked were the right ones. Indeed, when relying upon a two-way exchange, it is incumbent on the researcher to capitalise on new or unforeseen information while also pursuing predetermined lines of inquiry (Turner, 2010). Although the two-way exchange was slightly more problematic through the online setting, the interviewees rarely put strict time limits on the interviews, allowing more than enough time to clarify any points.

Exchanging views aside, there is also the potential limitation that the participating interviewee may simply be the *obtainable* participant rather than the *required* one. Fortunately, the research avoided many of these limitations, often interviewing the director, team leader, or senior organisation member. Experiencing some degree of these limitations outlined above is, however, almost unavoidable. Mitigating against this problem is, of course, possible and is the responsibility of any diligent researcher. Several steps were taken to mitigate these problems in this research. Firstly, all interviews were anonymised. By anonymising the response, interviewees were able to respond as if they were 'off the record' (Dexter, 1970), helping 'give voice' to their authentic and personal insights (Harding, 2006). Secondly, given the volume of interviews over a relatively lengthy period, interviewing was ultimately an iterative process, allowing questions to be returned to 'steeping' myself in the data and cross-verifying key answers (Galletta, 2013).

Given that the interviews took place during an unprecedented time, COVID-19 allowed interviewees to shape their answers about ongoing events, including the proposed green/COVID recovery packages. These insights are incorporated into subsequent chapters (see chapters 6 & 7). Overall, the interviews proved an indispensable aspect of the research, influencing and forming much of chapters 5 to 7. Building upon the document analysis, the interviews performed the required function and yielded the data's high quality and most trustworthy elements (Kitto et al., 2008). They allowed the interviewees to express complex, diverse and often emotional responses to the subject of automobile decarbonisation, which undoubtedly enriched the data (Galleta, 2013; Dexter, 1970). More than any other method used in this thesis, the interviews provided this research with its most original, novel, and useful contribution to the subject of the EV transition.

#### 4.5.4 Data Analysis

For the analysis of the document and interview data, Nvivo was used as the main software tool. Nvivo offers a convenient coding process which allows for the data to be allocated within a code or ‘node hierarchy’[[30]](#footnote-30) (Godau, 2004). This hierarchy serves for a descriptive coding method which allows the data to be analysed in novel and unique ways, including the easy identification of themes, time-saving data classifications and diverse presentation tools (Hoover and Koerber, 2011; Welsh, 2002).  For the purposes of qualitative data, Nvivo has become a key software tool (Bazeley and Jackson, 2013). The practical undertaking of this research analysed the documents first, allocating the data within a pre-designed coding framework while making additional codes based on the data.

Coding proceeded in two stages for several practical reasons. Primarily, the rationale for this approach was motivated by the accessibility of the documents, being readily available online. Given that the authors of the documents were mostly governments and industrial actors, an advantage of the content of the documents was that they provided instructive, or even the ‘official’ accounts of automobile decarbonisation, that served to contextualise the responses of interviewees who were themselves able to engage with this material (Bowen, 2009; Denzin, 1970). As noted in Section 4.5.2, this may also be perceived to be somewhat problematic given that these same actors are likely to take an uncritical position. After beginning the coding process, additional, country specific nodes were added to avoid generalised data. In many instances, data were allocated to several codes.

Having made the coding scheme more efficient, the documents provided a coding framework within which to allocate semi-structured interview data. Accordingly, the data analysis of interview data proceeded along the following procedure. Firstly, the audio files created from the semi-structured interviews recordings were transcribed on Microsoft Word. Key quotes and information were identified in the initial transcription in Nvivo and Microsoft OneNote. Second, the documents were uploaded to Nvivo and coded in line with the coding scheme noted above, mobilising raw data within the organised and thematic analysis (Fereday and Muir-Cochrane, 2006). Finally, the themes and data were organised to ‘tell’ the findings of the data throughout this thesis (Bazeley and Jackson, 2013; Atkinson and Coffey, 2004). The following chapters duly mobilise the data organised in Nvivo to organise findings from both the UK and Germany and make navigating the data easier for subsequent chapters.

Aside from primary qualitative data gathered during this process, the thesis also draws upon secondary quantitative data. Secondary sources therein included publicly available information on car registration data provided by the Driver and Vehicle Licensing Agency (DVLA) in the UK [Driver and Vehicle Licensing Agency - GOV.UK (www.gov.uk)](https://www.gov.uk/government/organisations/driver-and-vehicle-licensing-agency) and the Kraftfahrt-Bundesamt in Germany [Kraftfahrt-Bundesamt - English (kba.de)](https://www.kba.de/EN/Home/home_node.html). Analyses of these data sets are provided by the Society of Motor Manufacturers & Traders (SMMT) in the UK and Verband der Automobilindustrie (VDA) in Germany. While both provide sound secondary accounts of vehicle registrations, the data were used to make a quantitative contribution to the research.

Given this thesis's subject – the barriers to decarbonising the automobile sector – there is the potential to statistically measure the extent to which decarbonisation is taking place. Having decarbonisation as the dependent variable, measuring this phenomenon may be conducted by (a) examining the % increase in EVs in the UK and Germany and/or (b) investigating the % decrease in emissions from the automobile sector. These measurable indices can be judged against the UK and German political economies acting as the independent variables in this thesis. Considering the nature of this research, however, it is important to note that quantitative data on the EV transition in this thesis has its limitations. Not least since EV sales and automobile emissions have stayed relatively constant over the last few years. But more importantly, considerable uplifts in these data sets lie beyond the timeframe of this research as the UK and Germany get closer to their 2030 and 2050 environmental targets.

### 4.6 Research issues

Some of the issues experienced during this research gathering have been touched upon during this chapter. The most significant issue I experienced while undertaking this research was one of finding willing participants for an interview. The respondents who ultimately proved unwilling to participate in the research were the German government and Tesla. After the initial contact, the German government, specifically the BMVI, stated that it was their policy not to participate in research of this kind. Contacting individual members of the BMVI through the usual channels (see 4.5.3) also proved difficult, as another policy of the BMVI is that all staff have premium/secured LinkedIn accounts[[31]](#footnote-31). Likewise, after initial contact, Tesla representatives also stated their company policy was not to participate in the research. To address these gaps, as noted, the research utilised the documents published by the BMVI and Tesla, as well as drawing on the insights from organisations with ties to both parties, such as the VDA, think tanks and German academics, to compensate for their absence.

A second issue, although a relatively minor one, was that interviews were limited exclusively to digital conferencing software, such as Google Meets, Skype, Zoom and Microsoft Teams, due to COVID-19. In the main, however, the circumstances were likely advantageous for the research as participants had greater availability and could take part from a convenient location. What occasionally proved problematic was that the video conferencing software would sometimes become intermittent regarding the sound quality, obscuring the participants' response, or missing it entirely. A subsequent issue arose when transcribing the interviews, as the audio quality was not as clear as it might be had it been conducted in person. For the most part, this issue, fortunately, like the other issues outlined here, did not prevent the research from developing. Conducting the interviews online was, by and large, advantageous insofar as it avoided travel restrictions and increased the availability of interviewees.

A final issue worth noting is the representation of women and ethnic minorities. Women were poorly represented in local government transport departments and charging infrastructure organisations. Research organisations and government departments, by contrast, were far better in this regard. When it came to women's representation, it transpired that woman were better represented in German organisations than they were in the UK. Nonetheless, of the 65 participants, only 17 (24%) were women. While it is difficult to be certain of the participants' ethnicity without their prior notice, the participation of minorities was also low. This narrowed the potential insights into decarbonising the automobile sector to a predominantly white, middle-aged male demographic, providing a potentially privileged view of the topic that reflected the structure of those industries.

### 4.7 Conclusion

In this chapter, I have outlined and justified the methodological design of this thesis, comprised of a qualitative, comparative analysis designed to develop upon my theoretical approach through a deductive methodology. This methodology was designed to gather empirical data from those analytical subjects identified in the theoretical framework providing a robust and thorough analysis of the barriers to decarbonising the automobile sector. Given that the subject of this research is presently unfolding, this methodology was designed to capture the insights from the actors presently shaping the EV transition through the document analysis. The subsequent interviews provided scope for policy experts to engage with this material, whilst advancing first-hand empirical accounts of the transition. In the interviews, many of the primary insights of this research were made.

Having established the research questions in the preceding chapter, this methodology proved appropriate to examine the hitherto under researched elements of the EV transition in the UK and Germany. While the UK and Germany had established the comparative case study for this research, the methodology proved well suited to establishing the common and competing elements present in both contexts. The methodology employed here proved appropriate to test the extent to which the state has developed EV markets as a technological fix to transport emissions.

I ultimately took a significant degree of confidence from the fact that this methodology neither required significant revision, nor left significant gaps in the data that needed to be addressed after the initial fieldwork was undertaken. In summary then, this methodology served its purpose in establishing a robust data set able to navigate the research questions identified in Chapter 3. I hereafter mobilise these data in the following chapters to establish a comprehensive understanding of the role of the state in facilitating sustainable transitions, how these dynamics differ in the UK and German context, and the necessary conditions for an EV transition. The following chapters consequently serve as the empirical chapters of this research and primary contributions of this thesis.

# Chapter Five

## Driving, not steering: The role of the state in decarbonising the automobile sector

“*If you want to use metaphors if you could imagine a traditional vehicle that's stalled. And then, you need two or three people to give it a good push so you can start it in second gear. Well, that's what governments need to be doing. You need to give the EV industry a big, hard push and push it now”* (G27)

“*My feeling is that if we just carry on with a market system of purchasing the way that we are and hoping that people will somehow voluntarily pick up on EVs, then I don't think that that will work”* (U21)

#### 5.1 Introduction

Electric vehicles, as demonstrated earlier in this thesis, are not an innovative technology that has emerged because of the free market. Rather, EVs have ascended the policy agenda because nation-states have identified them as a technological fix to CO2 emissions emanating from the transport sector (see Chapter 1). Yet, while the Paris Agreement has foregrounded the transition to EVs in policy making, what is often neglected in the EV debate is that the transition has also unfolded against the backdrop of almost ceaseless economic crises over the last decade, from the Financial Crises to the Eurozone crisis and most recently COVID-19. It is therefore within the context of meeting the objectives of the Paris Agreement whilst negotiating these adverse economic conditions that I undertook my methodological approach outlined in Chapter 4. As I show in the following, the data indicated that the economic crises have brought a renewed focus on whether the existing political and economic conditions that preceded them were appropriate for the EV transition.

In this chapter, I identify some of the most common barriers to the EV transition that emerged from my empirical data. The barriers identified in the following analysis are not made with sole reference to the case studies of this thesis but outline a common set of barriers that have implications for the UK and Germany in subsequent chapters. Incidentally, some of the wider barriers in the data included a lack of imagination (U5), lack of information (U25; G24), towards the more common barriers of range anxiety (U24; G16), deviation from the norm, i.e., that of ICE vehicles (U26), lack of infrastructure (U17; G19), and affordability (U31). Many of these barriers speak to the more technical aspects of the EV transition but lacked an explanatory account of the political and economic factors.

Of the barriers that emerged from the data I focus on three that were highlighted as fundamentally problematic by interviewees. First, I find an ideological barrier, reflecting the presumptions of neoliberalism, emerged in both the way some interviewees framed the transition as a form of ‘common sense’ and others who indicated that such a framing was itself the barrier. Second, interviewees noted that the fiscal austerity implemented by many states after the Financial Crisis acted as a barrier to facilitating the EV transition. Some interviewees highlighted the alternatives, approaches adopted in Norway and China that contrasted with the UK and Germany to show how different fiscal approaches have led to higher EV uptake. The final barrier identified was that of administrative fragmentation, as central governments have passed the emphasis on to local state institutions with little support. Again, interviewees contrasted this approach with outlying examples of Stuttgart in Germany and Nottingham in the UK, to show how alternative approaches can yield higher EV uptake.

By virtue of many of the interviewees arguing for a departure from the market-led approach to the EV transition to one in which the state plays an even greater role, I revisit the common presupposition of the Ecological Modernisation literature (see Chapter 3) that states should 'steer, not row' low carbon transitions (Eckersley, 2020; Carter, 2007). Based upon my empirical data, I suggest in this chapter that the state should not merely steer the transition but *drive* it. In the following, I provide the first answer to two of the questions raised in Chapter 3, beginning with ‘*what are the barriers to decarbonising the automobile sector?* I thereafter also provide the first such answer to the question of “*how can those barriers be overcome?’* The barriers identified in this chapter, and how they are subsequently overcome, traverse both the UK and Germany. I, therefore, identify a set of common barriers upon which I develop in the unique context of the UK and Germany in Chapters 6 and 7, respectively. The common barriers to have emerged from the data are thus as follows.

### 5.2 The Ideological Barrier

The first barrier found in the empirical data was the way in which EV policy has been designed according to a neoliberal framing of a low carbon transition. This barrier was not only identified by certain interviewees as a barrier (U4; U17; U24; G1; G20) but was also evident in the ways other interviewees perceived the EV transition (U11; U17; G14; 20). It is widely accepted that neoliberalism has been the dominant ideology within many developed capitalist economies since the 1980s (Harvey, 2007). The utility of identifying ideology as a variable has previously been called into question (Maynard, 2017; McLellan, 1995; Rorty, 1989) due to it being an often 'slippery' and 'shifting' concept (Rodrik, 2017). Interviewees were not directly asked about neoliberalism, nor were they expected to engage with the term explicitly, but many responses in the interviews addressed the ideological framework that colours the political context in question (Fisher, 2009).

Neoliberalism has previously been defined as the marketisation and liberalisation of global trade (Beibricher, 2015), institutional reform (Kashawn et al., 2019), and an authoritarian form of governance (Bruff and Tansel, 2018). Whilst these definitions all present a diverse understanding of neoliberalism, they share a common understanding that it is a political project in some form (Harvey, 2016; Venugopal, 2015; Bockman, 2012). Neoliberalism's market-led approach is maintained by a global institutional architecture, which includes the World Trade Organisation (WTO), the Organisation for Economic Co-operation and Development (OECD), and the International Monetary Fund (IMF). The institutionalisation of these transnational actors as key influences in the global economy is also emblematic of a simultaneous delegitimisation of the state’s role in the economy, determining its influence to be an inhibitor to competitive markets (Maynard, 2017; Harvey, 2016).

Such diverse conceptual interpretations of neoliberalism have made it an agile and multi-faceted subject of analysis. For the purposes of this research, I understand neoliberalism to be emblematic of a political and economic system that constitutes the deregulation of the economy, privatisation of public industries and assets, controls on the money supply (or monetarism), and increasing integration of global trade through the liberalisation of trade barriers from the 1980s (Bloom, 2017; Springer et al., 2016; Goldstein, 2011; Campbell et al., 2005). With the state established as the key analytical subject of this thesis (see Chapter 2 and 3), I propose that a neoliberalist interpretation of the state is one that demands it runs a budgetary surplus (Springer et al., 2016) that allows for competitive markets to guide the economy (Boas and Gans-Morse, 2009).

The understanding of neoliberalism I advance here is reflected in two ways in the empirical data. The first was how some interviewees indicated that neoliberal prescriptions for the state ignored its fundamental importance in EV transitions, inhibiting the transition through an ideological aversion to state intervention. For example, one interviewee stated, "there needs to be intervention because the market is not regulating itself fast enough" (G22), echoing a broad scepticism of the market's ability to respond to landscape pressures. (U25, U26, G13). This was summarised by another interviewee who stated that they "cannot see in our market of private operators, that they are going to do anything without some quite severe government intervention" (U21). In a more explicit acknowledgement of the ideological implications of neoliberalism, an interviewee who works alongside MPs in the UK stated that "their [policymakers] ideological interpretation of the state is minimal " (U23).

The second element was that several interviewees tended to frame the EV transition in neoliberal terms. Neoliberal ideas were subsequently expressed in the critiques of banning ICE vehicles as ‘illiberal’ state intervention (U15; U28) and faith that manufacturers would simply respond to the demand of EVs once market signals dictated the need to do so (G2; G6). Some interviewees stated that states should simply 'hand the emphasis' of EV development over to the market (U31; G28). Even some interviewees who had argued for greater state intervention noted that it is only required to reach a certain, albeit undefined, development of the EV market (U29; U30; G8).

The findings of this research reflect the assumption within the literature that neoliberalism is used as an implicit, even unconscious, framing of policies. More precisely, neoliberalism has been perceived to be a 'common sense[[32]](#footnote-32)' understanding of policy (Hatzsavvidou, 2020; Hall, 1979). Some interviewees echoed some of the common neoliberal ideas found within the literature, such as the sophistication of private enterprise (U13: G18; Eagleton-Pierce, 2016), or that markets in their current form are the optimum allocators of resources (U3; G10; Mendoza, 2015; Chomsky, 2011). A minority of interviewees consequently not only contrasted with the interviewees who stated current policy proposals were themselves problematic, but instead saw these policies as common sense.

The ideological barrier evident in the interview data ultimately then divided interviewees on the notion that EV policy should be determined by the state or by individual decisions. The latter of these perspectives again speaks to the notion that neoliberalism ‘individualises’ economic problems, independent of structural factors (Harvey, 2007). This framing reflects the idea that consumers are self-governing agents who act independently of predetermined objectives of the state (Magnuson, 2018). Alternatively, one interviewee said, "I think at the individual level it is less important because I don't think it's at the individual level that change is really going to happen" (U21). The minority of interviewees who reflected neoliberal ideas were therefore contrasted by the majority, who argued for a break from such a framing of EV policy.

The document analysis also revealed more explicit examples of neoliberal ideology. Specifically, the documents were often framed with an emphasis on the market. For example, Germany defines itself as a 'market' economy (BMU, 2016, p.11). The UK likewise deemed it important to specify that it is 'pro-business' and a 'free market economy’ (H.M. GOV, 2017, p. 4) as states apparently deemed it imperative to highlight their adherence to the market. This reflects Hatzisavvidou’s (2020) notion that states are simply 'inventions' of the broader neoliberal institutional architecture, which permeates throughout the governing rationality of language and policy. Through their actions, states provide neoliberalism with a sense of coherence and cogency (Steadman Jones, 2012; Peck, 2010). A reluctance, then, to significantly intervene in the market is institutionalised within even the strongest states (Christoff, 1996).

The data, therefore, indicated that neoliberalism presents an ideological barrier to the EV transition, manifesting in the minds of policymakers as a 'common sense' interpretation of the low carbon transition. So much so that rather than question this common-sense view of the transition, considering EVs typically account for just 2-3% of the automobile market, some interviewees used it as a vindication of the approach (U13; U26; G6; G18). Therefore, whilst the immateriality of the ideological barrier has previously been called into question, it can nonetheless help to answer the research questions guiding this thesis. Furthermore, I show in Sections 5.3 and 5.4 how the ideological barrier is brought to bear in material ways.

### 5.2.1 Overcoming the Ideological barrier

Rather than an immutable ideological paradigm, neoliberalism has been the subject of contestation, particularly from Keynesian and Marxist scholars, and social movements and political parties for decades (O'Connor, 2010). Interviewees identified two ways in which the ideological barrier was being overcome. To overcome the barrier that the common perception of EV policy presented, interviewees highlighted two features of the current policy debate which undermine the framing of EV policy (i) rationalising further policy intervention in terms of air quality as opposed to climate change, and (ii) incoming EU emissions standards.

#### 5.2.2 Reframing EV policy as a solution to air quality

Contrary to the emphasis on CO2 emissions in the literature, interviewees stated that the most pressing driver for automobile decarbonisation was air quality[[33]](#footnote-33), with air quality historically traded-off with climate change (Vaughan, 2016; Kollewe, 2015). One interviewee argued that reframing EV policy in terms of air quality was a more expedient political narrative "because it is measurable and accountable, and you need to act upon that as sort of a proxy for climate change" (G3). Another interviewee currently working at the National Grid stated that couching EV policy in climate change rhetoric was a problem because "there is no feedback loop. They feel good that they are helping the planet, but there's no instant feedback loop" (U15).  They stated that while climate change is sometimes difficult to observe, air quality is "hyperlocal, you know when you walk past a dirty old diesel bus that you think oh, this is probably shortening my life. You can taste it, smell it, feel it" (U15). Several interviewees suggested then that air quality provides better grounds for rationalising intervention in the automobile sector than climate change.

This reframing of the EV narrative speaks to Brand (2006) who has previously stated that air quality has played only a limited role in automobile policy, even though it is a highly relevant policy narrative as the 'costs' of air quality are easier to calculate than those associated with climate change. For example, it is estimated that each ton of PM2.5 emitted in urban areas incurs an annual health cost of €450, 000 in Austria and the UK and €430, 000 in France and Germany (European Commission, 2019a). Likewise, Hong et al., (2019) state that the public health implications of air quality, in the form of respiratory problems and even deaths, are material implications of automobile use. The contributors to declining air quality has also been linked to COVID-19 rates (EEA, 2021).

The document analysis suggested that air quality is not necessarily as neglected an element of EV policy as Brand assumed, as documents from the UK and Germany highlighted it (H. M. GOV, 2018). However, this emphasis from some interviewees suggested a greater focus on air quality, as opposed to CO2 emissions, as a political narrative could empower the state to adopt a renewed role in the EV transition to overcome the ideological barrier.

#### 5.2.3 European Union Emissions Standards

Other interviewees emphasised the efficacy of CO2 emission framing as having a profound impact on the automobile sector. Several drew attention to the 2021 EU emissions standards (U1; U8; U13; G8; G21; G27). Briefly, the impending standards constitute a €95 fine for each gram of exceedance beyond 95g of CO2 per k/m, in contrast to the €5 fine for exceeding 130g of CO2 per k/m since 2011[[34]](#footnote-34) (European Commission, 2021a). The emissions standards were incidentally described as a 'pincer movement' on the manufacturers who had to acknowledge, however reluctantly, not only the increasing policy emphasis on EVs, but that failure to adhere would result in significant fines being implemented (U8). Interviewees suggested that the fact that states helped to design and implement these standards suggests that states can dismantle the 'blockers to decarbonisation' (U30), mainly the political power exerted by automobile manufacturers, whom many saw as strategically holding the transition back (U8; U10; G12; U13) when states act collectively.

As noted in chapter 1, transport emissions remain the only sector of the economy in which emissions continue to rise. This is largely due to the composition of manufacturers' product portfolios, which are increasingly made up of higher polluting Sport Utility Vehicles (SUVs). Consequently, such was the leniency of previous standards that manufacturers had been able to meet emission standards while seeing emissions rise due to high SUV sales (Abnett, 2020). Faced instead with potential fines, numerous manufacturers, including Volkswagen, Audi, and Jaguar, have since committed to completely electric vehicle portfolios by 2030 onwards, just as other manufacturers, including Hyundai-Kia and Renault have stated that they will overhaul their portfolios . Even in the short term, simply the prospect of this policy saw EVs rise to as much as 8% of new sales in the first half of 2020 (Transport and Environment, 2020).

However, a closer inspection of the impending emissions standards reveals that there remains a significant degree of leeway for manufacturers. In particular, the policy retains a zero-and low-emission vehicle (ZLEV) 'super-credits system' between 2020 and 2022, whereby vehicles that have emissions less than 50g of CO2/km are counted multiple times (I.e, 1 compliant vehicle is counted as 2 in 2020, 1.67 in 2021 and 1.33 in 2022) based on NECD standards (see Chapter 1). From 2025, a different crediting system will be introduced in which manufacturers will be judged by the aggregate % of total vehicle sales rather than vehicles per unit. The new system also allows for relaxation or tightening of the following standards should the manufacturers meet the yearly target of 15% EV in 2025 and 35% in 2030 (European Commission, 2021a).

Manufacturers are also allowed to form 'pooling' arrangements in which they may pool their collective resources to meet the emissions targets and further dilute any potential stringency. Both 'closed' (formed solely by manufacturers who are committed to one undertaking/objective) or 'open' (in which at least one member is not part of the same group of connected undertaking) pooling arrangements can be established so long as they meet the European Commission competition rules (EEA, 2020). For example, companies with higher emitting portfolios, including Daimler and BMW, may in principle pool their resources with Tesla, whose vehicles will satisfy the emission standards as they are all-electric. Hence, while marking a slight break in the neoliberal framework, the EU's standards ultimately remain a construct of the same paradigm (Paterson, 2020).

### 5.3 The Fiscal Barrier

The second barrier identified by interviewees was the constrained fiscal policy in both the UK and Germany implemented after the 2008 Financial Crisis, often referred to as austerity. Interviewees in both case studies highlighted that given the importance of states’ fiscal support in developing the EV market (U7; U8; U23; G9; G20) the austere fiscal approach adopted in the UK and Germany was a barrier to the transition (U1; U10; G13). Rather than independent barriers, the constrained fiscal policy is instead both a product and manifestation of neoliberal 'common sense' (see section 5.2).

As noted in Chapter 3, the influence of neoliberalism on the fiscal policy of states across the global economy has a longer history than simply since the Financial Crisis. Instead, neoliberalism has had an influence on both the Ecological Modernisation and Socio-technical literatures that inform this research. The neoliberal fiscal approach itself marked a departure from the more fiscally expansive Keynesian approach of managing aggregate demand in the economy as a way of stabilising fluctuations in the business cycle prevalent after the Second World War[[35]](#footnote-35) (McManus, 2015; Keynes, 1936). The advent of neoliberalism instead led to a focus on controlling the monetary supply, otherwise referred to as monetarism (IMF, 2014).

The austerity which followed the Financial Crisis in 2008 is perhaps the most overt example of fiscal austerity. It is also unique to previous crises, which had previously called for expanded fiscal spending (Blyth, 2013). This departure from the norm led some scholars to say austerity was a political decision rather than an economic imperative (NEF, 2018; Blyth, 2013; Callinicos, 2012). The ideological barrier here manifested in a fiscal framework within which state spending was attributed to the inflationary pressures in the economy (Morton, 1951) and prescribe states to run budgetary surpluses (Baum, 2019). Fiscal austerity is a perennial theme of classic liberal political economy, which also perceived the state as a peripheral figure in a market economy (Gamble 2013).

With specific reference to the EV transition, interviewees highlighted that the pursuit of austerity in both the UK and Germany limited EV policy. It limited the design of the electric vehicle development strategy consisting of the demand and supply side measures implemented by the government. Documentary analysis revealed that the foremost measure highlighted by governments was the EV demand-side subsidies, introduced in the UK in 2011 and Germany in 2016. Whilst these subsidies have been subject to change since their initial design, the average subsidy in the UK and Germany was between £/€3 000 – 5, 000. I examine the subsidies in the following chapters (see Chapters 6 and 7).

As indicated by interviewees, EV subsidies sit uneasily within a neoliberal fiscal policy framework. On the one hand, subsidies are inconsistent with neoliberal fiscal spending as they insulate the emergent technology from market dynamics. On the other, they are somewhat insignificant given that the level of EVs account for a relatively small amount of the market, meaning the amount of government spending is ultimately low in comparison to the broader fiscal requirements to the automobile sector (see Chapter 2). The latter led some interviewees to suggest that subsidies were simply a form of 'greenwashing' (U11; G28). However, as indicated in Table 1, Lévay et al., (2017) state that the introduction of subsidies was a key condition for EV development in many developed economies.

**Figure 7: EV subsidies in Europe**

Chart, bar chart

Description automatically generated

Source: Transport & Environment (2020)

Aside from the EV subsidy, interviewees highlighted other measures that account for a country’s electric vehicle development strategy. As I outlined in Chapter 2, these include the demand side subsidies, and reconfigured supply-side measures in the form of Vehicle Excise Duties/taxes (or road tax). Interviewees stated that businesses also benefit from changes to the corporate tax framework, otherwise known as Benefit-in-Kind (BIF), which performs much the same function for exempting private businesses from tax on low carbon vehicles as does vehicle excise duty for private consumers (U13; U21). Governments and private businesses can also decarbonise their fleet of vehicles when procuring new vehicles (U7).

The fiscal barrier identified by interviewees, therefore, speaks to the fundamental problem that whilst the state has played a pivotal role in developing the EV market through fiscal means, the state’s capacity to do so is limited by a constrained fiscal policy. This response from interviewees suggested a lack of fiscal stimulus to the EV market, leading to lower EV consumption. This is however not limited to consumers, but also includes businesses that depend on the state’s fiscal policy to provide confidence for the future development of the EV market and the automobile sector more broadly (Jolly, 2021).

To exemplify the impact that constrained fiscal policy on EV consumption, interviewees identified examples of countries which had adopted alternative approaches, including California and the Netherlands (U14; U30; G30). Of these examples, interviewees often referred to two key case studies outside of the primary case study of this research, namely Norway and China, that highlight how different fiscal policies can yield higher EV uptake. With reference to these examples, interviewees also stated that Norway and China exhibit two different metrics by which to measure EV development (U8; U17). These include the proportion of vehicles sold (% of vehicles sold over a given time) and the number of vehicles sold (per unit of total vehicles) (U8). In benefiting from the former, interviewees note that Norway's relatively small population (around 5 million) is well suited to this form of accounting, whereas China by contrast sold 1,000,000 EVs in 2020, therefore, selling the equivalent of 1/5th of Norway's entire population but only around 1% of their own (G11; G17).

