Electric Vehicles and Just Transition to a Low-Carbon Economy in the German Automotive Industry

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Statement of Originality

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Abstract

The transformation of the German automotive industry is crucial in mitigating transport related pollution and cutting greenhouse gas emissions. This has significant and differentiated implications for carmakers, their suppliers and autoworkers, altering the organisation and functioning of global automotive production networks. EV manufacturing not only changes conditions for workers at engine factories or car assembly plants in Germany, it also affects global labour such as workers employed in natural resource extraction, raw material mining and chemical processing across the world economy.

Warning against potentially unequal distribution of burdens of environmental pollution regulations and introduction of emissions reduction technologies/products, the concept of just transition aims to protect workers and their communities, which are dependent on existing fossil fuel sectors. Incorporated in 2015 into the Paris Agreement as part of the UNFCCC negotiations, the concept of just transition is promoted by intergovernmental institutions and some governments, especially in the case of coal phase-out. Combining the social, environmental and economic aspects of sustainability/energy transitions, just transition is also key for national and international labour organisations. This thesis investigates the extent to which the proliferation of EV manufacturing in Germany contributes to a just transition to a low-carbon economy, with its winners and losers; and asks how justly the shift to EVs in Germany unfolds.

In addition to review of technical/policy documents and related academic literature, the thesis is based on historical analysis of the past transitions in the German automotive industry and on a detailed analysis of the current transition to EVs through semi-structured interviews with transport and automotive departments of international organisations, national (German) and international trade union organisations, industry lobby groups at the global, European, national and regional levels, as well as skilled and semi-skilled workers in Germany's carmakers and large automotive suppliers. It constructs a five-parameter analysis to judge the shift to EVs in the German automotive industry.

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List of Acronyms

ACEA: European Automobile Manufacturers' Association

ADGB: Allgemeiner Deutscher Gewerkschaftsbund (Free Trade Union Confederation)

ASEAN: Association of Southeast Asian Nations

BAFA: Bundesamt fuer Wirtschaft und Ausfuhrkontrolle (German Federal Office for Economic Affairs and Export Control)

bayme vbm: Bayerischer Unternehmensverband Metall und Elektro Industrie (Bavarian Employers' Associations for the Metalworking and Electrical Industries)

BEV: Battery electric vehicle

BGR: Bundesanstalt fuer Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources)

BMWi: Bundesministerium fuer Wirtschaft und Energie (Germany Federal Ministry of Economy and Energy)

BMWK: Bundesministerium fuer Wirtschaft und Klimaschutz (German Federal Ministry for Economic Affairs and Climate Action)

BOG: Best Owner Group

BWemobil: Stuttgart Landesagentur fuer neue Mobilitaetsloesungen und Automotive Baden-Wuerttemberg (BW State Agency for New Mobility Solutions and Automotive)

CEE: Central and Eastern Europe

CLEPA: European Association of Automotive Suppliers

Coal Commission: Kommission "Wachstum, Strukturwandel und Beschaeftigung (Growth, Structural Change and Employment Commission)

DAF: Deutsche Arbeitsfront (German Labour Front)

DERA: Deutsche Rohstoffagentur (German Mineral Resources Agency)

Destatis: Statistisches Bundesamt (German Federal Statistical Office)

DGB: German Trade Union Confederation

DRC: Democratic Republic of Congo

ELAB: Electromobilitaet and Beschaeftigung (Electromobility and Employment)

ETUC: European Trade Union Confederation

EUROFOND: European Foundation for the Improvement of Living and Working Conditions

FCEV: Fuel cell electric vehicle

Fraunhofer IAO: Fraunhofer-Institut fuer Arbeitswirtschaft und Organisation (Fraunhofer Institute for Industrial Engineering and Organisation)

Gesamtmetall: Gesamtverband der Arbeitgeberverbaende der Metall- und Elektro-Industrie (Federation of German Employers' Associations in the Metal and Electrical Engineering Industries)

GFAs: Global framework agreements

GPN: Global production network

GTAI: Germany Trade and Invest (Gesellschaft fuer Aussenwirtschaft und Standortmarketing) under BMWi

GUFs: Global union federations

GVC: Global value chain

ICE: Internal combustion engine

IEA: International Energy Agency

ifaa: Institut fuer angewandte Arbeitswissenschaft (Institute of Applied Industrial Engineering and Ergonomics)

IG Metall: Industriegewerkschaft Metall (German Metal Workers' Union)

IKA, RWTH Aachen: Institute for Kraftfahrzeuge, Rheinisch-Westfaelische Technische Hochschule Aachen (RWTH Aachen University Institute for Motor Vehicles)

ILO: International Labour Organisation

IndustriALL: The industry and manufacturing GUF

IPCC: International Panel on Climate Change

IRENA: International Renewable Energy Agency

ITF: International Transport Workers' Federation

ITUC: International Trade Union Confederation

JTC: Just Transition Centre at ITUC

JTRC: Just Transition Research Collaborative at UNRISD (United Nations Research Institute for Social Development)

KDP: Kommunistiche Partei Deutschlands (German Communist Party)

NAFTA: North American Free Trade Agreement

NDCs: Nationally determined contributions to emission reductions under UNFCCC

NGO: Non-governmental organisation

NPM: Nationaler Entwicklungsplan Elektromobilitaet der Bundesregierung (National Electromobility Development Plan of the Federal Government)

NASDP: National Socialist German Workers' Party

OECD: Organisation for Economic Cooperation and Development

OEM: Original equipment manufacturer (carmaker)

OICA: International Organization of Motor Vehicle Manufacturers

PHEV: Plug-in hybrid electric vehicle

PSI: Public Services International (The GUF of workers in public services)

SAIC: Shanghai Automotive Industry Corporation

SDGs: United Nations Sustainable Development Goals

SSCM: Sustainable supply chain management

SDP: Sozialdemokratische Partei Deutschlands (German Social Democratic Party)

TUAC: Trade Union Advisory Committee to the OECD

TUDCN: Trade Union Development Cooperation Network at ITUC

TUED: Trade Unions for Energy Democracy

UAW: United Auto Workers (The International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America)

UNCTAD: United Nations Conference on Trade and Development

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

USDP: Unabhaengige Sozialdemokratische Partei Deutschlands (German Independent Social Democratic Party)

UNSC: United Nations Statistical Commission

USGS: United States Geological Survey

VDA: Verband der Automobileindustrie (German Association of the Automobile Industry)

WCED: United Nations World Commission on Environment and Development (Brundtland Commission)

CHAPTER 1 INTRODUCTION

Organised in five sections, this chapter introduces my research on the impacts of the proliferation in Germany of electric vehicle (EV) manufacturing on a just transition to a low carbon economy. I start by flagging some of the key just transition demands emerging from worker organisations as the German automotive industry begun shifting to EVs. I then show how EVs are perceived as 'sustainable' - the solution to road transport emissions - by a broad coalition of forces in and around the German automotive industry. This broad coalition includes car manufacturers, workers and the state. I root this interest alignment around EVs in the broader context of sustainability and energy transitions and introduce the research questions of the thesis. Driven by the research questions, I briefly present a set of original parameters constructed to analyse the EV transition in Germany. I conclude with the structure of the thesis and explain each chapter's link to the research questions.

1.1 Just Transition and EVs

When I conducted my interviews during research trips to Germany in 2019, the metalworker's trade union in Germany (IG Metall) organised demonstrations across the country with the motto of just transition (*Fairwandel*). In June, the members of IG Metall – the largest trade union in the country – marched in Berlin to support climate change mitigation and emission reduction policies and warned that workers risk bearing the burdens of new products such as electric vehicles (EVs) that are promoted to cope with road transport emissions.[1] IG Metall had been raising alarms against recent announcements of their employers pertaining to jobs losses in vehicle manufacturing caused by the shift to EVs. This time they emphasised *Fairwandel* and demanded that existing workers in impacted assembly plants and/or component suppliers are protected, and workers are not excluded from decision-making processes in the greening of this key industry for the German economy. IG Metall members

[1] *Die Tageszeitung* 23.06.2019 IG Metall steigt beim Klima ein: Die Gewerkschaft ruft zu einer Großdemo fuer einen 'fairen und oekologischen Wandel'. Gleichzeitig warnt sie vor einem Fiasko in der Autoindustrie. https://taz.de/Gewerkschaft-fuer-Umweltschutz/!5604810/ [IG Metall gets involved in the climate; Union plans large demonstration in Berlin for fair and ecological change. At the same time, it warns of a fiasco in automotive]

gathered with the motto of just transition in Stuttgart too. I witnessed one of these meetings of the union members in Stuttgart city centre in late October 2019. The two southern states – Baden Wuerttemberg and Bavaria, especially the region around the city of Stuttgart – are the heart of the German automotive industry with several headquarters of large carmakers and key multinational automotive suppliers. IG Metall's just transition demonstrations gained public and political attention around significant potential job losses at plants of large German original equipment manufacturers (OEMs) such as Daimler, Porsche, Audi, BMW, MAN, Neoplan and automotive suppliers such as Bosch, ZF Friedrichshafen, Mahle, Brose, Eberspaecher and Mann+Hummel. Throughout my research trips, job cuts and corporate announcements were top of the agenda of anyone I met in Germany who was part of, or interested in, the automotive industry. Indeed, this research coincided with the unfolding complexity of the 'green transition' within the German automobile industry.

Prior to IG Metall's *Fairwandel* demonstrations, the German metal workers' trade union had conducted surveys to explore the awareness of workers about unfolding changes in their sectors (IG Metall 2019).[2] The trade union looked at how the increased push for digitalisation and electrification of vehicles might influence its membership and autoworkers. The results showed that impacted not only workers employed by large OEMs, but also the employees of myriad number of small and medium sized enterprises (SMEs) that supply components, goods and services to the German automotive industry – the country's biggest export and revenue generating sector. One survey in 2019 showed that only a minority (8%) of the workers expected an increase in employment at existing vehicle assembly and parts production factories. In line with other studies focusing on changes in the German automotive industry (Drahokoupil 2020; Meil 2020; Haipeter 2020), more than half of the autoworkers stated in the IG Metall survey that the number of jobs at their sites will decrease, and an additional one third saw no increase in employment levels in the future (IG Metall 2019).

Key players in the German automotive industry – unions, OEMs, suppliers and the state – were involved since 2009 in various policy-making mechanisms to identify industry policies with respect to the shift to EVs. First, a national platform for electromobility was established

[2] IG Metall (2019) *Transformationsatlas wesentliche Ergebnisse,* 5 June 2019, Press Release of the Board of IG Metall [Atlas of transformation: Essential results] https://www.igmetall.de/download/20190605_20190605_Transformationsatlas_Pressekonferenz_f2c85bcec886a59301dbebab85f136f36061cced.pdf

in 2009 (NPM 2009).[3] The aim of this federal body is to prepare workers, large OEMs and suppliers for the coming age of electric vehicles. Second, regional state governments focus on policy proposals to cope with the proliferation of EV production. This was especially prevalent in the auto states (*Laender*) in Germany – such as Baden Wuerttemberg, Bavaria, Lower Saxony and North-Rhine Westphalia, bringing together automotive companies, IG Metall and regional/local authorities in an effort to discuss the shift to EVs (BWemobil 2019; BAYME 2021; HBS 2021; IKA 2014).[4] For instance, the transformation alliance in the Stuttgart region is composed of the members of political parties at state parliaments (*Landtag*); representatives from the trade union and the employer association – IG Metall and Gesamtmetall; chambers of commerce and industry; and automotive and supplier industry associations (see Section 7.3). Third, to identify potential impacts of EVs on regional and national employment, research centres coordinate and conduct research with trade unions, the state and employers. Major OEMs and multinational first tier suppliers, German Trade Union Confederation (DGB), and IG Metall commissioned pivotal ELAB studies in 2012 and 2018, which were undertaken by the industrial engineering unit of Germany's national research institute, the Fraunhofer Institute IAO, and the German Aerospace Agency. These studies produced scenarios on the roll-out of EVs and tried to predict employment changes depending on the types of EVs introduced, pace of the shift in vehicle manufacturing, and the scope of the state intervention in investments in charging infrastructure, base materials research and product development (ELAB 2012, 2018).

Contrary to the beliefs of IG Metall members about a decreased number of jobs with the shift to EVs, these national, regional and sectoral studies highlighted *new* jobs that EVs bring to the German automotive industry. Studies (BWemobil 2019; ELAB 2012, 2018; IKA 2014) on the German automotive industry to identify employment changes prompted by the shift to EVs predict job reductions in mechanical trades due to the lack of the internal combustion engine

[3] NPM (2009) Nationaler Entwicklungsplan Elektromobilitaet der Bundesregierung [National Electromobility Development Plan of the Federal Government] available on https://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/nep_09_bmu_bf.pdf last accessed on 14/12/2020.

[4] „Autolaender" fuer europaeischen Dialog zur Transformation der Automobilwirtschaft, Press Release 18/11/2020 Ministry of State Baden Wuerttemberg, [German Auto States in European Dialog in Transformation of the Automotive Industry] available at https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/autolaender-fuer-europaeischen-dialog-zur-transformation-der-automobilwirtschaft/ last accessed December 2020

(ICE) and complex transmission in the architecture of the EV, but also emphasise that these losses are compensated by the creation of new jobs in the production of EV components such as battery packs, fuel cells and electric motors. They also draw attention to the role of the state to help the German automotive industry maintain its competitiveness and secure well-paid jobs through support for vocational educational programmes and for retraining of autoworkers (BWemobil 2019; IKA 2014). I did not come across this level of optimism during my research trips to Germany. Still, it was obvious to me that labour organisations think of their role in automotive research and development, design and technology as one of shared leadership with employers. Put directly, most representatives of works councils and trade unions that I met support the idea that if employers take the lead in transitioning to the proliferation of EV manufacturing, they can keep 'good' jobs and/or retrain their members for new ones without losing much of the privileged working and living standards of automotive employees in the country. I think that this interest alignment among German labour organisations, automotive employers and the state, and the necessity to maintain global competitiveness of the German economy in the shift to EVs is strengthened by recent developments around key global environmental and transport policies, to which I now turn.

1.2 Transport Emissions

Two key global environmental and political developments bring the German employers and employees together to embrace the proliferation of EV manufacturing. These are the increasing attention to the impact of road transport emissions on climate change and the scandal of emission test defeat devices used in vehicles produced by large German OEMs between 2009 and 2016.

The climate change and global environmental problems caused by atmospheric concentrations of greenhouse gas emissions renders transition to a low carbon economy an urgent challenge for governments and businesses (IPCC 2014, 2019). As one of the most polluting and largest greenhouse gas emitting sectors in the world economy, road transport constitutes one quarter of total CO_2 emissions, 95% of which is caused by fossil fuel burning internal combustion engines (Berners-Lee 2021; IEA 2017). This requires new and stricter regulations on road motor vehicles. For instance, as part of the European Green Deal and in line with the 2015 Paris Agreement, EU countries commit to reduce transport emissions of

cars by at least 55% by 2030, compared to 1990 levels (EU Commission 2020). In this context, dominant multinationals in the automotive industry along with transport, energy and oil companies lobby national and international policy frameworks to help promote EVs as the key solution to road transport emissions. They argue that replacing the existing world vehicle fleet with battery EVs in the long term and using hybrid EVs in the short to medium term can limit transport emissions (IEA and IRENA 2017; OECD 2004, 2021). By doing this, automotive and transport companies expect to gain a foothold in decarbonisation efforts. Limiting maximum levels of transport emissions, setting deadlines on the registration of fossil fuel vehicles, replacing them with EVs and investing in electric charging infrastructure for individual automobility is one way of decarbonising road transport. Other examples include investments in public transport, decreasing the use of private vehicles, and redesigning the transport needs of urban and suburban areas for walking and cycling. However, I did not find during my research trips to Germany as much support among those connected to the automotive industry for these alternatives compared to very active support for EVs. This narrow approach tended to be justified by a shared belief on the need to secure employment and Germany's competitiveness in advanced manufacturing sectors, to which EVs are expected to contribute.

The second development that I felt influenced a broad convergence of interests in embracing EVs has to do with the recent German emission scandal. Just before and during my research trips to Germany in 2019, German OEMs and some of their multinational suppliers were under public and political pressure following the scandal that came to light in September 2015 in the USA. Defeat devices with software detecting the driving and road conditions were installed in around 11 million ICE vehicles to manipulate emission tests (Jung and Park 2016). Volkswagen, BMW and Daimler were subject to legislative and judicial processes in the USA, Germany and the EU countries. The emission scandal in 2015 hit the trust in the country's flagship companies and resulted in significant costs to German OEMs. Volkswagen paid more than 32 billion Euros for settlement, legal fees and compensation, roughly the same amount of money the company had invested in the shift to EVs up to 2020 (Miller 2020). The EU fined BMW and Daimler due to their illegal collusion in vehicle emission technology (Ewing 2021).

The scandal and its increased publicity had important implications for decision-making processes in the German automotive industry. On the one hand, national authorities in

developed countries as well as the European Commission introduced new regulations that tests vehicle emissions in real driving conditions rather than in merely engine testing laboratories (Arbour 2022). The introduction of stricter emission testing regulations led large OEMs to publicise and accelerate their plans to produce electrified models. Members of individual works councils at vehicle factories, as well as representatives of IG Metall, did not refute management demands, however they asked for, and advocated around, a just transition for the autoworkers. Companies, workers and the state supported decarbonisation of transport by EVs, but they did not consider ways of solving the range of other ecological problems caused by the industry, such as biodiversity loss from raw material production (e.g. mining, rubber plantations). While wider ecological problems generated by the vehicle manufacturing and use are outside the scope of my thesis, it is important to note. The next section sets out and explains my Research Questions and clarifies the scope of the thesis.

1.3 Context and Research Questions

Parallel to growing promotion of EVs as a solution to mitigate greenhouse gas emissions in transport, the concept of just transition is gaining attention especially since the signing of the Paris Agreement in 2015. With respect to the phase-out of coal mining and fossil fuel-based power generation industries, governments and companies introduced plans for impacted workers and their communities. A famous recent sectoral example of this is the Coal Commission of Germany [5], which in 2019 suggested that the state and coal companies should protect workers through active labour market policies in the phase-out of lignite mining in Germany until 2038 (BMWi 2019). The labour-focused policies of the Coal Commission seek to protect coal and energy industry workers from dismissals with early retirements, and demands public and private funds for retraining opportunities as well as new jobs in environmentally friendly sectors. The Coal Commission also asks the government to commit to ensuring that affected regions are not worse-off during and after the transition.

[5] Or the Commission on Growth, Structural Change and Employment BMWi 2019 *Kommission "Wachstum, Strukturwandel und Beschaeftigung": Abschlussbericht*, Berlin: Bundesministerium fuer Wirtschaft und Energie [Growth, Structural Change and Employment Commission: Final Report, Federal Ministry of Economy and Energy] available at https://www.bmwk.de/Redaktion/DE/Downloads/A/abschlussbericht-kommission-wachstum-strukturwandel-und-beschaeftigung.pdf?__blob=publicationFile last accessed January 2022.

Broader industry polices that use the concept of just transition include Green New Deal proposals in the USA. The EU also developed a similar approach. The just transition mechanisms of the European Green Deal[6] are tangible social and economic policies with funds of around 150 billion euros. However, these policies do not target the automotive industry. The EU's just transition funds are allocated between 2021 and 2027 to carbon and energy intensive industries, mining of coal and lignite, production of peat, oil shale and sands.[7] Several clusters of the European automotive industry claim that their sector should also be included in a similar funding facility.[8] Regions in Germany, France, Italy, Spain, the Netherlands, Austria and Slovakia with significant autoworkers and vehicle factories are calling for governments and the EU to provide additional funds for a just transition in the shift to EVs before the 2035 deadline of registering passenger vehicles with ICEs (Kurmayer 2022).[9]

The concept of just transition was first coined by the North American trade union movement in the oil and chemical sectors in the 1970s. When workers faced potential job losses due to new technologies and environmental regulations, the trade unions asked governments and companies to help ease the burden on impacted workers and their communities (Young 1998; Morena et al. 2020). Originally referred to as 'superfund' for workers, just transition demands included income support and benefits for workers, redeployment of the workforce to comparably well-paying and unionised jobs, tuition fees for retraining, funds for early retirement schemes, and financial support to impacted communities and workers' families (Mazzochi 1993). Moreover, especially in the 1990s, the North American labour organisations began emphasising broader social and political policies that target environmental and social justice (Bell 2020). Along with social movement activists, trade unions tried to campaign for

[6] The EU Commission 'Financing the green transition: The European Green Deal Investment Plan and Just Transition Mechanism' 14 January 2020 available at https://ec.europa.eu/commission/presscorner/detail/en/ip_20_17 last accessed January 2022.

[7] The EU Commission 'Allocation method for the Just Transition Fund' 15 January 2020, available at https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_66 last accessed October 2022.

[8] CLEPA (European Association of Automotive Suppliers) 'CO2 standards trilogue: Urgent need for inclusion of a Just Transition framework for Europe's automotive workforce' 21 October 2022, available at https://clepa.eu/mediaroom/co2-standards-trilogue-urgent-need-for-inclusion-of-a-just-transition-framework/ last accessed December 2022.

[9] Euractive 'EU carmaker regions clamour for 'just transition' aid scheme, 1 July 2022, N. J. Kurmayer available at https://www.euractiv.com/section/electric-cars/news/eu-carmaker-regions-clamour-for-just-transition-aid-scheme/ last accessed August 2022

the poor, marginalised, working-class and other disadvantaged communities (Faber and McCarthy 2003). Rather than solely regional and sectoral restructuring demands of the workforce, this broader approach can address social, historical and political aspects of the transition from fossil fuel-based economy to a low-carbon economy.

Such a broader approach to just transition can bring together coalitions of social movements and advocate for environmental and economic justice for all of global labour. This can address the ecological problem posed by existing business models and the production of goods and services in the German and global automotive production networks. I argue in this thesis that just transition efforts in the German automotive industry should emphasise socioeconomic implications of sustainability and energy transitions, including that of EVs. Such an approach is grounded in the argument of this thesis that EVs do not 'simply' replace traditional cars. EVs are associated with various social and political developments. For instance, EV production constitutes a number of changes in the labour process in vehicle manufacturing, the identification of which requires exploring technologies and management techniques used in the global automotive industry.

The immediate shift in vehicle manufacturing is most easily observed in industry clusters with large-scale employment in OEMs and component suppliers. The auto states in Germany noted above are examples in the context of European-wide manufacturing, which are hit significantly by the EV transition. In addition to capital's efforts to mitigate the shift and calls for the state to help, the German trade unions are active in trying to deal with the problems of the EV transition for their membership. For instance, IG Metall established in 2020 its own fund to help automotive suppliers to finance the restructuring of their existing business models, which heavily rely on the revenues of manufacturing ICE and transmission components used in conventional vehicles (HBS 2021; IG Metall 2020). With this fund, *Best Owner Group* (BOG), IG Metall aims at attracting national and international capital and portfolio investments to help combustion technology-focused suppliers in Germany to finance their downsizing and/or product differentiation strategies (IG Metall 2020).[10] Setting

[10] IGM Niedersachsen und Sachsen-Anhalt, 'Joerg Hofmann: „Fuer die IG Metall steht der Erhalt der Industriestrukturen im Mittelpunkt"' 20 October 2020 [For IG Metall, the preservation of industrial structures is central] available at https://www.igmetall-nieder-sachsen-anhalt.de/home-aktuelles/news-details/joerg-hofmann-fuer-die-ig-metall-steht-der-erhalt-der-industriestrukturen-im-mittelpunkt last accessed December 2020

an initial goal of 500 million euros, the trade union hopes to leverage it to acquire a portfolio of five to seven billion euros (Gaisenkersting 2020). However, as of February 2022, the BOG fund could not achieve its initial targets and failed to attract funding from international capital markets (Reimann 2022).

Despite these initial and regional changes to the German automotive industry that are bringing trade unions, the state and companies in Germany together to ease the shift to EVs, the roll-out of EVs influences several other aspects of the world economy and global labour. These include, but are not limited to, renewable energy storage technologies, resource extraction and raw material mining in developing countries, chemical processing, and investments in EV charging infrastructure by governments. Concerning companies, consumers and new markets such as batteries, charging infrastructure, renewable energy technologies, and other mobility products and services create challenges. On top of this, the analysis of just transition with EVs includes national and international labour organisations, works councils, impacted communities and non-unionised workers, who are trying to intervene in decision-making mechanisms around the transition to a low-carbon economy.

In other words, the analysis of just transition with EVs in the German automotive industry should be based on a global perspective that considers socioeconomic and ecological impacts. Critical disciplines such as economic geography and international political economy (Castree et al. 2004; Massey 1984; Silver 2003) that use global production networks framework (Cumbers et al. 2008; Henderson et al 2002; Horner 2017; Levy 2008; Smith 2015; Werner 2016), and the labour regime analysis (Baglioni et al. 2022; Campling et al. 2021; Jonas 1996; Pattenden 2016; Peck 2022; Smith et al. 2018) can help us to explore the global political economy of the shift to EVs. Furthermore, the historical materialist approach to capitalist sustainability and energy transitions can contribute to exploring the material and social repercussions of EVs on global labour. As previous capitalist energy transitions such as the shift in the 19th century from mills powered by animate power and human labour to steam engines, as well as the shift in the 20th century from coal-based fossil fuel energy regime to a combination of oil and gas, showed, capitalist energy transitions provide capital and the state new ways of organising industrial production and challenge workers' social and political power (Malm 2013, 2016; Mitchell 2009, 2011). What EVs and broader sustainability transitions set out for global labour should be a fundamental part in just transition studies.

Consequently, combining the labour regime analysis with a historical materialist approach to the shift to EVs can help pose questions around the emerging political economy of transition to renewables.

Trying to approach EV transition in the German automotive industry from such a broader approach, the main objective of this thesis is to examine the shift to EVs and consider how justly it unfolds. To examine this complex phenomenon that has regional, national and global implications I used a research design based on a detailed case study. While I focus on the German case in my fieldwork, I argue that EVs are linked to existing structures in motion in complex *global* automotive production networks and to environmental conditions (e.g. critical minerals) and labour processes through the *entire* supply chain of vehicle manufacturing. To do so, I pose four Research Questions, which my thesis sets out to answer. These are structured to cover various aspects of EVs' role in just transition to a low carbon economy through an industry-level analysis based on Germany:

1. Why is the just transition important, for whom and how justly is the shift to EVs unfolding?
2. How are workers in the German automotive industry positioned vis-à-vis transition to EVs? And how can they influence decision-making processes?
3. What are the implications of EV production on workers in the German automotive industry?
4. What are the implications of EV production on global labour and the environment?

Research Question 1 can be considered as the overarching research question of the thesis. It consists of two parts. The first part of the question – *why is the just transition important* – lays out the significance, validity and feasibility of the concept of just transition as set against the proliferation of EV manufacturing. The importance of just transition stems from its emergence as an alternative to notions of 'sustainable development', the mainstream approach to transition to a low-carbon economy. Even though the concept of just transition is arguably a limited one, it has the potential to significantly broaden debates around sustainability and energy transitions. The second part of the first research question – *for whom and how justly the shift unfolds* – is equally essential. This part sets out to analyse conceptual and empirical implications of the shift to EVs on global labour and the

environment and thus drives the analysis in the thesis through the following research questions.

Research Question 2 – *how are workers in the German automotive industry positioned vis-à-vis transition to EVs, and how can they influence decision-making processes* – requires situating workers and their position in the German automotive industry in historical perspective. The ways in which workers are included in EV-related decision-making mechanisms today are the results of historically inflected power relations, institutional frameworks and the political economy of the automotive industry in Germany. As we shall see, the balance of power among labour, capital and the state in Germany had shaped the automotive industry in the country, as well as the broad structuring of its global automotive production networks.

Research Question 3 – *what are the implications of EV production on workers in the German automotive industry* – applies historical and contemporary analysis of automotive production networks, labour processes and the dynamics of worker involvement in the German automotive industry. It identifies and examines the winners and losers of the shift to EV manufacturing.

Answering Research Question 4 – *what are the implications of EV production on global labour and the environment* – shifts focus away from the national context and turns to investigate the global labour and environmental implications of EV manufacturing in Germany. In a way, it completes the overarching research question of the thesis. I explain in the next section how I deal with each research question in the following Chapters and why I devised my five-parameter analysis of 'just transition'. Conceptual, methodological and political elaboration on the five parameters unfolds through Chapters 2, 3 and 4, respectively; the next section introduces them.

1.4 Just Transition Parameters

One of the main arguments of the thesis is that, instead of laying out EVs as a sectoral or regional industrial restructuring policy, discussions around the shift to EVs should be established with references to broader sustainability and energy transitions. Similarly, debates around the concept of just transition are also wide-ranging and unfolding. As I explain

in the following chapters, this renders studying the extent to which EVs contribute to just transition to a low-carbon economy a relatively difficult phenomenon to grasp in detail, because, neither the phenomena around the proliferation of EV manufacturing, nor conceptual and policy debates around just transition are stable; they are unfolding and subject to dynamic power relations. My overarching research question entails the fluidity of such a study. Beyond addressing the meaning of just transition, it also sets out to explore winners and losers, how *just* the transition unfolds, and for *whom.* Historical analysis of previous transitions in the German automotive industry helps to cope with this (Research Question 2). However, investigating the impacts of EV manufacturing and just transition on autoworkers in Germany (Research Question 3), and on global labour and the environment (Research Question 4) is a complex and ambitious task. This effort requires using a relatively specific set of parameters to gauge the unfolding phenomenon, while maintaining a broad analytical lens that is able to capture broader socioeconomic and ecological aspects of sustainability and energy transitions.

To be able do this, this thesis constructs five just transition parameters (JTPs). Informed by the academic disciplines used in the thesis, the original synthesis of JTPs emerge from my understanding of primary and secondary sources on the concept of just transition and the material characteristics of EVs. I develop JTPs iteratively through the chapters 2, 3 and 4 in so far as they relate to just transition literature and policy documents, conceptual frameworks and methodological issues, respectively. Given their pivotal role in helping to keep the analysis relatively steady, I briefly set out the five JTPs here.

JTP1 is concerned with the *protection* of workers and their communities during the shift to EVs, i.e. the protection of those impacted directly by the technological changes associated with the transition to EVs. The first parameter is based on actual historical and contemporary just transition demands by labour organisations in developed countries. While the scope of JTP1 tends to be articulated by unions and others as concerned with the micro scale of the firm and the labour process, the protection of autoworkers and their communities should also be established at the meso scale given the implications of EV production on competition and power relations among automotive enterprises. Overall, meeting JTP1 is location-specific and subject to industry level competition and coordination among capital.

JTP2 revolves around the *inclusion* of workers in decision-making processes during the ongoing transition to EVs. This parameter is highlighted not only by labour organisations representing workers who face the risk of losing their jobs, but also by the academic literature on the concept of just transition. Meeting JTP2 with the shift to EVs is a path-dependent variable, as institutional mechanisms that negotiate with workers are the results of historical outcomes of the previous transitions in the German automotive industry.

JTP3 is focussed on ensuring that workers receive enough financial and organisational support for their *retraining*. Retraining in the shift to EVs is crucial, as many workers in the German automotive industry need to adopt to the new labour process in the production of EVs. This parameter is based mainly on trade unions demands. But it is also echoed by policy reports on the concept of just transition, as well as by technical reports on skills and employment levels for EV manufacturing (see Sections 5.4 and 7.3).

JTP4 and JTP5 are both broader than the first three JTPs. JTP4 is concerned with the impacts of the proliferation of EV manufacturing in Germany on global labour such as workers employed midstream and upstream of EV production networks who extract natural resources, mine raw materials and process chemicals that are used in EVs. JTP5 is about the impacts of these activities on the environment and the livelihoods of local communities. As I argue in this thesis, JTP4 and JTP5 are fundamental parts of any just transition to a low-carbon economy. Production of any good or service has inevitable impacts on global labour and the environment. This is particularly the case with EVs, the production of which relies heavily on natural resource extraction, mining and chemical processing. My sources for choosing the last two JTPs are technical and policy reports on EVs and academic literatures on sustainability and energy transitions. This choice is also informed by my conceptual framework (see Chapter 3) that brings insights of labour regime analysis and the historical materialist approach to transitions to the analysis of just transition with EVs. The other source that led me include JTP4 and JTP5 are some of my data collected in the semi-structured interviews with representatives from labour, capital and the state; that is the data that shows the mismatch of the understanding of EV-related challenges to the shared interests of in German automotive industry on the one hand, and the lack of understanding of the shift's implications on global labour and the environment.

1.5 Structure of the Thesis

The structure of the thesis broadly mirrors the sequence of the Research Questions. Chapter 2 delves into answering Research Question 1 (Why is just transition important, for whom and how justly is the shift to EVs unfolding?) by reviewing the sustainable development and the just transition literatures. Chapters 3 and 4 explain how and why I develop the five JTPs analysis for the shift to EVs. Chapter 5 sets out the contemporary dynamics in global automotive production networks and analyses differences between EVs and ICE vehicles, which provides the empirical insights for the discussions in the following chapters on labour process with EVs, implications on the environment and global labour. Chapter 6 provides the historical background for answering Research Question 2 on the ability of workers to influence decision-making processes, before the next chapter covers in Section 7.3 the contemporary local, regional and national channels of EV decision-making processes; Chapter 7 also examines in Sections 7.2 and 7.4 the impacts of EV production on workers in the German automotive industry (Research Question 3). Chapter 8 explores the answers to Research Question 4 and discusses some of the implications of EV production on global labour and the environment; this is a very broad and thus more speculative chapter that relies heavily on secondary sources. Chapter 9 concludes with summaries of the answers to each of the Research Questions, the key academic contributions, brief policy recommendations, as well as limitations of the thesis and suggestions for future research. I start each chapter with a short introduction on its analytical contribution to the thesis, and its links to both the Research Questions and the JTPs.

To answer the first part of the overarching Research Question (RQ1), Chapter 2 examines the meaning and significance of the concept of just transition. I first compare and contrast sustainable development as a top-down approach to sustainability and energy transitions and just transition as a relatively bottom-up approach. This is important for my later argumentation on the need to enhance just transition conceptually, because the latter tries to overcome the limited approach of the sustainable development paradigm to sustainability transitions, including that of EVs. I then introduce the five JTPs and clarify the extent to which sustainable development and various understandings of just transition include these parameters.

In Chapter 3, I provide an overview of the literatures, conceptual tools and analytical frameworks I used to derive the five JTPs. This chapter is also an effort to enhance the concept of just transition by methodological and theoretical insights. To do this, I start with discussing the central role of vehicle manufacturing to capitalist development in its national and global dimensions. I flag the structural role of the state in the automotive industry, which we revisit in the historical analysis of Germany in Chapter 6 (see below). Finally, I explain how the analytical frameworks contribute to the thesis and to the use of the five JTPs. The global value chain/production network frameworks inform the analysis in Chapter 5 on the existing structures of global automotive production networks. Labour regimes analysis adds the centrality of exploitation in the spheres of labour and the ecology the ecological dimension, and situates the understanding on the shift to EVs within the dynamic and multi-scalar relationships in global uneven economic development. The historical materialist approach to sustainability and energy transitions helps me think about the characteristics for different actors after the ongoing shift.

Chapter 4 presents the data collection and analysis strategies of the thesis. The review of academic literatures and technical and policy documents accompanies the two main methods – semi-structured interviews and historical analysis. I also explain the research design and case study selection for the shift to EVs. I discuss how and why the research on EVs and just transition requires dealing with unfolding phenomena, with EVs as part of broader sustainability and energy transitions, and with just transition as a contested concept. All of this fluidity demanded relatively stable parameters to judge the shift to EVs in the German automotive industry, and I conclude the methods chapter with an explanation of how I arrived methodologically at each of the five JTPs.

Chapter 5 is important for the thesis in two ways. First, I map out global automotive production networks and dominant companies – large OEMs and multinational automotive suppliers. Second, I present the insights of the review of technical reports. Based on the material differences between EVs and ICE vehicles, this not only informs the analysis of the relative *national* focus of the first three JTPs, which I discuss in Chapter 7, but also explores EVs' implications for JTP4 and JTP5 that are analysed in Chapter 8. In other words, Chapter 5 presents some initial findings on Research Question 1, and equips Chapter 7 and Chapter 8 in answering Research Question 3 and 4, respectively.

Chapter 6 is an historical analysis of the previous major transitions in the German automotive industry. I identify three transitions – 1933, post-1945 labour regulations and post-1980 globalisation – interconnecting the four periods – craft production, introduction of mass production, expansion of mass production, and domination in global production networks. The first transition in 1933 dissolved craft production and introduced mass production techniques between 1933 and 1945. The second transition after 1945 helped the German automotive industry expand mass production. The third transition after the 1980s brought the domination of global production networks by large OEMs, including German carmakers. This chapter seeks to explore JTP2 through a historical lens in support to the argument that the involvement of autoworkers in decision-making processes during the past transitions in the German automotive industry is influenced by power relations, as a result of which workers' say is mainly excluded in the ongoing negotiations about transitioning to the fifth period in the industry – the proliferation of EV manufacturing.

Based on this historical analysis, I thus argue that the shift to the fifth period must be discussed in the context of power relations in global political economy. This argument is also supported by the analysis based on the material characteristics of EVs covered in Chapter 5, and by the conceptual insights of Chapter 3, which help me develop the five JTPs. As a key take of the historical analysis, the role of the state in facilitating the previous transitions in the German automotive industry sheds light on the growing role of the state(s) in facilitating/reproducing the dire working conditions and decreasing environmental standards in today's natural resource intensive nodes of global EV production networks such as Latin America or Africa, as well as the role of the state(s) in repressive labour regimes in chemical processing and battery cell manufacturing locations such China. Therefore, in Chapter 2 I highlight, and in Chapter 9 conclude with, the need for labour organisations in Germany to support more effectively the focus of ITUC on democracy and peace in the world economy.

Chapter 7 starts with a short summary of the previous chapters' answers to the four research questions and their links to JTPs. It then moves on to the analysis of the first three JTPs in the context of Germany with respect to the proliferation of EV manufacturing. On JTP1, I examine how various groups of workers are protected in the shift to EVs. I explain potentially different outcomes of the shift to EVs for workers with varying contractual status and for companies with different size and capacities. On JTP2, I look into the ways in which workers and their

representatives are involved in decision-making processes at national, regional and industry-wide policy initiatives. On JTP3, I show that the lack of funds and the competition among workplaces for retraining schemes hinders the meeting of this parameter.

Chapter 8 completes answering Research Question 1 and 4, which started in Chapter 4 on the concept of just transition and in Chapter 5 on material differences between the EV and ICE vehicles. Focusing on JTP4 on global labour and JTP5 on the environment, I show German autoworkers' weakening solidarity vis-à-vis workers in other nodes of global automotive production networks. Autoworkers at the centre of these networks (Stuttgart/Germany) do consider the challenges of EV manufacturing faced by workers in other national contexts, but this tends to be focussed on neighbouring Central and Eastern Europe (CEE). However, at the same time, autoworkers in Germany are also in competition with workers in CEE, as well as their colleagues in other plants in Germany. The centre of the competition is securing investment for EV manufacturing, which autoworkers believe is the way to guarantee good jobs in the future of the automotive industry. With regard to workers at outer tiers of emerging EV global production networks, the need to secure raw materials for the sake of jobs in and competitiveness of the German automotive industry hinders meeting JTP4 and JTP5. Similarly, working and living conditions of autoworkers/EV workers under authoritarian labour regimes do not draw enough attention of just transition demands in the German automotive industry, hindering again JTP4 and JTP5. The actors in the German automotive industry including the state, companies, trade unions, and autoworkers, perceive battery chemicals processing in China, low value added vehicle assembly in India or resource extraction in Latin America and Africa as various ways in which workers in these regions can participate in global production networks to develop their economies and to help sustainability transition to EVs.

In Chapter 9, I present the summaries of the answers to each of the Research Questions, and conclude with the key academic contributions and brief policy recommendations. Chapter 9 also explains limitations of the thesis and my ideas on potential areas for future research.

CHAPTER 2 SUSTAINABLE DEVELOPMENT AND JUST TRANSITION: TWO APPROACHES TO TRANSITION TO A LOW-CARBON ECONOMY

2.1 Introduction

In the context of environmental regulations and technological changes to cope with the ecological problem, trade union organisations warn that replacing fossil fuel products and services with environmentally friendly counterparts brings differentiated costs and burdens to workers employed and the communities built around these industries. The concept of just transition refers to protecting workers and their communities against the uneven distribution of the burden of introducing environmental regulation and emission-reduction technologies (JTRC 2018, 2019; TUED 2018). Even though it is promoted by national and international trade union federations, and claims/promises to overcome the jobs vs. environment dilemma, I argue that the concept of just transition falls short of covering all constituents of global labour and addressing the dynamics and structures of global production networks. In order to fully address the socioeconomic and ecological problem and social inequalities driven by carbon intensive industries, and include all workers in the world economy who are not often represented in the current international institutional climate change context, the concept of just transition should be structurally, conceptually and institutionally improved.

This can be done by linking specific environment and climate change policies, and just transition demands by workers to the inherent inequalities and uneven economic development caused by processes of capitalist industrialisation within specific sectors. For the present work, this corresponds to considering the implications of the proliferation of electric vehicle (EV) manufacturing in Germany on working conditions and environmental standards in global automotive production networks. This means nuancing and enriching the concept of just transition with the insights of labour regime and GVC/GPN analyses (Baglioni et al 2022; Coe et al. 2007; Newsome et al. 2015; Smith 2015), and from the historical materialist approach to capitalist energy transitions (Malm 2016; Mitchell 2011). This broadened approach not only links just transition to a low carbon-economy to broader social transformations in the world economy, but also considers the different interests and positionalities of the workers, states and companies in global production networks. As I

discuss in Chapters 5 and 6, benefitting from differentiated working conditions and environmental standards in several labour regimes, global production networks enable, maintain and reproduce existing power relations of uneven development in the world economy. Without aiming to challenge those power relations, the concept of just transition risks remaining limited to a partial industrial restructuring circumscribed to specific locations in industrialised countries *and* increased environmental and labour exploitation in other nodes of the given global production networks.

This chapter explains why the concept of just transition is crucial (Research Question 1) with an analysis of its meaning, scope and depth in sustainability and energy transitions to a low-carbon economy. In addition to insights from my interviews, I examine policy papers by national and international organised labour participating in the UN system of environmental negotiations (see Chapter 3 on methodology). In Section 2.2, I start with a discussion on the history of international environmental negotiations under the auspices of the United Nations, where today the culmination of the organised labour's just transition demands resonates. In Section 2.3, I explain the origins, contours and tensions around organised labour's just transition demands based on the review of critical sustainability and energy transitions literature. A critical analysis of the dialogue between sustainable development and just transition with the relevant justice dimensions is key to understanding the limits of the concept of just transition as it resonates in international climate change policy frameworks.

In Section 2.4, I link the just transition literature and policy documents to my five-parameter analysis. The five Just Transition Parameters (JTPs) are further developed in relation to my research design and methodology in the next chapter, which frame my analysis on the shift to EVs in the German automotive industry. JTP1 is protection and compensation of existing workers and their communities during the transition. JTP2 is inclusion of workers in decision-making processes. JTP3 is retraining of workers for new jobs or sectors. In Chapter 6, I apply JTP2 historically to the automotive decision-making processes in Germany, to shed light on workers' involvement in transition today (Research Question 2). In Chapter 7, I use JTPs 1-3 to analyse the implications of EVs on autoworkers in Germany (Research Question 3). JTP4 is implications on global labour and JTP5 on the environment. In Chapters 5 and 8, I use JTP4 and JTP5 to analyse EVs' impacts on global labour and the environment (Research Question 4).

2.2 Sustainable Development: A Linear and Top-down Approach to Transition to a Low-carbon Economy

As I set out in Chapter 1, transition to a low-carbon economy is widely posited as the principal solution to the challenges and risks associated with climate change and other fossil fuel-based ecological challenges of the world economy. Air, water, soil and ocean pollution, depletion of natural resources, biodiversity loss and global warming all underline the need to transform economic activities and to reduce consumption levels of hydrocarbons (IPCC 2014, 2019). The Intergovernmental Panel on Climate Change (IPCC), the body of the United Nations (UN) responsible for providing member states with relevant scientific information, calls for urgent climate action. Recently, the Panel announced in its Special Report that net emissions must decline by about 45% from 2010 levels by 2030, because 'global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate' (IPCC 2019: 19). Since 1995, IPCC reports have fed into climate change negotiations held under the UNFCCC (UN Framework Convention of Climate Change), which was set up by an international treaty signed at the Earth Summit of the United Nations Conference on Environment and Development in 1992, in Rio de Janeiro, Brazil.

However, several meetings of the member states of the UNFCCC at Conference of Parties (COP), have so far failed to bring countries with divergent interests together to help achieve a clear way to reduce greenhouse gas emissions (Allan 2019; Brand and Wissen 2013; Kuyper et al. 2018). Following the failure of the Kyoto Protocol, adopted in 1997, and the negotiation impasse in Copenhagen in 2009, the parties at the 21st COP in 2015 signed the Paris Agreement as another milestone in international climate change negotiations. The agreement has so far failed to force and guide the member states to reduce greenhouse gas emissions, which is left to voluntary individual country policies through nationally determined contributions (NDCs) for greenhouse gas emission reductions.[11] The Agreement referred to the concept of just transition and acknowledged that workers should be part of climate change mitigation and adaptation policies.

[11] 'NDCs are submissions by countries that have ratified the Paris Agreement which present their national efforts to reach the Paris Agreement's long-term temperature goal of limiting warming to well below 2°C. New or updated NDCs are to be submitted in 2020 and every five years thereafter. NDCs thus represent a country's current ambition/target for reducing emissions nationally.' (UNEP 2019: x)

Though acknowledging the workers' role in facilitating the change and implementing environmental regulation, the policy proposals under the UNFCCC prioritise market mechanisms, technology transfer and investments in environmentally friendly products and technologies developed by business and supported by states to create 'green jobs' (UNEP 2007, 2008). Before I delve into the position of workers and labour organisations in Section 2.3, the rest of this section describes the foundations of the climate change negotiations under the auspices of UNFCCC. I show that the ecological modernisation theory based on economic growth, market mechanisms and private enterprise set the framework for sustainable development in a top-down fashion, which neglects various justice dimensions highlighted by critical sustainability and energy transitions literature. As a result, the sustainable development paradigm contradicts with, and actually limits, the just transition demands of global labour.

2.2.1 From Stockholm to Paris: Sustainable development through growth and markets

Prior to the concept of just transition promoted by international and national trade union organisations and adopted in the UN climate change negotiations, impacts of economic activities on the environment were covered in the concept of sustainable development based on ecological modernisation theory (Hajer 1995; Warner 2010). Sustainable development can be achieved via environmental standards and certification schemes, recycling and waste minimisation, pollution abatement, increased use of renewable resources, and financing environmentally friendly or 'green' products and services (Buchholz 1993; Dillon and Fischer 1992; Elkington 1998; Friedman 1993; Jennings and Zandbergen 1995). A fundamental reorganisation of core institutions, production processes and politics *is not* necessary (Mol and Spaargaren 2000). In this framework, environmental policies are carried out by states, entrepreneurs and corporations, international institutions or non-governmental organisations *for* the poor who need to be empowered (Selwyn 2014: 3, emphasis in original). The UN policy documents about sustainable development, such as the Brundtland Report in 1987, the UNFCCC treaty in 1992 and its first additional protocol in Kyoto in 1997, all underlined the primacy of markets and private enterprise in dealing with sustainable development. Sustainable development is a concept that can unite everybody from industrialists to farmers, as well as bureaucrats, politicians, workers and citizens. This makes it less useful in suggesting environmental policy proposals with wide-ranging implications on

the world economy (Lélé 1991). The sustainable development paradigm has dominated the UN system of international climate change negotiations since the 1970s.

The UN Stockholm Conference on the Human Environment in 1972 drew attention to major ecological problems associated with energy, transport, forests, water, agriculture and biodiversity. The UN set up the United Nations Environment Programme in 1972, and ten years later commissioned a committee for a comprehensive policy report. Sustainable development was the overarching term settled on in the resulting 1987 report of the World Commission on Environment and Development (WCED), the Brundtland Report. The early UN conferences on the environment coincided in the 1960s and 1970s with efforts by major industrialised countries to meet increasing demands from bottom-up movements such as environmental activism against nuclear energy and the use of chemicals in agriculture, as well as protests against the Vietnam War leading to broader social unrest (Urry 2013: 80). The focus on the environment also concurs with the end of the rapid post-war economic growth in Europe due to expansionary fiscal and monetary policies backed by the USA, the UN agencies, the International Monetary Fund (IMF) and the World Bank (WB) (Lélé 1991).

In line with the concept of sustainable development informed by ecological modernisation theory that highlights the primacy of markets and private enterprise, the role of the state diminished after the 1980s through structural adjustment programmes of the IMF and WB as well as in 1990s through changes to the WTO rules on international trade and regional trade agreements, such as NAFTA and the European common market. As a result, on the one hand, in many key sectors in the world economy, including the automotive industry, there emerged a system of geographically dispersed production networks. On the other hand, these networks are dominated by a handful of multinational companies with headquarters in Europe, Japan and North America (see Chapter 5). The concept of sustainable development does not consider these historical, socioeconomic and ecological dimensions of the world economy.

Considering environmental impacts of the economic activities, the Brundtland Report ambiguously put forward the concept of sustainable development to achieve the ‘next’ level in development, and provided a clear but open definition of sustainable development that has been used later by both academia and national and international policy documents

(WCED 1987).[12] The report refers to sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs […] It does imply limits — not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources' (WCED 1987: 8). Here environmental sustainability is equated to 'an economic system that is able to generate surpluses and technical knowledge on a sustained basis, and a production system that respects the ecological base for development' (WCED 1987: 364-365).

Similarly, at the UN Earth Summit in 1992, the UN General Assembly once again acknowledged the need to protect the environment while ensuring economic growth via markets and private enterprise: "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations" (UN 1992).[13] The prevalence of business and market mechanisms is not surprising, given the institutional context. Governments, companies and environmental NGOs (Vormedal 2008) dominate the negotiations, where '… policy-making forums and processes are neither procedurally nor substantively neutral. Even though more environmental NGOs than businesses participated in the 1992 Rio Conference, business is more influential' (Stevis and Assetto 2001). This dominance is possible due to the epistemic authority of development experts, scientists and politicians, which excludes and marginalises workers, women, indigenous people, the poor, and farmers from decision-making processes (Katz-Rosene and Paterson 2018: 65).

The last wave of the UN international climate change negotiations brought the signing of the Kyoto Protocol and the Paris Agreement. Similar to the Kyoto Protocol, the aim of the Paris Agreement is to reduce greenhouse gas emissions to help mitigate their impacts on climate change and keep global warming at less than 2 degrees Celsius above pre-industrial levels.[14]

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[12] The World Commission on Environment and Development was created to study the link between the environment and economic activities, following the United Nations General Assembly resolution 38/161, adopted in 1983.

[13] UN (1992) *Report of the United Nations Conference on Environment and Development to the General Assembly*, Rio de Janerio 3-14 June 1992, http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

[14] Paris Agreement, twenty-first session of Conference of Parties (COP21) to UNFCCC, Paris, 12 December 2015, in force since 4 November 2016.

Under the Kyoto Protocol, parties had agreed to a higher level of responsibility for climate change mitigation from the industrialised countries and exemptions from making commitments to reduce carbon emissions for developing countries (Clapp and Helleiner 2012: 494). As Levy and Spicer (2013: 669) argue, the Kyoto regime, with its modest emission reduction targets and their market-based implementation, would not threaten the fossil fuel-based automotive, transport and energy industries. Even though negotiations under the auspices of the UNFCCC have not provided prolific emission reductions, and can be seen as an elusive institutional arrangement (Dryzek 2013: 47), the Kyoto Protocol was the first step in the long road of international environmental governance under the UNFCCC, with both industrialised and developing countries considering some form of emission reductions (Bodansky 2010: 231; Jotzo 2005: 86).

The Paris Agreement, signed in 2015, leaves it to participatory countries to voluntarily determine ways in choosing and implementing emission policies. Rather than setting clear targets for emission reductions, this current voluntary approach through nationally determined contributions is due to the collapse of the Kyoto regime at COP15 in Copenhagen (Hurrell and Sengupta 2012: 471). Owing to the refusal of the USA to participate in the Kyoto Protocol (Paterson 2009: 141-142), and the reluctance of the EU member states, Australia, Canada, Japan and Russia to sign on to Kyoto's further emission reduction commitment period, the new voluntary and incremental approach in the Paris Agreement was adopted (Allan 2019: 6; Bodansky 2010: 233). Nonetheless, The UN Environment Programme warns that, with current policies by individual countries, cutting greenhouse gas emission to the levels suggested by the 2015 Paris Agreement goals[15] will not be possible (UNEP 2019). In the meantime, emissions due to fossil fuel use keep increasing. The world total energy supply — the capture, extraction or manufacture of fuels or energy ready for the general use — increased by 62% from 1990 to 2017, while the share of coal, oil and natural gas together did not change and stood at 82% (calculated from the data in UN 2020: 1).[16] In the next section,

[15] "With only current policies, GHG emissions are estimated to be 60 GtCO2e in 2030. On a least-cost pathway towards the Paris Agreement goals in 2030, median estimates are 41 GtCO2e for 2°C, 35 GtCO2e for 1.8°C, and 25 GtCO2e for 1.5°C." (UNEP 2019: 22-23)

[16] Much of the energy production occurred in a handful of countries: China and the United States of America (USA) produced 56% of world coal; USA, Russia and Saudi Arabia produced 38% of oil; USA, Russia, Iran, Canada and Qatar produced 54% of all natural gas. Of consumption, 20% occurred in

I explain how the UN system of international environmental policies updated the concept of sustainable development by a new set of 'sustainable development goals' (SDGs). In the wake of 2008 economic and financial crisis, when not only some major financial institutions and investment banks, but also multinational companies including vehicle manufacturers from the US and Europe had been bailed-out by their respective governments, the UN system managed to reconfigure the concept of sustainable development via SDGs.

2.2.2 Update on growth imperative and primacy of markets: Sustainable Development Goals

Building on eight Millennium Development Goals (MDGs) (UN 2000), the Sustainable Development Goals (SDGs) are 17 general policy goals resulting from decades-long international environmental negotiations since early 1970s (UN 2015). Although the 2008 crisis gave rise to arguments for a potential return to Keynesian macroeconomic policies, with a call for a 'Green New Deal' by the UN agencies, as well as by the EU and some national governments (Bloomfield and Steward 2020; Calhoun and Fong 2022; Tienhaara and Robinson 2022), SDGs kept as their foci the imperative of economic growth and primacy of market mechanisms in transition to a low-carbon economy. Nevertheless, both the Paris Agreement and SDGs consider workers in transition in some ways. In this context, international and national labour organisations and their just transition demands could have been echoed in the UN system of climate change negotiations (Morena et al. 2020).

The Paris Agreement states in its preamble that it takes 'into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities' (UNFCCC 2015). Apart from this, it does not include specific articles about just transition; nor does it cite examples of national or international economic policies and development institutions. Indeed, it takes time for just transition to be specified by concrete policy mechanisms. A technical paper by the UNFCCC on transition to a low-carbon economy states that no parties so far made such a specific reference to just transition (UNFCCC 2020: 10). Yet, the indefinite and limited approach of the Paris Agreement towards just transition tries to connect two different policy processes, and so claims that workers are considered. First, the agreement incorporated, via the concept of just transition, the trade union movement's efforts to call for creation of jobs and protection

China, 18.5% in Europe (two thirds of which was in Russia, Germany, France, the UK and Italy) and 15.6% in USA (UN 2020: 6).

of workers in transitioning sectors. Second, the agreement borrows wording such as 'green jobs' and 'decent work' from the UN SDGs.

The relationship between the concept of just transition and SGDs is important because each approaches from a different, but intertwined, angle to the environment and transition to a low-carbon economy. Trade union organisations emphasise the need to solve uneven economic development and social inequalities, and in doing so, contrary to the idea of sustainable development, they challenge existing structures and dynamics of the world economy (ITUC 2018; TUED 2018; JTRC 2019). This is not, however, reflected in the UN SDG agenda, which merely updates previously promoted sustainable development in new ways that do not solve uneven economic development and social inequalities. According to ITUC's Trade Union Development Cooperation Network (TUDCN)[17], the most relevant SDGs for the trade union movement are poverty (SDG 1), gender equality (SDG 5), decent work (SGD 8), reduced inequalities (SDG 10), climate action (SDG 13) and peace, justice and strong institutions (SDG 16) (TUDCN 2017: 1). Two of these, decent work and climate action, are most pertinent to just transition demands of workers with respect to the shift to EVs.

SDGs are limited in bringing just transition to a low-carbon economy for a number of reasons. For instance, the indicators to monitor the progress in achieving decent work (SDG 8) are reduced to economic growth, labour productivity, compliance of labour rights (freedom of association and collective bargaining) based on ILO conventions and national legislation, formal and informal employment levels, female and male average hourly earnings, as well as the number of commercial bank branches per 100,000 adults (UN 2019: 38-39). These are insufficient to meet just transition demands of workers for two reasons. On the one hand, as I detail in Chapter 8, compliance on ILO conventions, most of which are not implemented by many locations of low-cost nodes in global production networks, would not secure better working conditions for global labour and higher environmental standards in the world economy. As an example from global production networks in the automotive industry,

[17] The Trade Union Development Cooperation Network (TUDCN) is an initiative of the International Trade Union Confederation, bringing together all trade union actors involved in development cooperation. This includes its affiliated national organisations and its regional organisations in Asia-Pacific, Africa and the Americas, as well as solidarity support organisations, global union federations (representing the different sectors), the European Trade Union Confederation and the Trade Union Advisory Committee to the OECD.

autoworkers in countries such as China, India, Mexico or Turkey face social and political limitations. On the other hand, statistical analysis via growth, productivity or employment changes does not address informal and precarious workers in the world economy. Examples for this include the dominance of informal work in developing countries such as manufacturing sectors in India, or formal but temporary and fixed-term contracts in many developed countries, including Germany.