To illustrate the problematic features of the market-led approach, in two case studies, I turn in sections 5.3.1 and 5.3.2 to the examples of Norway and China, which emerged as a counterpoint to the empirical data from the interviews. Due to interviewees emphasis of Norway and China, these examples are worth examining in more detail. Both Norway's 'Nordic model' (Knutsen, 2017; Hilson 2008), and China's dual socialist/capitalist, or socialism with Chinese characteristics (Dittmerl 2021; Deng, 2011; He, 2001) are used here to contrast the fiscal orthodoxy adopted in the UK and Germany. These examples demonstrate alternative approaches to state involvement in automobile decarbonisation.

#### 5.3.1 Norway

Interviewees frequently cited Norway as *the* state-business model required for automobile decarbonisation (U4; U9; U24; G3; G17). Some noted that "Norway, in general, is simply an outlier because it is such a wealthy country" (U25) given the economic capacity available to it by virtue of its Sovereign Wealth Fund. Either way, Norway has developed a novel approach to decarbonising its automobile market, yielding a record 54% of new vehicle sales, and 74% when including hybrids (Reuters, 2020). As also noted in Chapter 1, of the countries committed to banning ICE vehicles following the Paris Agreement, Norway comfortably set the most ambitious target of 2025.

In designing the supply-side model, the Norwegian government endeavoured to instil the 'polluter pays principle’ into their automobile taxation framework, making it economically beneficial to choose a 'cleaner' vehicle (Haugneland et al., 2017). This taxation framework includes the foregoing import tax, 25% exemption from Value Added Tax (VAT), exemption from vehicle duty, and 50% reduced company car tax. There is a 50% rule for all automobile charges, including parking, ferry travel and toll roads. Attempts to future proof the road network infrastructure was also undertaken, with charging infrastructure positioned every 50km along all main roads (Norsk elbilforening, 2017). In essence, this supply-side model rests upon two notable features. Firstly, it produces a tax rate per ton of CO2 at €475 in contrast to the EU’s €26.76 per ton (Fridstrøm, 2021). Secondly, the taxes from ICE vehicles are used to offset the subsidy measures for EVs (U17).

The Norwegian supply-side electric vehicle development strategy, therefore, contains many seemingly small measures that nevertheless had a cumulative impact. Beyond the taxation framework, other measures include free use of toll roads, access to bus lanes and a scrappage scheme for ICE vehicles when purchasing an electric vehicle. One interviewee who has spent time in Norway noted that when talking to a Norwegian EV Owners Club, they said, "the reason he bought one is not anything to do with saving money or saving the planet, it is just because ‘I could save an hour and a half on my day’ [travelling]" (U25). Norway's development strategy has not only been one of the more novel mixes of policy implemented across the global economy, but one which has also sought to move EVs beyond being a niche technology (Steinbacher et al., 2018).

Yet, far from receiving universal praise, the Norwegian model has also been criticised due to the Norwegian economy making the strategy non-transferable. Norway's Sovereign Wealth Fund is the largest such fund in the global economy. While the fund operates according to specific investment guidelines, the source of income being one yielded from the extraction of oil from the North Sea is considered by some to undermine Norway’s environmental leadership (Ulven and Sutterud, 2021; 2018). And while some argue that without the fund, Norway's EV development strategy would not be impossible (Nilsen, 2010), others argue that the fund has little to no effect on Norway's EV model as it is contingent upon the purposely designed taxation framework independent of the country's Sovereign Wealth Fund (Fridstrøm, 2021). Ultimately, the fund does provide the Norwegian state with a fiscal stimulus[[36]](#footnote-36), but it does not afford Norway a capacity beyond equal in the global economy.

#### 5.3.2 China

China, alternatively, has pursued a far different approach to EV development. Zhang et al., (2017) note that China's strategy is defined by (i) finance policy, (ii) infrastructure promotion, and (iii) research and development (R&D). Interviewees pointed out that China's position in the electric vehicle market is far more pronounced as it continues to acquire the raw materials across in the world (U22). China now dominates the global supply chain of processing critical minerals, such as lithium, cobalt and graphite, the most important element of electric vehicle battery production (Penke, 2021). China's capacity to produce batteries is subsequently greater than the United States and European Union combined (Jin et al., 2021). Like other emergent technologies, electric vehicles form a pivotal part of China's 'Made in China 2025 strategy', aimed at gaining a comparative advantage in emerging markets. China has adopted a similar strategy in the energy transition, becoming the world's main manufacturer of photovoltaic technology (Rapoza, 2021), designed to secure China's position as a world leader in emergent technology.

Under the Auto Industry Adjustment and Revitalisation Plan, China's demand-side development strategy proceeded to develop three independent but interrelated elements of the market; (i) manufacturing/production, (ii) consumer and (iii) infrastructure. A key part of the industrial development strategy was subsidies in the form of ¥10 billion/$1.5 billion for grants and discounts to the industry to develop productive capacity in cars and buses (Chen and Tong, 2017). To make China less dependent on traditional automobile-producing nations, particularly Germany (see Chapter 7), China's longer-term goal is to develop nationally owned automobile companies, with Build Your Dream (BYD), Geely, Nio, X-Peng and more to enter the global market. Many of these manufacturers are a product of China's attempts to augment automobile output, which have also seen restrictions eased on vehicle joint partnerships for foreign development in China since 2018 (Jin et al., 2021). Tesla, BMW, and Volkswagen are all manufacturing new electric vehicles within China and entering a partnership with Chinese manufacturers.

Apart from the industrial ends of EV production, China's demand-side strategy has taken the form of stimulating the consumption of vehicles through subsidies of ¥16 200/ per vehicle which will be reduced to ¥13, 000 and capped between 2020-2022 for automobiles with a price of ¥300,000/$42, 376 (Sun and Goh, 2020). To further illustrate the need to develop state-led development strategies, China's electric vehicle subsidy was extended to 2022 due to fears that EV uptake would slow without it (Shi, 2021). In terms of infrastructure, China has provided ¥120m/€18m for cities to install the requisite charging infrastructure requirements (ibid). It has also established a centrally planned pilot scheme, including electric bus networks and the 'Ten Cities, Thousand Vehicles' programme[[37]](#footnote-37) (MIIT, 2019) to integrate electric vehicles into the transport system.

Not only has the development of the electric vehicle industry come to form a key part of China's industrial policy, but, like the UK and Germany, the strategy is particularly notable in that it is a response to an acute landscape pressure in China, namely that of intense urban air pollution or smog. Called the 'airpocalypse' in 2013, Chinese cities such as Beijing implemented a series of novel policy instruments, including a quota-based system on new ICE, vehicles in which potential drivers were required to enter a lottery to win a licence plate and an air quality alert system, limiting ICE vehicles to alternate days of use with forgoing restrictions on low carbon vehicles (Jin et al., 2021). Through the subsequent Clean Air Law, broader emission limits were also implemented at the national level, which put ICE vehicles at an economic disadvantage, like Norway. In addition, China's supply-side measures have recently developed a mandatory dual-credit system in which automakers that produce or import over 30, 000 ICE vehicles must offset them by developing low carbon vehicles or purchasing credits from competitors (Cui, 2018), reflecting the Zero Emission Vehicle credit market in California (see Chapter 8).

As promising as the demand side development strategy is, the Chinese model, like the Norwegian, has been the subject of criticism. Not least due to the limits to the transferability of the model, given China's centrally planned economy and its industrial and economic capacity. While yielding high uptake, demand-side measures have also been susceptible to exploitative behaviour, such as bus makers who claimed the subsidy disproportionately to their production (Tang et al., 2017). However, contrary to the criticism that China's demand-side model is contingent upon a centrally planned economy, Chen (2016) suggests that the strategy is far more profit-driven, with incentives for independent companies being subject to insufficient, rather than too much, supervision. Moreover, regional variation within China suggests that the benefits of China's rigid centrally planned or autocratic approach may be overstated.

Norway and China, therefore, provide two instances of effective electric vehicle development strategies. Inevitably there is some overlap in the supply and demand-side models examined above, but both exhibit important distinctive features. What is clear for both Norway and China are that the development of electric vehicles formed part of wider political and economic objectives. For Norway, EVs present a viable opportunity to invest, or 'green', the proceeds of their sovereign wealth. China, alternatively, seeks to establish industrial expertise and manoeuvre its way into a leading role in one of the biggest emerging markets. These two examples suggest that EVs become more politically expedient when the state can position EVs as part of its broader industrial and economic development strategy, but that they are also not necessarily constrained by ideological precepts of fiscal responsibility. Such contingencies are problematic, for they suggest that automobile decarbonisation is a means to an end instead of an end in itself.

### 5.3.4 Overcoming the fiscal barrier

Norway and China serve to illustrate that the environmental policies designed to support the EV market are ultimately questions of fiscal policy. Due to the function of fiscal policy in developing EV markets, I found that many interviewees identified the need to depart from the fiscal orthodoxy underpinning austerity policies to enable the development of the EV market. Indeed, one interviewee stated that "we can see where it is going and so setting up those conditions does require planning, at the very least, and it requires some sort of centralised planning" with enough money to finance the transition (U6). Interviewees were not asked to propose an alternative fiscal policy, nor to identify changes to the fiscal landscape. The means by which to overcome the fiscal barrier was instead found in document analysis. I hereafter outline three potential ways in which the fiscal barrier may be overcome, namely the (i) Green New Deal, (ii) the COVID recovery package or (iii) 'green' monetary policy.

#### 5.3.5 Green New Deal(s)

The document analysis indicated that one way to overcome the fiscal barrier that was present in the document analysis is Green New Deals (GNDs). Green New Deals have emerged across many developed economies in recent years, including the Green Deal for Europe, the USA's Green New Deal, and the UK's Green Industrial Revolution[[38]](#footnote-38). Although it is beyond the scope of this research to examine the contrasting and common features of these strategies, suffice to say that they all advance the need for a new growth strategy/model (European Commission, 2021b; H.M GOV, 2020). European Commission president Ursula von der Leyen has positioned the European Green New Deal as the EU's 'new growth strategy', proposing to invest €1tn of the EU budget into 'green investment' (Harvey and Rankin, 2020; Siddi, 2020; EU Commission, 2019). In a marked departure from previous fiscal austerity, states will be required to contribute €114bn to the Deal, and the European Investment Bank will be expected to lend €279bn to the private sector (Lehmann, 2021). Similarly, the UK government’s Green Industrial Revolution outlined a £12bn state-led 'green investment' package (H.M. GOV, 2020).

All such measures have been described as 'ending the hostility against green spending' (Harvey, 2021). Yet it remains to be seen whether Green New Deals constitute a clean break from the fiscal constraints attributed by interviewees to the underdevelopment of the EV market, although GND’s indicated an almost certain increase in EV investment. For example, Europe's GND is partly designed to deliver the European wide 'Green eMotion' initiative, allocating a total of €41.8 million to facilitate the rollout of electric vehicles, of which the Commission will contribute €24.2 million alongside 42 partners in the industry. It is an initiative designed to address CO2 and NO2 emissions. The Green eMotion initiative is designed to achieve 13 million EVs in Europe by 2025, in contrast to the previous target of 975 000 (European Commission, 2019).

The advent of GNDs has been reflected in the literature as scholars emphasise it is an opportune moment to reimagine the role of the state on the economy (Rifkin, 2019). Not only do GNDs open the prospect of further fiscal spending on the EV transitions, but also as seen in the solar transition following Germany's *Energiewende* (energy transition), once one economy begins to enact a transition, the spillover effects in the global economy make it cheaper for subsequent movers (Rapoza, 2021). Hence, the UK and Germany may benefit from the actions taken by Norway and China's state-led transitions as they have helped to 'crowd-in' investment in emergent technology (Hickel, 2020). This marks a stark contrast to the 'crowding out' of long-term investment engendered by fiscal austerity (Jacques, 2021).

#### 5.3.6 COVID-19: Building Back Greener

A second avenue is the ‘green’ recoveries from the COVID-19 pandemic, which saw states across the global economy forego longer term fiscal restraints, including Germany's Black Zero (see Chapter 7). In perhaps the most overt break with the fiscal paradigm, and in contrast to the economic policy approach after the Financial Crisis, bodies such as the OECD (2020) and IMF (2020), previous proponents of austerity, stated that fiscal policy is a tool for driving economic recovery. After mitigating the economic downturn, they note that fiscal policy should now be used to green the recovery through targeted investment in green industries (IMF, 2019). By virtue of the Financial Crisis, states may have little choice but to invest in the economy given that historically low, in some cases, negative, interest rates have further compounded the dearth of investment from the private sector in the 'real' economy since the Financial Crisis.

Several interviewees also stated that COVID-19 had revealed the fiscal capacity of the state (U23; U25; G1; G15). In contrast to the peripheralisation of the state and of environmental policy, "COVID has shown us is that the government can intervene in quite a strong way. And for things to change very dramatically, in a really short space of time" (U20). Another interviewee stated, "you have suddenly made all this money available for this Coronavirus, yet the earth is in a climate crisis, which will kill more people if left unchecked" (U25). Incidentally, the macroeconomic stimuli that have followed COVID were couched within 'green' rhetoric by countries across the global economy as governments emphasised the need to not only 'build back better' but 'build back greener' (Bakker and Elkington, 2020).

This shift in the position of intragovernmental institutions such as the OECD and IMF, and the shift in green rhetoric, indicate a reappraisal of economic recoveries from the Financial Crisis, which precipitated an austere, fiscally-constrained environment. Yet, as the strategies continue to be developed, COVID-19 has led some to demand a re-evaluation of the state's role in all facets of the economy (Blakely, 2020; Bristow and Gilland, 2020; Galloway, 2020). COVID-19, perhaps unlike Green New Deals, have revealed a tension at the heart of neoliberalism in that expanding fiscal policy during crises is not simply an ideological position but a necessary intervention to aid a struggling economy. Scholars have already stated that COVID-19 will pave the way for a post-neoliberal order (Tooze, 2019), or at the very least, economic models reconfigured to reflect COVID's impact on forms of mobility, labour, states finances and more (Blakeley, 2020; Galloway, 2020).

Electric vehicles have incidentally come to form a common element of COVID recovery packages[[39]](#footnote-39). For example, both France's (€100bn/3.7% of GDP) and Germany's (€130bn/3.8% of GDP) recovery packages have committed to channelling newly allocated capital into green technologies (Djankov, 2020). France has committed up to a third of the package (€28bn) to a green transformation, of which €8bn was reserved for the automobile sector to boost domestic manufacturing of EVs and hybrids and enhance the demand side subsidy (DW, 2020). France also provided local manufacturer Renault with a €5bn loan to ensure that it maintained operations in France and produced EVs as a stipulation of the loan. Germany has likewise committed a quarter (€24bn) of the recovery package to green technologies, including €1bn in R&D for new technology, 2.5bn for EV infrastructure and battery cell production and tripling the demand side subsidy from €3, 000 to €9, 000 (Taylor 2021; Reuters, 2020).

It is, however, important not to overstate these shifts in rhetoric from governmental and intergovernmental actors. Many of the same debates emerged following the Financial Crisis in 2008, with green recoveries and green stimuli emerging but ultimately to no avail (Ferguson, 2015; Tienhaara, 2013). In particular, the UK embodies this green recovery rhetoric. For example, the government announced a 'Green Brexit' following its departure from the European Union, and a green stimulus following the Financial Crisis (Ludivine et al., 2019). In both instances, green recoveries and green stimuli have yet to pass. Yet, the COVID recovery packages provided a degree of detail previously absent from green recovery rhetoric.

#### 5.3.7 Monetary policy and the issuance of Green Bonds

Fiscal policy, whether constrained or otherwise, ultimately pales into insignificance compared to the central banks’ capacity to control monetary policy. Indeed, fiscal, and monetary policies have shared an interesting relationship since the Financial Crisis. Namely, in contrast to the austerity placed on state budgets, monetary policy has experienced, and continues to undergo, a significant expansion in the form of Quantitative Easing (QE)[[40]](#footnote-40). In a reverse of monetary offsetting[[41]](#footnote-41), central banks have offset the reduced spending of states by providing economic stimulus to the economy, ensuring the inflation of asset prices and additional spending (Coppola, 2019). For example, Johnson and Chandler (2014) note that the UK's post-2008 recovery relied upon an 'implicit contract' in which austerity's fiscal credibility relied upon monetary activism, whereby the Bank of England (BoE) stimulated the economy through £517bn of newly printed money in the absence of an expansionist fiscal policy.

By extension, QE has also blurred the once clearer distinction between fiscal and monetary policy. Ryan-Collins et al., (2013) state that the hybridity of fiscal-monetary policies has made for a broader policy toolkit for governing the economy. Because of this enhanced policy repertoire, two policies have recently emerged that may prove fertile ground to circumvent the fiscal barrier. Firstly, in the 2021 Autumn budget, the UK treasury set the Bank of England a green mandate to assist in achieving environmental objectives. Climate change had also been defined as 'mission critical' by the European Central Bank (ECB) as the bank shifted from a position of 'market neutrality' to 'market efficiency' on environmental policy (ECB, 2021). Terminology aside, the prospect of 'green' central banking could see extra finances made available for government and businesses working towards environmental objectives (Hodgson et al., 2021). As noted in Chapter 2, such is the automobile sector’s dependence on accessing credit from financial markets, that placing criteria on finance could make *not* investing in EVs financially unviable.

Second, on the side of the fiscal-monetary hybrid of issuing newly created Green Bonds. These newly fashioned fiscal tools allow the government to issue bonds (debt) for green lending. Though they are a new financial category, couched within the broader green finance typology, green bonds have emerged across many developed countries since Poland issued the first green bond of this kind in 2016 (Stubbington, 2021). The UK and Germany have utilised these new financial instruments in the Green+ Gilt and the Green Bund (BMF, 2020). The issuance of green bonds provides states with a new avenue to channel liquid capital on capital markets, such as insurance and pension funds, into the EV transition in the form of EV infrastructure, R&D, and production.

Perhaps more important than government bonds, however, the assurances given to financial markets by state-issued green bonds have been replicated by automobile manufacturers. For example, Volkswagen and Daimler have issued their green corporate bonds to finance their EV projects and charging infrastructure since Germany began their Bund program. Having followed the trend set by the state in issuing green bonds, manufacturers have benefited from a developed financial market with lower borrowing costs than conventional debt (Rocha and Cohen, 2020). Therefore, while the green bond market is in its infancy, it is important not to understate its importance, as state capital markets have provided security for the automobile's corporate market.

### 5.4 The Administrative Fragmentation Barrier

The final barrier identified in the empirical data, particularly by interviewees working at local government institutions, was administrative fragmentation (U15; U25). This concept refers to the reshaping of the internal institutional architecture of the state, dividing policy areas into distinct ministries or departments (Grossman and Lewis, 2014; Kimura, 2013; Carter 2007). In addition, the process of departmentalising policy, Billing (2018) states that the administrative fragmentation that has unfolded across developed economies in recent decades also represents the rolling back of national government, as they pass the burden onto local authorities.

Interviewees from both countries made claims that were consistent with this interpretation, stating that national EV development strategies had suffered from a lack of coordination between the central and local governments (U9, U13; G7; G18). Administrative fragmentation, according to interviewees, has had an impact on EV policy by leading to a lack of policy focus, uncertainty around the required charging infrastructure for EVs and the required budgets at the local level (U4; G7). Due to the constrained fiscal policy, I outlined above, and the impact which austerity had on local governments' budgets, interviewees stated that central governments passed the emphasis on EV policy onto local institutions without required funding, leading to a lack of capacity to focus on EVs. As one interviewee stated, "it is a nightmare, trying to find the right person in the Council, because it [EV policy] is either in environmental health, or it is in transport, or it is in economic development, or it is in the fleet team" (U25).

The administrative fragmentation experienced by interviewees at local institutions was also highlighted at the national level by interviewees based at central government institutions. In particular, an interviewee from the National Grid and the UK's EV Task Force pointed out:

*"In the real world, I've got a conversation tomorrow with the head of BEIS, so Business Energy and Industrial Strategy. So that is the carbon measurement, the risk of carbon fines and the industrial strategy benefits, so there are three drivers for them. Then, after that call, tomorrow I've got to jump to the Department for Transport. And they are all about facilitating movement of people. Nowhere in their metric is emissions, nowhere in there a metric is carbon budgets. Right? So, what you've got is this strange interplay where you've got two different government departments, not with a shared vision or strategy, and they've both got their different drivers"* (U15)

Administrative fragmentation, and the lack of a clear policy steer, also has an impact on business, particularly for charging infrastructure providers. As one interviewee who is a policy advisor pointed out:

"*what we tend to find in 250 local authorities is that each one has got a singular contact who's supposed to be the person that knows everything about every type of infrastructure, types of vehicles, new vehicles coming to the market, the technical difference between electric and hydrogen, etc. and they're pretty much in a pretty bad place" (U8).*

Charging infrastructure providers thus stated that this lack of coordination has led to a dearth of investment by local government and so less EV infrastructure (U2; G3). Moreover, due to local state institutions having constrained budget, they "have locked themselves into long term contracts with an inefficient provider" (U12), just to install some infrastructure (U12; U27; G3).

The administrative fragmentation identified by interviewees should not be conflated with decentralisation. Rather, while decentralisation denotes the political, financial, and administrative delegation of decisions to sub-national governments (Falleti, 2005), administrative fragmentation simply refers to the redrawing of political boundaries of institutions and/or geography without the relinquishing of power on the part of the state (Grossman and Lewis, 2014). However, environmental challenges do not respect these artificial or arbitrary boundaries but cut across institutions, sectors, and departments (Oberthur, 2009; Carter, 2007). Administrative fragmentation therefore indicates that states in both the UK and Germany have only tried to pass on the emphasis of EV policy to local institutions.

Determining the efficacy of institutional change, or lack thereof, is not clear cut within the different administrative structures of the case studies. For example, Germany's federal system allows its 16 provincial states, or Länder, to create their laws independently. Therefore, local state actors in Germany can exercise more power than their equivalents in the UK, particularly in newly defined administrative units, such as Greater London and Greater Manchester. However, decentralisation of power to Scotland, Wales, and Northern Island is more akin to Germany's Federal system.

Importantly, interviewees in both case studies stated that fragmentation was simply a political decision on the part of the national government to absolve itself of more stringent intervention and pass the impetus onto local governments (U9; U25; G18; G19). Fragmented administration combined with fiscal austerity (see 5.3) has accordingly created a policy vacuum in both the UK and Germany. One consequence is that the vacuum has been filled by non-state actors such as ClientEarth and *Deutsche Umwelthilfe*. Both the UK government and the German Federal government have subsequently been subject to environmental lawsuits on account of exceeding the European Union's air quality standards or nitrogen dioxide (NO2) standards (Neill, 2021).

Lawsuits have brought the fragmented state of the UK and Germany's EV development strategy into sharp focus. Of the few measures available to local municipalities, the lawsuits have helped usher in the sweeping declaration of local climate emergencies on the part of councils and Länders alike (U24; G11). Interviewees indicated that climate emergencies had, to some degree, allowed local governments to exert political leverage on their national counterparts, raising the prospect of enhanced budgetary capacity, though it remained a prospect rather than a reality (U8; U25). In so doing, interviewees appeared to reflect more critical trends in the administrative fragmentation literature and identify an acute empirical barrier to automobile decarbonisation. Yet, just as this barrier is perhaps the most tangible of those identified in this chapter, it may also offer viable means to overcome it.

### 5.4.3 Overcoming the administrative barrier

Scholars have previously stated that administrative fragmentation may be addressed, as Cejudo and Michel (2015) note, with administrative coordination, coherence, and integration. Pollak et al., (2008) accordingly refer to the process as one of legislative harmonisation. Interviewees indicated that legislative harmonisation was most required for the Low Emission Zones (LEZ) becoming increasingly common in the UK and Germany. In the following section I will therefore outline (i) the potential administrative harmonisation of LEZs and highlight two outliers identified by interviewees as potential blueprints for legislative harmonisation. The examples I examine are (ii) the petrol and diesel ban introduced in Stuttgart, Germany and (iii) the Workplace Levy implemented in Nottingham, UK, as measures that could be used to coordinate national EV policy.

#### 5.4.4 Legislative Harmonisation

Key examples of legislative harmonisation provided by interviewees were Low Emission Zones (LEZ) or Clear Air Zones (CAZ) that have emerged in 15 countries and 200 cities across Europe. At present, the absence of government guidance has made the implementation of LEZs asymmetrical and inherently problematic, if not impossible (U8). Asymmetries in the stringency, malleability, and coverage of LEZs were thus identified between interviewees in both the UK and Germany (U16; U29; G14; G24).

For example, Bath's class C LEZ[[42]](#footnote-42) will omit private vehicles from its emissions-related fines, whereas Bristol's class D will include them (ITV, 2021). Without coordination, fragmented local governments become susceptible to political pressure, often leading to many such measures being delayed during COVID or abandoned completely (Barret, 2020). However, both the UK and Germany have primary legislation which could, in principle, simply incorporate the legislative harmonisation of LEZs. The UK's Automated and Electric Vehicle Act and Germany's E-Mobility Act thereafter have the capacity to address this barrier relatively easily.

Even in the event of administrative harmonisation, problems may still arise from the constrained fiscal environment. Not simply in the capacity of local state actors to retain, or gain, expertise as they lose more employees than ever. But a common theme amongst local authorities was that they had a limited contingent of officers employed solely to devise EV policy, ensure compliance with LEZs, or to install or request infrastructure (U9; U25; U29). LEZs could, however, be used as a mechanism to increase the income of authorities through the fines applied to non-compliant vehicles. And whilst such fines tend to affect vehicles owned by lower-income consumers who are least able to afford them (Scorrano et al., 2021), harmonising the implementation of LEZs nonetheless remains an underutilised tool in the state’s policy toolkit.

#### 5.4.5 Stuttgart

Stuttgart has previously been referred to as the 'Beijing' of Germany, due primarily to the poor air quality because of the high use of automobiles in local travel. So acute is the problem that it led to the implementation of the *Feinstaubalarm[[43]](#footnote-43)* (fine dust alarm). Stuttgart's reputation as a 'car city', stems from it being home to automobile manufacturers Daimler and Porsche (Osterath, 2016). Several interviewees noted that Stuttgart provides a typical example of how the German manufacturers lobby governments at both the national and local levels to avoid stringent policies (G4; G12; G19). Stuttgart, therefore, symbolises the power of manufacturers to circumvent environmental policies (see Chapter 2) and demonstrates within the context of administrative fragmentation how instead of emboldening local authorities, this process may leave them more susceptible to pressures of capital.

Stuttgart has a unique manufacturing capacity because it is home to Daimler. However, it is also situated in a provisional state, namely Baden-Württemberg, the only regional state in Germany governed by the green party (Bündis90/Die Grünen). As a result of these novel features, Stuttgart illustrates how political will has been historically subordinated to the economic interests of local manufacturers (Karnitsching, 2018). For example, after several Länder governments introduced Low Emission Zones (LEZ) in 2008, Stuttgart's EURO-4 iteration was considered the 'green standard' in Germany. However, attempts to raise the standard to EURO-6 have since proved unsuccessful as the Länders have neither the resources nor support from the Federal government to withstand pressure from manufacturers who argue the standards threaten their economic status.

The implementation of the original EURO-4 standard followed a court ruling, in which environmental lawyers, Deutsche Umwelt, argued Stuttgart had exceeded European Union PM10 standards (DW, 2018). As noted by Bennhold (2018), such a policy was previously unthinkable due, in large part, to the inertia of the national government. The diesel bans continued to be a key policy in a broader suite of measures that saw the discontinuation of *Feinstaubalarm,* including investment in public transport and liquefying transport flows. Rather than consume higher standard diesel vehicles, Stuttgart also saw the percentage of EVs rise after the ban (Mallig et al., 2016). Interviewees therefore noted that before banning all petrol and diesel vehicles (as was introduced in the UK), introducing standardised bans for certain vehicles is a more immediate, and indeed viable, policy (G20; G26). Stuttgart's deviation from the broader political context in Germany, one beholden to the interest of national manufacturers and reluctance to introduce a national ICE ban, nonetheless provides a useful example of designing an effective EV development strategy.

#### 5.4.6 Nottingham:

In the UK, Nottingham is often perceived as the pioneer of electric vehicles among local governments (U1; U17; U24). An interviewee from Nottingham City Council stated that the key to their success was utilising government funding. Central government funding in the UK is allocated through two forms, (i) capital funding - a single transfer of capital (allocated on a competitive basis), and (ii) revenue funding - a continuous inflow of capital from taxes, a form of the venue that has become further constrained since the Financial Crisis (U10; U18; U25; U29). Nottingham's utilisation of state funding has come in the form of the Go Ultra Low campaign[[44]](#footnote-44), a state-led initiative to increase EV uptake.

This method by which the UK government disseminates capital to local authorities on a competitive basis was said to disincentivise bids from some Councils as much as it incentivises bids from others (U18). In many instances, councils do not have the resources in either labour-power or finance to design a bid independent of other Council functions. Those Councils able to manoeuvre around the constraints can accumulate more capital funding through regular successful bids. To some extent, this has created a hierarchy within state funding, as successive bids tend to lead to further successful bids (U3; U14). Nottingham has benefited from this model, which has allowed the City Council to decarbonise its fleet of vehicles, decarbonise the local bus fleet, offset the cost of vehicle procurement to provide 'try before you buy' trials to local taxi and non-taxi drivers, install 400 charge points, and develop one of the UK's first vehicle-to-grid (V2G) scheme (U25). Nottingham also supplemented these measures by introducing EV-only lanes, engagement events, and EV-only service stations like the Norwegian supply-side model.

What distinguishes Nottingham from the fragmented local system in the UK, however, is the implementation of the Workplace Levy (WPL). As noted by an interviewee at Nottingham City Council, the WPL is "essentially any employer in the city that's got more than 10 parking spaces and the vehicles are parked every day, they have to pay the council just over 400 pounds every year for that parking space" (U25). The WPL has proved beneficial on two counts; (i) it discourages car travel, and (ii) the revenue raised is ring-fenced for transport alternatives (U25). An interviewee indicated that the WPL was seemingly an affront to neoliberal ‘common sense’ (see 5.3) as the policy means “there is going to be no businesses that relocate to Nottingham, and businesses are going to leave, it's going to be terrible, you know, everything's going to be awful and not one business has left" (U25). Such has been the evolution of climate emergencies in the UK that, importantly, rather than avoid the WPL, local state actors are looking to implement their version of the measure (U25).

Rationalising the success of the WPL, an interviewee from a transport consultancy stated that because transport is a supply-side sector, transport solutions need to be supplied by state institutions, not demanded by consumers (U28)**.** Stuttgart and Nottingham, therefore, typify how bold intervention on behalf of local state actors, rather than incremental measures, can yield higher EV uptake. EV policy requires greater coordination from national governments to make such measures possible. However, this need not depart from the current administrative model but instead provide local governments with the resources to make the institutional arrangement more efficient. Indeed, local administrations have an appetite for policies should the conditions allow (U7; U9; U18). Whether or not these measures manifest may depend upon overcoming ideological and fiscal barriers.

### 5.4 Conclusion

In this chapter I have identified three of the most prominent barriers to automobile decarbonisation to have emerged from my empirical data. Whilst this chapter has only made tentative reference to the case studies of this research, the barriers identified here provide an important basis from which build in the following chapters, identifying common barriers that traversed both the UK and Germany. The main contribution of this chapter to this research is that a significant proportion of the interview data reflected an emergent trend within the literature that identified the need for a break from the market-led approach to the EV transition. The findings outlined in this chapter consequently highlighted the need to revise the state’s role in the economy to further develop the EV market.

I have ventured initial answers to two of the research questions identified in Chapter 3. In answer to the first question, ‘*what are the barriers to decarbonising the automobile sector*’ I have shown that while a minority of interviewees perceive that the market will bring to bear the EV transition, most interviewees perceive the problem to be with how the transition is presently understood. Interviewees of a more critical predisposition, therefore, tended to ignore the role of the state in developing the EV market so far. The ideological barrier was intimately then linked to the fiscal barrier, in that a relationship was identified between the level of state intervention in the supply and demand side measures and the development of the EV market. That the UK and Germany had adopted a fiscally austere approach since the Financial Crisis was contrasted with the expansive approach adopted in Norway and China, to reveal why the approach of the former was problematic. The fiscal barrier was thus itself related to the administrative fragmentation barrier identified in both the UK and Germany, as both case studies indicated that national governments had historically ceded emphasis to local government without the requisite fiscal capacity.

In answer to the second question, ‘*How can those barriers be overcome?’* I found that the state had seemingly begun to adopt a more interventionist role in the EV transition. With reference to the ideological barrier, I showed that the issue of air quality was a useful alternative to CO2 emissions as a means to legitimise state intervention. I also showed that the European Emissions Standards indicated that the state, albeit at a European level, had implemented punitive regulation on the automobile sector. In overcoming the fiscal barrier, I found several ways in which the fiscal barrier had, at least, been addressed. The Green New Deals, economic recovery from COVID-19, and issuance of green bonds all indicate an enhanced capacity for the state. I outline how these measures manifest in the UK and Germany specifically in the following chapters. Finally, whilst the emphasis onto local institutions leaves a significant gap in EV policy, I showed how Stuttgart and Nottingham over valuable insights into how the administrative fragmentation barrier may be overcome. By the state asserting itself in this way, the empirical data challenged the assumption of the literature I examined in Chapter 3, in that the state appeared far stronger than Ecological Modernisation had tended to assume.

The assertion made by many interviewees that there needs to be a break from the neoliberal paradigm will importantly play out differently in different case studies. The way in which the states drive the EV transition requires examination in the following chapters to determine how it has unfolded in the UK and Germany specifically. Therefore, as this chapter has outlined many of the common barriers to have emerged from the empirical data, the subsequent chapters are designed to further develop robust analytical accounts as to how the EV transition has manifested in different national contexts, forming new barriers therein. I turn in the following chapter to how these questions applied to the unique case study of the UK.

# Chapter Six

## Decarbonisation through modernisation: The UK’s attempt to cultivate the electric vehicle transition

“I think that we still have no idea whose responsibility it is to look at electric vehicles… but whoever it is, they're doing an awful job, they're really doing an awful job” (U17)

“What this comes down to again, is that the Bank of England and the Treasury, I think, what they want to do essentially is reproduce the status quo… it's kind of their job to reproduce the status quo” (U11)

### 6.1 Introduction

In this chapter I examine how the EV transition has unfolded in the UK, drawing on my empirical data that found that EVs have been identified by the British government to (re)industrialise the UK economy as part of its Green Industrial Revolution (GIR) objectives (H.M. GOV, 2021a; 2017a). The data accordingly indicated that the EV transition presents an opportunity to cultivate a domestic automobile industry around EVs, simultaneously reducing the UK’s dependence on the financial sector (Coulter, 2018; Craig, 2015). With the EV transition part of the UK’s broader attempts to decarbonise the economy, I show in this chapter that decarbonising the automobile sector in the UK is ultimately contingent upon modernising its economy. I seek to contextualise the UK government's political objectives by situating this analysis amongst the events of the Financial Crisis, Brexit, and COVID-19 to determine the barriers to the UK’s EV transition.

Unlike in other modern automobile manufacturing economies, such as Germany and Japan, the automobile sector makes a smaller contribution to the UK economy, accounting for around 10% of GDP, though this still accounts for its largest export of goods (SMMT, 2021). The UK economy is instead characterised by a flexible labour market, foreign investment capital, and above all else, a dominant financial sector (Lavery et al., 2019; Rosamund, 2019; Gamble, 1994). Financial services, one of the few markets in which the UK runs a surplus with trading partners, is the sector around which the UK economy is orientated (Shalchi et al., 2021). Alternatively, the UK is thought to typify a form of ‘rentier’ capitalism (Christophers, 2020), predicated upon the accumulation of assets, mainly housing, by leveraging the serving of borrowing onto renters, and so further exacerbating wealth inequality (Roberts and Lawrence, 2017). And while these perspectives differ on the precise nature of the UK economy, they both speak to the absence of an industrial core.

Contrary to these commonly attributed features of the UK political economy, I find in this analysis that EVs have been identified to reorientate the economy. What developed economies such as the UK are looking to capitalise on low carbon transitions to modernise elements of the economy has been underexplored in the literature (see Chapter 1). Ecological Modernisation has tended to focus on the environmental policies that will facilitate transitions with less emphasis on the modernisation elements[[45]](#footnote-45) (Curran, 2009; Schlosberg and Rinfret, 2008). Indeed, Mol et al., (2000) state that this 'de-modernisation' perspective has tended to reflect the actions of grassroots movements which reject the notion that all countries need to reach the level of industrial capacity seen in many developed economies[[46]](#footnote-46). The Socio-Technical literature is also relatively silent on how transitions are shaped by and determined by policy (Lawhon and Murphy, 2011; Smith and Kern, 2007).

From the data I collected, I identified three unique barriers to the UK's *political cultivation pathway* outlined in Chapter 3, wherein the UK transition is contingent upon cultivating industry to fulfil its EV objectives. The first primary barrier identified was the present composition of the UK political economy as one reliant on financial flows and a historically peripheralised state. The second barrier was the impact of Brexit on the UK's automobile sector. Capturing the entirety of Brexit's impact on the UK is difficult, but three ancillary problems were cited as the UK's automobile sectors became disentangled from the EU, including the emissions standards, the absence of EU environmental policy, and manufacturing processes tied to the UK’s just-in-time (JIT) manufacturing model. The final barrier identified was consequently a product of the preceding two barriers, namely the present state of the automobile sector. By virtue of its limited industrial capacity, the UK cannot significantly shape the EV transition but is instead influenced by exogenous forces.

In the following analysis of the EV transition in the UK, I address the three research questions identified in Chapter 3. I develop upon the common barriers identified In Chapter 5, providing initial answers to two of the research questions that traversed the UK and German case studies. In this chapter, I answer, ‘*what are the barriers to decarbonising the automobile sector?*’ with specific reference to the UK’s industrial modernisation objectives. I also address the question ‘*how can those barriers be overcome?*’ in the UK by drawing on the empirical data gathered for this thesis. This chapter also addresses the third research question posed in Chapter 3 by providing the first answer to the question *‘are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?*’, providing the beginnings of this research’s comparative analysis in advance of Chapter 7.

### 6.2 Financialised political economy barrier

Many interviewees cited the composition of the UK economy as the most pronounced barrier to the EV transition (U1; U9; U10; U22; U27). The UK economy is often thought to have been 'dematerialised' through a reduction in national manufacturing capacity as it became increasingly reliant on the financial sector since the 1980s (Craig, 2016; Hay, 2013). It is instead characterised by a finance-driven accumulation strategy contingent upon the liberalisation of the economy with little regulation on capital flows, as financial assets make up the largest proportion of assets in the domestic economy[[47]](#footnote-47) (Hay, 2013; Hall, 2013). The light regulatory environment that this created inhibited the UK's EV transition in several ways according to interviewees. Firstly, at a technical level, the lack of regulation on petrol and diesel has insulated ICE vehicles from a more punitive policy framework that could have disincentivised carbon intensive vehicles, particularly through a 10-year freeze in fuel duty price[[48]](#footnote-48) (U14; U31). Secondly, through a reluctance on the part of the state to profoundly intervene in the economy, the UK's EV development strategy has lacked policy coordination, especially concerning the low emission zones (LEZs). As one interviewee from a quasi-governmental body noted, "the national government could have just come up and said, right, you 5-10 cities, you're all getting one [LEZ], here's the list of suppliers, here is where you can get everything. Bang. Go." (U10). However, instead of a coordinated, state-led transition, the UK government has instinctively deferred to the market.

Other barriers relating to the UK economy are far more structural in nature, relating to the economic policy in the UK and the state’s role within it. An interviewee based at the Department for Transport (DfT) noted that the investment criteria of the Treasury, the UK’s finance ministry, were itself a barrier to EV policy (U10; U25). In the UK, the Green Book serves as the Treasury’s appraisal framework, by which cost-benefit analysis of potential infrastructure investment is undertaken. The institutionalisation of state investment through the Green Bookhas garnered relatively little attention in the literature (Craig, 2015). However, where it has been put under an analytical lens, several charges have been levelled at the Green Book’s methodology. Firstly, due to its 'economic philosophy', it often failed to integrate environmental considerations and negative externalities into the cost or benefits (Coyle and Sensier, 2019; Eddington, 2006). The narrow parameters of cost and benefit are also determined by the minimum input for maximum output, thereby leading to investments that disproportionately fund regions and projects which already benefit from investment, particularly London (Graham and Van Dender, 2011; Pollack et al., 2010). Both critiques were accordingly reflected in theresponse from the DfT interviewee who noted, "It's still far easier to get funding for a bypass than it is for some sort of, you know, more sustainable green travel " (U24).

The responses from interviewees indicated a broad acknowledgement that the UK’s economic policy had shaped the EV transition because of the ideas and ideology of the actors who occupy the state to carry out the UK’s economic objectives (Matthijs and Blyth, 2017). As mentioned in Chapter 5, this relates to the perceived ‘common sense’ approaches to policy making. A state-led industrial reorganisation, akin to that exhibited in China, is thus often considered impermissible in the UK since the 'stagflation' experienced during the 1970s and the subsequent ‘neoliberalisation’ of the economy (Dutta, 2019; Rogers, 2012). Interviewees subsequently appeared to echo the idea in the literature that certain actions and/or policies are unlikely given the nature of the UK political economy.

Illustrative of this point was the idea that because the environmental policy is too shaped by an economic policy, the UK’s environmental credentials are a site of contention because of the composition of the UK economy. One interviewee summarised this view in stating that while the UK met its first, second and third carbon budgets as set out in the 2008 Climate Change Act[[49]](#footnote-49), it did so by "just export[ing] a lot of its manufacturing to other countries where labour is cheaper, and nature is cheaper. And then we just import the final products and then we celebrate territorial emissions reductions" (U11). The UK's EV policy is subsequently a product of the tension between an economic and environmental policy which, by the government's admission, has made the transport sector a 'hard to reach' area for UK environmental policy (H.M. GOV, 2017a).

The UK's financial economy has accordingly produced an EV development strategy largely centred around a demand-side approach in the form of subsidies, including a combined £1.5bn for consumer and taxi vehicles alongside investment in charging infrastructure[[50]](#footnote-50). And, contrary to some of the assumptions in the literature that the 'neoliberalisation' of the UK economy makes it pathologically averse to intervening in the market, the very existence of the EV development strategy suggests that there is more empirical scope for manoeuvre (Oren and Blyth, 2019). The UK was indeed one of the first countries to introduce a demand side subsidy for EVs in 2011 (H.M GOV, 2017a), although the subsidy is now at the lowest level of £2, 500 (H.M GOV, 2021a).

The data I gathered in the document analysis found that the publication of the Industrial Strategy in 2017 marked a point in which the EV transition became tied to a wider reorientation of the UK economy. Indeed, Berry et al., (2021) has previously suggested the publication of the Industrial Strategy departed from the 'conventional wisdom' of the UK economy and indicated that it was one with a faltering accumulation strategy. By its own admission the UK government used the Industrial Strategy to identify four grand challenges to the UK economy, namely that of (i) artificial intelligence and the data economy, (ii) clean growth, (iii) future mobility and (iv) an ageing society (H.M. GOV, 2018a). Like China (see Chapter 5), the UK has sought to couple the EV transition with a broader industrial reorganisation. And while the economic ideas which define both China and the UK are very different (Blyth, 2007) with China’s capitalist/socialist economy approach contrasting the UK's market-led, 'Anglo liberal' economy (Hay, 2013), both frame EVs as an opportunity to (re)industrialise their domestic economy.

To address at least two, if not three of the grand challenges identified by the UK government, an explicit focus was placed on EVs through the publishing of the Automotive Sector Deal, designed to invest 2.4% of GDP into the EV transition, increasing the proportion of each vehicle, per unit, that is made in the UK and to re-skill the UK labour force[[51]](#footnote-51) (H.M GOV, 2018a). It was thereby stated that "we must take advantage of the once in a generation opportunity to build a world-leading EV supply chain here in the UK" (H.M GOV, 2021a, p. 14) as it was estimated that low carbon growth could be up to four times faster than the broader UK economy. The intention to capitalise on the low carbon transition in the automobile sector was reiterated throughout the document analysis, from 'levelling up' and modernising industry to creating new jobs and augmenting economic growth (H.M GOV, 2021a; 2021c; 2016). The Automotive Sector Deal acknowledges that the state will have to lead the way in the transition (H.M GOV, 2019a, 2017b) for the UK to establish the world's first net-zero industrial cluster by 2040 (H.M GOV, 2019b).

The EV transition presents several ways in which to develop an industrial core far from simply the final vehicle. The wider supply chain includes digital systems, AI driving technology, refined steel, recycled rubber, and more, all of which the UK could use as the basis for cultivating a new domestic industry. The empirical data gathered in the document analysis indicated that the UK modernisation agenda was focused on increasing the percentage of each vehicle made in the UK to 50% (H.M GOV, 2018a), transforming the automobile sector with battery cell production through the creation of 'gigafactories’[[52]](#footnote-52) and developing the requisite EV supply chains. EVs thus presented the opportunity to create 2 to 3 times more value than ICE vehicles (ibid). Interviewees also noted that battery chemistry was the most viable route for the UK to modernise, given its pre-existing expertise in science and research (U8; U29).

The cultivation pathway I proposed in Chapter 3 was therefore evident in the UK’s intention to specialise in battery technology and produce a high proportion of each vehicle in the UK. As also noted in Chapter 1, the UK was one of the few countries to introduce a ban on petrol and diesel vehicles following the Paris Agreement, committing initially to 2040 before subsequently bringing it forward to 2030 (H.M. GOV, 2021a). The ban was illustrative of the problems faced by the UK, however, in that while it lacks an industrial base like export-driven, automobile producing economies such as Germany or Japan, the ban still elicited a negative response from legacy manufacturers. The UK's automobile lobby group, the Society of Motor Manufacturers and Traders (SMMT), argued on behalf of manufacturers including BMW, Ford, and Jaguar Land Rover, that the prospect of overhauling production processes and asset portfolios 'would put significant strain on [their] commercial viability' (Jolly, 2021a). The absence of a major industry in the UK thus meant that the government’s attempts to modernise were no less contested by industry incumbents.

Since the ban, the UK's EV development strategy has tended to avoid similarly stringent policy measures by instead focusing investment in certain areas and a demand-side policy for consumers. An interviewee, however, stated that this is problematic as the "problem won't just be solved by throwing money at it, there are some aspects of the transition that might even involve having a lot less money in the system or in particular sectors for sure" (U11). Other interviewees said that what capital had been allocated to the EV transition was welcome but only a limited substitute for a stringent policy framework (U2, U8; U17; U20; U22). Such a framework might, according to many interviewees, require wiping out a high proportion of manufacturers' asset portfolios and balance sheets, namely those invested in conventional vehicles (U11; U13). On this point, interviewees incidentally reflected a recent focus on fossil fuel divestment to meet net-zero objectives (IEA, 2021).

By identifying the shortcomings of the UK’s EV strategy, interviewees spoke again to the barriers to the transition, namely that placing restrictions on the velocity of capital in the UK economy is inherently problematic. Not only because the market exchanges are also the primary indicators of economic prosperity (Pilling, 2019; Raworth, 2018). But more immediately, the automobile sector, like the UK's economy, is capital intensive. As previously noted in this thesis, much of the value of automobiles is contingent upon a diverse financial ecosystem (see Chapter 2). Those interviewees working with automobile retailers noted that this itself produced a problem, as the commission rates attached to EVs are far lower than conventional vehicles if they exist at all (U1; U3; U17; U22).

One interviewee who works with automobile retailers for consumer and commercial purposes indicated that manufacturers themselves were indirectly inhibiting the transition by failing to implement similar incentives for EV sales to ICE vehicles. This, again, reflected the UK’s liberal approach to the transition. More specifically, they stated that "what dealerships do, [and] they openly said to me, is if somebody comes in and asks for an electric car, [they say] sure we'll sell them an electric car. But, if they don't, we wouldn't sell them an EV [as there is no economic incentive to do so]" (U7). Another interviewee who works with manufacturers such as Nissan and Renault developed this further, stating that retailers were excluding EVs from commission rates and so disincentivising their sale (U22) due to EVs requiring fewer services, experiencing fewer faults, and requiring less maintenance.

Despite the liberal approach, an emphasis on EVs nonetheless formed a central part of seemingly annual policy publications in the document analysis, from the *Industrial Strategy* (2017b), *Clean Growth Strategy* (2017a), the *Road to Zero* *strategy* (2018b), the *Clean Air Strateg*y (2019), the *Green Industrial Revolution* (2021a), and most recently, the *Transport Decarbonisation Plan* (2021b). The frequency of these publications epitomised the tension between the UK government's instinctive inclinations to policy, ceding emphasis to the market, and the demands of the EV transition. By way of an example, the Industrial Strategy (2017b) emphasised the discernible role of the state, only for the focus to return to private actors in the Clean Growth Strategy (2017a). Thereafter, the Road to Zero Strategy's (2018b) commitment to the ban on ICE vehicles made it unavoidably determined by the state. But the Green Industrial Revolution (2021a) again ceded to the emphasis on the market. Most recently, the Transport Decarbonisation Plan (2021b) has again taken on a more state-led focus, but in the form of a regulatory approach on the part of the state. See Figure 8 for an overview.

**Figure 8: UK government’s state to market-led approach**

|  |  |
| --- | --- |
| **Strategy/Year** | **State/market** |
| **Industrial Strategy (2017b):**   * **Automobile Sector Deal - State investment as proportion of GDP into cultivating the UK’s automobile sector centred around EVs.** | **State** |
| **Clean Growth Strategy (2017a):**   * **Along with an emphasis on offshore wind and smart meters, EVs formed a central pillar of the UK’s attempts to ‘green’ its growth model. The Clean Growth Strategy was thought to represent a strong investment into the economy but contained gaps that comprised the fourth and fifth carbon budgets (Gault et al., 2018).** | **Market** |
| **Road to Zero (2018b):**   * **Formalised the ban on petrol and diesel vehicles by 2040 as announced after the Paris Agreement in 2015. The ban has since been brought forward to 2030.** | **State** |
| **Green Industrial Revolution (2021a):**   * **With the GIR represents the UK’s Green New Deal, the strategy is primarily designed to incentivise private finance into the transition. This seemingly reflects the notion that state investment leads to a ‘crowding-in’ of private investment (Hickel, 2021; Hatano, 2010; Aschauer, 1989).** | **Market** |
| **Transport Decarbonisation Plan (2021b):**   * **Though the plan is not solely confined to EV transition, the state’s commitment to decarbonise the wider transport network not only represented a more state-led approach that contrasted with the Green Industrial Revolution but was again reiterated the intention on the part of the state to decarbonise the economy through a series of modernisation commitments.** | **State** |

Authors graphic: Source H.M. government (2021a; 2021b; 2018; 2017a; 2016)

There are material implications for this oscillating state-market approach to EV policy. For example, an interviewee who works at the DfT stated that now "there's not a government strategy that says this is the best approach" (U24) in developing EVs nationally. An interviewee from the Office for Low Emission Vehicles (OLEV), (the governmental body established to support the UK's EV transition), also noted that attempts to implement an essentially 'top down' and information-intensive transition in an economy predicated upon limited government intervention makes those individuals adverse to dictates from the state, whether it be banning vehicles or a curtailing of the perceived free market (U19). The interviewee from OLEV subsequently stated that after "years of kind of stepping back, the current government who said, 'we want this to be an industry-led transition" (U10) now wants to lead the transition itself. They continued, "and that's why they've had loads of issues with their cleaner zones because the national government didn't want to be seen as imposing these zones on these cities and [now] take the political hit for saying we're doing this because it's better for you" (ibid). Both interviewees from the UK governments consequently indicated that UK, who’s long since insisted on benefits of liberal market economy, cannot simply now begin steered low carbon transition, no matter the landscape pressures.

Yet, for all the modernisation rhetoric to have emerged since the Industrial Strategy, the document analysis also examined the Green Finance strategy (2019a), which, while released as part of the Industrial Strategy, deviated significantly from the emphasis on industry. Instead, the Green Finance strategy was focused on integrating environmental policy in the financial system and the financial services in which the UK, as noted, already enjoys a comparative advantage. The Green Finance strategy is made all the more noticeable because it makes little reference to the industrial reorganisation highlighted elsewhere in the document analysis. This could therefore be interpreted as an alternative to, rather than complementary with, the aims of the Industrial Strategy.

Green finance, alternatively, presents a viable means to overcome the financialised barrier, albeit in an all too different way to the industrial strategy, that greens their present expertise in financial services. Instead of pioneering new industry production, the UK may be the pioneers of the financial flows that allow domestic and international manufacturers to finance their operations. In the case of EVs, the UK might then seek to stipulate the terms upon which credit is allocated for existing automobile manufacturers as opposed to cultivating an industry that competes with the very same manufacturers. The latter would, of course, constitute less in the way of an overt intervention into the EV market, but could nonetheless still have a profound impact on the transition globally.

### 6.2.1 Overcoming the financialised barrier

As already tentatively outlined above, from the document analysis, I found two possible ways of overcoming the financial barrier: (i) the Green Industrial Revolution or (ii) 'greening' the financial services of the economy through a focus on green finance (H.M. GOV, 2021a; 2019a). The extent to which either of these strategies may indeed overcome the barrier is, of course, debatable. They nonetheless constitute the most viable alternatives in which the UK may circumvent the barriers to the EV transition created by its financialised political economy. The first has been briefly introduced in Chapter 5, as the UK's Green Industrial Revolution presents a distinctly viable opportunity to reconfigure aspects of the economy through an investment programme into the previously established Automotive Sector Deal. Alternatively, the UK has taken steps to 'green' its fiscal and monetary policies through both the Treasury and the Bank of England (BoE) as green finance was identified as an 'opportunity' for the financial sector (H.M. GOV, 2019) and thus modernise UK political economy in a different way.

#### 6.2.2 Green Industrial Revolution

As noted in Chapter 5, several countries across the global economy have produced a Green New Deal in recent years, including the USA, Europe, and Australia (Chomsky and Pollin, 2020; Zycher, 2019). In the UK, this has been internalised in the Green Industrial Revolution. Building on the industrial strategy, the integration of industrial and green objectives has meant that the Green Industrial Revolution has become one of the UK's principal political objectives. The Green Industrial Revolution consists of a ten-point plan to 'pioneer' a new age of British industry' (H.M. GOV, 2021a, p. 6) to deliver its net-zero commitments. EVs form a key element of the Green Industrial Revolution along with investment in offshore wind, carbon capture and storage and green finance; EVs form a key element of the Green Industrial Revolution and vice versa.

In part 4 of the ten-point plan, EVs were identified as "[the] most visible incarnation of our ability to simultaneously create jobs, strengthen British industry, cut emissions, and continue travelling" at the current rate (H.M. GOV, 2021a, p. 14). Key to the modernisation plan is building 'gigafactories' and securing jobs down the EV supply chain. Accompanying the ban on ICE vehicles by 2030, the strategy was designed to reshape British industry with £2.8bn of investment in a demand-side subsidy, development of charging infrastructure, and UK based 'gigafactories' for EV production (ibid). The GIR is also intended to incentivise £3bn of private capital into the EV transition (ibid). Aside from acknowledging the need for a more state coordinated influence on the economy, the GIR is also a product of the UK's post-Brexit ambitions, in which EVs may play a significant role (see below). Exogenous factors could therefore be considered to have propelled EVs to the front of UK industrial and economic policy.

Interviewees were, however, critical that it took these events for the state to intervene. Not only because, as one interviewee based at a research organisation stated, the GIR had exposed the "various myths about monetary and fiscal policy that are constraining the sort of political imagination" in the UK (U11). But it exhibited that "the UK Government has far more fiscal capacity than it’s ever willing to show (ibid). The public capital allocated in the GIR is primarily intended to give private investors’ confidence to attract £12bn in private capital. Therefore, while research suggests that public capital tends to crowd in private capital (Hickel, 2021), there remains uncertainty about the extent to which the GIR can achieve the required level of investment, given the dearth of private investment since the Financial Crisis (Keen, 2021; Varoufakis, 2015). Moreover, such a reliance on the private sector also raises questions over the actual guaranteed level of investment proposed by the GIR and simply reflects the UK’s oscillation between a state and/or market led transition noted above.

It is therefore easy to overstate the impact of the GIR. And while the UK has now begun to establish its Green New Deals in earnest, its intellectual history extends to the aftermath of the Financial Crisis[[53]](#footnote-53) (NEF, 2008). Initially, it was proposed to regulate the financial system while delivering a 'transformative' stimulus into the economy (ibid). Subsequent scholarship has sought to develop the term alongside innovative policy instruments, including universal access to renewable energy, climate debt payments, de-commodified public spaces, and food sovereignty (Ajl, 2021), and a 'workers' transition ensuring people made redundant by phasing out fossil fuels are (re)employed in green industries to green investment without growth (Kallis et al., 2020). It is clear then that the UK’s government interpretation of the Green New Deal is significantly far removed from the scholar interpretation.

More recent developments in the Green New Deal scholarship have only further revealed limitations in the UK’s approach. Firstly, as one of the contributors to the original Green New Deal, Pettifor (2020) has (re)emphasised the need to address the financial system, particularly how it finances fossil fuel activity, having increased since the signing of the Paris Agreement (Bank Track, 2020). Such a focus seeks to not simply ask how much money needs to be invested in the GND but question the function of money in the global economy as a whole. Pettifor then looks to address monetary policy and fiscal aspects of the GND. The second trend is that many scholars turning their attention to GNDs are considering whether they will ultimately need to rethink economic imperatives, moving away from economic growth and towards new socio-economic indicators (Hickel, 2021, Lawrence and Laybourn-Laytion, 2021; Mann, 2021). An interviewee incidentally stated that for automobile decarbonisation, "we need fewer, not just newer vehicles" (U13) as policymakers themselves echo some of the more recent debates in degrowth/post-growth literature.