In a similar way, the indicators to achieve climate action (SDG 13) are quantitative data such as the number of deaths by disasters and funds to developing countries for emission reductions (UNSC 2020: 24-26), which do not redress the historically differentiated nature of responsibility for the causes of the ecological problems. As explained below (Section 2.3), recent COPs of the UNFCCC could not find ways to determine how financing loss and damage should be put into the system of UNFCCC. Crucially, SGDs and their specific indicators overlook the unequal and uneven structure of the world economy, and apprehend sustainable development only through 'green' economic growth (Katz-Rosene and Paterson 2018). This ahistorical and non-relational approach to climate change and global warming only reproduces existing unequal power structures and furthers a neoliberal vision based on the concept of sustainable development (Weber 2017).

Another SDG, reducing inequality within and among countries (SDG 10), aims to achieve income growth for the bottom 40% of the population at a higher rate than the national average, empowering social and economic inclusion of all and eliminating discrimination, increasing labour's share of GDP, and involvement of developing countries in international economic and financial institutions (UNSC 2020: 19-20). However, the indicators of SDG 10 neglect vertical economic distribution and the concentration of income and wealth at the top (Fukuda-Parr 2019: 61), and the limited approach of SDGs to poverty and inequality avoids considering power asymmetry within and among countries (Fukuda-Parr 2019: 64). Instead, more redistributive tools are needed, such as adding Palma ratio to the Gini coefficient.[18]

[18] 'Palma ratio is the share of the top 10 per cent share of national income relative to the bottom 40 per cent share. This measure captures shifts at the top and bottom ends of the distribution and overcomes the problem with the Gini coefficient, which is sensitive to shifts in the middle.' (Fukuda-Parr 2019: 66).

Such redistributive policies are advocated by trade unions, women's and other organisations to help deal with inequality, and the concentration of power and wealth among small elite.

The mismatch between SDGs and just transition that accounts for global labour and the environment applies to other SDGs too. For instance, affordable and clean energy (SDG 7) aims to increase access to electricity in transportation and heating sectors, but does not address increasing emissions due to the production of energy storage or battery technologies, which I will return to in Chapters 5 and 8 when analysing EVs by JTP4 and JTP5. Furthermore, indicators for ending poverty (SDG 1)[19] do not discuss why poverty varies dramatically across geographies; among the 736 million people who lived on less than $1.90 a day in 2015, 413 million were in sub-Saharan Africa (UN 2019: 22). The income levels proposed in SDGs to study extreme poverty do not account for the disproportionally large share of value added in global production networks captured by a number of firms, large OEMs and their multinational first tier suppliers in the case of automotive industry (see Chapter 5). Similarly, the indicators for sustainable industrialisation (SDG 9)[20] are merely of statistical value, and the disparities in manufacturing value added in the world economy between rich and poor nations (UN 2019: 40) are not recognised.

2.2.3 Weaknesses of sustainable development

A common starting point in studies of sustainable development is the clear but open definition of the World Commission on Environment and Development. It defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' and while this 'does imply limits' they are 'not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources' (WCED 1987: 8). The acceptance of the status quo and the roles attributed to economic growth, market mechanisms and private enterprise by the UN SDG agenda and the Paris Agreement show that broader aspects of sustainability and energy transitions are not included by the concept of sustainable development that is

[19] Population below the international poverty line ($1.90), population covered by social protection, deaths and missing persons due to disasters, economic loss due to disasters, countries adopting disaster risk reduction strategies.

[20] Passenger and freight volumes, manufacturing value added/employment, small-scale industry credits, emissions, research expenditure, international aid to infrastructure and mobile network coverage.

promoted by the agreements, protocols and processes under the UNFCCC. Overall, environmental sustainability is equated to 'an economic system that is able to generate surpluses and technical knowledge on a self-reliant and sustained basis and a production system that respects the obligation to preserve the ecological base for development' (WCED 1987: 64).

This approach to sustainability and energy transitions is based on ecological modernisation theory (Blowers 1997), which claims that economic growth and market-based solutions to ecological problems are reconcilable (Hajer 1995). Incremental and voluntary adjustments to business activities in manufacturing industries and a push from the state towards compliance with environmental regulation bring sustainability (Warner 2010). Practices suggested by environmental sustainability are mostly firm centric that promotes the consumption of environmental products and services (Holden et al. 2017; MacFeely 2019; Weber 2017). Technology-centred policies to mitigate environmental degradation and ecological problems are tied to the production of new goods and services that maintain economic growth and primacy of market mechanisms. In achieving this, a fundamental reorganisation of core institutions, production processes and politics is *not* necessary (Mol and Spaargaren 2000).

Sustainable development does not fully consider the social, historical and political aspects of the transition to a low-carbon economy. When social issues are referred to, as in the concept of 'the triple bottom line' popularised as profits, planet and people (Elkington 1998), the focus is on business, markets and profits, and the goal is to measure and overcome limits to green growth and welfare of consumers, rather than workers and their communities. However, transitions to a low-carbon economy are not devoid of controversies and tensions (Kouri and Clarke 2014), and as the just transition literature discussed below shows, the shift to a low-carbon economy implies dramatic changes for workers and their communities (Newell and Mulvaney 2013; Rosemberg 2010; Stevis and Felli 2015; Räthzel and Uzzell 2013). Within this context, labour organisations warn that replacing fossil fuel services and products with environmentally friendly counterparts can bring differentiated costs and burdens for workers employed in these industries. The next section demonstrates the extent to which the just transition demands by labour organisations overcomes the weaknesses and omissions of the mainstream sustainable development. It also shows that both the UN SDG agenda and the Paris Agreement are incompatible with some of the trade unions' just transition demands.

2.3 Just Transition: A bottom-up Approach to Transition to a Low-carbon Economy

Following the discussion above on the influence of ecological modernisation theory as a top-down approach prioritising economic growth, market mechanisms and private enterprise, this section analyses the extent to which just transition demands go beyond the existing structures and power dynamics embedded in the mainstream sustainable development paradigm that dominates the UN agenda. The concept of just transition emanates from national and international labour organisations and constitutes a major area of research and policy making. I identify three strands of the critical sustainability and energy transition literature based upon their underlying concepts of justice that are important for the analysis of today's just transition demands. These are environmental justice, labour justice, and climate/energy justice. I classify and present the three strands in this section, which evolved at different times and places, and represent challenges and objections by various social groups against the mainstream sustainable development paradigm.

The focus on environmental justice aims to show that social groups with limited income levels, mostly the communities of colour and in developed countries get fewer environmental goods, more environmental bads and less environmental protection (Agyeman et al. 2003; Byravan 2014; Bullard and Johnson 2000; Martinez-Alier 2002; Pellow and Brulle 2005; Pulido 2016; Pulido and De Lara 2018). Studied by scholars from various disciplines including sociology, anthropology, political science and geography, environmental justice was prompted by the grassroot activism in the late 1970s and the early 1980s in developed countries, especially in the USA, against the disproportionate impact of environmental degradation and pollution on minorities and disadvantaged groups (Holifield et al. 2018; Banzhaf et al. 2019). At times, environmental justice movements opposed labour organisations that try to protect their jobs in polluting industries at the expense of local communities and to delay new regulations and technology (Evans and Phelan 2016). At the same time, the environmental justice movement advanced the argument that semi-skilled and unskilled workers from communities of colour face higher levels of health and occupational risks than white workers do (Faber 2018). Pulido and de Lara (2018) showed that, as in the case of migrant workers in agriculture in California, USA, specific sectoral unions with membership from communities of colour and migrants supported environmental justice movements.

The second focus in critical sustainability and energy transitions literature is on labour justice, from which today's just transition demands gradually evolved. Labour justice is associated with the need to protect workers and their communities who are dependent on polluting industries, as well as their inclusion in the decision-making processes in planning and managing transitions (Goods 2013; Hampton 2015; Lewin 2019; Mazzochi 1993; Page 2019; Rosemberg 2010; Snell and Fairbrother 2011; Weller 2019). Over the course of the development of different sectoral and regional policies by trade unions and other labour organisations, the focus on labour justice came to terms with the need to protect the environment while at the same time protecting jobs and workers' rights. This is referred to in the literature as overcoming the jobs vs. environment dilemma (Felli 2014; Räthzel and Uzzell 2011). The 2015 Paris Agreement is the latest significant milestone of intergovernmental negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), which recognised the need to protect impacted workers while reducing greenhouse gas emissions and mitigating climate change. With the increasingly urgent need to limit global warming and biodiversity loss, and cut greenhouse gas emissions, it was recognised that plans for phasing out fossil fuel-based industries via industry and enterprise policies in developed countries require governments and companies to work with labour organisations (UNEP 2008; ITUC 2010; ILO 2015). This is significant not only due to the labour's integral part in facilitating and implementing sustainability and energy transitions, but also due to the backdrop of right-wing regional political outcomes of the previous rounds of deindustrialisation under the mainstream sustainable development paradigm with its ecological modernisation assumptions (JTRC 2018: 7; TUED 2018: 22-23; Stevis 2013; White 2019: 6; Guertler et al. 2021). This helped the labour justice demands of trade unions and other labour organisations in developed countries to get better represented in national and international policymaking processes.

The third strand in critical sustainability and energy transitions literature is relatively recent compared to the first two. The climate justice and energy justice strand is concerned with the idea that sustainability and energy transitions such as the proliferation of renewable energy sources may have differential impacts on local communities and consumers (Bond 2012; Healy and Barry 2017; Heffron et al. 2015; Newell and Mulvaney 2013; Okereke 2010; Sovacool and Dworkin 2014, 2015; Swilling and Annecke 2012). Other examples are that the

rising sea levels because of global warming can displace people in certain locations, and that the lack of access to cheap energy disproportionately affect consumers in developing countries. This is useful, on the one hand, to support the argumentation on fossil-fuel infrastructures by economic geographers that the uneven development energy infrastructures create winners and losers who face differentiated impacts in national and international political economy (Bouzarovski 2022; Bridge et al. 2013; Guertler et al. 2021); on the other hand, climate/energy justice focus can urge international policy making platforms address the resulting unequal distribution of costs and benefits of climate actions (Bickerstaff et al. 2013; Fuller and McCauley 2016; Heffron et al. 2015; Sovacool and Dworkin 2014, 2015; Sovacool 2017).

The climate/energy strand advances at least three major suggestions for thinking about the justice dimensions of Just Transition. The first is to achieve a procedurally inclusive climate/energy justice by addressing the interests of those impacted the most by environmental decline (Ciplet and Harrison 2020: 443); and this also requires restoring damages already caused (Swennenhuis et al. 2022). Velicu and Barca (2020: 271), however, warn that such an inclusion should go beyond assuming workers are victims of climate change and environmental problems; workers should rather be seen as agents and be given the political and institutional tools to be able reject being involved in wage-labour relationships in the 'green' economy. Therefore, starting with the labour justice focus is better positioned to make use of the agency of labour in transitions. The second suggestion is to achieve an equal distribution of costs, burdens and harms in sustainability and energy transition policies (Ciplet and Harrison 2020: 449; Sovacool et al. 2020: 17; Swennenhuis et al. 2022: 8). This is similar to the arguments of the environmental justice strand, but it does not explicitly refer to the marginalisation and exclusion of communities of colour and the poor. The third suggestion is to solve the recognition tensions of transition policies by acknowledging the diverse rights and values of marginalised peoples in the world economy (Ciplet and Harrison 2020: 445), including the voice of indigenous groups. This necessitates, according to Mathai et al. (2021), co-producing knowledge for, and co-organising actions in sustainability and energy transitions, which is not possible under the current system of national and international environmental governance (Section 2.2). Nevertheless, climate/energy justice

strand believes that its suggestions can help the UN system of environmental governance ensure just transition.

These suggestions by the climate/energy justice strand of the critical sustainability and energy transitions literature are valuable to help think about the complexity of ecological problems. In particular they provide critical insights to interrogate other sustainability and energy transition approaches. However, there are shortcomings of the climate/energy justice strand that can be overcome by the insights of labour justice and environmental justice strands. The major shortcoming is that climate/energy justice strand obscures the fact that most just transition research and relevant policies, that are developed by labour organisations in a dialogue with environmental justice strand, are grounded in the agency and politics of labour (Stevis et al. 2020: 6-7). The lack of attention to agency in climate/energy justice strand, compared to the explicit focus by the first two strands on the agency of social movements and workers, is because of the impact on the literature of the multi-level perspective to transitions (Geels 2005, Geels et al. 2019; Geels and Schot 2007; Sovacool 2017; Sovacool and Hess 2017). Following Swilling and Annecke's (2012) attempt to combine sociotechnical transitions with justice approaches in the case of South Africa, Newell and Mulvaney (2013) argued that the concept of just transition has analytical links to the socio-technical transitions literature.

The multi-level perspective to transitions perceives sustainability and energy transitions as results of non-linear and complex socio-technical relationships between 'niche' technologies, technological 'regimes', and the 'landscape'. The niche is developed in industrial 'incubation rooms' of incumbent technological regime that can act as both barrier and facilitator for the new technology. The landscape is the overarching structure for regimes and niches, that can accelerate, slow, or change the changes by niches to the regime. This line of thought is not particularly interested in the concept of justice in its approach to sustainability and energy transitions, nor does not explicitly refer to workers, labour organisations, disadvantaged communities as key actors (See also Chapter 4). Geels (2005:76) specifies that this thinking is based on the combinations of insights from evolutionary economics (Nelson and Winter 1982), science and technology studies (Latour 1987; Rip and Kemp 1998), and innovation studies (Clark 1985; Kline and Rosemberg 1986). Earlier critiques on multi-level perspective on socio-technical transition literature show that it lacked political economic lens and instead

leaned towards technocratic and management tones (Scrase and Smith 2009) Additionally, it is neglects spatial and regional dynamics in sustainability and energy transitions (Berkeley et al. 2017; Propris and Bailey 2021).As Jenkins et al. (2020: 140) put it, the climate/energy justice strand should not forget the political role of labour unions and the origins of the concept of just transition, while conceptually presenting various dimensions of climate/energy justice to be advocated at policy circles of the UN system of environmental governance. I showed in Section 2.2 that current international environmental decision-making platforms cannot meaningfully resolve socioeconomic and ecological problems. Additionally, as a counter to narrowly focussed national decision-making, in addition to emphasising the historical role of labour organisations, I seek to argue in this thesis that more attention in critical sustainability and energy transition literature should be paid to the integral and structural exploitation of global labour and the environment across the world economy through global production networks. This is especially important in the context of global automotive production networks, which depend on several commodities from around the world such as steel, iron, copper, aluminium, plastic, oil, timber, leather, rubber and cotton. EVs require additional commodities, specifically for batteries, such as cobalt, nickel, copper, graphite, manganese and lithium (Bos and Forget 2021; Castelvecchi 2021; EU Commission 2020; UBS 2017; UNCTAD 2020; USGS 2021).

As Baglioni et al. (2022c: 324) indicate, much work on sustainability and energy transitions has played down the roles of and the implications on exploitation of global labour and the environment. With the skyrocketing demand for EV batteries in the global automotive industry, natural resource and chemical processing workers, material and mineral miners, and the impacted communities situated at several nodes of global production networks often in oppressive social and political environments (see Chapter 8). As the first two strands focusing on labour justice and environmental justice highlight, a wealth of formal and informal economy employees and social groups with limited income levels that face disproportionately the negative results of the ecological problems, should be part and parcel of the current sustainability and energy transition, including domestic labour (Barca 2017, Velicu and 2020), racially marginalised workers (Pulido 2016; Pulido and De Lara 2018), migrant labour (Geenen and Cuvelier 2019; Nest 2011; Smith 2011). In doing this, bringing environmental justice and

labour justice foci together for a full just transition for all segments of global labour and the environment is crucial.

2.3.1 Origins of just transition: From a jobs versus environment dilemma to international labour environmentalism

As explained above, different justice dimensions of the concept of just transition are reflected in the three different strands of the critical sustainability and energy transition literature. This section shows the ways in which social movements advocating for environmental justice and labour organisations supporting labour justice aligned their interests with the concept of just transition and overcame the 'jobs versus the environment dilemma'.

The environmental justice movement emerged from, and brought together, various local social and political initiatives (Martinez-Alier 2002). These include the civil rights movement led by African-American communities, occupational health and safety initiatives to protect non-union migrant workers, the indigenous and land rights movement, public health and safety advocacy against lead poisoning and toxic materials, human rights campaigns for self-determination of peoples in developing countries, and other grassroots justice movements organising poor communities (Faber and McCarthy 2003: 45-46). What brought together organised labour and environmental justice initiatives was their shared positionality vis-à-vis corporate attempts to solve environmental degradation via voluntary market initiatives and outsourcing of heavy industries to low-cost regions in the world with lower environmental standards. Voluntary and market-based sustainable development initiatives did not consider environmental justice, and companies kept impacting vulnerable communities. At the same time, outsourcing of some of the manufacturing jobs led to major job losses in unionised sectors living in these vulnerable communities.

The origins of the concept of just transition dates back to the 1970s, when the North American trade union movement in the oil and chemical sectors asked for protection of workers and their communities that made their livelihoods in fossil fuel-based industries. In this early formulation the focus was on labour justice through occupational health and safety regulations in energy-intensive and polluting industries (Young 1998; Morena et al. 2020). Young (1998: 44) explains how North American organised labour called for a superfund in chemical and fossil fuel industries to support those who were about to lose their jobs. These early transition demands pursued sustainability and distributive justice simultaneously (Ciplet

and Harrison 2020). For example, the proposed superfund was to include full income and other benefits until retirement, possibly redeployment with comparable work, up to four years of tuition fees to attend vocational schools to gain new skills, and financial help for workers and their families to relocate in search for new jobs (Mazzochi 1993). Back in 1976, a number of trade unions in North America were joined by African-American unionists, environmental and urban community activists to discuss economic and environmental justice (Stevis 2023: 12). From these claims by organised labour in the late 1970s and early 1980s on protection and compensation of workers in transition, the focus on labour justice gained increased resonance in the 1990s when the North American environmental justice movement and trade unions came together as a broader social movement (Burrows 2001). The concept of just transition itself was first coined in 1995 by the Oil, Chemical and Atomic Workers' Union (OCAW) that was supported by labour justice and environmental justice activists (Stevis 2023: 10).

Overcoming the environment vs. jobs dilemma and creating a shared understanding between environmental justice and labour justice foci in sustainability and energy transitions was possible due to two facts. First, as with health and safety requirements in the workplace or collective bargaining on wages in different sectors, environmental justice considerations such as climate change and global warming directly affect the core business of trade unions, because new technologies and environmental regulations change employment levels (Felli 2014). Second, tackling climate change impacts and environmental degradation of fossil fuel and energy industries provides labour organisations and impacted communities a shared agenda in transitional decision-making processes. Environmental justice activists and labour organisations call companies and governments to support renewable energy and related technologies to solve environmental degradation and pollution faced by communities, and to offer new jobs to workers. In other words, contrary to what Levy and Spicer (2013) call the climate impasse post-2009, organised labour came to terms with the reduced jobs and benefits in carbon intensive industries and began supporting new technologies, as in the case of Germany with EVs, discussed in Chapters 7 and 8.[21]

[21] See Allan and Robinson (2022) for a similar case for Canada; Meckling and Nahm (2021) for France and the USA; Kenfack (2018) for South Africa; Soder et al. (2018) for Austria; and Lundström (2018) for Sweden.

Consequently, the boost for the use of the concept of just transition was international organised labour's need, in the early 2000s, to find a motto to bring various justice dimensions together and advocate workers' involvement in the UN climate change negotiations (Silverman 2006; Stevis 2011). As Rosemberg (2020) explains, the International Confederation of Free Trade Unions (ICFTU), one of the predecessors of the ITUC, was unable to publicly endorse the Kyoto Protocol at the time and ask governments to enhance emission reductions (Rosemberg 2020: 34). Instead, the ICFTU demanded, at COP3 in Kyoto, an equitable distribution of costs through the UN climate change programmes (ICFTU, 1997:1 cited in Stevis et al 2020). The merger, in 2006, of varying ideologies of international trade union confederations,[22] as well as trade unions from developing countries and former communist regimes, under ITUC was possible through a shared goal to overcome the jobs vs. the environment dilemma by combining labour- and environmental justice foci, which was the previously dominant reactive position of organised labour on environmental rules and regulations, focused only on securing employment of union membership (Räthzel and Uzzell 2013). The concept of just transition in the context of international climate change negotiations also offered labour organisations a shared terrain with climate/ energy justice proponents (Interview with trade union), through which labour organisations from different countries under the leadership of the ITUC started pledging commitments to fight climate change within the UNFCCC (Burgman 2016: 119; Felli 2014: 378; ITUC 2010: 42).

Organised by the UN Environment Programme and the ITUC, the first Trade Union Assembly on Labour and the Environment took place in 2006, where trade unions discussed environmental issues. This assembly proposed the integration of environmental degradation, greenhouse gas emission reduction and renewable energy policies into workers' agenda as a way to promote the concept of just transition. ITUC, along with the sectoral global union federations, is today among the leading supporters of the concept of just transition in the UN system of climate change governance. They believe that with the state intervening in transition to a low-carbon economy to protect impacted workers and reskill them for new

[22] Previous international trade union confederations are WCL (World Confederation of Labour) with mostly Christian Democratic orientation, ICFTU (International Confederation of Free Trade Unions) with Social Democratic national unions and WFTU (World Federation of Trade Unions) organising trade unions from former Eastern bloc and some developing countries (Cotton and Gumbrell-McCormick 2012: 708)

jobs, mitigating climate change and reducing carbon emissions can and should bring decent jobs with high entitlements enjoyed by the employees in fossil fuel industries in developed countries. What the environmental justice activists and workers achieved in the 1990s locally in North America is being advocated now at the global level to connect the fight for workers' rights and the focus on labour justice to the other two justice strands in the context of dealing with ecological problems (Barca and Leonardi 2018; Felli 2014; Stevis and Felli 2015; Soder et al. 2018).

2.3.2 Contours of just transition: Embracing green growth, ILO conventions and global framework agreements

This section explains the general international institutional framework in which just transition demands by national and international organised labour are advocated for. In general, labour organisations continue to support the dialog between environmental justice and labour justice. However, with the inclusion of the concept of just transition in the UN system of environmental governance in the last decade and due to the need to bring together various interests of national trade unions, just transition demands try to cover climate/energy justice focus that potentially leads to embracing the institutional and political assumptions and tools of the sustainable development paradigm. These include the ideas that workers will benefit from green growth, where ILO conventions promote the rights of global labour, and that large multinational companies can be held accountable by global framework agreements signed between the GUFs and lead firms for working conditions and environmental standards in their global production networks.

While solving the social, environmental and economic problems of carbon intensive economic activities and addressing the climate change with a just transition (ILO 2013, 2015; UNFCCC 2015), winners and losers arise due to possible job losses and higher energy prices (UNEP 2008). This argument is key to the success or failure of the environmental policies for political reasons. As the Just Transition Centre (JTC) at the ITUC underlines, workers' acceptance of climate change measures makes it easier for both the state and companies to introduce new technologies (JTC 2017). However, such measures and technologies should not negatively affect the livelihoods of workers and impacted communities (ITUC 2018). The JTC at the ITUC work with large businesses and multinational companies to campaign for the compatibility of business interests and climate change action: 'From a commercial perspective, implementing

a just transition allows companies to plan for, manage and optimize the operational and reputational effects of cutting emissions and increasing resource productivity' (JTC 2018: 2).

Without the successful involvement of, and cooperation with workers, environmental regulations and new products restructuring industrial employment risk fuelling extreme-right movements in developed countries, as in the case of certain locations in Germany (Interview with trade union). In considering the question of job losses in the pursuit of sustainable development, the UNEP (2007, 2008) commonly draws attention to the creation of new jobs or the transformation of existing ones using environmentally friendly technologies. This is to ensure that the coming transition will not be poorly managed, as were previous transitions such as deindustrialization in the Western economies, structural adjustment programmes of the World Bank and IMF in the Global South and excessive liberalisation of global commerce, finance and investment (UNEP 2008). However, they still focus on an expectation for businesses and international finance to lead the shift to green technology, which echoes key principles of sustainable development. Instead, labour organisations advocate the involvement of the state and trade unions to direct the transition to a low-carbon economy.

National and international organised labour is generally committed to embracing green growth via technological fixes such as renewable energies, EVs, energy storage and batteries (IndustriALL 2016: 24; ITF 2010: 34; ITUC 2017: 11); however, some technologies, such as carbon capture, are contentious and others, such as nuclear energy, are potentially politically divisive (Felli 2014: 379). A generally accepted view on global working conditions and environmental standards is that ILO conventions can further social and environmental sustainability (UNEP 2007; ETUC 2007; ILO 2015). The GUFs sign global framework agreements (GFAs) with multinational companies in their respective sectors about respecting human rights, banning child labour and forced labour, recognising right to organise, collective bargaining and non-discrimination (Helfen et al. 2016: 634). However, GFAs do not necessarily lead to better working conditions and/or cross-border union cooperation, due to their vague content (Fichter et al. 2011: 75), which is mainly based on the same principles referred to by ILO conventions (Luterbacher et al. 2017: 313). There is a lack of implementation of basic ILO conventions in various low-cost countries, notwithstanding the weak environmental standards rendering such locations attractive for multinational companies to move their carbon and energy intensive operations.

The just transition demands are one of the four pillars of policy tools advocated by the ITUC.[23] The pillars are: (i) peace, democracy and rights, (ii) regulating economic power, (iii) just transitions, and (iv) equality (ITUC 2018: 5). These just transition policy tools aim to secure pensions, redeployment and reskilling guarantees, investment in new and green jobs, and reinforced information and consultation rights in workplaces. ITUC draws attention to decent work with labour rights, minimum living wage, collective bargaining and social dialogue with efficient tripartite mechanisms, equal treatment of migrants and refugees, increasing the share of formal economy and combating growing informalisation of work, and universal social and income protection (ITUC 2018: 28). The Global Union Federations (GUFs) and the ITUC urge national governments and international institutions to create jobs, expand universal social protection and reduce inequality (ITUC 2010, 2017, 2018; ITF 2010).

In addition to the immediate protection and compensation of those workers employed at polluting factories impacted by transition, and the need to create alternative employment, the ITUC (2010) articulated demands for a new approach to the mainstream idea of sustainable development. In contrast to reproduction of existing structures and power dynamics in the world economy by sustainable development, the approach of the concept of just transition is based on domestic market and regional integration, decent work, income redistribution, public investments in key sectors such as transport, education and health, the protection of the environment and workers' rights. Further, in their statement to the 2017 annual meetings of the IMF and the World Bank, they also pointed to high unemployment rates and wage stagnation as the key problems of working people along with environmental degradation (ITUC 2017). The GUFs and the ITUC also demand stronger sectoral and national collective bargaining and extensive public spending in energy-efficient infrastructure and quality public services (ITUC 2017).

During the diffusion of the concept of just transition in international climate change negotiations the language of just transition has been adopted by prominent environmental NGOs and entered into the set of industry policies in developed countries in North America

[23] The International Trade Union Confederation (ITUC), with a membership of around 181 million workers in 163 countries, is the framework institution for trade unions. The Global Union Federations (GUFs) represent their respective sectors at the international level (BWI, EI, IAEA, IFJ, IndustriALL, ITF, IUF, PSI and UNI) (Räthzel and Uzzell 2013).

and the European Union (Stevis 2023: 23). In other words, the ITUC and large national labour organisations add to the combination of environmental justice and labour justice the last strand of climate/energy justice, which helped them make their way in the UN system of environmental negotiations. However, this risked the dilution of labour- and environmental justice foci in just transition demands and the acceptance of some of the aspects of the sustainable development paradigm. In other words, there is diversity of policies advocated for in the context of just transition. These policies range from mainstream policies of the UN system of environmental governance, reforms to labour market mechanisms and decision-making processes, and to redesigning how industries are organised or whether public ownership should be considered in the key industries with high level emissions.

2.3.3 Katowice 2018 and later COPs: Failure to understand just transition

Following the Paris Agreement, the concept of just transition gained traction in the subsequent UNFCCC meetings. This is in line with the announcements by governments and large business to accelerate efforts in greening manufacturing and energy industries, where they need the cooperation of the workers involved. As part of the environmental regulation programmes and introducing new technologies, the key parties to UNFCCC recently declared important industry and enterprise policies such as the EU's Green Deal and the Green New Deal in the USA, which also aim to get the workers on board (Bloomfield and Steward 2020; Tienhaara and Robinson 2022). The Commission of the European Union, headed by Germany's former defence minister, Ursula von der Leyen, announced in 2019 that the EU needs to invest an additional annual amount of 260 billion euros to achieve its current 2030 climate and energy targets.[24] A vital part of this 'green new deal' is a 'just transition mechanism' which will mobilise around 150 billion euros over the period of 2021-2027.[25]

As part of the successive meetings under auspices of the UNFCCC, the Silesia Declaration at the COP24 in 2018 in Katowice shows that the efforts by the trade union organisations advocating workers' perspectives regarding the environment and climate change gained

[24] Communication from the Commission 11/12/2019 'The European Green New Deal' available https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF accessed 01/05/2020

[25] EU Commission press release 26 June 2020 'Green Deal: Coal and other carbon-intensive regions and the Commission launch the European Just Transition Platform' available https://ec.europa.eu/commision/presscorner/detail/en/ip_20_1201 accessed 30/06/2020.

wider public and policy attention (Jenkins et al. 2020; Markkanen and Anger-Kraavi 2020). The declaration restates the need for measures to support negatively affected workers and their communities, while maintaining economic growth and jobs. It refers to the ILO's guidelines for just transition (ILO 2013, 2015) and the UN's 2030 agenda for sustainable development goals (UN 2015). Referring to workers' perspectives on that occasion was significant not only because of the explicit recognition of a labour's linkage to climate change, but also because Katowice lies at the heart of the Central-Eastern European coal region stretching across Poland, Germany, Czechia and Slovakia, which in turn feeds into heavy industry and manufacturing in Europe. However, as Stevis et al. (2020: 2) put it, the 'just transition COP' in Katowice, rather than providing a clear way to achieve just transition to a low-carbon economy, once again shows that the climate policy makers do not fully understand "the complex and multifaceted reality of a 'living concept' whose origins and meanings lie deep in the everyday experiences of workers and frontline communities".

Despite the increased attention to the concept of just transition in meetings, participants to the UNFCCC COP24 in Katowice, Poland, failed to agree to incorporate the 2018 IPCC report, which underlines the urgency of additional climate actions. One year later, at the COP25 in Madrid, there were again no enforceable results. The COP25 could only suggest countries communicate further climate plans, without any tangible targets for new emission reductions or a call for enhanced implementation of existing NDCs (Newell and Taylor 2020), notwithstanding the lack of policies on just transition to a low-carbon economy in fossil fuel industries. Neither could the COP26 in 2021 in Glasgow, or the COP27 in Sharm el-Sheikh, produce a tangible outlook for a harmonised and collective emission reduction strategies by the members (Carrington 2022). The parties could not achieve a plan for the phasing down of fossil fuel investments and financing the loss and damage suffered by developing countries due to climate change and global warming (Harvey 2022). Some representatives of fossil fuel companies even held talks during the COP27 on how to develop new oil and natural gas exploration projects in African countries (Hodgson 2022).

Even though echoing, at times, the concept of just transition, and being attended by national and international organised labour, the UN system of environmental governance displays an increasing mismatch between rhetoric, intentions and actions (Stevenson 2021). I argue that the insistence by the UN agencies, governments and fossil fuel companies on the imperative

of economic growth and primacy of markets, and the partial understanding by most labour organisations of just transition focusing on 'green' jobs, share the ideas of ecological modernisation theory. There are also tensions among just transition demands put forward by national and international labour organisations that I discuss below.

2.3.4 Tensions on just transitions: Ecological modernisation or a new approach to ecology

This section explains institutional, political and conceptual tensions around just transition strategies by organised labour in developed countries, and shows how they are connected to limits of sustainable development paradigm informed by the ecological modernisation theory discussed above.

With regard to institutional tensions, on the one hand, trade union representatives point out that workers and their communities might suffer from an unequal distribution of burdens during transition and therefore advocate for their participation in the decision-making processes on running and managing the change, as well as policies for better distribution of income (Stevis and Felli 2015: 34). On the other hand, however, they are institutionally weakened with declining coverage rates and union membership in national industrial relations. Furthermore, the ITUC and sectoral GUFs fail to recruit trade unions from most of the developing countries, perhaps most importantly China. Most affiliates of the international trade union movement are from the OECD countries (Cotton and Gumbrell-McCormick 2012: 710). The geographical distribution of carbon-intensive industries is not adequately addressed by the just transition demands of these institutional forms of international organised labour, mostly consisting of affiliate trade unions from the industrialised countries.

Political tensions around just transition strategies make policy making very difficult for national and international labour organisations. Trade unions in some of the most polluting fossil fuel-based and energy intensive industries, including automotive, coal, oil and gas, are still not sure how to bring together environmental protection and maintaining highly paid and stable jobs (Interview with trade union). For instance, this is the case for trade unions and workers in Germany's coal mining industry, where the government launched an independent ad hoc commission, 'The Commission for Growth, Structural Change, and Employment', commonly referred to as the 'Coal Commission', to determine how to phase out the mining of coal in Germany, as part of introducing more environmentally friendly energy generation

(Guertler et al. 2021). The country will, by 2035-2038, use large amount of public funds (40 billion euros) for retirement and compensation schemes for around twenty thousand workers. However, the reliance on fossil fuels in power generation, resource extraction and industrial manufacturing has not even peaked yet, let alone started to decline (IPCC 2018; UNEP 2019). Thus, just transition demands should better address this as suggested by the climate/energy justice strand.

Large fossil fuel and energy extraction industries in the USA, Canada, Australia, Saudi Arabia, Qatar and Russia emit greenhouse gases. Similarly, China and India view and use their large coal reserves as engines of economic growth (Allen et al. 2021; Levy and Spicer 2013: 663). This contributes to the increasing emissions in China, India and Southeast Asian countries due to their enlarging industrial manufacturing sector, led by Western multinationals in medium- to high-technology sectors such as electrics/electronics, vehicles, batteries, rare earth element processing and parts assembly for renewables. Solar, wind, hydropower, biofuels and other energy sectors introduce pressure on the environment and land, as well as species and people (Bouzarovski 2022; Bridge et al. 2013). Therefore, in short, phasing coal mining out in one of the developed countries with a large public budget, over a couple of decades, given the limited number of workers employed in the coal industry in Germany, does not necessarily solve political tensions. The employment level, economic and social significance of the automotive industry is much higher than for coal, and political tensions arise in developing countries in the shift to EVs, which is seen by most organised labour from developed countries as a product for green growth in the automotive industry (FES 2018; IG Metall 2014, 2021, 2023; ITUC 2021; UAW 2022). EVs accelerate resource extraction, chemical processing and raw material mining in developing countries (Morgan 2020; Narins 2017; Prause and Dietz 2022; Smith 2011; Sovacool 2019). I think this can only be solved by separating just transition strategies from the aspects of sustainable development such as the imperative of growth, as well as from the focus on energy justice that sees cheap energy as central to economic development and consumer welfare.

As another level of political tension around just transition, some international organised labour policy documents draw attention to public ownership of the remaining fossil fuel industries and transport industry (ITF 2010). ITF also urges stringent regulations and carbon tax on oil companies, car and aircraft manufacturers, and airlines. Similarly, national trade

unions in public services call for nationalisation and broadening of public transport, and argues that EVs as the focus of the UNFCCC COPs to solve ecological problems of transport emissions should not sideline public transport (ITF and C40 Cities 2021; PSI 2021). Such an approach does not necessarily find space in policy documents of the national and international labour organisations in manufacturing industry, IG Metall and IndustriALL respectively. These political tensions are related to the membership of the national and international labour organisation; whereas public service and transport workers tend to be familiar with public ownership, manufacturing industry workers have been employed by mostly private companies. Those that work in Chinese state-owned manufacturing enterprises are, of course, outside this generalisation for which structural tensions around just transition explained above apply. I argue that the just transition demands of trade unions and other labour organisations should broaden their labour justice focus from manufacturing and services industries to also look for ways to apply it in the context of global labour (e.g. those working upstream supply chains).

This is important because, as a study commissioned by IndustriALL (2022) shows, both the Chinese and global lithium-ion battery industries are based on a large internal migrant workforce that are employed in China under dormitory labour regimes conceptualised with respect to the workers in Central European electric/electronic industry by Schling (2022) and Andrijasevic (2022). And IndustriALL (2022) only reports what they were allowed to observe by the state in China, and guesses that flexible mass-production techniques with high turnover and often illegal overtime in battery assembly with limited pay levels are probably better compared to other nodes of the battery production networks in the country such as mining, resource extraction and processing in rural towns. As I explain in Chapters 5 and 8, similar political tensions apply to other resource-intensive nodes of global EV production networks, such as those in Latin America and Africa. As the shift to EVs will have much larger political impact, given the large manufacturing clusters of OEMs along with their parts and component suppliers announcing job losses in developed countries, it is an open question whether the just transition demands of national and international organised labour in manufacturing sectors can address these wider political issues rather than directly embracing the proliferation of EV production, a policy that is also supported by the UN sustainable development agenda.

Tensions around just transition strategies are highest with regard to conceptualising the sustainability and energy transitions (Interview with international trade union). The concept of just transition that both accounts for global labour and the environment (see JTPs below), and that also challenges uneven economic development in various labour regimes (Baglioni et al. 2022), should go beyond viewing workers and the poor as victims of climate change and environmental degradation (Velicu and Barca 2020). This view is shared by both sustainable development and climate/energy justice foci in critical sustainability and transition thought. As the latter points out, such an enhanced conception of just transition requires a new understanding of the labour-environment relationship, in which people are part of nature and not just immersed in it (Stevis et al. 2018). As Barca (2015) argues, following the ILO guidelines (ILO 2013, 2015) for a just transition to a low-carbon economy under the auspices of the UNFCCC is not querying the inequalities of the current political economy of the fossil fuel intensive world economy. To do that, along with the protection of a small number of unionised workers in manufacturing and energy industries, child labour and informal employment, as well as the lack of trade union rights or the dismissible coverage rates of union membership in these countries should be on the agenda of the ITUC and GUFs in their just transition demands. Similarly, just transition demands should also consider unpaid/underpaid domestic work, both in the industrialised countries by the marginalised, mostly immigrants, and in developing countries mostly by women (Barca and Velicu 2020; Pulido 2016).

It is possible to conceptually enrich just transition demands by first solving structural and political tensions, which requires demanding and putting forward a broad, democratic movement, with unions playing a key role (Morena et al. 2020) as suggested by the labour justice strand. Increasingly after the UN Rio Summit in 1992, trade unions from Europe and North America highlighted this and tried to take part in the broader social movements that reached their peak at the turn of the century with anti-globalisation demonstrations in Seattle. However, this broader reach in the protests against the existing structures and power dynamics abruptly stopped for a while in the wake of terrorist attacks on large cities in Europe and North America, after which the key social mobilisations such as demonstrations against the Iraq War or Occupy movements failed to achieve broader social support (Interview with trade union). According to both policy reports and academic literature on just transition, a

broader political movement combining the three foci on justice (environmental, labour, climate/energy) is needed to achieve a better position in sustainability and energy transitions, which will help global labour fight against socioeconomic and ecological inequalities in global production networks. The next section explains the ways in which various concepts and analytical tools discussed so far in this chapter can be operationalised; this in turn informs my analysis of the shift to EVs.

2.4 Just Transition Parameters: Strengths and Weaknesses of the Just Transition Literature

In this section, I discuss the strengths and weaknesses of the just transition literature. I do this by explaining the links I build between the just transition literature and my five-parameter just transition framework that I developed to analyse the shift to EVs, which was introduced in the previous chapter.

The first dimension that labour organisations brought to the UN system of climate change negotiations regards the protection of and compensation for existing workers and their communities impacted by the technological change and/or environmental regulation. For this reason, this is the first parameter (JTP1) that I consider in my analysis. As I showed in Section 2.3, this is the backbone of workers' demands in fossil carbon- and energy-intensive industries in developed countries. This makes just transition a more grounded approach than mainstream sustainable development that focuses on only green growth via markets through private enterprise. All policy documents by national and international labour organisations include JTP1.

Then inclusion of workers in decision-making processes during ongoing transitions – my second parameter, JTP2, represents a more enhanced demand from labour, because it further questions the primacy of markets and private enterprise in achieving a more sustainable industry. It represents a nuanced version of discussing contours of just transition demands, which limit themselves to JTP1 as a local industrial restructuring issue, as in the case of the Coal Commission in Germany, which is restricted (in terms of global implications of transition) to only asking for the implementation of ILO conventions by governments and the GFAs by multinational companies. This further enhanced aspect of just transition demands resonates

also within critical sustainability literatures focusing on labour justice and environmental justice. These go beyond calls to protect workers and address the issue of their inclusion in decision-making processes during transition as fundamentals of a just transition (Felli 2014; Goods, 2013; Mazzochi 1993; Morena et al. 2020; Snell and Fairbrother, 2013; Stevis and Felli 2015, 2020; Weller 2018).

The focus on reskilling workers to channel them to new jobs through retraining programmes funded by the companies in question, and more importantly by the state (JTP3), derives from just transition demands' challenge to the mainstream sustainable development paradigm, which assumes that workers losing their jobs in the transition are absorbed by the market (or not) and/or by early retirement schemes. This challenge highlights that, contrary to the assumptions of the sustainable development paradigm, labour market mechanisms are unable to protect workers impacted by regulatory, environmental and technological shifts and fail to channel their skills towards new jobs in the industry under consideration or towards jobs in other sectors. In other words, instead of leaving impacted workers at the mercy of free labour markets and facing early retirement schemes, the focus on labour justice demands material interventions. Until the just transition demands put forward in the context of labour- and environmental justice-focused studies and policy documents, claiming state involvement in, and highlighting companies' responsibility for, workers' livelihoods was not part of the sustainable development narrative in the UN system of climate change negotiations.

I argue that this challenge should also be extended to the other key markets of the world economy such as commodities, international trade, finance, or intellectual property, which are not questioned in sustainability and energy transitions. Specific climate change policies and technologies can contribute to inequalities and uneven development in the world economy, which are not fully addressed in the climate/energy justice strand of the critical sustainability and transition literature. This strand does not tend to approach analysis of the world economy with the exploitation of workers and nature as the starting point of the analysis. Instead, this strand tends to focus on injustices in relation to potential limitations on development trajectories in the Global South and disadvantages for consumers and impacted communities due to the lack of cheap energy (Fuller and McCauley 2016; Jasanoff 2018; Heffron and McCauley 2018; Newell and Mulvaney 2013; Sareen and Haarstad 2018; Sovacool

and Dworkin 2014, 2015). Moreover, these recent foci of the climate and energy justice literature do not attempt to historicise power relations in the industries under consideration, and nor do they examine the material characteristics of new technologies, products and services such as EVs.

To overcome this issue, combining the global production network framework with labour regimes analysis, as well as the material characteristics of the product (EVs) helped me expand the analysis using two additional parameters, one that includes global labour (JTP4), and one that includes the environment (JTP5) (See Chapter 3). In this way, I suggest ways to solve tensions around just transition demands. The inclusion of global labour in the picture also emerged from my interviews with industry representatives and state officials in Germany. These highlighted a mismatch between their immediate focus on their prospects while simultaneously referring to a global phenomenon and the global dimensions of the industry. (see Chapters 3 and 7 on avoiding becoming a 'second Detroit'). This global dimension also reflects the broader approach of the just transition approach of national and international organised labour, as opposed to one inscribed in the sustainable development paradigm: the ITUC and GUFs stress the need to think about other political and socio-economic problems along with climate change and emission reductions, such as the ITUC's pillars on peace, economic power and equality. Yet, JTP4 is better achieved via broader labour environmentalism, as suggested by Stevis et al. (2018), and Velicu and Barca (2020), rather than only limiting just transition demands to sustainable development along with better implementation of ILO conventions and GFAs with respect to global labour. Stemming from the material characteristics of EVs and being informed labour regime analysis, JTP5 on the environmental impacts of the proliferation of EV production, is similarly a broader look at the impacts of the new product at the outer nodes of the global automotive production networks. It replaces the mainstream approach of sustainable development, which sometimes limits the ideas around EVs, especially at manufacturing industry unions, to only supply chain security, a strategy shared by the dominant companies in the global and German automotive industry, which the next chapter discusses.

2.5 Conclusion

In this chapter I show that the concept of just transition is increasingly being incorporated into the UN system of international climate change governance. Starting from North America, and enriched by the shared work and interests of trade unions and environmental justice movements, just transition in the 1990s began to gain attention. Following the global economic and financial crisis in 2008, the newly merged international union confederation (ITUC) and sectoral union federations (GUFs) used the concept at UN agencies and negotiations around international agreements, the most famous of which is the 2015 Paris Agreement. This is where just transition was acknowledged by the governments and businesses as part of emission reduction policies, and by labour as part of dealing with the ecological problems. The most recent UN sustainable development agenda, the SDGs, includes references to labour's part in transitioning to a low-carbon economy.

However, this still carries the ideas and dominance of the existing power structures in the world economy. The focus of SDGs and the UN's 'green jobs' is still market mechanisms, technology transfer and investments in environmentally friendly products and technologies by both businesses and the state, without necessarily challenging the dynamics and power relations in the world economy that influence global working and environmental conditions. To overcome this, rather than locating itself in the UN system of environmental governance and embracing 'green growth', just transition proponents should interrogate the material basis of the world economy and dependence of proposed technologies such as EVs and their future infrastructures on *other* natural resources. This can prevent the missing of broader socioeconomic and ecological implications of sustainability and energy transitions, including increased resource use, biodiversity loss and embedded emissions.

Which workers does just transition aim to protect from the coming environmental and technologic change? Even though the concept of just transition challenges the mainstream, top-down sustainable development approach in important ways, just transition demands stem mostly from national and international labour organisations of industrialised countries (Morena et al. 2020; Räthzel and Uzzell 2011, see Chapter 4). I argue that the concept of just transition has hitherto encapsulated the demands of a rather small portion of workers as it fails to account for *all* workers involved in the shift to EVs. This includes both a vast section of workers at the epicentre of GPNs (employees at small- and medium-size German enterprises,

and mostly migrant workers with fixed/short-term contracts in Germany) and workers employed at the outskirts in material extraction and chemical processing (see Chapters 7 and 8). Unlike Europe and North America, where just transition demands are put forward by the organised labour in the strongest terms, informal and precarious forms of work and worsening environmental standards are the norm rather than the exception in manufacturing industries in the Global South (Davis 2006; van der Linden 2008). Poor health and safety conditions in developing countries in the resource extraction, waste processing and recycling nodes of global production networks require attention. These points highlight the need to strengthen the foci on labour- and environmental justice.

To represent workers who are not heard in the current institutional context of international environmental negotiations, the just transitions agenda should be politically, conceptually and institutionally improved. All constituents of global labour should be regarded as active and important agents of the labour-nature relationship for sustainability and energy transitions. Protecting jobs, communities and the environment should be agreed upon in more transparent and *democratic* ways, instead of the dominance of technocratic international (the UN) and national (German) institutional decision-making. Decision-making processes in the automotive industry have displayed very limited labour say, this is because of the gradually increasing exclusion of workers in the 20th century by multinational companies and governments (See Chapter 5 and 6). Just transition demands should include visions of indigenous communities (Mathai et al. 2021), domestic labour and wider issues of global inequality (Barca 2017, 2020), the relationship between race and environmental justice (Pulido 2016; Pulido and De Lara 2018), and the crucial role of the exploitation of labour and appropriation of nature through different labour regimes in the world economy (Baglioni et al. 2022b).

CHAPTER 3 CONCEPTUAL APPROACH

3.1 Introduction

This thesis develops an original synthesis of concepts and frameworks, from a range of literatures and disciplines, to build a synthetic framework of five just transition parameters (JTPs). I use my JTP framework to analyse the extent to which the proliferation of EV manufacturing in the German automotive industry contributes to just transition to a low-carbon economy, with its implications for global labour and the environment. This chapter provides an overview of the literatures, conceptual tools and analytical frameworks used in this thesis. It shows how I operationalise JTPs at different scales, with various takes on the literature and frameworks explained here.

The previous chapter discussed the mismatch of the foci and priorities of sustainable development and just transition to a low-carbon economy. The former's focus on market-based approaches in achieving decarbonisation as a top-down approach does not match with the bottom-up ideas of the latter, which aims to support impacted workers and their communities. Unlike the sustainable development approach, the concept of just transition draws attention to social, historical and political aspects of the transition to a low-carbon economy and requires active intervention by fossil fuel companies and the state, which links the demands of impacted workers and their communities to social movements (Foster 2010; Jakopovich 2009). The major difference between the two is reflected in the roles they attach to the state. Section 3.2 starts with the crucial historical and contemporary role of the state in both the established automotive industry and in its transitioning phase at present to EVs. I elaborate these points in Chapters 5 and 6 in relation to the history of global and German automotive industries, respectively.

Section 3.3 combines different academic literatures that are useful at different scales in understanding the changes EVs bring to the global and German automotive industries, while I explain how the historical materialist approach to capitalist socioeconomic transformations helps me to consider EVs' broader implications for sustainability and energy transitions. As I show in the previous chapter, just transition demands need to reach out to global labour and the disproportionately impacted communities, which face worsening environmental and living conditions after three decades of uneven development as a result of complex global

production networks. The expansion of global labour and production necessitates coordination among national and international organised labour in the global automotive industry for organising at a larger scale than that of labour organisations in North America in the late 1970s and the early 1980s. Therefore, the Section 3.3 focuses on bringing global labour and the environment into the analysis of just transition to a low-carbon economy with EVs. I benefit from the academic literature on labour-focused global production networks, which helps me map out the global automotive industry. To be able to insert the ecological dimensions of just transition, and to achieve a more nuanced view on the environment and global labour as the key exploitation spheres in the work economy, I use the insights of the labour regimes analysis. Finally, Section 3.4 sets out the ways in which my JTP framework helps me examine the unfolding shift to EVs and answer the Research Questions.

3.2 The Historical and Contemporary Role of the State for the Automotive Industry

This section shows the key role of the state at various scales in the development of the automotive industry, both in its earlier phases with national vehicle markets and later with expanding global vehicle markets. Chapters 5 and 6, on the structure and history of the global and German automotive industries in their major transitioning phases, detail the arguments put forward in this section.

In meeting the challenges of just transition to a low-carbon economy, organised labour in developed countries, including Germany, faces significant challenges. On the one hand, the number of industries and workers facing transformation as a result of responses to ecological problems, including the climate crisis, grew rapidly in the 2010s and the growth continues into the 2020s. Just as with the North American oil and chemical sectors in the late 1970s and the early 1980s, trade union representatives in the 21st century point out that workers and their communities might suffer during transition from an unequal distribution of burdens compared to companies and governments responsible for the ecological problems; they therefore advocate for participation of workers in decision-making processes, as well as in the creation of policies for income distribution (Stevis and Felli 2015: 34). On the other hand, unions are institutionally weakened with declining coverage rates and union membership in national industrial relations (Pulignano et al. 2015; Eichhorst and Marx 2021), including Germany (Artus 2013; Benassi 2017; Doellgast and Greer 2017; Eichhorts and Kendzia 2016).

In addition, the International Trade Union Confederation (ITUC) and the sectoral Global Union Federations (GUFs) tend to fail to recruit trade unions from most developing countries, with most affiliates of the international trade union movement coming from OECD countries (Cotton and Gumbrell-McCormick 2012: 710; Meardi et al. 2021). To understand why trade unions in developed countries fall short in establishing a global outreach in their just transition demands, I explain the role of the state in both the automotive industry specifically and in environmental problems in general.

The state is widely recognised as being central to transition to a low-carbon economy, from UNFCCC commitments (EU Commission 2017, 2018b; IPCC 2014, 2019; UN 2019; UNEP 2018) to subsidies to, and trade remedies on, new renewable-energy technologies (Allen et al. 2021; Curran 2015; Kulowesi 2014; Lewis 2014; WCED 1987). Transport is among the most polluting and greenhouse-gas emitting sectors, along with energy and agriculture (Berners-Lee 2021); it constitutes one quarter of total CO_2 emissions from fuel combustion, and oil accounts for 95% of total CO_2 emissions from road transport (IEA 2017a). To cope with the ecological problems caused by the automotive industry, the state at various levels is called to intervene, whether in promoting EVs, investing in new charging infrastructure and electrified public transport, or banning the registration of fossil fuel-based internal combustion engine vehicles, all of which are only possible through state intervention.

The automotive industry, with its current and highly polluting characteristics, has also been, and remains sustained by state intervention for two main reasons (see Chapter 5). First, the automotive industry was a catalyst for economic growth by enlarging markets, ensuring mobility and increasing consumption in Western Europe and North America (Paterson 2007). It is still regarded as one the most promising sectors to promote growth and consumption levels in both developed and developing countries (Freyssenet 2009). That it was mainly financial institutions and vehicle manufacturers that were bailed out following the 2008 global economic and financial crisis shows the industry's significance to national governments (Bailey et al. 2010; Gamble 2009; Grigolon et al. 2015). Second, road transport and vehicle consumption are only possible with governments at various levels providing infrastructure for automobility in urban and suburban areas (Boehm et al. 2006; Paterson 2007; Urry 2013).

In developed countries, the state is involved in revenue generation, employment and functioning of the automotive industry by regulating vehicles and emission levels, promoting

registration of EVs, putting bans on registering traditional cars, investing in or holding shares of automotive companies, and supporting research and development of vehicles technologies and related disciplines at OEMs and universities (Freyssenet 2009; Holweg and Oliver 2016). Regarding the most recent products of the automotive industry today, i.e. nascent and relatively more expensive EVs, among the biggest consumers are local and national government agencies for passenger cars and commercial vehicles, as well as local public transport providers for electric buses (Mersky et al. 2016; Kokocinska 2021; Tsoi et al. 2022).

In developing countries, especially those with significantly sized vehicle markets, such as China, India and Southeast Asia (Dicken 2015; Dauvergne 2008; Luethje 2014), large OEMs and their multinational first-tier suppliers invest in vehicle manufacturing and component production. The state in these jurisdictions promotes FDI at various levels. In order to incorporate their workers and local businesses into the global automotive production networks, local and national authorities in developing countries offer fiscal incentives, tax exemptions, land grants and/or tax relief to investments by the dominant multinational companies (Humphrey 2000; Liu and Dicken 2006; Pavlinek 2015, 2022). In addition to accessing new markets, multinationals also use these low-cost locations as bases for vehicle assembly in free trade or customs union regions, such as Mexico to access the North American market, or Central and Eastern European countries and Turkey to access the EU market. Japanese and Korean carmakers use Thailand, Vietnam, Indonesia and Malaysia as assembly locations for accessing the ASEAN market. In a similar but slightly different manner, for the Chinese and Indian vehicle markets, currently the biggest in the world and among the fastest growing respectively, OEMs operate through their joint ventures due to local content requirements (Dicken 2015; Sturgeon and van Biesebroeck 2011).

Another major area of state intervention includes the 'management', whether active or passive, of industrial relations in the automotive industry. Regulations allowing or restricting the use of temporary and part-time workers play an important role in allowing OEMs to control geographically dispersed production networks (Benassi 2017; Haipeter and Lehndorff 2005; Pulignano and Doerflinger 2013). For instance, whereas union or company-level worker representatives in Western countries, South Korea and Japan can, in theory, have some access to decision-making mechanisms regarding the move toward EV manufacturing, those employed by OEMs' joint ventures and outer-tier automotive suppliers in developing

countries are not involved in this process (Campling et al. 2019). Whereas the joint ventures of large OEMs with state owned enterprises in China largely limit labour influence in production decisions and leave a larger space for a massive number of temporary workers (Luethje 2014: 538), the automotive industry in India relies heavily on informal labour, which lacks legal and social protections (Nair and Friedman 2021: 27).

Similarly, Sancak (2022) shows that following economic liberalisation and labour market flexibilisation through NAFTA in 1994 for Mexico, and through the European Customs Union in 1995 for Turkey, both countries' labour unions suffered from low unionisation rates, weak collective bargaining and marginal influence in industrial and social policies. These countries display very segmented labour markets in manufacturing industries, including automotive; with workers in large companies and public sector on the one hand, and those employed by smaller companies in the informal economy on the other. In addition to high levels of informal employment, long working hours limit implementation of the core ILO standards. Another key issue in relation to the role of the state is that workers in low-cost countries that supply the North American and European automotive multinationals earn much less than workers in developed countries. Moreover, general pay levels in those economies with a large automotive supplier base maintain the international division of labour. For instance, the share of minimum-wage earners is extremely high in Turkey compared to that in developed countries such as Germany (ILO 2021; see Chapter 5); in this way, small and medium-size enterprises help large OEMs and first-tier automotive multinationals cut costs effectively and maximise their profits. Regarding the organisation of the global automotive industry, the ILO (2020: 42) underlines 'cutthroat wage competition' in vehicle manufacturing in developing countries. Thus, the global union federations draw attention to varying levels of pay and informal employment conditions in global automotive production networks.

The state, in the case of Germany, also plays a crucial role for the automotive industry. Industrial relations in the German context have witnessed decreasing coverage of collective agreements between trade unions and employer associations, as well as a diminishing role of local works councils in participation and consultation with their management. This forces automotive workers to accept variegated workplace-regimes. On the grounds of increasing competition in the industry, and to avoid plant closures, automotive companies in Germany tend to create plant-level deviations from the coverage of collective agreements (Hassel

1999: 499). This means that some workers in the same plant work under lower pay, standards and conditions, or that the workers at multiple sites of an OEM do not enjoy same terms and conditions. Moreover, small- and medium-size enterprises, an important part of the German automotive industry, generally opt out of membership of employer associations, which means that the coverage of collective agreements does not reach their employees (Hassel 1999, 2002; Doellgast and Greer 2007).

The increasing share of agency workers with part-time/temporary jobs within the German automotive workforce has been made possible through changes to labour market regulations (Benassi 2017; Doellgast and Greer 2007: 60). On the one hand, Artus (2013) highlights that one consequence of this is low levels of access to co-determination processes at works councils by part-time or temporary workers. Greer (2008) analyses a similar trend at large OEMs' plants and their first-tier multinational suppliers. On the other hand, Eichhorst and Kenzia (2016) argue that the workforce of German manufacturing industries was always fragmented, with unionised workers with long-term contracts as the core of workforce and others without union membership under short- and fixed-term contracts with less pay and unskilled jobs. These trends can have important implications for the just transition demands of autoworkers in the shift to EVs. Dorigatti (2017) argues that trade unions can and do try to negotiate not only on behalf of the core workforce, but also for other types of employment with a lack of union membership. Yet, it is an open question to what extent trade unions, despite decreases in membership, can take part in establishing good conditions for new jobs or restructuring vehicle factories during the proliferation of EV manufacturing. This shift has also various ecological and global labour aspects, which I discuss next.