The GIR consequently had, and to a certain extent still has, the potential to make a break with the UK’s economic model, but it has since become a compromise with, rather than challenge to, the UK’s economic status quo. Furthermore, while it is beyond the scope of this research to consider these different interpretations in full, the GND literature indicates that there is a significant disparity between conceptual interpretations of the GIR and how it has been implemented in the UK. Even beyond the literature, when considering the GIR's linear development within the UK, it still hardly represents a uniquely profound intervention into the environmental-economic relations, given that it followed the Clean Growth strategy and the Road to Zero strategy, which made similar overtures to state intervention but ultimately manifested very little. That is not to say that it is not an important intervention, but that the GIR by no means represents a revolution in greening or the industrialising of the UK economy.

#### 6.2.3 Green Finance and the Bank of England (BoE)

Like the Green New Deal, green finance has become an increasingly common feature of environmental politics in recent years (H.M. GOV, 2019a). Unlike the GIR, however, rather than any reconfiguring of the UK's industrial core, the UK’s Green Finance strategy instead aligns with the UK's present expertise in financial services and encourages investment in innovation. The Green Finance Strategy addresses the role of the state, regulators, financial institutions, and industry in green finance (ibid). It is intended to provide a financial case for the environment and vice versa, focusing on the financial cost of poor air quality instead of the health risk (ibid). Though not directly focused on an opportunity presented by EVs, green finance may expand the UK's domestic and international opportunities through green financial products, including green loans, green mortgages and channelling pension, hedge, and investment funds into such green technologies.

How the transition will be financed and who will be the financer of them are inevitably intertwined questions. Those who assume the role of the latter stand to glean greater benefits from the transition. For the UK, which has expertise already in the mechanics of the financial system, there is an opportunity to position itself as the global hub for green finance, reshaping the UK but in an all too different way to that of the GIR. For example, given the UK's financialised orientation, the Green Finance Strategy suggests that it may make it well suited to financing particular industrial clusters across the global economy without necessarily having an industrial policy of its own. Green finance would allow the UK to continue to export 'green' financial services rather than export finished products.

The benefit of this model could accrue to those industrial actors down the EV supply chain, such as those in the battery manufacturing and gigafactories, which could access credit underwritten by the state and ensure private capital for small to medium businesses to channel private capital into the burgeoning industry, such as EVs, energy and farming (H.M. GOV, 2019a). Rather than cultivate an industry, at least in the traditional sense, the UK might then work alongside organisations, including the Financial Conduct Authority, Financial Reporting Council, the Pension Regulator, and the Bank of England, to cultivate a financial environment that could nurture low carbon transitions within a green financial framework (ibid). This might also internalise the environmental costs of automobiles, as CO2 to NO2 emissions may be better incorporated into the financial system. The strategy incidentally includes the Transition Pathway Initiative, in which pension funds are to be invested in companies that can provide information on how they manage their CO2 emissions. Having already identified the automobile sector, the initiative is designed to make portfolios align with net-zero goals.

To that end, two important steps have also already been taken. The UK's most overt example of green finance is the issuance of Green +Gilts (bonds) within the green financing framework (H.M. GOV, 2020a). Issued to raise £15bn, the bonds will be allocated for six purposes: clean transport, renewable energy, energy efficiency, pollution prevention, living and natural resources and climate change adaptation (Schomberg, 2021). Part of the issuance is to establish a green 'yield curve', which makes the efficacy of green bonds presently uncertain. Issuances elsewhere in the globe suggest the demand for green bonds is not only high but also makes investments in once illiquid green assets liquid (Tew, 2020). Moreover, as noted in Chapter 5, these green bonds have also been replicated by corporate bonds markets.

The second is ‘greening’ monetary policy at the Bank of England. Both the Bank's Financial and Monetary committees have stated their intentions to internalise the cost of CO2 emissions through insurance programmes or to no longer buy corporate bonds from automobile manufacturers without EV commitments. Yet, while the Bank of England is one of the founding members of the Network for Greening the Financial System (NGFS) and the Task Force on Climate-Related Financial Disclosures (TCFD), the Bank has itself been reluctant to integrate climate and environmental risks into its monetary and financial policy frameworks (H.M. GOV, 2019a). By then giving the Bank a green mandate in 2021, the British state not only sought to address this gap in green finance but also the problems of the green finance framework. The BoE could, therefore, play a pivotal role in aligning the financial markets that encircle the automobile sector with Paris Objectives (see Chapter 2).

Beyond the Green Gilt and mandate for the Bank of England, however, the green financial strategy has not significantly greened the financial system. UK commercial banks have instead continued to lend to fossil fuel companies, with over 33 of the biggest banking institutions in the world investing $1.9tr alone since 2015, with Barclays being the highest lender of all UK commercial banks, suggesting that there remains an absence of fines or penalties for non-green lending (Bank Track, 2020). More recently, one interviewee stated that lending to fossil intensive companies had continued through COVID, including the "COVID Corporate Financing Facility, the Bank of England administers that... giving the country's biggest corporations access to newly created money at the bank. An exclusive, really privileged facility, very low rates and we've estimated that about 10 billion has gone to high carbon companies" (U11).

As with many such strategies in recent years, the UK also created the Green Finance Taskforce following the Green Finance Strategy to recommend how the UK may most effectively deploy green financial measures. Because the initiative remains a voluntary scheme with few or no enforcement mechanisms, it has had seemingly little impact. Therefore, like the Green Industrial Revolution, the Green Finance strategy is faced with profound difficulties in overcoming the financialised barrier. Gaining any comparative advantage in emerging markets or exporting services, whether green or otherwise, does not, however, occur in a vacuum solely defined by the UK but is embedded within the trade agreements of the global economy. Therefore, cultivating any green industry or finance is tied to the UK's trading relationships with international partners, particularly with the EU, and requires situating within a broader international arrangement.

### 6.3 The Brexit barrier

As well as the composition of the UK economy, interviewees stated that the UK's departure from the European Union (Brexit) had formed a barrier to the UK's EV transition (U1; U5; U10; U22; U30). Brexit was also noted by several of the German interviewees as a barrier to the wider EV transition (G1; G14; G15; G19). The interviewees' emphasis on Brexit reflects the debate in the literature and public discourse centred around the economic impact of Brexit on the UK, ranging from a recession (Bocse, 2019) to capital flight and 'bond vigilantes' (Blakeley, 2020) and opened the question as to the UK's growth model or economic relationship outside the EU (Perraton and Spreafico, 2018). One immediate impact of Brexit on the UK's EV transitions is that Tesla refused the option to open a new gigafactory in the UK because of economic uncertainty (Jolly, 2020). Brexit did, however, (re)politicise the UK’s financialised growth model (Rosamund, 2019), and provide the backdrop for many of the documents analysed in this thesis.

Aside from the political and economic implications of (dis)entangling itself from the EU, Brexit presents profound challenges to the UK's environmental policy framework (Burns et al., 2019), and, by extension, the EV development strategy. Historically, the EU has been portrayed in the literature as a positive influence on UK environmental policy, even sometimes acting as a guarantor (Burns and Carter, 2018; Jordan, 2004; Lowe and Ward, 1998). By leaving the EU, interviewees noted that the barrier(s) posed by Brexit might manifest in three ways:

(i) Failure to reflect the EU's incoming emissions standards, putting the UK at a comparative disadvantage in both the supply and demand of EVs.

(ii) Restricting access to the European market would put what little manufacturing capacity the UK has, through its just-in-time (JIT) manufacturing model, at risk due to its embeddedness within the EU's Single Market and customs union.

(iii) European Union legislation has served as the political leverage for environmental politics, particularly in the case of ClientEarth, to exert influence over policymking (U1; U4; U13; U17; U22). Therefore, while Brexit was a pronounced barrier to the EV transition, interviewees saw the manifestation of such a barrier as arising in several ancillary barriers, all of which require examination.

Taking these barriers in turn, the first barrier identified by interviewees was that the EU Emissions Standards could inhibit the UK's EV transition in several ways. At the very least, the UK's environmental credentials would be undermined by not implementing or adhering to similar emissions standards (U1; U15). The EU standards will profoundly impact the demand for EVs across Europe. In many instances, such has been the reluctance of manufacturers to produce EVs that demand already outstrips supply (U3; U8; U13). But as an interviewee who works alongside Renault and Nissan stated, "this means EVs [will] sell in Germany, or France or Spain, so, therefore, you're going to find EVs are also going to get sucked out of the UK into the EU market because we opted out" (U22). While interviewees noted that supply would increase, they also noted that there would be a 'lag effect', whereby the required increases in supply could take years. The lag is only compounded by the composition of the global automobile industry: larger European manufacturers are based in Germany, France, and Italy. This would likely lead to an implicit prioritisation of these countries, as states will provide manufacturers support to meet *their* own environmental objectives (U10; U14; U22).

The second ancillary barrier identified by interviewees from research-based organisations was that the EU had provided an important foundation for environmental policies (U7; U13; U23; U33). This has also been a theme in the environmental politics literature since the UK voted to leave the EU (Bocse, 2019) as concerns were raised over the long-term implications of leaving on the UK's Climate Change Act (Farstad et al., 2018), the Paris Agreement (Stua, 2019) and the UK's ability to meet environmental objectives (Reid, 2016). For this research, interviewees indicated that the EU's legislation on Air Quality had been pivotal in instigating a more robust EV development strategy (U4, U6, U13).

The final ancillary barrier created by Brexit echoed that of much of the debate in the literature and public discourse, in that the UK automobile sector relied upon access to the EU's Single Market (U20; U31; Foy, 2014). Given the UK's current just-in-time manufacturing model, the automobile sector relied upon the frictionless trade of products throughout Europe before final assembly in the UK (Franco and Rubha, 2017). The reservations of interviewees thereby reflected a broader scepticism amongst many British manufacturers who reiterated that 'any' deal would be better than 'No Deal' between the UK and EU (Strachan, 2021). Since conducting the interviews, the UK and EU have concluded the EU-UK Trade and Cooperation Agreement, in which both parties agreed to no tariffs (taxes) or quotas (limits) on the goods traded (EU, 2021). However, to further define the barrier Brexit presents to the UK’s EV transition, I here turn to interviewees from ClientEarth (6.2.2) and Nissan (6.2.3), who provided lucid accounts of its impact empirically.

#### 6.2.2 ClientEarth

In 2017, environmental lawyers ClientEarth sued the UK government for the illegal level of air pollution linked to 40, 000 early deaths every year (Carrington and Taylor, 2017). ClientEarth used the EU's Nitrogen Dioxide (NO2) legislation (or Council Directive 85/203/EEC) as the basis for legal proceedings which had previously been linked to diesel vehicles. Following the 2017 court case, incidentally, the third instance in which ClientEarth had sued the government, the court ruled that the government's plans were a 'woefully inadequate' approach to addressing air quality in the UK (Carrington, 2017). By extension, ClientEarth helped reveal the gaps in the UK's EV development strategy, which, until that point, had been largely characterised by a demand-side strategy (Mason and Carrington, 2017). The lawsuit thus preceded the ban on petrol and diesel vehicles and an increase in funding for local authorities to address NO2 emissions.

An interviewee from ClientEarth reflected upon the process of lawsuits, stating that "after every court case the government said, "yep, local authorities, it is time for to deliver air quality plans' but [did] not give them the required finance or expertise or national direction" to implement EV policy materially. The interviewee said the process was simply designed to produce 'fall guys' outside the government (ibid). Remarking upon the spate of publications I noted above, the interviewee stated that these plans lacked detail, citing a lack of a clear roadmap to automobile decarbonisation. They stated the policy documents that had followed the lawsuits were "just kicking the can down the road. We would see [them] as not without value. But it is not enough, nowhere near enough" (U13). As previously noted in Chapter 5, the interviewee suggested that EU policy had provided the basis for UK EV policy.

The same interviewee suggested that the UK government's approach to the EV transition was insufficient to expediate the transition because it had been designed simply for "prolonging the life of internal combustion engines artificially because the demand is there, the technology is ready. The barriers are bureaucratic, not technological" (ibid). The interviewee argued that these barriers persist in meeting air quality standards, and EV transition was due to the lobbying influence of oil and automobile manufacturers, whose influence on national policy was strong. Motivated by maintaining their present business model and asset portfolio, the interviewee stated that automobile manufacturers 'peddled myths' and were simply "paying lip service to electrification for as long as possible before facing what I'm sure they see as inevitable, but they do not want to come any sooner than it has to" (U13). The EU was not above criticism but overall was seen as a positive influence on UK policy.

#### 6.2.3 Nissan

Though Nissan is a Japanese company, it accounts for the largest automobile output in the UK, with 70 000 jobs down the supply chain (Jack, 2021). Furthermore, in the Nissan Leaf, a vehicle produced in the UK's Sunderland plant, the UK produces one of the highest-selling EVs in the global economy. Consequently, the Sunderland Nissan factory was politicised in the Brexit debate by both the Remain and Leave sides as to how the relevant merits of each position would benefit the company. Nissan also appeared to typify the polarised debate, simultaneously stating Brexit could make remaining in the UK difficult, before stating it could provide Nissan with a 'competitive advantage' in the market (Chapman, 2021; Campbell and Inagaki, 2020). Nissan, therefore, typified the choices presented to manufacturers with the prospect of EV transition, as they must decide whether to undertake a profound internal reorganisation or simply adjust present investments into the emergent technology (see Chapter 7 for how this affected German automobile manufacturers).

Nissan thereby serves as an instructive example of how the UK's EV transition has become tied to Brexit. In the Automobile Sector Deal, the Nissan factory was also frequently referenced as the basis for, and example of, the UK's potential automobile capacity (U8; U22). An interviewee who currently works with Nissan's Sunderland factory stated Nissan were one of the earlier movers in the EV transition, alongside Renault and Tesla, but they are now "treading water" (U8). They continued to state that "Nissan makes the Leafs for Europe out of Sunderland and seven years ago they had a capacity of 50 000 and in 2020 they have a capacity of 50 000" (U8). The uncertainty over Brexit had, therefore, contributed to a lack of pressure on Nissan to increase output. Interviewees suggested that the longer implications were that the insufficient supply had inhibited EV consumption across Europe as, rather than a lack of demand for EVs, it was the manufacturer's unwillingness to supply the vehicles (U13; U17; U29).

This was not simply the fault of Brexit but, as another interviewee who previously had worked for Nissan stated, a gap within the EU's policy framework itself, as the Sunderland plant had been reluctant to expand the production of the Leaf due it is using the same production line as the Nissan Qashqai, one of their higher selling petrol vehicles (U22). This, they suggested, was then a failure of the EU's policy framework as much as it was the UK's. The interviewee noted that the implications for Nissan not expanding Leaf production affected the UK and had more profound effects on the global EV market. They stated that while Nissan, like other European manufacturers, had failed to embrace the EV transition, this allowed China to monopolise many raw materials, including lithium and Cobalt, for their domestic production (U22). Whether the UK, then, attempts to wrestle capacity back from China or include such resources in any potential trade deal with China could determine the UK's modernisation objectives.

With the Brexit picture becoming clearer since conducting the interviews, it has since emerged that the UK's initial steps outside of the EU remain ones committed to augmenting domestic production of EVs. Exemplified by the opening of their first gigafactory with Envision, the gigafactory has been incorporated into the UK's current automobile sector, with Envision establishing an 'all-electric crossover' to Nissan's future EV range (Kelso, 2021). Elsewhere, the creation of the Advanced Propulsion Centre has subsequently assisted in establishing UK start-up enterprises, such as Britishvolt and AMTE, all to increase the UK gigafactory capacity despite fears persisting that the UK's automobile industry will find it difficult to secure the raw materials for EVs in the long term (Jolly, 2020).

The EU-UK deal still came at a cost to the UK, as companies specialising in financial services lost their automatic right to access EU markets, restricting their access to the bloc (Edgington, 2020). This will indirectly impact the automobile sector as the UK's financial sector provides insurance, especially holiday insurance, for vehicle users in the UK and EU. However, longer-term, to ensure there remain no tariffs, the UK must comply with the rule of origin, customs declaration, and regulatory standards. These 'non-tariff barriers further are said to have transferred the cost of tariffs into time spent on administrative tasks (Strachan, 2021). Such time-sensitive and time-intensive tasks are there likely to have a profound impact on the just-in-time manufacturing model.

### 6.3.2 Overcoming the Brexit barrier

Due to the timeframe of this research, the interviewees offered little in the way of overcoming the Brexit barrier, given that negotiations were ongoing. It is worth noting however that interviewees did note the change had taken place under Theresa May and most recently under Boris Johnson regarding environmental policy. Specifically, they pointed to the setting of the NetZero target under May to the hosting of the 26th Conference of the Parties (COP26), and an electric bus city under Johnson (U10). However, clearer insights into how the barriers identified by interviewees might be overcome were found in the document analysis. As noted, Brexit instigated the raft of strategies, which formed the basis of the document analyses here (see above), such as the *25 Year Environment Plan,* which was released in the wake of the vote to leave the EU and ensure a 'green' Brexit (H.M. GOV, 2018c).

More recently, the UK's Environmental Bill, while yet to be fully implemented, included the ambition to differentiate itself from EU law (H.M GOV, 2021). The bill offers little in the way of clarity on automobile decarbonisation, but subsequent documents have provided for a clearer path around the barriers created by Brexit. Therefore, while leaving the EU is still presented as an opportunity and determinant to design public policy in equal measure (U16; U27; U33), the data suggests that there are two possible ways to overcome the Brexit barrier; (i) the Transport Decarbonisation Plan and how that might replicate EU policy and ensure the UK does not deviate from the standards and (ii) the trading arrangements which demand that the UK continue its development of gigafactories to ensure future access to the European market.

#### 6.3.3 Transport Decarbonisation Plan

Since the UK's formal departure from the EU, it has sought to ensure that around 500 major items of EU environmental law will be retained in UK law, at least in the short term (Burns and Jordan, 2021). The EU's legislative framework encompasses numerous laws relating to automobiles, from safety standards to emissions. Documents published by the government have been keen to stress that being outside the EU gives the UK scope to deviate from EU rules and 'go further' on many of these issues than the EU themselves (H.M. GOV, 2021b). As noted in Chapter 5, one of the key drivers in automobile decarbonisation has been EU emission standards. Given the importance of this policy, it is here worth considering how the UK might replicate its impact.

The Green Industrial Revolution was designed to provide a 'regulatory signal' to the UK economy (H.M. GOV, 2021a). This, however, manifested further in the form of the *Transport Decarbonisation Plan*, which was framed to represent the break from EU policy. The government states two options are being considered: (i) developing the CO2 emissions standard or (ii) using a zero-emission vehicles sales target alongside CO2 regulation (H.M. GOV, 2021b). Like the more novel features of the Norwegian and Chinese EV development strategies, the plan has also seen the introduction of green number plates for zero-emission vehicles and the intention to decarbonise the public sector fleet (ibid). This would decarbonise the vehicles used by public organisations by 2027-28 and make EVs more affordable for consumers on the second-hand market.

Published alongside the Transport Decarbonisation plan, the 2035 Delivery Plan provided a clearer indication as to the strategy the UK intends to pursue outside the EU. Therein, the UK continues to weaken its development strategy by phasing out demand-side subsidies (currently 2023), which already excludes vehicles above £35, 000 (H.M GOV, 2021b, 2021c). Aside from the impact this might have on domestic consumers, given the market segmentation of the European automobile market (see Chapter 7), that £35 000 excludes many of the UK's European competitors, such as Mercedes, Porsche, and Audi, and so removing the subsidy will also impact the UK twice over. In addition, neither the Transport Decarbonisation Plan nor the 2035 Delivery Plan addressed a key issue raised by interviewees, namely that the ban on ICE vehicles lacked detail (U11; U28; U32).

Gaps, therefore, remain in the UK's post-EU framework as the Environment Act, the proposed 'landmark' in policy, still does not contain a 'non-regression' clause which might have guaranteed the UK mirrors EU standards (Burns and Jordan, 2021). As the policy framework continues to take shape, the future of UK environmental policy does not appear orientated towards replicating the EU emissions standards, although that does not discount the prospect of exceeding the standards at this stage (H.M. GOV, 2020b). Doubts nonetheless remain over the future regulatory environment in the UK. Despite the developments in policy, Bailey and Rajic (2020) argue that the UK still requires a 'policy reset' that departs from the liberalised economy approach that has served as the context of this chapter.

#### 6.3.4 Gigafactories and the Trade and Cooperation Agreement (TCA)

The UK's trade arrangement, as noted, has been established under the EU-UK Trade and Cooperation Agreement (TCA). Much like the Environmental Act, this free trade agreement addresses elements of the UK's arrangement in the short term as it forgoes tariffs on finished vehicles and products needed to produce the vehicles (Ayele et al., 2021). Unlike the Environmental Act, the TCA does contain a 'non-regression clause’ (Burns and Jordan, 2021). However, the longer-term implications, which, with regard to the TCA, refer to the period beyond the six years 'phase in', are that given Rules of Origin requirements will see that manufacturers and suppliers down the supply chain will still incur tariffs if, under the TCA, the UK cannot increase its production of the final vehicles[[54]](#footnote-54) (H.M GOV, 2019). Specifically, the Rules of Origins requirements state that automobiles are required not to exceed 45% of their total assembly outside of parties to the trading arrangement (Howe et al., 2021), which raises questions over the long-term capacity of the UK automobile sector to increase its percentage of domestic production.

Circumventing future tariffs, therefore, requires agreeing on new Rules of Origin or augmenting the UK's industrial capacity. UK automobile lobbyist SMMT states that doing this would require the creation of gigafactories within the six-year phase period to enhance UK manufacturing down the EV supply chain (SMMT, 2020). Establishing gigafactories in the UK would, they argue, require an industrial strategy further developed than the UK's current modernisation agenda (ibid). However, industrial investment of this kind potentially risks infringing upon the level playing field of open competition, and sustainable development is also agreed upon within the TCA. As noted by Crowley (2021), such are the terms of the agreement that by either the EU or UK seeking to lower perceived burdens on business in the form of tax, or indeed produce a domestic policy that might benefit their exports, then either party might violate the terms of the agreement.

Essentially, Howe et al., (2021) state that the UK's dilemma is to establish a greater percentage of vehicles in the UK or rely on Japanese manufacturers to support its automobile sector. Beneath the TCA's agreement then, lies an all too different reality as this constraining agreement appears to be a deliberate move on the part of the EU, which with full knowledge of the UK's Japanese dependency, could have introduced a 'diagonal cumulation of origin' in which the EU-Japan trade arrangement wherein the Rules of Origin are foregone. Industrial and agricultural products too are omitted from the agreement by the EU despite the UK attempting to replicate the EU-Canada Trade Agreement (Theodore et al., 2017). The TCA consequently represents an indirect exertion of power by the EU, and an alternative to the intentions of the UK established here may represent an opportunity for the EU to make the UK dependent upon EU exports.

Given the finer details of the TCA, however, Syrrakos (2021) states that it represents a 'very hard Brexit' in terms of bilateral trade on goods. As the UK and EU move more towards a 'regime of equivalence' on financial services and regulation (Moloney, 2021; Scott and Quaglia, 2020), the UK might simply opt to minimise any uncertainty by simply playing to the economy's current strengths, further entrenching the barriers I have highlighted here. Both the Brexit and financialised barriers are not simply exogenous events that have simply happened to the UK but are the result of decisions made by the British government, which have contributed to the UK automobile sector being acutely susceptible to external factors.

### 6.4 Automobile sector barrier

The final barrier highlighted by interviewees was the present state of the UK automobile sector itself (U10; U14). As previously noted, the UK's automobile industry is defined by a Just-In-Time model that has been contingent upon access to goods and services in the EU Single Market and Customers Union, and relying on foreign, mainly Asian manufacturers, and integrating into the European market. By depending on external actors in the form of Nissan and Toyota, interviewees stated that the trajectory of EVs was being shaped by forces beyond the UK's control, such as Volkswagen, Tesla, Volvo, and Renault (U5; U14; U20). Without a strong industrial core, the UK is therefore led by decisions made elsewhere in the global economy without shaping EV policy. In acknowledgement of this fact, and as I have already outlined, EVs represent an opportunity to address the UK's limitations in the automobile sector.

Understanding how the current structure of the UK automobile sector is a barrier requires taking a historical perspective, by looking back to the point at which British Leyland collapsed, and the UK became the net-importer of automobiles in 1975-77 (Cowin, 2012). While it is beyond this research to provide an extensive history of British Leyland, it is nonetheless important to note that the company was the product of a merger between Leyland Motors and British Motor Holdings with then UK brands including Jaguar, Rover, and Land Rover (Cowin, 2012). Then, the creation of British Leyland was emblematic of its often-attributed Keynesian form, just as its subsequent decline typified the economic transition to neoliberalism during the 1970/80s (see 6.1). As a result, British Leyland came to reflect many of the common features of neoliberalism, such as the issuing of corporate bonds and mergers (Cole, 2020). British Leyland, and the UK's automobile sector, are thus tied to the broader shift in the financialisation and de-industrialisation of the economy.

Situating the UK amidst the shifting political landscape during the 20th century also requires considering its integration into the EU. Incidentally, the decline of British Leyland has only been attributed to the broader industrial decline of the UK, but its entrance into the EU (then the European Economic Community) in 1973 is often attributed to European manufacturers outperforming British Leyland, resulting in its collapse (ibid). British Leyland was, however, like EVs are now, an attempt to address the UK's post-industrial decline and establish a comparative advantage for the UK economy.

Cultivating an automobile industry presents a profound challenge to the UK that it has failed to address. Not simply in that it needs to develop substantial productive facilities, but the labour, expertise and supply chains needed to establish an industrial core require long-term planning. Moreover, as noted above, even attempting to lure emergent actors in the EV to the UK is problematic, as seen by the UK's failed attempt to attract Tesla in 2019. Despite the cost, interviewees in the UK nonetheless argued that addressing this barrier would address several problematic elements of the UK economy. They noted that countries with productive automobile sectors tend to produce higher-skilled, well-paid jobs (U28; U31) contrary to the low skilled, low paid jobs that have come to characterise the UK economy, particularly outside of London (King and Millard, 2014; Sawyer, 2005). This, in turn, might diffuse the tensions cleaved open by Brexit (U20; U22). So too might it address the UK's productivity problem (U1; U6; U10) as the UK tends to work longer hours than many European counterparts[[55]](#footnote-55) (TUC, 2019; Barnet et al., 2014; Weale, 2012).

Interviewees reiterated much of the post-Brexit literature that if the UK intends to cultivate an industry, it will require a change in policy conducive to industrial reorganisation (U2, U17). As the interviewee suggested, this was simply an economic argument in that "from a policy perspective you know, if you are talking about value to the UK, even though we have that [just-in-time model], there isn't a British owned industry, there isn't an English brand that's owned by the UK" (U10). Contrary to the trend of offshoring production since the 1980s, this idea of an increased value, albeit one which went undefined, was stated by several interviewees on the topic of a (re)established automobile sector (U3; U13; U17). Interviewees again indicated that the decarbonisation of the automobile was contingent upon its modernisation, at least since the post-war period.

What efforts have previously been made to address this barrier subsequently have only served to accentuate the scale of the challenge. The documents examined in this research continuously referred to the current capacity of the UK, including the Warwick Manufacturing Group, the Automotive Council, Advanced Propulsion Centre, and Battery Industrialisation Centre (H.M GOV, 2018). The EV Taskforce was established with the publication of the Road to Zero Strategy, charged with ensuring collaboration between state and business. A state-investment programme was formulated through the Faraday challenges, and the Challenge Fund was designed to augment the design, development, and manufacture of batteries for EVs and the commercialisation of batteries (H.M. GOV, 2017a).

Contrasting interviewees' responses with the document analysis, therefore, indicated that the Automobile Sector Deal, one of the prominent features of the Industrial Strategy, had little effect on the state of the UK automobile sector. This, in turn, suggested that the impact of the Industrial Strategy has been overstated. Indeed, this debate, on whether industrial strategies represent a rethinking of economic foundations (Froud et al., 2021) or simply 'neoliberal wine in an interventionist bottle' continue in the literature (Berry and Barker, 2021). Interviews conducted for this research with the Advanced Propulsion Centre and EV Taskforce suggested that the organisation felt the latter was more likely. Much like the neoliberal common sense in Chapter 5, the interviewee from the Advanced Propulsion Centre expressed an aversion to state investment and policies perceived to be averse to business (U31). The interviewee on the board of the EV Taskforce appeared to be less overtly sceptical of taxes but was by no means advocating a state-led approach as set out in the Road to the Zero strategy (U15).

The recurring emphasis on addressing frailties in the UK’s automobile sector since the decline of British Leyland makes it easy to overstate the salience of the Industrial Strategy after 2016. Despite the Industrial Strategy symbolising a unique and uncharacteristic intervention into the UK economy on the part of the UK government, the empirical data gathered here indicated that has yet to constitute much in the way of a material change in the UK. Failing to address the problematic features of the UK’s reliance on the financial sector consequently raises the question as to how this persistent barrier may be overcome.

### 6.4.1 Overcoming the automobile sector barrier

Again, interviewees did not provide insights into how the automobile sector barrier may be overcome, nor were they necessarily expected to provide their thoughts on the matter. Instead, I found within the documents analysis three actors who operate between the rigid distinctions of state and automobile manufacturers. By these actors proposing means in which the barriers in the UK automobile sector may be overcome, they also touched upon problems of the UK’s financialised economy, however inadvertently. Notwithstanding, I refer to three policy proposals by three of the actors who, to varying degrees, made up the institutional architecture for the UK's EV transition. I therefore found that the UK might address the automobile barriers through (i) the access to credit highlighted by the Automotive Council, (ii) the Automotive Transformation Fund from the Advanced Propulsion Centre and (iii) the whole systems thinking by the EV Taskforce. It is thus by virtue of the following organisations proposing these additional measures that their interventions can be considered to address gaps in the UK's present industrial and environmental policy.

#### 6.4.2 Access to credit: Automotive Council

From the document analysis, the Automotive Council appears to occupy a unique role in the UK's EV transition, as it sits at the intersection of state-business relations. It was tasked with developing a roadmap for the automobile sector, addressing critical skills shortages required to capitalise on the emergent EV market (H.M. GOV, 2018). By virtue of this fact, the council was established to yield greater investment in the automobile sector through fostering public-private partnerships. Typically, it possesses no regulatory or financial powers. Its main role is instead to signpost businesses to what is available from potential research and/or private funders. The virtues of the Council's role were nonetheless reiterated in the document analysis for helping to ensure that one in five EVs sold in Europe has been manufactured in the UK (H.M. GOV, 2018a; 2017b). Furthermore, it stated that public-private partnerships had yielded 20% greater investment in the automobile sector (H.M. GOV, 2018a). Aside from the accomplishments attributed to the Council, it has itself revealed the shortfall in EV policy by stating that the transition still requires greater access to capital,

this was despite the council's remit of channelling state investment into a targeted, localised context. For example, the Automotive Council sought to establish links between the Biorenewables Development Centre and Yorkshire based food and drink companies or the Business Continuity Forum in Manchester (H.M. GOV, 2017b). The extent to which the Automotive Council has helped address the gap in finance is highlighted by the council itself. However, due to the Automotive Council having markedly limited capacity, operating in only an advisory capacity, it defers the responsibility of capital requirements for the sector to the Department for Business, Energy, and Industrial Strategy (BEIS). The Council, therefore, reiterates that the EV transition is contingent upon the state.

Within this research, the Automotive Council was established before the spate of policies introduced by the British government. Yet, in many regards, the council set the tone for the government's current approach, insofar as the Council has neither power, nor capacity, to influence policy. However, the council did establish the blueprint by which the subsequent task forces, from the Green Finance Task Force with the Green Finance Strategy to the EV Taskforce from the Road to Zero strategies were created. The proliferation of powerless actors simply creates the illusion of a robust institutional infrastructure but inadvertently highlights the issues of the EV transition being occupied by actors without the capacity to address them.

#### 6.4.3 Automotive Transformation Fund: Advanced Propulsion Centre

The Automobile Transformation Fund was established in 2020 as a joint venture between BEIS, the Department for International Trade, and Innovate UK. The fund is designed to facilitate foreign investment in the UK's automobile sector. Far from simply a state-led investment programme, the Advanced Propulsion Centre administered the fund to the value of £1bn, based on funding projects 50:50 with private investors. This reveals two important features of the UK's transition. Firstly, it demands that one acknowledges the amount of capital required to cultivate an automobile industry. Coincidentally, the fund itself has helped lay this bare. Even in its infantile state, the fund alone has already facilitated the investment of over £20m in scaling up the industry (Business Wire, 2021). But given that it was established to attract £24bn of investment, it shows the finance gap separating the UK's actual and required investment programme.

Secondly, by highlighting the £23bn deficit in funding, the UK is again reliant upon foreign investment and does little to guarantee either that the financial gap will ever be filled, or to free the UK from a dependency on foreign countries. Rather than represent a significant departure from the UK's current automobile model, recent allocations of the Transformation Fund have further developed ties with Japanese manufacturers through £1.5m in Japanese manufacturing. Limitations of the fund, therefore, persist due to the undeveloped or weak automobile sector. Indeed, an interviewee from the APC suggested the fund must "balance between supporting resilience in the UK manufacturing base, versus what you're doing as [fiscal] policy because ultimately, we do not have UK owned OEMs[[56]](#footnote-56)" (U31). This indicated that neither the fund nor the APC itself was designed to address the prominent gaps in the Industrial Strategy.

#### 6.4.4 Whole Systems Thinking: EV Taskforce

Created following the publication of the Road to Zero strategy, aside from the financial implications of the EV transition, the EV Taskforce was created to review the gaps in the UK's EV development strategy. It subsequently stated that overcoming the automobile barrier would necessitate development of charging and electricity infrastructure (EV Taskforce, 2019). The Taskforce intimated that the government's focus on financing the transition was too narrow. Instead, they proposed a 'whole systems thinking approach’. Of the various features of the EV transition, then, the Taskforce charged with aiding the transition shifted the focus from how EVs may be consumed; whole systems thinking attempts to address an ill-considered 'pre-condition' of mass-market adoption (Neill, 2020). The primary pre-condition they identified was the need for more charging infrastructure, which would need to be addressed.

The Whole System Thinking approach is therefore staged in different phases. In phase one, the EV Taskforce proposed 21 proposals that may aid in overcoming the automobile barriers (EV taskforce, 2019). The second phase is turning the proposals into action (Neill, 2020). An interviewee from the Taskforce stated that the group's purpose was to influence the secondary legislation of the Automated and Electric Vehicles Act Bill, the UK's primary legislation on EVs (U15). The Taskforce also works alongside various actors in the UK, including BEIS, Ofgem and OLEV. Within this institutional arrangement, the interviewee said that all were state or research organisations aside from the National Grid who helped shape the EV transition from the side of business (ibid).

In their role on the Taskforce, the interviewee also indicated that the transition was far less state-led, and that the state was looking to distance itself from orchestrating the role. They stated that instead "everything is couched through the lens of the consumer because if you don't get consumer buy-in this is worthless" (U15). The influence on the Taskforce, by their admission, was limited, however. Beyond the 21 proposals, the interviewee stated "it's very difficult to define what is the next step for the EV Taskforce" (U15). Ultimately, the task force has produced nothing since the initial document analysed here. Such is the nature of the Taskforce, like the Automobile Council and Advanced Propulsion Centre before it, it is imbued with little to no power from the British state. Therefore, the Taskforce, like the other actors identified here, again highlights how the automobile sector barrier may be overcome, but they are ultimately ill-equipped to take on this task. A Whole Systems Thinking approach is examined later in this thesis (see Chapter 8).

### 6.5 Conclusion

In this chapter, a key finding that emerged from the analysis of the documents and interviews is that decarbonising the UK’s automobile sector via the EV transition was part of a wider modernisation of the economy. I situated the barriers to this modernisation agenda within the broader political-economic context of COVID-19, Brexit, and the lingering effects of the Financial Crisis. Amid such a backdrop, the data for this research suggests that decarbonising the automobile sector presents the UK with an opportunity to modernise its economy, and so address several of the adverse socio-economic elements of the UK political economy, including a de-industrialised and low paying economy. As I noted in Chapter 1, how states are attempting to capitalise on the EV transition to modernise the economy has been neglected in the literature thus far, but the data collected for this research showed a clear intention to do so in the case of the UK.

Rather than seeing the transition to a decarbonised state as an uncontested process, I have outlined the main barriers which obstruct the UK from transitioning to a decarbonised automobile sector. Therefore, in answer to the question ‘*what are the barriers to decarbonising the automobile sector’* in the UK, the two primary barriers identified were the nature of the UK political economy, which is structurally dependent upon financial services and the import of finished goods. Second, Brexit presented several ancillary barriers, which have not yet been fully addressed. At this juncture, the UK still can capitalise on the EV transition as envisaged in various documents (H.M. GOV, 2021a; 2017a; 2017b) by investing in the requisite infrastructure through the Green industrial Revolution, particularly in gigafactories and down the supply chain. Alternatively, the UK may yet modernise to a lesser extent by pioneering green finance, an area that more closely reflects its competitive advantage in the global economy. Both barriers subsequently contributed to the absence of a developed automobile sector, producing an acute barrier in the UK.

The second question addressed in this chapter ‘*how can those barriers be overcome?’* initially found two alternatives which the UK may adopt. The Green Industrial Revolution and green finance were, however, opposite strategies with little overlap, with profound implications for the UK’s EV transition. Whereas the former would indicate a stronger role for the state in keeping with the data of Chapter 5, the latter would suggest that less change would be made to the UK political economy. Overcoming the Brexit barrier was acutely problematic, and by all accounts still unfolding at the time of writing this thesis. However, just as the industrial strategy that gave rise to the UK’s cultivation pathway came in the wake of the UK’s vote to leave the EU, the fruition or failure of the pathway may ultimately be determined by this barrier. Finally, the document analysis revealed that overcoming the automobile barrier was contingent upon access to capital and a different approach to the automobile sector in the UK that was not yet seemingly forthcoming.

The range of strategies published since 2016 reveal the UK government had acknowledged problematic features of the UK EV transition, and the UK economy as a whole. In addressing this issue, the documents revealed a tension at the heart of the government born from the seeming realisation that it is needed to shape the EV transition and its structural inclinations to cede the outcome of such change to the market. Therefore, on the one hand, the strategies examined here set out the UK's objectives for decarbonising the automobile sector, notwithstanding their lack of detail at times. But, on the other hand, the finance gap and ultimately powerless quasi-government bodies do little to shape the transition but signal the state's intentions, however lightly, to business. Nevertheless, decarbonising the UK economy through modernisation remains a valid political project that binds environmental, economic, and industrial policy towards a specified end.

In terms of the third research question, ‘*are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?’* it would appear the UK has had only moderate success so far. The reasons for this may be linked to the UK’s EV transition being embedded within a broader modernisation of the economy, making it a structural transition as much as one isolated to the automobile sector. When considering the comparative element of research, then, the limited success shown by the UK raises initial questions over the interlinked EV transition within the case study selection of this thesis. That is to consider whether the UK’s limited EV transition can be linked to the transition unfolding in Germany. In other words, it is reasonable to assume that the UK's transition, or lack thereof, would come at the expense of Germany, and vice versa. I accordingly shift the focus of this research to this link in the next chapter by examining the EV transition in Germany.

# Chapter Seven

## (Re)coordinating the German political economy: E-mobility and the Verkehrswende

“The whole story about electric mobility has not been very successful in Germany” (G7)

“It's lamentable the effort that manufacturers have put in, really, and they'll pay the price for it, and they deserve it because they should have sorted this out a long time ago” (U30)

### 7.1 Introduction

Germany's political economy is synonymous with its automobile sector. Companies such as Volkswagen, Audi and Mercedes allow Germany to export its national image to the global economy while facilitating surpluses in trade and the Federal budget (G11; G14; U10). In Chapter 3, I outlined that Germany is often thought of as the archetypical coordinated economy. Drawing on the empirical data, I depart from the common assumption in the literature to argue that the transition to EVs (or *e-mobility[[57]](#footnote-57)*) in Germany is becoming markedly *uncoordinated* in the face of decarbonising the automobile sector. I find that unlike the UK, whose barriers are rooted in its structural composition, the means to (re)coordinate the e-mobility transition lies in the long-neglected and ill-considered *Verkehrswende* (mobility transition).

Following the *Wirtshaftswunder* (economic miracle) after the Second World War, the German economy was (re)constructed around a new growth model defined by currency reform (from the Reichsmark to Deutsche Mark), a highly-skilled workforce and an export-driven model, centred around automobiles (Van Hook, 2004). This new growth model was designed alongside domestic industry to the extent that Germany is often portrayed as the quintessential example of a coordinated state and giving rise to the "narrative in Germany that if the car companies are doing well, then the German economy is doing well" (Dyson, 2021; Thelen and Kume, 2006; G23). As I outlined in Chapter 2, analyses of the automobile sector often operate at the aggregate level, paying little attention to individual companies, contrasting the focus of scholars who have elsewhere paid specific attention to companies such as Bosch (Börsch, 2006) or Siemens (Feldenkirchen, 2012). Instead, the constituent auto-actors, including Volkswagen, Daimler, and Bayerische Motoren Werke AG (BMW), are often combined to emphasise their embeddedness within the German, and more recently, European economies.

The automobile sector's structural power is subsequently coupled with its relationship to the state, whether that be the Federal ([*Bundesregierung*](https://en.wikipedia.org/wiki/Cabinet_of_Germany)*)* or the provincial government (*Länder)*, to form the 'regime of automobility' (Bohm et al., 2006). Haas (2020b) has examined the co-constitutive nature of this relationship, as the state has fiscally supported the expansion of road building, commuter allowances and stimulants (see below). In return, the sector is Germany's largest employer, a provider of apprenticeships, and contributes to the national balance of payments (Kampfner, 2020). This close relationship has contributed to conceptualisations of Germany as a 'social market economy' (Weishaupt, 2021; Bonefeld, 2017), an 'Ordoliberal' state (Dold and Krieger, 2019; Biebricher, 2017), or the 'Model Deutschland' (Haas 2020b). Such conceptual forms often seek to contrast Germany with liberal, or competitive, economies in which the state instead merely endeavours to provide affable conditions for capital to flourish but does not emphasise any industry in particular (Meckling and Nahm, 2018; Hall and Soskice, 2001; Soskice, 1990).

What makes this accord struck in Germany important is that it is contingent upon internal combustion engine vehicles, juxtaposing the economic importance of the automobile sector with the Federal state's environmental objectives, from its net-zero commitments to its Climate Action Law. This has led transport to become a 'problem child' (Haas and Richer, 2020) for Germany wherein, on the one hand, it accounts for the second-highest source of national emissions but, on the other, abandoning the internal combustion engine means abandoning Germany's most important competitive advantage in the global economy (Karnitschnig, 2018; G15). For example, one interviewee stated that because BMW's patent and intellectual property lies mainly in the design of internal combustion engines that abandoning the engines would make BMW little more than a packaging company (G15). Several interviewees also stressed that the e-mobility transition would be a structural one for Germany (G17; G19), which some compared to a 'Nokia-Kodak moment' for the German economy (G12; G15; G27) if they fail.

The e-mobility transition is one of three environmental transitions, including the coal phase-out and nuclear phase-out (G22). Since 2010, German environmental politics has been largely attributed to the *Energiewende* (energy transition), designed to transition the national energy system away from coal and oil to solar, wind and hydroelectricity (Baker et al., 2021). The *Energiewende* also coupled renewable energy development with Municipal and community ownership and established the *Agora Energiewende* think-tank to oversee the transition. The focus of this chapter lies on the far less considered *Verkehrswende*, established concurrently with the *Energiewende,* and formalised by the creation of the *Agora Verkehrswende* think-tank. The latter has, however, remained a somewhat peripheral element in German environmental politics to its counterpart.

Analysis of documents and interviews suggest that there are three primary barriers to the successful delivery of the *Verkehrswende,* which have manifested at different levels of the German political landscape. First, the main barrier cited by interviewees was the power of the automobile sector, exerted through its influence on environmental policies and the revolving door between the state and industry. Second, Germany's fiscal policy, the Black Zero, was identified as a barrier to the transition, reflecting a common fiscal barrier in this thesis in Chapter 5. Thirdly, through its Giga-Berlin gigafactory, the presence of Tesla was highlighted as a barrier, particularly to manufacturers. Tesla also sits uncomfortably at the intersection of competition or coordination previously employed in the literature (Meckling and Nahm, 2018), as interviewees were often divided as to whether Tesla represents competition or coordination with Germany's broader EV objectives.

The following analysis of the EV transition in Germany addresses the three research questions of this thesis. As shown below, the Diesel Scandal provides a unique context in which to examine the barriers to Germany’s EV transition. Once again taking lead from Chapter 5, and indeed Chapter 6, the following chapter answers the research question concerning ‘*what are the barriers to decarbonising the automobile sector*?’ in Germany, before as in the previous two chapters, examining ‘*how can those barriers be overcome?’* in the German case study. And finally, the chapter parallels Chapter 6, and the limited success found in the UK case study, by providing the second answer to the question ‘*are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?’* to establish the comparative element of this research.

### 7.2 The Automobile Industry barrier

The power of automobile manufacturers was cited as the biggest barrier to Germany's EV transition by interviewees (G6; G13; G22; G30). Manufacturers are a significant contributor to the German economy, accounting for a quarter of domestic industry at around €282.4bn, as 1 in 5 of all automobiles in the global economy are German (GTAI, 2021). They therefore play no small part in shaping domestic policy. Former Chancellor Angela Merkel, like her predecessors in the Chancellery, have long been accused of kowtowing to the industry and watering down environmental policies to maintain Germany's path dependency in petrol and diesel vehicles (Haas, 2020a). This barrier, and the industry's power, is not simply exerted by the manufacturers, but also by the automobile lobby, the *Verband der Automobilindustrie* (VDA), whom one interviewee suggested have always lobbied on behalf of the sector to create doubt over alternative technologies such as EVs (G18).

As noted above, the sector is often analysed at the aggregate level, but it is a more heterogeneous entity than it might first appear. Specifically, Volkswagen, the largest manufacturer in Germany, is orientated around mid to lower price range vehicles to allow for greater scale and output. BMW and Daimler AG, by contrast, are 'luxury' brands targeted at the luxury car segments. Within this trio of prominent actors exist various other manufacturers, for example the Volkswagen Group are the parent company of Bentley, Audi, Porsche, Skoda, SEAT, Lamborghini and more, BMW owns Rolls-Royce and Mini, and Daimler AG owns Mercedes Benz, Smart and Setra amongst others (Neto et al., 2020). All manufacturers also have financial service arms, including the Volkswagen Bank, BMW Bank GmbH, and Mercedes-Benz Bank, to finance their operations in the market (see Chapter 2).

Historically, Germany has been the symbol of a ‘coordinated’ economy due in no small part to the relationship between Germany’s Federal government and its domestic automobile sector. Coordination, in this regard, is often thought to be synonymous with a corporatist interdependence between the state and business, as political and economic objectives are the subject of negotiations from both parties to ensure future stability (Rademacher, 2021). Both the work of Meckling and Nahm (2018), whose contribution to this thesis was highlighted in Chapter 3, and Hall and Soskice’s (2004) *Varieties of Capitalism* perspective refer to Germany as coordinated polity due to its strategic interaction between state and business actors, incremental innovation, and a comparative advantage in manufacturing.

What unites all actors located in Germany is the desire to remain competitive in the global economy, their expertise in automobiles, and the accumulation of capital (Mazur et al., 2013; IFRI, 2021). As such, I found that manufacturers erected several barriers to the EV transition, according to the responses of interviewees:

1. The revolving door between the state and industry. Aside from the structural power they can exert through portraying their ends as aligned with those of the broader interest of society, various actors move between the state and the industry to influence policy.
2. Due to Germany being central to the European Union (EU), the automobile sector endeavours to influence policy at the European level through financial and political means.
3. Aside from lobbying, the automobile sector and the VDA have attempted to frame the EV debate as one of 'technological neutrality’ in a bid to avoid committing themselves to EVs.
4. The interest of the automobile sector has shaped and driven the *National Platform Elektromobilität* (NPE), the policy forum established to coordinate Germany's EV transition.

Taking these factors in turn, the interviewees stated an observable revolving door between the automobile industry and the state at the Federal level. For example, one interviewee stated that "there is a strong connection between the automotive industry and the Conservative Party [but] also the non-conservative parties. I have to say so, the Social Democrats, they [too] have a strong, very strong connection to the automotive industry" (G5). Recent examples of the revolving door reveal the extent to which it envelops parties from across the political spectrum, including Eckart von Klaeden (CDU), previously the Ministry of State in the Chancellery, who is now the chief lobbyist at Daimler, who, when transport minister, presided over the watering down of CO2 standards in 2013-2014 (G23). In addition, Thomas Steg (SPD), previously the government spokesman, is now the chief lobbyist for Volkswagen, Maximillian Schöberl (CSU), former spokesperson for the party in Munich, is now chief lobbyist for BMW, and Matthias Wissmann moved from the Federal Ministry of Transport and Digital Infrastructure (BMVI) to the VDA. So prevalent is the revolving door that even former chancellor Gerhard Schröder moved to Volkswagen after leaving the Chancellery (G23). Figure 9 provides a list of the actors who have moved between this revolving door in recent decades.

**Figure 9: The revolving door between the state and the automobile industry**

|  |  |
| --- | --- |
| **Politics** | **Automobile Industry** |
| **Gerhard Schröder** - Chancellor of Germany (1998 - 2005) | **Volkswagen -** supervisory board (1994) |
| **Matthias Wissman -** Federal Ministry of Transport | **Verband der Automobilindustrie (VDA)** – President |
| **Eckart von Klaeden -** Minister of state in the federal chancellery (2009-2013) | **Daimler -** Chief lobbyist (2013) |
| **Michael Jansen -** CDU chief of staff (2006-2009) | **Volkswagen -** Berlin chief lobbyist (2015) |
| **Thomas Steg -** SPD Media counsel (2009) | **Volkswagen -** chief lobbyist (2012) |
| **Maximilian Schöberl** - CDU spokesperson in Munich (1992-1998) | **BMW -** chief lobbyist (2006) |
| **Automobile Industry** | **Politics** |
| **Martin Jäger - Daimler -** Chief lobbyist (2008-2013) | Secretary in interior ministry of Baden-Württemberg (2016) |
| **Joachim Koschnicke -** Minister president of Lower Saxony, with seat on Volkswagen board of directors (1999-2003) | CDU campaign manager (2017) |
| **Sigmar Gabriel -** Minister president of Lower Saxony, with seat on Volkswagen board of directors (1999-2003) | German foreign minister (2017) |
| **Christof-Sebastian Klitz - Volkswagen** lobbyist (1999-present) | Local head of CDU economic council (Wirtshaftsrat) + chief lobbyist for Volkswagen in Brussels (2008) |

Authors graphic: Source: Mudge (2017)

The influence of the sector is such that former chancellor Angela Merkel had been accused of being the biggest lobbyist on behalf of the automobile industry (Bennhold, 2018). Alternatively, this perception of Merkel has also been referred to as a legacy of Gerhard Schröder, who was referred to as the 'car chancellor' (Miller, 2020). However, both accounts speak to the notion that despite different parties and electoral coalitions gaining power, the automobile sector retains an influence in German politics. By way of explanation, one interviewee stated that despite electoral outcomes, "nothing really changes the picture there [influence of automobile sector], as there is very strong conservative influence in [the] transport [ministry]" (G5). Therefore, the sector remains close to the BMVI, independent of the parties that form the government.

Contrary to the homogenous framing of the automobile sector's influence, some interviewees stated that the automobile sector's presence, and by extension influence, is felt differently across Germany (G7; G11; G21). The literature too notes that the effects of this can be felt differently across the nation, as provinces with a considerable automobile presence, such as BMW in Bavaria, Daimler and Porsche in Baden-Württemberg and Volkswagen in Wolfsburg (the so-called car-states), are further anchored into the socio-economic fabric of the Länder (Hildebrandt and Trüdinger, 2021). An interviewee based in Bavaria spoke to this fact by stating that "everyone in Munich, that doesn't work for BMW works for someone that works for BMW, it drives the economy there. And then it finances the city as well" (G16).

Beyond the confines of German politics, several interviewees thereafter stated the sector's influence extends to the sphere of European politics. One interviewee stated that "national parliaments really can't do anything because the rule is set in Brussels. It's a European rule" (G8), seen most vividly when transport emissions were omitted from the EU's Emission Trading System (ETS). Another interviewee, who is a member of the *Bundesrat*[[58]](#footnote-58), noted that in their experience, the automobile lobby at the European Level is very strong (G8), making any analysis of Germany one which inevitably must also take account of the EU. They continued to state that the intransigence of German politics is best displayed by Ursula Von Der Leyen, who had long since lobbied for the automobile industry before her role at the European Commission[[59]](#footnote-59) (ibid).  So much so, that the interviewee noted that von der Leyen's role in the Green Deal for Europe stands in stark contrast to her lobbying on behalf of the automobile sector when in the German government.

The influence of the automobile sector on actors in the EU has been observed by Eberhardt (2012), who noted how the industry could shape the formative designs of policy as the expertise of the BMVI is often drawn upon by the European Commission. Haas and Sander (2019) likewise provide a lucid account of the automobile sector’s efficacy at the European level, noting that they attend formative meetings, give their expertise, and are often called upon by various commissioners and directorates-general in the European Commission, including deteriorate-general for Mobility and Transport, Climate Action, as well as the European Parliament through the Committee on Transport and Tourism and the Committee on Environment, Public Health, and Food Safety.

To be clear, the ability to influence actors within European institutions is not simply the sole privilege of German manufacturers. Rather, its European neighbours, including France and Italy, have a significant automobile sector in the form of Renault, Citroen, and Fiat. All such actors lobby the European Parliament's Committee on Transport and Tourism and other EU institutions within the European Automobile Manufacturers Association, Europe's automobile lobby (Balsmeyer and Knierim, 2018). However, of the €20m spent on 70 automobile lobbyists in Brussels, €10m is from German industry alone (Katzemich, 2018). The automobile sector consequently walked the halls of power of the European Commission and European Parliament as well as the Bundesregierung and the Länder.

Such is the sector's influence at both the domestic and European levels that they can shape the framing of policy. Scholars have conceptualised this capacity differently, with Haas and Sander (2019) referring to this power as the 'political-automotive industry complex', whereas Meckling and Nahm (2018) refer to it as 'regulatory capture'. Examples of how this effected Germany’s EV transition included how manufacturers and the VDA had argued against EVs on the ground that the fuel economy of German cars is such that they are not that 'dirty' (G18; G26). Moreover, Interviewees stated that manufacturers had framed the EV transition as one inevitably incurring an economic cost, and subsequent job losses to make trade unions adverse to the transition (G14; G23). Through this economic framing, manufacturers have also stated that the transition will lead to stranded assets, redundant R&D sunk investments and all for a technology that remains 'unscalable'.

In the context of e-mobility, interviewees stated that the sector has attempted to deter the implementation of EV policy by arguing that Germany, and by extension its manufacturers, should remain 'technologically neutral/open' (G11; G17; G21). This framing was also prevalent in the document analysis (BMVI, 2019). Technologically neutral herein refers to the manufacturers arguing against narrowing the framing of policy to simply battery technology but instead remaining 'open' to the possibilities of hydrogen-fuel cell vehicles, biofuels, and other emergent technology. Interviewees were often sceptical of the focus found in the document analysis, suggesting that the notion of technologically neutral was intentionally non-descriptive to avoid regulation and to obfuscate the policy framing in order to essentially continue with the path dependency of ICE vehicles (G21; G22; G23). Moreover, some indicated that technological neutrality was a narrative independent of trends in the market, as seen by actors such as Tesla, whose popularity in Germany seemingly undermined the need for neutrality (G31) (see 7.5).

Finally, interviewees noted that the influence of the sector was clear upon the establishment of the *Nationale Plattform Elektromobilität* (NPE), the advisory council made up of different economic actors to shape Germany’s EV transition, of which many were from the automobile industry (G12; G26). An interviewee who had previously worked for BMW stated that the company had a strong influence over the creation and functioning of the NPE (G14). The purpose of the NPE, some suggested, was simply to assuage doubts over Germany's EV policies, given that the environment ministry (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) was a notable absentee from the group (G1; G31; G32). What is more, an interviewee from the NPE suggested that aside from the group producing several documents analysed in the document analysis, the future remained somewhat unclear (G16).

The reason the barrier presented by the automobile sector is so problematic, beyond Germany’s environmental goals, is that because it has slowed Germany's response to the EV transition it has allowed external actors, particularly China, to shape the global EV market and leave German domestic manufacturers at a comparative disadvantage. Incidentally, with China presently dependent upon Germany for automobile imports, the EV transition allows them to address such trade imbalances with actors across the global economy. As noted by an interviewee, China's ascent in the automobile market can therefore only come at the expense of Germany (G5). This, another interviewee noted, had implications for the European economy, too (G6). Against the backdrop of changing global automobile market, then, several interviewees stated that if Germany failed to transition to EVs, it would not only cost the country its environmental credentials, but its entire political and economic model (G15; G21; G27).

### 7.2.1 Overcoming the Automobile Industry Barrier

The barrier born from the historically close ties between the state and the automobile sector is consequently the biggest in this chapter. However, interviewees stated that these ties have become fragmented and may be overcome. Firstly, interviewees emphasised that (i) Dieselgate provided an unavoidable event in which state-business relations began to diverge and elicited a different approach to the sector on the part of the state. Secondly, by extension, (ii) Volkswagen has begun to unilaterally diverge from the sector's 'technological neutral' position and embrace EVs. Thirdly, (iii) new carbon pricing mechanisms, designed to capture the emissions of transport, are in the process of implementation in both Germany and the European Union. Finally, some interviewees suggested that (iv) the difference in recovery packages between the Financial Crisis and COVID-19 indicated that the automobile sector's influence over policymaking is now beginning to wane.

#### 7.2.2 Diesel gate

In 2014, automobile manufacturers, particularly Volkswagen, were found to have manipulated air standardised pollution tests on their vehicles by introducing software to adjust the recordings (Mujkic and Klingner, 2018). The subsequent Diesel scandal (Dieselgate) reshaped the political landscape of emission standards, particularly air quality (G8; G9). Initially, it brought into question and helped expedite the replacement of the New European Driving Cycle (NEDC) with the World Harmonized light-duty Vehicles Test Procedure (WLTP) to better reflect laboratory estimates of fuel consumption (see Chapter 1). However, it also had a profound effect on German state-business relations in the automobile sector, or a 'wakeup call' (U5), as the state began to distance itself from the automobile industry.