With direct relevance to the state, the automotive industry generates taxes, revenues and employment. It supports other economic activities due to vehicle manufacturing's links to key industries such as agriculture (cotton, leather, rubber), mining and resource extraction (steel, iron ore, copper, fossil fuels, minerals), manufacturing (various electronic and mechanic components) and services (financing, retailing, servicing and recycling of vehicles). Just as the automotive industry itself, most of these related industries are organised today in complex global production networks with various forms of employment relations, pay and working conditions. In addition to global labour, maintenance and running of vehicles with fossil fuels creates pressures on the environment as the expansion of the world vehicle fleet indirectly

gives rise to further greenhouse gas emissions and pollution: metals, glass, rubber, plastic and road construction are all mostly based on natural resource extraction. Moreover, high levels of dependence on extraction of natural resources in vehicle manufacturing lead to increasing biodiversity loss. Thus, the transformation of the automotive industry is crucial to the environment in its transition to a low-carbon economy. The increased resource use with EVs and additional burden on the environment for resource extraction, mining, chemical processing and recycling in battery production put pressure on the environment in China, the DRC, Chile or Indonesia.

3.3 Developing a Framework for the Shift to EVs: Analytical Levels and Conceptual Tools

This section shows how and why I bring together conceptual tools and analytic frameworks from the different academic fields discussed so far, to inform my synthetic framework of five just transition parameters to be applied to the shift to EVs. Chapters 6, 7 and 8 use this JTP framework to analyse historically and contemporarily the German and global automotive industries at micro, meso and macro scales. The three main sets of literature, the GVC/GPN framework, labour regime analysis and historical materialist approach to capitalist energy transitions, inform my application of JTP framework in assessing how justly the transition to EVs unfolds.

3.3.1 The micro scale of the firm and the labour process

Two sets of phenomena are identified as being of primary significance at the micro-scale firm strategy in labour process and agency in the workplace. To understand the dynamism and relationality of firm strategy in the transition from ICE to EVs, this section first draws on the prism of sustainable supply chain management (SSCM) to understand how a firm makes internal decisions in relation to innovation and supply chain in the context of the shift to EVs. I then turn to labour process theory to investigate how the impact of EVs can be conceptualised at the micro scale in relation to changes to labour process in vehicle manufacturing.

At the micro scale, SSCM is useful in conceptualising how automotive companies coordinate their businesses and their suppliers in order to increase profits *while* claiming that they improve environmental sustainability of their products or services. From the SSCM prism, we can identify two corporate strategies at play by automotive companies in the shit to EVs. First,

EVs can be regarded as a move to differentiate products in the vehicle markets, which had achieved saturation by the early 21st century in North America, Europe and Japan (Maxton and Wormald 2004: 4-5).[26] As the automotive industry is standardised with high sunk costs (Clark and Wrigley 1995), new products such as EVs are a way to restart the product cycle and capital accumulation. This can yield profits from innovation (Henderson and Clark 1990) or first mover advantage (Baumol 2002). This firm-centric approach to the analysis of innovation and new product development sees the niche products as an opportunity to provide a basis for premium prices. With this line of thought, EVs can help value and rents accrue to leading firms in the automotive industry, i.e. large OEMs and multinational component suppliers.

Second, EVs can also be conceptualised as a strategy to ensure better (more 'agile') supply chain management. The framework of supply chain management addresses how firms can cut costs with reduced inventories and just-in-time production, and undertake environmental improvements in products and services to achieve higher customer value, differentiating them from their competitors (Fawcett et al. 2007; Mentzer et al 2001). The argument is that supply chains should plan and coordinate the flow of materials from source to end users so that they meet customers' demands, as quickly as possible (just-in-time) and at higher levels of service with lower costs (Christopher 2011: 9; Fawcett et al. 2007: 8). To do so, firms are required to keep their core business activities and outsource others based on transaction cost economics (Williamson 2008: 14). This includes lead firms' strategies to change and update their products, to outsource some parts and components to cut costs, and to create/meet demand for new products or services (Touboulic and Walker 2016). What is then essential for sustainability in this mainstream approach to business strategy is an ability to coordinate and encourage existing or new suppliers to adapt to the change and help lead firms innovate accordingly. It is concerned with cost reduction, better customer experience and increased profits for the lead firm, (Faruk et al. 2002; Seuring and Müller 2008) by following seemingly environmental improvements that actually shift risks to suppliers, the environment and workers.

[26] Motorisation rates in these regions are very high compared to other regions in the world. It reaches above 800 vehicles per 1000 inhabitants in the USA, while the world average is less than 200 vehicles per 1000 inhabitants (OICA n.d.).

Thus, despite providing some insights, SSCM is insufficient as a single framework to analyse the multidimensionality of any just transition. Informed by a lead-firm-centric approach to innovation (Baumol 2002; Henderson and Clark 1990), SSCM is mainly concerned with cost reduction, inventory elimination, supplier performance control, increased profits and the welfare of consumers, and overlooks the socioeconomic relations at macro and meso levels, and intra-firm relations and changes to the labour process at the micro level. Most obviously, in addition to the lack of any sensitivity to social dimensions, SSCM has a very narrow understanding of the environment. The triple bottom line (profits, planet and people) (Elkington 1998) — which informs SSCM — posits that environmental sustainability improvements not only increase profits and render the firms competitive, but also take people and planet into consideration. The 'people' dimension of the concept of triple bottom line does not account for workers, either those in industrialised countries where the environmental sustainability discourse is being mainstreamed or those in developing and least developed countries as parts of global production networks, where workers in labour-intensive sectors face conditions that are actually environmentally degrading in order to contribute to lead firms' efforts to cheapen goods and services consumed in developed countries (Kiely 2008). The 'planet' dimension of the triple bottom line concept fails to address increasing pressures on the environment via raw material extraction and processing at the outer nodes of the global automotive industry.

Therefore, to overcome the micro scale firm-centrism of SSCM, this thesis draws on the labour process theory to bring in a labour-centric analysis of the workplace in the shift to EVs. Labour process theory clarifies how management aims to deskill the workforce and codify knowledge into technical manuals and machinery. This gives engineers and management better control on the indeterminate nature of the labour process, where workers exhibit agency threatening management's attempts to ensure labour discipline and control in the organisation of production (Braverman 1974). By dropping some tasks and creating others in vehicle manufacturing, the transition from ICE vehicles to EVs changes conditions of labour control and disciplining strategies of management, including automation and the use of robots in factories, as well as workforce segmentation in labour markets. The shift to EVs changes skill levels and the number of people required in the vehicle manufacturing. As part of worker demands for a just transition to EVs, retraining and reskilling of the workforce can be crucial

in the organisation of EV production and restructuring of the global automotive industry. This is explained in detail in Chapters 5 and 7, based on the differences of material characteristics between the two types of products. The trajectory for workers affected by the changing skill sets for EVs depends upon availability of public funds and investments for new jobs and training schemes.

Both the global and German automotive industries operate highly automated and robotised plants, and use fixed-term, temporary and/or part-time workers at assembly plants of large OEMs depending on the fluctuating demands of vehicle markets. This is made possible by the state through labour market regulations. Management's enhanced control over vehicle production processes, however, does not fully exclude skill requirements and labour. Directing these complex machines and robots at factories of large OEMs gives parts of the workforce (the core, unionised and skilled workers) leverage over management. Differently from capital investment and machinery deployed in restructured vehicle plants for EVs, workers play a vital role. This is because labour is not like any other input in the production process; it is in fact a pseudo-commodity (Storper and Walker 1985). Workers have agency to influence workplace relations and decisions around investments and organisation of production. Moreover, their social reproduction is tied to outside of the workplace and this has a bearing on their workplace interactions. As Massey (1984) argues, industrial restructuring is driven by both the current socioeconomic structure and the history and goals of the actors involved. As a result, workers' needs and demands at the local scale can be divergent in an industry (even within the same factory), especially in the case of the German automotive industry where workforce segmentation has been increasingly an important foundation of the industry's competitiveness (Eichhorst and Kendzia 2016). These factors are associated with wider politics of production rather than confined to the individual workplace.

Thus, a broader view of industrial restructuring and sustainability transitions is necessary. As Newsome et al. (2015) argue, the labour process theory does not fully consider the wider socioeconomic structures outside the workplace. In a critique of Braverman's (1974) labour process theory, Burawoy (1985) introduced various ways that institutions and the state help companies achieve better consent from the workforce through the politics of production. In addition to their exploitation in the interest of capital accumulation, this regulatory involvement of the state can create various levels of oppressive or progressive workplace

regimes, leading to a variety of conditions for workers and their unions to cope with (Baglioni et al. 2022a: 5). More important with regard to the shift to EVs is that the characteristics of the new product lead to a narrower supplier base, which in turn affects the small- and medium-size companies that are controlled by, and dependent on, large OEMs and multinational automotive component producers, and therefore cannot afford to be excluded in an updated supplier network. Equally important is the issue of raw materials, minerals and natural resources used in EVs. As elaborated in Chapter 5, this leads major OEMs to seek ways to secure medium- to long-term supply arrangements upstream with their new global supply networks. I turn to these two scales in the next two sections, starting with the meso scale below.

3.3.2 The meso scale of competition and power relations

At the meso level, the GVC (global value chain)/GPN (global production network) framework (Bair 2009; Coe et al. 2008; Gereffi et al. 2001; Gereffi et al. 2005; Gibbon et al. 2008; Henderson et al. 2002; Ponte et al. 2019) maps and explains inter-firm competition and power relations in the automotive industry. Distinct from the lead-firm-centric problem-solving focus of the SSCM approach and from labour process theory, which focuses on individual workplace relations, the GVC/GPN framework has four strengths for my analysis of EV production.

First, this framework focuses on environmental upgrading as a competitive strategy in network governance, which emanates from and is shaped by inter-firm power relations within a production network (Ponte 2019). What is distinctive here is that power asymmetries among firms, as well as institutional and collective actors, are key to determining winners and losers in uneven capitalist economic development (Henderson et al. 2002: 450-451) and to understanding the importance of market power (Levy 2008: 945). Vertical, horizontal and diagonal conflicts and cooperation inside a network determine outcomes for conditions of social and economic development, and environmental standards. Especially in light of the labour-focused GPN literature, conflict and cooperation do not just occur between the lead firm and their suppliers, all of which may be parts of other networks, but also within the firm, between the capital, management, shareholders and labour (Coe and Jordhus-Lier 2011; Cumbers et al. 2008).

As part of network governance mechanisms, Ponte (2019) elaborates on how lead firms in various industries make use of environmental standards by using corporate strategies to shift risks to suppliers. Bolwig et al. (2010) show how supplier control and coordination can affect the environment in increased commodity production and greenhouse gas emissions. To dilute environmental standards and turn them into a market expansion strategy (Jaffee and Howard 2010), large multinationals lobby the state at various jurisdictions to secure their interests in environmental regulation (Dauvergne and Lister 2013; Havice and Campling 2017). Thus, chain governance mechanisms analysed by the GVC/GPN framework enable a better understanding of how and why OEMs seek to influence allocation of resources and distribution of rents. This is also important because changing corporate ownership, mergers and acquisitions, and future investments in the automotive industry can set new industry-level standards (Bollhorn and Franz 2016; Dauvergne 2008). More importantly, by introducing and revising environmental thresholds or corporate codes of conduct, lead firms can enforce their dominant positions and create strategies around the appropriation of value and distribution of costs and risks through environmental improvements, whether real or symbolic (Havice and Campling 2017).

Second, distinct from SSCM approach, the GVC/GPN framework attaches a key role to the state at various scales. Enhancement of value by labour, technology, knowledge and skills and their capture by different forms of governance mechanisms, which are set by local, national and international norms and regulations, show the relevance of the state (Henderson et al. 2002: 449). Using a variety of tools, such as fiscal, industrial, commercial, environmental and social policies, states support capital accumulation (Coe et al. 2007; Horner 2017; Smith 2015). The GVC/GPN framework highlights the role of the state in making sure that capital accumulation continues in major industries, including vehicle manufacturing, in its jurisdictions. This applies to EVs too, given the calls from both capital and labour to regulate, subsidise and invest in EV charging stations and to make sure research and development in base metals, batteries, and lightweight material maintains international competitiveness in the automotive industry (see Chapter 7). Additionally, across global production networks, there are a great variety of labour-market regulations and institutional frameworks that shape workers' organisational opportunities, and the ways in which workers are hired, fired and

controlled (Taylor 2007). This is important when exploring EVs' role in just transition to a low-carbon economy in the face of job losses and new tasks in vehicle manufacturing.

Third, contrary to the lead-firm-centric SSCM approach and the workplace-focused labour process theory, the GVC/GPN framework can consider just transition demands in a restructured industry via its concepts of 'embeddedness', 'social upgrading' and 'economic upgrading', which are used to analyse uneven economic development in global production networks. While network embeddedness concerns regional and locational dynamics in the concentration or dispersal of industrial structures; territorial embeddedness refers to how local socioeconomic characteristics influence the location and functioning of supply chains(Henderson et al. 2002; Levy 2008). In other words, the positions of large OEMs and suppliers do not solely depend on firm-specific capabilities and resources. The concept of embeddedness can be used to examine how the dominant automotive companies are affected by various local socioeconomic characteristics (Pavlinek 2015). Firms and their workforce can alter power relations and the architecture of geographically-dispersed production networks (Selwyn 2012); this highlights that GVCs/GPNs are contested economic and political organizational fields where actors try to realise their interests in the construction of relationships (Levy 2008: 944).

Economic upgrading refers to capturing higher levels of profits and rents in a supply chain via several strategies.[27] Social upgrading is connected to whether, and if so how, rents and profits are distributed among stakeholders, including workers. Economic upgrading mechanisms do not always result in social upgrading with improved rights and entitlements of the workers involved in the production networks (Barrientos et al. 2011). The question around upgrading in the case of the shift to EVs is profoundly concerned with the outer nodes of global automotive production networks, where resource extraction and material mining takes place. It is also linked to other nodes such as component and battery manufacturing with more sophisticated industrial capital and investment, where chemical processing occurs with significant working and environmental outcomes. The extent to which EVs lead to a just transition to a low-carbon economy will depend on both environmental and social upgrading

[27] Process upgrading (more efficient technology), product upgrading (more sophisticated products), functional upgrading (activities with more value added), and chain or inter-sectoral upgrading (moving into chains/sectors) (Coe and Yeung 2015: 12).

potentials in global automotive industry networks. This issue is reflected in the GVC/GPN framework by emphasising the agency and power of workers.

Thus, the fourth strength of the GVC/GPN framework is its attempt to approach workers as both objects and subjects in the configuration and restructuring of supply chains. Some research using this framework looks at the ways in which workers or trade unions seek to actively shape their production networks around their own agenda (Anner 2015; Coe and Jordus-Lier 2011; Cumbers et al. 2008; Werner and Bair 2019). This is useful to understand just transition demands of workers, as well as attempts by the GUFs to push international environmental negotiations towards acknowledging the concept of just transition (ITUC 2012; ILO 2015; UNEP 2008; UNFCC 2015). Against anti-union strategies of multinational companies in both developed and developing countries, IndustriALL, the GUF in manufacturing industries including the automotive sector, aims to contribute to the voice of workers in decarbonisation efforts (Conchon and Triangle 2017), which, as we saw see in Chapter 2, is in turn shaped by organised labour from developed countries including the German trade unions. At the same time, however, unorganised workers play an important role in the automotive industry, which benefits from distinct labour market regulations on the use of temporary and part-time workers. Large OEMs and their close tier multinational suppliers also operate in labour markets with large shares of informal employment relations. These issues and the impacts of the shift to EVs on the global political economy require us to look at the macro scale of socioeconomic and ecological transformations, which I turn to in the next section.

3.3.3 The macro scale of socioeconomic and ecological transformations

At the macro scale of analysis, the labour regime analysis with its focus on the exploitation of global labour and the environment is crucial to understanding any sustainability and energy transition in the world economy, especially the one under investigation here, with EVs having dramatic implications for increased resource extraction, chemical processing and infrastructural investments. Chapters 7 and 8 on how and for whom the just transition to EVs unfolds in the German and global automotive industries, respectively, elaborate arguments put forward below.

Change in the production process of a major industrial product like vehicles and their components is a dynamic process. Studying the changes that the automotive industry is undergoing with EVs and matching this with the idea of a just transition requires a detailed

analysis of both the current structure of the industry and investment plans, as well as how the two are shaped and by whom. Social conflicts arise from firms' relocation strategies, investment plans in new technologies and consequent employment effects such as unemployment or the worsening of working conditions (e.g. casualisation). The urgent challenge of decreasing the number of semiskilled and skilled trades due to EVs (see Chapters 5 and 7) is especially important for the local workforce in Germany, as well as the workforce in the parts- and material-supplying locations. This brings management and union officials together to decide which plant is to produce what parts of EVs. However, as argued in this thesis, a nationally focused approach to just transition is limited in producing insights on impacts on the world economy.

Ultimately, a dialogue between the GVC/GPN framework focusing on the roles of labour and the state in a supply chain, and the labour regime analysis linking uneven development in, and ecological problems of, global capitalism to multi-scalar systems of economic integration across workplaces with various labour process struggles, allows for the reconciliation of the tensions around just transition with EVs in the global automotive industry. The GVC/GPN framework clarifies power relations among different firms, actors, institutions and states, and detects how outcomes of these interrelationships support or hinder local, regional and national development. It is a useful methodological tool to map out various nodes of the automotive industry. However, it does not allow us to understand how and why those relationships are present, in any time and space, as parts of the uneven capitalist development. Whether just or not, transitions are phenomena that are changing at present (see Chapter 4), and require an understanding of the dynamics of change. To overcome this and bring together the micro and the meso levels of my conceptual framework, I use the insights from labour regime analysis.

Labour regime analysis allows me to grasp the relations between different workplace regimes that are in competition or cooperation, to capture value during the shift to EVs, and ways in which those relations shape and are shaped by labour and capital. Labour regime analysis examines social relations and institutions that bind capital and labour in relative stability, and sees exploitation of labour and nature at the heart of the relationship (Baglioni et al. 2022). It offers tools to understand how and why changes to those relationships occur, both at the local and the workplace scale (Braverman 1974) and in the wider social relations of production

(Burawoy 1985). With multi-scalar, relational and ecological lenses of labour regime analysis, I believe we can bring together the various struggles and tensions around the exploitation of labour and nature in the shift to EVs. In other words, this framework allows the conceptualisation of social, political *and* ecological implications of the proliferation of EV manufacturing. This informs my JTPs 4 and 5 detailed below.

However, this dialogue between the GVC/GPN framework and labour regime analysis falls short in thinking about what happens to the structures and power relations in the global economy *with* and *after* the transition. Therefore, I use the historical materialist approach to capitalist energy transitions (Malm 2016; Mitchell 2011) to ask questions around how renewable energy transition, of which EVs are one part, change and/or articulate with existing structures and power relations seen in various supply chains under differentiated labour regimes. Malm (2013, 2016) and Mitchell (2009, 2011) show that changing labour-capital relations with major energy transitions in the history of industrial capitalist society influences power relations around resource extraction and its transport infrastructures. Malm (2016) explains how the shift from mills powered by animate power and human labour, to steam engines powered by fossil fuels helped create a different organisation of production. This transition facilitated large-scale industrial organisation with a different set of labour and skills required for its functioning, as well as new transport infrastructure with new rail and shipping technologies. Similarly, Mitchell (2011) shows that the introduction of oil to the fossil energy regime helped Western capitalist societies to ease class struggles around coal as the main energy source, where the conditions of coal mining and its transportation raised workers social and political power. In contrast to coal, oil did not require such labour-intensive rail and port networks, and helped introduce highly capital-intensive extraction and transportation techniques (Malm 2016: 356), and thus externalised the social and environmental costs to highly undemocratic and repressive societies where hydrocarbons are extracted (Mitchell 2011). Despite the obvious question about whether EVs will be charged by renewables or fossil fuel-based power stations, the historical materialist approach to capitalist energy transitions helps us to think about how phasing out fossil fuel technologies such as ICE and its related infrastructures, will shape capital-labour relations in global economy.

The five JTPs that I use in my analysis of the shift to EVs cover the conceptual tools discussed above. Different labour, non-governmental, and governmental organisations, in creating

policy proposals for fossil fuel industry transitions in developed and developing countries, use the first three of these parameters in separate cases. I add the last two parameters to combine the GVC/GPN framework, labour regime analysis and historical materialist approach to capitalist energy transitions in my examination of how justly, and for whom, the EV transition unfolds.

3.4 Revisiting Just Transition Parameters

The core objective of this thesis is to investigate the shift to EVs in the German automotive industry, with its winners and losers, and the extent to which the proliferation of EV manufacturing matches the idea of 'just transition' to a low-carbon economy. The research therefore aims to explore this current development as it unfolds in Germany, while also scrutinising and deconstructing the very notions driving it, i.e. sustainable development and just transition. In this section, I devise a set of just transition parameters (JTPs) to investigate the history and current architecture of the German automotive industry, and the role of the state in this; to examine the impact of EVs on workers employed in global automotive production networks in particular and on the environment in general; and lastly to explore how 'justly' the transition is unravelling, by whom and for whom. Chapters 5, 6, 7 and 8 historicise, elaborate and apply the five JTPs to the German and global automotive industries. As I introduce in the previous chapter and also explain in the next chapter on methodology, in deciding on the use of JTPs, I reviewed technical reports on the differences between EVs and traditional vehicles with ICE, and policy reports of national and international trade unions on the concept of just transition. I also used the GVC/GPN framework as a methodological tool to trace global automotive production networks, and labour regime analysis to devise the five JTPs.

The JTPs used in this thesis consist of two sets of parameters. The first group includes JTP1, JTP2 and JTP3. JTP1 is protection of workers and their communities during sustainability and energy transitions due to new environmental regulations and/or technological and industrial restructuring, which I draw from actual historical and contemporary claims by labour organisations in developed countries. If applied to a specific factory or workplace, JTP1 brings in the micro scale of the firm and the labour process. In addition to that, meeting JTP1 in a regional or national industrial restructuring scheme should be studied at the meso scale, with

implications on competition and power relations among enterprises. However, even if some regionally specific coal phase-out plans, such as Germany's, can be considered as such, meeting JTP1 in a location generally affects other workers and labour regimes, which necessitates the macro scale of analysis on global production networks operating under distinct labour regimes and impacting on broader socio-ecological power relations (see Chapters 2, 5 and 8).

JTP2 is the inclusion of workers in decision-making processes during ongoing transitions. While trade unions have historically struggled to claim this as part of their ontological objectives, at least at the micro-level of the workplace and at the meso-level of an industry, expanding JTP2 to the macro scale to address national and international implications of the configuration of production networks is a new phenomenon, which just transition demands in Germany *can* make possible. German institutional arrangements such as transformation committees at city, regional or state agencies, industry-wide policy initiatives about EV technologies' employment impacts, and federal level parliamentary ad hoc committees are potentially key platforms where JTP2 needs to be met for a just transition (see Chapters 1 and 7).

The third parameter is also part of the roles and objectives of trade unions in industrial relations and national political economy. JTP3 requires support from the state and their employers on workers' retraining and reskilling programmes, to adjust workers' skills during industrial restructuring and/or channel workers to new trades. This matters particularly in relation to the shift to EVs in the face of changes to labour process and production network reconfiguration. JTP3 is informed not only by the literature reviews of technical and policy reports on either EVs or just transition, but also by the GVC/GPN framework, with its emphasis on the role of network and territorial embeddedness in uneven capitalist development. This can refer to labour via developing skills, knowledge and human capital, to capital via supporting industry clusters and small- and medium-sized enterprises, and to the state via providing funds for education, investing in research and infrastructure, and regulating labour markets.

Being very tangible and specific, and promoted institutionally by national and international labour organisations and by some of the international climate change policy documents (see Chapter 2), the first three JTPs cover important themes in my analysis on the extent to which,

how and for whom the shift to EVs matches the concept of just transition to a low-carbon economy. However, in practice, they fall short in accounting for the other aspects of sustainability and energy transitions that have implications beyond a specific workplace, region, sector or national political economy. Section 3.3 explained the reasons behind this, with insights from labour regime analysis and the historical materialist approach to capitalist socioeconomic transformations. By broadening my analysis with the second set of JTPs, I aim to solve this methodologically- and conceptually-limited scope of the first three JTPs.

The remaining two JTPs are JTP4, global labour, and JTP5, the environment. In addition to being informed by the use of the GVC/GPN framework as a methodological tool and by the central role in labour regime analysis of the exploitation of nature and labour for uneven capitalist economic development, JTP4, on global labour, stems from my preliminary data, too. The common fear in the German automotive industry, first expressed in a semi-structured interview as 'avoiding becoming a second Detroit' (Interview with a regional economic policy institution), shows that addressing just transition demands in the German automotive industry requires a global outlook. This 'German' or 'local' fear refers to the fact that Detroit, once an automotive industry employment hub, has, since the 1980s, lost its manufacturing jobs, because final assembly, component and parts production shifted gradually abroad (Silver 2003; Sturgeon et al. 2008). As this influences other nodes and workers in the global automotive production networks, JTP4 covers a crucial part in my JTP analysis of the shift to EVs.

Finally, JTP5 is on the environment. This parameter is methodologically informed by reviews of technical reports on EVs and policy reports on the concept of just transition. The labour regime analysis and the historical materialist approach to capitalist energy transitions inform this parameter conceptually. JTP5 sets out to highlight ecological implications of EVs on resource extraction, material mining and chemical processing nodes of the global automotive production networks. The labour regime analysis' focus on ecology as one of the four major parts in the functioning of the world economy is empirically strengthened by my review of technical reports on EVs. Ecology is the sphere in which the environment is transformed into commodities by labour under capital dominance, whereas the sphere of production also consists of labour-capital struggles on exploitation. Encompassing both spheres, EVs enable further ways of transforming the environment into commodities and putting global labour to

work in new ways. The other two spheres analysed in the labour regime analysis, circulation and social reproduction are outside of the scope of this thesis. However, the thesis aims to contribute to labour regime analysis by posing questions about the role of EVs in the broader socioeconomic and ecological transformations, which is informed by the historical materialist approach to capitalist energy transitions.

3.5 Conclusion

The just transition agenda can be improved politically, conceptually and institutionally by linking specific decarbonisation and emission reduction policies, including EVs, to the unequal power relations and uneven capitalist development in the world economy. This is possible by considering the different interests and positionalities of the workers, states and companies that are organised through global production networks. These contested organisational fields maintain, update and reproduce existing power structures and environmental conditions in the world economy. To do this, I suggest using a synthesis of five just transition parameters. These JTPs are used separately by different labour, non-governmental, and governmental organisations in creating policy proposals for fossil fuel industry transitions in developed and developing countries (see Chapters 2 and 4).

Labour process theory at the micro scale, the GVC/GPN framework at the meso scale, and the labour regime analysis and historical materialist approach to capitalist energy transitions at the macro scale inform my conceptual approach to the analysis of EVs with respect to the just transition demands in the German automotive industry. Labour regime analysis brings the three scales together. With its insights on factory regimes at the intersection of the micro and meso scales, it informs my first set of my JTPs. JTP 4 is informed by linking regional and global uneven development at the intersections of the meso and macro scales. JTP5 is informed by emphasising the role of labour and ecology in shaping transitions. However, its understanding of the relationship between various labour regimes and major energy transitions as broader socio-ecological transformations can be improved by use of the historical materialist approach to capitalist energy transitions, because such transformations influence directly ways in which capitalist relations in the spheres of production and ecology pan out, notwithstanding impacts on the other two spheres of circulation and social reproduction that are excluded in the present work.

CHAPTER 4 METHODOLOGY

4.1 Introduction

I frame my research in general as part of the political economy approach to sustainability and energy transitions and argue that efforts to address the ecological problem posed by the existing business models, and production of goods and services, shape and are shaped by the social and environmental characteristics of the world economy. In this context, EVs do not 'simply' replace traditional cars. Technologies and management techniques used in the labour process in vehicle manufacturing, renewable energy storage and fossil fuel phase-out in transport, resource extraction, mining and chemical processing, investments in charging infrastructure, and economic and social policies facilitating large-scale EV deployment all come together in the context of the shift to EVs. I use the case study research design to examine this complex phenomenon, because studying the shift to EVs, and more importantly judging how justly it unfolds, requires a detailed analysis of the historical and existing structures in motion in complex global automotive production networks and impacts on the labour process in vehicle manufacturing.

This chapter explains the research design and methodology of the thesis in the analysis of the two unfolding phenomena in combination, with a focus on global labour and the environment. After briefly introducing the links between various dimensions of the concept of justice and my five Just Transition Parameters, Section 4.2 continues with the methodological implications of studying sustainability and energy transitions. It summarises what EVs mean for the current transition and how this influenced my research design and methodology; and lists the main reasons in choosing the German automotive industry in examining just transition in the context of EVs. Section 4.3 outlines my data collection strategies, aimed at analysing why just transition is important, how justly and for whom the shift to EVs is unfolding (Research Question 1). To understand how workers are positioned in the German automotive industry and the ways in which they have influenced decision-making processes (Research Question 2), I read about the history of German industrial relations and political economy. Understanding how these processes are shaped, by whom and for whom — the state, automotive companies and workers — is useful in order to analyse the shift to

EVs, which takes place within the institutional frameworks and power relations that are the historical outcomes of the nexus among these key actors.

To examine the implications of the proliferation of EV manufacturing on workers in the German automotive industry (Research Question 3), as well as on global labour and the environment (Research Question 4), I collected data using semi-structured interviews and reviews of academic literature, technical and policy documents. I made use of industry commissioned technical reports in German, industry magazines and news outlets in English and German, and held communications in Turkish with my personal contacts in Germany. I also participated in and observed automotive industry events about EVs and lithium-ion batteries, and attended academic and policy discussions around the concept of just transition. These additional research tactics were helpful for me in overcoming problems in accessing interviewees during my trips to Germany. At the end of Section 4.3, I discuss research ethics and positionality.

In Section 4.4, I explain how I analysed my data through the JTPs, which display a combination of insights from the review of just transition policy documents of labour organisations, the relevant academic literatures, and technical reports on the differences between ICE vehicles and EVs. As I explained in the previous chapter on my conceptual framework, I used the GVC/GPN framework as a methodological tool and combined it conceptually with labour regime analysis and the historical materialist approach to capitalist sustainability and energy transitions. The GVC/GPN framework helped me trace key actors and understand their relationships in the global and German automotive industry. Labour regime analysis and the historical materialist approach guided me in data analysis and operationalising my framework of the five just transition parameters (JTPs).

4.2 Research Design for Transition to EVs

This section summarises the key conceptual and analytic arguments around studying sustainability and energy transitions, and the reasons behind choosing the case study methodology in my analysis on how justly the shift to EVs in the German automotive industry is unfolding.

4.2.1 'Justice' in transitions

The following discussion is on the dimensions of justice drawn on by just transition policy reports and critical sustainability and energy transitions literature. It summarises the fundamental theoretical underpinnings of the concept of justice in relation to the five-just transition parameter framework used in the thesis for the analysis of the ongoing shift to EVs in the German automotive industry. Though not claiming to cover the vast literature on the theories of justice, this section presents the theoretical takes on justice linked to the protection, inclusion and retraining of auto workers as the important just transition demands, as well as the EVs' implications on global labour and the environment.

The concept of justice is central to thinking about how one would like to see how a society functions and might transition to a new form. Conceptions and expectations around justice set the basis of ethical, philosophical, social, economic and political views. The vast literature on the theories of justice in political theory and philosophy highlights various dimensions of justice as its key tenets. These are also reflected in critical sustainability and energy transitions literature. There are five main dimensions of justice used in this literature and policy documents about just transition – distribution, procedure, recognition, capabilities, and intergenerational (Bond 2012; Folke et al. 2021; McCauley and Heffron 2018; Ohlsson and Skillington 2023; Schlosberg 2007; Tremmel 2009; Velicu and Barca 2020). I briefly explain their positions and limitations in what follows.

Rawls (1999) defines justice as a 'standard whereby the *distributive* aspects of the basic structures of society are to be assessed', where the standards define the appropriate division of social, political and economic goods and bads (Schlosberg 2007: 12-13. Emphasis mine). Basing the analysis of justice and inequality on the idea of 'the veil of ignorance' assumed to occur in an impartial 'original position', Rawls (1999) presents two basic principles of justice. The first principle is that members of a society would agree on having the same basic political rights and liberties. According to the second principle, the distribution of economic and social inequalities should benefit everyone, including the least well-off, and should be attached to positions and offices open to all (Rawls 1999: 53). In other words, in an experimental original position that assumes a 'veil of ignorance' about their current status, members of a society without any given perspectives on and interests in the structure of the society, would choose the best justice system possible, in which even the least well-off are distributed with the basic

political rights and social goods. Inequalities are to be solved by addressing any divergence from such an abstract position by redistributive terms. This reasoning, however, does not problematise existing inequalities.

Young (1990) looks beyond how the distributional aspects of justice should be improved, and claims that one should consider the ways in which unjust distribution occurs in the first place. This dimension of justice is based on the idea that socioeconomic distributional patterns happen because of the lack of relevant *procedures* that result in domination and oppression (Young 1990 in Schlosberg 2007: 14). This claim does not reject the Rawlsian theory of justice – justice as fairness – but it argues that distributional injustice can be prevented through a new focus on *procedural* justice via relevant institutional mechanisms. Young (1990) asserts that, even though the Rawlsian theory of justice can think of models to improve distribution, it cannot fully address social, cultural, symbolic, and institutional patterns that cause inequalities without acknowledging the lack of justice procedures and institutions. Honneth (2001) elaborates on this and claims that processes that construct maldistribution lead to various forms of insults, degradation and devaluation, which should be dealt with by individual, cultural and social recognition.

Acknowledging that the distributional dimension is significant and integral to solving economic inequalities, Fraser (2001) argues that the underlying reasons for distributive and recognitive injustices lie in the context of the economic inequality. In this line of thought centred on the question of inequality, ensuring justice requires the combination of the two tenets of the concept of justice – *distribution and recognition*. That is to say that since the different groups or individuals are not recognised as crucial parts of a society by dominant groups, 'participatory parity' in politics and economics cannot take place (Schlosberg 2007: 16). Expanding on the political economy of inequalities due to the lack of just distribution and recognition, Fraser (2016) adds that the unsustainable capitalist relations between nature and labour are also linked to the unpaid exploitation of care work. Another major critique is that to prevent global socioeconomic and ecological inequalities in the context of transition to a low-carbon economy, the recognition dimension is not enough to end maldistribution in the world economy (Velicu and Barca 2020). This is because providing workers, as well as to other subaltern subjects, with the chance to be recognised in order to enable them to demand protection against inequalities, does not necessarily free them from the dichotomy of being

in or out of the wage relationship. That is to say, instead of accepting 'green' jobs as more just and less risky than maintaining the same economy and dirty jobs, workers, the unemployed and other subaltern groups who are subject to unequal power relations, should be able to demand alternatives outside the given employment/unemployment relations. An example could be demanding the racialised, patriarchal and militarised control of access to resources be removed and replaced with what subaltern subjects might want themselves to live in (Velicu and Barca 2020: 3, 9).

Based on the works of Amartya Sen and Martha Nussbaum (Sen 1985; Nussbaum and Sen 1992), Schlosberg (2007) adds *capabilities* as a fourth dimension of justice that is used in critical sustainability and energy transitions literature. The capabilities approach in the theory of justice problematises how various forms of distributional injustice affect our well-being and the ways in which various communities function. It asks, 'what is each person able to do and to be?' (Nussbaum 2011: 18). This body of work argues that the mainstream economic indicators such as GDP cannot measure the quality of life in different locations, especially in developing countries (Schlosberg 2007: 30). Akin to a list of human rights, Nussbaum (2011) provides a list of capabilities, ranging from life, health, emotions, imaginations, affiliation, to political and material environment, for which the state is to take the responsibility in ensuring necessary conditions. Even though received limited attention in critical and sustainability transitions literature (Holifield et al. 2018: 6), the capabilities dimension can help us to think about measuring the degree of development and inequalities in a society (Day 2018: 124).

The fifth dimension of justice – *intergenerational* – adds temporality to the distribution dimension. Tremmel (2009) and Folke et al. (2021) argue that the contemporary use of resources of the planet is able to throw the global ecosystems off balance. Based on the idea of mainstream sustainable development that environmental policies should also consider future generations' ability to meet their needs (WCED 1987), intergenerational justice has become a significant concern for science, policy and research communities (Ohlsson and Skillington 2023; Thompson 2009; Weiss 2021). The recently growing attention to the concept of Anthropocene refers to the irreversible impacts of human species on planetary ecosystems such as biosphere. Even though Anthropocene is often used in the context of inter-species justice (Biermann et al. 2016; Steffen et al. 2011) and thus criticised for its silence on power and spatial responsibility (Hornborg 2009; Malm and Hornborg 2014), it might shows that the

future generations of the human species are at risk. The interest in intergenerational justice under the UN system of environmental and emission reduction negotiations is supported by IPCC reports, which show that the timing and speed of climate change mitigation and adaptation policies a crucial part in solving the ecological problems. However, what intergenerational justice really means and how it will be asserted has not been answered so far clearly (Ohlsson and Skillington 2023). Agyeman et al. (2003) warn that the focus on intergenerational justice should not prevent policy makers from dealing with the current intra-generational justice. Similarly, based on the concept of unequal ecological exchange that problematises the exploitation of labour and nature in the Global South by industrialisation in the Global North (Emmanuel 1972), scholars suggest that the implications of industrialisation in developed countries on developing countries be accounted for (Brand and Wissen 2013; Hornborg 1998, 2011).

I think that all five dimensions in the theory of justice are, in various ways and to different degrees, linked to central arguments in the just transition literature and associated policies advocated by labour organisations. By drawing attention to the need to protect existing workers and their communities against environmental harms and unemployment during industrial restructuring in relation to new environmental regulations and new technologies, products and services, the just transition demands of workers since the 1970s have been drawing on the idea of *distributional* justice (Dewey 1998; Räthzel and Uzzell 2013; Rosemberg 2020; Silverman 2006; Stevis 2002; Weller 2018; Young 1998). The just transition policies advanced by labour organisations tend to approach sustainability and energy transitions (including emissions reductions in energy industry or EVs in automotive industry) by warning against unjust distributional impacts. The argument goes that workers employed in these fossil fuel-based industries and their communities should not be left alone in dealing with transitional challenges, and be supported by government and corporate policies. This argument is reflected in my first parameter – JTP1 protection. The third JTP can be associated to the distributional and capabilities aspects of justice, since it highlights that impacted workers and communities need access to funds for retraining, where policy mechanisms help them to adjust to changing conditions and to be able to sustain their livelihoods.

My second JTP, the inclusion of impacted workers in decision-making mechanisms, combines different dimensions of justice, too. JTP2 reminds us that workers should enjoy effective

procedural and recognitional dimensions of justice, and to achieve a better foothold in ongoing industrial and sectoral negotiations which are subject to uneven power relations and path-dependent institutional mechanisms. In terms of the procedural dimension, autoworkers request sufficient levels of involvement in the EV related investment, restructuring and employment policies, along with corporate management and government representatives. The recognition dimension calls attention to the ways in which decisions are made, as well as the capabilities reconstructed, depending on the positions of social groups vis-à-vis the shift to the new phase of the industry. This is to be applied to the positions of both autoworkers in Germany and other parts of global labour employed in automotive parts producing locations, as well as natural the resource extraction and chemical processing nodes of the emerging EV production networks. The capabilities dimension also supports the idea of accounting for various parts of global labour and impacts on the environment in the transition. In other words, the last two JTPs, global labour and the environment, combine various dimensions of justice to call for a wider outlook for just transition policies in the shift to EVs.

As explained in detail in Section 2.3, the concept of just transition builds on insights from three research strands in the critical sustainability and energy transitions literature (Swennenhuis et al. 2022: 7-8), which use different dimensions of justice (McCauley and Heffron 2018; Stevis 2023; Doorey 2015). First, environmental justice highlights distribution, procedural and recognition dimensions in its focus on disproportionate experiences of people of colour and the poor in different geographies. Using insights of the capabilities dimension of justice helps environmental justice strand be applied to the world economy as a whole. Second, labour justice began in the late 1970s and the early 1980s by pointing out to the distribution and procedural dimensions of justice to warn against regional unemployment and deindustrialisation in impacted communities. With the development of the concept of just transition over time and it's alignment with environmental and climate/energy justice strands, labour justice refers now to the recognition and capabilities dimensions. Third, with its focus on developing countries' needs for cheap energy as an essential human right and a tool for economic development, the climate/energy justice encompasses recognition and capabilities dimensions. The third strand also uses procedural dimension in studying policy

making around public and private investments in renewable energy technologies in developed countries.

In addition to these combinations of different justice dimensions, critical sustainability and energy transitions literature recently draws attention to other principles to be advocated in the UN system of environmental governance. Some examples in this context include the principles of Common But Differentiated Responsibility and accounting for historical emissions in capitalist industrialisations (Pulido 2018; Gunnarsson-Oestling and Svenfelt 2018; Malm and Hornborg 2014), or non-human species justice (Bal et al. 2023; Eckersley 2004; Sunstein and Nussbaum 2004). Rather than covering all dimensions of justice studied in the critical sustainability and energy transitions literature, my research design aims to develop a relatively stable set of parameters to be able to examine an emerging and dynamic phenomenon, proliferation of EV manufacturing in the context of transitions, to the methodological and conceptual challenges and implications of which the following section turns to.

4.2.2 Studying transitions

Recent announcements by governments for banning registration of traditional vehicles are justified by an urgent need to take action in achieving lower carbon emissions. Sustainability and energy transitions are lengthy socioeconomic and ecological phenomena. It takes different periods of time for particular sectors in the economy to implement new technologies, products and services (Fouquet 2010; Fouquet and Pearson 2012; Smil 1994, 2003). Even though the multi-level perspective in socio-technical transitions highlights the role of technological innovations in non-linear interrelationships impacting technological regimes influenced by facilitating/slowing/boundary drawing landscapes (Geels 2002, 2005, 2011; Geels and Schot 2007), energy and sustainability transitions are part of wider historical, socioeconomic and ecological phenomena (Boyer 2011; Clark and Yusoff 2014; Malm 2016). Recognising sustainability and energy transitions as parts of dynamic power relations, rather than changes to inputs in production, technology, product development, innovation or management techniques, provides greater explanatory power (Huber 2008). In line with the insights of the historical materialist approach to capitalist energy transitions, the shift to EVs influences and is shaped by the power relations and infrastructures of capitalist economic development in the world economy. Thus, studying the current transition to EVs should

include the understanding of the material characteristics of EVs and power relations in the automotive industry, the profound importance of vehicle manufacturing in the history of capitalist industrial development, as well as EVs' link to broader ecological systems of the world economy. In other words, the shift from the internal combustion engine (ICE) to the EV is not just a change to the production process of a major and very complex industrial product (see Chapter 5), the automobile and its components, but it is a dynamic process with broader socio-economic and ecological implications.

To begin with, a major part of the global industrial workforce, especially in Germany, is employed in jobs related to this industry, some of which are unionised. Therefore, demands for a just transition at national and international levels are expressed by autoworkers. As I discuss in detail in Chapter 2, the ongoing shift to EVs brings about not only micro-level changes to technology and management techniques, but also meso-level corporate strategies and industry embeddedness, and macro-level socioeconomic power relations. It affects workers at various scales employed by large carmakers (OEMs), their close and outer-tier suppliers; and it brings in the state and various institutions. The role of the state is decisive for driving or shaping energy and major industrial transitions, as it is for the functioning of markets and the economy (Horner 2017; Smith 2015). Moreover, workers at different locations, or different workers within the same firm, could perceive the transition in different ways (Castree et al. 2004), because the regulation and functioning of labour markets are locally specific, and organisation and control of production processes are locally embedded (Henderson et al 2002).

The roles of labour, capital and the state in the German automotive industry shape, and are shaped by, global automotive industry dynamics impacting various labour regimes across geographically scattered and structurally complex global production networks. Workers and labour organisations in the home countries of large OEMs and their close-tier multinational automotive suppliers negotiate the shift with their management, while their employers profit from differentiated working conditions and environmental standards by sourcing raw materials and automotive parts from around the world (see Chapter 5). An understanding of the workers' social and political power at outer tiers of EV production networks, as well as restructured plants in OEMs' headquarters, is vital for a full understanding of just transition to EVs. More important for my research design is, as Malm (2016) and Mitchell (2011) show,

that labour-capital relations play a major role in capitalist energy transitions shaping social, industrial and energy infrastructures throughout the history of capitalism. My identification of historical turning points, in the automotive industry in Chapter 5 in general and in Chapter 6 in Germany in particular, is central to understanding the ways in which the roles of states, companies and workers have played out and with which consequences (e.g. winners and losers).

4.2.3 Research design: Using case studies

A research design is a framework for collecting and analysing data in answering certain research questions (Bryman and Bell 2019: 27). Specific demands of the research questions determine the suitability of a particular method or research design (Bryman 1988: 106). Despite the openness of the concept of just transition to interpretations (see Chapter 4), my specific research questions around how justly the transition to EVs occurs also underlines the need for such a detailed inquiry. The material characteristics of the EVs and batteries under investigation, with various possible chemistries, as well as the complexity of the global automotive industry networks as contested organisational and institutional fields, contribute to the need for a detailed case study that seeks qualitative data. Qualitative data can provide a view of social reality as a dynamic and emergent property of actors' agencies (Bryman and Bell 2019: 16).

The case study methodology can better examine such a complex phenomenon, because, as Simons (2009) argues, it can shed light on multiple perspectives and contested viewpoints of actors and interactions among them. A case study is 'an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident' (Yin 2003: 13), which can trace this process with multi-layered power relations. Collecting in-depth qualitative data that is unique to time and place is one of the characteristics of the case study method (Bryman and Bell 2019: 44). Another advantage of the case study methodology is that it allows for attempts at theory building (Rueschemeyer 2003). My attempt to build a synthetic framework to analyse how justly the shift to EVs unfolds with its winners and losers is such an attempt to understand EVs' impacts on labour regimes and capitalist energy transitions.

However, there are limits to the case study methodology. In general, these correspond to the fact that generalising from a single case study is not always possible (Bryman and Bell 2019:

45). However, my research mitigates this problem in two main ways. First, the research questions of this thesis are situated, i.e. not directed to generalise about a specific phenomenon; they rather aim to understand different approaches to, and perspectives on EVs' role in just transition to a low-carbon economy, with the example of industry level analysis based on Germany. Second, the transition is itself still unfolding, with its dynamic and relational nature changing labour process in vehicle manufacturing. Since EVs are products of emerging (EV) global production networks, and part of the broader social and historical capitalist energy transitions, generalisation is not as important as understanding why actors take certain positions at a given moment. I use examples in Chapter 6 from the history of the German automotive industry to generate some clues on the interests and positions of different actors in major social and industrial transitions, in particular the past shifts in the German automotive industry.

I identify three limitations to the case study selection and methodology in my research. I argue that judging EVs with respect to just transition requires consideration of the positions of all workers and suppliers in existing (automotive) and emerging (EV) global production networks. The first limit of my thesis is that my primary data does not include positions of workers and the state at outer tiers of these production networks. Even though I included labour representatives from global labour organisations in my sample, and I interviewed representatives from international governmental and non-governmental organisations, this is not enough to suggest that I covered all workers. This limitation in my thesis is dealt with by reviewing academic literature on working and environmental conditions in resource extraction, chemical processing and auto-parts supplier locations in developing countries.

The second particular limit of my research design is the fact that I did not cover workers in Germany with all types of employment contracts, which I again deal with by a review of academic and policy literatures on industrial relations in Germany.

The third limit is that I did not cover how proponents of social movement unionism approach the shift to EVs and its impacts on broader social and historical capitalist energy transitions. I tried to deal with this by examining academic literature on just transition and linking what it tells us about just transitions' inclusiveness and conceptual strength in the case of EVs. In short, even though I argue that the last two JTPs on global labour and the environment are key for a full just transition, my primary data is not enough to address it all because of these

limitations, which I have tried to mitigate by supplementary research, the advantages and disadvantages of which are detailed in Section 4.3. Before that, I explain the rationale of my case study selection.

4.2.4 Case study selection

With the goal of finding, revealing and analysing in-depth information, the case study research design entails an intensive analysis of a single case — a community, family, organisation, person, event, city, province, state or sector of the economy, which is 'an object of interest *in its own right*' (Bryman and Bell 2019: 44, emphasis in original). Researchers not only benefit from practical and concrete aspects of the case under investigation; they can also understand broader phenomena (Baxter 2021: 114). Selection of the relevant unit of analysis is only possible when one specifies the overarching research question (Yin 2003: 24), which in the case of this thesis is how justly the shift to EVs unfolds in the German automotive industry. Thus, the unit of analysis of my case study research design is not a traditionally defined unit; it is subject to a combination of insights from several units of analysis (technology, product, industry, national economy and international political economy) and the extent to which these units relate to my primary research question.

The automotive industry as a case study on just transition

Choosing the automotive industry in studying just transition is based on the industry's historical and contemporary importance for capitalist development and for wider sustainability and energy transitions. The automotive industry is highly dependent on hydrocarbons and resource extraction for the production, maintenance and propulsion of vehicles. Moreover, the global transport sector helps large multinational companies, including large OEMs and their multinational automotive suppliers, manage cross-border flow of parts, components and raw materials used in their products and services (Coe 2014; Cowen 2014; Bonacich and Wilson 2008). Vehicle manufacturing itself is a major manufacturing sector and, more importantly, ICE vehicles emit large amounts of greenhouse gas emissions. The shift to EVs affects the status-quo in these three fundamental sectors of the world economy.

Despite their large and historical responsibility for ecological problems such as climate change and biodiversity loss, and their role in geopolitics in the 20th century, OEMs and multinational automotive suppliers, hydrocarbon and resource extraction enterprises, and the transport

industry are now seeking new business models with EVs, so that they can portray themselves as integral parts of the transition to a low-carbon economy. Despite important caveats due to the embedded emissions in production of the key EV component, the battery, and shortcomings in terms of timing, financing and pace of emission reduction policies (Morgan 2020; Berners-Lee 2021; see Chapter 5), EVs are used by the dominant fossil fuel industry regime to gain a foothold in decarbonisation efforts, without considering the social and political backgrounds of their respective sectors. Therefore, the proliferation of EV manufacturing has repercussions on workers employed in these key sectors of the global economy.

The automotive industry was also chosen as a case study on just transition based on the industry's historical role in determining capital-labour relations in the workplace and political economy. Essentially, the role of workers in both spheres has been restricted by the labour process control and management techniques. The automotive industry first applied assembly-line and mass-production techniques on a large scale with ever-increasing levels of machinery and automation to employ large semi-skilled and unskilled workforces under the supervision of a limited number of line managers and industrial engineers (Braverman 1974; Silver 2003). Thus, similar to the restructured role and power of labour due to previous energy transitions in the history of capitalist industrial development (Malm 2016; Mitchell 2013), the current transition with EVs has implications for global labour in terms of workplace struggles between labour and capital. This can in turn influence conditions for workers' say in social and political power relations in the world economy. In relation to the specific control mechanisms in individual automotive plants, EVs can change labour-capital relations in various ways.

Organisational knowledge and the absorptive capacity of existing workers, managers and technicians (Cohen and Levinthal 1990; Henderson and Clark 1990) in individual vehicle plants are dramatically affected by EVs. The global automotive industry, and indeed the German OEMs, were until recently, and for some still are, based on incremental innovations in mechanical engineering and improvements in the field of fuel efficiency of the internal combustion engine. However, manufacturing better and cheaper batteries with ever-longer ranges is distinct from improving established technologies such as production of more fuel-efficient diesel, gasoline or other forms of engines. Replacing traditional vehicles run on ICE

burning fossil fuels with those that run on battery-powered electric motors is the technological shift that large OEMs and their multinational close-tier suppliers need to master today. This changes parameters for organisational knowledge and the absorptive capacity affecting labour-capital struggle for workplace control in individual vehicle plants *and* capital-capital struggle for industry-level competitiveness.

Contrary to mechanical, performance and fuel efficiency engineering used in manufacturing ICE vehicles, which enable large OEMs and their close-tier multinational automotive suppliers to maintain their market power, EVs require new governance mechanisms to control automotive parts, and resource and raw material suppliers. EV manufacturing depends on critical technologies around resource extraction, chemicals and mineral processing, and material and battery recycling. Batteries are not the most state-of-the-art technology, and neither are traditional engines; both have been used as established components in the automotive industry since the turn of the 20th century. So, battery producers as newcomers to global EV production networks have some leverage over large OEMs and multinational automotive component producers in capturing value through GVC/GPN governance mechanisms. In response to this, the latter group can use its experience on consumer markets, and more importantly benefit from ICE technology and market power in the short term, in which hybrid EVs consist of both ICE and EV components. Moreover, industry incumbents can seek alliances with battery producers in order not be sidelined in the long term, when ICE-related technologies and market power will decrease. In short, due to the potential impacts of EVs on labour, capital and the environment, the automotive industry is very relevant as a case study on just transition to a low-carbon economy.

The German automotive industry as a case study on just transition to EVs

The reasons for choosing the German automotive industry as a case study are associated with the significance of the German automotive industry for the German economy, global automotive production networks, and national and international labour organisations.

The first rationale behind choosing the German automotive industry is the crucial role of vehicle manufacturing in the German economy. In 2021, all manufacturing sectors (excluding

construction) accounted for 23% of the GDP in Germany.[28] With a gross domestic product of 783 billion euros, total GDP of manufacturing sectors in Germany is far ahead of many other national economies with manufacturing, services, construction and agriculture combined. Manufacturing sectors in Germany employ 8.1 million workers.[29] Vehicle manufacturing is the most important manufacturing sector for both employment and exports. Of the total manufacturing employment at 8.1 million, vehicle manufacturing employs close to a million workers — the largest share of EU vehicle manufacturing employment, which totals around 2.6 million (ACEA 2022: 9, 15).[30] 27% of total jobs in Germany are directly or indirectly linked to exports, and more than half of the employees in industrial manufacturing sectors depend on exports (BMWK 2022: 1). The leading group of Germany's exported goods is vehicles and vehicle components, accounting for 15% of all exports in goods, followed by machinery (14%), chemicals (10%) and electric/electronics (9%) (BMWK 2022: 2). Domestic value-added in exported goods is very high — in 2019, the proportion of imports contained in German goods exported stood at 41% (BMWK 2022: 1). Similar to exports and employment, vehicle manufacturing in Germany is also key to capital accumulation and taxes. The German automotive industry achieved a 411 billion euro turnover globally in 2021 (GTAI 2022: 3). In 2020 the German federal government received a fiscal income of 90 billion euros from taxes on vehicle ownership, sales and registration (ACEA 2022: 98). Regarding the capital invested in vehicle manufacturing, Germany has 44 of the total 194 EU vehicle factories (ACEA 2022: 28).

The second rationale for my case study selection is the crucial role of German OEMs for global automotive production networks. In 2021, the German OEMs provided one-third of the global automotive research and development spending (GTAI 2022: 2), most of which was

[28] Destatis, Statistisches Bundesamt: Production, use and distribution of the GDP 2021, available at https://www.destatis.de/EN/Themes/Economy/National-Accounts-Domestic-Product/_node.html#266026 accessed 07/01/2023.

[29] Destatis, Statistisches Bundesamt: Employment national accounts 2022, available at https://www.destatis.de/EN/Themes/Labour/Labour-Market/Employment/Tables/persons-employment-sectors-economic.html accessed 07/01/2023.

[30] Slightly higher than this figure by the ACEA (European Automobile Manufacturers' Association), Eurostat estimates that 53% of total EU vehicle manufacturing employment is located in Germany, 10% in France, 7% in Italy, 6% in Spain and 5% in Sweden (EU Parliament 2021: 20).

channelled to the EU countries, with 59 billion euros in 2020 (ACEA 2022: 91). More importantly, as I explain in detail in Chapter 5, German OEMs produce more vehicles abroad than in Germany. Of a total 12.5 million passenger cars produced by German OEMs in 2021 globally, 4.5 million units were produced in China, 3 million in other EU countries and close to 2 million in the Americas (VDA 2022: 68-69), whereas passenger cars produced in Germany by all major OEMs stood at 3.1 million (GTAI 2022: 2). This applies to commercial vehicles, busses and trucks as well. In 2021, Volkswagen produced a third of trucks, busses and light commercial vehicles in South America, while this figure was 12% in North America (VW 2022: 37). Daimler, the other German OEM with significant bus, truck and commercial vehicle deliveries, have more than 40 production facilities for this group of products in North America, Europe, Asia and Latin America (Daimler 2022: 45).

The third rationale for the case study selection in this thesis is the German automotive industry's importance for organised labour. Trade unions in Germany are very active in national and international platforms (Gumbrell-McCormick and Hyman 2013), including in relation to the environment and climate change (Räthzel and Uzzell 2013). As the largest trade union in Germany, IG Metall organises most of the industrial workforce in Germany, including vehicle manufacturing, steel, machinery, shipbuilding, aerospace, electric/electronic engineering. Equally important is that IG Metall is part of international labour organisations, the International Trade Union Confederation (ITUC) and the sectoral global union federations (GUF) such as IndustriAll[31], which have strong voice on global labour movement (IndustriALL 2016; Papadakis 2011, Stevis 2002), as well as on discussions on international climate change and just transition (Räthzel and Uzzell 2013). IG Metall is in constant dialogue with OEMs and the state in Germany, taking part in both corporate governance and regulation of labour markets (Hall and Soskice 2001), including and especially the automotive industry (Streeck 1984, 1987).[32] The German automotive industry as a case

[31] IndustriALL represents 50 million workers in 140 countries in the mining, metals, chemicals, energy and manufacturing sectors, available at http://www.industriall-union.org, last accessed on 25/05/2018.

[32] Regarding corporate governance, some states' governments in Germany are major shareholders of major industrial firms, as in the case of The State of Lower Saxony's 20% voting rights as Volkswagen's second largest shareholder (Volkswagen 2017: 113). Porsche Automotive Holding is the largest (52%) and Qatar Holding LLC is the third largest (17%) shareholder in Volkswagen.

study on just transition promises vital insights with respect to the role of unions and the state in transition to a low-carbon economy.

The mere fact that EVs are 'technologically possible' is not enough to attract further investments in research and development, not least because of the need to build the required charging and servicing infrastructure that this technology relies upon. Most of this infrastructure is indeed funded by the state, globally and in Germany, as I discuss in Chapters 5 and 7, respectively. In line with the role of the state in maintaining capital accumulation (Horner 2017; Smith 2015), large-scale EV deployment in most of the industrialised countries requires additional political and economic policies to cope with major concerns, such as loss of employment and tax-generating activities in their respective jurisdictions. The state, at various scales, tries to mitigate this; examples include Stuttgart city council's automotive transformation alliance at the regional scale, Germany's national platforms for electromobility at the national scale, and, at the international scale, the EU's push for a continental battery alliance to secure EV raw materials and minerals. I discuss these initiatives in detail in Chapter 7. In addition to semi-structured interviews, Section 4.3, below, lists the initiatives that are part of my data collection strategies.

4.3 Data Collection

This section explains research methods to collect data and research tactics for triangulation, which are listed in Table 3.1, with respect to my four research questions. I used three main data collection methods: semi-structured interviews, review of technical/policy reports and academic literature, and historical analysis. Semi-structured interviews are the main data collection method for the first (RQ1 just transition) and third (RQ3 labour process) research questions, which are supported by review of technical and policy reports. For the second research question (RQ2 workers and decision-making), semi-structured interviews supported my main research method, historical analysis. Review of technical reports for the fourth research question (RQ4 global labour and the environment) is supported by academic literature review.

Similar to the multiple data collection methods, I benefitted from different ways of triangulation in my research. The main triangulation tactic of the thesis for RQ1 is academic

literature review. Answering RQ2 is triangulated by policy report review. For triangulation of answers to RQ3, I made use of communications with my personal contacts in Germany. Semi-structured interviews helped to triangulate answering RQ4. Additional triangulation for each RQ was online platforms of industry news.

Table 4.1: Research Questions, Data Collection and Triangulation

Research Questions	Data collection	Triangulation
1. Why is just transition important, for whom, and how justly is the shift to EVs unfolding?	Semi-structured interviews. Policy report review.	Academic literature review. Industry news.
2. How are workers positioned in the German automotive industry; how can they influence decision-making processes?	Historical analysis. Semi-structured interviews.	Policy report review. Industry news.
3. What are the implications of EV production on workers in the German automotive industry?	Semi-structured interviews. Technical report review.	Personal contacts. Industry news.
4. What are the implications of EV production on global labour and the environment?	Technical report review. Academic literature review.	Semi-structured interviews. Industry news.

In the analysis of the data to answer my RQs, I used my framework of five just transition parameters (JTPs) (see Sections 2.4 and 3.4). JTP1 is protection and compensation of existing workers and their communities during the transition. JTP2 is inclusion of workers in decision-making processes. JTP3 is retraining of workers for new jobs or sectors. JTP4 is implications on global labour and JTP5 is implications on the environment.

4.3.1 Academic literature review and historical analysis

In addition to the crucial role of semi-structured interviews and review of technical and policy reports, three sets of academic literature enhance my analysis on just transition possibilities during the shift to EVs in the German automotive industry.

EV and just transition

First, I read academic literature on the concept of just transition, to triangulate my answers to RQ1. This was useful because, similar to the wider context of EVs in renewable energy transition, debates around the concept of just transition are also in motion with broad repercussions. As Chapter 4 outlines, what started off almost half a century ago as a set of local and sectoral demands from workers and labour organisations in the North American oil and chemical sectors, has been evolving, during the last two decades, into a global framework

of labour position in international climate change negotiations. Especially since the Paris Agreement, the concept of just transition has gained traction in academic and policy circles studying fossil fuel phase-out and transition to a low-carbon economy. More recently,[33] academic literature from a wide range of disciplines (industrial relations, international relations, economic geography, political science and law, especially in relation to climate change) have turned to the concept of just transition.

Second, as explained above in Section 4.2.2 on specific limits of my thesis, I reviewed academic literature on working and environmental conditions in resource extraction, chemical processing and auto parts supplier locations in developing countries. This helped me to gain a more sophisticated understanding of various labour regimes upstream of EV production networks, on which I elaborate in Chapter 8.

Prior transitions in the German automotive industry

Third, I used academic literature review to historicise major transitions in the German automotive industry. Historical analysis helped me answer RQ2 on the position of workers in automotive decision-making processes. Moreover, since JTP2 of the framework that I used in data analysis is inclusion of workers in decision-making processes (see Sections 2.4 and 3.4), understanding historically how this parameter played out in previous major automotive transitions and changes to labour process in vehicle manufacturing enriched the thesis. I identified how and why labour organisations could or could not effectively take part in decision-making processes in transitions from local, craft production to the current global, flexible and diversified production. Historical analysis of the German automotive industry shows that the balance of power in political economy from the end of the 19th century to the early 2000s has been fundamental for major transitions.

Historical analysis is important for my thesis for two main reasons. On the one hand, the shift to EVs in Germany is being negotiated now among labour, capital and the state in institutional frameworks that are the result of the historical, social and political power relations among these key actors. These institutional frameworks, which determine the extent to which workers can be involved in decisions, are path-dependent and their historical development is

[33] Since I began my research in October 2017, just transition has turned into a kind of 'buzzword'. This is increasingly the case in the wake of the COVID-19 pandemic, which highlighted dramatically impacts of ecological problems on, and the role of the state in society.

useful in analysing EVs today. On the other hand, historical analysis showed me that the combination of new technologies, management techniques, differentiation among labour, the characteristics of capital, state involvement in the industry, and international political economy shaped previous transitions in the German automotive industry (see Chapter 6). Since I argue in this thesis that EVs should be considered as part of a wider processes of capitalist energy transitions, not only as the move from fossil fuel powered ICE to battery-run electric motor in vehicle design, the wider multi-scalar, social and political dynamics I identified by zooming in on prior transitions in the German automotive industry can intellectually contribute to the analysis of just transition with EVs.

4.3.2 Review of technical and policy reports

EVs and vehicle technology

In addition to my semi-structured interviews about the relationship between just transition and EVs (RQs 1 and 3), and the historical analysis on workers' roles in, and ability to influence, decision-making during prior transitions in the German automotive industry (RQ2), another research method used for this thesis is review of technical and policy reports about EVs' impacts on global labour and the environment (RQ4).

I identified key technical and policy reports in German, written in coordination of OEMs, large component suppliers, trade unions, industry associations, research centres and state authorities.[34] I also searched industry news outlets[35] for the term EV with a combination of one or some of the related concepts, such as OEM, supplier, plant restructuring, works council, trade union, ICE, battery, electric motor etc. Industry news, technical and policy reports were crucial for me in grasping technical details of, and differences between, the two major products of the automotive industry, ICE vehicles and EVs. As an outsider to the vehicle industry in terms of knowledge on functioning and engineering of a vehicle, not least the organisation of production in vehicle assembly and engine plants, this material was invaluable

[34] (i) ELAB (2018, 2012) *Electromobilitaet and Beschaeftigung* (Electromobility and Employment), Stuttgart: Fraunhofer Institute for Industrial Engineering and Organisation.

(ii) IKA (2014) *Modellierung der zukuenftigen elektromobilen Wertschoepfungskette und Ableitung von Handlungsempfehlungen zur Staerkung des Elektromobilitaetsstandortes* (Modelling future electromobility value chains and recommendations to strengthen production locations), Aachen: RWTH Aachen University Institute for Motor Vehicles.

[35] *Electrive.com*; *Electrive.net*; *Labournet.de*; *Plattform-zukunft-mobilitaet.de*; *Battery-news.de*

in equipping me for fieldwork and key to formulating more technical questions to pose to my interviewees.

Receiving daily or weekly email newsletters from, and then reviewing specific online news outlets focusing on labour and OEMS provided me with up-to-date information about plant-specific restructuring for corporate cooperation in, and investment decisions about, the EV technology, as well as reactions from, and involvement by, labour organisations, mainly IG Metall and DGB, while job losses were being announced. This also helped me to target potential interviewees at vehicle plants that are, or would potentially be, restructured for EVs. Similarly, I reviewed automotive and mobility transition reports and policy documents from national[36] and regional/local[37] bodies in Germany. In addition to understanding EV-related technicalities and finding potential interviewees, transition reports were useful for me to test JTP2 on inclusion of workers in decision-making processes.

Review of technical and policy reports was significant for me during and after the fieldwork trips to Germany, for two reasons. First, not everyone I talked to was knowledgeable enough to answer my questions about the labour process implications of restructuring an existing traditional vehicle assembly or engine plant into one for assembling EVs and/or assembling the battery pack. Second, and more importantly, some interviewees, especially those at OEMs and large first-tier suppliers, did not go into detail about such information, adding that this could be company specific and thus not easy to disseminate. I tried to deal with this via

[36] Nationaler Entwicklungsplan Elektromobilitaet der Bundesregierung (National Electromobility Development Plan of the Federal Government). The steering committee of this ad hoc federal consultancy agency consisted of the chair of the National Academy of Science and Engineering, officials from four federal ministries (education, environment, economy, and transport), four big OEMs (VW, BMW, Daimler and Audi), first tier big suppliers (BASF, Siemens), automotive industry associations (VDA — German automobile association, BDI — Federation of German Industries), and two big power generation companies. The agency had six working groups: vehicle technology; battery technology; charging infrastructure; regulation, standardisation and certification; information and communication technologies; and general framework.

[37] (i) Baden-Wuerttemberg Saatsministerium Strategiedialog Automobilwirtschaft (Baden-Wuerttemberg Prime Ministry Automotive Strategy Dialog).

(ii) Landesagentur fuer neue Mobilitaetsloesungen und Automotive Baden Wuerttemberg (Baden-Wuerttemberg State Agency for Mobility Solutions and Automotive).

(iii) Wirtschatsfoerderung Region Stuttgart (Stuttgart Region Economic Development Agency).

communications with my personal contacts, most of whom were my high-school friends from Turkey who now work and live in Germany,[38] as well as via informal chats before and after my interviews. The former was especially valuable for me, as some were mid-level production or project managers, and others were mechanical and electric/electronic engineers. These personal contacts helped me to understand specific requirements of EV manufacturing and battery assembly that are different from those of ICE vehicles.

Documents on vehicle emission regulations and just transition

I reviewed two sets of policy reports. First, I reviewed policy reports around emission regulations, critical raw materials for renewable energy, and other mobility aspects published by agencies of the European Union and the German and other (USA) national authorities. I focussed on identifying and understanding the involvement of the German automotive industry in the macro-regional regulatory sphere of the EU. This attempt was specifically triggered by two contemporary events at the time, Volkswagen's diesel emission scandal proceedings in the US, and the EU Commission's policy preparations for the European New Deal, which included policy incentives and guidance to member states to support EVs. I used the publicly available documents and policy briefs of the EU agencies and the German authorities to understand the involvement of trade unions and labour organisations in this critical period for major German automotive companies. Using the GVC/GPN framework as an analytical and methodological tool to trace companies that are influential in setting industry standards as part of their governance mechanisms, this effort included reviewing annual reports of German OEMs and multinational automotive suppliers.

Second, as discussed in Chapter 2 in detail and in Section 4.4 below briefly, I reviewed national and international trade union policy reports on international climate change negotiations under the auspices of the UNFCCC, to the extent that they refer to either EVs or just transition. National and international trade union organisations and governmental and non-governmental institutions taking part in these negotiations acknowledge the need to address just transition implications. Although these were mainly on the shift in power generation from

[38] That high school used German as the language of instruction in maths and sciences and sent, in the last few years, two thirds of its cohort to German universities. When I graduated high school in 2004 with A level equivalents, this figure was nowhere near as high; had it been, that would have made sampling much easier and enlarged my personal contact network in Germany.

coal to renewables — as in the COP in Katowice, one of the biggest European coal mining regions — in line with the UN agenda on sustainable development and SDGs (see Chapter 4), labour organisations also referred to EVs as part of just transition to a low-carbon economy in transport. I tracked later during my research that more and more unions began drawing attention to the concept in relation to the shift to EVs in the automotive industry, in Germany and elsewhere. By mapping and analysing these policy documents on the concept of just transition and/or EVs, I was in a position to ask interviewees about their knowledge of, and ideas around, just transition *as a process in motion*. I also asked them how they thought about potential ways to improve or implement just transition strategies with respect to EVs in the German and global automotive industries. Along with technical and policy reports review, which informed the ways I ask questions to my interviewees, I conducted semi-structured interviews in my research. The next section sets out my approach to, and conduction of, these interviews.

4.3.3 Semi-structured interviews

As summarised in Table 4.1, conducting semi-structured interviews with representatives from labour, capital, the state, as well as German and international non-governmental institutions, is the mainstay of my research methods. The analysis, using the five JTPs, of the data from the interviews helped me answer RQ1 (just transition) and RQ3 (EVs' implication of workers in Germany). It was also useful in answering RQ2 (workers and decision-making). Lastly, I used some of the interview data to triangulate answering RQ4 (global labour and the environment).

Before starting my trips to Germany in 2019, I completed an advanced language course in German. This helped me refresh and further develop my German language skills. Although most of my interviews were in English, this was very useful because, I carried out initial contacts in both German and English with potential interviewees in Germany. Two of my interviews and one group discussion with labour representatives and workers were in German. I carried out interviews mostly in English with national and international trade unions, officials and industry representatives in Germany, Brussels and Geneva. Two of my interviews with the German labour organisations in Germany were in Turkish. Further, I met personal contacts during my trips to Germany. Among these, I spoke in Turkish with 10 people working at either OEMs or large suppliers in Stuttgart, Munich and Nurnberg, who were skilled workers or mid-level production and project managers. Communications with personal

contacts included talks for around half hour to an hour, some of which later continued via Skype or WhatsApp calls during my research. In total, I carried out 32 semi-structured interviews ranging from 45 minutes to 90 minutes, most of which took around an hour.

Gathering qualitative data via semi-structured interviews was useful for me in two ways. First, with questions informed by literature review, I followed my own line of inquiry and was able to better grasp technical details of the issues at hand. Second, open-ended and flexible discussions shed light on what the interviewees thought about personal and social implications (Yin 2003: 89-90) of the shift to EVs in the context of just transition. I collected primary data through semi-structured interviews with trade union representatives, workers and officials at various scales. Some of my interviews were recorded on a voice recorder. If this was not possible, I simultaneously took hand-written notes. I transcribed each interview as soon as possible after it took place and kept all files in a password-protected format to ensure the anonymity of my sources.

Before the fieldwork (Table 4.2), I contacted potential interviewees in OEMs and their close-tier suppliers via email. Due to its size, I aimed first at accessing workers and production managers at the various plants of Volkswagen. Among the large suppliers, the sample included those potentially affected by the shift to EVs, i.e. powertrain, engine and electronic components providers. As accessing enough employees at one OEM proved difficult, my research was also based on alternatives at BMW and Daimler. Personal contacts at these large OEMs and key suppliers such as Bosch brought access to information about restructuring and investment processes for EVs. However, technical details about managing the labour process in EV component manufacturing and assembly lines, as well as battery pack assembly, proved the most difficult aspect of my research, which, as explained above, I supplemented by a literature review of technical reports and informal personal communications. This difficulty, I believe, had two underlying reasons. First was the fact that there were, and still are, not large enough numbers of plants manufacturing battery cells and/or assembling battery packs in Germany. Second was, as explained above, the interviewees self-censorship in disseminating technical differences between the two products, ICE and EVs, because I often felt that they were not unaware of the shift's implications on the labour process in vehicle factories.

Table 4.2: Research trips and interviews

Date	Location	Interviews	Personal Contacts
November 2018	London	Labour (2)	
December 2018	Brussels	Labour (2), state (3), industry (2)	
February 2019	Hannover		Industry conference
February 2019	Wolfsburg	Labour (1)	
February 2019	Berlin	Labour (2) state (1), NGO (1)	
February 2019	Geneva	Labour (1), state (2)	
June 2019	Berlin	Labour (1), state (1), industry (1)	Industry conference
June 2019	Dresden	NGO (1)	
June 2019	Stuttgart	Industry (2), state (1)	OEM (1), supplier (1)
October 2019	Stuttgart	Labour (3), state (2),	OEM (1), supplier (1)
October 2019	Munich		OEM (2)
November 2019	Stuttgart	Labour (1), labour (group discussion), state (1)	OEM (2), supplier (2)
November 2019	Nurnberg		Industry conference

Labour: National or international trade union representatives and works council members.
State: Officials. *Industry*: National or international industry association. *OEM*/*supplier*: Skilled workers, junior/medium level project managers. *NGO*: Labour or environmental advocacy.

Interviewing managers and workers from a single firm or multiple firms has both advantages and disadvantages. With the former, I achieved an in-depth analysis of the supply chain architecture and EVs' potential effects on reconfiguration of suppliers by an OEM. When facing problems of access to a range of informants at a single firm covering the various managerial and technical roles, data collection across the industry provides a better basis for triangulation (Yin 2003: 98-99). With the latter, I gained an overview of broad developments in the industry in transition to EVs. This was especially important to my research, as both the nature of transition and competition among plants of even the same OEMs made an industry level analysis a requirement. Additionally, because of diverging and antagonistic positions of informants, e.g. between managers and employees, and/or between those who work at distinct divisions of an automotive company (e.g. those effected negatively/positively or not at all by the EV transition) and/or even different locations (e.g. those with more investment or divestment), examining implications of EVs on the industry as a whole helped me analyse the primary data.

I interviewed local, regional and national automotive industry associations and state agencies in Germany. In addition to a literature review of some of these agencies' policy documents, data I gathered through semi-structured interviews with people working at these agencies gave valuable insights, especially on the broader political economy in the country. I additionally conducted interviews with international and transnational automotive industry associations in Berlin and Brussels that represent large OEMs and/or their large multinational suppliers at regulatory platforms of the state, the EU in this case. Although limited to a few interviewees, these different channels also enhanced my access to OEMs and suppliers. The VDA (German Association of Car Industry), ACEA (European Car Manufacturers' Association) and CLEPA (European Association of Automotive Suppliers) were important stakeholders in my research. I also interviewed officials at manufacturing, raw material and automotive units at the agencies of the EU, ILO and UNCTAD. The units they worked at in these organisations covered themes such as mobility and transport, automotive employment, energy transition and climate action. Along with the semi-structured interviews, I also participated in automotive industry conferences and trade union events. This was key for networking, as well as for obtaining access to a wide range of people in the industry, even though most declined a formal interview after our relatively lengthy (15-30 minutes) exchanges before or after the event.

4.3.4 Access and 'the field'

I lived in total for around two months in Germany during my research trips. In June and October 2019 mostly, I stayed either in Stuttgart or Nurnberg, depending on the interview or personal meeting lined up next. My other trips, to Berlin, Hannover, Wolfsburg, and Leipzig, were short trips back and forth between London and Germany; this also applied to my trips to Brussels and Geneva. Planned, additional trips were made unfortunately impossible by the COVID-19 pandemic, which curtailed my ability to further develop relationships with key informants.

My access to works councils, the key institutional negotiating platform for the shift to EVs at German OEMs and large suppliers between labour and management (see Chapter 6), was very limited. Almost none of my emails, in English or German, were replied to by either management or EV project engineers at OEMs and large suppliers, who at times suggested that I contact the press or human resources teams. When in Germany, I called potential

interviewees at works councils of plants being restructured for EV manufacturing, but, again, access was not possible. For instance, I specifically contacted Volkswagen's plant managers in Emden, Zwickau and Hannover, because these were the first large plants to be restructured for EVs. They either said that they had no time or that the notice was too short. After I referred to my previous emails during the call, they argued that they had no knowledge about EVs or that 'everything was fine' with their companies. In particular, managers were most difficult to access at large OEMs, who were responsible at the time for restructuring some of their plants in preparation for EVs with large-scale investments and employee guarantee and/or early retirement schemes. Similar access problems occurred with small- and medium-size family-owned companies supplying to either OEMs or their first-tier suppliers.

Access to state officials and industry associations were not easy, but not very difficult, as with OEMs, large suppliers and SMEs. Nevertheless, with these two groups, the interviewees were rather reticent, as if they were in an interview with a journalist for a newspaper article. Access to labour was possible after several emails and follow-up calls. Access was gained through a snowballing technique. Once a relatively rich and lively interview ended, some of the interviewees provided additional contacts, even before I asked for them, which I usually did with any interview or personal contact. Such facilitation helped me access most of those I reached out to for my research.

Elite and non-elite interviewing in practice

According to the literature on interviewing elites, the researcher should use appropriate techniques to reach out to potential contacts (Conti and O'Neal 2007). What social scientists know about their elite contacts is gained through content analysis of the relevant institutions' reports and websites (Bryman and Bell 2019: 300), and interviewing requires diplomacy in contacting potential informants and overcoming institutional obstacles to access and privacy (Dunn 2021: 148). Most of my interviewees and personal contacts can be regarded as 'elite' informants. In spite of the difficulties, outlined above, with accessing labour organisations in Germany, especially works councils, I did not face specific hurdles in accessing informants from international labour organisations.

I interviewed and contacted mostly national and international trade union officials, who had either qualifications or work experience in industrialised Western European countries. Their insights on industrial change and characteristics of global automotive production networks

were highly advanced. Yet for some, their understanding of the concept of just transition was arguably limited. Those that underlined the significance of the concept linked their expectations of a just transition to implementation of ILO conventions and/or voluntary private codes of conduct. Works council members or leaders I interviewed, and coded as part of labour, were mainly skilled and/or experienced workers who had comfortable lives in Germany, and who did not demonstrate a deep concern for, or understanding of, global labour and environmental parameters of just transition. However, they were very active in highlighting that during EV transition they feel the need for common struggle against a race-to-the-bottom in the European automotive macro-region.

Similarly, officials at local, regional and national state agencies I interviewed in Germany, as well as those in Brussels and Geneva, are 'elite' interviewees. The major difference between this group and the labour discussed above was that the state officials drew significant attention to three themes around the shift to EVs. First, they highlighted the competitiveness and technological leadership of both Germany and Europe, which must be retained during the shift to EVs, in order to secure new well-paid jobs, employment and profits 'in house' (in Europe, as opposed to the Chinese EV companies). Second, many respondents highlighted that Europe would be better off coordinating and investing together in EV technologies – specifically the battery technology and building EV charging infrastructure – because vehicle manufacturing experience, advanced base-metal research and a large market with high-income costumers in Europe was up for grabs.

Third, a slight differentiation in this group was the fact that officials in Brussels and Geneva were more keen to discuss issues around raw material and mineral processing at outer-tiers of global automotive production networks, rather than officials in Germany who were quick to refer to OEMs and large first-tier suppliers' relative inability to control their whole supply chains; the states at those jurisdictions were more responsible about embarking on developmental projects and pursuing higher standards in human rights, working conditions and the environment. This point was widely shared and underlined by representatives of industry associations, who believed that by pressuring on those states in the global South in coordination with the EU, UN agencies and ILO, OEMs would be keen to work with partners and companies to find ways to correct any wrong-doings gradually and create better living, working and environmental conditions.

4.3.5 Research ethics and reflection on positionality

Since my research project involved interviews, communications and discussions with elite level people working in or around the industry, I followed Queen Mary's research policy and protected my sources' anonymity as rigorously as possible. In doing so, I devised a systematic way of referencing my interviewees, so that their anonymity is ensured. This is in line with the research ethics approval I was granted by my university after I prepared my draft interview questions (question sheets). I am similarly sensitive to key informants who provided me with access to other interviewees. This type of gatekeeping by key informants from the trade union helped me build trust and reach a high quality of rapport. Some of my interviews were recorded, which I then transcribed verbatim and have kept secure.

Overall, during my interviews, I did not feel disturbed at all. However, I did not feel very comfortable either. Although some of the interviews with labour were quite informal, most of my interviewees kept a relatively distanced approach to me. This was always almost the case with in interviews with state and industry associations. (They had questions of their own: Why would I do research on German companies? What was the situation in Turkey? How was British industry coping with such issues?). There was always the feeling between my interviewee and myself that we were talking on somewhat uneasy themes, especially when it came to the impacts of the shift to EVs in Germany on global labour and the environment.

I felt the most natural and comfortable during exchanges with my personal contacts in Turkish. These interviewees, despite not agreeing on a recorded interview nor accepting my visits to the company premises, did their best to help me to understand technical details and changes to the labour process in vehicle plants. In fact, some of them were quite happy that I, as someone from their cohort, would embark on such a research project in a developed country: 'In Germany, it is mostly Germans who do such research or project development,' said one.

4.4 Data Analysis

The proliferation of EV manufacturing in Germany has implications on the global automotive industry. This change affects global workforce as it does autoworkers employed at the German OEMs and their suppliers. EVs also have environmental implications globally. To analyse these impacts in consideration with various aspects of EVs discussed above (see also

Chapters 1 and 2), I devised the five just transition parameters. I operationalised the JTPs as a relatively stable set of parameters to judge an ongoing phenomenon, that itself is part of broader social and ecological transformations of capitalist uneven development. However, my selection of JTPs is inevitably partial and should be seen as one method among several possible methods for understanding the dynamics and processes under investigation in this thesis. Yet, I believe the five JTPs cover most of the key historical and contemporary dynamics and processes at multiple scales and with consideration of different positionalities.

4.4.1 Five Just Transition Parameters

The five JTPs for the shift to EVs are based on two sets of sources. First, I draw from actual claims by trade unions' reports and other policy papers used in climate change negotiations under the auspices of the UNFCCC. National and international trade union organisations and governmental and non-governmental institutions have been taking part in these negotiations and have proposed specific policies and platforms (see Sections 2.2 and 2.3). Perhaps, the most ubiquitous claim emanating from trade unions and various other parties within this international institutional framework is that existing workers and their communities should be protected during transitions to a low-carbon economy, which is my first parameter, JTP1 – protection and compensation of existing workers employed in fossil fuel based industries and their communities during a transition.

Following from this, and coming more specifically from labour organisations, another pervasive request is to include workers more substantially in decision-making processes. JTP2 is inclusion of workers in decision-making processes, demanded by labour organisations and governmental and non-governmental policy initiatives for political support to sustainability transitions. With the second parameter, I examine the extent to which workers are able to influence the change towards EVs.

JTP3 is retraining of, and schemes for, fossil fuel industry workers to channel them onto new jobs and sectors. The third parameter is related to EVs through lost and new tasks in vehicle manufacturing, for which autoworkers need funding for retraining from companies and the state during the proliferation of EV manufacturing. The first three JTPs are advocated for by labour organisations — individual plant works councils at the micro scale of the firm and the labour process, company works councils at the meso scale of metal and automotive

industries, national trade unions at the macro scale of national political economy, and global unions (ITUC and GUFs) at the international level of the UN climate change negotiations.

The second source I used in devising my five-parameter just transition analysis is original synthesis of academic literature on energy and sustainability transitions. Critical approaches to transitions seek the augmentation of national and international environmental policy outcomes and support transitions that could achieve better social, environmental, economic and political results for all that are involved (see Sections 2.3 and 3.3). The critiques emerging from this literature highlight first that, even though coined by regional and national trade unions in the North America, the concept of just transition originally had a global outlook (Morena et al. 2020). Just transition demands by trade unions refused voluntary corporate initiatives that used new technologies and environmental regulation to outsource production processes with high greenhouse gas emissions to other countries and proposed, along with environmental justice movements, that sustainability transitions should consider the global economy as a whole (Stevis and Felli 2015; Mathia et al. 2021). Second, just transitions should achieve distributive, restorative and procedural justice at the same time (Ciplet and Harrison 2020; Heffron and McCauley 2018; Swennenhuis et al. 2022). Third, just transition demands should approach the labour-nature relationship in depth; that is, acknowledging that labour, the environment and communities are integral parts of the ecology (Moore 2015; Stevis et al. 2018). Fourth, just transitions should keep in mind social reproduction (Barca and Leonardi 2018) and race-related (Pulido 2016) aspects of sustainability transitions. Fifth, just transitions should not approach workers as only victims of environmental degradation, and consider their agency and ability to refuse and/or transform employment relations in transition to a low-carbon economy (Stevis 2018; Velicu and Barca 2020).

By adding JTP4 and JTP5 to my framework, I cover these critiques to just transition proposals by organised labour. I synthesised these from academic literature. JTP4 is on global labour and JTP5 is on the environment. This second set of parameters overcome the methodologically nation-state-focused weaknesses of the first three. Another reason why I expanded my analysis is that the data gathered on implications of the shift to EVs in the German automotive industry culminates in a phenomenon that can only be addressed at the global scale. That is the fear in Germany of becoming a ‘second Detroit’ or a ‘second Nokia’. This ‘common’ fear at local (Stuttgart) and national scale (the state, German OEMs and large

first-tier suppliers) corresponds to the idea that limited investment in infrastructure and lack of funding for research and development in EV and battery technologies would lead not only to job losses in Germany, but also to loss of competitiveness in global manufacturing for the German economy. This line of thought reckons that German OEMs and their first-tier large suppliers are most likely to lose their dominance and lead roles in global automotive production networks (see Chapters 7 and 8).

The widespread referral, by my interviewees from the German automotive industry and labour organisations, to losing their dominance and competitiveness to other key players (Japanese or American OEMs) or newcomers (Tesla or BYD) during the ongoing transition to EVs was almost always followed by the calls to the state to intervene. At any scale - regional (Stuttgart), national (Germany) or international (the EU), the state is expected to increase investment in the manufacturing industry and ensure the security of access to raw materials and minerals used in EVs, so that employment, taxes and capital accumulation are maintained in their jurisdictions. However, very rarely do these calls pay enough attention to the working and environmental conditions at the outer tiers of the global automotive production networks. The interviewees who did consider global labour and the environment (JTP4 and JTP5), limited their just transition expectations with EVs to implementation of international public labour law such as ILO conventions, and voluntary private sector initiatives such as codes of conduct banning the use of child labour and gender discrimination between OEMs or large first-tier automotive companies and their outer tier, smaller suppliers.

In addition to my principle data-gathering strategy, semi-structured interviews, as well as critical reviews of the relevant academic literature, the decision to incorporate the last two parameters in my analysis of just transition to EVs was dictated by a thorough analysis of the technical review of seminal texts in German on the differences between an ICE vehicle and an EV (see Section 4.3). Commissioned by consortiums of large German OEMS, key first tier suppliers, IG Metall and regional and/or national state agencies, these texts fail to consider the implications of EVs on global working and environmental conditions. Despite delineating technicalities of the two products and calling for major state interventions in both restructuring existing vehicle plants and building new charging infrastructures for EVs, as well as highlighting additional efforts by companies and the state to reskill workers for new jobs,

such texts never touched upon material characteristics (embedded emissions) of EVs and impacts on global labour and the environment.

4.4.2 Analysis of the data

Different research tactics helped me synthesise the case study methodology, the five-parameter just transition framework, and the analysis of the interview data.

After establishing the analytical targets for semi-structured interviews, I prepared three sets of interview question guidelines. The first was for interviews with representatives from labour organisations, the state and the industry. The second aimed at operation and production managers at OEMs and their multinational first-tier suppliers. I devised the third set of interview questions for supply chain managers in the automotive industry. This differentiation was mainly because of my thinking that questions around the concept of just transition would not be very useful for the third group, as they would help me trace the GPN by giving information on suppliers of their companies. The questions I asked to my interviewees are in Appendix 1. I analysed my interview data after transcribing those that were recorded. In total, I could record 22 interviews out of 32, of which 15 included valuable insights for my five-parameter just transition analysis. I have grouped, compared and coded the data sources' answers to the Research Questions and ordered them in my five-Just Transition Parameter framework.

Following the transcription of the interviews, I first reviewed them all and identified the common examples and indicative lines in the interviewees' answers to my questions (see Examples of Indicative Lines in Table 4.3). For instance, with regard to the Research Question 1 (Why is just transition important, for whom and how justly is the shift to EVs unfolding?), indicative lines included statements about

- Winners and losers with the new production networks after EVs
- What happens to workers who lose their jobs?
- IG Metall's motto, Fairwandel (just transition).

Indicative lines for Research Question 2 (How are workers in the German automotive industry positioned vis-à-vis transition to EVs? And how can they influence decision-making processes?) included statements about

- Who decides, how (involvement of workers) and where (institutional settings)?

Some indicative lines corresponded to more than one Research Questions. Some examples of these included answers to and statements about

- How do individual plants and their workers react to change from EVs? Or
- 'Why Stuttgart is afraid of becoming a second Detroit? What does that mean?',

which helped answer Research Questions 2 and 3, and Research Questions 1 and 4, respectively (see RQs 1-4 in Table 4.3).

Following identification of the relevant statements through such indicative lines, I allocated 'themes' to the groups of statements and brought them together in Microsoft Excel as data answering each of the Research Questions. Examples of themes used in my coding process included 'plant competition', 'global labour', 'decision-making' or 'retraining schemes'. For instance, data answering Research Question 3 (What are the implications of EV production on workers in the German automotive industry?) are identified and analysed by different themes such as 'employment change' and 'workers' reactions' (see Themes in Table 4.3).

This coding system of matching several themes and indicative lines not only helped me order data from the interviews, but also eased triangulation within and between my data sources. In ensuring rigour and internal consistency within the data source of semi-structured interviews, the coding system helped me identify similar statements and provided me with tools of comparison in the case of conflicting statements. In ensuring rigour and consistency between my data sources, I made use of the coding system in identifying areas to triangulate between interviews, review of policy and technical reports and literature review (see Main Data Collection Methods in Table 4.3).

In the next stage, I matched the themes to Research Questions by utilising the five Just Transition Parameters (JTPs) that I developed in my thesis to think about the shift to EVs in the German automotive industry. Reaching a full just transition to EVs in the German automotive industry was to mean all of the five parameters being met. To prevent a mechanical data analysis, I constantly benefit from other sources of data throughout the research which included not only reviews of technical and policy reports, and academic literatures, as well as the insights from historicising the past transitions in the German automotive industry. In fact, the data analysis in general, and the analysis of the interview

transcripts in particular, took place in a cyclical fashion with several short- and long-term revisits to different data sources.

The cyclical data analysis included evaluating the insights in data about impacts of EVs on labour process and workers' reactions in the context of the historical analysis on the previous transitions in the German automotive industry. I compared the data with the insights from the contemporary academic literature on working and environmental conditions in outer tiers of global production networks. Similarly, the review of technical and policy reports on EVs and/or the concept of just transition helped me analyse data from the semi-structured interviews. In this process, I also made use of industry news on EVs and batteries, and more importantly, I benefitted from my key informants in the form of my personal networks working at engineering departments of OEMs and Germany-based large first-tier multinationals, who helped me with valuable insights on changes to labour processes and potential future competition among labour and capital. Finally, in the write up phase, I selected the most relevant quotes from the interviews to give representative 'voice' to interviewees and texture to the points being made, data from the technical and policy reports, and insights from the historical analysis and literature review.

Table 4.3: JTP Framework for Data Analysis

RQs 1-4	JT Parameters	Themes	Examples of Indicative Lines	Main Data Collection Methods
RQ1	JTP1, JTP4, JTP5	Winners-losers	Winners and losers with the new production networks after EVs	Int, PC, AcEV, all Docs
RQ1	JTP1	Losers	What happens to workers who lose their jobs?	Int, DocTU, DocInd
RQ1	JTP1	Just transition	IG Metall's motto, Fairwandel (just transition)	Int, DocTU, AcJT
RQs 1, 3	JTPs 1-3	Employment change	Jobs and skills lost/added/changed with the transition to EVs	Int, PC, DocTech, DocTU, DocInd
RQs 1, 3	JTP3	Retraining	Retraining schemes for existing workforce	Int, PC, DocTU, DocInd
RQs 3, 4	JTP2, JTP3	Working conditions	Working conditions of the new skills/jobs	Int, PC, DocTU, DocInd
RQ2	JTP2, JTP3	Decision-making	Who decides, how (involvement of workers) and where (institutional settings)?	Int, DocTU, DocInd, AcGerIR
RQs 2, 3	JTPs 1-3	Workers' reactions	How do individual plants and their workers react to change from EVs?	Int, DocTech, DocTU
RQ 3	JTPs 1-3	Plant competition	Any competition for new tasks/jobs in producing EVs?	Int, DocTech, DocTU
RQs 3,4	JTPs 1-3	Company-level changes	Which workers at this OEM will produce EVs or parts for the EVs?	Int, PC, DocTech, DocTU
RQs 3,4	JTP1, JTP4, JTP5	Supply chain changes	Relations among German carmakers and suppliers	Int, PC, DocInd, DocTech, DocTU
RQs 1,4	JTP1, JTP4	Stuttgart-Detroit	Why Stuttgart is afraid of becoming a second Detroit? What does that mean?	Int
RQ4	JTP1, JTP4	Global labour	How to approach other workers in the global automotive industry?	Int, AcJT, AcEV
RQ4	JTP1, JTP5	The environment	How to approach the environment?	Int, AcJT, AcEV

RQ: Research questions. *AcEV*: Academic literature on EVs. *AcJT*: Academic literature on just transition. *AcGerIR*: Academic literature on Germany and industrial relations. *DocEU*: European Union policy documents. *DocInd*: Industry association policy documents. *DocTech*: Technical/engineering policy documents. *DocTU*: Trade union policy documents. *DocUN*: United Nations agencies' documents. *Int*: Interviews. *PC*: Personal communications.

CHAPTER 5 'INDUSTRY OF INDUSTRIES': ORGANISATION OF THE GLOBAL AUTOMOTIVE INDUSTRY AND EMERGENCE OF EV MANUFACTURING

5.1 Introduction

This chapter provides a broad overview of the global automotive industry and sketches some of the major structural changes underpinning the current shift to electric vehicles (EVs). It places the automotive industry at the heart of key structural, technological and spatial changes in capitalist economic development over the 20th century and summarises the intertwined roles of car manufacturers (OEMs) and the state in these developments. This chapter also charts the current structure of the global automotive industry; 'tripolar global production networks' structured around core and gradually peripherical activities. Following from this broad contextual outline, the chapter then examines the main differences between traditional cars and EVs and finally considers some of the major implications resulting from the shift to the proliferation of EV production.

By providing a broad map of automotive industry dynamics and explaining key differences between internal combustion engine (ICE) vehicles and EVs, this chapter has two contributions to the thesis as a whole. First, it sets the context for my just transition parameter (JTP) analyses on decision-making processes in the German automotive industry in Chapter 6 (answering Research Question 2) and implications of EV production on workers in the German automotive industry in Chapter 7 (Research Question 3). Second, this chapter explains impacts of EVs on global labour and the environment, which I elaborate in Chapter 8 (Research Question 4).

I structure the chapter into three main sections. Section 5.2 highlights the importance of the automotive industry for capitalist development in the 20th century. Its importance continues with the proliferation of EV production today, which depends on state intervention in EV production and consumption, investment in research and product development, as well as building EV charging infrastructure. Section 5.3 describes the main differences between ICE vehicles that run on fossil fuels and EVs powered by batteries. The overall reduced number of components in EVs alters the labour process in vehicle manufacturing, while increased resource use for battery cells, electric motor and charging infrastructure influences labour

regimes and environmental conditions in global automotive production networks. Section 5.4 gives an overview of the implications of these changes. On the one hand, in the core and integrated peripheries, second-tier parts suppliers and first-tier component producers for internal combustion engines (ICEs), transmission and chassis face reduced revenues and labour shedding. On the other hand, large OEMs and multinational automotive suppliers try to reconfigure their supply relationships with resource- and labour-intensive operations in raw material extraction peripheries in Africa and Latin America, as well as with chemical processing and vehicle assembly peripheries in Asia (e.g. China and India), which are at the same time the largest EV markets.

5.2 'Industry of Industries': Vehicle Manufacturing

This section summarises the historical and contemporary significance of vehicle manufacturing for the world economy, the theme I detail in Chapter 6 in the case of the German automotive industry. I then show the involvement of the state in the industry through various dimensions, which I examine in the case of EVs in Chapters 7 and 8. The section ends with mapping the current configuration of global automotive production networks organised around large OEMs and multinational automotive suppliers that dominate local second- and third-tier suppliers. I use this mapping in Sections 5.3 and 5.4 to explain the implications of EV manufacturing on production networks.

5.2.1 'Vehicles' of capitalist development

Underlining the importance of the automotive industry and its contribution to economic growth in industrialised countries, Drucker (1946: 149) called vehicle manufacturing 'the industry of industries'. Capitalist development in Europe, North America and newly developed countries in East Asia went hand in hand with the proliferation of vehicle manufacturing throughout the 20th century. Increasing the motorisation rate, i.e. vehicle number per capita, in countries such as Brazil, Russia, China and India is regarded as a growth strategy for the global automotive industry today, where the business models of large OEMs benefit from high barriers to entry in research, product and technology development (Liu and Dicken 2006; Maxton and Wormald 2004; Wong 2018). For saturated vehicle markets in North America, Japan and Europe facing new vehicle regulations to reduce greenhouse gas emissions, improving alternative vehicle technologies and mobility services are widely hailed as opening

up new ways of capturing profits and rents for the automotive industry (Freyssenet 2009; Holweg and Oliver 2016). Thanks to EVs, large OEMS can pave the way for a phase of growing profits, and potentially facilitate further standardisation of industry interfaces and enhance the modularisation of vehicles (Nieuwenhuis 2015; Wakefield 1994; Westbrook 2001).

Vehicle manufacturing has had profound impacts on the global economy in a number of ways that significantly influenced consumption, organisation and management of production, technological research and development, and internationalisation of production. In terms of consumption, spreading around the world from North America in the early 20th century, vehicle manufacturing was a catalyst for economic growth based on enlarging and connecting local markets, and ensuring personal mobility of consumers between urban and suburban areas in a consumption-based economy (Paterson 2007; Dauvergne 2008). The automotive industry also benefitted from states' military consumption during the two World Wars (Link 2020). Flink (1990) shows how 'the automobile age', beginning in the 1920s ushered in the mass production era in capitalist development and, until 1970s, provided the industrialised countries with manufacturing jobs and economic growth. Today, due to replacing the existing world vehicle fleet with EVs, the global automotive industry is regarded as one the most promising sectors to promote growth and increase consumption levels in both developed and developing countries (Kochan et al. 1997; Freyssenet 2009). Middle- and low-income regions in Latin America, Central and Southeast Asia and Africa, or indeed the whole population in urban centres across the world, can be consumers of new products for 'electrified' private road transport. One example for the former is large OEMs' investments in Indian electric two-/three-wheeler market; examples for the latter are automotive, transport and energy companies' investments in car sharing and leasing businesses, as well as electric bikes and electric scooters for personal transport in urban areas (IEA 2021; VDA 2022), all of which help capitalist consumption move into new areas.

In terms of organisation and management of production, vehicle manufacturing changed the way workers are organised and controlled in large factories. In the interwar period, automotive companies were the pioneers of the new organisational approach to manufacturing — mass production of vehicles by semi-skilled workers assembling standardised parts on a moving assembly line, i.e. Fordism (Braverman 1974; Flink 1990). Engineers and managers from Western Europe and Japan came together in Detroit to

examine what the Ford Motor Company, then the leader in the introduction of the new world of work at factories at an unprecedented scale, did to direct and control the labour process with a large number of workers around a moving conveyor belt equipped with certain machines and tools (Link 2020). This type of organisation of production helped managers decrease workers' say and power in the workplace, as assembly line and management could set the pace and rules of work in manufacturing plants (Braverman 1974; Silver 2003). Fordist mass production spread to other manufacturing industries in the interwar years, but it truly became the industry norm following the Second World War.

The automotive industry updated mass-production techniques from the 1960s onwards and introduced group work and diversified quality production in-house, and lean production in supply chains (Janoski and Lepadatu 2021; Kochan et al. 1997; Wood 1993). Embraced and referred to as Toyotism by automotive-industry funded studies (Womack et al. 1990), large OEMs' cost-cutting techniques with auto parts and component suppliers in developing countries helped the industry to reap the benefits of poor working conditions when its profitability declined due to increased competition, high costs and saturated markets in developed countries (Steinberg 2022; Williams et al. 1994; Wood 1993). Today, both OEMs and multinational automotive suppliers, as lead firms in global automotive production networks, are in the midst of discussions around increasing productivity and changing the organisation of production via new techniques (often called digitalisation or industry 4.0), which is the use of more digitally-controlled robotisation and automation techniques (Haipeter 2020; Mahnkopf 2019). In Detroit, Stuttgart or Tokyo, automotive companies seek ways to lobby the state authorities at various jurisdictions and cooperate with universities in robotisation and digitalisation efforts. This is at the same time a growing concern for workers and trade unions (ILO 2020; IG Metall 2019), partly because vehicle plants can further be robotised and subject to automation with regard to major EV components such as battery packs and electric motors.

In terms of research and development, vehicle manufacturing in the 20th century was considered as a cutting-edge technology given the complexity of the product, especially its modular platform design, fuel efficiency and engine development. This still holds true today as the industry leads on technology around autonomous vehicles, driverless transport and EVs, to meet emission standards and environmental regulations. Multinational companies in

the automotive industry are also seeking to secure raw materials for EV batteries and to help improve new technologies in base metal and chemical processing, due to range- and weight-related issues in EVs (Chappell 2022; Hofer et al. 2012; Olivetti et al. 2017; Thies et al. 2019). In seeking to meet increased raw material and mineral requirements for replacing the world vehicle fleet with EVs, the automotive industry is trying to secure long-term supply arrangements with multinationals operating in mining and extraction of minerals (Bridge and Faigen 2022; EU Commission 2020; IEA 2021; LaForest 2022; UNCTAD 2020).

As for consumption, organisation and management of production, and research and development, vehicle manufacturing is also crucial in internationalisation of production and globalisation of supply chains (Barrientos et al. 2011; Dicken 2015; Sturgeon et al. 2008). American carmakers initially opened assembly plants in the United Kingdom and Europe, and later most OEMs in Western Europe, Japan and South Korea relocated some of their assembly and manufacturing plants to developing countries (Humphrey 2000; Silver 2003). More specifically, the European OEMs did this in Latin America and South Africa, while Japanese carmakers operated in Southeast Asian countries (Sturgeon and van Biesebroeck 2011; Pavlinek 2019). The latest wave of internationalisation of vehicle manufacturing has occurred through joint ventures between large OEMs and state-owned enterprises, in China since the 1980s and India since the 2000s (Liu and Dicken 2006; Nair and Friedman 2021). Similar ventures have occurred between European multinationals' mergers with, and acquisitions of, vehicle manufacturing facilities in transition economies in Central and Eastern Europe since the 1990s (Pavlinek 2015; Gerocs and Pinkasz 2019). Today, large OEMs build strategic alliances and/or large groups through mergers and acquisitions, to coordinate and control small- and medium-sized suppliers in global production networks. This corporate concentration also helps them to lobby states for increased public spending in charging infrastructure and battery material research. Other major roles played by the state for the automotive industry are discussed in the next section. The state was and is the key stakeholder for proliferation of both traditional and electric vehicles.

5.2.2 The state and the automotive industry

The automotive industry has been and remains sustained by state intervention. Like other large sectors of the economy, state involvement in the industry occurs via a variety of tools and policies (Horner 2017; Smith 2015). Smith (2015) argues that the state, at various scales,

plays a vital role in regulating and ensuring capitalist accumulation strategies; the state directly creates new spaces (special economic zones) for globalised production, builds alliances with other states to participate in global production networks, and frames specific enterprise and industrial policies in line with the dominant international institutional framework that enables globalised production. In addition to the role of facilitating global production networks, Horner (2017) summarises other roles of the state — producing for, regulating in, and buying from global production networks.

Pertaining to the automotive industry specifically, large OEMs have been protected against international competition or business cycles throughout the 20th century in leading OECD countries and towards the end of the century in developing countries, since the states consider them as crucial parts of a strategic sector (Dicken 2015; Dauvergne 2008). Some of the large OEMs were publicly owned until the 1960s, and some are now partly (Volkswagen, Renault) or wholly (Chinese state-owned enterprises) owned by the state. The involvement of the state in protecting automotive companies continues into the 21st century. For instance, the USA bailed-out or credited to large OEMs in addition to financial institutions after the 2008 financial crisis (Gamble 2009; Grigolon et al. 2015; Stanford 2010). Similarly, in new vehicle markets, such as China, India and Southeast Asia, industrial policy helped the automotive market to achieve rapid economic growth (Fu and Lim 2022; Luethje 2014; Natsuda et al. 2022; Schwabe 2020; Zhang 2014). In order to upgrade their national economies via strategic coupling that incorporates their workers and firms into the global automotive production networks, local and national authorities in developing and transition countries offer fiscal incentives, tax and land cost exemptions and/or tax relief to investments by large OEMs and multinational first-tier suppliers (Coe and Yeung 2015)

State involvement in vehicle manufacturing includes regulating emissions, promoting EV registrations, implementing local or national bans on registering traditional cars, investing in or holding shares in large automotive companies, and supporting research and development activities at large OEMs or universities that work together in advancing fuel-efficiency technologies, base metals, mineral or chemical research. For instance, the EU member states committed to turning the EU into the first climate-neutral continent by 2050 and pledged to reduce car emissions by at least 55% by 2030, compared to 1990 levels (EU Commission 2020); the USA support local EV manufacturing via additional funds (UAW 2022); UNFCCC (2015) set

the target for 2030 to achieve 100 million EVs in the world vehicle fleet, while at the national scale 14 countries had electric car targets in place by 2017 (Austria, China, Denmark, France, Germany, India, Ireland, Japan, the Netherlands, Portugal, South Korea, Spain, the United Kingdom and the United States (with 8 states)) (IEA 2017: 23). Regarding the most recent products of the automotive industry today, i.e. nascent and relatively expensive EVs, among the biggest consumers are local and national government agencies for passenger cars and commercial vehicles, as well as local public transport providers for electric busses. Moreover, automobile production and private transport are only possible with governments at various levels providing infrastructure for urban areas; through a diversity of fiscal, industrial, commercial, environmental and social policies, states support infrastructural investments for EVs and charging stations (Bakker and Trip 2013; IEA 2021; Kokocinska 2021; Merksy et al. 2016; Mordue and Sener 2022; Tsoi et al. 2022).

In addition to influencing the industry regarding ownership of companies, production and consumption of vehicles, and infrastructure investments, another major area of state intervention includes the 'management,' whether active or passive, of industrial relations in the automotive industry. Corporate decisions to change production processes or relocate plants to cut costs and deal with autoworkers' demands for better working conditions, secured pensions and higher wages are influenced and shaped by national labour market regulations. Across supply chains, there are growing disparities between labour market regulation and institutions, workers' organisational opportunities, and ways in which workers are hired, fired and controlled by employers (Taylor 2007). Silver (2003) draws attention to the relationship between peak times of labour unrest and industry relocation decisions. Today, in China and India, as well as Central and Eastern European countries, regulations allowing or restricting the use of temporary and part-time workers play an important role for the industry (Barnes 2022; Pavlinek 2022; Zhang 2014).

Table 5.1: Average wages and hours worked in key vehicle-producer jurisdictions

Country	Average earning per month, US Dollar	Minimum wage per month US Dollar (before tax)	Average working hours	Share of workers working more than 48 hours
China	880	344	46	
USA	4,500	1,260	35	
Japan	2,260	1,270	36	
Germany	5,100	1,840	34	
India	-	40	46	
Mexico	350	-	39	30%
South Korea	3,200	1,530	39	20%
Brazil	460	190	39	10%
Spain	2,000	1,100	36	10%
France	3,180	1,550	36	10%
Thailand	460	205	40	20%
Russia	635	160	36	
Turkey	360	375	43	25%
Czechia	1,740	680	38	8%
Indonesia	180	110	37	25%
Iran	-	80	42	35%
Vietnam	300	195	42	34%

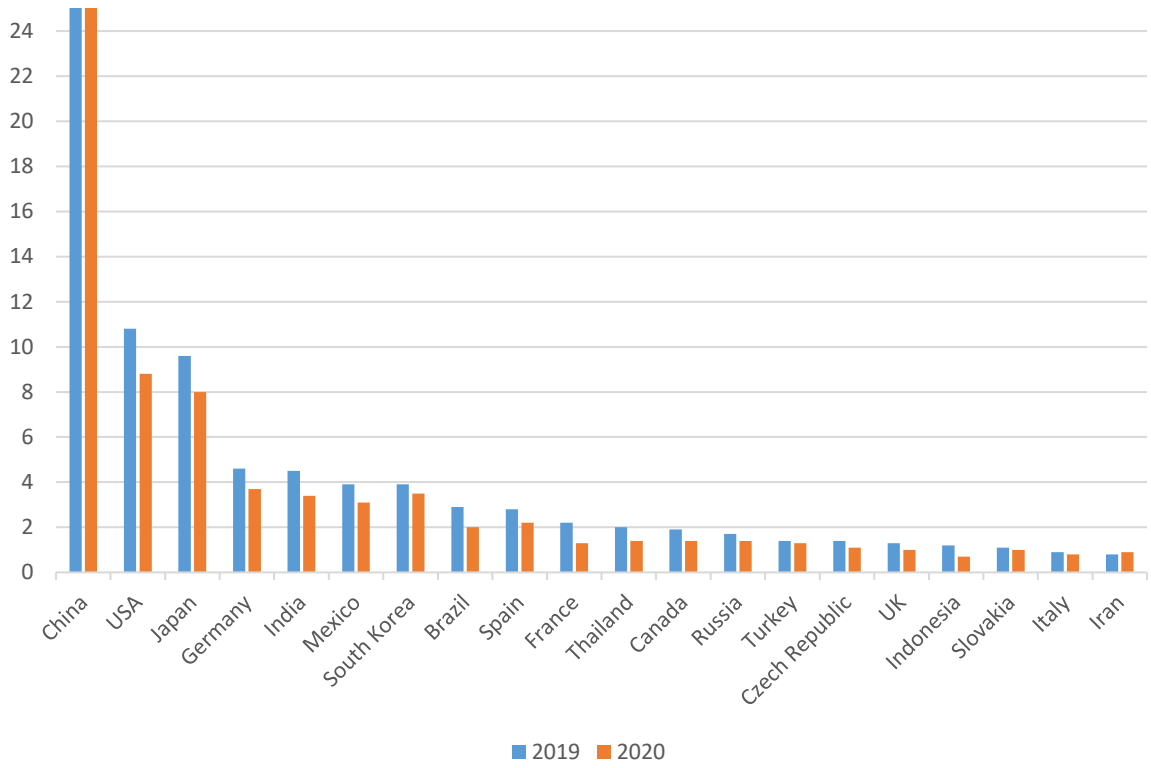
Source: Compiled from data on https://ilostat.ilo.org/data/country-profiles/ accessed on 28/10/2021.

Whereas trade unions or company-level worker representatives in Western countries, South Korea and Japan can, in theory, have some access to decision-making mechanisms regarding the change to EV manufacturing, those employed by outer-tier smaller suppliers and by OEM plants assembling low- and medium-segment vehicles in developing countries are not involved in this process. For instance, joint ventures between large OEMs and Chinese state-owned enterprises largely limit labour influence in production decisions, and leave more room for a massive number of temporary workers (Luethje 2014: 538). Similarly, the automotive industry in India relies heavily on informal labour who lack legal and social protection (Barnes 2022: 337; Nair and Friedman 2021: 27). Sancak (2022) shows that following economic liberalisation and labour market flexibilisation, through NAFTA in 1994 for Mexico and the European Customs Union in 1995 for Turkey, both countries' labour unions suffered from low unionisation rates, weak collective bargaining and marginal influence in decision-making. Both countries display segmented labour markets in the auto industry; workers in large companies and the public sector on the one hand, and those employed by smaller companies in the informal economy on the other. In addition to high informal employment levels, according to the ILO there are big differences in wages and employment conditions among the top vehicle production jurisdictions (Table 5.1). Regarding to the organisation of the global automotive industry, the ILO (2020: 42) underlines 'cut-throat wage competition' in vehicle manufacturing in developing countries, especially at second- and third-tier suppliers to large OEMs and multinationals' first-tier suppliers.

5.2.3 The dominance of large OEMs and multinational first-tier suppliers on geographically dispersed low-cost suppliers

The global automotive industry reached its highest level of production in 2019, when in total 92 million vehicles were produced — 67 million passenger cars and 25 million commercial vehicles (trucks and busses). By 2020 this figure had come down to 77 million, a reduction of 16%, due to the pandemic. However, a crucial point is that the production decreased in North America, Europe, Japan, India and South America, while Chinese vehicle manufacturing decreased only by 2%, from 25.7 to 25.2 million vehicles (Figure 5.1).

Figure 5.1: World Vehicle Production, million units



Source: Compiled from data on the OICA website, https://www.oica.net/category/production-statistics/2020-statistics/ accessed on 28/10/2021.

The dominance of China and Asia in the global automotive industry continued after the pandemic. In 2021, China, with 26 million vehicles, represented one third of the total (80 million); that is higher than the combined vehicle output in the EU (12.2 million) and NAFTA (13.3 million). Asian countries excluding China produced a quarter of the world's vehicles: Japan (7.8 million), India (4.4 million) and South Korea (3.5 million). Only five countries contributed to the world output with more than a million vehicles: Brazil (2.2 million), Thailand (1.6 million), Russia (1.5 million), Turkey (1.3 million) and Indonesia (1.1 million).[39]

The epicentre: OEMs

Automotive manufacturing is essentially an assembly industry (Dicken 2015). A vehicle consists of more than ten thousand components (Sturgeon and Florida 2004; Scannell et al. 2000). Vehicles are among the most complex products manufactured, and the most complex

[39] Passenger cars, light commercial vehicles, trucks and busses, calculated in December 2021 from the OICA data available at https://www.oica.net/wp-content/uploads/By-country-region-2021.pdf

owned by an average household, for which several modules and parts are traded several times across borders (Dicken 2015). Table 5.2 lists broad categories of vehicle components.[40] Large OEMs' core business is designing and developing modules in the first and second columns; they cooperate with suppliers for powertrain, chassis and interiors. A typical OEM facility is primarily engaged in body shop (pressing, welding and painting of the car body) and final assembly of components, while the internal combustion engine, chassis and transmission are made in dedicated OEM plants (Nieuwenhuis 2015: 43). Mainly headquartered in the global triad — North America, Japan and Western Europe — OEMs invest in and maintain facilities for design, research and new product development, and marketing (Sturgeon et al. 2008: 303). They buy from a global set of companies that produce parts and components, extract raw materials and process chemicals.