Interviewees accordingly stated that the historically close ties between the state and the industry had implicated the state in the scandal by association. One interviewee stated that the state's response appeared to reflect the idea that "by cheating that way you've caused huge embarrassment to yourself and to this country" (G11). Another interviewee from the Financial Times stated that the subsequent distancing was evident by Angela Merkel's refusal to make a public appearance with the sector until Volkswagen released its all-electric ID.3 in 2016 (G15). Moreover, while the Diesel Scandal only had a short-term economic impact, with Volkswagen's share price higher now than in 2014, a former employer of Volkswagen stated that "what I hear now from colleagues is that the doors to the politicians are not as open as they used to be" (G9) and that a 'disconnect' had emerged between the state and industry (G11).

Dieselgate has subsequently had a profound impact on the EV transition in Germany by fracturing the once coordinated ties between the state and its allies in the industry. Indeed, as noted above, it has seen Germany become markedly uncoordinated, as the Federal state has subsequently gone on to design the European Emission Standards, which Volkswagen has described as a 'tremendous challenge', and the VDA as moving the limits of what is 'technologically achievable‘ (Campbell and Miller, 2021a). It has even bled into election campaigns, as the 2021 Federal elections saw CDU leader Armen Laschett maintain the notion of 'technological neutrality', while SPD leader Olaf Scholz called for a ban on ICE vehicles. Yet, as one interviewee from the Agora Energiewende stated, the response from the state and society to the sector was that "this misery is of your own making, deal with it" (G30). Consumers too have become more sceptical of domestic manufacturers (G22), leading to a diversification of brands (see 7.5 for Tesla). As one interviewee surmised, "I don't think we would be in the situation we are now (see below) if Dieselgate hadn't happened. That was the best [thing] to ever hit the car industry, they may not understand it now, but it was" (U29).

#### 7.2.3 Volkswagen

As noted above, Volkswagen drew most of the ire from the Dieselgate, becoming the main actor associated with the scandal, leading to a $4.3 billion fine in the USA. Other manufacturers have subsequently been implicated, such as Mercedes-Benz, Audi, and Porsche. Volkswagen has subsequently made the most profound change to its internal organisation, committing to a complete EV asset portfolio by 2035 with €33bn of investment, and repudiating the technologically neutral framing employed by its German counterparts (Szymkowski, 2021).

The decisions made by Volkswagen therefore will have a profound effect on the German automobile sector, since, as one interviewee stated, "where Volkswagen goes, everyone follows" (G15). Nowhere is this more evident than in the decision made by Audi to release only electric vehicles by 2025 and end the production of internal combustion engines by 2033 (Katsianis, 2021), and Mercedes-Benz which has increased its EV production to, in essence, become fully electric by 2030 (Boeriu, 2021; Campbell and Miller, 2021b). Beyond Germany, Ford, Volvo, and Jaguar have made similar commitments to go all-electric between 2025-2030 Since Volkswagen’s decision. One interviewee, a former employee of Volkswagen, stated that the manufacturer is all too aware of the impact of e-mobility on them and the wider German economy. Therefore, Volkswagen will essentially operate " two businesses at the same time while building a new, essentially a new, carmaker" (G15).

The commitments made by automobile manufacturers again point to the increasing lack of coordination of state-business relations. Volkswagen's EV investment was made as it threatened to leave the VDA if the group did not withdraw from its technologically neutral position (Wehrmann, 2019). Elsewhere, former BMVI minister Andreas Scheuer continues to state that the transport sector should remain technologically neutral (Amelang, 2019) as Markus Söder, leader of the Bavarian party, the Christian Social Union (CSU), calls for petrol and diesel vehicles to be banned by 2035 (DW, 2020). Therefore, so uncoordinated has Germany become that it is now in a position where the transport ministry is sometimes more 'pro-car' than the automobile lobby (G11, G32).

#### 7.2.4 Carbon pricing and emission trading

Since the interviews took place, as part of the broader aims of the European Green Deal, Germany has introduced a new carbon pricing, or 'cap and trade’ system, on transport and the building sector. The measure follows the introduction of the fuel emission trade law (*Brennstoffemissionshandelsgesetz* or BEHG) that first introduced a price on CO2 for transport (BMJV, 2019). The new price mechanism sets a fixed price for carbon, increasing every year before implementing an auction scheme in 2026 (Wettengel, 2021). Until 2021, transport emissions had been omitted from German, and the broader European, pricing system. However, the new carbon price will not necessarily be paid by manufacturers but reflected in the prices of petrol and diesel and are thus an indirect incentive for EVs (ibid). However, the €40bn generated between 2021 and 2024 could be channelled into the direct EV measures.

The new system will exist in parallel with the EU's own Emission Trading Scheme (ETS) to cover transport emissions (European Parliament, 2021). Since the establishment of the ETS in 2005, the EU has employed two tools to reduce emissions: the trading system, and the Effort Sharing Decision, now known as the Climate Action Regulation. The ETS is a 'cap and trade’ system whereby emission 'allowances' are issued to participating actors (or generators) to place a cap on the acceptable number of emissions from the region. The Climate Action Regulation, by contrast, sets an annual reduction target on member states, in which they too must buy and sell allowances depending on their target (Transport and Environment, 2018). Transport emissions, and by extension the manufacturers of vehicles, have previously not been covered by the Climate Action Regulation.

With the implementation of the European Green New Deal, the European Commission has placed climate policy under review under the 'Fit for 55' proposals to reduce emissions by 2030 (Amelang et al., 2021). Extending the ETS to road transport would increase the emission coverage by 50% (European Parliament, 2021). Due to the disparity in wealth between participating states (e.g., Germany and Estonia), the policy would require a 'solidarity mechanism' in which allowances could be redistributed to prevent poorer states from paying higher costs (ibid). However, while extending the ETS presents a viable avenue to cap vehicles emissions, previous allowances of the ETS have been the site of contention, such as following the Financial Crisis in which too many allowances were allocated, leading to a low price of carbon (Oroschakoff, 2021). This reliance on market mechanisms also runs counter to the need for the German state to play a greater role in the low carbon transitions (see Chapter 5).

#### 7.2.5 Economic recovery: from the Financial Crisis to COVID-19

Dieselgate and the divergence of state-business relations have taken place against the backdrop of crisis for Germany, from the Financial Crisis, the Eurozone Crisis and most recently COVID-19. These crises incidentally demonstrate how state and business priorities have diverged. Following the Financial Crisis in 2008, the state provided industry, and the broader German economy, with a stimulus in the form of a scrappage scheme (Ab*wrackprämie*), the largest scrappage scheme across the global economy. The state provided a €2,500,000,000 stimulus directly to the industry, albeit with the potential for an overspill to foreign manufacturers, sometimes at the expense of the premier German brands (Ewing, 2009).

In contrast to the Financial Crisis, COVID-19 saw the state refuse to implement a similar scheme, despite a 52% demand-side shock to the economy and requests from the industry (Dao and Mineshima, 2021). Several interviewees stated this change represented a profound moment in state-business relations whereby the state had exerted once unthinkable power on the industry (G1, G14). Instead, as noted in Chapter 5, the Federal government tripled the EV subsidy from €3 000 to €9 000, along with a quarter (€24bn) of the COVID recovery package (€100bn/3.7% of GDP) into green technologies, including €1bn in R&D for new technology, €2.5bn for EV infrastructure and battery cell production and tripling the demand side subsidy from €3, 000 to €9, 000 (Reuters, 2020). However, the state did provide more indirect subsidies to the industry, particularly through the *Kurzarbiet* (shorter working) furlough scheme to guarantee the salaries of workers in the sector (IMF, 2020). The €9bn stimuli provided to Germany's largest aviation company, Lufthansa, was described by interviewees as another legacy of the Dieselgate Scandal, once again indicating how economic policies can take precedent over environmental policies in Germany (G5; G9).

### 7.3 The Black Zero & the Debt Brake barrier

Another prominent barrier to Germany's EV transition identified by interviewees was the Federal government's reluctance to adopt a more state-led approach and provide more financial incentives to the economy. This is perhaps a legacy of the historically coordinated approach to policymaking, allowing the automobile industry to shape the market with a relatively lenient legislative framework. But Germany has previously been perceived as the archetype for a balanced fiscal budget. Germany's fiscal policy, particularly since the election of Angela Merkel’s government, has been characterised by the Black Zero (*Schwarze null*) approach of running a budgetary surplus, totalling €13.5bn in 2019 (Partington, 2020; Powell, 2020). The Black Zero forms part of a wider economic policy characterised by the Debt Brake (*Schuldenbremse*), preventing the Federal state from running a fiscal deficit larger than 0.35% of GDP and a debt to GDP ratio of 60%[[60]](#footnote-60). And while this has proved economically advantageous for Germany, as noted in Chapter 5, this constrained fiscal policy has contributed to EVs typically accounting for only 2.8% of the automobile market (ICCT, 2019).

In the literature, scholars are divided between those who perceive Germany's fiscal approach to be an astute form of budgetary management (Siebert, 2014) and those who highlight that it has had a detrimental effect on investment in the country (Rixen, 2019). A debate too has centred around whether Black Zero is a necessary form of austerity (Biebricher, 2017), while others argue that it is a necessary measure to avoid running the high structural deficits (83% of GDP) incurred immediately after German reunification (Bozo et al., 2016). Therefore, because automobiles are so embedded in the German economy, the e-mobility transition is not independent of the economic debates of Black Zero and the Debt Brake but central to them.

How the Black Zero inhibited Germany's transition subsequently fell into three categories amongst the interviewees. Firstly, unlike most countries across the global economy such as the UK, Norway, and the Netherlands, which implemented EV subsidies after the Financial Crisis in 2010, the Federal state was relatively late in introducing its subsidy, which was finally implemented in 2016 at €4,000 for purely electric vehicles and €3,000 for plug-in hybrids until 2019 (BMVI, 2019). The purpose of the scheme was to help Germany reach 1, 000, 000 EVs by 2020, which, once again, highlighted the limitations of the market to address the EV transition (G6; G14). The detrimental impact of this fiscal approach on EV policy subsequently manifested in Germany missing its 2020 target and extending the subsidy to 2025 (Wacket, 2020; G23; G26).

Secondly, contrary to the demand-side measures, Germany quickly provided supply-side incentives by exempting EVs from motor vehicle tax (*Kraftfahrzeug Steuer)* in 2012. Interviewees suggested the policy was introduced in isolation of a broader EV development strategy, however, due to the income of motor vehicle tax levied onto petrol and diesel vehicles to the Federal budget remaining relatively consistent at around €9bn since 2014, suggesting that it had done little to incentive EVs (G26; G32). Again, an interviewee stated it was indicative of the lack of coordination between the economics and the transport ministries as to how to approach EVs (G26).

Thirdly, the literature has previously stated that budget surpluses are simultaneous 'infrastructure deficits' (Wulandari et al., 2018; Arestis and Sawyer, 2004). Germany has subsequently been afflicted by infrastructure deficits, particularly digital infrastructure and the requisite EV infrastructure in batteries and charging (G13). The impact of Black Zero has therefore not only been linked to the e-mobility transition, but the broader infrastructure required in digitisation, 5G installation and renewable energy infrastructure, even since the Energiewende (Eberlein, 2000).

Notwithstanding the problems highlighted by interviewees, the documentary analysis found a growing acknowledgement among Federal Ministries that there were gaps in Germany's EV development strategy, including the BMWi, who indicated a change in policy around e-mobility was required to secure 'Germany's position as a global leader' (BMWi, 2018). Furthermore, the Federal Ministry for Economic Affairs and Energy (BMWi) stated it was necessary to 'remain competitive' in that global market (BMVI, 2019). One of the less critical interviewees stated that "I don't think people dispute the legitimacy of climate legislation, it is more about policy and how can the German industry survive" while the sector is transitioning (G12). Other interviewees stated that because of the slow EV uptake, e-mobility had moved beyond being simply a green issue to an industrial one (G3). Both the document analysis and interviewees consequently suggested that part of the e-mobility debate in Germany had shifted to the question of how, and indeed *who*, should finance the transition.

### 7.3.1 Overcoming the fiscal barrier

Black Zero and the Debt Brake are just as pronounced features of German politics as the automobile sector. However, neither the interviewees nor the document analysis suggested clear ways to overcome this barrier. Furthermore, before COVID-19, scholars observed broad support for Germany's fiscal approach (Hishow, 2011; Hayo and Neumeier, 2016). But since the crisis, the debate has seen a re-evaluation of German fiscal policy, such as suspending or ending the debt brake (EIU, 2021), taking on more debt, and forgoing the black zero restraints (McLellan, 2021). Accordingly, the event following the economic impact of COVID-19 gave rise to three ways in which the fiscal barrier may be overcome or is being in some way circumvented. The avenues identified are (i) a temporary suspension of the debt brake, (ii) the Green Bund programme which has seen the Federal state issue its first Green Bonds, and (iii) a revised approach to the monetary policy adopted by the European Central Bank (ECB) that incorporates environmental policy.

#### 7.3.2 Temporary Debt break

As noted above, there was a difference in the fiscal response to the Financial Crisis and COVID-19 (see 7.2.4). Indeed, Germany's broader response to COVID-19 has been perceived as a radical break from the Black Zero fiscal rule as the state accrued more than €150bn of new debt, temporarily suspending the debt break from 2020-2023 (Chazan, 2020). This contributed to Germany's economy contracting just 5% compared to 9% in France and 11% in the UK in 2020 (Partington, 2021). Germany is also expected to recover much earlier than most countries in the global economy (OECD, 2021). Germany's fiscal response was initially typified by the Economic Stabilisation Fund (including a total of €600bn made up of €400bn to refine banks and capital markets, €100 for company equity, and €100bn for the investment bank) is thus said to represent a new era in German fiscal policy as its additional spending is the biggest in the Eurozone (Chazan, 2020; Dao and Mineshima, 2021).

Aside from the Economic Stabilisation Fund in 2020 to counteract the economic shock of COVID on the economy (Bundesrepublik, 2020), as part of the broader EU's Recovery and Resilience Facility (DARP), Germany proposed the Recovery and Resilience Plan with a stated ambition to spend €5.5bn to promote EVs by tripling the demand-side subsidy (from €3000 to €9000) and increase charging infrastructure (BMF, 2021). Yet, despite the broader investment package, the DARP still remains primarily reliant upon market-based instruments, including Contracts for Difference, that insulate private providers from variations in energy prices, as opposed to a radical intervention on the part of the Federal state. The target of the DARP, to support 500 000 EVs, is also lower than previous EV targets.

The proposed 'signal' sent by the DARP that Germany is reorienting domestic spending, and by extension, the economy around climate and digital infrastructure, is nonetheless undermined by investment towards non-green ends. The document analysis indicated that climate objectives make up just €11.5bn of the €672.5bn (BMF, 2021). Instead, loans and credit provided to bond and capital markets were issued without green criteria, allowing them to flow indiscriminately into carbon-intensive sectors of the economy. The DARP, too, is primarily focused on hydrogen, described as 'tomorrow's petroleum' by the Bundesministerium fur Bilding und Forschung rather than EVs (BMBF, 2020).

#### 7.3.3 Green Bund

As previously outlined in Chapter 5, in contrast to some of the debt issued by the Federal state during COVID, Germany also issued its first green bond (*Bund*) in 2020. The state investment bank KfW oversees this initial €20bn issuance with a commitment for further annual issuances to bond markets. Germany's green bonds are allocated within a framework criteria that consists of (i) transport, (ii) international cooperation, (iii) research, (iv) energy and industry, and (v) agriculture, according to the UN's Sustainable Development Goals (SDGs) and Green Bond Principles of the International Capital Market Association introduced in 2014 (BMF, 2020). Equipped with this new fiscal tool, the Federal State can now issue 'green' debt with low interest to a maturity that allies with their environmental objectives (see below).

Demand for the green bunds has remained high since the initial issuance, providing Germany with a degree of certainty on future issuance as it looks to establish the benchmark for the Eurozone and a green bond yield curve (Stubbington and Arnold, 2020). However, alternative accounts of Germany's issuance have criticised it on the same grounds insofar that it has impeded a broader European issuance, given that most European countries do not have a AAA bond rating (Saunders, 2020). Furthermore, unlike bonds issued by other countries, such as France and Poland, Germany's issuance is also a 'twin bond concept' where all bonds are simultaneously issued with equal conventional bonds, which can be swapped for green bonds and vice versa (Stubbington and Anrold, 2020). Therefore, for all the issuances of 'green debt', the same level of 'non-green' debt is being issued to bond markets.

#### 7.3.5 European Central Bank (ECB)

Like the Bank of England in the UK in Chapter 6, while constrained fiscal policy correlated with poorer EV uptake, fiscal barriers can be circumvented by alterations in monetary policy (see 6.2.3). Indeed, an interviewee stated that Germany's role in the European Union, being its biggest economy and having Ursula von der Leyen as President of the European Commission, provides them with ample capacity to shape different policy spheres (G13). Moreover, Germany's central bank, the Bundesbank, provided the blueprint for the ECB, of which it is now a constituent member[[61]](#footnote-61) (Maier and Bezoen, 2004; Kaltenthaler, 2005). Following criticism of central banks' positions on climate change[[62]](#footnote-62), ECB President Christine Lagarde has sought to incorporate climate change into its monetary policy framework, covering the lending disclosures, risk assessments, collateral frameworks, and asset purchasing programme better to reflect climate breakdown (ECB, 2021).

The potential of this new strategy is that it provides scope to overcome domestic fiscal barriers for EU member states through monetary policy at the European level. The new fiscal frontiers presented by green bonds, and the ECB's incorporation of climate change into monetary policy have raised the prospect of a broad suite of measures, from asset purchases being made only to businesses with environmentally oriented asset portfolios, lending credit only with environmental strings attached and 'helicopter money' (money paid directly to citizens) to purchase environmental commodities, such as EVs (Arnold, 2021). These measures therein sit at the crux of an emergent debate in the literature between adhering strictly to the central bank's commitments to maintaining price stability, and environmental scholars who argue that climate change, amongst many things, is indeed a threat to the financial system and price stability (Dikau and Volz, 2021; Volz et al., 2015). The prospect of ‘green’ monetary is an issue that will extend far beyond the scope of this thesis.

### 7.4 The Tesla barrier

In opening its first non-US 'Gigafactory' in Berlin-Brandenburg, Tesla will become the first non-German company producing vehicles in Germany. The arrival of Tesla divided interviewees as to whether it represents a form of competition to German businesses (G6; G10; G25) or reflects a coordinated approach on the part of the state in allowing Tesla into Germany as a form of soft power to leverage onto manufacturers (G12; G13; G27; G30). Rather than sit comfortably within either the coordinated or uncoordinated dichotomy, Tesla is seemingly indicative of Germany's lack of coordination. Tesla has moved into the space left underexplored by state and business actors who, rather than future proof EV supply chains, have been reluctant to disrupt their path-dependent reliance on internal combustion technology.

Consequently, Tesla presents a barrier to German manufacturers (re)gaining their position in the automobile market as it moves towards EVs. Different interviewees described Tesla as a market disruptor (G1) to a profound reorientation of the industry (G14). More specifically, one interviewee stated that they perceived the move by Tesla as a statement whereby "we [Tesla] are placing our Giga factory in the heart of Germany" (G1) and that "people from the car industry, it is probably more what they tell you off the record that they [manufacturers] see it clearly as an attack on the German car industry" (ibid). The fact that Tesla is situated in Berlin-Brandenburg is even more significant given that it is in the capital of Germany, an area the Federal government had identified as a location for the new age of German industry (G1; G12; G19; G30). Therefore, the significance of Tesla's imminent arrival in Germany is difficult to overstate but has ultimately received relatively little attention in the literature.

According to interviewees, if nothing else, Tesla has posed several uncomfortable questions for the German automobile sector. Firstly, Tesla's Model S showed that a premium EV was capable of market penetration, despite industry claims to the contrary (G6). Secondly, the Model 3 then showed EVs could also be made at an 'affordable' mass-market price, raising questions about why German automobile actors had not already provided it (U5). Specifically, an interviewee described the Model 3 as showing that EVs worked technically and commercially, "and so June the 23rd, 2016 is when the game was over" for the manufacturer's technologically neutral narrative (U5). And finally, because Tesla's Supercharger network is more developed than Germany's charging infrastructure, in both range and scope, it raised the question as whether Germany could overcome its significant comparative disadvantage.

Far from a recent encounter, Tesla has a long-standing tense relationship with its German counterparts. In 2016, when the German government and automobile sector were designing what came to be the subsidy for EVs, Tesla was omitted from the scheme as the €60 000 caps then excluded the Model S and Model X, which started at €82 700 (Manthey, 2017). Tesla responded by claiming that "[the plan] was drawn up jointly with the Chairman of the German automobile manufacturers and the relevant ministries… this part of the program is directed against Tesla." (Tesla, 2016). After growing pressure from German consumers looking to purchase the Tesla S, the Federal Office for Economic Affairs and Export Controls () allowed Tesla under the scheme after they released a 'base model' at €60, 000, as German consumer trends changed following Dieselgate (see 6.2).

Beyond the proportion of market share attributed to each manufacturer, Tesla CEO Elon Musk has declared his ambition to eliminate petrol and diesel vehicles from the market, calling them a 'passing fad' whose future belongs in a museum (Fichtner et al., 2019). Tesla's production model contrasts with that of the traditional manufacturing model in the automobile sector, particularly in Germany. Whereas traditional German manufacturing is labour-intensive, Tesla intends to remove labour input with an automated production line, with smaller supply chain dependence to form an industrial enterprise, which Musk himself likened to an 'alien dreadnought' (DeBord, 2020). Should such productive processes allow Tesla to produce automobiles (at a lower cost per unit than German manufacturers, then it could reasonably be assumed that to maintain a comparatively efficient production model German manufacturers would follow suit (G26). Tesla's economic model is also defined by lower average sales but an appreciation of share value, due in part to the perception that Tesla will facilitate the transition. Due to Tesla's industrial and financial form, Volkswagen is now looking to replicate Tesla, not vice versa (G27).

Nowhere is Tesla's impact on the German sector more pronounced, then, than its effect on Volkswagen. Indeed, two days after Tesla's announcement that it was building Giga-Berlin (13th Nov 2019), Volkswagen announced plans to release 75 EVs and 60 hybrid models (PHEVs) at the cost of €66.3bn by 2023 (G9; G26). It also announced the partnership with Northvolt, whose executives worked on Tesla's first Gigafactory, to reduce their dependency upon Tesla and Asian manufacturers (see above). Moreover, Porsche has created 1 500 new jobs to rival Tesla. Finally, BMW announced its i4 model many years after the i3, following a broader slate of flagship EV models, including Volkswagen's e-Golf, Audi's E-Tron, and Daimler's EQ to be released to coincide with the opening of Giga-Berlin.

Due to the profound effect Tesla has had on the automobile market and German manufacturers, an interviewee stated that the rationale for Tesla's arrival could have been an industrial one on the part of the state to exert a degree of soft power over domestic manufacturers (G9). Former economics minister, Peter Altmaier, incidentally, stated that Tesla's arrival would help Germany become a world leader in the EV transition. Tesla was therefore allowed to forgo many of the bureaucratic processes that have characterised German politics, including elements of the planning permission process and strictly observing environmental regulations (G12). An interviewee from Daimler duly stated that unlike the laboured bureaucratic process they have encountered, Tesla has progressed with "really a new level of the quick building and quick starting automotive production" (G10).

Even within Germany’s internal automobile market, Tesla forms a key part of the continued growth as a proportion of the automobile market, despite domestic manufacturers attempting to respond with their own vehicles. For environmentally conscious consumers, then, one interview stated that Tesla offered a legitimate electric alternative from the inertia of manufacturers (G16). Indeed, Tesla is now the highest-selling EV in Germany, competing in the luxury market segment traditionally occupied by Mercedes-Benz, Audi, BMW, and Porsche (G31; Voigt, 2019). Moreover, with Tesla perceived to be the primary driver of e-mobility for the industry, consumers are becoming increasingly aware that not only are alternatives coming, but that soon these alternatives can be found in Germany (G3). Tesla's influence, therefore, has seeped into various levels of the German automobile sector.

Interviewees were divided as to whether Tesla's ascent in the EV automobile market is likely to be a temporary or permanent feature of the EV transition (G4; G6; G23; G30). Firstly, some interviewees were confident that traditional manufacturers could overtake Tesla in the electric vehicle market. For example, an interviewee from Deutsche Bank said, "German manufacturers do not need to be the first, they just need to be the best" (G6) and that they had a long history of being the best (ibid). Alternatively, other interviewees thought Tesla had permanently reconfigured the automobile market and that its position in the market would be permanent (G13; G30). Ultimately, many interviewees, particularly those from Volkswagen, Daimler, and Audi, indicated that Tesla was a challenge to Germany's national identity and industry (G9; G10; G11; G25) and therefore was a barrier that would need to be overcome.

### 7.5.1 Overcoming the Tesla barrier

The Tesla barrier, in part, is linked to the broader barrier of the automobile sector outlined above (7.2). Tesla's ascent, then, like China, has come at the expense of German manufacturers. Moreover, while Tesla resides in this uncertain territory between a competitor to the German industry, or as part of broader coordination with Germany's EV development strategy, interviewees ultimately seemed to suggest that the possibility of Germany becoming once again coordinated, and Tesla remaining the prominent actor in the market, were irreconcilable.

In addressing the Tesla barrier, I outline three possible ways Germany may overcome the challenges it presents. First, Germany's recent Climate Action Law presents a more robust environmental policy framework to influence domestic manufacturers. Second, given that the EV transition is contingent upon the overhaul of German manufacturers' product range, the expertise of the manufacturers to operate in diverse segments of the market could allow them to secure market share (G3; G15; G24). Finally, interviewees suggested that Germany's EV transition lacked a coordinated approach. Therefore, to (re)coordinate its EV development strategy, and by extension, its fractured state-business relations, the EV transition required *Verkehrswende* to become more central to German politics.

#### 7.5.2 Climate Action Law

In gathering the empirical data, interviewees stated that Germany had an insufficient environmental policy framework (G1; G7; G11). In the specific case of EVs, some interviewees identified the absence of a ban on internal combustion engine vehicles in Norway, the Netherlands, and the UK (G15; G20). At the time of the interviews, it was also stated that Germany did not have a 2050 target enshrined in law like the UK's net-zero objectives (G18). Essentially, interviewees suggested that Germany's environmental policy framework required further development to exert a more stringent influence on the automobile manufacturers, as Tesla can avoid many of the environmental regulations due to its entire product range being zero emissions (G12; G14; G20).

Since the interviews, however, Germany has established its Climate Action Law or Climate Change Act (Appunn and Wettengel, 2021). Moreover, the document analysis found that the Climate Action Law had a predecessor in the form of a 'Climate Action Plan' that outlined Germany’s intention for climate neutrality by 2050 (BMU, 2016). Incidentally, document analysis found that the Climate Action Plan was implemented in 2016. But, interviewees' responses, this had seemingly been a peripheral event in German politics compared to the *Energiewende* that had defined Germany's environmental credentials. Moreover, where the Climate Action Plan was acknowledged, interviewees suggested that it was not necessarily a formal 2050 target but a broader ambition for a 90% reduction of domestic emissions (G26).

Yet, while the Climate Action Law may appear to have addressed this element of the interviews, the Law has already required revision since its initial design. Specifically, Germany's Constitutional Court stated the initial objectives of the Law were unsatisfactory, stating that they 'violate fundamental freedoms of the young by transferring the burden of reducing domestic CO2 emissions onto them (Appan and Wettengel, 2021). The subsequent revision of the Climate Action Law included bringing the climate neutrality target to 2045 and reducing transport emissions by almost half in 2030 (ibid; Bundesregierung, 2021). Whether Germany needs Tesla to reach the targets established in the revised Climate Action Law or can use it to exert power over domestic manufacturers, however, remains to be seen.

#### 7.5.3 EV product range/asset portfolios

Overcoming the Tesla barrier, and reaching the target outlined in the Climate Action Law, are ultimately contingent upon overhauling the product range and asset portfolios of manufacturers, particularly Volkswagen, Daimler, and BMW. Interviewees from manufacturers, including Volkswagen, Audi, and Daimler, subsequently stated that this process was already taking place. An interviewee from Audi even spoke of their pride in their division within the company, stating that before Germany's climate objectives, and the arrival of Tesla, "we were already on the course to the division for production [proportion of EVs as a total of product range] and we want to have a carbon-neutral production by 2025" (G25). They stated that Audi had already put into motion plans to replicate Tesla's infrastructure model, providing charging infrastructure while simultaneously promoting their brand with the intention that their brand will be seen as superior (ibid).

As already stated in this chapter, Tesla's impact on the automobile sector has already been seen in the asset portfolios of manufacturers. Not only Volkswagen but also BMW and Daimler, who plan to increase the proportion of EVs as a total of their vehicle range, including four from BMW and six for Daimler. However, it must be noted how a higher proportion of EVs does not preclude the complete divestment from combustion engine vehicles. Instead, manufacturers will need to sell a high proportion of ICE vehicles, at least in the short term, to finance their EV development. Therefore, unlike Tesla, the development of EVs for German manufacturers is paradoxically contingent upon the success of ICE vehicles.