Table 5.2: Four main groups of vehicle components

Body in White	**Powertrain**	**Chassis**	**Exterior-interior trims**
Frame/body	ICE (prime mover)	Suspension	Seats
Doors-hood-tail gate	Transmission/gear system	Steering components	Cockpit
Sides and pillars	Crank shaft	Tires	Doors

Source: Summarised from Omar (2011: 1-14)

Contrary to the large number and limited size of their suppliers, OEMs are a limited number of very large multinational enterprises (Table 5.3). Because of the mergers and acquisitions and the strategy of economies of scale practised by OEMs, i.e. using same platforms for several brands/marques, which target different vehicle market segments, the global automotive industry reached high levels of consolidation. For instance, the VW Group produces luxury brands such as Porsche, Bentley and Lamborghini, premium brands such as Audi, and middle-segment cars such as VW, Seat and Skoda. The Group also produces sports utility vehicles across the brands, as well as light and heavy commercial vehicles such as pick-ups, vans, trucks and busses by its subsidiaries MAN and Scania. A similar approach, targeting

[40] Parts supplied by second-tier suppliers and used by first-tier suppliers and OEMs in these components include fabric, foam, frames, panels, dashboards, wheels, sensors, wires, plugs, alternators, radiators, fans, lights, airbags, navigation devices, breaks, stamping, fasteners, paint, lenses, mirrors, baskets and bumpers (Sturgeon and Florida 2004:75), all of which require metals, other raw materials, minerals, and various smaller parts produced by third-tier suppliers.

all market segments, is the case for Stellantis,[41] operating with 14 brands, and the alliance between Renault-Nissan-Mitsubishi with a dozen brands, splitting their markets among the three companies, Renault in Europe, Nissan in China and the USA and Mitsubishi in Southeast Asia.

Table 5.3: Revenue of large OEMs in 2021, in billion USD.

OEM	Revenue	Headquarters
Volkswagen	295	Germany
Toyota	281	Japan
Mercedes-Benz (Daimler)	178	Germany
Stellantis	176	The Netherlands
Porsche	151	Germany
Ford	136	USA
BMW	131	Germany
Honda	130	Japan
General Motors	127	USA
SAIC	121	China
Hyundai	102	South Korea
Nissan	79	Japan
Tesla	53	USA
Daimler Trucks	47	Germany

Source: Statista 2022 and company annual reports.

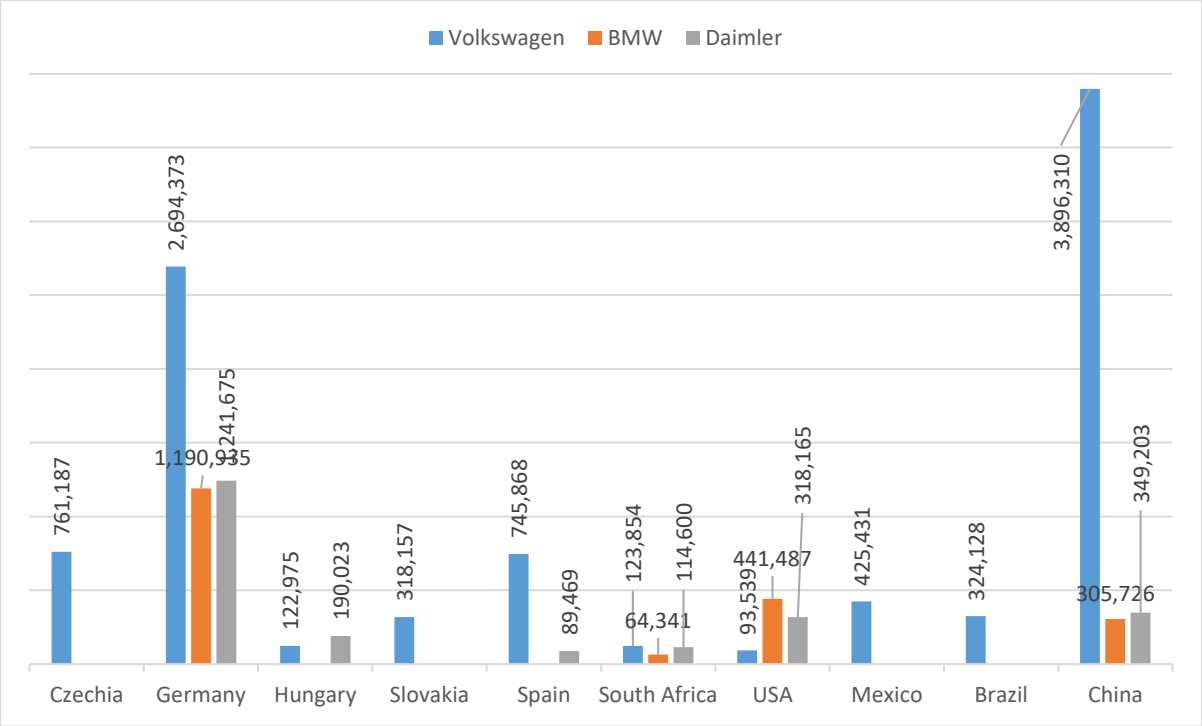
The operations of large OEMs span across several locations, but the key facilities in research and development and the largest workforces are based in their home countries. For instance, of around 660,000 personnel employed at 118 facilities by the VW Group and its joint ventures in China, 44% work in Germany, 31% in European countries, and 16% in Asia-Pacific. Yet, the VW Group also has production locations in the USA, Mexico, Brazil, Argentina, India and South Africa (VW 2021: 152, 158). Stellantis and the Renault-Nissan-Mitsubishi Alliance too have a wide-ranging geography of operations, with their core operations taking place in the USA, Italy, France and Japan, with EVs such as Renault Zoe and Nissan Leaf among the best-selling battery EVs in the world.

Some OEMs, such as the German carmakers Daimler and BMW, mostly produce premium and luxury vehicles. Contrary to the VW Group, Toyota, General Motors or Stellantis, this group

[41] Headquartered in the Netherlands, Stellantis was established in January 2021 following a large merger between Fiat-Chrysler and Peugeot. It produces Fiat, Chrysler, Peugeot, Opel, Citroen, Alfa Romeo, Vauxhall, DS, Abarth, Dodge, Lancia and Jeep.

of OEMs operate a relatively limited number of facilities with a limited product range. However, due to their specialisation in luxury and premium vehicles with more value added by the skilled workforce, they make significant levels of revenue with limited output (Table 5.3). Almost half of their production is in Germany, with significant overseas production in China (Figure 5.2).[42] Still, for some key markets for luxury segment vehicles, such as the USA and UK, producing abroad is also important to provide Daimler and BMW with access to markets. BMW acquired Mini in the UK and established vehicle plants in the USA. Daimler tried a similar model in the early 2000s, using the Chrysler for the North American market. This highlights the key role of consumers and local markets, and once again the important role of the state at the national level regarding regulation of emission standards, different features of trade policy, and industrial policy promoting or discouraging manufacturing industries.

Figure 5.2: Production volume and key locations of German OEMs in 2016.



Source: Compiled from data of OICA.

A final group of OEMs produces a variety of models ranging from premium and mid-range to small vehicles, and including light and heavy commercial vehicles, with a large range of models in their own brands/marques. This group includes Toyota, Ford, General Motors,

[42] OICA stopped reporting on production locations of OEMs in 2017.

Honda and Hyundai. They have significant market shares in almost all key vehicle markets, such as Europe, China and North America, in all vehicle segments. For instance, Toyota tries to maintain its market share in all key vehicle markets; its highest share is in its home country with 52% of new vehicles sold in 2021 in Japan produced in Toyota's 16 domestic locations. However, its presence in other locations is significant too (14% in North America, 9% in China, 6% in Europe, and 12% in the rest of Asia). This is achieved with vehicles produced in 53 overseas facilities in 27 countries, accounting for 70% of non-domestic sales (Toyota 2021: 22-31, 63).

First-tier suppliers

Table 5.4 lists multinational first-tier suppliers used by OEMs and their product groups. Following the classification in Table 5.2 of major groups of vehicle components, I group under *powertrain* internal combustion engine parts, transmission parts, pistons, cylinders, valves, electric motors, batteries and turbochargers. Under *chassis,* I group steering systems, bearings, wheels, brakes, gearboxes and shafts, which are made of iron and steel. Under *electronics*, I group electronic control units, driving and brake assistance, audio-visual entertainment, sensors, lights and cameras. Under *exterior* are glass, hoods, doors, handles and bars. Under *interior* are airbags, plastic, leather and fabric parts. Except for Magna and Aisin, no suppliers produce body, which is the core business of OEMs. There are a few specialised suppliers for wires, seats, air conditioning, fluids, minerals and lubricants.

First-tier suppliers provide OEMs with pre-assembled complex modules (Pavlinek and Janak 2007; Wong 2018). They cooperate with OEMs in designing and setting standards for these components. Therefore, those multinational first-tier suppliers with a very close relationship to OEMs are characterised by the category of '0.5th tier' or 'mega suppliers' (Humphrey and Memedovic 2003: 22; Scannell et al. 2000; Sturgeon et al. 2008), and they are very close to OEMs' research and development operations (VDA 2016: 33). At the same time, these multinational companies have plants across the world that are clustered around assembly complexes of various OEMs (Mondragon and Lyons 2008: 2871; Bennett and Klug 2012: 1291; Holmes 2015: 68; Pavlinek and Janak 2007: 134; Sturgeon et al. 2008: 304).

Table 5.4: 30 largest automotive parts suppliers based on revenue in 2021

Firm	Automotive revenue, billion USD	Headquarters	Parts supplied to OEMs used in:	Share of biggest market in company's sales
Bosch	49.1	Germany	Powertrain, electronics	Asia (42%), Europe (41%)
Denso	43.5	Japan	Powertrain, electronics	Asia (67%)
ZF Friedrichshafen	39.3	Germany	Powertrain, chassis	Europe (45%)
Magna	36.2	Canada	Body, exterior, interior, powertrain, electronics	N. America (46%), Europe (43%)
Aisin	33.4	Japan	Body, powertrain, chassis, electronics	Asia (72%)
Hyundai Mobis	29.1	South Korea	Chassis, interior, electronics	Asia (68%)
Forvia	25.8	France	Seats, interior, electronics	Europe (45%)
Continental AG	24.1	Germany	Chassis, interior, tires, electronics	Europe (48%)
BASF	21.3	Germany	Chemical, coating, plastic, fluids and lubricants	Asia (43%)
Lear	19.2	USA	Seats, electronics	N. America (39%), Europe (35%)
Valeo	16.7	France	Powertrain, electronics	Europe (45%)
Tenneco	15.1	USA	Powertrain, chassis	N. America (35%), Europe (35%)
Yazaki	14.8	Japan	Wires, electronics, air conditioning	Asia (56%)
Sumitomo	14.3	Japan	Electronics, metals and minerals	n/a
Borg Warner	13.9	USA	Powertrain	Europe (35%), N. America (30%)
Yanfeng	13.7	China	Seats, electronics, interior	Asia (72%)
Hitachi Astemo	13.7	Japan	Powertrain, chassis	n/a
Panasonic Automotive	13.7	Japan	Electronics	Asia (49%), N. America (45%)
Mahle	12.9	Germany	Powertrain, electronics, air conditioning	Europe (46%)
Marelli	12.1	Japan	Powertrain, electronics, interior	Europe (35%), Asia (35%)
JTEKT	11.5	Japan	Chassis	Asia (66%)
Motherson	11.3	India	Wires, metals, electronics	Europe (39%), Asia (35%)
Gestamp	10.8	Spain	Chassis, exterior	Europe (57%)
Thyssenkrupp	10.7	Germany	Chassis	Europe (61%)
Plastic Omnium	9.5	France	Exterior, interior	Europe (53%)
Vitesco	9.4	Germany	Electronics, chassis	Europe (45%)
Toyota Boshoku	9.3	Japan	Seats, interior, exterior	Asia (71%)
Dana	8.9	USA	Electronics	N. America (47%)
Schaeffler	8.4	Germany	Powertrain, chassis	Europe (42%)
Autoliv	8.2	Sweden	Seats, interior, chassis	Asia (41%)

Source: Automotive News (2022)

There is a vital difference between multinational first tier automotive companies (also called 0.5th tier, mega, or close-tier, suppliers) and other first tier suppliers. Some of the biggest mega suppliers such as Bosch, Magna, Tenneco, Sumimoto, Continental, Thyssenkrupp and BASF, have a considerable size of operations in other industries independent of car manufacturing.[43] In contrast, most national first-tier suppliers supply almost entirely to OEMs and have smaller operations.[44] The levels of consolidation and market power in large multinational automotive suppliers is remarkable. The three biggest tyre producers (Bridgestone, Goodyear and Michelin) controlled, in 2015, 38 per cent of the global automotive market; this figure was more than 75 per cent for seats (Johnson Control, Lear and Faurecia) and braking systems (Continental, Bosch and ZF Friedrichshafen), while two producers of constant velocity joints (GKN and NTN) had a market share of 65 per cent, and four semiconductor producers (NXP Semiconductors, Infineon Technologies, Renesas Electronics and STMicroelectronics) achieved 40 per cent in the automotive industry (Wong 2018: 4). Germany is home to a considerable number of multinational and national first-tier suppliers. In 2015, almost a fifth of these (18 out of 100) was based in Germany and accounted for almost a fifth (190 billion dollars) of the world automotive suppliers' revenue (751 billion dollars) (Automotive News 2017). Most German automotive suppliers produce for traditional cars.

Up until the 1970s and 1980s, operations of today's multinational and national first-tier suppliers were performed in facilities vertically integrated by the OEMs. These facilities started to dissolve due to three historical developments in the global automotive industry. First, large OEMs changed the organisation of vehicle manufacturing from a continuous assembly line to a combination of final assembly and various attached subassembly lines. Subassembly lines produced major components such as gearboxes, seats, drive shafts and electronic control units (Hartley 1981; Omar 2011; Wong 2018). To cut costs, subassembly lines were transferred to the ownership of different suppliers, to leverage lower wages and

[43] The share of total sales to OEMs is not dominant for these suppliers: approximately 44 of 77 billion euros for Bosch, 31 of 44 billion euros for Continental, 11 of 41 billion euros for Thyssenkrupp, 10 of 64 billion euros for BASF (Automotive News Magazine (2022) Global Automotive Supplier Rankings and firms' annual reports).

[44] For some suppliers, their dominant share of sales is to OEMs: approximately 29 of 36 billion euros for ZF Friedrichshafen, 10 of 13 billion euros for Schaeffler, and 11 of 12 billion euros for Mahle (Automotive News Magazine Global Automotive Supplier Rankings and firms' annual reports).

often non-unionised workforces (MacDuffie 2013: 15; Sturgeon and Florida 2004: 62). Increase in modularity in vehicle final assembly by large OEMs enabled de-verticalization of some tasks from OEMs to suppliers (Humphrey 2000: 247; Sturgeon and Florida 2004: 54). Most of these spin-off companies are now standalone companies that have reached global levels of operations (Maxton and Wormald 2004: 146). Second, to reach greater economies of scale and increased standardisation in major trading blocs such as the European Single Market or the North American Free Trade Area, these suppliers accelerated standard consolidation and aimed to produce complex modules and components for a number of OEMs at the same time (Dicken 1992; Humphrey 2000; Nolan et al. 2008). The third factor was the need for the European and North American OEMs and their first-tier suppliers to respond to competition by Japanese automotive companies. Toyota, Honda and Nissan each controlled a large number of smaller suppliers in Southeast Asia without any vertical integration or ownership (Jacobides et al. 2016: 1949; Steinberg 2022; Wood 1993).

Second and third tier suppliers

Dealing with such a high level of complexity in supply relations as well as products, OEMs and multinational first-tier suppliers control geographically and institutionally diverse production networks (Humphrey 2000). In 2021, Ford had a network of indirect suppliers that reached around 13,000 companies, of which around 1,000 were first-tier suppliers working directly with the carmaker (Ford 2021: 55). In 2020, the VW Group used a rating system on 13,041 suppliers, covering three-quarters of the Group's total orders (VW 2021: 150). The share of the inputs supplied to OEMs is very high. For instance, in 2019 the cost of sales for the VW Group reached 203 billion euros (VW 2021: 364). This corresponds to 80% of its overall sales revenue of 252 billion euros.[45] The cost of sales in 2021 was 84% of Ford Motor Company's sales revenue of 136 billion USD (Ford 2022: 110). In the financial year ending in March 2021, the cost of products Toyota Motor Company sold stood at 84% of its sales revenue (Toyota 2021: 66).

Second-tier suppliers produce smaller and less complex components for modules that are mostly produced by first tier suppliers, but some also supply parts directly to OEMS (Maxton and Wormald 2004: 152). Third-tier suppliers produce standard and technically basic inputs for the first- and second-tier suppliers. Third-tier suppliers, as local content providers to the

[45] The VW Group had a similar rate in cost of sales to sales revenue in 2020, 82% (VW 2021: 364).

first and second tiers, are subject to high levels of cost competition (Humphrey 2000: 267). Neither the second-tier nor third-tier automotive parts suppliers are involved in design and R&D processes; they instead follow directions given by close-tier mega suppliers and first-tier national suppliers (Sturgeon et al. 2008). In other words, most produce for a limited number of markets or indeed one national market such as the Brazilian, Turkish or Mexican auto parts industry (Humphrey 2000: 267; Humphrey and Memedovic 2003: 22), these outer-tier automotive parts suppliers are SMEs that are under the control of first-tier suppliers in their respective locations. These SMEs can also be subject to the control of multinational first-tier suppliers in their respective regions: for instance, Faurecia, Valeo, Bosch or Siemens in Europe; Johnson, Lear or Magna in North America; and Denso, Aisin or Hyundai Mobis in Asia have considerable leverage in their relationships with second- and third-their suppliers (Jacobides et al. 2016: 1948; McDuffie 2013: 16-17; Natsuda et al. 2022: 221). Trying to cope with low-cost-based competitive pressures from large OEMs and these multinational automotive companies, SMEs producing basic parts at outer tiers pay their employees considerably less than the average in the automotive industry. Most of the employees of SMEs work informally and/or under precarious contracts (Barnes 2022: 326; Campling et al. 2019: 144; Sancak 2022: 89; Sturgeon and Biesebroeck 2011: 194).

Base metal and mineral suppliers

Base metal suppliers for the global automotive production networks provide the basics common to many goods or services produced in the world economy. These include companies in resource extraction, raw material and mineral mining and chemical processing, as well as agriculture. Extraction, mining and processing are vital for vehicles and related components (Table 5.5). Agriculture in large plantations and other enterprises provides vehicle manufacturing with rubber, cotton and leather.

These activities, at the last tier of automotive supply chains, prepare inputs for any automotive product and service, mostly for both OEMs and first-tier suppliers, which are often in close cooperation for research and development in relation to the use of resources, materials and minerals (IKA 2014: 16-18). Among most important of these raw materials are iron, steel, aluminium, copper, brass, zinc, glass, plastic, resin and rubber (Omar 2011: 269; Mallick 2010: 4). OEMs then process these materials at foundries, melting and casting iron, steel, aluminium and copper into vehicle body and powertrain (Hartley 1981: 2). Some metals

are strengthened with other chemicals, for instance steel is strengthened for security in stamping processes (Omar 2011: 46). Multinational and national first-tier automotive suppliers acquire these inputs from international commodity markets or large international traders, as well as directly from large multinational mining and chemical companies (Bridge and Faigen 2022; Gibbs 2022; LaForest 2022; UNCTAD 2020). I explain the implications of EVs on base metal and mineral suppliers in Section 5.4.2 below. This node of global automotive production networks acquires new relevance and greater resource-intensity with the proliferation of EV production, especially in lithium-ion battery packs.

Table 5.5: Material distribution in ICE passenger vehicle

Material	Percentage of Vehicle Weight	Major areas of application
Steel	55	Body structure, body panels, internal combustion engine and transmission components, driveline components
Cast iron	9	Internal combustion engine components, brakes, suspension
Aluminium	8.5	Internal combustion engine block, wheel
Copper	1.5	Wiring, electrical components
Polymers (plastic) and polymer matrix composites	9	Interior components, electrical/electronic components, under-the hood components,
Rubber and Elastomer	4	Tires, trims, gasket
Glass	3	Glazing
Other	10	Carpets, fluids, lubricants, etc.

Source: Mallick P K (2010: 4)

5.3 Key Differences between Traditional and Electric Vehicles

In this section, I compare the key component groups of ICE vehicles and EVs, in order to understand the impacts of changes in vehicle architecture and the labour processes. There are three different types of EVs[46] — battery electric (BEVs), hybrid electric, and fuel cell electric (FCEV).

[46] EVs are, in fact, older than traditional ICE vehicles. The first EV, an independently moving carriage for passengers, appeared in 1835. This ran only for a short distance on a Volta pile, the first type of storage of chemical energy in batteries, which was invented by Alessandro Volta in Italy in 1800, following 18th century experiments by Luigi Galvani from Bologna. The voltaic pile was not a rechargeable battery and so the vehicle could only go for a short distance. The distance travelled by electric vehicles widened thanks to chargeable battery technology, lead-acid batteries, which are very large and heavy (Westbrook 2001). Up until the turn of

BEVs run only on electric motor(s) powered by battery packs. The battery pack can be charged externally at charging stations (home, street etc.). There is no ICE in BEVs.

Hybrid EVs have both ICE and electric motors. The battery pack powering the electric motor can be charged in two ways: earlier examples of hybrid EVs could not run only on the electric motor; rather their electric motors, powered by a small battery pack, support the ICE and are charged internally by energy regeneration during driving and braking; recent hybrid EVs, on the other hand, can be charged externally, and are thus known as plug-in hybrid EVs (PHEVs). They can run on only the electric motor, and only on ICE.

FCEVs run on an electric motor powered by a battery pack. The battery pack is charged only internally, by a fuel cell. The fuel cell produces electric energy with hydrogen from an internal tank and oxygen from the air (ELAB 2012: 17-23; IKA 2014: 9, 55-56). The major difference between FCEVs and BEVs is that the former is far less efficient in channelling power to propelling the vehicle, with overall efficiency of 26% compared to that of BEVs at 69% (NPM 2019: 27). Compared to the other types, BEVs, the most common EV type, are projected to increase their share of the global EV fleet, which consists of a much lower number of parts and components (ELAB 2012, 2018; IKA 2014). This has a dramatic impact on vehicle manufacturing and implications for suppliers and labour in global automotive production networks, on which this section elaborates based on technical and material characteristics of EVs and ICE vehicles.

5.3.1 Key component groups in ICE vehicles

Figure 5.3, below, shows the six component groups in an average small/medium sized passenger ICE vehicle, in the order of their share in the total cost of manufacturing.

First, the *interior* includes cockpit, seats, air conditioning, textiles/leather, door/window units, panels and seat safety. This is the core business of multinational first-tier suppliers controlling a large number of national first-tier, and other second- and third-tier suppliers.

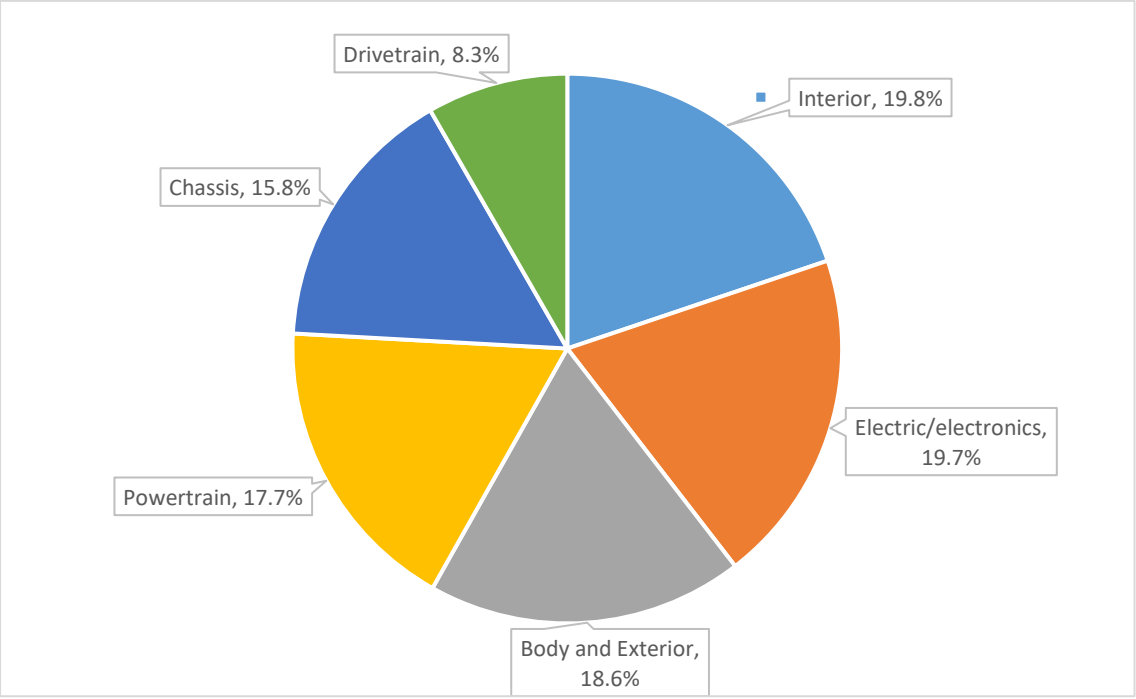
This governance mechanism in global automotive production networks applies to the second component group, too, *electric/electronics*. This group consists of wiring, power electronics,

the 20th century, there were more electric vehicles in the world vehicle fleet than those run on ICE, which were developed at the time as sports and racing vehicles. With the invention of lithium-ion batteries in 1980 by Sony, and their commercialisation in the 1990s, the possibility for a greater range travelled by EVs was apparent.

drive electronics, comfort electronics, security electronics, electric supply and entertainment. For both these groups, interior and electrical/electronics, a large number of suppliers produce various parts and units in harmony with the standards and requirements set by multinational first-tier suppliers.

Third, the *body and exterior* are the major core business of OEMs, which includes design and production of a vehicle's main body. By deciding on a vehicle's architecture, with specific size and positioning of components, large OEMs can control suppliers via various component specifications and standards. Moreover, design and marketing gives OEMs the upper hand even against their multinational first-tier suppliers, as it helps them to identify, control and manipulate customer choice in distinct markets.

Figure 5.3: Cost of component groups in ICE vehicles



Source: IKA (2014: 21 and 33).

Fourth, the *powertrain* includes ICE, motor management and cooling, fuel control system, air supply, exhaust system and ancillary units. Unlike the interior and the body, the control of which belongs to large multinational first-tier suppliers and OEMs respectively, in global automotive production networks, network control and division of labour for the powertrain group depends on the unit. For instance, while manufacturing ICE, motor cooling and management are the core business of OEMs, the fuel control system is a unit of multinational

first-tier suppliers. However, first-tier national suppliers and/or second tier suppliers manufacture exhaust system parts or other ancillary units.

Fifth, the *chassis* group is a shared core business for OEMs and multinational first-tier suppliers. They closely cooperate in the production of braking systems, suspension, steering systems, axles, wheels and tyres.

This governance mechanism applies to the sixth component group as well, the *drivetrain*. Both large OEMs and multinational first-tier suppliers lead smaller suppliers in the production of transmissions, gearboxes, propeller shafts, clutches and differentials that are used in the drivetrain.

EVs bring changes not only to OEMs but also to any type of automotive supplier. Table 5.6 summarises these changes. It shows how units of ICE vehicles are dropped, changed and maintained in EVs. Unlike in Table 5.2 above (Omar 2011), for a more detailed analysis, powertrain and chassis are separated here into three component groups (powertrain, drivetrain and chassis), and an electrical/electronic parts group is introduced. This is useful in order to see a more detailed picture of traditional ICE vehicle components and later compare them with EV components. With EVs, several units are introduced to different components groups, which are highlighted in yellow. These include battery or power electronics. Changes required, such as wiring or drive electronics, are underlined, and ICE vehicle units that are dropped in BEVs, such as ICE or transmission, are listed as strikethrough.

Table 5.6: New, changed, and ~~dropped~~ units of ICE vehicles in component groups of EVs

Powertrain	**Drivetrain**	**Body and Exterior**	**Chassis**	**Interior**	**Electric/ Electronics**
~~ICE~~ Electric Motor (also acting as generator) Battery Pack Fuel Cell Hydrogen Tank	~~Transmission~~ ~~Gear System~~	Body (additions such as carbon-fibre parts ~~Some dropped frames~~)	Braking system (minor change)	Cockpit	Wiring system (changes to low voltage cables) High Voltage Wiring System Power electronics module for AC/DC conversion
~~Motor management~~	Input and propulsion shafts	Passenger saloon	Suspension	Seats	
~~Fuel system~~	Differential system for tyres	Doors	Steering system (minor change)	Air conditoning	Drive electronics
~~Motor cooling system~~	Propeller shaft	Glass	Axles	Doors and window units	Electric supply
~~Air supply system~~	Clutch and coupling	Lights	Wheel	Textiles/leather	Comfort electronics
~~Exhaust system~~		Add-on components	Tyres	Panels	Communication and entertainment
~~Ancillary units~~				Seat safety	Security electronics

Source: IKA (2014), ELAB (2012, 2018).

5.3.2 Dropped, new and changed units in EVs

Major units in component groups of ICE vehicles that are dropped and changed in EVs belong to the powertrain and drivetrain, which in total correspond to more than a quarter of the total cost of a small- and medium-sized ICE vehicles (IKA 2014). The key unit dropped in the powertrain is ICE, which is the prime mover of a traditional fossil fuel burning vehicle. An electric motor replaces the ICE — the most complex mechanical unit, made mostly of iron and steel, and a battery pack as the power source in EVs replaces the fuel tank and related units. The key units dropped in the drivetrain are the transmission and gearbox. Since the electric motor can power the drivetrain with a single gear or a limited number of gears, complex transmission systems are dropped; in the case of a two-gear system, a smaller and simpler transmission is required (ELAB 2012: 142). These are big changes, because, in addition to the dropped ICE in BEVs, the lack of complex transmission and gearbox systems decreases the number of mechanical parts dramatically. Both the electric motor and the battery pack are additional components in PHEV, as a transitioning product.

OEMs, as well as large multinational first-tier suppliers, produce ICE and transmission units, so the shift to EVs influences their relationships. EVs also do not require other units produced by national first tier suppliers, such as fuel injection control and optimisation systems. This brings a key change to the configuration of automotive production networks. Smaller first-tier and second/third-tier suppliers risk losing revenue and labour shedding in these units, including valves, pistons, air and oil filters, alternators, starters, turbochargers, fuel pumps, catalysts, exhaust systems, tanks and others (ELAB 2012: 122). In other words, dropped units in EVs not only affect the relationship between OEMs and multinational first-tier suppliers, but also that between smaller first-tier suppliers and a myriad of second- and third-tier regional suppliers.

With regard to new units, the electric motor (induction motor) in an EV is powered by the battery pack, which is charged either internally by a fuel cell or externally by the electricity grid. Electric motor, battery pack, fuel cell and power electronics are not likely to fall into the business areas of smaller suppliers. As detailed below in Section 5.4, these are highly complicated units, for which smaller suppliers' financial and investment skills, knowledge and absorptive capacity would be limited. Thus, there is the potential that automotive production networks shrink to a smaller supplier base once BEVs follow the short-term transitioning

period with PHEVs. With PHEVs the smaller suppliers, of course, do not lose out due to the presence of both powertrain component groups.

In addition to the electric motor, fuel cell and/or battery pack, there are three other main units for the new propulsion system that require some changes (ELAB 2012: 27-28). First, a high-voltage wiring system facilitates the movement of electric energy and charging. This has implications in relation to skills for the workforce in OEMs assembling EVs and battery packs. Second, an electric conversion is needed to perform the transition between alternating and direct currents (IKA 2014: 49). Thus, EVs have a very sophisticated power electronics unit (ELAB 2012: 80; ELAB 2018: 34). This impacts the two dominant groups and their workers in automotive production networks; both OEMs and multinational first-tier suppliers can take on these tasks (Personal contacts at OEM and suppliers). Third, carbon-fibre material should be used in the EV body, due to the heavy weight of the battery pack and security requirements of the hydrogen tank in the case of fuel cell EV (ELAB 2012: 28 and 101-102; IKA 2014: 114). This is the core business of OEMs, and it does not significantly change the labour process in body-shop plants designing and producing vehicles' main structures (Personal contact at OEM).

Changes with EVs are also needed for the adjustment of the body of the vehicle. For instance, shafts attached to the electric motor moving the vehicle need to be adjusted. Contrary to the new key roles of the electric motor as prime mover and battery pack as power source in BEVs, and the need for a more complex power electronics unit, no change is required for most of the interior (cockpit, seats etc.) and exterior (lights, glass) parts of the vehicle; similarly, chassis (suspension, brakes etc.) remain almost the same.

5.3.3 Impacts of EV types on vehicle manufacturing

Despite the crucial role of the state in the roll-out of EVs and the required investments in building charging infrastructure, the implications of the shift to EV manufacturing depend on decisions by the OEMs and their multinational first-tier suppliers to prioritise among the three types of EVs. Decisions can depend on struggles for dominance in the global automotive production networks. For OEMs and large multinational first-tier suppliers, the emergence of new firms in the industry new OEMs, established battery producers, key commodity miners and chemical processors — can be a potential threat to the existing power balance in the global automotive industry. The emergent and contested reconfiguration of global

automotive production networks due to EV manufacturing has important implications also for smaller suppliers.

PHEVs have two propulsion systems (both ICE and electric motor), which is a disadvantage to OEMs due to increased component costs (Westbrook 2001: 190). However, this EV type might be the best way to transition, when considering workers' demands in car manufacturing and meeting customers' range expectations, as well as waiting for the state to prepare the necessary infrastructural adjustments. Due to the fuel cell and hydrogen tank, in addition to the battery pack, FCEVs have a considerably more complex structure, similar to that of PHEVs (ELAB 2012: 18). Both PHEVS and FCEVs maintain the necessity of inputs from first-tier national suppliers and smaller suppliers at the second and third tiers of global automotive production networks.

Contrary to PHEVs and FCEVs, BEVs run only on an electric motor powered by a battery pack. This can be seen as an advantage for OEMs in reducing the labour input in vehicle assembly, and for large multinational first-tier suppliers in reducing supplier costs. BEVs can be produced more easily in product-based layouts. This layout form is for simple and repetitive operations that are carried out on single-type and high-volume products (Omar 2011: 290). The movement of the assembly line requires less planning and scheduling, and limited training for workers, thus less skills (Personal contact at OEM). Another possible advantage of BEVs for OEMs is their simplicity leading to more space for an enlarged battery pack to meet the range demands.

However, this simplicity and the lack of ICE in EVs renders advanced fuel efficiency and ICE technologies at OEMs gradually obsolete, making it a major disadvantage for the dominant companies in global automotive production networks. Furthermore, this makes it easy for the new entrants and smaller OEMs to manufacture EVs. Yet, battery technology prevents this; the close relationships between the incumbents, commodity miners/traders and battery producers in the production of EVs promises a consolidated power structure in the industry. Should this be advanced and maintained in the shift to EVs, BEVs could be a major source of shifting environmental impacts to the last tier of the base metal and mineral suppliers, and some of the labour process in vehicle manufacturing to China, while keeping OEMs and some of the multinational first-tier suppliers intact in business.

5.4 Implications of the Emergence of EV Manufacturing for the Global Automotive Industry

The difference between EVs and traditional cars is far from technical. The proliferation of EV manufacturing can create favourable conditions for the dominant automotive companies and some suppliers, while increasing competition and shrinking profits for others. Large OEMs announce that they will increase BEVs' share in their EV output and gradually leave PHEVs. Manufacturing PHEVs is very useful as a transitioning corporate strategy by the incumbents that make use of established capital, investment, technology, labour and skills for ICE vehicles. BEVs already represent the major share of the 16 million EV fleet on the road globally, 80% in China, 65% in the USA and 55% in Europe (IEA 2022: 16-18). A large part of the rest in global EV fleet is PHEVs. FCEVs are in the minority among the three types. BEVs are small- and medium-sized vehicles, while PHEVs are mostly marketed as sports utility vehicles with longer ranges.

The proliferation of EV manufacturing also influences two other large workforces, which are outside the limits of this thesis. First, the reduced number in components of EVs affects workers in service jobs at maintenance workshops and fuel stations (Interview with industry representative; EUROFOND 2018a). This is a shared concern by labour: 'Differences between charging stations and fuel stations would likely cause jobs losses' (Interview with the local trade union office). Second, EVs will have an impact on energy generation facilities and contribution of renewable energy sources to the electricity grid, via both electricity consumption and storage (IEA 2018). The key factor contributing to local unemployment is that such tasks are either lost or will be performed with less labour input at new EV charging stations or through battery replacement units by large companies.[47] Finally, although outside the scope of the research, another key topic raised by the interviews and personal contacts, as well as industry and government reports, is the source of electricity for charging batteries, i.e. renewable, coal/gas plants etc. The picture is not really good in this regard as, according to IEA, the levels of fossil fuel use for power generation is not declining, even though its share is not rising, due to major deployment of renewable electricity generation. Below, I continue

[47] Energy companies such as Total, Shell and others began investing in EV charging infrastructure and cooperating with the state and the EU authorities. Similarly, the US subsidiary of Volkswagen announced that it was investing in developing EV charging infrastructure for its branch to operate in the USA soon.

with my analysis of changes to manufacturing sector jobs with differentiated skill levels and employment contracts at OEMs and their big suppliers.

5.4.1 Insights on employment

Following the projections on the larger share of BEVs in EV market after the initial phase of adoptions (ELAB 2012, 2018; IKA 2014), which is to be cushioned by PHEVs, there will be major redundancies in the industry at OEMs, powertrain and drivetrain component suppliers, as well as smaller suppliers. It is important to know how ICE and transmission workers will be employed in restructured EV and battery plants. Major losers in the EV transition surely are metal and mechanical trades, while winners could be electric/electronic-units-related jobs (ELAB 2012: 200). Though stamping and welding of steel panels with some carbon-fibre content might require compensation, these processes are the least labour-intensive and mostly R&D focused, and contributions to mitigate redundancies in skilled and semi-skilled jobs are limited.

Both the OEMs' and the governments' leaning towards BEVs causes major job losses in skilled and semi-skilled trades in the production of ICE and complex transmission systems, which are carried out by OEMs and multinational first-tier suppliers. More crucially, whether OEMs will produce or outsource battery production is key for existing workers. However, it is possible to argue that projected and announced investments and acquisitions in Europe and North America by the Chinese, South Korean and Japanese battery producers, as well as demands from national governments, trade unions, and the European Commission to have some modes of battery supply chains, can limit the loss of manufacturing jobs. The extent to which battery cell manufacturing and/or assembly in these new facilities will be robotised and automated is also, as yet, unknown.

As products of an established sector in the machinery industry, electric motors[48] are used in residences, commercial buildings, agricultural machines, industrial machines, transport and energy industries (IEA 2011: 18). The sector is dominated by established industrial machinery companies from industrialised countries, such as Siemens, Bosch, General Electric, Hitachi, Mitsubishi, ABB, Johnson Electric and GKN, some of which, including Bosch and GKN, already supply electric motors to OEMs. Other multinational first-tier automotive suppliers, such as

[48] The global electric motor market is expected to grow from 113 billion USD in 2021 to 180 billion USD in 2028 (https://www.fortunebusinessinsights.com/industry-reports/electric-motor-market-100752).

Continental, ZF, Schaeffler and Mahle, are looking into this and invest in electric motor production to compensate their losses in parts they currently supply for ICE, which will be dropped. Similarly, power electronics is also an established sector; electric/electronic components are produced by multinational first-tier suppliers (see Table 5.4) and used by OEMs in vehicles. In contrast to the mostly established nature of electric motor and power electronics production, the structure of global traction battery production is changing rapidly.

Battery pack consists of several battery cells that are produced by established global companies such as Panasonic, LG, SK Innovation and Samsung, lead firms in lithium-ion battery production networks. There are also new battery cell producers and pack assemblers, such as CATL and BYD; these are Chinese firms that have been growing exponentially in the last two decades, following increasing demand for batteries in EVs and financial support they receive from the Chinese state. The top three battery producers — CATL from China, LG Energy from South Korea and Panasonic from Japan — account for 65% of global battery production (IEA 2022: 151). Three quarters of global lithium-ion battery production takes place in China, which also has 70% of global cathode[49] production capacity and 85% for anodes,[50] the two key components of batteries (IEA 2022: 6-7). The European Battery Alliance, established in 2017 by the EU to lobby for private and public funds for EVs, aims, by 2030, to bring one third of global lithium-ion battery production to Europe (Bechberger et al. 2022: 10-11). Bridge and Faigen (2022: 5) estimate that European battery production capacity can increase from 28 GWh in 2020 to 368 GWh in 2025, raising its 6% of global battery supply to 22% and decreasing China's share to 65%. So, there emerge regional or local start-ups and newcomers such as Northvolt, Britishvolt, Akasol, Voltabox and Nio; these are also supported through joint ventures by OEMs and through research and investment funds by EU member states. Finally, large OEMs such as Daimler, GM, BMW, and Renault invest in battery-pack assembly (Bridge and Faigen 2022: 10).

Despite the differences among the three types of EVs, they all share key material and technical characteristics when it comes to the labour process in existing vehicle assembly

[49] Seven companies produce 55% of global cathode materials; these include Sumitomo (Japan), Tianjin B&M Science and Technology (China), Shenzhen Dynanonic (China) and Ningbo Shanshan (China) (IEA 2022: 150).

[50] The top-six companies are Chinese and account for two-thirds of global anode production. The largest players include Ningbo Shanshan (China), BTR New Energy Materials (China) and Shanghai Putailai New Energy Technology (China) (IEA 2022: 150).

plants and key component production sites. This is the ability of OEMs and their large close-tier suppliers to decrease the labour input in EV manufacturing. This applies to production of battery cells, assembly of battery packs and production of electric motors. Trade unions in developed countries, including IG Metall in Germany, are concerned with possible job losses due to the fact that an internal combustion engine has about 1,200 parts, while an electric motor only has around 200 (Vidal 2017). Most recently, Ford announced that, in order to make sure that its existing workers continue to have a role in restructured plants for EVs, the OEM should produce more parts in-house (Bushey 2022; Nilsson 2023). Manufacturing of battery cells, performed by mostly Japanese, South Korean and recently Chinese companies in China, does not require the same level of skills and demand for labour; however, assembling battery packs does, which should be brought to Europe (Personal contact and works council member at OEM).

5.4.2 Major changes to material extraction and chemical processing

EVs bring about major changes to resource extraction, raw material mining and chemical processing. Electric motors, fuel cells and batteries require high levels of natural resources. This is due to their larger mineral and material requirements, as well as the necessary infrastructure changes. According to a teardown study of a medium sized EV and its counterpart ICE vehicle by UBS (2017), the former consists of an additional one kg of rare earth elements, 70% more aluminium, 80% more copper, 7% less steel and 60% less iron. According to Harper et al. (2019), Keppeler et al. (2021) and Castelvecchi (2021), limited recyclability of lithium-ion batteries, fuel cells and electric motor materials and minerals brings additional burden on the environment.

Table 5.7 shows major environmental implications of EV component groups. Despite lower use of natural resources due to the lack of or simpler transmission systems, EVs necessitate higher natural resource use in all other key component groups, as well as higher resource and land use for charging and infrastructure. First, batteries and electric motors replacing ICE in the powertrain rely on various raw materials and elements, which include copper, graphite, manganese, lithium, cobalt, nickel and silicon (EU Commission 2020: 11), as well as rare earth elements (REEs) such as dysprosium, neodymium, praseodymium and terbium (EU Commission 2018: 48). Second, changing the body and chassis to decrease vehicle weight requires more use of lighter-weight resources such as aluminium, manganese and carbon

fibres (ELAB 2012; Chappell 2022). Third, extraction and mining of these natural resources, as well as processing them in chemical plants, demands energy-intensive processes (Hawkins et al. 2013; Morgan 2020). Fourth, the natural resources used in batteries, fuel cells, electric motors and lighter-weight vehicle bodies are not as recyclable as the iron, steel and aluminium used in ICE vehicles (Olivetti et al. 2017; Castelvecchi 2021).

Table 5.7: Material and environmental implications of EV components

Component group	Environmental implications
No or basic transmission	Decrease in resource use: • Iron and steel
ICE vs. battery, fuel cell and electric motor	Increase in resource use: • Materials, minerals and REEs • Battery waste and recycling problems • Biodiversity loss and societal impacts of resource extraction and mining
Power electronics	Increase in resource use: • Materials, minerals and REEs for electronic chips
Chassis and body	Increase in resource use: • Aluminium • Manganese • Carbon fibre composites
Charging infrastructure	Increase in resource and land use: • Materials, minerals and REEs for electricity grid • Land use for charging stations

Source: Compiled from DERA (2016, 2021), EU Commission (2020), IEA (2022), USGS (2018, 2021), Westbrook (2001).

In general, most of the key natural resources required for EVs are extracted and mined in Latin America, China and Africa, and are often refined and processed in China. 40% of global copper was mined in 2018 in Chile and Peru; China and Chile refined, in that year, half of all global copper (DERA 2021: 51). The geography of graphite is much more concentrated. Close to three-quarters of world graphite was mined in 2019 in China (USGS 2021: 73) and 80% of refined graphite was exported in 2018 from China (DERA 2021: 48). In 2019, South Africa, Gabon and Ghana mined half the world's manganese (USGS 2021: 105); in 2018, China processed close to two-thirds of the world's manganese (DERA 2016: 54). Most lithium mining

took place in 2019 in Australia (52%), Chile (22%), China (12%) and Argentina (7%) (USGS 2021: 99), while two-thirds of lithium processing occurred in China (Bridge and Faigen 2022: 4). Cobalt is the most geographically concentrated natural resource used in EVs, with 70% of its mining taking place in the Democratic Republic of Congo in 2019 and 2020 (USGS 2021: 51). In 2018 close to two-thirds of cobalt processing happened in China (DERA 2021: 50). When it comes to nickel, another key material for batteries, like lithium, cobalt and manganese, the centre of resource mining shifts from Latin America and Africa to Southeast Asia. In 2019, Indonesia, New Caledonia and the Philippines accounted for more than half of the world's nickel mining (USGS 2021: 113); despite China's leading role (32% in refinery and 53% in nickel oxide production), nickel processing is geographically widespread with Indonesia, New Caledonia, South Africa, Malaysia, Japan, Canada and Germany involved (DERA 2021: 56).

Similar to graphite, rare earth elements are also an important part of China's involvement in the international division of labour in natural resource extraction and processing for EVs; in 2018 the country accounted for 69% of extraction and 86% of refinery (DERA 2021: 61). Finally, 68% of silicon production of was also concentrated in China (USGS 2021:149). Rare earth elements (REEs) are actually abundant in the world, but they exist in other material and mineral ores, so they are difficult to mine and obtain from the mix of various other rock, carbonites, alkaline and clay deposits (USGS 2018: 133). This applies to silicon as well, the source of which is silica, abundant geographically (USGS 2018: 149). Intensive energy use, dire environmental impacts of processing and working conditions in chemical plants are what make China the leading location to produce REEs.

5.5 Conclusion

In this chapter, Section 5.2 mapped out the existing structure of the global automotive production networks and showed crucial historical involvement (in ICE vehicles) and contemporary role (for EVs) of the state for vehicle manufacturing. The role of the state continues through various industries and enterprises, as well as consumption policies; its major contribution to the proliferation of EV manufacturing happens in establishing incentives for production in, and funds for research and development on, EV batteries. Understanding the role of the state and the existing map of the global automotive industry is

useful for my thesis, before I analyse, in the next chapter, the historical roles of workers, companies and the state in transitioning periods of the German automotive industry, and their current roles in Chapters 7 and 8. Ongoing and/or future reconfiguration of the global automotive production networks with EVs will be shaped the dominant actors —OEMs, their multinational first-tier suppliers and the state.

Section 5.3 explained key material and component differences between ICE vehicles and EVs, which decrease the roles and thus profits of smaller first-tier and second-tier suppliers, and enhance those of large base-metal and mineral suppliers. The OEMs and multinational first-tier suppliers have conflicting interests in occupying new nodes in production networks, such as manufacturing battery cells and assembling battery packs in industrialised countries, where the state, at various scales, pushes for industrialisation to achieve better competitiveness in EVs, and thus continued capital accumulation in their jurisdictions. Chapter 7 elaborates on this.

Section 5.4 shows that the proliferation of EV manufacturing is based on an increased natural resource use in vehicles, which influences other locations extracting, mining and chemically processing raw materials, minerals and rare earth elements. These are Latin America, Africa and Southeast Asia for mining and resource extraction, and China for chemical processing and refinery. In Chapter 8, I analyse these environmental and global labour impacts using JTI4 and JTI5, to understand how justly, and for whom, the transition to EVs unfolds.

CHAPTER 6 'DAS AUTOLAND': POLITICAL ECONOMY IN THE GERMAN AUTOMOTIVE INDUSTRY

6.1 Introduction: Three Transitions in the German Automotive Industry

This chapter traces the changes to power relations among the state, labour and capital in different periods in the history of the German automotive industry that have led to the shape of the current global production networks detailed in the previous chapter. I identify three transitions between the four main periods: (i) the origins of the sector between the 1890s and the 1930s, characterised by craft production of mainly luxury cars; (ii) introduction of Fordist mass production between 1933 and 1945; (iii) expansion of mass production after the Second World War until the end of the 1970s, under protected national markets; and (iv) the dominance of German OEMs and their close-tier multinational suppliers after 1980, in global production networks. For each period, the chapter details the evolving structure of capital invested in vehicle manufacturing, type of workforce employed, main industrial relations and role of the state. The state, at expanding scales, is the key agent in the three transitions. Capital grew through, and thanks to, the state(s), consolidated under private ownership in the second and third periods, and finally completed its transnationalisation in the fourth period. Workforce and skills employed in the organisation of vehicle production changed dramatically — artisans and craft workers in local labour markets in the first period; semi-skilled workers and coerced/forced labour in the second period; semi-skilled workers, migrant workers and women in national labour markets in the third period; global labour in semi-skilled and unskilled jobs in vehicle assembly, parts production, resource extraction and processing in the fourth period (see Table 6.1).

As I argue, whether or not, and to what extent, workers can engage in decision-making processes in the automotive industry is an historical outcome of the balance of power between workers, the state and companies. By tracing the evolution of the sector, this chapter reconstructs the historical evidence in relation to the second research question: How are workers positioned in the German automotive industry and what are the ways in which they have influenced decision-making processes? Understanding this sheds light on how the second just transition indicator (JTI) put forward in Chapter 4 — involvement of workers in decision-making processes — played out in major previous transitions. The actors in the

German automotive industry negotiated through trade unions, employer organisations and political parties in late 19th century. Works councils accompanied this in early 20th century, which helped secure and stabilise industrial relations after the Second World War. The two World Wars and successive labour migrations to Germany increased output and productivity in vehicle manufacturing. In the last period, when vehicle manufacturing internationalised, workers' involvement in decision-making in the German automotive industry continued its relevance, because the German OEMs and their close-tier multinational suppliers dominated global production networks.

In the next section, 6.2, I discuss the evolving power of autoworkers during the transition from the first period to the second and their involvement in decision-making mechanisms during a chaotic political economy in Germany. Section 6.3 looks at the third period after the Second World War and the balance of power in German industrial relations when mass production techniques in vehicle manufacturing expanded dramatically. Lastly, Section 6.4 describes the role of the nation state in changing employment regulations in Germany, which helped the German OEMs achieve regional and global leadership in the fourth period of global production networks, as well as reiterating the role of the state at the international level, both of which enabled the present nature of the global automotive industry analysed in the previous chapter. Section 6.5 provides a summary of the main points about the history and dynamics of decision-making processes in the German automotive industry between capital, labour and the state.

Table 6.1: Characteristics of the Key Periods and the Three Transitions in the German Automotive Industry.

Periods	Labour	Technology	Capital	State	Decision-making
Until 1930s Craft Production	Artisans. Skilled workers.	Craft production. Basic tools.	Small German OEMs. Multinational foreign OEMs.	Major consumer of vehicles.	Self-employed artisans in small firms. Works councils and trade unions in large firms.
Transition I: Coming to Power of the Nazi Regime					
1933-1945 Introduction of mass production	Semi-skilled workers. Coerced/forced unskilled workers.	Assembly line. Automation. Machines and tools.	German OEMs. Multinational foreign OEMs.	State ownership of VW. Major consumer of vehicles.	Suspended worker power in decision-making.
Transition II: Labour regulations for industrial peace					
1945-1980 Expanding mass production	Semi-skilled workers. Unskilled migrants. Women.	Assembly line. Enhanced automation. Introduction of robots.	Multinational German OEMs. Multinational foreign OEMs.	Market protection. Privatisation of VW. Facilitator of guest-worker schemes.	Unions, works councils, capital, and state in Germany.
Transition III: Proliferation of GPNs					
After 1980 Dominating global production networks	Semi-skilled workers in Germany. Semi-skilled workers and unskilled workers overseas.	Assembly line. Subassembly line. Increased automation. Complex robots.	OEMs as multinational conglomerates. Multinational first-tier suppliers. National and local second-/third-tier suppliers.	Shareholding in VW. Facilitator of flexible working schemes. FDI incentives overseas. State ownership in China.	Capital and works councils in Germany. Capital in overseas. Capital and state in China.

6.2 First Transition from Craft to Mass Production: Suspending Workers' Power in 1933

In this section, I show that workers in Germany were engaged in both workplace struggles, and local and national politics, with their statutory labour rights established early in the 20th century. At the macro level, until the 1930s autoworkers joined other workers in other metal working factories and mines in intense industrial relations, while organised labour and its political party, the Social and Democratic Party[51] (SPD), exercised political power. At the micro level, vehicle manufacturing was a highly skilled artisan trade with workers controlling and organising their trades.

6.2.1 Sectors paving the way for automobile manufacturing: Skills and labour organisations

State-of-the-art manufacturing sectors, such as machinery, chemicals, optics and electronics, and business cartels in traditional heavy industries such as iron, steel and coal, provided the basis for rapid industrialisation in Germany in the late 19th century (Fairbairn 2008: 73-5; Reich 1990: 26). Vehicle manufacturing was in its infancy until the 1930s and composed of many small firms concentrating on luxury vehicles. The majority of Germans could not afford passenger vehicles, even those relatively well-off such as white-collar workers or professionals (Link 2020: 140; Blaich 1987: 150). By 1929, the number of major vehicle producers in Germany was 17, with another 85 producing motorcycles (Overy 1975: 467-8). Vehicle manufacturing in Germany was the only sector dominated by foreign capital. 40 per cent of the cars sold in Germany in 1928 were foreign brands. American car companies brought the assembly line to Germany, with Ford opening a factory in Cologne, and with General Motors' acquisition of Opel in the 1920s (Tolliday 1995a: 278).

Germany did not experience a speedy development in motor vehicle production until the end of 1930s (Table 6.2). In 1920, Germany had only one car per 1,497 inhabitants compared to 228 in Britain and 245 in France; however, Germany had caught up with these countries by 1938 (Purs 1987: 206). In 1928, there were only about 350,000 cars and 100,000 trucks registered in Germany, whereas these figures for the USA were 20 million and 3 million vehicles, respectively; the Nazi regime sped up motorisation in only ten years, with the

[51] The Social Democratic Party in Germany was established with the merger of two labour organisations in 1875. The first was the General German Workers' Association (ADAV, Allgemeine Deutsche Arbeiterverein) established in 1863, and the second was Social Democratic Workers' Party (SDAP, Sozialdemokratische Arbeiterpartei), established in 1869. Following a few years of operation, the SPD was dissolved by Bismarck's Anti-socialist Law in 1878. The party became legal again in 1890 (Hunt 1964: 7-11).

number of registered motor vehicles reaching two million in 1938 in Germany and Austria combined (Blaich 1987: 148). Between 1936 and 1943, under the Nazi regime, the transport, infrastructure and manufacturing sectors were the leading areas of capital investment, contributing to the rise of vehicle production and use immediately after the war (Kirner 1968 in Vonyo 2018: 53). Further consolidation and expansion of vehicle manufacturing with German OEMs occurred after the Second World War.

Table 6.2: Motor vehicle production in Germany before the Second World War

Year	1926	1928	1930	1931	1933	1936	1938
Volume (Thousands)	42	133	85	70	118	303	340

Source: Overy 1975: 468-9.

Paving the way for the motor vehicle industry depended on two sectors. The first consisted of standardised parts manufacturing, often associated with the sewing machine and metalworking trades, which were dominated by craft production (Barker 1987: 13; MacDuffie and Pil 1997: 10). Artisans and skilled mechanics carried out motor vehicle production and developed their skills through training in bicycle and carriage shops; they controlled their work by setting the pace of work and the division of labour in the workshop (Braverman 1974: 101). Early in the 20th century, skilled workers in German vehicle manufacturing worked with no supervision or direction (Bellon 1990: 25). Craft workers and artisans were organised into industry trade unions, which supported the Free Trade Union Confederation (ADGB)[52] and the SPD. Both in large cities such as Berlin, Nurnberg, Hamburg, Cologne and Stuttgart, and small towns, skilled workers influenced the political economy locally through their unions, workers clubs, social events, and nationally through voting in elections for the Social Democratic Party (Bellon 1990; Fairbairn 2008; Evans 2020; Hunt 1964; Marks 1939; Roll 1939). The second sector contributing to nascent vehicle manufacturing included mining and metal working industries, which employed unionised workers who had significant political power. The

[52] Free/independent trade unions chose their name to distinguish themselves from company unions and other non-socialist and Christian unions (Hunt 1964: 17). The name changed after World War I to General German Trade Union Federation (ADGB, Allgemeiner Deutscher Gewerkschaftsbund). Today's German Trade Union Confederation (DGB, Deutscher Gewerkschaftsbund) is a continuation of this federation, changing its name following the Second World War. In addition to this, there was, and still is, the conservative Christian Trade Unions Confederation (CGB, Christliche Gewerkschaftsbund Deutschlands), with negligible membership.

consolidation of nation-state in Germany during the late 19th century and emerging industrial and mining conglomerates increased workers' opportunities to enhance their positions and establish labour organisations such as unions, clubs or consumer cooperatives.

6.2.2 Workers' power: Industrialisation, trade unions and the party

The rapid industrialisation of Germany during the 19th century gave workers, their unions, and the social democratic and left-wing political parties significant power. The organisation of production into large factories and mines helped Germany to catch up with other industrialised countries in Western Europe and North America (Roll 1939: 64). Even though the agricultural workforce grew in the last quarter of the 19th century, its share of the German economy declined (Fairbairn 2008; Hunt 1964). While only 600,000 workers, 4 per cent of the total in Germany, were employed in 1850 in mining and manufacturing; by 1873, this had tripled, and reached, in 1900, almost 6 million workers, 22 per cent of the total labour force (Kocka 1986: 296-7 cited in Silver 2003: 134). The share of artisans and skilled workers in self-employment and family businesses declined during this period — in 1882, small enterprises with five or less workers provided two thirds of the total employment, but this figure had reduced by half in 1907 (Fairbairn 2008: 78). Large factories operated in shipbuilding, chemicals, the iron and steel industries, coal and lignite mining, cement and infrastructure (Liefmann 1925: 88). Industrialisation increased inequalities; in 1911 one tenth of the German society owned almost two thirds of total personal assets (Fairbairn 2008: 63), which labour opposed through its organisations and political parties.

Workers in large mines and factories challenged the balance of power in the political economy and rejected the poor working and living conditions that came with rapid industrialisation. Chancellor Bismarck followed the same course as the industrialists in the mining and heavy metal industries who, by initiating social and welfare schemes, attempted to secure paternalistic workplace regimes, discipline labour and limit independent unions' reach to the workforce (Lerman 2008: 37; Rosenberger 2014: 155; Sweeney 2009: 42). Even though judicial and police interventions tried to limit the activities of labour organisations (Evans 2020: 35-36), the SPD, backed by workers and unions, became the largest political party after the abrogation of Bismarck's antisocialist laws in 1890. At the turn of the 20th century, legislation aimed at controlling labour organisations was brought in (Mueller-Jentsch 1995:

53; Rogers and Streeck 1995: 14-15; Schwerdtner 1979: 455-456).[53] As a response to the growing power of trade unions and workers in key industries, several welfare measures such as accident and health insurances were introduced (Owen-Smith 2007: 3).

In 1891, an amendment to the trade union regulations for the German Empire introduced optional workers' committees. In 1905, an amendment to the mining act brought mandatory workers' committees to mines with more than 100 employees. Nevertheless, these regulatory reforms did not change oppressive and dangerous working conditions; reforms in the 1890s, for instance, prohibited night and overtime labour for women and youth, but there were still numerous exceptions and violations (Weitz 1997: 36). Through workers' autobiographies, Kelly (1987) shows in detail the appalling living and working conditions for miners and factory workers, who contested workplace conditions and poor pay both through strikes and other activities (Evans 2020). The political power of workers and labour organisations in enterprises paving the way to the nascent auto production, especially in heavy industries, was noteworthy at the outset of the First World War.

Working class districts and rural areas did not support the decision to wage a war, which was taken by small groups of military and industrial elite that lacked democratic legitimacy (Verhey 2008: 244). However, with the start of the First World War, the SPD politicians and leaders of the unions gave up the idea of a future workers' revolution and concentrated exclusively on current reforms, acting more or less as the parliamentary lobby for organized labour (Hunt 1964: 17; Verhey 2008: 245). During the war, workers' and soldiers' committees were recognised to ensure labour's support for the Empire government's war effort. The war and *Burgfrieden*[54] ceased the class antagonism for a while. Following the war and the establishment of the new regime, the Weimar Republic, the SPD was split into three political

[53] However, attempts to curb the expansion of the workers' organisations were not successful – the SPD had 9% of the total vote in 1877, this reached 20% in 1890 (Hunt 1964: 9). The SPD captured almost a quarter of the vote in 1903 and one third of the total vote in 1912. Both the party and the union confederation had significant financial and operational capability with membership dramatically increased (Hunt 1964: 100, 155; Sombart 1909: 229-232).

[54] 'Burgfrieden', literally 'peace inside the castle', is a metaphor in which the German nation was described as a medieval stronghold under siege, in which all inhabitants needed to cooperate against the enemy (Hoffrogge 2014: 21).

parties[55] along the very lines of the approach to the war effort. The new left-wing political parties spinning out of the SPD and revolutionary local works councillors aimed at socialisation of key industries, while the SPD in government, and union leaders, thought parliamentary democracy and reforms could bring better working conditions and higher wages. Introducing mass production and expanding vehicle manufacturing in Germany would have seen a more worker-led transition than machinery and assembly line led change, had the war not suspended domestic political unrest.

6.2.3 Decline in workers' power: From workers' councils to works councils, and divisions among labour

Forced to accept many of the claims of organised labour in November 1918, the employers and the state in defeated Germany recognised trade unions' right to collective agreements and decreased work hours; however they prevented socialisation of the industries. Even though workers received constitutional rights in 1919 and statutory rights with the works councils in 1920, real wages did not increase due to hyperinflation, due to the fact that Weimar Germany was paying reparation payments in the 1920s from the profits of the coal, iron, steel and manufacturing industries (Wiesen 2001: 3; Liefmann 1925: 100; Williams 1922: 501). However, the expectations of the SPD and union leaders for positive impacts of labour law reforms did not materialise. Roll (1939: 80) estimates that real wages did not achieve pre-war levels until 1928. Class conflict was also heightened and violence erupted throughout the country in the 1920s. The SPD-led Weimar government followed the example of the previous regime and championed 1920 works council law, with the objective of gaining support from the ADGB and limiting the power of rank and file in factories, some of which could be organised by the SPD's 'rivals', the USDP and the KDP.

[55] First, politicians and union leaders who accepted the *Burgfrieden* and the war effort of the German Empire had the control of the SPD. They called for parliamentary social democracy without collective control in the economy. Indeed, the SPD won the a third of the votes after the war, and its leader, Friedrich Ebert, became the first president of the Weimar Republic, which introduced works councils. The coalition government, led by the SPD, included the conservative Catholic Centre Party (ZP, Deutsche Zentrumspartei) and liberal German Democratic Party (DDP, Deutsche Demokratische Partei). Second, politicians and union members, as well as members of workers' and soldiers' councils that emerged locally right after the war, founded, in 1919, the Independent Social Democratic Party (USDP, Unabhaengige Sozialdemokratische Partei Deutschlands). Third, in 1920 one faction in the USDP founded the Communist Party of Germany (KPD, Kommunistische Partei Deutschlands). While the KPD expected a quick economic and political collapse of the new republic and called for a revolutionary workers struggle, the USDP called for nationalisation of heavy industries and mines through winning general elections. The USDP later re-joined the SPD in 1922.

The law in 1920 turned local workers' councils (*Arbeiterraete*), aimed at parity in *the political economy* including organisations of production, personnel management, investment, prices and ownership (in other words effectively a producer democracy) (Rogers and Streeck 1995:14) into works councils (*Betriebsraete*), which are limited to *the workplace* and aim at consultation and cooperation with management (Mueller-Jentsch 1995: 53-54). Aware of this limited scope, however, independent unions and left-wing political parties began trying to have as many of their members as possible elected to the works councils. Yet, this was not enough for even skilled workers to increase their say in decision-making processes using their statutory rights in state-of-the-art sectors such as vehicle manufacturing, because their employers were ready to crush their demands with coercion and violence if necessary. Similar worker demands, no matter the skill level or the sector, were denied by the coming regime, which enabled the introduction of mass production in vehicle manufacturing and eliminated workers' say in decision-making in all industries.

In addition to the competition with unions and other political parties in reaching out to the rank and file, the SPD also faced severe challenges from industry lobbyists. The industry representatives complained about increased worker demands during the SPD-led Weimar governments that secured statutory rights for works councils and collective wage bargaining on pay and working hours. Works councils, which consisted mainly of union members, as a result of the unions' objective to keep the workplace at bay, were seen as a hindrance to company profits, because employers and business management were required to consult workers on changes in the organisation of production and staff dismissals (Patmore 2013: 533). The Weimar Republic was seen by employers as a 'trade union state' and its policies described as 'cold socialism' (Geary 1991: 156). This was to be overcome especially when employers introduced new production techniques, which changed employment levels and rationalised the ways goods were produced.[56]

[56] Pertaining to vehicle production, Bellon (1990) shows how local government, the army and the management at Daimler worked together, sometimes using force, against the works council in its Untertuerkheim factories, to stave off the mobilisation of the rank and file protesting against management's role in the organisation of production, low pay and increasing inflation. Referring to the management's war profiteering during the First World War, by altering financial records of profits and salaries (Bellon 1990: 112-4), the Daimler Stuttgart works council, controlled by independent socialist and communist members wished to examine their employer's finances before responding to the management's demands for layoffs in 1920. This demand was declined by the labour court. The dispute ended with the local state's occupation of Daimler plants and lockout of workers (Bellon 1990: 192-201).

Although their political movement was divided, now both part of the new regime's governmental body and its dissidents, workers in factories continued to use their statutory rights in industrial relations. The 1920 Works Constitution Act (*Betriebsraetegesetz*) provided works councils with certain rights at companies with 20 or more employees. Workers struck over a wide variety of issues relating to power in the workplace, including the personnel of the labour force and of management, the scope of labour representation, the work schedule, and plant security (Weitz 1997: 137). The employers in key sectors such as mining and metal processing locked out workers, especially works council members who were members of new left-wing parties (Bellon 1990; Geary 1991; Shearer 1995). Paramilitary groups composed of former soldiers and right-wing political party members attacked trade union shop stewards and their political representatives (Hunt 1964; Sweeney 2009).

6.2.4 Seeds for mass production: Investment in infrastructure, VW Wolfsburg plant, and coercion

After *Burgfrieden* in the First World War suspended class conflicts and led to increased divisions between labour organisations and political parties, the Weimar regime's efforts to limit workers' demands in the workplace, via works council regulations, also decreased labour power. Furthermore, workers could not use even these limited power resources in the workplace, as the Nazi regime crushed labour organisations and political parties. In 1933 The NASDP abolished trade unions and labour rights that had been established since Bismarck's initial welfare reforms in the last quarter of the 19th century (Guettel 2018). Especially when the economic depression hit in the early 1930s, business representatives increasingly opposed taxes and social policies (Shearer 1995: 502). Employers' attacks on workers' rights under the Nazi regime after 1933 brought the exclusion of workers from decision-making processes in the economy, including vehicle manufacturing. This period saw large investments and considerable expansion in vehicle manufacturing in Germany.

Building and maintenance of roads, tunnels, bridges and highways contributed significantly to decreasing unemployment in Germany (Abelshauser 1998: 126). By investing in large-scale road building and pushing for a German type of mass produced people's car (*Volkswagen*), the new regime wanted to decrease unemployment and sought electoral support and legitimacy from workers, whose rights to be involved in the decision-making mechanisms at the workplace and to influence the political economy via their parties or elections they

abolished. Funding for the introduction of mass production and setting up the most state-of-the-art factory at the time, Volkswagen's Wolfsburg plant, came from the independent union confederation's assets, confiscated by the Nazi regime's labour organisation, German Labour Front (DAF: *Deutsche Arbeitsfront*) (Overy 1982: 59; Link 2020: 164). Volkswagen, which later absorbed some other existing vehicle firms such as Auto Union, was established in 1937 under the Nazi regime with the aim of producing cheap vehicles for workers similar to the example of Ford's Model T (Link 2020: 141).

While introducing mass production techniques with semi-skilled workers in large factories, carmakers were also operating in conjunction with the demands of the largest consumer, the state. BMW started its production with parts and engines for aircrafts used in both world wars; it later produced for other carmakers (Overy 1973: 403; Scherner et al. 2014: 1004). Opel, General Motors' subsidiary in Germany, and Ford's Europe plants in Cologne also worked with the new regime and contributed to the increase in motor and military vehicle output in Germany (Overy 1973: 407; Reich 2004: 114; Tolliday 1995a: 283), as well as contributing to the war effort in the USA via their home factories (Rockoff 1998: 104). Daimler produced engines for military road vehicles, components and engines for warships, and provided three quarters of the German army's aircrafts in the First World War (Bellon 1990: 87). During the Second World War, Daimler-Benz factories in both Germany and Nazi-occupied territories recruited half of their workforce from foreign workers (Bellon 1990: 231). If concentration camp inmates and prisoners of war are included in foreign labour, almost one third of Germany's industrial workforce in pre-war frontiers was foreign in 1944, and another third were German women (Abelshauser 1998: 161-2).

The new regime contributed to the rise of motorisation and road building, and the introduction of mass production in the German vehicle factories with an increased number of semi-skilled workers (Blaich 1987; Overy 1973, 1975; Tolliday 1995a, 1995b). The transition to mass production happened when most of the industrial heartland of Europe and raw materials from Northern Europe were either under Nazi control or collaborating with the Nazis (Froland et al. 2016). In 1944, a quarter of workers in Germany were foreign forced-labour, operating in defence-related industries (Herbert and Hunn 2001: 187). This included carmakers in Germany, Opel of General Motors, Volkswagen, Daimler and Ford Europe (Bellon 1990; Link 2020; Reich 1990; Turner 2005; VW n.d.).

6.3 Second Transition for '*Wirtschaftswunder*': Industrial Peace and Migration after 1945

This section contrasts the involvement of workers in decision-making processes, industrial relations and national political economy in the third period of the German automotive industry to that in the first period, when workers in heavy industries and mining, along with artisans and skilled autoworkers, wielded considerable power until the first transition in 1933. After 1945, the second transition expanded mass production and helped Germany secure industrial peace through corporatist works councils, peaceful unions, economic growth and rising wages. The reputation of the automotive industry as the flagship of Germany's economic miracle, *Wirtschaftswunder*, and relatively high wages for autoworkers helped keep industrial peace in place until 1980. I argue that the role of the state, initially the Allies and later the Federal Government, was key in both restructuring capital and managing unions and the workforce to ensure that their involvement in decision-making in the workplace was not detrimental to the expansion of vehicle manufacturing in Germany.

The seeds sown for private transport infrastructure and vehicle manufacturing by the authoritarian regime in the second period, between 1933 and 1945, came to fruition in the third period. The showcase of German industrial mass-production, Volkswagen, owed its success to the Nazi era when it was blessed with enormous capacity and infrastructure, so that it was ready to expand output; the Volkswagen Beetle (Vonyo 2018: 114), the German version of the American model T Ford, was rolled out from the assembly line for mass consumption. Given the small vehicle market in Germany before the Second World War, it was not possible for any commercial enterprise to achieve this level of production capacity without large-scale investment and introduction of mass production by the state in the second period. Right at the beginning of the third period, from 1946 until 1951, Volkswagen increased vehicle output tenfold, reaching the one-million vehicle threshold in 1961 (Tolliday 1995a: 326). At the end of the 1950s, Volkswagen earned approximately half of West Germany's surplus in balance of payments (Link 2020: 211). This also helped the industry to keep wages relatively high. By 1950, Volkswagen was the highest-paying company in Germany (Tolliday 1995a: 319). Other German OEMs also contributed to this extreme growth in the third period via export-oriented vehicle manufacturing. Motor vehicle output in Germany more than doubled in 1955, and reached five times the 1938 levels in 1960 and ten times

those levels in 1970 (Vonyo 2018: 90). Such dramatic expansion of the German automotive industry in the third period was the result of rapidly-introduced mass-production techniques in the second period, between 1933 and 1945, when workers had no power in the workplace or in the national political economy. The state, first the Allies and then German governments, continued its vital role in the third period and helped expand the German automotive industry.

6.3.1 The Allies and the new Republic

In the third period of the German automotive industry after 1945, Germany achieved high economic growth rates in an economy directed largely by the state. Industrial output in 1945 was only a quarter of that achieved in 1936, but this had doubled by 1949 (Owen-Smith 2007: 8). The state-led post-war boom in manufacturing and industry, especially vehicle production, was not accidental, given Fordist mass production and management techniques (Abelshauser 1998: 163) introduced in the second period. Economic historians argue that post-war high economic growth was possible thanks to the efficient reorganisation of productive forces already available in Germany in the armament and defence industries to others including vehicle manufacturing. The impact of the Allied States' economic policies in Europe with the Marshall Plan, as well as their increasing demands for armament, machinery and capital goods in wars in Korea and Vietnam, helped the German economy generate rapid growth based on export-oriented finished and semi-finished goods (Gruenbacher 2017: 34; Vonyo 2018: 139; Abelshauser 1998: 162).

Prior to the foundation of the Federal Republic in 1949, German entrepreneurs and managers successfully lobbied the Allies for anti-union and anti-codetermination policies they benefited from in the second period of the automotive industry, as long as they were able to demonstrate non-involvement in the Nazi regime (Gruenbacher 2017). For instance, the decision to nationalise the mining industry adopted by the North Rhine-Westphalian parliament was suspended by the US and British authorities, who suggested such decisions be made under a new constitution (Mueller-Jentsch 2018: 635). The first federal elections in 1949 ended with the victory of a conservative parties' coalition, which remained in office until the late 1960s. In the 1950s, Western Allies and the new state in West Germany provided

strong incentives[57] for entrepreneurs and managed to keep wages low, therefore protracting workers' difficult living and working conditions. The Allies cooperated with the German business and industry elites to limit worker demands, such as nationalisation of key industries and increased labour role in economic policies (Leaman 1988: 32; Gruenbacher 2017: 19-20). Trade unions were excluded from the economic council set up in 1947 advising the Allies, at which company managers, some of whom were recruited also by the previous authoritarian regime, took part. (Leaman 1988: 40). This was when socialist and communist political parties were gaining support not only in the Eastern occupation zone in Germany but also in Greece, France and Italy (Leaman 1988: 35; Shaev 2016).

Such national-level participation in decision-making processes during transitions was important for workers. However, with their exclusion, the new balance of power was set up by companies and the state, both the Allies and later the Federal Republic. There were plenty of workers ready to work with extremely low levels of expectation, and people in the country survived on average on no more than half of accepted nutrition levels (Leaman 1988: 23; Vonyo 2018: 38). The recovery of the West German economy was possible due to the availability of this large and mobile workforce expelled from former territories of the Third Reich right after the defeat, and from Eastern Germany until the end of 1950s, who were ready to take jobs under any conditions. The coal, iron and steel industries in the Ruhr and Rhine basins drafted workers from refugee camps established for Germans arriving from former territories and the Eastern Zone (Vonyo 2018: 59-60, 125). Having secured mobile labour ready to work, German elites and industrialists, in cooperation with the Allied Military Occupation, turned to the codification of labour law to limit trade unions' power, to prevent a repetition of the labour insurgency that had occurred in the first period of the German automotive industry. Contrary to the second period, this was not achieved by coercion and force; instead, labour regulations for industrial peace facilitated the expansion of mass production in the third period.

[57] For instance, vehicle producers were excluded from reparation payments and dismantling, and secured projects from the Allied military officials who allocated scarce raw materials and resources in Germany. Until the currency reform, a quasi-barter system prevailed in markets, where one car was exchanged for a hundred tons of cement or two hundred thousand bricks (Tolliday 1995a: 299).

6.3.2 Industrial peace: Works councils and trade unions

To elevate the social and economic status of workers, from the 1950s trade unions aimed to redistribute control over the German economy, nationalising heavy industries and mining, and reducing the power of employers (Kerr 1954: 536). They sought to transfer codetermination rights at the micro level in some of large enterprises to other sectors and all workplaces, to achieve parity in economic and political decision-making processes. However, labour legislations prevented this by setting up a dual system of governance of industrial relations.

Regarding the first leg of governance of industrial relations, the 1949 Collective Bargaining Act abolished the Allied wage controls and recognised unions and employers' associations as bargaining partners in autonomous wage bargaining without government interference. BDA (Confederation of German Employers' Associations) and DGB (German Trade Union Confederation) are the umbrella organisations of the two sides. Although neither takes part in actual bargaining, they coordinate and represent the interests of their members. Collective bargaining for wage agreements takes place between industry-specific organisations from each side. *Gesamtmetall*, the Federation of the Metal Trades Employers' Associations, and *IG Metall*, the Metalworkers' Union, negotiate nationwide agreements in the manufacturing sector, including the automotive industry.

The second leg of governance of industrial relations in Germany consists of works councils. The Allied Control Council Act No 22 in 1946 recognised the works councils that had sprung up spontaneously in large factories (Owen-Smith 2007: 301). This was a practical response to the strategic importance of the coal mining and related heavy industries in the Ruhr and Rhine basins for economic development, reparation payments and cooperation between the new German state and the Allies. Miners and workers in these regions were actively demanding better rights and conditions at the time of an overall anti-union and anti-left approach in Germany and Europe, where a transnational sectoral common market in coal, iron and steel was in the making, sowing the seeds of the later European Union. Wanting to seize this political economic atmosphere, trade unions and the DGB lobbied the conservative Adenauer government to enshrine codetermination practice in coal for all other sectors in the German economy into national law, but could not achieve this goal.

Instead, the government created a differentiated system of works councils, depending on the sector and size of the companies. On the one hand, the law, in 1951, on codetermination in mining companies in coal, iron and steel with over thousand workers led to the establishment of works councils (Eichhorst and Kendzia 2016: 307). Given the initial demands of the unions, limited codetermination in only some companies was a victory for the industrialists and the new state (Wiesen 2001: 180). On the other hand, trade unions wanted to expand the mining example to other industries no matter the sector and size. The 1952 law allowed works councils in all companies with more than five employees, providing limited inclusion of workers in key decision-making processes. Unions remained critical of this as they saw employers as uncooperative and having the upper hand over workers (Vonyo 2018: 186).

As summarised in Table 6.3, the 1952 law granted working councils very limited power and prompted the opposition of the unions (Leaman 1988: 155; Mueller-Jentsch 1995: 54). Most of the demands made by the trade unions were declined, including labour's inclusion at federal- and state-level economic councils advising the government, which would be composed of representatives from all industries, with half the members from trade unions and half from employers' associations. Moreover, economic chambers to promote self-administration in the economy, with equal representation of labour and management, were not set up. Trade unions did not achieve half of the supervisory board membership of large enterprises, who would be non-stock holding labour representatives elected by the unions. Kerr (1954) argues that proposals of the German Trade Union Federation can be regarded as calls for a joint economic pluralism, a meeting ground between liberalism and socialism.

Still, the industrialists and the government used severe propaganda against the workers' and unions' demands, calling the proposals a call for a new *Machtgreifung* (referring to Hitler's rise to power in early 1930s) and warning the public that 'democracy is in danger' (Wiesen 2001: 184-5). Gruenbacher (2017) shows how employers, who were divided on issues of government subsidies and the 1952 investment law channelling funds from the banks to industry, coal and mining, came together against the union proposals of expanded codetermination and used the 'communist' threat in their public relations propaganda in international media and institutions. However, it was actually a defeat for trade unions, with most of their demands declined. Worker representatives at company supervisory boards are far from the daily operations and cannot by law interfere with actual operations. Thus, the

1952 law was a co-formation of general policy rather than the codetermination of plants; labour membership at supervisory boards is not enough to effect decisions (Kerr 1954).

Table 6.3: 1952 Codetermination Law

Theme	Works council power	Scope
Social affairs	Codetermination	Remuneration, health and safety, welfare schemes, working hours, bonus rates, overtime
Personnel affairs	Codetermination	Recruitment, transfers, dismissals, up- and down-grading
Supervisory boards at firms with more than 2,000 workers	Almost codetermination	One member less than parity representation (brought by changes to law in 1976)
Supervisory boards at firms with 500-2000 workers	1/3 representation	Not equal. Moreover, many companies reduced their supervisory board membership to six, so only two labour members could join, and union members from outside the plant were unable to enter the board.
Personnel planning	Information and consultation	Work processes, working environment
Financial affairs	Information	Price, profit, investment
Technology	Information	New technology, organisation of production (Brought by new law in 1989)
Disputes	Limited	Arbitration through labour courts and governmental agencies.
Works council elections	Limited	Separation of elections for salaried and manual workers, is contrary to the wishes of the DGB.
Civil servants	No Power	No codetermination for workers in public agencies.

Source: Kerr 1954; Mueller-Jentsch 1995.

As a result, the post-war labour regulations of the Federal Republic of Germany did not bring back workers' engagement in social and political spheres, which had been an important and dynamic part of industrial relations in the first period of the German automotive industry until 1933. In the beginning of the third period, the operational grounds of the labour movement were clearly divided into two independent institutional settings, unions and works councils. Works councils themselves were then divided between sectors, heavy industry and others, with differentiated rights granted to various sections of workers. This made it difficult for workers to come together on a wider basis and organise large strikes as they did in the first period, especially before and after the First World War. Indeed, after the Second World War, Germany saw the lowest level of labour activity and strikes (Dribbusch 2008: 277). While

industry-level trade unions were legally bound not to intervene in plant-level decisions, sticking to national and industry-wide negotiations on pay and working hours, works councils were no longer able to strike locally either, due to the principle of peaceful coordination with their company management. Due to the monopoly of the unions in strikes, the rank and file was unable to organise wildcat strikes; these are illegal by law and by Federal Labour Court case law (Schwerdtner 1979: 461). This dualism eased the expansion of mass production in vehicle manufacturing and increased output in the base metal and mining industries, where increased automation and labour migration played a crucial role in the third period of the German automotive industry.

6.3.3 '*Wirtschaftswunder*': Foreign workers and manufacturing growth

Until the early 1970s, the West German manufacturing industry grew by attracting migrant labour from abroad (Vonyo 2018: 97). In 1955, unemployment stood at around five percent in West Germany, while the figure was two percent for more industrialised states such as Baden-Wuerttemberg and North-Rhine Westphalia (Herbert and Hunn 2001: 189). While labour-intensive branches of the then state-of-the-art technology companies in automotive and electronics expanded, using migrant labour from Southern Europe, German workers moving on to engineering and services were replaced by their foreign colleagues in declining sectors such as steel forming, glass, timber/woodworking and textiles (Leaman 1988: 158-159). Between 1961 and 1973, about three million German workers moved to white-collar jobs, leaving low paid, heavy and manual jobs (Owen-Smith 2007: 264). Foreigners held very small proportions of higher-paid jobs, and when they did they worked longer hours and more overtime than their German counterparts did (Blitz 1977: 486). 90 per cent of foreign males were employed as blue-collar workers with low wages, and in 1966 72 percent were semi-skilled and unskilled workers, mainly in the construction, mining, iron and metal industries (Herbert and Hunn 2001: 198-9).

Labour migration was facilitated by intergovernmental guest worker agreements between Germany and Southern European countries that encouraged their surplus labour to leave for the industrialised Western Europe.[58] Due to high demand for semi-skilled and unskilled labour

[58] West German Federal Labour Office signed agreements with Greece and Spain in 1960, Turkey 1961, Morocco in 1963, Portugal in 1964, Tunis in 1965 and Yugoslavia in 1968. The proportion of skilled and semi-skilled workers among migrants was highest among those from Turkey, with 38 percent. This figure was 20 percent for Italy, 5 percent for Spain, and 10 percent for Greece (Herbert and Hunn 2001: 194). Though most foreigners

in West German manufacturing sectors, migrant workers had already begun to self-mobilise before the agreements, as early as 1952, when Italians and Spanish found jobs in southern parts of West Germany (Stokes 2019: 30). Similarly, workers and miners from Turkey had been coming to Germany before the two governments signed a treaty (Herbert and Hunn 2001: 193). However, an official intergovernmental recruitment process accelerated labour migration and systematically met company demands. Between 1959 and 1965, foreign workers in West Germany jumped by one million (Herbert and Hunn 2001: 192). Their number reached two million in the early 1970s, with four of every five migrants finding jobs in manufacturing (Vonyo 2018: 97). By mid-1973, when West Germany stopped recruiting foreign labour in changing business cycles during financial and oil crises, 2.6 million foreign workers were employed in West Germany (Schoenwaelder 2006: 253), comprising more than 11 percent of the total workforce (Blitz 1977: 482-3).

Incorporation of foreign labour into manufacturing in West Germany coincided with overall declining levels of skill used in vehicle production. The skilled labour ratio in vehicle production was 60 percent in 1950 and this had gone down to 42 percent by 1970 (Vonyo 2018: 122). However, from 1948 to 1970, annual labour hours worked in vehicle production quadrupled (Vonyo 2018: 96). This shows that newly-arriving migrant labour was used in the expansion of semi-skilled and unskilled tasks in automotive factories. In 1975, a quarter of the workforce in the West German automotive industry consisted of foreign workers (Reich 1990: 51-52). Migrants worked night shifts, overtime and weekend shifts (Cohen 1987: 121). For instance, in Ford Europe's Cologne plant, almost all exhausting, unskilled and low-paying tasks done by German workers until 1963, especially in final assembly, were given to foreign workers (Gonzalez 2022: 10). Miller (2018) shows that West German recruitment priorities for foreign labour focused more on health, physical strength and basic literacy rather than skills and qualifications. The living conditions of migrant labour were very basic, and they were usually housed in large dormitories near and around factories. Some guest workers occasionally stayed in camps that had been constructed in the 1930s by the previous regime (Herbert and Hunn 2001: 190). The general rule was that migrant workers were segmented from society in social and housing relations (Cohen 1987: 135). Having contributed to the

were young and single males (Blitz 1977: 483), some brought their families later, bringing the foreign population in West Germany up to around four million in 1974 (Cohen 1987: 157).

expansion of vehicle production in Germany, and facing low living and working conditions in the third period of the automotive industry, foreign labour was also victim of industrial restructuring, precarious employment relations and increased internationalisation of vehicle manufacturing in the fourth period.

6.3.4 End of the boom, restructuring and redundancies

The West German automotive industry faced several crises in the third period, between 1945 and 1980. The post-1945 boom ended in the 1970s. In agreement with works councils, which are legally bound to put company interests first, as well as with cooperation of the trade unions, which aim to secure domestic jobs via technology and investments, in competition with East Asian carmakers at the time, German carmakers restructured vehicle plants. OEMs introduced new models, group work and diversified quality production. OEMs also diversified marketing strategies; for instance Volkswagen acquired Audi in 1965 to move up the passenger vehicle market (Owen-Smith 2007: 431). The decreased need for semi-skilled and unskilled jobs at auto plants, which now run on increased mechanisation and robotisation, brought a large number of redundancies. Another reason for this decline and the redundancy schemes was that Volkswagen invested in Mexico, Brazil and South Africa for less skilled Beetle production. By 1975, one third of the global output of the company was produced abroad (Tolliday 1995b: 124).

The relationship between works councils and management became very close and IG Metall agreed to internal reorganisation of vehicle production at Volkswagen (Streeck 1987: 441). Miller (2018: 145) shows how distribution of wages at carmakers changed over the years; between 1963 and 1973, Italian workers at Volkswagen's Wolfsburg plant earned less than their German colleagues. With the partial local state-ownership of the company, Lower Saxony state officials, trade unions and works councils cooperated with the company management (Tolliday 1995a: 315, 345). Major redundancies occurred in 1974/75 when Volkswagen changed from a single model (Beetle) volume producer to diversified production with a set of various models. As a result, two thirds of those who lost their jobs were foreign workers, particularly Italians and Tunisians; women and older German workers had to leave their jobs too (Tolliday 1995b: 122). Similarly, nearly two thirds of those who left Audi in 1974 and 1975 were foreign workers; restructuring at the expense of foreign workers was worst at BMW, where foreign labour accounted for 80 percent of redundancy and labour shedding

(Reich 1990: 52). Streeck (1984: 62) argued that a large number of foreign workers were ready to take severance payments and give up their jobs voluntarily, and that this loss eased the language problems in the factories. However, as Reich (1990) explains, foreign workers faced risks of their visa being cancelled and being fired without severance pay, so they had to opt into government schemes for voluntary leave and return to their home countries. As in the case of voluntary withdrawals of migrant workers from the labour market in 1966-1967, foreign workers employed in southern parts of West Germany migrated back to Italy and Yugoslavia (Leaman 1988: 175).

6.4 Third Transition for Dominating GPNs after 1980: Flexible Security in *Das Autoland* and Repressive Labour Regimes Abroad

After 1980, the German automotive industry acquired regional and global leadership in both medium- and high-segment vehicles, with considerable market power in established markets such as Europe and North America, as well as new markets in Asia. The state, at various scales, again played a vital role in the fourth period of the German automotive industry. At the global level, regulations on trade in goods and services, as well as on protection for intellectual property rights, helped OEMs widen the geographical scope of vehicle manufacturing without incurring costs of ownership and local competition from new entrants. Governments in developing countries eased the conditions for large OEMs and incentivised FDI in vehicle manufacturing with much more limited attention to working and environmental conditions than those present in Germany. At the national level, the state restructured the domestic labour market for flexible employment in two ways that are suited to the needs and demands of the OEMs. On the one hand, new labour regulations gave way to differentiated working conditions among OEMs' plants. On the other hand, easing the use of additional employment contracts helped the German automotive industry increase its competitiveness at the expense of labour.

6.4.1 Internationalisation of vehicle manufacturing and accessing new markets in developing countries

In the fourth period of the German automotive industry, OEMs and their close-tier multinational suppliers, such as Bosch, Continental, BASF, ZF Friedrichshafen and Thyssenkrupp internationalised their operations and diversified organisation of production for four main reasons. First, they sought greater control over smaller suppliers in developing

countries and better access to product markets in industrialised countries (see Chapter 5). Second, they relocated some of their labour-intensive component manufacturing and assembly of lower-segment vehicles to industrialising countries. As a result, large OEMS and their multinational suppliers were able to exploit not only varying working conditions and environmental standards, but also small- and medium-sized parts suppliers in peripheries close to European and American vehicle markets. Third, thanks to changing dynamics between labour, capital and the state with an updated welfare system, OEMs offered trade unions and works councils job security in domestic plants in exchange for increased use of short-term and temporary work contracts with lower pay and longer working hours. Fourth, thanks to their joint ventures with state-owned vehicle enterprises in China, the German OEMs were able to access today's biggest vehicle market.

In this period, trade unions and works councils in Germany aimed to secure jobs for their membership, as well as helping OEMs increase profits, some of which they expected to be reinvested in domestic plants for more competitive and higher-value activities in vehicle manufacturing. They agreed to more short-term and temporary work contracts and plant-level concessions to stave off demand fluctuations. On their companies' investments abroad, the German labour representatives were cooperative as well, as long as these attempts increased the international competitiveness of the company without exporting the union membership's skilled jobs.

6.4.2 Flexible security in a unified *Autoland*

Since the wildcat strikes in the early 1970s initiated by foreign labour, the biggest strike wave in the metalworking industry took place in 1984, striking for a 35-hour working week, this time with the support of IG Metall. An agreement was reached on 38.5 hours in exchange of accepting flexibility in working hours arrangements (Dribbusch 2008: 281). For instance at BMW, an agreement in 1988 with the works council gave management the possibility to run its Regensburg plant six days a week, nine hours a day, resulting in a 30 per cent increase in output compared with the standard working week (Whittal 2005: 578-9). The 1985 Employment Promotion Act, which trade unions and Social Democrats opposed, laid the foundations for the subsequent growth of flexible types of employment. The proportion of temporary jobs in relation to job vacancies in West Germany rose from 6 per cent in 1980 to over 15 per cent in 1985 (Dombois 1989: 361). This permitted employers to issue fixed-term

contracts for up to 18 months. Agency work was liberalised by increasing the maximum length of temporary assignments from three to six months and in 1997, following the 1994 economic recession after the German unification, the maximum duration of temporary contracts and agency work assignments was extended to 24 and 12 months, respectively (Eichhorst and Marx 2011: 77).

After 1980, and increasingly in the 1990s following the German unification, employers increasingly perceived such contracts as a strategic option to circumvent social insurance contributions and establish a low-wage segment of the labour market (Eichhorst and Marx 2011: 76-77). In metalworking and vehicle production, agency work has become a second tier in employment (Eichhorst and Marx 2011: 76-77). Eichhorst and Kenzia (2016) argue that the workforce of the German manufacturing industries was always fragmented; unionised workers with long-term contracts at the core, and others without union membership and with short-term, poorer-paying and less-skilled jobs. In line with that, Greer (2008) finds a similar trend at different carmakers and their multinational suppliers. A key trend for the German automotive industry is the increasing share of agency workers with part-time/temporary jobs within the workforce (Benassi 2017; Doellgast and Greer 2007: 60). In the automotive industry, both regular and contingent workers are employed side-by-side in the labour process and perform similar tasks with different pay levels (Holst et al. 2010: 135).

In addition to differentiated employment contracts adopted to meet changing market demand and new model cycles, OEMs asked works councils and IG Metall for increased flexibility in working hours so that they could avoid outsourcing of some components to suppliers or abroad (Benassi 2017: 431-2). Growing unemployment and the threat of plant relocations made labour organisations sensitive to these company pressures (Dribbusch 2008: 282). As a result, the automotive industry benefitted from plant-level deviations outside the coverage of collective agreements (Hassel 1999: 499). Plant level deviations then spread across the German automotive industry, altering wage and working hours arrangements. The paradigm in this respect was summarised in 1996 by Volkswagen as a ‘breathing factory’, based on the principle of production of as many models as possible with flexible labour arrangements (Haipeter and Lehndorff 2005: 142).

Following unification, changes to the balance of power at the expense of labour accelerated. Two thirds of Eastern Germany’s industrial employment in manufacturing was lost (Katz and

Darbishire 2000: 185). This increased unemployment in the country. Small- and medium-sized enterprises (SMEs), an important part of the German automotive industry, opted out from membership of employer associations, which meant that the coverage of collective agreements did not reach their employees (Hassel 1999, 2002; Doellgast and Greer 2007). Those large employers remaining in the associations, and thus bargaining with IG Metall, cancelled collective agreements, and in 1993/1994 agreement was reached with reductions in bonus payments (Dribbusch 2008: 283). Deviations from collective bargaining brought three main changes in the German automotive industry; first is the immediate result of frozen or declining wages; second, changes to work organization brought increased work intensity; and third, flexible working time and introduction of annual hours meant that not only was overtime pay not possible, but the limit on the working week lost its meaning (Katz and Darbishire 2000: 192).

6.4.3 Hartz Laws: The voice of the German automotive industry

Thanks to Hartz's reforms at the turn of the century, local and company-level demands of OEMs and multinational suppliers were codified to labour market regulations by the state. The Hartz Commission, named after Peter Hartz, the head of the Volkswagen human resources department, was set up to seek ways of reforming the social security system and create more irregular forms of employment. Their proposals were adopted under the Hartz Acts in 2003-2005. These included regulation for greater use of fixed-term employment contracts, relaxing employment protection legislation,[59] increased scope of part-time and temporary work, reduction of unemployment benefits, and an increase in 'minijobs'[60] not liable to social security contributions (Mueller-Jentsch 2018: 644). More and more workers are now hired temporarily in German plants and assembly lines, for periods of 3-6 months to 1-2 years, depending on the changes in the market demand. This decreased the power of workers in the political economy. 'In business cycles, agency workers are affected first. That is agreed with the trade unions. It is always agency workers who disappear first' (Interview

[59] Maximum entitlement to unemployment benefit for older workers was shortened from 32 to 18 months, removing a de facto early retirement tool. Additionally, the merger of earnings related, but means tested, unemployment assistance and social assistance into unemployment benefit was actually a general minimum income support scheme, which implied the creation of a general in-work benefit system (Werner and Marx 2011: 78).

[60] The previous working-time ceiling of 15 hours per week was removed. Since there is no binding minimum wage in many areas of the economy, the creation of 'minijobs' enabled employees to accept low hourly wages, supplemented by state subsidies (Werner and Marx 2011: 78).

with a European-level union federation). Following the Hartz social and labour market reforms, non-standard jobs in 2015 constituted one fifth of all employment in Germany, and almost half of the female employees (Mueller-Jentsch 2018: 645).

The Hartz Laws were, in a way, a reflection of a Volkswagen's 2001 project onto national labour market regulation. In collaboration with the local government, IG Metall and the company works council, Volkswagen established a separate collective agreement at a lower flat rate for its 5,000 workers than that offered by the agreement reached with IG Metall (Haipeter and Lehndorff 2005: 148). This was an example of placing rules of collective bargaining aside to cut costs, in exchange for which workers in this scheme, who worked alongside their colleagues at the Wolfsburg plant, were provided with employment security (Herrigel 2010: 261-271). The Hartz reforms in return provided a workforce for the German economy who had to work under precarious employment contracts, with reduced social and personnel costs to employers. This also meant that collective agreements were no longer being undermined by only firms and the state, but also by employees on their own initiative (Haipeter and Lehndorff 2005: 152).

The strategic use of temporary agency work and deviations from a collectively-agreed set of rules decreased the power of IG Metall and put union membership in competition with new types of contract workers (Holst et al. 2010). In 2006, more than half of the newly established jobs in Germany occurred thanks to temporary agency work (Holst et al. 2010: 115). This, along with further threats to outsource component production to new EU member states in Central and Eastern European countries, and examples of that taking place, weakened power of workers, not only in Germany, but also in neighbouring countries such as Poland, Czechia and Hungary (Bernaciak 2010). In the fourth period of the German automotive industry, large OEMs and multinational automotive suppliers achieved 'flexible security' in industrial relations at domestic factories, while expanding their operations to developing countries and China, with considerably more repressive labour regimes that display lower worker protection and less worker involvement in decision-making processes, as well as weaker environmental standards.

6.5 Conclusion

In this chapter, I show that the political economy has played a crucial role in limiting worker-led efforts in the three transitions of the German automotive industry: (i) the coming to power of the Nazi regime in 1933; (ii) the post-1945 labour law and industrial peace; and (iii) the proliferation of global production networks after 1980.

When industrialisation and urbanisation in Germany was in full swing, craft production and skilled workers, who joined other workers in the heavy and manufacturing industries along political party lines to engage in national politics, dominated the nascent German automotive industry. Following the First World War, however, workers were divided between the different political parties during the Weimar Republic, and became both a part of the new regime's governmental bodies and its dissidents. They gained statutory rights in industrial relations with the 1920 Works Constitution Act (*Betriebsraetegesetz*), which gave workers certain rights in engaging in decision-making in companies. In the context of industrial relations, workers in the 1920s struck over a wide variety of issues relating to power in the workplace, including recruitment and personnel management, the scope of labour representation, the work schedule and plant security. However, in the second period of the German automotive industry, between 1933 and 1945, craft production was dissolved and introduction of mass production accelerated, with no labour involvement in the decision-making processes.

The transition, in 1933, from the first period to the second in the German automotive industry, under the authoritarian political regime, silenced workers and abolished labour organisations, suspending mounting class conflict. Simultaneously, the introduction of mass production techniques in vehicle manufacturing went in parallel with the uneasy relationship of large automotive companies to the Nazi regime. Military and public funds were channelled into a publicly affordable passenger car (*Volkswagen*), aircraft engines (*BMW*) and heavy military vehicles (*Daimler-Mercedes*). The role of the state in motorisation and private transport infrastructure prepared the country for expansion of the industry in the third period after 1945.

The transition from the second period to the third period in the German automotive industry was possible thanks to new labour laws after 1945 that brought industrial peace. Even though workers had their freedom of association returned, ending the coercive industrial relations of

the second period, the post-war labour regulations of the Federal Republic of Germany did not bring back workers' engagement in social and political spheres, an important and dynamic part of the first period. This was because the operational grounds of the labour movement were divided by law into two independent institutional settings – trade unions and works councils, which weakened workers say overall. The monopoly of trade unions on calling for strikes made the rank and file less effective in reacting to increased automation, and prevented guest workers from taking industrial action. The legally mandatory collaborative approach of works councils to their factory management made it easier for capital and the state to expand mass production. This was also possible thanks to the key input to West Germany's post-war economic growth 'miracle' (*Wirtschaftswunder*) — a mobile and disciplined workforce sourced by internal and external waves of labour migration between 1945 and the mid-1970s. After 1945, a large migrant workforce from both East Germany and the previously Prussian territories supplied the German manufacturing, metal and construction industries with labour. This was later further accelerated in 1960s by migrant workers from Southern Europe — Italy, Portugal, Greece and Turkey — which boosted vehicle and machine manufacturing, and the mining, iron and steel processing, and chemicals industries. The end of the influx of foreign workers, as unskilled and less protected labour, into Germany in the 1970s coincided with collaboration of unions and works councils on increased automation and rationalisation of production.

The transition from the third period to the fourth brought two things. First, the relocation of some of the labour-intensive low-segment vehicle-assembly and parts-production to industrialising countries. Second, an increased use of differentiated work contracts to meet demand fluctuations in capital-intensive component production and premium vehicle assembly in Germany. In the face of rapid internationalisation, and for the security of employment of their membership, trade unions and works councils could not prevent individual German plants implementing open clauses to tariff agreements after 1980. On top of this local differentiation in working conditions and pay, the Hartz reforms in the 2000s brought an expansion of part-time, fixed term and temporary contracts. The share of the irregular forms of employment is high both in Germany and in Central- and Eastern-European countries, the key region for investments by the German OEMs and multinational suppliers in labour-intensive assembly and parts production.

Following the last transition, the German automotive industry benefitted from internationalisation of production and industry consolidation, to control their production networks and coordinate supplier operations globally. This was possible thanks to the state at global level, which liberalised trade in goods and services, protected intellectual property rights and weakened global labour across the board. Joint ventures in China for market access and foreign direct-investment in developing countries for labour intensive parts and assembly operations were possible because of global state involvement in vehicle manufacturing. During these changing dynamics between labour, capital and the state, trade unions and works councils in Germany mainly limited their scope to the job security of their membership in domestic plants.

This historical exercise gives important insights. First, considering today's shift to EVs, we should include labour's political and practical involvement in decision-making not only in Germany, but also in other locations. Similar to the cooperation of heavy industry workers, miners, and autoworkers before 1933 in Germany, the workers employed in related industries around EVs should cooperate for global action. Additionally, the role of the state in preventing or facilitating the cooperation among labour organisation should be kept in mind. The conditions in peace and at war that make labour regimes possible are important, too. Thus, comparing the impacts of the 1930s and 1940s on the workforce in Germany to the miners and resource extractors for EVs today in developing countries can give us insights on regional conflicts' impact on miners in developing countries. Finally, as in the case of post-World War Two period that eased industrial relations for capital and state in Germany through institutions and labour laws, today's labour and environmental regulations, migration patterns, and divisions in and competition among workforces can affect the shift to EVs in global production networks. Before thinking about these aspects in Chapters 8 and 9, Chapter 7 examines the first three JTPs in the case of Germany.

CHAPTER 7 TRANSITION IN THE GERMAN AUTOMOTIVE INDUSTRY: '*FAIRWANDEL*' INTO AN EV-LAND?

7.1 Introduction

Large original equipment manufacturers (OEMs) and their multinational first-tier suppliers dominate global automotive production networks and are in the midst of substantial changes with the shift towards electric vehicles (EVs). As described previously in Chapter 1 (Introduction), this process gained pace in the global automotive industry following the Volkswagen emission scandal in 2015, in which the German OEMs and multinational suppliers of fuel injection units equipped some vehicles with a 'defeat device' to alter emission test results. To reduce greenhouse gas emissions in road transport and deal with the climate change, international and governmental policies aim to accelerate the shift to EVs. Large OEMs and their key first-tier suppliers, as well as transport, energy and oil companies, are key lobbyists in national and international transport policy frameworks, and work with governments to help promote EVs as the key solution to transport emissions without acknowledging their historical responsibility in the ecological problem. Considering EVs as a major corporate environmental strategy to reduce greenhouse gas emissions ensures their dominance as key players in global automotive production networks. Moreover, it also potentially provides them with continuous profits, or even increased profits and capital accumulation, by replacing the existing world vehicle fleet with EVs in the long term. In the short to medium term, while internal combustion engine (ICE) continues to be used in PHEVs, EVs can expand global automotive capital accumulation as a niche product. Indeed, in the early phase in presenting the shift to EVs, second or third family cars in rich urban areas in developed countries are EVs, which helps OEMs to increase product diversification and maintain customers.

In this context, I examine, in this chapter, the extent to which the proliferation of EV manufacturing in the German automotive industry corresponds to a just transition to a low carbon economy. Since the definition of just transition is a controversial and increasingly mainstreamed phenomenon (see Chapter 2), I use a framework of just transition parameters (JTPs) in my analysis of the transition to EVs. JTPs as a relatively stable set of parameters to judge an ongoing phenomenon that itself is part of broader social and ecological

transformations of capitalist uneven development. While my selection of JTPs is inevitably partial and should be seen as one method among several possible methods for understanding the dynamics and processes under investigation in this thesis, I believe the five JTPs cover most of the key historical and contemporary dynamics and processes at multiple scales and with consideration of different positionalities.

On the one hand, while JTP1 (protection of existing workers and their communities) and JTP3 (retraining of workers for new jobs) are more focused on contemporary developments with EVs in the German automotive industry, JTP 4 (EVs' implications on global labour) and JTP5 (on the environment) approach EVs and power relations in global automotive production networks as part of a broader social and ecological transformation. On the other hand, my analysis based on JTP2 (inclusion of workers in decision-making processes) is informed by the historical analysis of past transitions in the German automotive industry, covered in the previous chapter. This is because, as I argue, current institutional mechanisms used by German workers and their labour organisations to negotiate the shift to EVs with their management and companies are the outcomes of the historical balance of power between labour, capital and the state. Chapter 6 shows that all three transitions in the history of the German automotive industry, particularly the second and the third, were parts of a broader international political economy, during which either the whole workforce or large parts of it were excluded from automotive decision-making processes.

As I explained in Chapter 5, the fourth and current transition, to EVs, is unfolding in a more fragmented and complex set of industrial relations in Germany, combined with differentiated global labour market regulations and political and economic environments. On top of this, the material characteristics of EVs, as compared to ICE vehicles, are based on more resource use, material extraction and mineral processing, which occur upstream of global automotive production networks, which leads to the need for JTP5. Similarly, involvement of the German workers in automotive decision-making processes does not directly account for meeting JTP2 and JTP4, unless workers and communities upstream are also involved and protected during the transition, leading to a just transition to EVs. I discuss this, and elaborate on what Chapter 5 set out, in Chapter 8. This chapter is organised around the first three JTPs, examined in the following three sections.

Focusing more on the micro level of firm strategies and the EV technology itself, as well as the meso level of industry competition, power relations and state involvement, this chapter is based on the qualitative data collected through semi-structured interviews and personal contacts (meetings and email exchanges) with different stakeholders in the German automotive industry. Additional sources include policy reports from the state, companies, industry associations and trade union organisations, as well as specific online news outlets focusing on labour, the automotive industry and EVs. My communication with the interviewees and personal contacts, based on at times limited access to information on EV-related restructuring of plants, required this form of triangulation. This methodological approach builds on the conceptual framework I developed in Chapter 3, which highlights the dynamically-contested nature of global production networks, whereby actors are in a continuous struggle over constructing socioeconomic relationships and dominating institutional governance mechanisms (Levy 2008). This shapes, and is shaped by, various labour regimes in the world economy that are 'the combination of social relations and institutions that bind capital and labour in a form of antagonistic relative stability in particular times and places' (Baglioni et al. 2022a: 1).

I begin with a summary of the main positions of German trade unions and that of works councils at OEMs and multinational first-tier suppliers towards job losses during the proliferation of EV manufacturing (JTP1). The focus on these two dominant sets of companies is justified in Chapter 5, based on the GPN analysis method and on ICE vehicle and EV material differences. Regarding the inclusion of workers in decision-making processes (JTP2), I examine examples from national and regional institutional settings, as well as company employment guarantees, and investigate conflicting decisions at various levels. Then, I explore the importance attached to retraining and early retirement schemes for, and competition among, the existing workforce in transition (JTP3). The synthesis of the data supporting my JTP framework is best paraphrased by the fear of becoming 'a second Detroit' and 'a second Nokia'; i.e. Germany losing its dominant role as an automotive R&D location ensuring well-paid jobs, and the German OEMs losing their lead roles in their global, and Central and Eastern European, production networks, respectively.

7.2 JTP1 via '*Standortversicherung*': Protection of the Industry or Existing Workers with EVs?

In this section, I start with recent industrial and national policies in Germany that claim to result in maintaining the leading positions of the German OEMs, while also securing some of the existing employment levels. In Germany, EVs are seen as redesigned products for passenger transport with strategic product differentiation outcomes that secure OEMs' technologically/architecturally dominant positions in global production networks. The proliferation of EV manufacturing is promoted by the local, regional and federal state in Germany, as well as by companies and trade unions, via industrial policies for future investment and employment in domestic plants.[61] Although, 'until very recently, some in the trade unions were opposed to EVs' (Interview with a national trade union), labour organisations now think that resisting EVs is not an option (IG Metall 2014, 2019). 'Recently, works councils and IG Metall have been trying to secure jobs via getting EV production into existing plants' (Interview with an OEM works council member). Thus, labour in Germany suggests that the state play an active role in the rollout of EVs as part of the *Standortversicherung, i.e.* a national industrial strategy to avoid losing Germany's leading role in advanced manufacturing and skilled employment:

> The realistic assumption of the different scenarios regarding the EV roll-out depends on regulation and the level of emission reductions, incentives, disincentives, targets and quotas to be implemented. (Interview with Brussels office of an industry union).

The regulatory role of the state in Germany is manifested in incentives and tax breaks for newly registered EVs.[62] In addition to this crucial support to demand in vehicle markets, the

[61] 3. Spitzengespraech der Konzertierten Aktion Mobilitaet: " Gestaerkt aus der Krise, gemeinsam die Mobilitaet der Zukunft gestalten" [3rd Summit of the Concerted Action on Mobility: 'Stronger out of the crisis, shape the mobility of the future together'] https://www.bundesregierung.de/breg-de/aktuelles/-gestaerkt-aus-der-krise-gemeinsam-die-mobilitaet-der-zukunft-gestalten-3-spitzengespraech-der-konzertierten-aktion-mobilitaet-1783382 Press Release on 8 September 2020, BPA: Presse- und Informationsamt der Bundesregierung) [Federal Press and Information Office of the German Federal Government].

[62] For battery electric vehicles (BEVs) and fuel cell (hydrogen) electric vehicles (FCEVs) under 40,000 euros, the subsidy includes 6,000 euros from the Federal Government, and 3,000 euros from the carmakers. For BEVs and FCEVs that cost over 40,000 euros, these figures are 5,000 and 2,500 euros respectively. For the plug-in hybrid electric vehicles (PHEVs) under the 40,000 threshold price, the subsidy includes 4,500 euros from the Federal Government, and 2,250 euros from the carmakers. For PHEVs over the threshold price, these figures are 3,750 and 1,875 euros respectively (BAFA 2020).

role of the state expanded, with support mechanisms facilitated for production of, and infrastructure for, EVs. In line with this, in November 2020, the federal government decided, at the fourth auto-summit,[63] to subsidise further the German automotive industry in the shift to EVs. The aim of the federal government is to equip at least 25 percent of all petrol stations with fast charging infrastructure by the end of 2022, at least 50 percent by the end of 2024 and at least 75 percent by the end of 2026. An economic stimulus package of two billion euros is to be implemented in order to initiate a transformation of the vehicle industry. The Federal Government is also creating a 'future fund for the automotive industry' of one billion euros available to supplier companies, and another one billion euros for public procurement of commercial vehicles and trailers with electric powertrains. The underlying motive is to create a national industrial policy in order to continue Germany's role in the vehicle industry and secure employment in industrial manufacturing. The trade unions are on board and welcome this policy, while they also warn that the transition needs to unfold cautiously, and thus call for a '*Fairwandel*' (just transition).

7.2.1 Transitioning carefully: IG Metall for a *Fairwandel*

Trade unions and works councils in Germany usually support their companies' management in order to limit employment losses and not to be left out of the implementation process for new products and work practices (Haipeter 2020; Mahnkopf 2019). According to the trade union representatives, workers are willing to be part of the environmental, technological and regulatory changes. However, as a key part of the just transition policies promoted by the national and international trade union movement, the German trade unions demand that the transition should take into consideration the existing workforce. This is also evidenced by IG Metall's recent internal investigations, where they see the existing workforce is not fully ready for the impacts of EVs.

According to the President of IG Metall, automotive workers, an important part of IG Metall's membership, will face job losses due to EV production. To highlight this, on the 29th June 2019, IG Metall gathered its members in Berlin to promote 'socially, ecologically, democratically just

[63] 4. Spitzengespraech der Konzertierten Aktion Mobilitaet: ‚Transformation unterstuetzen, Wertschoepfungsketten staerken' [4th Summit of the Concerted Action on Mobility: 'Support transformation, strengthen value chains'] https://www.bundesregierung.de/breg-de/suche/4-spitzengespraech-der-konzertierten-aktion-mobilitaet-transformation-unterstuetzen-wertschoepfungsketten-staerken--1815818 Press Release 410, Press Release on 17 November 2020, BPA: Presse- und Informationsamt der Bundesregierung) [Federal Press and Information Office of the German Federal Government].

transition' and called for workers' inclusion in decision-making that shapes policies on decarbonisation, climate change and digitalisation.[64] The aim of *Fairwandel* (just transition), IG Metall's slogan for the demonstrations in Berlin, 'is to ensure that the transition does not unfold against the interests of the IG Metall members' (Interview with an OEM works council member). The concept of just transition is useful to IG Metall's intervention, because 'you cannot organise this big an event without such an encompassing concept. Only saying that we, as workers and trade unions, are afraid of something would not work; instead, making TUs' own points is a good way to intervene.' (Interview with a national trade union). My JTPs 1 and 2 are explicitly referred to as crucial by the trade union for a successful transition from a labour point of view. The unions proactively prepared for this by drawing the attention of the membership to the changes unfolding with EVs.

To cope with the job losses due to industrial change with EVs, in 2019 IG Metall looked into whether its members were prepared, by sending questionnaires to around 2,000 companies' works councils in all sectors, where 1.7 million workers are employed. In its enquiry, referred to as *Transformationsatlas*, IG Metall specified that more than half of the companies involved in the production of motor vehicles and their parts are not ready for change.[65] More than half of the autoworkers[66] stated that, due to the structural changes, employment at their sites will decrease, and an additional one third saw no potential job increase in the future. Only eight percent of the autoworkers predicted an increase in the employment levels at their current factories. Among the mostly robotised and automated plants in manufacturing sectors, Meil (2020) and *Transformationsatlas* by IG Metall (2019) show that workers at OEMs' and big first-tier auto suppliers are not informed of the potential impact on jobs. Indeed, changes to the number and nature of jobs in the transition to EVs in the German automotive industry are reflected in various workforce reduction plans in OEMs and suppliers. Informed by the

[64] IG Metall steigt beim Klima ein: Die Gewerkschaft ruft zu einer Großdemo fuer einen 'fairen und oekologischen Wandel'. Gleichzeitig warnt sie vor einem Fiasko in der Autoindustrie. *Die Tageszeitung* 23.06.2019 https://taz.de/Gewerkschaft-fuer-Umweltschutz/!5604810/ [IG Metall gets involved in the climate; Union plans large demonstration in Berlin for fair and ecological change. At the same time, it warns of a fiasco in the automotive industry].