#### 7.5.4 The Verkehrswende

To address both elements of the preceding barriers, and indeed (re)coordinate German state-business relations, requires a coherent EV policy. Interviewees noted that the mobility transition (the *Verkehrswende)* had remained a relatively peripheral feature of German environmental politics (G12; G26). Instead, German environmental politics has been so synonymous with the *Energiewende* since 2010 that the *Verkehrswende* has been under-researched in literature and policy discourse (G12; G26; G31). So much so that it is confined to a strategy or concept rather than policy, meaning that the *Verkehrswende* could potentially mean a lot of different things (G30). Presently, the Verkehrswende is founded upon 12 insights that extend beyond simply e-mobility and driverless vehicles, rural mobility, and freight (Agora Verkehrswende, 2017).

The focus of this chapter lies with the 11th of these 12 insights[[63]](#footnote-63), the transport transformation to strengthen German industry. Insight 11 is therefore tied to three elements of Germany's mobility transition; (i) that the future belongs to carbon-neutral vehicles, (ii) creating new jobs through a structural change of the German economy and (iii) financial markets need to recognise the importance of sustainable transport (ibid). Insight 11 is thus in keeping with the argument advanced in this chapter. Not least because it highlights the potential impact on the German economy in the event that it *does not* pursue e-mobility. But it equally highlights the impact that climate breakdown will have on the financial system, as greater climate risk will be reflected in the manufacturer's ability to access capital on financial markets through their banking subsidiaries (see Chapter 2).

Haas (2020a) has outlined the initial form of the *Verkehrswende*, made up of (i) the establishment of the (NPE), following the Financial Crisis, whose formation was thought to mark the beginning of a new age in state-business relations; (ii) the implementation of the Electro Mobility Act (Elektromobilitätsgesetz) to outline rules on parking charges and road lanes, while extending the definition of EVs to include hybrid vehicles; (iii) the introduction of the EV subsidy; and (iv) Germany's 2030 climate package to reach one million electric charging stations and ten million EVs (ibid).

Building upon Haas' initial insight, four developments to the Verkerhrswende's have been identified in this chapter. First, the COVID recovery package, investing in EV development while circumventing the demands of the automobile industry (G30) and an increase in the EV subsidy (see above). Second, the first green bond (*Green bund*) issuance aligns with the Climate Action Programme 2030 (Bundesrepublik Deutschland Finanzagentur, 2020). The confidence given to the capital market from the *Bundesregierung’s* initial €6bn issuance and Olaf Scholz's commitment to annual issuance to the industry has seen Volkswagen and Audi issue €2bn of their green bonds for EV investment (Bundesrepublik, 2022). Third, described as 'epoch making', Germany's supreme court ruling over the 'impossibility' of the Federal Climate Law has seen targets revised from 2050 to 2045 and includes shorter milestones in Germany's transition (Hargreaves, 2021). Moreover, finally, changes also to the European Union's Emission Trading Scheme (ETS) come into force in 2026, alongside the emission standards outlined above. However, doubts remain over the efficacy of these measures in constituting a strict carbon market (Defour, 2021).

Haas (2020b; 2018) has also drawn parallels between the *Verkehrswende* and the *Energiewende*, with the latter having then been the subject of a significant degree of scholarship, the *Energiewende* provides an analogue for the *Verkehrswende* (Rechsteiner, 2021; Hake et al., 2015). Indeed, one interviewee said the *Energiewende* helped portray Germany in a flattering light (G18), while another stated that Germany's leadership on the environment is 'based on politics from the 2000s' (G1). Haas (2019) states that the *Energiewende* was purposely designed to not infringe upon Germany's primary means of capital accumulation, with the *Verkehrswende* likewise oriented around automobiles at the expense of rail, mobility as a Service and other forms of transportation (Haas, 2018; 2020b). Therefore, the *Verkehrswende* could prove more beneficial than its predecessor. By neglecting the *Verkehrswende,* the Federal government, Volkswagen, BMW and the VDA all take different approaches to e-mobility in the absence of a defined EV development strategy. This raises a broader question of whether Tesla remains in Germany within a (re)coordinated state-business relationship. However, as suggested by interviewees, the answer is that Germany's present, and uncharacteristic, lack of coordination could be resolved by the implementation of the *Verkehrswende,* wherein an accord can once again be reached between the state and manufacturers (G1; G12; G20; G26).

### 7.6 Conclusion

This chapter has drawn upon empirical data to identify three barriers present in Germany’s EV transition. A key finding is that rather than the typical portrayal of Germany as a coordinated polity, the e-mobility transition shows a clear lack of coordination, or as I term it here, *unncoordination*. The closely tied state-business relations historically associated with Germany are notably absent from its attempts to internalise the global transitions to EVs. However, given the profound questions that EVs present to Germany, (re)coordinating its environmental, transport, and industrial policy spheres is imperative. The potential ramifications for Germany's economy pertain to the relinquishing of its position in the automobile market and its subsequent implications for industrial expertise, employment, and its trade and budget surpluses. I have shown in this chapter how Germany can (re)coordinate through the *Verkehrswende,* which could both coordinate the EV transition and ensure the future competitiveness of Germany’s automobile sector.

In answer to *‘what are the barriers to decarbonising the automobile sector?’* in the case of Germany, I found that it was the revolving door that existed between the state and industry that had allowed the latter to circumvent stringent policy. As shown here, the industries’ most recent attempts to broaden the scope of the policy lay in the assertion that Germany should remain ‘technologically neutral’. The second barrier, like that already identified in Chapters 5 and 6, was particularly acute in Germany given its historical Black Zero approach to fiscal policy and the debt brake. Germany, unlike the UK, has benefited from its fiscal policy by running a pre-COVID fiscal surplus which was, in turn, linked to its trade surplus. However, the fiscal surplus has produced an infrastructure deficit born out in the EV sector. Finally, Tesla presented a barrier to Germany’s EV transition due to the company not only occupying a curious role in Germany’s coordinated state-business relationships, but it also exhibited a tense relationship with German manufacturers. Indeed, interviewees identified that the fetishisation of the Debt Brake and maintaining the budgetary surplus had created a space in the EV market occupied by actors such as Tesla and China. The possibility that Germany could be one of the losers in the transition to EVs thus had profound implications for its domestic political economy.

When considering ‘*how can those barriers be overcome?’* in the German case study,the advent of the Diesel scandal indicated that it had been a catalyst for a change In German state-business relations, with the state adopting a stronger approach between the Financial Crisis and COVID-19. Volkswagen’s unilateral actions have also significantly contributed to the overcoming of the automobile barrier. Similarly, I found that progress has been made in overcoming the fiscal barrier through the temporary easing of fiscal restraints implemented alongside the issuance of Germany’s first green bond (bund). This has been reflected in the greater engagement with environmental policy at the European Central Bank, of which Germany is a member through the Bundesbank. I found that progress had also been made in addressing the Tesla barrier through the implementation of the Climate Action Law which will force manufacturers recently reticent to the EV transition to better incorporate them within their product ranges, lest they be financially reprimanded.

In observing the progress shown by Germany, it makes for a contrasting answer to the question ‘*are there difference in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?’* outlined in Chapter 6. Indeed, I found that Germany had experienced more success in overcoming the barriers identified, as the state has begun to exert greater control over the automobile industry, Volkswagen has committed to EVs, and Tesla has also now based itself in the country. Whilst this progress stops short of the (re)coordination I proposed above, it does indicate that Germany has made significantly more progress when compared to the UK. That said, that the *Verkehrswende* continues to be a neglected feature of German politics indicates that there remains still some way to go in completely overcoming the barriers in Germany. Given Germany's incumbent position in the global automobile market, the barrier the manufacturers presented nonetheless seemingly gives it an advantage over the UK, for it allows Germany to overhaul its domestic industry as opposed to cultivating one. Interviewees were therefore divided on whether Germany's industry was ultimately positive or negative for the transition (G1; G3; G23; G31). Interviewees were also divided on what the transition ultimately meant for the German sector, with some perceiving it as perhaps spelling the end for the industry (G15) and some seeing it as a transitory phase, one which automobile manufacturers will ultimately navigate with success (G5; G16). Either way, it was clear from the empirical data that the UK and Germany exhibit an acute difference in their success, or lack thereof, in transitioning to EVs. And while it is by no means a global leader on the EV transition, Germany has enjoyed far greater success than the UK until now.

# Chapter Eight

## Conclusion

*“I think in 50 years, you will see a lot of automobile companies fall by the wayside, but, you know, I’m not going to cry into my cornflakes about it. They’ve made their bed; they can lie in it” (U13)*

*“If you want to target decarbonisation by 2050, it’s not just about changing the engine. It’s actually about changing your socio-economic system” (G21)*

### 8.1 Introduction

The purpose of this research was to undertake an analysis of one of the most prominent, yet under-considered, features of the Paris Agreement since its signing in 2015 to analysed in the politics literature, the transition to EVs[[64]](#footnote-64). I have investigated the barriers inhibiting the EV transition in the UK and Germany by drawing on a novel dataset to make an original contribution to the literature. In the previous chapters, I have discussed the theoretical underpinnings, methodological approach, and key empirical findings of this research. To conclude this thesis, I begin this chapter by reiterating how the foundations laid in earlier chapters shaped this analysis, before once again returning to the research questions outlined in Chapter 3. I then highlight the contributions made to the literature and the potential future directions that may follow this thesis in advance of some closing remarks.

This thesis provides a much-needed account of the EV transition which has yet to be adequately examined in either the environmental politics or political economy literature. By comparing these case studies, I have been able to provide a comparative analysis of the EV transition, outlining how both the presence and absence of a developed automobile sector influenced the transition across two developed capitalist economies. I have shown that the EV transition entails significant political and economic reorientation (Katz-Rosene and Paterson, 2018; Klein, 2015; Dryzek et al, 2003). Specifically, the UK intends to cultivate a modern, low-carbon industry antithetical to its current financialised political economy, whilst Germany’s attempt to redress the carbon intensity of its automobile sector has seen it become uncoordinated.

My intervention into the literature followed my assertion from the outset of this thesis that the transport sector presents a unique challenge in meeting the Paris Agreement, being the only sector in the global economy in which emissions continued to rise. After reviewing the prior literature concerning the automobile sector, which had been the subject of interdisciplinary scholarship, I situated this research in the political economy literature. I adopted a critical perspective given the moderate growth in the EV market and the automobile sector’s significant contributions to climate breakdown. Reviewing the literature helped to establish the automobile paradigm, how automobiles are far more than a mode of transportation, but the key to capital accumulation within capitalism, and what features of the literature required revisiting in light of the Paris Agreement. For all the insights gained from prior scholarship on the automobile paradigm, I identified the absence of a satisfactory transitionary account, able to examine the transition from the current carbon-intensive form to a decarbonised state.

To address this shortfall in the literature, I designed a synergistic theoretical framework that combined the Socio-Technical Transitions and Ecological Modernisation approach. The Socio-Technical Transitions literature served to provide a useful conceptualisation of the different levels at play within the transitionary process, through the Multi-level Perspective (MLP). I coupled this revised interpretation of the regime level of the MLP with Ecological Modernisation to gain a more analytically precise account of the state, at least as assumed in the literature, rather than simply adopting an abstract conceptualisation. I completed my synergistic framework by drawing on the work of Meckling and Nahm (2018) to categorise three potential pathways for the EV transition and identified three research questions. To empirically probe these research questions, I designed a multi-method, quantitative methodology comprised of 65 semi-structured interviews with actors in the EV transition and a document analysis of key documents. The formative stages of this research subsequently led to the production of an original data set to investigate the research questions

### 8.2 Revisiting the research questions

The previous chapters of this thesis have been concerned with answering the following research questions:

(i) *What are the barriers to decarbonising the automobile sector?*

(ii) *How can those barriers be overcome?*

(iii) *Are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?*

To reiterate the empirical contributions of this research, I turn here to show how chapters 5, 6 and 7 addressed these questions.

**RQ1 - What are the barriers to decarbonising the automobile sector?**

As shown in Chapter 5, there are three common barriers experienced across both case studies, including the ideological barrier, the fiscal barrier, and administrative fragmentation. Firstly, EV policies have been viewed through a (neo)liberal lens that has tended to lend too much emphasis to the dynamics of the market. This view of the EV transition was not only seen as problematic by virtue of the slow rate of EV growth, but as noted by interviewees, it also failed to acknowledge the key role of the state in the development of the EV market thus far.

The finds indicate that EV growth exhibited a seemingly consistent relationship with fiscal state intervention, insofar as greater state intervention, through demand and supply-side measures, infrastructure investment, and an industrial focus, led to higher EV consumption and vice versa. To further illustrate the impact of the fiscal barrier, interviewees contrasted it with the altogether different fiscal approach adopted in Norway and China, whose high EV growth rates reveal the shortfalls in UK and Germany. The final barrier identified was administrative fragmentation, in which central governments tended to cede the emphasis of the EV transition to local government without the required fiscal capacity. Whilst this barrier manifested slightly differently in both case studies due to the different political systems in the UK and Germany, both countries were cited by interviewees as being fragmented in their approach to EVs.

These common barriers then manifested differently across the case studies. In terms of the UK, the financialised political economy barrier was a clear reflection of the neoliberal barrier, for the advent of neoliberalism helped give rise to the UK’s current structural form (Whiteside, 2016; Blyth, 2013). The way in which the financialised barrier inhibited the EV transition in the UK was nowhere more obvious than in the way that it oscillated between its tendency to prioritise the market to a more state-led approach, leading to uncertainty as to the UK’s approach to the EV transition (Berry et al, 2022; Berry 2016). Amid such uncertainty, the EV transition had been subjected to the Treasury’s Green Book appraisal framework, itself a product of neoliberal/neoclassical methodology, a framework that has long been criticised for its singularly economic approach. The Brexit barrier was, of course, unique to the UK, altering its trade arrangements with the European Union and the Just-in-Time manufacturing model upon which its domestic automobile sector was based upon. The implications of Brexit thus revealed the deep-seated problem rooted in the UK, i.e., the UK economy’s financialisation in the later 20th century, which had left it without an automobile sector capable of capitalising on the EV transition.

In Germany, the main barrier contrasted the UK,  insofar that it was *because* of Germany’s developed automobile sector, that incumbent manufacturers sought to maintain the sector in its current form. This barrier manifested in the significant power the industry was able to exert over the Federal government and European Union and the revolving door between the state and industry. The influence of the industry was frequently cited in interviews with examples including its attempts to argue for ‘technological neutrality’ and obfuscating environmental policy in the name of openness. The second barrier echoed that o the UK, was the adoption of an austere fiscal approach, known in Germany as Black Zero and the Debt Brake. The precise implications differed from the UK, in that Germany has traditionally run a fiscal surplus, linked to the trade surplus made up of automobile exports. Fiscal surpluses have, however, been alternatively deemed infrastructure deficits due, in part, to Germany's inability, or unwillingness, to invest in areas of the economy that require state investment, such as EVs. A lack of infrastructure fed into Germany’s other barrier pertaining to the role of Tesla, and how it sat within the German state-business relations. Tesla is a barrier to the German EV transition, insofar as Tesla has exhibited a tense relationship with German manufacturers in the past, but more importantly, that their production model is the antithesis of its German counterparts’. The success of Tesla therefore, despite now being in Germany, can only come at the expense of German manufacturers, with a declining domestic automobile sector putting Germany's very economic model at risk.

Ultimately, many of the barriers I outlined differed in the scale and scope of the problem they presented. Interviewees in many instances were keen to emphasise that some of the barriers I outlined could feasibly be addressed, but there was a need for the political will to do so. As I show in the following section, some of these barriers have already been addressed, or have at least begun to be negotiated by the state or manufacturers. The data indicated a common  perception that the barriers were seen as current but surmountable in the near future. Indeed, the recent uptake in EVs throughout the writing of this thesis (2018-2022), including 10.7% in the UK (SMMT, 2021) and 13.5% in Germany during 2020 (Kraftfahrt-Bundesamtes, 2021) was seen as evidence of the barriers to EV being overcome. Yet, while 10+% represents promising growth, it belies the counterpoint that non-EVs still account for 80+% of the market. Rather than being inevitable, overcoming these barriers requires a concerted effort on the part of key actors within the global economy.

**RQ2 - How can those barriers be overcome?**

Initially, interviewees highlighted that, to varying degrees, the ideological barrier had been overcome, or at least circumvented, by the European Union’s Emission Standards and air quality providing an alternative policy arena. That is not to say that the ideological barrier was no longer problematic, but that progress had been made in addressing the barrier. As already stated, I showed in Chapter 5 how the alternative fiscal approaches to that adopted in the UK and Germany, in particular, by Norway and China, had yielded higher EV uptake. Adjustments to fiscal policies in the UK and Germany ranged from the ambitions outlined in the different iterations of the Green New Deals and those required to arrest the economic contraction induced by COVID-19. A focus on greening the economic recovery from COVID-19, as well as the issuance of green bonds, further indicated a change to fiscal policy, however tentative.

I showed how overcoming the financialised barrier in the UK could take two markedly different, potentially antithetical, routes. The first of these was the UK’s own Green New Deal in the form of the Green Industrial Revolution, in which the state would adopt a more interventionist role to cultivate the UK’s EV transition. Alternatively, the UK might opt to become the financier, rather than cultivator, of EV transition by leaning into its expertise in Green Finance, wherein the Bank of England could also play a key role in regulating the financial model that surrounds the automobile market. As Brexit posed a prominent barrier that continues to develop at the time of writing, the ways in which to overcome it centred around the Transport Decarbonisation Plan and the Trade and Cooperation Agreement. Overcoming the automobile barrier was, however, less clear, with the document analysis indicating that the UK sector lacked access to either the required amount of capital, or a plan to achieve the objectives identified in the Automotive Sector Deal.

In Chapter 7, I showed that overcoming the automobile sector barrier in Germany had, to a certain extent, started since Dieselgate, with Volkswagen departing from the broader reticence exhibited by BMW and Daimler. Moreover, I showed that the carbon pricing introduced in recent years, coupled with the different approaches adopted by the Federal government from the Financial Crisis to COVID-19 symbolised a more assertive approach to business in Germany. And whilst Germany’s fiscal barrier was markedly similar to the UK, overcoming the barrier appeared relatively simplistic insofar as Germany could suspend the debt brake or exceed *Schwarze Null,* albeit temporarily. Much like the UK’s issuance of a green bond and the potential role of the Bank of England, Germany has also issued its own green bond (*bund*), and the European Central Bank has likewise engaged with environmental objectives. The Tesla barrier also seemed as if it was being addressed with the introduction of the Climate Action Law and the measures adopted by the industry, primarily by Volkswagen but increasingly by BMW and Daimler too. Interviewees did, however, note that the *Verksehrswende* would be the most important way to address these barriers, but that it remained at the periphery of German politics.

In many instances, overcoming these barriers was contingent upon a new, revised role for the state, one which departed from the weak, techno-corporatist understanding of the state assumed by the Ecological Modernisation literature (Mol et al., 2020). That is not to say that the state more accurately resembled a strong Ecological Modernisation interpretation, but that it was not as weak as scholars had assumed. Indeed, many of the solutions proposed in this thesis resemble the policy solutions found in the Keynesian (Tienhaara, 2018; Cato, 2013) or post-Keynesian literature (Kriesler, 2002; Holt, 2001). This focus reflects a consensual feature in the environmental politics literature, taking root in the various (post)Keynesian ideas, from the Green New Deal (Lawrence and Laybourn-Langton, 2021; Chomsky and Pollin, 2020; Pettifor, 2020) to Modern Monetary Theory in recent years (Kelton, 2021; Wray, 2015).

I have shown in this thesis that many such measures highlighted in emergent bodies of literature are not simply abstract or normative interventions but can be increasingly observed in both case studies. Overcoming these barriers was broadly contingent upon a central role for the state, particularly in outlining the EV trajectory as a target, redesigning the supply and demand-side measures and evening banning petrol and diesel vehicles. Many of the significant measures I outlined here were instigated by the economic crises of the Financial Crisis and COVID-19. To a lesser degree, some of the measures followed political crises, from Brexit in the UK to Dieselgate in Germany. Aside from the measures implemented by the state, however, manufacturers have increasingly played a greater role in overcoming the barriers. Indeed, it was the actions of Volkswagen and Tesla, at least within the scope of this research, that have demonstrated that EVs are indeed a viable future for the automobile sector.

**RQ3 - Are there differences in the success of the UK and Germany in decarbonising their automobile sector, and if so, why?**

To address this question, I examined the differences between the UK and Germany in Chapters 6 and 7. To determine the differences and potential success of the EV transition observable in both case studies, I used (i) the barriers present in both cases and (ii) how they can be overcome, as indicators to determine their comparative success. On the first of these points, in Chapter 6, I identified in the document analysis a clear ambition on the part of the UK government to cultivate a domestic EV industry. Precisely how it would be achieved varied in the data, often shifting from a state to a market-led focus as the UK negotiated its internal barriers in the form of its economic model, Brexit, and the lack of a developed automobile sector. The barriers I identified were deeply rooted issues in the UK political economy. By contrast, the German barriers were born from the political power of the automobile manufacturers and the Federal government’s approach to fiscal policy. The barriers in both case studies were, then, different, with the UK’s more structurally constraining than those in Germany.

In terms of overcoming the barriers, the data indicated that progress had been made in both the UK and Germany, with both countries seemingly embracing a more state-led approach to the EV transition, adopting a relatively different fiscal approach since COVID-19, and acknowledging that their respective automobile sectors will need to change. The extent to which these measures had addressed the unique barriers was, however, markedly different, with little progress yet made in the UK in overcoming the Brexit barrier and the absence of the automobile industry. While the Green Industrial Revolution in the UK raises the prospect that these barriers could be addressed, through the development of an industrial policy, the document analysis suggested that the Green Industrial Revolution is only the most recent document to have outlined an ambition to adjust the UK’s economic model, and all of which had previously failed. By contrast, the events of Dieselgate and COVID-19 have instigated a relative shift from the German Federal government, which appears more willing to challenge the power of market incumbents. The Climate Action Law and the development of the *Verkehrswende*, alongside the issuing of Green Bunds and the European Emission Standards, indicate changes in German policymaking. The actions taken by Volkswagen alone, overhauling its vehicle range and asset portfolio, also indicated that Germany has made progress in addressing its barriers.

Until the automobile sector has been decarbonised, however, only a tentative answer can be provided to this question. Nonetheless, the data indicated that Germany appears comparatively more likely to overcome its internal barriers than the UK, not least due to the influence of the Treasury over economic policymaking and the absence of a developed automobile sector leaving the UK in a fragile position to cultivate an industry, at least in the short term. But the data I gathered for this thesis subsequently indicated that the German case study had exhibited a marked change in recent years. These changes are ultimately brought to bear in the most recent EV consumption statistics at the conclusion of this thesis. Here, the UK exhibit a broadly average trend of around 10-15% EV consumption, in keeping with developed capitalist economies, but Germany has recently exceeded it with an EV uptake accounting for 24% of new sales in its automobile market[[65]](#footnote-65) (Holland, 2022).

### 8.3 Original contributions

This thesis has made a number of original contributions to the literature as well as providing an original empirical study of the EV transition. I have contributed to two key bodies of literature in both environmental politics and political economy. Secondly, I have made a novel contribution to the Socio-Technical Transitions literature, having sought to continue its 'political turn' through further engagement with the discipline of political economy. My contribution to the Socio-Technical Transitions literature stems from my reconceptualisation of the Multi-Level Perspective, to establish a more refined explanatory framework, highlighting the benefits of a regime-centric focus approach and outlining a sequential transitionary process. Here, I inverted the MLP from a bottom-up to a top-down framework that could account for the environment.

I further developed the regime level by employing a weak, techno-corporatist application of Ecological Modernisation, combining this literature to form the synergistic approach. The synergistic approach I employed was designed to establish a framework through which the EV transition could be examined whilst overcoming the shortfalls in the Socio-technical and Ecological Modernisation literature. Hence, rather than resorting to the abstractions that have tended to characterise much of the Socio-technical approach, or framing sustainable transitions as win-win, as per Ecological Modernisation, the theoretical approach was designed to provide scope for critical insights. I found that the states in the UK and Germany were stronger than scholars in the Ecological Modernisation literature had tended to assume, albeit a strength ironically brought about by the economic crisis.

From an analytical perspective, I have outlined how the EV transition may take different pathways depending on the political and industrial composition in the UK and Germany, and the state's relationship with the domestic automobile sector. Here, I contributed the *political cultivation* pathway to Meckling and Nahm’s (2018) initial categories, a novel conceptual framing that can provide  analytical leverage in cases like the UK with little productive capacity in the global automobile market. In addition to the UK, I outlined how this pathway was also relevant to the case of China (see Chapter 5). I also demonstrated that contrary to the typically assumed coordinated approach of Germany that it has become *uncoordinated* in the transition to EVs, wherein the state and business have pursued different strategies to achieve, any even avoid, the transition. Within these transition pathways, I have also sought the show how the unique barriers of the UK and Germany may be overcome, considering the shifting political landscape during COVID-19.

Empirically, by drawing on primary data, the thesis has contributed a novel account of the EV transition in two case studies. It has outlined the limitations of the UK and Germany's current EV trajectory and the potential to overcome the barriers they face. Here, the thesis has drawn on insights from the policymakers responsible for designing these policies and the documents that outline their vision for EVs. Whilst the analysis focuses on the UK and Germany, the insights established here can be used to inform analyses of EV transitions in other states.

Ultimately, in this thesis, I have argued for the need to depart from the paradigmatic or 'common sense' perception that has pervaded public discourse, policymaking, and literature at times, that capitalism *will* be 'greened' (Ferguson, 2014; Damonte, 2013). Instead, I have shown that the automobile sector would not be ‘greened’ in its present form. That is to say little of heterodox, or radical, alternatives to capitalism, from degrowth to post-growth present in other literature. But simply that the market-led approach, whether conceived of as green growth, Ecological Modernisation, or otherwise, is ill-equipped and ill-suited to decarbonising the automobile sector. I consequently contend that this faith in the market historically shown by governments and automobile manufacturers has blinded them from the reality of the situation.

### 8.4 Future directions

The main contribution of this thesis to the future direction of the literature is to highlight the need for a departure from the market-led approach to decarbonising the automobile sector. As noted above, the data gathered for this thesis has demonstrated that what progress has been made in the EV transition has been due, in no small part, to measures introduced by the state. To decarbonise the automobile sector, it is proposed here that the state will need to play an even greater role in the EV transition, whether that be further punitive measures, such as that introduced by the European Union, further subsidising EV demand as seen in Germany, or the banning of ICE vehicles as in the UK. The transitions to EVs will therefore consequently be determined by the decisions made by the state in the coming years.

As a result, there is a need for a profound and sophisticated re-examination of state-business relations in 21st-century capitalism. This, on the face of it, reflects the emergent Green New Deal literature, but it proposes that this re-examination needs to extend beyond the industrial and fiscal role of the state. Instead, it demands an examination of how the state reorganises the institutional architecture of a national economy, from industrial actors to financial actors. The rudimentary market mechanisms, such as the fiscal measures examined throughout this thesis, might then give way to more blunt policy instruments, including bans, fines, and prohibitive measures.

From the preceding chapters, this thesis may point to three directions for the literature. The first direction is asking  whatform the state should take in the transition and how it takes on this function. Both contemporary and critical perspectives, therefore, need to answer these questions with greater analytical precision.

Secondly, while the analytical focus of this thesis has been orientated around the automobile sector, it intersects with other policy spheres. The analytical focus here reflects the tendency in the environmental politics literature to focus on one policy or industrial sphere in isolation, This is an analytical boundary that requires acknowledgement, as the ultimate decarbonisation of the automobile sector is  contingent upon a decarbonised energy mix, a decarbonised production process and recycling of the material that makes up the vehicle. Some approaches have touched upon these themes, including the circular economy analysis (Weetman, 2020; Geissdoerfer et al., 2017), or Life Cycle Analysis (Crawford, 2011). However, there still needs to be greater sensitivity to the interconnected contingencies of sustainable transitions, and the implications that decarbonising one sector has for other sectors in the economy.

Thirdly, whilst the objectives set out in the Paris Agreement, and the commitment to net-zero, have been a key focus of the analytical and methodological concerns raised here, these targets are largely considered insufficient and unreflective of climate science by those from a natural science discipline (Mann, 2021; UNEP, 2021). The discrepancy was nowhere more evident than in the *IPCC's Sixth Assessment Report* (2021) that issued a 'code red' warning for climate breakdown as states continue to work towards objectives set out in the Paris Agreement 35 years hence. Consequently, there needs to be greater recognition that the Paris Agreement objectives are largely politically constructed rather than scientifically advisable.

### 8.5 Closing remarks

This thesis aimed to capture the decarbonisation of the automobile sector in the UK and Germany with as much analytical precision as possible. In the pursuit of this endeavour, the growth of the EV market, and automobile’s impact on the environment, demanded a critical position adopted from the outset. The proceeding empirical findings did little to dissuade this initial position, for the problematic and deliberative nature of the EV transition continues to compromise the objectives of the Paris Agreement. The consequences of exceeding the targets of Paris are difficult to convey here, though they become increasingly observable across the world. Decarbonising the automobile sector is ultimately not the sole responsibility of the UK or Germany, but their leadership could nonetheless yet prove to be the catalyst for change.