[65] *Transformationsatlas wesentliche Ergebnisse,* 5 June 2019, Press Release of the Board of IG Metall [Atlas of transformation: Essential results] https://www.igmetall.de/download/20190605_20190605_Transformationsatlas_Pressekonferenz_f2c85bcec886a59301dbebab85f136f36061cced.pdf

[66] One fifth of all questionnaire participants work in the automotive industry.

analysis in Chapter 5 on the technical and material differences between ICE vehicles and EVs, next section explains the overall patterns regarding tasks created and dropped by EVs in the organisation of vehicle production, and then delves into identifying the losers among the German automotive workforce.

7.2.2 Ambiguity in changes to skills in the German automotive industry

German automotive companies have recently been announcing job cuts in existing plants. To be able to keep well-paid jobs in Germany, the trade unions and workers, along with the companies, look forward to seeing increased investment and regulatory decisions taken by the local, regional and national state authorities. Almost all those I interviewed in the German automotive industry and contacted during my research trips in Germany agree that EVs create new jobs while rendering others obsolete, and requiring some to be transformed in terms of skill sets and the ways in which the production process is organised. Considering JTP1 in my just transition analysis, protection of the existing workforce and their communities, the ongoing discussions highlight that the extent to which the new and transformed jobs will compare to those that existed previously depends on successful national and industrial policy mechanisms.

As outlined in sections 5.3 and 5.4, the major difference between ICE vehicles and BEVs, the EV type taking the lead in technology and investment decisions of OEMs, is the relative simplicity of EVs due to the lack of moving mechanical parts as compared to ICE vehicles. Therefore, many trades at OEMs and first-tier suppliers in relation to ICE, transmission, oil and air supply and injection components are lost with EVs. Similarly, workers at other, often smaller suppliers, forging and manufacturing parts for these traditional components, will be impacted; these jobs employ large numbers of skilled and semi-skilled workers.

Additional changes with EV production occur in battery cell manufacturing, battery pack assembly and electric motors. The production of batteries[67] and electric motors[68] are quite established trades, performed by mostly Japanese, South Korean and recently Chinese factories (see Chapter 5). Manufacturing battery components does not require the same level

[67] Sony first produced lithium-ion batteries in the early 1980s. These were disseminated in 1990s in cameras and other electric/electronic consumer goods, and in the 2000s in mobile phones.

[68] Electric motors have been used since late 19th and early 20th centuries. Today, their manufacture and assembly is highly automated and robotised (IKA 2014; ELAB 2012).

of skill and demand for labour; however, assembling battery packs does (Personal contact and works council member at a major OEM). Thus, workers and trade unions in Germany are concerned about the location of assembly lines of battery packs, which include the most labour input when producing and assembling EV components (IKA 2014: 90; ELAB 2018: 18), and require high upfront capital investment at existing OEM plants (Personal contact with an OEM worker).

> The shift to EVs is principally OK with the trade union, but [a] major concern is the question [of] where batteries will be produced. They [OEM company management] said that currently no plant is finished and fully in operation in Germany. A big question [asked by the local trade union office here] is how and where they [the company management] will get those batteries and electronic units to be put in the vehicle to build 2-3 million EVs by 2025 (Interview with a local trade union office).

Warning against potential job losses in Germany due to insufficient public and private investment in existing automotive plants, Jörg Hofmann, the president of IG Metall, said that nobody is sure where, and under what conditions, new jobs will be created.[69] 'With the battery cell production and battery pack assembly, our demand is to have a European battery chain, because otherwise it [jobs] can go to the Asian countries, China or South Korea or the US' (Interview with the Brussels office of an industry union). The uncertainty is also on pay levels of the new jobs, and whether their conditions and social rights would match those of the diminishing number of auto jobs. Nevertheless, one interviewee commented:

> IG Metall in Germany is pretty secure and convinced that they can handle this, with retraining and upskilling. I am a bit more pessimistic about all of these, because when the market for EVs takes off, you will not be able to manage this anymore, then things will happen, events will go fast, there will be

[69] *IG Metall Press Release* 29.06.2019 Interview mit Berliner Zeitung: 'Wir demonstrieren gegen das Nichtstun' IG-Metall-Chef Jörg Hofmann fordert mehr Engagement von Arbeitgebern und Politik beim digitalen Wandel https://www.igmetall.de/presse/ig-metall-vorstand/wir-demonstrieren-gegen-das-nichtstun [Interview with Berliner Zeitung: 'We demonstrate against doing nothing'; IG-Metall-Chief Jörg Hofmann calls for more commitment from employers and politicians in the digital transformation]

disruptions and some plants will be closed (Interview with a European trade union federation).'

Therefore, there seems to be an ambiguous, and perhaps more likely negative, impact from the shift to EV production, regarding manufacturing-industry jobs, as foreseen by the trade union representatives in the German automotive industry, as well as by those at international labour organisations. Bigger concerns apply in the areas of pay levels and the quality of jobs to be added to the existing plants, mainly based on the facts that, first, there is not sufficient investment in new component manufacturing and assembly in Germany, and second, these components, such as lithium-ion batteries, have been produced and developed for decades in other locations (see Chapters 5 and 8).

EV production also influences two other large workforces, which are outside of this research's limits. First, the reduced number of components in EVs affects workers in services jobs at maintenance workshops and fuel stations (Interview with industry representative; EUROFOND 2018a). This is a concern shared by labour: 'Differences between charging stations and fuel stations would likely cause jobs losses' (Interview with the local trade union office). Second, EVs will have an impact on energy generation facilities and the contribution of renewable energy sources to the electricity grid through both electricity consumption and storage (IEA 2011, 2018). The key factor contributing to local unemployment is that such tasks are either lost or will be performed with less labour input at new EV charging stations or battery replacement units in large companies. In the next section, I continue with my analysis of changes to manufacturing-sector jobs with differentiated skill levels and employment contracts at OEMs and their large suppliers.

7.2.3 Losers with EVs: Company size and contract differentiations among autoworkers

EVs have a negative impact on employment levels in the German automotive industry. This concern is obviously related to both JTP 1 and JTP3. It is crucially linked to JTP2: involvement of workers in decision-making processes, given the fact that research and new-product development in vehicle manufacturing in Germany is intertwined with skills necessary for the organisation and management of manufacturing. This has repercussions for the national political economy in Germany. 'Social stability is under pressure with changes after job cuts by Bosch, Mahle and others' (Interview with a local trade union office). My interviewee, as a unionist, was referring here to recent right-wing demonstrations in Eastern Germany, where

populist parties had gained ground following deindustrialisation of the region, while the then recent refugee influx from Syria was used to mobilise extremist political action. As small automotive suppliers, as well as some factories of OEMs and large suppliers, are located in this region, my interviewee feared that EV related job losses would echo these views. Overall, there are three main groups of workers whose jobs are at most risk. Potential losers in the German automotive industry include temporary/agency workers employed on OEMs' assembly lines, no matter how skilled they are; skilled and semi-skilled workers at both OEMs and multinational first-tier suppliers, and owners and employees of SMEs in the second and third tiers, producing vehicle parts.

First, considering components workshops and assembly plants in Germany affected by the job losses due to changes with EVs, the temporary workers, *Leiharbeiter*, constitute the initial wave of the workforce to be laid off. As discussed in Section 6.4, the German automotive industry has increasingly made use of temporary, part-time and/or fixed-term employment contracts to cushion vehicle demand fluctuations without jeopardising unionised permanent workers. In the 2000s, this was enshrined in national labour law after the Hartz Reforms. 'In business cycles, agency workers are affected first, and that is agreed with the trade union. It is always agency workers who disappear first' (Interview with a European trade union federation). This helps OEMs to avoid the additional labour costs of full-time employment while meeting the increased market demand for vehicles (Benassi 2017; Doellgast and Greer 2007; Greer 2008; Holst et al. 2010). This is not specifically a German phenomenon; it is common worldwide in the global automotive industry (Bernaciak 2010; Hancke 2000; Morley et al. 2006; Pulignano et al. 2008; Sancak 2022). For instance, in Japan:

> Carmakers employ a large number of seasonal workers, to whom not all tariff agreements and other entitlements apply. These are mainly designed for regular/unionised workers. Seasonal workers come from rural areas, are provided with housing around car industry plants, and rents are deducted from their wages. Once out of work, they are evicted from such housing and a very serious social problem occurs (Interview with an international governmental organisation).

The negative impacts of EVs on temporary agency workers are seen early on in the plans of the largest German carmakers, which were negotiated with the company works council,

whose membership are almost entirely also members of IG Metall. As outlined by Volkswagen in 2016, regarding its future pact between the central works council and management, the group will reduce the workforce by 30,000 workers (Fasse 2017). Around two thirds of the total affected by this arrangement are located in domestic plants and assembly lines of VW.[70] Temporary workers and older permanent workers (under early retirement schemes) are expected to be the biggest groups losing their jobs. This indicates an inability to meet the JTP1 – protecting the existing workforce and their communities.

Second, the major group of the workforce affected by the shift is skilled workers (*Facharbeiter*). These are employed by OEMs and their large first-tier suppliers. The skilled workers are the backbone of the country's 2.3 million strong metal and manufacturing industry trade union, IG Metall. They acquire their skills and expertise through both experience and the country's dual vocational education system, with its curricula set up with the involvement of IG Metal, and funded by both the government and the industry (Berg 1994: 82-83; Soskice 1994: 27-8). 'Their feedback to the engineering processes is vital and there is not much difference between an engineer and *Facharbeiter* in that regard' (Interview with Brussels office of an industry union). This group of workers is subject to different schemes in the shift towards EV production. The approach of employers ranges from the retraining of some of the skilled workers and engineers for the restructured production lines designed for EVs, to allocation to other OEM workshops operating mainly for ICE vehicles, and to early retirement plans.

'There will be golden handshakes, people will retire without replacement - following the 2008 crisis, it was almost impossible to find jobs for people older than 50; but nobody will be fired' (Interview with a European trade union federation). 'Demographics is key, ICE workers are relatively old, so they are going in retirement' (Interview with a regional economic policy institution). Because, 'it is difficult for workers to retrain after some age' (Interview with a local trade union office), early retirement 'is a small help, but it will not play out very smoothly' (Interview with a trade union's research institute). Retraining can be successful 'maybe for some small number of workers at R&D centres, in whose reskilling or retraining

[70] Christoph Rauwald 'German autoworkers raise alarm over job losses in electric shift' Bloomberg, 5 June 2018, https://www.bloomberg.com/news/articles/2018-06-05/german-autoworkers-raise-alarm-over-job-losses-in-electric-shift

the company has an interest. Other than that, I cannot see any retraining or life-long-learning possibilities' (Interview with a global trade union federation).

The third group of workers in the German automotive industry impacted by the shift is employees of the small- and medium-sized companies (*Mittelstand*). 'Honestly speaking, big OEMs are able to manage this process, and big parts suppliers are able to manage too. This is not so for small suppliers. Thousands of them will disappear; the aftermarket services will disappear, too" (Interview with a European automotive industry lobby). 'Regarding the Mittelstand, it is hard to see how they can address this' (Interview with a regional economic policy institution). The employment within this group is composed of skilled workers and engineers with degrees from universities or vocational schools. Among them and their experienced team leaders is often the owner of the family enterprise. Unionisation rates at such SMEs are not high. Thus, they will not be able to follow what the big industry and trade unions do in order to mitigate the impacts of the shift towards EVs.

> 'Big players such Bosch or ZF have in place concrete plans about the future. Small suppliers have the big challenge, because they are more specialised. Now they need to differentiate and sell to other industries' (Interview with automotive industry association).

> 'Some of these companies will downsize their production. Some will do OK because EVs will be a minor part of the world fleet for the short to medium term' (Interview with a national trade union).

However, regarding the long-term trajectories for Mittelstand, those that produce mainly the moving and mechanical parts of the ICE are most vulnerable to job losses. Thus, the German federal government recently introduced, with IG Metall, the 'Best Owner Group' fund, to overcome their loss via product diversification and even look for ways of engaging in other manufacturing or services sectors.[71] This aims to eliminate 'overcapacity' in the auto parts industry. As explained in Chapter 1, the fund aims financing smaller suppliers in the shift to

[71] Christoph Boeckmann 'Viele Zulieferer stehen zu Unrecht im Schatten' Metallzeitung IG Metall (2020) ['Many suppliers are unfairly threatened'] https://www.igmetall.de/service/publikationen-und-studien/metallzeitung/metallzeitung-ausgabe-dezember-2020/viele-zulieferer-stehen--zu-unrecht-im-schatten (Note that key people at BOG, the fund for small suppliers to finance the transition, are the former head of the Federal Work Agency and previous head of the vehicle division at Bosch. SMEs are not as actively involved as the state and the large first-tier suppliers, meaning that JTP3 is not ideal for labour in SMEs.)

EVs, however, the trade unions could not attract enough funds from capital markets. The next section is on how such institutional arrangements perform with respect to JTP2 - inclusion of workers in planning the shift.

7.3 JTP2 - Who Decides: The Exclusion of Workers from Planning the EV Transition

In line with JTP2, this section analyses to what extent the institutional mechanisms in Germany include workers and their communities in decision-making processes. Starting with the national level and continuing to others, I ask whether and how the organisations that represent workers in such mechanisms are able to address the losers demonstrated in the previous section - temporary agency workers, skilled workers subject to retaining or early retirement plans, and employees of the small- and medium-sized companies supplying to the OEMs and big first-tier component suppliers.

7.3.1 NPE/NPM: A 'national' platform for electromobility

As part of the second economic stimulus package, adopted as a response to the financial and economic crisis in 2007/2008, the Federal Government of Germany agreed, in November 2008, to bring together a national platform for electromobility (NPE)[72] with participants from the automotive industry (NPM 2009: 4-5). As a standalone federal advisory body, the NPE's objective is to prepare the automotive and supplier industries for the coming age of electric vehicles. Between 2009 and 2018, the NPM coordinated around 150 members to suggest economic and industrial policies to expand the EV market, only one of whom was a worker representative – the president of IG Metall, as member of the steering committee.[73] Of more than 150 members of the NPM's six working groups[74] on different aspects of transition to EVs, none included a trade union or works council representative. Only the 21-person-strong editorial team had two members from trade unions. In 2018, the federal government renamed the platform. Under the new organisation of the NPM, National Platform for the

[72] NPE was later named NPM, highlighting 'mobility for future' instead of electromobility.

[73] The NPM's steering committee consisted of the chair of the National Academy of Science and Engineering, officials from four federal ministries (education, environment, economy, and transport), four big OEMs (VW, BMW, Daimler and Audi), first-tier big suppliers (BASF, Siemens), automotive industry associations (VDA - German automobile association, BDI - Federation of German Industries), and two big power generation companies.

[74] Vehicle technology; battery technology; charging infrastructure; regulation, standardisation and certification; information and communication technologies; general framework.

Future of Mobility, among the same six working groups, only one includes three trade union members, in addition to a union member at the platform's steering committee, Jörg Hofmann, the president of IG Metall.[75] 'IG Metall agrees with the companies that EVs are the future for the industry; but main drivers are the capital decisions and climate targets' (Interview with an OEM works council member).

Due to the limited representation by IG Metall at various working groups, the organisational structure of NPM is unable to bring forward the say of even skilled workers, who will potentially be subject to early and voluntary retirement schemes. Other losers with EVs identified above, temporary workers across the industry and owners and employees at SMEs, have the least say of all in the institutional decision-making processes. Regarding the impacts on SME workers, there is an institutional weakness with regard to the JTP2. The NPM includes the heads of some SMEs in working groups, but managers from big automotive suppliers, energy companies, public university research centres and the officials from the federal government ministries dominate the platform's working groups. In addition to that, civil society associations are excluded from the platform (Bloecker 2018: 6). In other words, 'the industry tells the politicians what to do' (Interview with a big first-tier supplier works council member).

> 'As trade unions, we hear the decisions, but the industry comes to those decisions, they do not tell us, all of a sudden, they made up their mind; it is their engineers and R&D stuff, I suppose, making decisions' (Interview with a European trade union federation).

Considering the content of the transition policies created by the NPM, there is a lack of appreciation of the impacts of EVs on employment; rather, the platform is focused on the demand side and market-oriented projections. Its policies are mainly concerned with market acceptance or customer choices as the defining figure (NPM 2018). Moreover, meeting 'the CO^2 emission regulations of the EU leads the way' (Interview with automotive industry association). Policy proposals discussed at the NPM, as well as *Standortversicherung* - incentives to secure employment and domestic production explained in previous sections,

[75] NPM working group four on production locations of batteries, raw materials, recycling, education and qualifications. https://www.plattform-zukunft-mobilitaet.de/schwerpunkte/ag-4/

mostly refer to the individual state governments, *Laender*, and company-specific measures. Implementation of these industrial polices is mainly organised via local industry committees, sometimes called transformation alliances, which I now turn to.

7.3.2 Regional institutional settings: Transformations alliances?

In addition to the national-level decision-making mechanisms on the future of the automotive industry, most regional state governments in Germany are focused on producing and implementing policy proposals to cope with the proliferation of EV production. There are four main automotive-cluster-states in Germany based on both the revenue and employment levels, each hosting large German OEMs and multinational first-tier suppliers: Lower Saxony, with VW and Continental; Baden-Wuerttemberg, with Daimler, Porsche, Bosch, ZF Friedrichshafen, Mahle, Brose and Eberspaecher; Bayern, with Audi, BMW, MAN, Neoplan and Schaeffler, Draexlmaier, Webasto and Infineon. In addition to these, the fourth state – North Rhine Westphalia has other international OEMs such as Ford and Opel (GTAI 2022: 6-7). The regional industry alliances are composed of participants from political parties represented at the state parliaments, *Landtag*; members of the trade union and employer associations — IG Metall and Gesamtmetall; industry units of chambers of commerce and industry; and automotive and supplier industry associations. Considering the internal functioning of such policy settings, achieving JTPs 1 and 2 is hard for workers and smaller suppliers; such regional platforms are mainly consultancy bodies to the local governments.

Similar to the NPE/NPM, the inclusion of workers, who lose the most with EV production, in such mechanisms is weak. Among the three vulnerable groups identified according to the material structure of EVs and employment structure in the German automotive industry, it can be argued the skilled workers are somewhat represented by IG Metall. However, ‘they are not fully heard at the meetings; even shop stewards are not welcomed by the state's political leaders, including prime ministers and the minister of the economy’ (Interview with a local trade union office). This is probably because not all of the political parties building coalitions for the state governments are in close contact with the trade unions.

Another significant issue with the representation via trade union officials is that this ignores potentially divergent internal interests among the membership. For instance, workers at the OEMs and big suppliers earn more than the workers at other suppliers. This creates ‘an asymmetric power balance between the OEMs and the suppliers; some suppliers need to

operate without the wage tariffs and they are impacted by the risks' (Interview with a trade union's research institute). Put differently, workers and local works council members personally are not always in agreement with the proceedings of the transformation policies, and see it as the preservation of the status quo: 'I do not believe what [they] say, it is just a strategy for not changing [status quo]' (Group discussion with works council members at supplier). Their priorities can be different from those working with institutional policy mechanisms: 'We have to make solidarity with the workers, not the states or the industry' (Group discussion with works council members at supplier).

From a point of view based solely on the institutional structure of such local level transformation alliances, it can be argued that SMEs are possibly active via chambers of commerce and other supplier associations. Such bodies might be useful to communicate and work with the SMEs regarding the potential impacts; however '[they] are sceptical of the transformation alliances' (Interview with a local trade union office), because chambers or other local industry associations are dominated by big companies, often in coordination via other informal settings. Furthermore, SMEs are unevenly exposed to risks of the production networks compared to OEMs and multinational first-tier component suppliers that can shift risks and costs to smaller suppliers in developing countries. SMEs are often exempt from the R&D initiatives put forward by the latter two (Liu and Dicken 2006; Pavlinek 2019; Vazquez et al. 2016). This is more significant for initial phases of EV component standardisation, as OEMs and first-tier suppliers refrain from sharing several project details, on powertrain, electronics, semiconductors or software used in vehicles, with other suppliers (Personal contact with worker at big first-tier supplier).

The most vulnerable among the groups at risk during the shift towards EVs is the case of temporary agency workers. Given the fact that they are not covered with the rights and benefits offered to the membership of IG Metall, and are subject to changing employment levels due to market fluctuations (Holst et al 2010), their just transition demands cannot be fully addressed through such institutional mechanisms. In addition to that, 'works councils are not the best way to change companies' (Group discussion with works council members at supplier), so incorporation of some of the works council members, most of whom are IG Members, makes it hard to solve issues faced by the third group at risk from EVs.

7.3.3 ELAB: The national narrative on EV roll-out scenarios and employment effects

Both the federal government and regional state governments refer in their policy initiatives to an industry-wide study, especially when it comes to employment impacts and EV adoption scenarios. This is the ELAB study (2012) and its updated version with new EV models, battery technology and ranges (ELAB 2018). Major OEMs and first-tier suppliers in Germany, in cooperation with the DGB, the German Trade Union Confederation, and the industry trade union, IG Metall, are involved in this research series. They commissioned it to Germany's national research institute's industrial engineering unit, Fraunhofer Institute IAO, and to the German Aerospace Agency.

According to the reference scenario of the first ELAB study (2012: 47), vehicles containing the mechanical trades will still dominate in 2030, with a share of 85% in total new sales.[76] ELAB (2018: 2-3) added to these figures another three scenarios, with BEVs reaching market shares of 25, 40 and 80%. Despite the overall uncertainty, with multiple scenarios, on when and how the roll-out of the different types of EV accelerates and changes employment levels, the updated ELAB report (2018: 6-7) warns that, based on 2017 production statistics and productivity growth, between one third and one half of the powertrain jobs in Germany will be lost by 2030. Technicians, mechanics and other skilled workers employed in relation to production of ICE vehicles and transmission units are not needed with EVs (NPM 2019: 77; ELAB 2012: 168), and these are a vital part of the German automotive industry's role in the global production networks (ELAB 2012: 195).

As ELAB studies and NPE/NPM policy decisions forecast, even with the most 'progressive' scenario, there seems to be some time for employment adjustment to new tasks, while workers perform their current duties. This is possible with plug-in hybrid EVs, based on the idea that hybrids include complex components and ICE, and will play a role in the transitioning phase. Thus, the two ELAB studies see PHEV and FCEVs, and future battery pack assembly plants in Germany as a major source of employment that will deal with the job losses at ICE and transmission plants replaced with those for BEVs. Indeed ELAB (2018: 8) argues that for a 'socially just transformation' towards EVs, the federal and local governments should support PHEVs and FCEVs. 'Diversification of EVs can secure some jobs, for instance with assembling

[76] This was an extremely conservative scenario with the following rates of vehicle types to be sold worldwide in 2030: Traditional ICE vehicles 40%, mild hybrids 15%, hybrids 20% and range-extended hybrids 10%. The figure for BEVs and FCEVs is quite low, 10% and 5% respectively.

luxury cars. These are highly skilled with furniture design, carbon fibre body etc.' (Interview with an international governmental organisation).

However, 'With the PHEV, there are no big changes; anyhow, changes with the hardware for electric motor and battery and recuperation, this is a standard evolution' (Interview with a European automotive industry lobby). 'Not just EVs, but digitalisation and automation are parts of the change too. Maybe bigger parts' (Interview with a national trade union). Therefore, while 'workers are in favour of hybrid EVs, as battery EVs are not more jobs-friendly, with the increased tendency of automation and digitalisation, even the complex structure of hybrid EVs would not lead to big job growth' (Interview with a global trade union federation).

Its strength and nationwide acceptance comes from the fact that the committee commissioning the report includes almost all of the stakeholders in the German automotive industry, ranging from industry associations to carmakers, suppliers and trade unions. However, these are not enough to include all workers in Germany influenced by the shift. ELAB studies are rife with apolitical and technocratic views on change in industry. 'On the technology, it is mainly engineers who decide' (Interview with local public official). Thus, the JTPs are not addressed in this policy document series, which is apparently a key resource for the interviewees in this research from the unions and German automotive industry.

This is in parallel with other recent developments in the industry. Almost all OEMs and big first-tier component suppliers have announced job losses in both domestic plants and international factories. However, as summarised in the previous two sections, similar to the national and regional policy initiatives, the ELAB studies do not include workers and local union members. 'On the types of technology, shop stewards are not involved in discussions on such technical issues (Interview with a local trade union office). A shared concern by ELAB studies and the data collected for this research is the fact that retraining of the workforce will be an essential factor with respect to just transition, which the next section discusses with regard to JTP3.

7.4 JTP3: New Jobs with Retraining and Investments?

This section is on the JTP3 of my just transition analysis, retraining of existing workers, which is highlighted as the key transitioning mechanism toward EVs by the state, industry and trade unions, as well as the interviewees and personal contacts reached out to for this research. The timing for introducing different types of EVs becomes vital for workers across the board, among whom not all can be retrained, depending on their ages, computer, machine and software literacy skills. Rather than funding for training activities, the federal and regional transformation schemes pay more attention to R&D activities, incentives for EV plant restructuring and customer support mechanisms for new EV sales.

7.4.1 Lack of funds for retraining

Discussions around retraining and new investments for EVs in existing plants in Germany are focused on funds for digitalisation of production. 'You do not need technicians for BEVs, you need electricians and software engineers. The pathways for FCEVs, PHEVs and BEVs are enormously different' (Interview with a European automotive industry lobby). 'In terms of qualification, electrochemical skills are lacking' (Interview with a regional economic policy institution). Digitalisation includes utilisation of robots, sensors, cyber-physical assistants, and software and hardware for autonomously operating tools and machines inside in the factory (Drahokoupil 2020: 7). Also referred to as the computerisation of jobs (Frey and Osborne 2017), it is the technologically latest version of automation and increased personal, bureaucratic and social surveillance mechanisms in the workplace (Moro et al. 2019). The shift is slow and often in combination with incremental changes to the old working methods; yet working conditions deteriorate as demand for different skills rises and cost-cutting pressures decrease employment (Haipeter 2020: 257).

Both EVs and digitalisation underline the need to retrain existing workers. Thus, trade unions are in favour of retraining mechanisms. 'Workers need time for shifts in employment structures. Regarding new qualifications and skills, we need other educational arrangements with new recruits for software' (Interview with a national trade union). However, 'the industry is highly focused on increased digitalisation and automation, but relevant education and new capacities are not paid enough attention to' (Interview with a local trade union office).

Therefore, 'with requalification and retraining, we need government intervention' (Interview with Brussels office of an industry union). This is key for the German automotive industry to

avoid losing its position in global automotive production networks, 'because the success in this region is based on expertise in diesel engines, especially in the premium segment. Detroit is a horrible example and we try to avoid it by attracting new skills, IT experts, software engineers, who go to Silicon Valley now, not to Stuttgart' (Interview with a regional economic policy institution). Transforming skills and retraining workers is seen as a vital solution to the problems faced by the European telecommunications industry, of which 'not so much is left anymore, see Erikson and Nokia; we have to ensure that the same does not happen to the automotive industry' (Interview with a European trade union federation).

7.4.2 Workers and factories against each other: Competition for EV investment

Workers cannot organise to demand fulfilment of just transition parameters either for funds to retrain or for restructuring investments for EVs in existing plants. 'Even at the firm level, there cannot be a fair transition in deciding on diversification and new investments, because this is an economic game' (Interview with a local trade union office). As companies decide to invest in EVs and other new technologies in a location, works council members at the individual factories are expected to cooperate with their management teams, and thus cannot develop strategies with their company or trade union peers, because, 'it is not the trade unions who participate in the decisions on future investment or plant restructuring, it is the works councils. Yet, company management teams and engineers dominate this process in accordance with competition and future plans' (Interview with a local trade union office).

As a result, 'IG Metall members are played against each other for the production of EV components' (Interview with a local trade union office). An ongoing example is discussions on producing transmission components by either a big German supplier or a German OEM. If the OEM works council cooperates, the planned competence centre for electromobility will be built in its plant, creating only a limited number of highly skilled, well-paid new jobs. However, if part of the previous production is not relocated and they keep the existing jobs for the powertrain components used in EVs, as requested by the works council, the OEM announces that it will invest in another location. A similar example demonstrates such conflicting decision-making in one of the biggest first-tier suppliers, where 'engineers have nothing left to work on doing research and development in one plant, because OEMs stop developing better diesel engines, while employees at other locations welcome funds for developing EV components' (Group discussion with works council members at supplier).

These types of conflicts around who should produce components for EVs also cause divergent EV policies from members of the VDA, the German automotive industry lobby.[77] Some members of VDA do not welcome a large OEM's investment in a specific branch to produce its own components. Suppliers want to keep producing parts, as well as electric motors and parts for chassis, while works councils at large OEMs can agree with the company management for future investment, in an exchange for cooperating on the introduction of different work contracts for temporary and part-time working arrangements.

On the one hand, at the corporate level, both the OEMs and their close-tier big suppliers are investing large amounts of their R&D budgets in projects on developing EVs, and restructuring their assembly lines, engine and transmission plants to increase EV production volumes, while also cooperating among themselves:[78] 'OEMs are joining forces, because transformation is very capital-intensive. OEMs' strategies are not always the same though: VW pushes hard for e-mobility, whereas BMW and Daimler are a bit reluctant' (Interview with a regional economic policy institution). On the other hand, potential conflicts of interest on future investments among individual factories of OEMs and their suppliers point out uneasy choices during the shift to EVs.

Consequently, divisions among both losers and potential winners with the shift towards EV production further complicate the contentious fulfilment of the three JTPs analysed in this chapter. This manifests itself also in a divide among the autoworkers and their approach to the union leadership. '[Just transition] is not a very easy positon for IG Metall, because they say, "We find this important for ecological reasons." However, the leader of the IG Metall got only 70% votes, even without any other candidate. This is a big problem. In 2015, he had 91% of the votes' (Interview with a trade union's research institute).

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[77] Mortsiefer, Henrik (2019) 'Autoverband in Aufruhr: Der von Volkswagen angezettelte Streit ueber die Elektromobilitaet spaltet die VDA-Mitglieder. Ein Krisengespraech der Autobosse soll nun helfen' *Tagesspiegel* 20/03/2019 ['Car association in uproar: The dispute initiated by VW on electromobility divides the VDA members. A crisis meeting of carmakers should help'] https://www.tagesspiegel.de/wirtschaft/provokation-von-vw-autoverband-in-aufruhr/24121642.html

[78] Hetzner, Christiaan (2016) Volkswagen weighs 2nd platform for EVs, Automotive News Vol. 90 Issue 6727 pp. 21, 30/05/2016 http://www.autonews.com/article/20160528/OEM05/305309989/vw-weighs-second-ev-platform

Zoia, David A. (2018) All-electric MEB platform to drive new firsts at VW https://www.wardsauto.com/technology/all-electric-meb-platform-drive-new-firsts-vw

7.5 Conclusion

This chapter analysed the first three JTPs to assess the shift towards EVs in the German automotive industry. JTP1, protection of existing workers, can be partially fulfilled, because EVs are regarded as a national industrial strategy in securing some employment in a vital manufacturing industry. Partial fulfilment is based on the ambiguity of the net effect of created and dropped trades with EVs, depending highly on the role of the state. More important is that not all German autoworkers are among the winners, especially those with no access to rights and benefits provided to skilled workers via membership of trade unions.

The JTP2 also provides a weak trajectory for inclusion of workers in EV and automotive decision-making processes. The NPE/PNM, the national platform for EVs as a high-level consultant unit to the federal government, does the least to consider or mitigate job losses with/after EVs. At the regional level, some of the losers (skilled and semi-skilled workers at OEMs and first-tier big suppliers) are potentially to be included in the decision-making via 'transformation alliances'. Yet, their trajectory depends on an opaque policy process, where their local representatives, shop stewards, are unable to access all the formal meetings, let alone have informal dialogue among corporate management teams and union leadership. Temporary agency workers and employees at SMEs are at high risk of being excluded. At the industry level, the ELAB research series does not represent a successful inclusion of workers in the decision-making process, and limits the idea of just transition to some types of EVs being supported by the state as a temporary solution to the employment loss to take place, due to BEVs initially being the dominant EV product.

JTP3, on retraining and investment schemes for EVs, will also lead to ambiguous outcomes for those at risk. The implementation of retraining and investment in new/restructured plants is not grounded on solid institutional mechanisms. More significant here is the fact that works councils at individual plants are expected to work with their respective company management, rather than constituting a position in investment negotiations. Lastly, investment negotiations are furthest away from considering those at risk of losing their jobs, as works council members of OEMs and big suppliers are relatively more powerful than SMEs. The next chapter covers the remaining two JTPs.

CHAPTER 8 THE SPECTRE OF DETROIT: EVS AND JUST TRANSITION IN THE GLOBAL AUTOMOTIVE INDUSTRY

8.1 Introduction

Based on a review of relevant academic literature, OEM annual reports and technical reports on the material characteristics of EVs, Chapter 5 provided mapping of global automotive production networks and explanation of the key differences between ICE vehicles and EVs. Chapter 6 looked at how JTP1 (protection of existing workers) and JTP2 (involvement of workers in decision-making processes) were realised in the history of the German automotive industry.

Chapter 7 analysed these two JTPs, as well as JTP3 (retraining), in the current context of the shift to EVs in the German automotive industry, showing that the first three JTPs are far from being fully achieved. Regarding JTP1, while some workers at OEMS and multinational first-tier suppliers are covered by employment guarantee schemes in the shift towards EV production, workers at SMEs and those with temporary and part-time contracts across the board are not. Instead, the latter two groups face job losses due to a lack of labour input in the assembly of, and component production for EVs, and face ambiguous employment projections. A similar case applies to JTP2, where German institutional arrangements, such as transformation committees at local and regional state bodies or industry-wide initiatives about the impacts of EVs on employment, hardly include workers in decision-making processes.

Regarding JTP3, there are two main drawbacks. First, the possibility of creating as many jobs in the future with similar conditions as there are now depends very much on funds from the state that are limited. Decision-making around retraining workers is not participatory, and planning for reduced number of jobs with EVs is mostly based on demographic solutions such as early retirement. The second drawback relates to the limited worker involvement in decision-making pertaining to technology, R&D and investment strategies, which are perceived only as technology-focused and apolitical corporate decisions. In fact, works councils at individual plants of OEMs and multinational suppliers have to compete with one another to attract corporate and public funds for retraining, while SMEs with no works councils or weak institutional tools have limited access to retraining activities.

In this chapter, I examine the two remaining JTPs. JTP4 is on global labour and JTP5 is on the environment. Even though Chapter 6 made clear that JTP2 is historically as much about cross-border developments as it is about the balance of power in the national political economy, JTP1 and JTP3 can be seen as nation-state focused. My analysis in this chapter with JTP4 and JTP5 overcomes this partial weakness. In terms of data collected and analysed, on the one hand this chapter is based on differences between ICE vehicles and EVs and their material characteristics, which are detailed in Chapter 5. On the other hand, this chapter is also brought about by data collected via semi-structured interviews. In other words, the reason to expand the analysis on EVs with JTP4 and JTP5 is justified by ideas identified in my interviews that culminate in a phenomenon that can only be addressed in a global context. This is about '*avoiding becoming a second Detroit*' (Interview with a regional economic policy institution), a phrase which expresses Stuttgart's (or German OEMs') shared fear of becoming a 'second Detroit'. This corresponds to the claim that if limited R&D activities and less highly-paid jobs remain in Germany following proliferation of EVs, German OEMs and multinational first-tier suppliers are most likely to lose their dominance and lead roles in global automotive production networks.[79]

As I explained in Chapter 4 on methodology, the fear expressed in interviews by both the industry and labour organisations about weakening Germany's dominance and competitiveness with the proliferation of EV manufacturing should be analysed in a global context. At any scale, regional (Stuttgart), national (Germany) or international (the EU), the state is seen as the most important actor in helping OEMs and large suppliers maintain international competitiveness, and thus providing the workforce with well-paid jobs by investing in the automotive industry and ensuring the supply of raw materials and minerals for EVs from around the world, including from Europe if possible. However, I argue in this chapter that these issues draw limited attention to working and environmental conditions at the outer tiers of global automotive production networks and thus fall short in meeting JTP4

[79] Powerful actors in the global automotive industry (OEMs, multinational first-tier suppliers, industry lobbies, and university research centres) continue to have presence with R&D and design centres in the greater Detroit area today. Nevertheless, final assembly and parts production have gradually shifted away (Silver 2003; Sturgeon et al. 2008). The same fear is also expressed in my interviews with reference to the fact that telecommunications and mobile phone companies, who were leaders until the 2000s, faced later greater competition and had to share their market power and lead roles with newcomers such as Apple and Samsung, who introduced new products, phones with better software applications and internet browsing.

and JTP5 in the shift to EVs. In short, the German (European) automotive industry's objective is to avoid a possible industrial decline that reduces capital accumulation, competitiveness in the global economy, and well-paid jobs. The German automotive industry players, the state, companies and the workforce, conceive public investments in EVs and securing supply of raw materials and minerals from developing countries as the solution to 'avoiding becoming second Detroit', rather than focusing on other ways in dealing with transport-related environmental degradation or reducing greenhouse gas emissions that exacerbate climate change. Since securing Germany's economic potential with EVs, expressed as *Standortversicherung* and discussed in the previous chapter, influences other nodes and workers in global automotive production networks, just transition (*Fairwandel)* demands of labour organisations in Germany inevitably requires additional analysis with JTP4 and JTP5.

8.2 Solidarity, Competition and Status Quo: Differentiation of Just Transition Demands in the Shift to EVs

In examining the shift to EVs with the lenses of JTP4 and JTP5, this section follows various nodes in the global automotive production networks identified in Chapter 5. Some of my interviewees also referred to these nodes in the emerging EV production networks. These are located in both main vehicle production macro-regions, and mineral and raw material supplying regions. A minority of the interviewees referred to the chemical processing nodes of production networks that today mostly correspond to the manufacturing and chemical processing factories in China, operated not only by Chinese state-owned or private enterprises, but also by international battery companies. Large OEMs aim to cooperate with battery producers via either joint ventures or long-term battery supply arrangements.

Regarding the vehicle production macro-regions, as shown in Section 5.2.3, German OEMs and their large multinational suppliers have vehicle assembly and key component production plants in Poland, Czechia, Slovakia and Hungary, where OEMs seek tax incentives from the host governments as well as a relatively cheap and vocationally-trained skilled workforce (Szalavetz 2020; Bohle and Regan 2021). The two other macro-regions, North America and East Asia, are also vital for the German automotive industry's profitability in these large

markets (Dicken 2015).[80] A fuller mapping of the global automotive production networks and Germany's position therein is provided in Chapter 5 and guides the analysis here. In addition, the combination of primary data from interviews, review of technical reports and online news outlets focusing on the EV and battery technologies provide a general understanding of the material bases of emerging nodes in EV global production networks outside of Germany. As we move from the headquarters of the German OEMs, we witness that the level of solidarity with global labour in just transition demands expressed in Germany decreases. In other words, it is the workers in the European macro-region that benefit the most from solidarity initiatives by the German unions and works councils at OEMs' headquarters.

These initiatives lack strength when it comes to global labour employed outside the European macro-region. Even though labour organisations in Germany are aware of the fact that vehicle plants in Europe, especially in neighbouring countries such as Hungary or Poland, are potential immediate competitors for battery and EV component investments, they show stronger solidarity with workers in these locations than they do with other workers in EV global production networks. Examples for the latter include cobalt miners in the DRC, workers in nickel extraction in Indonesia or communities impacted by the lithium brine operations in Latin America. This is partly explained by already existing cooperation among labour organisations in Europe to secure jobs, given the fact that battery pack assembly in Germany, Poland and Hungary can cushion some job losses with EVs (Interviews with European and national trade union federations). In addition to this, what I argue in this chapter is that just transition demands in developed countries lack consideration of JTP4 and JTP5 because they are focused, similarly to the concepts of sustainable development and policies suggested by the UNFCCC, on economic growth.

Thus, avoiding relocation threats and facing competitive pressures for a diminishing number of jobs, while trying to secure highly-paid jobs, requires solidarity between the German labour organisations and workers in neighbouring countries. Contrary to that, human rights issues such as child labour, and environmental impacts of EV material mining and mineral processing

[80] The North American market for premium-segment passenger cars and commercial vehicles, and the Asian market for all segments contributed significantly to German OEMs in 2020. The shares of North American and Asia-Pacific markets in total revenues of VW were 16% and 20%, respectively. A fifth and a third of total BMW revenues came from the Americas and Asia respectively in 2020. Almost half (46%) and another 14% of all Daimler passenger car sales took place in Asia and North America respectively; the figures for Daimler trucks and busses were 39% and 27%, respectively (VW 2021; BMW 2021; Daimler 2021).

on workers and local livelihoods in third countries does not draw enough attention. In other words, when corporate interests such as German OEMs' profitability in foreign markets and security of supply in materials and minerals are considered, the approach to just transition demands by the German labour organisations fall short.

8.2.1 Solidarity and competition within the macro region: German vs. Central/East European plants

As indicated previously in Chapters 5 and 7, initially ambiguous but in the long-term negative impacts of the proliferation of EV production on employment levels drive the transition demands of local unions and the existing workforce in Germany. *Standortversicherung* – Germany's EV policy shared by the state, companies and organised labour, aims to secure domestic vehicle and component manufacturing, R&D for product development and EV investment. The first plants to be restructured and allocated funds for reinvestment were mostly in Germany. Volkswagen's Emden, Zwickau, Wolfsburg and Dresden plants saw major investments for EV production. Similarly, Both BMW and Daimler focused on domestic plants for EVs. BMW declared that the group will produce at least one model of BEVs in its German plants (BMW 2021).

The German OEMs also prioritised their foreign direct investments in North American lines in the USA and Mexico for EV production, as well as introducing initial EV products at their joint ventures with state-owned companies in China. In addition to that, the German automotive industry decided to expand their FDI in neighbouring countries. BMW, for instance, is building a new EV plant in Hungary to introduce its 'cluster architecture technology' before 'exporting' this to its German and other plants (BMW 2021). VW Group's Audi will produce, in 2025, EV models in Gyor, Hungary, which is the largest VW engine plant.[81] BMW initially stated it was investing one billion euros in eastern Hungary for EVs[82], and then announced that it planned to double that amount;[83] Daimler laid the foundations for a second plant in this country with

[81] 'Audi to manufacture MEB electric drives in Hungary' available https://www.electrive.com/2022/06/23/audi-to-manufacture-electric-drives-in-hungary/ accessed August 2022.

[82] 'BMW to build billion-dollar car factory in Hungary' available https://www.autoblog.com/2018/07/31/bmw-new-factory-hungary/ accessed September 2018.

[83] 'BMW doubles investment to 2.1 billion USD in Hungary EV plant' available https://www.bloomberg.com/news/articles/2022-11-25/bmw-doubles-investment-to-2-1-billion-in-hungary-ev-plant?leadSource=uverify%20wall accessed December 2022.

the lowest corporate tax rate in the EU (Bohle and Regan 2021), where the authoritarian government tightened regulations on strikes.[84] This makes it difficult for unions in Hungary, where union coverage even before these regressive labour regulations was very low and decentralisation of labour rights was extreme (Kun 2019: 346). IG Metall supported trade unions in Hungary against these anti-union measures.[85] It also guides and supports trade unions of neighbouring countries in their relations with management in German companies (Gajewska 2009; Papadakis 2011). Yet, job losses in domestic plants due to the introduction of new models and EV components by German OEMs or multinational suppliers abroad cause ambiguity and competition among organised labour in Europe. For instance, despite plans about a factory in Germany, the Chinese battery producer CATL, a first-tier supplier to Daimler, BMW and Volkswagen, plans to build a battery plant in Hungary.[86]

Given the fact that most of the large OEMs and multinational suppliers located in Germany have factories and operations in Central and Eastern Europe as well, employees in this region face same uncertainties with the shift to EVs. Thus, one major example of labour competition within the European macro-region regarding EVs is about corporate location decisions for new product development and initial investments to restructure existing assembly lines for EVs. Automotive companies cannot always easily relocate, due to high sunk costs of such restructuring investments, especially during the initial phases of the shift to EVs where funds and employment are limited compared to those for ICE vehicle production, which keeps profits coming. However, initial EV investments and plant restructuring are key for future competitiveness and updating the skill base of a given factory, which then potentially would lead EV product development, design, battery research and development; these operations bring in the initial phase of well-paid jobs. In the long term, to remain competitive and profitable, OEMs can employ downsizing, outsourcing, technological change, automation and

[84] 'Audi workers' strike over wages gap highlights salary strain in eastern Europe' available https://europe.autonews.com/automakers/audi-workers-strike-over-wages-gap-highlights-salary-strain-eastern-europe accessed February 2019

[85] 'Audi workers in Hungary go on week-long strike for higher wages' available https://www.intellinews.com/audi-workers-in-hungary-go-on-week-long-strike-for-higher-wages-155255/ accessed February 2019

[86] 'CATL to build $7.6B Hungary battery plant to supply Mercedes, BMW' available https://europe.autonews.com/automakers/catl-build-76b-hungary-battery-plant-supply-mercedes-bmw accessed September 2022

corporate reorganisation (Pavlinek 2022), even in the case of EV manufacturing. This industrial characteristic intensifies competition for initial EV investments and jobs in the Central and Eastern European automotive macro-region. Managers tend to use this as leverage in moments of transition, to demand concessions and other gains from labour organisations.

As one European level trade union official pointed out: 'Companies ask unions and works councils how to reduce costs and produce more efficiently … especially when there is a new model or product' (Interview with a European trade union federation). This takes various forms such as flexible working conditions and freezing wage increases (Mueller 1992; Haipeter and Lehndorff 2005). A similar compromise also takes place during and after economic downturns and unexpected market shocks; for instance, both the 2008 economic crisis and the 2019 global pandemic brought freezes to wage negotiations in collective bargaining between the automotive companies and IG Metall (Dorigatti 2017). Asking unions to reduce costs and adjust to more flexible working conditions for new products or models is easier for management when it comes to EV investments. In their demonstrations for *Fairwandel* (just transition) in June and October 2019, the IG Metall membership opposed this blackmail and stated that, to secure investments by their management, works councils in individual plants in Germany face risking longer working hours and more intensive working conditions.[87] However, in reality, companies and management have the upper hand against unions and individual works councils about plant-level investment decisions. This is because, as explained in Chapter 6, contrary to the demands of the German trade unions in the 1950s, when institutional mechanisms were about to be set, limited codetermination rights of works councils in the future of the company do not allow workers to take proactive steps. Similarly, collective wage-bargaining rights of unions cannot intervene in plant-level specific corporate projections.

Because of this institutional disadvantage, even though highly unionised in factories and mostly in works councils, worker representatives need to accept corporate compromises in relation to the shift to EVs in Germany. Individual employment security agreements between

[87] 'Berlin, Berlin, wir fahren nach Berlin… Die IG Metall demonstriert Absurditaet und Angst' available https://www.labournet.de/branchen/auto/auto-brd-allgemein/berlin-berlin-wir-fahren-nach-berlin-die-ig-metall-demonstriert-absurditaet-und-angst/ accessed June 2019 [We march to Berlin. IG Metall demonstrate against absurdity and fear]

works councils and management are negotiated, along with locational decisions, around production of new components for EVs. This even takes the form of local works council or trade union member competition. For instance, in the state of Baden Wuerttemberg workers at a large first-tier automotive supplier producing parts and assembling transmissions and chassis components, are played against the works council at a major OEM; when works councils at both companies negotiate on future investments and costs, they need to accept more flexible working hours with no extra pay inside the 35-hour work week (Interview with a local trade union office). Due to proliferation of EV production, even sharper competition is playing out among multinational first-tier suppliers such as Continental, Bosch, ZF, Mahle and Brose, whose products will not be needed as much by OEMs after the transition to EVs (Fromm 2019, see Chapter 5). A researcher on codetermination at the national trade union confederation stated that 'all plants would like to produce new components for EVs, which is simply not possible' (Interview with a national trade union).

Another important example of competition within the European macro-region regarding EVs is over the location of potential battery investments. Interviewees from national German unions highlighted this key point. A national trade union member claimed that 'Around twenty battery plants would be needed in Germany,' while another union member emphasised that a big question for IG Metall is how and where a major German OEM will procure the batteries necessary to achieve its targets in 2020s (Interviews with national trade unions). While some see China as the biggest contender in this 'race,' others think neighbouring countries are strong candidates too, as I show in the case of Hungary above. 'The other [issue] is of course whether the production will be localised in Europe, or will be in China or US' (Interview with an international industry union).

As part of the national EV policy in Germany of securing investments, employment and industrial competitiveness (*Standortversicherung*), there is a shared anticipation that EV batteries are to be produced and/or battery packs assembled in Germany, backed by the interview data. However, competition for new EV lines and parts production does not hinder a strategically oriented solidarity among organised labour in the European automotive macro-region. Another question with battery plant investments is related to the extent to which works councils at those plants will be chosen from trade union members, if IG Metall secures access to the plant in question. For instance, Tesla's new large battery plant in Gruenheide,

Brandenburg, near Berlin, has recently become a major target of the union.[88] The plant, with around three thousand workers as of March 2022, will, in the long-term, employ up to twelve thousand workers.[89] Despite the company's opposition to unionisation efforts,[90] the list who are close to management of the factory could not win the majority of the votes in the first works council elections in March 2022. They will have to cooperate in the future with the works council members who are members of IG Metall.[91]

The German trade unions have been reaching out to workers and unions in the European macro-region since the late 1990s, especially following these countries' membership to the European Union (Bernaciak 2010; Silvia 2018), the main reason being that lower working conditions, and different government incentives and tax systems, make it attractive for automotive companies to relocate their operations to these lower-cost locations (Hancke 2000), as well as less organised labour (Pavlinek 2015). To cope with this, German unions tended to work with local trade unions. 'Trade unions in Germany cannot accept new plants with no collective bargaining and works councils in its neighbouring countries' (Interview with a local trade union office). Yet, there are still clear gaps between working conditions and wages in the German automotive industry and other countries in the European macro-region. 'National differences among automotive trade unions are one of the biggest weaknesses, given the organised and aligned OEMs and big suppliers' (Interview with a global trade union federation). In addition to that, large employers can hinder national trade unions' global campaigns. 'The International employers association (IOE) does not include all automotive

[88] 'Tesla's European factory electrifies California-Germany culture clash' available https://europe.autonews.com/automakers/teslas-european-factory-electrifies-california-germany-culture-clash accessed November 2021

[89] 'Neue Tesla-Fabrik in Gruenheide offiziell eroeffnet' available https://www.tagesspiegel.de/berlin/neue-tesla-fabrik-in-grunheide-offiziell-eroffnet-6853399.html accessed April 2022 [The new Tesla factory in Gruenheide officially open]

[90] 'IG Metall ruft Tesla-Mitarbeiter in Gruenheide zu Betriebsratswahl auf' available https://www.automobilwoche.de/agenturmeldungen/ig-metall-ruft-tesla-mitarbeiter-grunheide-zu-betriebsratswahl-auf accessed March 2022 [G Metall call Tesla employees in Gruenheide to works council elections]

[91] 'Erste Betriebsratswahl bei Tesla - gelungene Premiere' Available https://www.igmetall.de/im-betrieb/mitbestimmung/erste-betriebsratswahl-bei-tesla-gelungene-premiere accessed March 2022 [The first works council election at Tesla factory – successful premiere]

companies; for instance GM is not a member of IOE, so employers are divided' (Interview with an international governmental organisation).

One major example of solidarity among workers within the European automotive macro-region is based on structural power, which accrues to autoworkers due to the integrated nature of tiered supplier networks in the auto industry (Silver 2003; Wright 2000). Different OEM plants and first-tier suppliers, as well as lower-tier auto parts and base metal suppliers are all potentially vulnerable to autoworkers' joint activities. Workers can enhance their positions vis-à-vis company management and ask for wage rises via worker activities such as sit-down strikes that shut down a particular section of an assembly or component production plant. This activity can affect the whole macro-region. For instance, the general works council of Audi and the IG Metall regional office in Bavaria supported Hungarian trade unions in engine and electric motor plants in Györn, Hungary, and helped the local strike achieve its objectives of 18 per cent higher wages (IG Metall Bayern 2019).[92] German trade union shop stewards at Audi headquarters in Ingolstadt also warned that there should not be a large pay divergence in Europe; the company pays the least in Europe, 1,100 euros, to Hungarian workers.[93] As explained below, Hungary is the most popular destination for EV components investments by the German OEMs. Bohle and Regand (2021: 99) argue that the German automotive industry supports and facilitates the authoritarian regime in Hungary:

> "As outlined in the Hungarian case, transnational elites in the German-led manufacturing automobile sectors have expended significant effort through various business channels to ensure the right-wing nationalist government protects their economic interests. Not only has Orban protected their interests; he has doubled down on trying to attract their investment through enacting favourable market reforms and granting generous incentives."

[92] IG Metall Bavaria Regional Office Press Release 25 January 2019 IG Metall Bayern unterstuetzt Streik bei Audi in Ungarn [IG Metall supports the strike at Audi in Hungary] available at https://www.igmetall-bayern.de/nachrichten/ansicht/datum/2019/01/25/titel/ig-metall-bayern-unterstuetzt-streik-bei-audi-in-ungarn/ last accessed June 2019

[93] Sandra Moenius 30 January 2019 Lohnplus von 18 Prozent: IG Metall begruesst Einigung bei Audi in Ungarn - Auswirkungen des Streiks noch einige Tage spuerbar [18 per cent wage increase: IG Metall welcomes agreement at Audi in Hungary effects of the strike will still be felt for a few days] available at https://www.donaukurier.de/nachrichten/wirtschaft/Audi-Lohnplus-von-18-Prozent last accessed December 2020

A similar case is Belarus, for which activists in Germany and German Trade Union Confederation (DGB) argue that local unions should be supported via implementing EU-imposed economic sanctions against the authoritarian regime (Smolentceva 2020). Even though unsuccessful, German unions and works councils have tried to export their ideas and institutions of industrial relations for more progressive working conditions into both the European and North American automotive macro-regions (Silvia 2018). A similarly ineffective approach seems to be the case pertaining to workers and miners outside the European automotive macro-region, such as those in South Africa, the DRC, Bolivia, India or China, to which next section turns to.

8.2.2 Weak solidarity with other macro regions: Economic development by ILO standards and voluntary GFAs?

Despite strategically oriented solidarity and employment-focused competition with workers from the European and North American automotive macro-regions, the German unions and works councils at OEMs and multinational first-tier suppliers display an indifference towards workers at other nodes of the global automotive production networks. Most German automotive companies have parts production and vehicle assembly plants in low-income countries. Moreover, their outer-tier big suppliers producing tyres, chemicals or textile parts, also operate in these locations. However, in my discussions with the German automotive industry around the low-carbon economy and proliferation of EVs, working conditions and environmental standards in various vehicle producing and material/mineral supplying regions did not come to the forefront in the list of the global 'challenges' facing the industry.

The main challenges the German automotive industry considers itself faced with are job losses due to EVs, automation, digitalisation of production, and new mobility 'solutions' such as autonomous driving etc., and cutting costs in ever-greater competition. One key industry lobby representative even suggested that the (European) automotive industry employs more cheap labour from abroad in domestic plants: 'The transition is always and everywhere; thus the just transition question is a little bit strange. We need changes in education, industry policy, immigration policy. We need to be open to Ukraine and other countries like Bulgaria and ask people to come and work in our factories' (Interview with a European automotive industry lobby).

Trade union representatives are more aware of this problem, and are keen to see a transnational effort to solve income inequalities. 'On the relationship between just transition and EVs, it would not be a truly just transition if there is a lack of attention to working conditions across the supply chains. The efforts of ILO and ITUC and national trade unions should be supported' (Interview with a local trade union office). However, even in developed countries, ratification of ILO conventions is not always enough to improve working conditions in practice, and this is only the first steps on paper (Boris et al 2018; Seekings 2008, 2019). Moreover, 'there are too many ILO conventions not fully implemented' (Interview with an international governmental organisation). 'We have only discussions based on slogans. Implementation still has to start; everybody agrees on the principles, but what are the tools?' (Interview with a European trade union federation). Thus, 'We should include global labour in the discussions on just transition. We need the new resources, so trade unions should consider working conditions in Africa, China or Latin America' (Interview with a national trade union). This is because, 'in some regions (Mexico, Turkey, India for example) wages and working conditions are unacceptably low. OEMs are arguing for even a 0.5 dollar increase in hourly wages. In some cases, local governments are also against the pay rises, because this could then be an upward pressure on the national wages' (Interview with a global trade union federation).

Efforts by the German unions and works councils at OEMs and multinational first-tier suppliers lack full understanding of lower environmental standards, poor working conditions and extremely low levels of income at various nodes of the global automotive production networks. 'There are extremely low levels of pay in some parts of the world automotive industry. Country specific or regional meetings are needed; in India, Turkey, Mexico, Thailand, where workers are not institutionally represented or where there are new conflicts' (Interview with a global trade union federation). These places experience various levels of repressive and authoritarian labour regimes, which are similar to those of interwar Germany with anti-union characteristics (see Chapter 6). As Nair and Friedman (2021) put it, automotive workers in India and China face union-busting and criminalising politically coercive methods to weaken labour activists and shop-floor unionists who are trying to act independently from the central/company trade unions. Moreover, temporary and part-time workers and student apprentices constitute a large part of the automotive workforce in these

two major vehicle production and consumption locations (Nair and Friedman 2021), where German OEMs and multinational suppliers have joint ventures and foreign direct investment. Although this is not an unknown phenomenon to the European macro-region, with dual labour markets in most countries (Eichhorst and Marx 2021) including Germany (Benassi 2017), the figure in China is staggering: in 2011 one-third to a half of the whole automotive workforce was agency workers; in India too, the automotive industry relies heavily on irregular workers (Nair and Friedman 2021: 22, 27).