This thesis does not attempt to forecast the point at which the automobile sector will become decarbonised, or whether, indeed, the sector will reach this point. Instead, it identifies where key barriers presently lie in preventing the automobile sector from keeping global emissions below 2o. It has combined novel and unique insights from actors presently shaping the transition with insights from emergent trends in the literature, to demonstrate that decarbonising the automobile sector is fundamentally political, with ramifications far beyond the sector. This thesis consequently offers a timely intervention into one of the key policy areas facing governments across the global economy today.

My motivation for this thesis was to investigate why growth in the EV market had laboured in the face of climate breakdown despite it being seemingly the most likely way to address transport emissions. And whilst this investigation has uncovered many of the key barriers inhibiting the transition, the transition continues to labour. I have shown in this thesis that overcoming the barriers that lie between the automobile sector's present form and transitioning to one that can be decarbonised through EVs, required adopting measures, and *continues* to require interventions, that until recently had been considered unviable, or indeed unthinkable. Thereupon, I propose that it is not only the automobile sector greatly in need of change, as it drives the world ever closer to climate breakdown, but of the political and economic orthodoxy as well.

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### Appendix A: Interviewees list

**The following is itemised in alphabetical order of the interviewees name.**

\*All names are anonymised as per the ethical consent

|  |  |  |  |
| --- | --- | --- | --- |
| **UK** |  | **Germany** |  |
| GreenTV | U1 | E3G | G1 |
| Electric Blue | U2 | Schaefleer | G2 |
| Delta EE | U3 | E-mobility Data Management | G3 |
| Crowd Charge | U4 | ICLEI | G4 |
| Zap Map | U5 | Ecology Institute | G5 |
| Institute of Transport | U6 | Deutsche Bank | G6 |
| Energy Saving Trust | U7 | Technical University Munich | G7 |
| Zero Carbon Futures | U8 | Circular Economy Institute | G8 |
| Transport for Greater Manchester | U9 | Volkswagen | G9 |
| Low Carbon Vehicle Partnership | U10 | Daimler | G10 |
| Positive Money | U11 | University of Dortmund | G11 |
| Ubitricity | U12 | Agora Verkehrswende | G12 |
| Client Earth | U13 | Sustainable Capital Advisor | G13 |
| Impact Global Solutions | U14 | PwC | G14 |
| National Grid/EV Task Force | U15 | Financial Times | G15 |
| University of West England | U16 | Institute for Transport Research | G16 |
| Cenex | U17 | New Climate Institute | G17 |
| Transport for Greater Manchester | U18 | Bellona Europa | G18 |
| Office for Low Emission Vehicles (OLEV) | U19 | GIZ | G19 |
| Transport Studies Unit | U20 | E3G | G20 |
| Institute of Transport Studies | U21 | Technical University Munich | G21 |
| Innogy | U22 | Wuppern Institute | G22 |
| Hope for the Future | U23 | Oeka Institute | G23 |
| Department for Transport (DfT) | U24 | Eurelectric | G24 |
| Nottingham City Council | U25 | Audi | G25 |
| Consultancy | U26 | Agora Energiewende | G26 |
| Carbon Trust | U27 | Transport & Environment | G27 |
| EO Technology | U28 | Octopus Energy | G28 |
| Oxfordshire Country Council | U29 | Hertie School Berlin | G29 |
| Vanarama | U30 | Clean Energy Wire | G30 |
| Advanced Propulsion Centre | U31 | Free University Berlin | G31 |
| Sustainable Development Strategist (SD21) | U32 | Fraunhofer Institute | G32 |
| Octopus Energy | U33 |  |  |

### Appendix B: Sample information sheet for interviewees

Research title - The barriers to decarbonising the automobile sector

**You are being invited to take part in the research study which aims to investigate the barriers to decarbonising the automobile sector in the United Kingdom and Germany. Before deciding whether or not to take part, it is important that you understand why the research is being conducted and what it will involve. Please take time to read the following information and feel free to ask any question should require any further information or clarification.**

**What is the purpose of the research?**

The purpose of the research is to examine the barriers to reducing the emissions in the automobile sector by a transition to electric vehicles (EV) for consumer and business use. Whether the barriers be political, economic, technological, or social, the aim to establish how the barriers exist in their present form and how they may be overcome. To do this, the research will place particular emphasis on meeting the 2040 target for banning petrol and diesel vehicles as set out by a number of countries since 2016. For that purpose, the project is examining both the role of the government, byway of their fiscal and policy instruments, but also the actions taken by automobile manufactures and charging infrastructure providers to achieve this objective. Just to note, it is not expected that interviewees will have an intermit knowledge of both countries, therefore, the questions will be asked in specific relation to their country of residence.

**Why have I been chosen to take part?**

Because of your *[INSERT EXPERTISE]* at [*INSERT ORGANISATION].* Your participation in the research will therefore inform the research findings of my PhD regarding this topic. I believe you can add valuable insights to the research and therefore wish to discuss this topic with you given your experience in this area.

**Do I have to take part?**

It is entirely up to you to decide whether or not to take part. Should you decide to take part you will be given this information sheet to keep and be asked to sign a consent form on the day of the interview before it commences. If you do decide to take part, you are free to withdraw at any time. Should you withdraw, none of the material collected will be used.

**What will be involvement entail?**

The questions I ask will be in relation to your thoughts, insights and experiences working for your organisation. The interview will last no longer than an hour. All data provided will be stored securely and all information will be confidential. I am happy to send the finished project to yourself should it be of interest to you. After the interview I do not foresee the need to contact you again but welcome any further correspondence.

**What will happen if I take part? What do I have to do?**

If you accept the invitation to participate in this study, you will be interviewed by myself. The interview shall take place in a location to negotiate between yourself and the research, or alternatively by Skype, on a date to be confirmed with yourself.

**Will I be recorded, and how will the recorded media be used?**

The interview will be recorded (audio only) for the purposes of transcription by the doctoral researcher. The original audio files will be anonymised and no one besides the doctoral researcher shall have access to them.

**Will my participation be kept confidential?**

Confidentiality will be ensured through the encoding and secure storage of the original audio files. No one besides the doctoral researcher will have access to them. Furthermore, you will be given the opportunity to decide to whom you would like to see your words being attributed in any of the written outputs of this project by choosing an anonymous descriptive ‘alias’.

**What will happen to the data collected, and the results of the research project?**

Original audio files shall be stored in a safe password-protected folder. In any case, data in an identifiable form will be destroyed within three years of the conclusion of the project. The transcription work will be carried out exclusively by the doctoral researcher. The project’s results will be submitted before the end of 2025 to the University of Sheffield for the degree of PhD in Politics. Additionally, they are also likely to be used in a few additional research outputs, such as peer-reviewed journal articles developed alongside the PhD thesis, as well as in the researcher’s future work.

This research will be given ethical approval by the University of Sheffield Politics and International relations department.

Should you wish to contact me, my name is James Jackson. I can be contacted via email through [jjackson13@sheffield.ac.uk](mailto:jjackson13@sheffield.ac.uk).

Thank you for taking the time to read this information. I hope that are willing to participate in my research.

### Appendix C: Consent sheet

Decarbonising the automobile sector

I agree to take part in the PhD research, specified above. The purpose of the research has been explained to me, and I have read the Project Information sheet, which I can keep for my records.

**Taking part in the project**

I have been given the opportunity to ask questions about the project:   Yes         No

I agree to be interviewed by the researcher:       Yes              No

I agree for the interview to be audio recorded:   Yes             No

I understand that i can answer any question in full or in part and reject to answer the question altogether:                                                  Yes             No

I understand that my participation is voluntary, that I can choose not to participate in part of, or all, of the project, and that I can withdraw at any stage of the project (prior to the completion of the thesis) without being penalised or disadvantaged in any way:

Yes              No

I understand that the information I provide may be used as part of future publications of this research in articles, web pages and other research outputs:

Yes              No

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in this project, or to any other party:

Yes              No

I understand that the recordings and transcripts from this interview will be stored securely in a password protected folder on a secure university drive. I also understand that the recordings and transcripts held by the university will be destroyed after the completion of the PhD research and that I can access my file at any time:

Yes              No

I understand that I can withdraw my participation from this research at any time:

Yes              No

Participant name:                                        Signature:                                       Date:

Interviewer name:                                       Signature:                                       Date:

### Appendix D: Sample of interview questions

**Main question:**

Do you think the UK/Germany will meet the target of banning petrol and diesel vehicles by 2040?

**Follow up questions:**

In your view, what reservations do you think people have over buying electric vehicles?

For example, do you think there are political, social, or financial reasons?

Do you think consumers have enough awareness of electric vehicles?

Do you think consumers have enough awareness of the 2040 target?

Is there enough market based instruments to support the uptake of electric vehicles?

Are you aware of any difference between governments in their approach to growing their?

national electric vehicle market?

Can you provide specific examples?

To your knowledge, have any of the alternative approaches yielded better results in your view?

Do you think more electric vehicles infrastructure needs to install for significant electric vehicle growth to occur or vice versa?

As it presently stands, do you think there are enough electric vehicles on the market?

Do you see car manufacturers advertising their electric vehicles to the same extent, or perhaps more so, than their petrol and diesel cars?

Do you think that the government’s current measures will achieve the 2040 goal?

Do you think there is a better way to decarbonise the transport sector than electric vehicles?

What is your opinion on environmental policy in the German government at the moment?

Do you see the decarbonising network in the UK as a three way one between government, manufacturers and infrastructure providers or more?

Do you think the UK would be better placed to exploit the future of low carbon transport by EV manufacturing or elsewhere in the supply chain (i.e. infrastructure, batteries etc)?

1. For clarity, the term ‘automobile’ is used throughout this thesis to denote the car or passenger vehicle as

   opposed to ‘automotive’ sector. The former refers to a four-wheeler vehicle for transportation, whereas the

   latter is used to refer to the motor *within* vehicles, thus broadening the term beyond the intended scope of this research. [↑](#footnote-ref-1)
2. The term climate breakdown seeks to better capture the severity of changing climatic conditions,

   following notions of ‘climate crisis’ and a ‘climate emergency’ (Carrington, 2019). The etymological roots of

   climate breakdown appear to stem from George Monbiot who stated that “climate change is a ridiculous thing to call it, it’s like calling a foreign invasion “‘unexpected guests” (Hymer, 2017). [↑](#footnote-ref-2)
3. Tailpipe emissions refer to the various chemicals produced by a vehicle as it in motion. These chemicals include carbon dioxide, nitrogen dioxides, hydrocarbon’s, sulphur dioxide, particular matter, and Ozone. When in reference to the climate implications of automobile use, tailpipes emissions are often centred around the carbon dioxide produced through the burning of gasoline/petrol and diesel fuel. [↑](#footnote-ref-3)
4. The history of EVs is often traced back to the founder of Porsche Ferdinand. Porsche developed an electric

   vehicle called the P1 in 1898. Furthermore, some have highlighted how the relationship between Thomas

   Edison and Henry Ford led to the exploration of early electric vehicles before Ford’s Model 3 ultimately

   established gasoline vehicles as the predominant type of vehicle (Matulka, 2014; Anderson and Anderson,

   2010; Strohl, 2010). [↑](#footnote-ref-4)
5. This process is otherwise known as Taylorisation, the process of producing commodities *en mass* through a

   rationalised production method which reduced productive tasks to their simplest elements, which was

   central to Fordism, leading to enhanced productivity. Fordism is itself attributed to the production of

   automobiles as pioneered by Henry Ford to produce Ford Motor Company. [↑](#footnote-ref-5)
6. How automobiles reflect one’s identity within the economy has been conceptualised in various guises from

   the notion of a ‘positional good’, reflecting the ‘conspicuous consumption’ of consumers (Veblen, 1899) and

   the ‘commodity fetishism’, wherein the value of a commodity is not tied into relationships among people, but

   the relationship between one’s financial capacity within the market (Marx, 1887). [↑](#footnote-ref-6)
7. This process has been discursively described by environmental scholars as a ‘carpocalypse’ (Bundale, 2021; Walker 2020) or ‘carmageddon’ (Monbiot, 2019; 2016). [↑](#footnote-ref-7)
8. A neoclassical approach Is typically considered a broad, predominantly macro, analysis of the market to explain the production, pricing, and consumption of goods and services in the economy through a complex relationship between supply and demand. Common tenets of the approach, include marginal utility, conditions of the market (dis)equilibrium, savings *vis-a-visa* investment and consumers as rational agents amongst others (Keen, 2021; Morgan, 2015). [↑](#footnote-ref-8)
9. Jones (2001) draws a distinction between neo-corporatism from the former category through an emphasis

   on the involvement of stronger trade unions, employers’ associations and states who all perform the function of ‘social partners’ to who together negotiate and manage the operations of the economy. By contrast, corporatism tends to refer to the corporate influence alone organising society (Clarke et al., 2001). [↑](#footnote-ref-9)
10. The real economy is often used to describe the production, consumption, and exchange of material goods,

    such as vehicle parts, wheat, or wood etc. [↑](#footnote-ref-10)
11. Fuel tax is often considered a ‘regressive tax’ wherein the rate leveraged decreases as the subject of the tax

    (here fuel) increases. Regressive taxes speak to a distribution effect on consumer demand in which the tax may

    be set high or low and has a disproportionate impact on lower income consumers as all consumers are taxed

    at the same rate (James, 1998). The opposite would be a ‘progressive tax’ in which the average tax increased

    as the subject of taxation also rises. [↑](#footnote-ref-11)
12. The 4.4% referred to here accounts for the entirety of economic affairs in the European Union of which the

    transport accounts for a smaller proportion. The average budgetary proportion here couples transport with

    other sectors of the economy, including agriculture, forestry, fishing, manufacturing, and others (European

    Commission, 2020). [↑](#footnote-ref-12)
13. The Multiplier effect refers to how changes in input produce changes in output. For example, higher government spending can produce higher aggregate demand in the economy so contribute to higher GDP, employment, or industrial output. Elsewhere, the multiple effects have been referred to as the marginal propensity to consume by households through the extra income produced by investments by external forces, such as business or the government (Veretekhina et al., 2017; Anderson, 2004). [↑](#footnote-ref-13)
14. To do this, organisations published non-peer-review work by a small group of scientific spokespeople. It has

    been concluded that this small group of climate scientists have been discredited by reputable climate scientists

    who advocate the now consensual outlook on climate science. These tactics are said to reflect those used by

    the tobacco companies during the 20th century to avoid taxes and bans on smoking cigarettes. [↑](#footnote-ref-14)
15. Creditworthiness here reflects the common investment criteria/credit rating attached to financial

    investment, comprised of ‘investment’ grades AAA to A-, BBB+ to BBB- to lower investment made, also known

    as ‘speculative’, with lower grades considered ‘junk’ bonds and non-investment grades determined by the

    credit rating agencies Standard & Poor, Moody, and Fitch. [↑](#footnote-ref-15)
16. Debt-to-equity ratio is a metric used to evaluate the financial health of an organisation or sector. According

    to the ratio, 1 here indicates a company with equal assets and liabilities. The indicator measures the

    proportion of capital for creditors and shareholders. Therefore, creditors measure financial health with lower

    D/E ratios (below 1), whereas debtors higher than 1 may become ever more reliant on debt (Affando and

    Sunarko, 2019). [↑](#footnote-ref-16)
17. According to Geels (2019), the Socio-technical Transitions approach is informed by a Schumpeterian notion

    of evolutionary economies, one which draws upon Austrian political economist Joseph Schumpeter’s notion of

    ‘Creative destruction’. In Schumpeter’s initial theory, creative destruction refers to the process of industrial mutation of the industrial and economic system in which new industries replaces the old during the flow of the business cycle (Schumpeter, 1942). [↑](#footnote-ref-17)
18. Visual illustrations of the MLP have differed across authors and indeed over time. Therefore, different graphics could have been used here. Geel’s (2011) interpretation, however, presents a development upon his own interpretations and, as such, a useful figure for the purposes of this chapter. [↑](#footnote-ref-18)
19. Steam technology had already been used during the industrial revolution for other modes of transportation,

    including trains and ships, but also factories and mines. [↑](#footnote-ref-19)
20. AT&T Mobility LCC is the largest wireless telecommunication company in the United States of America (USA), turnover $165.9 million in Q4 of 2019 (AT&T, 2020). [↑](#footnote-ref-20)
21. Apple was originally called Apple Computer Inc. until it changed its name to simply ‘Apple’ in 2007

    (Mazzucato, 2018) [↑](#footnote-ref-21)
22. In large part, this has been due to the commodity-product spread of each iPhone yielding such high returns

    (i.e., the cost of production of Apple’s iPhone 11 Pro Max is around $490.50, whereas the commodity price is

    between $1,099-£1,449). [↑](#footnote-ref-22)
23. Externalities are not unique to the environmental debate. Otherwise referred to as ‘spill over effects’ the

    term has been used to describe factors which exist outside of the profit and cost formulas. [↑](#footnote-ref-23)
24. The polluter pays principle is, as the name suggests, the notion that those who pollute should pay the cost.

    The principle has tended to underpin the pollution of land, water, and air. However, the debate about the principle refers the effectiveness of the principle and whether it is implemented in practice (Haas, 2021; Gendron, 2011). [↑](#footnote-ref-24)
25. Often attributed to the 1987 Brundtland Report, Sustainable Development has since become embedded

    within the United Nations (UN) environmental approach as they took on mantle of Sustainable Development

    since the 1992 UN Conference on Environmental and Development (UNCED). Successive programmes have

    come in the form of 2012 UN Conference on Sustainable Development (UNCSD), the 2030 Agenda for

    Sustainable Development, 17 Sustainable Development Goals and the 2015 Millennium Development Goals

    (Atkinson et al., 2014). [↑](#footnote-ref-25)
26. Richardson and Rootes (1995) note that the debate between ‘fundis’ and ‘realos’ has its roots in German

    politics since the 1960s. [↑](#footnote-ref-26)
27. Several scholars have linked the HD model to John Stuart Mill, following on from other classic scholars such

    as Adam Smith and Karl Marx (Nola, 2007). Its philosophical principles can be traced back as far as Plato,

    however. [↑](#footnote-ref-27)
28. At the beginning of this thesis the UK was still a member of the EU but following the vote to leave in 2016. [↑](#footnote-ref-28)
29. Otherwise known as epistemological holism, this view is an important part of sciences philosophy, asserting that no statement can be wholly validated nor invalidated by virtue of empirical experiment. Instead, such experiments may only produce a series of statements which may be revisited to test their veracity again. [↑](#footnote-ref-29)
30. Categorising data on Nvivo is allocated into primary categories (nodes), sub-categories (codes) and sub-

    codes. [↑](#footnote-ref-30)
31. LinkedIn provides both a free and premium service, whereas the former offers a basic means to connect and

    communicate with other ‘users’, the latter is often used to secure accounts with limited to no accessibility to

    non-premium members. Premium accounts also differ between career, business, recruiter, and sales accounts

    which limits the messages or ‘InMail’ messages which can be exchanged. [↑](#footnote-ref-31)
32. Neoliberalism as common sense is rooted in the notion of ‘everyday neoliberalism’, in which constructivist

    scholars in International Political Economy (IPE) have perpetuated the ideas as to how the state and market should function (Cannizzo, 2018; Davies, 2014) [↑](#footnote-ref-32)
33. Air quality is the measure of a mixture of solid particulars and liquid droplets in the air from sulphur dioxide

    to nitrogen dioxide and airborne particulates. Often, the focus of air quality policies is centred around PM 10

    (particles with diameters generally around 10 micrometres or smaller) and PM 2.5 (with diameters from 2.5

    micrometres and smaller. [↑](#footnote-ref-33)
34. The emissions have otherwise been referred to as EURO7 emissions standards, though this is an unofficial

    title (Nijhuis, 2021). [↑](#footnote-ref-34)
35. Keynesianism is often associated with a discretionary fiscal and monetary policy approach in contrast to a

    rules based approach, which spends and taxes in line with the business cycle along what is often called the

    Philips curve (Blakeley, 2020). [↑](#footnote-ref-35)
36. This is known as Norway’s fiscal rule (*handlingsregelen),* stipulating that the revenue raised from fossil activity must be transferred into the SWF and is primarily invested abroad. Within the domestic economy, this fiscal approach of the Norwegian economy ties the state budget to the proceeds of the oil fund, as 3% (down from 4%) of the fund contributes 20% to the state budget. [↑](#footnote-ref-36)
37. The 10 cities actually became 13 cities, including Beijing, Shanghai, Shenzhen, Wuhan, Hangzhou, all of which developed at a different pace as Shanghai, Changchun, Shenzhen, and Hangzhou emerged as frontrunners in their industrial development (Jin et al., 2021). [↑](#footnote-ref-37)
38. The Green Industrial Revolution was first proposed in the Labour Party’s 2019 general election manifesto but has since been adopted by the Conservative government in 2021, aligned with their 10-point plan for the

    environment (GOV, 2020). [↑](#footnote-ref-38)
39. COVID recovery packages are primarily designed to insulate employees and businesses for economic shocks for the pandemic by extending a ‘cash bridge’ to businesses. In brief, both France and Germany’s recovery

    packages have been state guaranteed for job retention schemes, deferral of certain taxes and rent payments,

    as well as additional funding for healthcare systems and suspension of insolvency (Djankov, 2020). [↑](#footnote-ref-39)
40. Quantitative Easing is the process by which central banks print digital money to purchase government bonds

    (or debt) on the capital markets. The intention is to provide liquidity for investors by making fixed-return assets more liquid, in theory providing the corporate sector with new liquidity to invest in production and thus

    investment. QE also provides capital markets with an enhanced degree of security, allowing for lower interests

    and increased loans (Coppola, 2019; Ryan-Collins et al., 2013) [↑](#footnote-ref-40)
41. Monetary offsetting typically refers to the process by which central banks constrain the monetary supply

    through increasing the interest rates at times when states adopt an expansive fiscal position. The rationale for

    this policy is to avoid inflation and the ‘overheating’ of the economy (IMF, 1998). [↑](#footnote-ref-41)
42. The UK’s LOZ class system is made up of four classes, including Class A which restricts the actions of buses,

    coaches, taxis, and private hire vehicles (PHVs), Class B which includes, buses, coaches, taxis, and heavy good

    vehicles (HGV), Class C that affects buses, coaches, PHVs, HGVs and light goods vehicles (LGVs) and Class D that

    incorporates buses, coaches, PHVs, HGVs, LGVs and cars (Fleet News, 2021). The extent to which these zones

    classes might be applied to each vehicle type is at the discretion of local government. [↑](#footnote-ref-42)
43. The Feinstaubalarm would mark the days when the city air pollution exceeded European Union limits. Once

    rung, citizens would be advised to change consumption habits, including alternative heating and transportation systems (Nair, 2017). [↑](#footnote-ref-43)
44. Go Ultra Low is a joint venture by the UK government and industry established to aid the transition to EV’s in

    the UK. Under the Go Ultra Low campaign, collaborative efforts have been made to provide informative events

    on EVs, champion low carbon leaders and facilitate the distribution of grants from the Office for Low Emission

    Vehicles (OLEV). [↑](#footnote-ref-44)
45. The focus of these analyses tends to frame Ecological Modernisation as addressing climate change or other

    impacts of climate breakdown as opposed to the economic or social benefits of modernising productive

    processes. [↑](#footnote-ref-45)
46. The authors referenced the German green movement Burger-initiativen and Dutch movement man and

    friendly enterprises (MEMO). Berglund and Schmidt (2020) also note that this has formed much of the focus of

    the more recent environmental movement Extinction Rebellion (XR). [↑](#footnote-ref-46)
47. Liberal Market Economies (LMEs) are a variety of capitalism as noted by Hall and Soskice (2001) marked by

    coordination on the part of capital through hierarchical and market-based mechanisms. From its inception in

    literature, the UK, alongside the USA, has been seen as the archetypal LME. [↑](#footnote-ref-47)
48. Fuel duty is a tax levied on fuels. In the UK, fuel duty is 57.95 pence per litre. Added to fuel duty, the price

    per litre of fuel is also made up of 20-25 pence in Value-added-tax (VAT) and a retailer’s margin of 5p (Goodall,

    2021). [↑](#footnote-ref-48)
49. The UK’s Climate Change Act, enacted in 2008, established carbon budgets for the UK economy to reduce its

    territorial emissions by 80% from 1990 levels by 2050 (Farstad, Carter, and Burns, 2018). The objective has

    thereafter been updated to 100% by 2050 aligning with the UK’s Net-zero objectives. [↑](#footnote-ref-49)
50. Under the umbrella of funding was included £1bn for the Plug-in Vehicle grant, £80m for charging grants, and £15 for Highways England to deploy charging infrastructure across the key roads in England. Also, £50m for the Plug-in Taxi Programme and £14m for taxi charging infrastructure. The fund was solely reserved for EVs, however, as £100m was also made available for retrofitting buses in England and Wales (H.M. GOV, 2017). [↑](#footnote-ref-50)
51. Part of reskilling and upskilling the UK labour force was the introduction of new T level qualifications

    administered by the Institute for Apprenticeships and the National Retraining Scheme (H.M. Gov, 2018a). [↑](#footnote-ref-51)
52. Gigafactories have become a common term by which to describe the production facility for electric vehicle

    batteries. The term was coined by Tesla CEO, Elon Musk, upon the construction of their Nevada plant, the

    world’s first Gigafactory. Since then, the term has now come to be used as a term for all production facilities

    (Jolly, 2021b). [↑](#footnote-ref-52)
53. The term Green New Deal was proposed by the New Economics Foundations (NEF) after the financial crisis

    to address the ‘triple crunch’ of the overlapping climate, energy price and debt-led consumption crises. It took

    inspiration from the New Deal introduced by President Franklin D. Roosevelt in America in 1929 during the

    Great Depression (NEF, 2008). [↑](#footnote-ref-53)
54. Rules of Origin is here applied to determine whether or not a sufficient degree of work has gone into

    transforming the two constitute it counting as ‘originating’ in that party’s jurisdiction for the purpose of

    maintaining a zero-tariff agreement (Howe et al., 2021). [↑](#footnote-ref-54)
55. Research indicates that in 2018 the UK had an hourly productivity output of 100 for an average of 42 hours

    in work per week. This was compared to other European countries, such as Germany whose productivity per

    hour was 114.6 for an average working week of 40.2, France’s 115 output for 39.1 hours and a European average of 91.4 for 40.2 hours (Eurostat, 2018). [↑](#footnote-ref-55)
56. OEMs here refers to Original Equipment Manufacturers. [↑](#footnote-ref-56)
57. E-mobility is the word for the electric vehicle transition often used in German discourse and was the word often used by interviewees. The word is itself a contraction of electromobility, used in Germany to describe the electrification of the transport section as a whole. E-mobility is thus specific to the automobile sector and EVs in general. [↑](#footnote-ref-57)
58. The Bundesrat is the legislative body in Germany that represents the individual federal states, or Länder, of which there are 16 in the country. Members of the Bundesrat can be installed independent of the incumbent party, or parties as is often the case in Germany, within the Bundestag, the national parliament. [↑](#footnote-ref-58)
59. For clarity, Ursula von der Leyen is the currently the president of the European Commission, the executive branch of the European Union. The Commission is the administrative body of the union, tasked with implementing the policies devised alongside the European Council (made up of the 27 heads of state) and the European Parliament (made up of elected officials). Until 2019, von der Leyen had previously been in Angela Merkel’s cabinet and is an elected member of the Christian Democratic Union party. [↑](#footnote-ref-59)
60. This fiscal approach is not simply unique to Germany but is part of the broader fiscal framework enshrined

    within the EU’s Maastricht Treaty in 1992. The Treaty served to establish a fixed threshold for sovereign debt

    for member states. The rules governing the fiscal capacity of members states are also enshrined within the Treaty on the Function of the European Union and Stability and Growth Pact. [↑](#footnote-ref-60)
61. Germany’s influence in the ECB is exerted through their representation on the Executive Board by virtue of being part of the Euro, The Supervisory Board and, to a lesser extent, German Isabel Schnabel’s position on the Executive Board. [↑](#footnote-ref-61)
62. Central banks have long argued that their ‘operational independence’ separates them from the official arena of politics, and, by extension, climate policy. Instead, central banks have asserted that achieving climate objectives, such as Net-zero, are government objectives, and so should be the task the of government alone (ECB, 2021). [↑](#footnote-ref-62)
63. Other insights of the Verkerswende include rethinking the development and financing of transport

    infrastructure, the benefits of transport transformation to society and how carbon neutral fuels can supplement wind and solar. [↑](#footnote-ref-63)
64. Analytics from Web of Science shows that of the disciplinary of focus electric vehicles, political science accounts for less than the lowest discipline listed at 1.8%. Instead, the subject of electric vehicles is most prevalent in the discipline of electric engineering (48%), with a significant gap to energy fuels (16%), transport science (13%) and automation controls (12%) thereafter. [↑](#footnote-ref-64)
65. This is of course only limited success and by no means represents a majority of EVs as a proportion of the automobile sector as a whole. Furthermore, as I have mentioned previously in this thesis, neither case study of this research are market leaders in the EV transition. [↑](#footnote-ref-65)