Similarly, Bolsmann (2010) shows that the bureaucratic relationship between the leadership of IG Metall, the central works council at the VW Wolfsburg plant and the National Union of Metalworkers of South Africa (NUMSA) led to the dismissal of striking workers at VW's Uitenhage plant, who were against plant restructuring designed to cut costs and boost profits, including the use of temporary agency workers. A loose network of some shop floor unionists from the German, Brazilian and South African VW plants, as well as members of other German trade unions, tried to show solidarity and disseminated information online. However, IG Metall supported NUMSA's stance, which focused on the plants' international competitiveness and referred to strikers as an irresponsible minority (Bolsmann 2010: 534). The strategic use of temporary agency workers in Germany and abroad is an industry-wide phenomenon, which is accepted by unions to secure the existing jobs of the core workers (Campling et al. 2019; Holst et al. 2010), whose wages are much higher due to profit-sharing corporate mechanisms (Dorigatti 2017: 933).

Holst et al. (2010) argue that even though the German trade unions try to include temporary agency workers, works councils are not always willing for this to happen. Artus (2013) underlines the fact that European industrial institutions are historically and contextually contingent, so they are not functioning today to include non-standard forms of employment. Yet, Meardi et al. (2021) argue that representational claims by the major trade unions in developed countries vis-à-vis migrant and temporary agency workers should not be underestimated; indeed, these could be successful, especially when traditional unions combine their efforts with emerging organisations and community-based initiatives dealing with inequality and vulnerability in societies. Nevertheless, as Munck (2013) elaborates, the type of work described as informal or precarious has always been the norm in the global South, and the welfare state, labour unions, or Fordism are the exception to the rule from a

global perspective. This is also seen in the nodes of the global automotive industry that are outside the major automotive macro-regions, which the next section turns to.

8.3 Supply Chain Security: '*Fairwandel*' for Global Labour and the Environment?

Regarding working conditions and environmental standards that make continuous flow of materials possible, supply chain security and economic development stand out as the German automotive industry's take on the transition to EVs. This argument goes on to say that companies from newly-industrialised countries can achieve higher value-added and higher profits with international economic integration mechanisms, and reduce poverty and exclusion. However, conditions in resource extraction and processing regions in the global automotive production networks display contrasting characteristics, full of weak environmental standards and repressed labour organisations under authoritarian regimes.

8.3.1 Sustainable development by resource extraction and raw material production?

Just transition demands in the German automotive industry regarding the shift to EVs fail to take into account environmental and material characteristics of the world economy. In other words, a major concern here is to ensure continuous flow of material to the processing and manufacturing nodes of the global automotive industry. In line with the concept of sustainable development discussed in Chapter 4, increasing volumes of minerals and raw materials are contextualised in the context of economic development via integration in global EV production networks. Some even suggest that these problems can be solved by a belief in science and research: 'There are ecological trade-offs like the effects of lithium and other rare-earth elements on the environment. Mining is very questionable, like cobalt from the DRC, but in the end research will solve that with substitute materials' (Interview with a regional economic policy institution).

Workers and miners, as well as the environmental degradation in countries such as the DRC (for cobalt), Chile (lithium), Indonesia (nickel) or Peru and Bolivia (copper) drew some attention from my respondents in our discussions around proliferation of EV production. These regions provide the key resources used in EV batteries (UNCTAD 2020). 'Raw material processing and mining conditions are a concern at IG Metall in relation to carmakers' responsible supply-chains and international labour standards – child labour' (Interview with a local trade union office). Another unionist from Germany stated, the 'problems of Chile or

African countries can be solved if they become parts of the industry supply chains; they should also work on and change their social institutions' (Interview with a local trade union office). This approach is compatible with the corporate sustainability discourses used by the German OEMs. For example:

- 'For many raw materials, the requirement to ensure that environmental standards and human rights have not been violated poses a particular challenge, for instance in the case of lithium and cobalt, both of which are key raw materials for manufacturing battery cells' (BMW 2021: 101).
- 'We are also closely cooperating with relevant stakeholders in raw-material supply chains in order to help improve working conditions and prevent human rights violations in raw-material mining operations' (Daimler 2021: 87).
- 'We address existing sustainability risks and violations of sustainability principles by systematically implementing measures; this also includes the upstream supply chain' (VW 2021: 150).

The similarities among these firms' CSR statements on raw-material supply chains are striking, as are the parallels with the view of German organised labour; each reflecting a narrow understanding of the dynamics of extractive industries in the global South, including the complicity of European and other multinationals.

Sovacool (2019: 915) examines benefits and challenges of cobalt mining in the DRC, 'to humanize the lived experiences of Congolese cobalt mining and to reveal the tensions and trade-offs associated with the recent mining boom,' where it is demonstrated that artisanal miners are exploited by their bosses, by trading companies and by other actors involved in the political economy of cobalt. Western industrial mining companies are involved in similar relations. For instance in the case of copper, cobalt and other minerals extracted in the DRC, Greenen and Cuvelier (2019: 396) show that transnational companies work with the local state officials and local elites to employ cheap casual labour. These mostly cooperate and sign mineral supply agreements with major OEMs (Dempsey 2019). Moreover, developed countries and the EU support Chinese and other international chemical processors that make supply arrangements with the mining countries in Africa and Latin America (Sanderson 2019).

Smith (2011) and Nest (2011) show just how dangerous and violent mining conditions are in DRC, a major aspect of which is the sequence of civil and regional wars that have occurred in East DRC since 1997. Thus, in addition to ways that artisanal miners are exploited by multiple actors (Sovacool 2019), it should also be asked why local and migrant miners and vulnerable local communities have to do artisanal mining to survive in the first place, and why the local and national state structures in the DRC failed to provide security to prevent violence and corruption, which maintains the repressive and violent labour regime in the country's extracting industry. Sovacool (2019) also claims that mineral extraction provides income for the local people, so it should be improved. But, as Barrientos et al. (2011) and Selwyn (2014) show, economic development includes the risk of social problems, which requires involvement of other factors, such as labour organisation, union involvement and transnational links that benefit poor workers and firms in production networks. Dealing with the global and environmental implications of the proliferation of EV production, if implemented globally in accordance with what Stevis et al. (2018) call the depth and breadth of labour environmentalism, and in line with the five parameters of just transition, should take into account what Munck (2013) calls the norm in the global economy; that is informal and precarious work in the global South.

8.3.2 Chemical processing under authoritarian regimes: European drive to secure batteries

Working conditions at automotive factories in China, no matter whether owned by the state, Chinese capital or joint ventures with German OEMs, are much poorer than those at German vehicle factories (Deng 2020; Fu and Lim 2022; Krzywdzinski 2018; Schwabe 2020; Zhang 2014). This applies to the chemical processing operations in the country by Chinese, South Korean and Japanese EV battery producers. Most interviewees are indifferent to chemical processing plants in developing countries such as China, which supply to EV battery assembly plants in Japan and South Korea. There is also a European-level attempt to encourage EV battery assembly (Espinoza and Chazan 2019), which is to be linked with other European and German chemical processing FDI in China (Hancock 2019).

This is important, because, in some of my interviewees from the German automotive industry, the German federal state and the EU officials tend to hold up the Chinese EV industry as a success story in achieving a growing number of EV registrations and relevant investments, but they tend to ignore the environmental hazards caused by chemical processing in the country

(Luethje 2014), which Luethje et al. (2022) guess[94] would be very difficult and environmentally degrading. This is similar, in many countries, with the situation regarding electronic waste, including China and South Korea (Dall-Orsoletta et al. 2022), Malaysia and Singapore (Wong 2018). As one EU official clearly states, environmental considerations are key in the European approach to EV mineral mining and processing:

> You need a lot more of certain materials, for instance, batteries - nickel, lithium, cobalt, graphite, magnets. All of these things come from the ground at some point or the other: That is the main challenge. In the EU countries, we *have* lithium, graphite, nickel, but there is *public opposition* to mining extracting activities, so there is the challenge there. We need an open global market to the EU and also explore how to make use of the raw materials that we have in the EU. (Interview with an EU official).

A combination of international competitiveness and national (European) focus on the issues prevails, which ignores the European, mostly German, joint ventures producing for the biggest EV market in the world: 'If the European car industry is to survive electrification, it is not certain that at the end of the day, 20 years later, the industry might not be taken over by China' (Interview with a European trade union federation). The German automotive industry and most interviewees perceive China as the 'state in China,' and they do not consider other actors or environmental degradation and working conditions in chemical plants, some of which sometimes explode (Interview with an NGO researcher in Berlin). They see the Chinese automotive industry as a major competitor, even though most auto production there is operated by major Western, and indeed German, OEMs and multinational first-tier suppliers, via joint ventures that have been established from the early 1980s onwards. As one interviewee from an NGO in Germany put it, 'problems arise from injustice of strategies of Germany and the EU countries; they are very conservative and industry-focused, they lack a method of understanding human rights and local parameters' (Interview with an NGO researcher).

[94] Because they were only allowed by the Chinese state into the automated and robotised EV and battery plants, not into those operating in chemical processing.

8.4 Conclusion: The Need for a Global Approach to Just Transition Demands with EVs

Chapter 6 provided a periodisation in the development of the German automotive industry, set in a global, relational context. It showed that the German industry witnessed rapid industrial expansion via mass-production techniques introduced after 1933 under the authoritarian Nazi regime, at the expense of labour rights. The role of workers and their political activities were curtailed, and the state played a major role in developing the industry with infrastructure building and vehicle procurement. In line with Silver's (2003) hypothesis, in the second phase following World War II, the automotive industry started expanding into other parts of the world in search of cheaper and more docile labour. At the same time, German domestic manufacturing and heavy metal industries, which supply automotive manufacturing, benefitted from cheap and docile foreign workers, who arrived in three waves: first in the late 1940s from territories in Eastern Europe occupied by the Nazi regime; second in the early 1950s from the East German Democratic Republic (Vincent 1964; Tolliday 1995a); and third from other countries in the 1960s. The last wave of cheap and docile labour was provided through international agreements between the Federal Republic of Germany and southern European countries such as Portugal, Italy, Greece and Turkey (Owen-Smith 1994). The rapid expansion of the West German economy in the 1950s brought an equally rapid expansion of recruitment of foreign workers with no citizenship or association rights, to be deployed at the bottom of the labour market (Cohen 1987: 156-157). Migrant workers carried out jobs with low pay, poor health and safety conditions, and low environmental standards in manufacturing, heavy industries and mining. Even today, among agency workers in manufacturing, 70 per cent are migrants (Pulignano et al. 2015: 819).

Today, the German automotive industry benefits from a similar technical division of labour (Benassi 2017; Haipeter and Lehndorff 2005; Pulignano and Doerflinger 2013), but within a larger, if not global, geographical setting, which is organised through global production networks (Campling et al. 2019; Nair and Friedman 2021; Luethje 2014; Sancak 2022), especially for EVs. As discussed in Chapter 5, the market power of dominant companies relies on shifting risks to other companies and workers (Bair 2009; Gereffi et al. 2005; Gibbon et al. 2008; Henderson et al. 2002), which leads to a deterioration in working and environmental conditions where materials are extracted and processed (Dauvergne and Lister 2015; Havice

and Campling 2017; Levy 2008; Ponte 2019). Similar conditions in the international division of labour exist in today's shift to EV production.

How the German OEMs and their multinational suppliers position themselves in global production networks determines the ways in which they offer their workers transition schemes during proliferation of EV production. In other words, their just transition demands do not challenge the main characteristics of the political economy of the global automotive industry (see Chapters 2 and 7), since working conditions and environmental standards at various nodes of the global automotive production networks are not included in just transition demands in Germany. Transition schemes and demands are put forward with a focus on competitiveness that secures German OEM's leading roles, as well as the continuity of global vehicle production. Approaches to other locations also carry the lens of Germany's competitiveness.

For instance, if a particular auto plant or parts supplier outside Germany increases Germany's international competitiveness in the proliferation of EV manufacturing, they are regarded as parts of the stakeholders in transition. This approach applies to autoworkers in neighbouring countries in Central and Eastern Europe, such as Czechia, Hungary, Poland or Slovakia, which are, following internationalisation of German OEMs and consolidation of the industry, the key component suppliers for luxury vehicle assembly in Germany, as well as assemblers of small vehicles for German OEMs. Because these locations increase profits and competitiveness of OEMs and their major multinational suppliers, workers in these locations are considered as part of the just transition demands in the shift to EVs. Contrary to that, for other locations with natural resource extraction and raw materials mining in Africa or Latin America, and chemical processing in China, the approach focuses on development and employment opportunities created by the German automotive industry for these locations, rather than on working conditions and environmental impacts. Similar to the mainstream sustainable development approach adopted at international climate change negotiations, supply to, and integration in EV global production networks are seen as economic development possibilities for developing countries. There is no effort, in the just transition demands of the German automotive industry, to problematise JTP4 and JTP5.

Consequently, material extraction and processing in developing countries will continue under the current poor conditions, which enable and maintain international division of labour in the

automotive industry. In essence, just transition approaches in Germany are limited to the final products – EVs replacing ICE vehicles – ignoring relevant production networks and without considering wider social and political impacts of energy transition to renewables. In addition to the partial just transition in relation to the assembly of the final product (EV) in the German automotive industry, the analysis of JTP4 and JTP5, as well as JTP2 across the world, shows limited just transition with regard to global production networks. In other words, as discussed in Chapter 4, the just transition approach in the German automotive industry fails to account for various aspects of justice in energy transitions such as procedural, distributional and recognition justice. As Stevis et al. (2018: 443) put forward, addressing the labour-nature relationship should 'incorporate the improvement of working and living conditions together with their impact on nature and the usage of natural resources', and should 'pay attention to the fact that they [German autoworkers in the case of this thesis] are located within global production networks that include workers in other sectors within their own country as well as workers around the world' (Stevis et al. 2018: 445).

CHAPTER 9 CONCLUSION

This thesis has analysed whether and for whom the shift to EVs contributes to a just transition to a low-carbon economy. Organised in four sections, this chapter presents the conclusions of my research. Section 9.1 offers direct answers to each of the four Research Questions. Section 9.2 and Section 9.3 summarise key academic contributions and policy implications, respectively. Section 9.4 outlines the limitations of the thesis and suggestions on future research.

9.1 Just Transition to EVs in the German Automotive Industry?

I start this chapter with an overview of the empirical contributions of the thesis and the core findings are presented in relation to the Research Questions (Table 9.1). I explain below how and where in the thesis the answers to each Research Question are provided. I developed and used five Just Transition Parameters (JTPs) to frame my analysis and to help me to answer research questions. Research Question 1 – *Why is the just transition important, for whom and how justly is the shift to EVs unfolding?* – is introduced in Chapter 1, conceptualised in Chapters 2 and 3, and methodologically elaborated on in Chapter 4. I then examine this in detail in Chapters 6, 7 and 8. Research Question 2 – *How are workers in the German automotive industry positioned vis-à-vis transition to EVs? And how can they influence decision-making processes?* – is discussed historically in Chapter 6 and contemporarily in Chapter 7. Research Question 3 – *What are the implications of EV production on workers in the German automotive industry?* – is examined in Chapters 5 and 7. Research Question 4 – *What are the implications of EV production on global labour and the environment?* – appears first in Chapters 2 and 3, and is examined in detail in Chapters 5 and 8. Table 9.1 gives a snap shot of the major findings, which are summarised in more detail through the rest of this section.

Table 9.1: Overview of the Thesis

Research Question	Key Chapters/Sections	Findings
1. Why is just transition important, for whom, and how justly is the shift to EVs unfolding?	Chapter 1 introduced. Chapters 2 and 3 conceptualised. Chapter 4 elaborated methodologically. Chapter 5 sets out empirical data for including JTPs 4 and 5 in the analysis. Chapters 6 and 7 examined JTPs 1-3. Chapter 8 examined JTPs 4 and 5.	Why: Just transition's challenge to mainstream sustainable development paradigm. Not just: JTPs not met. Domestic interest alignment around EVs not accounting for impacts on global labour and the environment. Limited impact consideration due to sustainable development's foci on green growth, market competition, supply chain security, soft law (ILO guidelines, GFUs).
2. How are workers positioned in the German automotive industry; how can they influence decision-making processes?	Chapter 6 historicised the analysis on JTP2. Chapter 7 examined JTP2 vis-à-vis current EV decision-making.	Weak position of labour due to regulation, institutional set-up, and proliferation of GPNs. Limited influence of labour in Germany on decision-making in Germany. Very limited/no influence of labour upstream/mid-stream EV GPNs.
3. What are the implications of EV production on workers in the German automotive industry?	Chapter 5 introduced labour process, employment, and GPN impacts of EVs. Chapter 7 examined JTP1 and JTP3.	Differentiated, mostly negative, impact on various parts of the workforce in Germany. Competition within workforce for private/public investments about EV component manufacturing and retraining.
4. What are the implications of EV production on global labour and the environment?	Chapters 2 and 3 conceptualised. Ch 4 elaborated methodologically. Chapters 5 and 8 examined by JTPs 4 and 5.	Increased reliance on exploitation of global labour and the environment upstream/mid-stream EV GPNs. Competition within global labour for EV component manufacturing. Limited/inefficient solidarity

9.1.1 Transition to EVs

I summarise in this section the conceptual contributions and empirical findings of the thesis in relation to Research Question 1 – *Why is the just transition important, for whom and how justly is the shift to EVs unfolding?* Pertaining to the first part of this research question, I explain in Chapter 2 that the importance of the concept of just transition lies in its potential challenge to the mainstream sustainability paradigm based on ecological modernisation theory, which has since the 1970s promoted a 'green' capitalist economic growth. Answering the second part of the overarching research question – *for whom and how justly is the shift to EVs unfolding* – starts in Chapter 3, where I argue that the scope of just transition should be broadened to cover the global labour dimensions of the industry under examination and to redress the environmental impacts of 'green' products, services or technologies. This effort continues in Chapter 7 in the context of the German automotive industry where I show that not all autoworkers in the country are protected against job losses being announced due to the shift to EVs. Chapters 5 and 8 also provide answers to the first research question based on the combination of document review, technical and policy report analysis and on secondary data drawn from the academic literature, respectively. I explain how and why the global labour and the environment is influenced by the shift to EVs, but not addressed by the just transition demands of the German automotive industry.

Just transition is a strong alternative to the mainstream approach to transition to a low-carbon economy. As we saw in Chapter 2, mainstream notions of sustainable development as a top-down and apolitical approach to transitions, privilege private enterprise based on the assumption that economic growth without environmental pollution and degradation is still possible through market mechanisms. It asserts that private innovation and the consumption of 'green' goods and services solves the ecological and socioeconomic problems. The main idea behind the concept of sustainable development is that the current generation of human species should meet their needs without jeopardising those of the next generations. Turned into an increasingly highlighted buzzword that does not impede the growth imperative and the leadership of businesses in uneven capitalist economic development, this paradigm overlooks historically and geographically differentiated responsibility for the ecological problem – the point argued by the environmental justice strand of the just transition literature. In this way, carbon- and energy-intensive industries expect to get away without addressing their role in creating the ecological problems such as environmental pollution,

biodiversity loss or the climate change. Moreover, sustainable development provides the dominant companies and governments in the developed countries with new areas to invest in and increase their technological and industrial competitiveness, which helps maintain the existing international division of labour and power relations in the world economy. The concept of just transition has the potential to refute this paradigm in the following ways.

Just transition demands of workers and labour organisations draw attention to the protection of workers and their communities that are impacted by new technologies, environmental regulation and the reduction of greenhouse gas emissions. It not only overcomes the dilemma of jobs vs. the environment – a reactive position of the organised labour on the environmental regulations that focused on securing employment for union members – but also emphasises that the greening of standards, products or production processes under the sustainable development paradigm creates new unequal power relations and waves of uneven economic development. As a bottom-up approach to sustainability and energy transitions, workers' demands for just transition challenge the status quo and centre on the protection of workers and their communities.

Protection is the first demand in just transition policy documents of national and international labour organisations, and I use it to frame my analysis via the first of the five Just Transition Parameters (JTPs) for EVs. On the one hand, Section 7.2 shows that not all workers in the Germany automotive industry are protected in the shift to EVs. The level of protection an autoworker receives depend on their age, unionisation, the trades their skills are centred around, their employment contracts, as well as the size of the company they are employed in. On the other hand, most of the just transition demands by the organised labour in developed countries fail to consider that 'green' products and services have material requirements that require the appropriation of nature and exploitation of labour. Thus, this thesis argues, the concept of just transition should account for ways in which resource extraction, material mining, and chemical processing for 'green' products and services, including EVs, occur.

Furthermore, just transition demands should recognise power relations of the international division of labour that help maintain the uneven structures of global production networks. To answer directly Research Question 1, even if the concept of just transition is important due to its fundamental challenge to the mainstream sustainability paradigm with respect to the

latter's inability to protect workers in labour market mechanisms, just transition bears the risk of taking place for a limited part of the global labour, while creating new environmental challenges and labour exploitation in the outer tiers of global production networks. In the following sections I turn to how this limited approach to the just transition plays out for the political economy of the German automotive industry, for the labour process in vehicle manufacturing, and for global labour and the environment, respectively.

9.1.2 Autoworkers and change

I summarise in this section the conceptual contributions and the empirical findings of the thesis that answer Research Question 2 – *How are workers in the German automotive industry positioned vis-à-vis transition to EVs? And how can they influence decision-making processes?* To begin with, I answer the first part of the question in Chapter 7 based on the analysis of the second Just Transition Parameter (JTP2) – the inclusion of workers in EV-related decision-making mechanisms in the German automotive industry. This analysis explains that not all workers in the German automotive industry are represented in these institutional policy frameworks and this jeopardises meeting JTP2 contemporarily. In addition to that, the thesis historicises the second part of the Research Question 2 in Chapter 6 based on the analysis of the inclusion and representation of workers (JTP2) in prior industrial transitions. Through an historical analysis of the previous transitions in the German automotive industry, Chapter 6 shows that the balance of power in the nexus among workers, companies and the state gradually shifted throughout the 20th century at the expense of autoworkers. In successive rounds of the past transitions, workers in the German vehicle manufacturing lost not only the control of their trades to management in the workplace, but also their political power to large companies and the state in wider social relations of production.

Thus, similar to the contemporary situation in JTP2, the inclusion of workers in decision-making mechanisms had not been met historically and structurally in the German automotive industry during the previous transitions. The introduction of mass production with the assembly line between 1933 and 1945, and expansion of mass production techniques after the Second World War decreased labour's voice in the workplace. These first two transitions happened in a rapidly changing political economy in Germany that limited labour's voice in social relations of production. While in the first transition, labour organisations were shut down by force and ripped of their financial and socioeconomic rights under the extreme Nazi

regime; the second transition that expanded mass production in the German automotive industry introduced subtle ways to curtail workers' say in decision-making mechanisms. Post-1945 labour laws created two different institutional settings that divided the operational grounds of the labour organisations – trade unions and works councils – and weakened workers say overall. The monopoly of trade unions on calling for strikes made the rank-and-file less effective in reacting to increased automation, and hindered mobilisations of semi-skilled autoworkers and less skilled guest workers across mining and metalworking industries. The legally mandatory collaborative approach of works councils to their factory management made it easier for capital and the state to expand mass production.

The third transition after the 1980s, from expanded mass production to global automotive production networks, did not display characteristics that meet the inclusion of workers in decision-making mechanisms. The German OEMs relocated some of the labour-intensive, low-profit segments of vehicle-assembly and parts-production to industrialising countries, where JTPs were not addressed. With regard to domestic automotive employment, the third transition increased the differentiated employment contracts in vehicle factories to meet the demand fluctuations in capital-intensive component production and premium vehicle assembly in Germany. The uneasy positions of works councils and trade unions in the context of opening clauses in collective agreements decreased workers' voice. Whereas works councils were more concerned with securing employment at individual sites, the trade union representatives struggled strategically against relocation threats, which the automotive companies linked to corporate profitability and international competitiveness, and argued that this was necessary to sustain the well-paid jobs of unionised workers at home in the long term. In short, the historical analysis showed that both the role of state and capital strategies rendered the positions of the two labour organisations – works councils and trade unions – weaker during previous transitions in the German automotive industry.

The structural weakness of the labour organisations in terms of the inclusion of workers in automotive decision-making mechanisms during prior transitions created path-dependent impacts on today's institutional setting. In addition to this, the ad hoc decision-making mechanisms in Germany for the shift to EVs brings other challenges in meeting in the inclusion of workers in decision-making mechanisms in the shift to EVs. Chapter 7 showed that this parameter is far from being met. Similar to the top-down approach of the sustainable

development paradigm, the national, regional and industry-wide EV policy initiatives in Germany are mainly constrained to the imperative of economic growth and primacy of markets and consumer demand. More importantly for JTP2, EV decision-making mechanisms in the German automotive industry – the national platform for electromobility, regional transformation alliances and industry-commissioned employment research – include merely a limited number of top-level trade union representatives and exclude workers in the automotive workforce. Neither the shop floor union members nor the mostly non-union (part-time, fixed-term, temporary agency) workers with differentiated employment contracts are part of these EV-related ad hoc institutional policy settings.

Moreover, as Chapter 7 shows, small- and medium sized companies are underrepresented in industry-wide discussions, which are mostly occupied by the interests of large OEMs, multinational automotive suppliers headquartered in Germany, the regional investment and employment authorities and the leaders of IG Metall. As one of my interviewees put it, 'this does not make much sense' because these small and medium-sized enterprises (*Mittelstand*) have low union representation in their workplaces, but correspond to a significant part of the skilled workers in the German automotive industry. The problem is that *Mittelstand* supplies parts and services to ICE and transmission plants of large OEMs, as well as to multinational automotive companies. They need to be involved in and informed by industry-level decision-making processes, because smaller suppliers have limited financial and organisational means to cope with the EV-led reconfigurations of automotive production networks (Group discussion with works council members at supplier). *Mittelstand* enterprises and their workers are affected just as much as large OEMs and multinational automotive suppliers are by the changes to the labour process in vehicle manufacturing in the shift to EVs. The next section elaborates on this.

9.1.3 Labour process in lost and new jobs

I show in this section how the thesis answers Research Question 3 – *What are the implications of EV production on workers in the German automotive industry?* The conceptual contributions and empirical findings are provided by the analysis in Chapter 5 based on the review of technical and policy reports on EVs, and by the analysis of application in Chapter 7 of JTP1 and JTP3 – *protection* and *retraining*.

In Chapter 5, I explain the differences between EVs and ICE vehicles based on the review of technical reports on and material characteristics of the vehicle types. Section 5.3 identifies the dropped, new and changed units in EVs in comparison to the major component groups of ICE vehicles. Most of the units, which are used in the assembly of two major component groups, ICE and transmission, are not required in the production of EVs. This has impacts on the relationship between OEMs and first tier multinational automotive suppliers, which compete with each other to gain a stronger foothold in manufacturing and assembly of new units used in the EV architecture. Consequently, smaller first tier and second tier automotive companies supplying the mechanical parts of ICE and transmission component groups lose out, because the manufacturing and assembly of electric motor, battery pack, fuel cell and power electronics are not likely to fall into the business areas of smaller suppliers. These units, except for the fuel cell, are all established trades, the respective production networks of which are dominated by large companies. The manufacturing and assembly of fuel cells is also not an area that smaller suppliers can master, where some of the OEMs will likely lead the way. More importantly, the fuel cell is not the key unit for emerging EV production networks, which focus on BEVs as the central vehicle type of the future EV fleet (see Chapters 5 and 8).

Chapter 5 also identifies the changed units in the production of EVs. These affect the core business operations of OEMs, that is the vehicle body. The EV body needs to be adjusted according to the new internal component architecture, as well as according to the increased weight due to the battery pack. Another major change is the increased role of and value added in electric/electronic control units compared to that in ICE vehicles, and this has the potential to create tensions between OEMs and multinational first tier automotive suppliers. Smaller suppliers are not likely to be better off with this change, unless they have the financial and organisational resources for research and development, and relatively closer relationships with the first-tier suppliers that outsource some parts of the electric/electronic control and/or battery management unit. Even in this case, the dominant companies will likely maintain the power structure depicted in Section 5.2. In short, workers at smaller automotive companies specialising in ICE and transmission component groups are the major losers in the shift to EVs. However, due to the potential tensions between large OEMs and first tier suppliers, workers at some larger companies are an additional group of potential losers in the transition. The prospects of the latter group of workers depend on the extent to which JTP1

and JTP3 are met during the proliferation of EV manufacturing in Germany, which Sections 7.2 and 7.4 examine, respectively.

In addition to workers at smaller suppliers, losers in the shift to EVs include the non-union (part-time, fixed-term, temporary agency) workers at large OEMs and multinational automotive suppliers. The IG Metall representatives and the works council members at individual plants claim that they try to protect and include non-union workers, but struggle to expand the membership within this group of workers. These efforts, however, are not strong enough to meet JTP1 for all of those employed in automotive companies. Both the data from my semi-structured interviews and the analysis on the previous transitions in the German automotive industry, as well as the most recent vehicle demand fluctuations after the 2008 global economic crisis, suggest that non-union workers and older union members are expected to be the biggest groups losing their jobs. As explained in Section 7.2, in addition to old union members, the second major unionised workers to lose out in the shift to EVs are some of the skilled workers (*Facharbeiter*) who are employed in Germany at ICE and transmission plants, as well as the skilled workers employed at assembly plants for high-segment vehicles.

With respect to meeting JTP3, there are three major limitations. First, initiatives in addressing JTP3 to retrain workers for new jobs at restructured automotive sites lack funding from both companies and the state (Section 7.4). Second, and equally important, autoworkers at OEMs and large suppliers in European automotive clusters are in competition to receive investments in EV manufacturing at their sites (Section 8.2). Even workers of a single OEM or large automotive supplier compete with their colleagues, because not everyone is likely to be employed in EV production due to the overall reduced number of jobs. Third, it is not easy to meet JTP1 and JTP3 in an environment that structurally (Sections 6.3, 6.4) and contemporarily (Section7.3) does not fully meet JTP2; this, as revisited in Section 9.1.2, renders the position of labour vulnerable compared to that of capital.

The proliferation of EV manufacturing also influences other large workforces, which are outside the scope of this thesis. The reduced number of components in EVs will negatively affect the services at maintenance workshops and fuel stations (Interview with industry representative; EUROFOND 2018a). Contrary to the small/local enterprises that provide skilled and labour-intensive services to ICE vehicles, EVs cause local unemployment because

EV charging stations, EV maintenance and battery service/replacement can be provided by large companies, as well as by OEMs themselves. EVs will also influence workers at power generation and electricity transmission infrastructure. EVs are expected to put pressure on the electricity grid, and their batteries can be used as renewable energy storage units via vehicle-to-grid connections (IEA 2011; OECD 2004). Another theme raised by people I met from the German automotive industry is the questions of the source of electricity for charging batteries, i.e. renewable, coal/gas plants etc., which has potential impacts on workers at these industries.

9.1.4 Global labour and the environment

I provide in this section a summary of how the thesis answers Research Question 4 – *What are the implications of EV production on global labour and the environment?* The conceptual contributions put forward in Section 3.3, and empirical findings provided in Sections 5.3, 5.4 and 8.3 answer this research question. The concluding argumentation of the thesis in Section 8.4 on the need for a global approach to just transition combining the five JTPs is supported by the conceptual frameworks drawn upon in the thesis, by the review of technical and policy documents about EVs and the concept of just transition, as well as by the data collected through semi-structured interviews during my research trips to Germany. Based on the secondary sources, Chapter 8 applies this argumentation to the outer tiers of global automotive/EV production networks.

Chapter 3 conceptualises the need for a global approach to just transition. The five-parameter analysis on just transition with EVs relies on the labour regime analysis and the historical materialist approach to capitalist sustainability and energy transitions. I used in this thesis two of the four themes central to the labour regime analysis's focus on exploitation in the world economy. While JTP4 corresponds to the centrality of labour exploitation in production for EVs, JTP5 accounts for the appropriation of nature in the world economy. Other themes highlighted by labour regime analysis such as exploitation in social reproduction and in circulation are outside of the scope of this thesis.

The other reason to include the last two JTPs in the analysis of just transition with EVs in the German automotive industry relies on the review of technical reports on EVs and policy reports on the concept of just transition. As Chapter 5 details, the fundamental reconfiguration of global automotive production networks in the shift to EVs takes place due

to the material characteristics of EVs. The increased reliance on resource extraction, material mining and chemical processing for the production of EVs requires for a full just transition that addresses environmental standards and working and living conditions in outer tiers of EV production networks. However, as Section 2.4 explains, only a minority of just transition policy reports address these problems.

Chapter 7 explains the last rationale behind the argument of the thesis for a global approach to just transition with EVs. The culmination of the data collected through semi-structured interviews suggest that a broad coalition of forces in and around the German automotive industry sees the securing the supply of raw materials and minerals used in EVs only in pragmatic terms of maintaining the country's international competitiveness and leadership in automotive production networks. This coalition includes car manufacturers, trade unions and the state in Germany. The fear of losing their shared interest is expressed as the threat 'to become a second Detroit', which highlights that the workers in Detroit lost some of the well-paid and unionised jobs to workers in overseas factories. Similar sentiments apply to the fear of 'becoming a second Nokia', underlying that the reconfiguration of power relations in an industry can lead to the demise of the dominance of some companies. The expression of these shared interests and fears by a majority of my interviewees show that the transition to EVs cannot be judged by an analysis of only the first three JTPs and that JTP4 and JTP5 are in theory accepted by the German automotive industry, even if not considered fully in their just transition demands.

Based on the secondary sources such as academic literature and industry news discussed in Chapter 8, this thesis argues not only that global labour (JTP4) and the environment (JTP5) are not fully addressed in the just transition demands of the German automotive industry, but also that the first three JTPs (protection, inclusion, retraining) are nowhere near being met in the locations that supply the German automotive industry with raw materials and batteries used in EVs. Similar to the case of JTP2 that has not been met during previous transitions due to the anti-worker balance of power in Germany (see Chapter 6), the fourth transition today with EVs does not meet JTPs for workers across the world. JTP1 is not applicable to workers in small-scale and artisan cobalt mining in the Democratic Republic of Congo and nickel mining in Indonesia. JTP2 is not applicable to workers in Chinese chemical processing and battery cell manufacturing factories, some of which directly supply EV

components to large German OEMs. JTP3 is not applicable to workers that risk losing their jobs at ICE vehicle factories in semi-integrated automotive peripheries such as Mexico, Turkey or South Africa, in all of which both large German OEMs and multinational automotive suppliers operate and make use of low-cost labour in auto-parts production and weaker environmental standards with respect to use of chemicals and fossil fuel powered energy.

9.2 Key Academic Contributions

The empirical and conceptual findings summarised above help to sharpen my thinking on the academic literatures that this thesis engages with and potentially contributes to. First, I show the value of the just transition literature in its challenge to the mainstream sustainability paradigm, which can be expanded to other areas of the world economy. Second, I historicise unequal institutional and power relations in the German automotive industry which enables me to understand and show the ineffective inclusion of workers in EV transition decision-making processes. Third, I develop the five Just Transition Parameter framework to help order complex and potentially competing claims around 'justice' both thematically (e.g. deliberative, distributional, etc) and spatially (e.g. to overcome the current dominant regional and national focus of just transition demands by organised labour in developed countries). Fourth, I add both to labour regime analysis and the just transition (critical sustainability and energy transitions) literature a new case study of EVs, which is perhaps the most popularly highlighted corporate strategy to 'solve' transport-related greenhouse gas emissions; and drawing on the world's most significant automotive producer, Germany.

First, the concept of just transition puts the responsibility to companies and the state of providing a protected labour market for those influenced by sustainability and energy transitions. It shows the inability of labour markets to provide workers with new jobs and benefits during and after a transition to environmentally friendly products and technologies. In other words, the just transition literature showcases how the mainstream, top-down, linear and ahistorical approach to sustainability fails to solve the labour market repercussions of new technologies and environmental regulations led by private enterprise and centred on economic growth. However, a shortcoming of the concept of just transition is that it does not continue this critique to other areas such as expansion of exploitation in the speres of production, ecology, circulation, that takes place under and reproduces unequal power

relations within and among countries. For instance, just transition demands in advanced manufacturing industries do not question the ability of commodity markets of bringing sustainable resource use.

Overcoming this requires approaching any just transition to EVs beyond national, regional and sectoral lenses and thus applying/doing labour regime analysis in emerging automotive/EV global production networks with the consideration of multi-scalar and relational structures in motion at multiple locations (Campling et al. 2021; Jonas 1996; Pattenden 2016; Peck 2022; Smith et al. 2018). In addition to the labour process theory's focus on control and struggles in the workplace (Braverman 1974) and Burawoy's (1979) attention to politics of production, the labour regime analysis also draws attention to environmental and material characteristics of new products or technologies altering the labour process and challenging the environment in different places in distinct ways (Baglioni et al. 2022b: 85). This thesis argues that the shift to EVs should be analysed with respect to changing time- and place-specific combinations of multi-scalar socioeconomic and ecological relations (Smith et al. 2018). As a result, the just transition demands of organised labour in developed countries including Germany need to have a broader outlook to consider the complex spatial and organisational implications of EVs on the environment and on power relations in the world economy.

For instance, on the one hand EVs put pressure on material mining and resource extraction workers, thus expanding exploitation in the sphere ecology; on the other hand, characteristics of manufacturing EVs expand exploitation in the sphere of production and influence industrial workforces, which competes for access to retraining and new investments. There is a potential differentiation of interest for workers even in the same workplace/sector vis-à-vis corporate management strategies about new products or technologies. To secure employment, workers can accept management strategies even without fully understanding its labour process implications. For instance, there is an ambiguity in Germany around working conditions in new battery plants, but most autoworkers look forward to such investments by their companies and the state around their regions. This can be explained by the fear of potentially worsening living conditions after a wave of deindustrialisation, which shows that wider socioeconomic and political reasons influence the decisions in the workplace.

Second, by applying the historical materialist approach (Malm 2016, Mitchell 2011) to the analysis of relationships between labour, capital and the state in sustainability and energy transitions, I argue in the thesis that the study of EVs should combine the role of institutional structures and political economy in shaping capitalist economic development during previous major transitions – which set the scene for the contemporary transition – with the analysis of contemporary power relations and the international division of labour. Such an approach is absent in the early socio-technical research that uses a multi-level systems approach to transitions, which instead is mostly focused on companies, niche markets and consumers (Geels 2002, 2005; Geels and Schot 2007). The proponents of this approach later acknowledged the fact that it accommodates agency in the form of routines, search activities and trial-and-error learning, and excludes labour agency and power struggles (Geels 2011: 30). The multi-level perspective's silence in the politics of transitions (Jenkins et al. 2020; Stevis et al. 2020) should be dealt with by 'opening the black box of public policy', that is to say the research on transitions should cover the intertwined nature of policy networks and interest coalitions (Smith et al. 2010: 446). Another significant missing link in the socio-technical transition research is the spatial nature of technologies and policies for sustainability transitions, and their impact on regional economies (Berkeley et al. 2017; Propris and Bailey 2021; Smith et al. 2010). This thesis draws attention to the broad coalitions around EVs at multiple scales. At the global scale, it accounts for the shared interests of global automotive, transport and energy industries in replacing the world vehicle fleet with a 'green' product instead of accepting their historical role in causing ecological problems by promoting individualised private transport in the 20th century. At the national scale, the thesis examines the focus in Germany of the state, OEMs and organised labour on maintaining the dominant position of the German automotive industry during and after the shift at the expense of global labour and the environment. The thesis also considers labour process changes, employment impacts and increased natural resource use by the shift to EVs based on the analysis by comparing material characteristics of the two products.

The more recent just transition literature with its focus on labour organisations and impacted communities is an advance on this earlier work because it includes workers as key actors in the process (ITF 2010; ITUC 2010; Stevis and Felli 2015; TUC 2019), but it could benefit from historicising prior major shifts in the industries under consideration. Based on a historical

materialist approach to capitalist sustainability and energy transitions, this thesis looks both at the historical and contemporary decision-making processes in the German automotive industry, and shows the asymmetrical power of capital and the state compared to labour in previous transitions in the German automotive industry, outcomes which tended to reproduce the asymmetry yet further in the interests of capital and the state. My approach adds to those in the just transition literature seeking to historicise and politicise the extant social relations and political economy within which sustainability and energy transition negotiations occur. It therefore establishes that weak inclusion of workers in decision-making processes with respect to the ongoing transition as the direct outcome of historical, political and path-dependent structures of the global production network under consideration. The just transition literature in general, and in particular its climate/energy focused strand (Swilling and Annecke 2012, Newell and Mulvaney 2013, Sovacool and Dworkin 2014, 2015; Sovacool et al. 2019) under the conceptual influence of the socio-technical approach (Geels 2005; Geels and Schot 2007; Sovacool and Hess 2017), could usefully draw on the insights of the historical materialist approach in examining capitalist sustainability and energy transitions. This is because historical materialism can better *explain* the dynamic reasons of climate/energy justice implications of renewable energies on deindustrialised communities in developed countries, as well as waste/mining peripheries in developing countries, whereas the socio-technical approach only *describes* these outcomes.

The reasons behind various injustices caused by the fossil-fuel energy regime include its attempts to control and to limit labour's say in political economy in industrialised countries and to increase natural resource extraction, pollution and waste discharge in peripheries in the Global South. As in the context of historical transitions in the German automotive industry throughout the 20th century discussed in Chapter 6, conflicts and power struggles in political economy have direct impacts on the shifts in an industry, where political and organisational power of not only autoworkers, but also that of other crucial workforces in iron and steel, coal mining, or transport infrastructure, had been curtailed by a combination of successive changes to the relationships among labour, capital and the state. The changes to the nexus among these actors do not apply solely in regional/national scale (see Chapter 6). Labour includes domestic and migrant autoworkers, as well as domestic and migrant miners and iron/steel industry workers. Capital includes national and international OEMs along with their

numerous suppliers. The state acts at various scales by regional and national authorities, as well as intergovernmental and supranational organisations. The state also acts in various *conditions*, in peace or at war, with strong or weak regulation on migration, labour and the environment, through authoritarian or repressive politics, all of which have substantial impacts on creating and/or reproducing specific labour regimes. For instance, the role of the state was crucial in interwar Germany in introducing mass production techniques to the automotive industry. Similarly, the role of the state in today's conflict minerals zones, or the lack of it during the 1990s and early 2000s, helped the proliferation of mining and resource extraction activities.

Third, bringing different ways of analysis and sources of data together, the other contribution of the thesis is that it develops a framework of relatively stable Just Transition Parameters to help simplify the layered analysis of ongoing and complex phenomena. In other words, the use of the JTPs as a framing device help approach and understand the complexity of an ongoing and dynamic process. At the same, I argue that parameters such as these should be broad enough in order to scrutinise socioeconomic and ecological dimensions. Constructed to grasp time- and place-specific approaches to a phenomenon, the parameters should be updated depending on global labour's and capital's changing priorities and interests, as well as that of the state(s) in intervening in working, living and environmental conditions across the world economy and in sustainability/energy transitions. I developed the five JTPs analysis based on the actual demands of labour organisations facing sustainability and energy transitions in their industries – the first three JTPs – as well as on analytical and empirical outcomes of my research – JTP4 and JTP5. In doing this, I used the methodological insights of the global production networks literature, conceptual insights of labour regime analysis, and the empirical insights I gained by comparing the differences and material characteristics of EVs and internal combustion engine vehicles.

I developed the first three JTPs to try to understand the traditional national focus of JT discourse, i.e. the contemporary shift to EVs in the German automotive industry. To do so, I analysed the contemporary institutional processes and political-economic dynamics in which the EV transition is being negotiated today. I also mapped and summarised the historical political of the state, labour and capital and their dynamic relationships in the German auto industry. This helped me to better explain both the ways in which contemporary changes are

inflected by history and what we can learn from the past for the study of transition in the present. I argued that the first set of three JTPs are not fully met in the context of Germany. I evidenced this using contractual differentiation among auto workers, their skills and age, size of their employers, and the availability of investment and public funds for retraining. In this vein, among losers in the shift to EVs, I identified workers with differentiated employment contracts, which are used increasingly in the German automotive industry since the 1980s due to growing asymmetries of power accruing to capital and the state on one side and labour on the other. Agency workers with part-time/temporary jobs within the German automotive workforce were found to be especially vulnerable. Another key factor preventing the meeting the first three JTPs is that, depending on the employer's size, business area, and financial and organisational capabilities, workers in ICE and transmission factories face redundancies due to insufficient funds for retraining. These worker groups and small and medium sized automotive companies struggle to get involved in EV decision-making processes with OEMs and other lead firms at due to the historical and institutional power imbalances in the industry between capital and labour and between large and small firms.

I developed JTP4 and JTP5 as framing tools in the analysis of just transition to EVs in an explicit to overcome the spatio-political methodological limits of the first three JTPs: i.e. methodological nationalism of the German labour organising model and the fact that environmental impacts do not stop at the border but bleed through raw material extraction on a global scale. I based my analysis and explanation on the review of technical reports on the material differences of EVs and ICE vehicles, and supported it by the relevant academic literatures on working conditions and environmental standards in the outer tiers of global automotive/EV production networks. I showed how perceived 'fears' to lose Germany's globally leading position in the auto industry prevents just transition demands from considering conditions of global labour and the environment. I argued that this limited outlook is influenced by the mainstream sustainability paradigm's insistence on economic growth, primacy of markets and private innovation, which pushes German labour organisations to embrace EVs without critically analysing their options. I elaborate on the latter below in some policy recommendations.

Finally, the fourth academic contribution of the thesis is to add a case study of EVs to the labour regime analysis and critical sustainability and energy transitions literature, and it uses

one of the most important automotive country's historical and contemporary insights on transitions. It depicts an interest alignment around EVs. This is because EVs are perceived as the solution to the road transport emissions, However, I argue in my thesis against the direct embrace of EVs by labour organisations in their just transition policy documents. Instead, labour organisations can help the shift to EVs in the German automotive industry contribute to a just transition to ensure that all the five Just Transition Parameter are addressed and met. To think about that process, the policy recommendations are developed in the next section, that are focused on the agency of labour and civil society organisations.

9.3 Key Policy Recommendations

I develop in this section policy recommendations for various actors in EV global production networks. Drawing on the above summary and crystallisation of the ways in which this thesis applies my framework of the five JTPs, I identify seven policy recommendations for the context of the proliferation of EV manufacturing and its relation to just transition to a low carbon economy. The first four aim at crafting a global labour and civil society organisations action plan, which include advancing a comprehensive global strategy, putting pressure on companies about reporting environmental performance, identifying solidarity actions, and creating alternatives to individual private transport. The remaining three policy recommendations can help national trade unions and civil society use the country- and manufacturing industry-specific policy tools against companies and their governments, which are using labour's political leverage, advocate for better local public transport and mobility services to reduce the number of vehicles, and designing socially, environmentally and materially effective and durable products.

9.3.1 Global labour (and civil society) organisations

In a methodological and conceptual dialogue between labour-focussed GPN research (Coe et al. 2007; Taylor 2007; Selwyn 2007; Smith 2015) and labour regime analysis (Baglioni et al. 2022; Campling et al. 2021; Pattenden 2016; Peck 2022; Smith et al. 2018), this thesis shows that the shift to EVs brings variegated conditions for global labour employed across workplaces with various labour process struggles. However, most just transition policy reports by national and international organised labour fail to consider effectively that workers *across* the world economy are impacted by the sustainability and energy transitions (Altintzis and

Busser 2014; Huq and Huge 2010; Rajan 2021; Urkidi and Walter 2018; Uzzell and Räthzel 2013; Veiga and Martin 2013). This omission also applies to the shift to EVs (Sehgal 2020; Prause and Dietz 2022; Geenen and Cuvelier 2019; Hass 2022). Among the few who do consider it, there is the assertion that the dire working, living and environmental conditions in developing countries can be solved by the tools of global labour governance such as ILO conventions and GFAs between large companies and trade unions in developed countries (argued in multiple interviews with labour, industry and state representatives). Intergovernmental initiatives are part of the linear and top-down approach to transitions by the mainstream sustainable development paradigm (see Sections 2.2 and 8.3). The fact that the ILO conventions are often not implemented fully, and that, even if implemented, they do not guarantee better working, living and environmental conditions (Barca 2015; Boris et al 2018; Seekings 2008, 2019) are not addressed in most just transition policy documents of national and international organised labour. The private organising of global labour relations through tools such as GFAs are generally not put into national law, and it is not easy to protect workers in developing countries with GFAs (See Chapters 7 and 8).

Instead, as a starting point, my first policy recommendation is that, similar to the case of ITUC's four pillars – (i) peace, democracy and rights, (ii) regulating economic power, (iii) just transitions, and (iv) equality (ITUC 2018) – there should be a comprehensive strategy adopted by labour organisations in the home countries of large OEMs and multinational automotive suppliers, replacing a just transition approach that is limited to only the first three JTPs, which as I explain above, are not fully met even for all workers in Germany. Thus, pertaining to the institutional and political advancement of the concept of just transition, I show the need for a global labour perspective (Section 8.4) that just transition proponents and labour organisations should carefully consider which workers are protected (JTP1) and be clear as to which are not. To address the limits of just transition policies, labour organisations should acknowledge and critique the limited processes of inclusion in decision-making processes during sustainability and energy transitions. In the case of Germany, the limits are related both to the divided institutional labour representation as an outcome of the German political economy and the contemporary exclusion of labour representatives from ad-hoc EV decision-making platforms. Considering the implications of material characteristics of EVs and scattered geography of automotive production networks with differentiated working

conditions and changing environmental standards, addressing the limits of just transition policies also requires considering the interests of several groups of workers, miners, and their communities employed in and impacted by existing automotive and emerging EV global production networks. They should have a say in national and international just transition mechanisms.

To do this, national and international trade union representatives, along with auto workers in developed countries, should implement my second policy recommendation. This is to put pressure on their governments and their employers to report and account for environmental and working conditions in the outer tiers of OEMs' supply chains. At a minimum, this would allow for a better conditions for building solidarities, and more positively, could be used to identify JT-related actions across borders and supply chain nodes. In addition to the lack of JTP1 (protection) and JTP3 (retraining) in most of the automotive parts and lower segment vehicle supplying locations in third countries, ineffective JTP2 (involvement in industry decision-making) is particularly important for workers across the world, whether or not they receive in the short term any EV related investment by OEMs and/or multinational automotive companies. Improving the ways in which workers in parts-supplying, and mining and chemical processing regions get involved in decision-making processes – or at least feature in German unions' solidarity campaigns – can make research and reporting on supply chain due diligence easier, about which the EU is looking for developing policy tools (Zamfir 2020).

This can ease the implementation of the third policy recommendation – identify locations for solidarity action. Given the complexity of supply chain, this effort could order locations for solidarity actions based upon an assessment to the urgency and significance of the cases and the existence ties (e.g. by region, trade agreement etc). For example, in the existing automotive production networks, research and reporting can focus on Central and Eastern European countries and Turkey in the European automotive macro-region, Mexico and Brazil for North American automotive macro-region, and India and Southeast Asian countries for the Asian automotive macro-region. With regards to the emerging EV production networks, the efforts of organised labour could centre on improving research and reporting on working and environmental conditions in crucial mining locations, such as the DRC, South America and Indonesia, as well as the vital chemical processing locations in China.

Depending on the needs and characteristics of those labour regimes, labour organisations in Germany and other industrial centres then can analyse ways to cooperate with their counterparts. If this might not be possible through local trade unions or national union confederations as in the case of authoritarian jurisdictions such as China, Hungary, India, Mexico, Thailand and Turkey, they can try to reach out to civil society organisations and consumer/activist networks advocating for human rights and environmental standards.

The fourth policy recommendation is about creating alternatives to private individual transport. As put forward in Chapter 5 and 8, various minerals and elements are required for the proliferation of EV manufacturing. Cooperation with workers, miners, and communities in these jurisdictions is vital for just transition to a low carbon economy. Regarding these nodes as only a matter of supply chain security does not help labour put forward a full just transition, and only can reproduce the mainstream sustainable development paradigm. Instead, a full use of the five JTPs should be demanded in the shift to EVs to secure a just transition to a low carbon economy. This requires creating alternatives to 'the solution' to transport emissions – EVs, as opposed to embracing EVs, which hardly fulfil JTP4 and JTP5. Any alternative to EVs for a just transition should start with asking automotive companies and governments acknowledge the shortcomings of EVs in solving the transport related emissions and other dimensions of the ecological problem such as increased biodiversity loss through rubber plantations or water/soil degradation in mining and chemical processing.

9.3.2 National labour (and civil society) organisations, large companies and the state

The policy recommendations in this section for OEMs and large multinational automotive companies and their countries such as Germany start with the required agency of labour organisations and civil society organisation, because I believe that without the involvement of the latter group, the first group of actors dominating the world economy can hardly think outside the existing business models. This argument is supported by the insights this thesis provides, especially in Chapter 6, on the fact that as automotive industry gradually expanded and transitioned from earlier phases, worker's say had been limited by states and capital. So, the following policy recommendations aim to roll back that trajectory as much as possible. Thus the fifth policy recommendation is about using labour's political leverage. The governments and automotive companies in the developed countries need the cooperation of workers at domestic factories for the proliferation of EV production, including to avoid trade

diversion to China. This is especially the case against the backdrop of right-wing populism in deindustrialised locations, as well as for investments in charging and other EV infrastructure, workers can use this leverage in the initial phases of EV product development and public/private investment programmes. Small and medium-sized automotive suppliers, which are worse off with the shift to EVs, can have political leverage especially in local/regional politics in small towns and rural areas.

The sixth policy recommendation is to advocate for better local public transport and mobility services, and reduction of the number of vehicles in the world fleet as opposed to replacing them with EVs. In the case of EVs, global labour, civil society organisation and organised labour organisations need to advocate together against the idea of replacing the world vehicle fleet with electric versions. As put forward by Morgan (2020: 965), this strategy can at best be a 'successful failure' given the fact that the embedded emissions of BEVs will in fact facilitate exceeding emission limits of the Paris Agreement if we were to rely on a straight swap between ICEs and EVs in the transportation transition. Instead, the large automotive companies should be called on by governments to invest in the ways in which mobility services are based on a reduced number of vehicles, vehicles and batteries that comply with circular economy design principles, and especially, focus investment on public transport.

The seventh policy recommendation is about labour's intervention in corporate investments plans. Labour organisations and governments can help solve the problem of road transport emissions by calling large automotive companies to divest from their existing business models and to find ways to produce transport goods and services for socially useful ends. This recommendation is of course difficult to imagine in the first place, but labour organisations and civil society organisation can push their governments to facilitate ideas such as the Lucas Plan[95] developed in the 1970s in the UK (Medwell 20220), which was not effective because of government and corporate management opposition to the plan (Stevis 2023: 9). A strategically stronger elaboration of such plans can initiate calls to companies to change their products and services into socially, environmentally and materially productive and durable products and services. Such initiatives can also help the national labour organisations in Germany find ways to maintain jobs for those members who are about to lose their jobs due

[95] 'An idea whose time has come?' Available at http://lucasplan.org.uk/ last accessed 26/10/2023.

to the differences in the labour process of manufacturing EVs and ICE vehicles. Moreover, the mostly unionised and skilled/semi-skilled senior workers in ICE and transmission plants should look for ways to come together with mostly non-unionised (part-time, fixed-term, and precarious) workers to develop more democratic ways of industrial relations and plant-level decision-making processes.

9.4 Limitations and Suggestions for Further Research

This section presents limitations of the thesis and suggestions for future research.

The thesis has three major limitations. The first limit is related to my sampling of the semi-structured interviews. Even if the overarching argument of the thesis is that judging EVs with respect to just transition requires consideration of the positions of all workers and suppliers in existing (automotive) and emerging (EV) global production networks, my interviews do not cover a cross section workers in the German automotive industry, nor in the global automotive industry. Pertaining to the former group of workers, my sampling does not cover non-union autoworkers in Germany who are employed under part-time, fixed-term and/or temporary contracts. With respect to the latter group, I did not conduct interviews with workers from the key integrated periphery of the German automotive industry – the Central and Eastern European automotive companies. Neither did I interview workers in the semi-peripheries of the German automotive industry such as those in Mexico, South Africa or Turkey. However, arguably the most important group of workers that are not interviewed but which would have tested my argumentation in the thesis are those employed in the upstream and midstream of emerging EV production networks. Upstream nodes here refer to the resource extraction and material mining activities, while midstream nodes are chemical processing and battery cell manufacturing plants in China. The analysis of JTP4 and JTP5 would have been stronger without this limit. My interviews with representatives from international labour organisations and intergovernmental institutions such as the UN and EU agencies could have been followed by interviews with workers from these nodes of EV production networks. The thesis deals with these gaps via review of technical and policy documents, as well as the academic literature.

The second limitation of my research corresponds to the access problems I faced during my research trips to Germany. The production and supply chain managers of large OEMs declined

to meet with me to discuss the impacts of the shift to EVs on their factories that were being restructured at the time of the research. Similarly, I did not have the chance to interview members of the works councils at the restructured plants in Germany. Finally, because it was an early phase for the German automotive industry in its shift to EVs under the increased publicity of a recent industry-wide scandal, I could not access the limited number of battery-pack assembly locations to interview workers or managers. The analysis of JTPs 1, 2 and 3 could have been better without these limits, nonetheless, I sought to address these gaps with semi-structured interviews with autoworkers, industry associations and the regional state authorities; the review of the major employment reports on EVs commissioned by the coalitions of forces in the German automotive industry; and personal communications (informal chats, email exchanges, and skype calls) with skilled workers and mid-level project managers, who were or whom I knew through my personal networks in Germany.

The third limit is that I did not interview proponents of other social movements or groups such as public transport activists or shop floor unionists aiming to organise non-union workers and migrants, who could potentially be more interested in a full just transition that meets all of my five JTPs. This could have enhanced my research analytically and methodologically. The potential analytical contribution would be understanding further reasons for the embracing of EVs by the large coalition in the German automotive industry, in addition to my argument in this thesis about their shared interest in industrial competitiveness and leadership. A question to be answered here is why other and better solutions to transport emissions are not discussed such as public transport, and that instead centre stage is dominated by EV-focused discussions such as securing the raw materials, developing a European battery alliance, asking the EU to fund the transition etc. The methodological contribution to my research would be the potential of such circles to direct me to autoworkers that would not support the embrace of EVs without addressing JTPs 4 and 5, who could talk about their experience with regard to JTP2 and EV investment decision-making.

I think that these three limitations of my thesis also indicate future research directions in the study of just transition possibilities with and without EVs. I believe that future research should prioritise JTP4 and JTP5 – environmental conditions upstream and working conditions midstream of EV production networks. Researchers could also find use in thinking about the first three JTPs in low-cost parts and components producers for ICE vehicles such as those in

Mexico or Turkey, and low-cost battery-pack assemblers such as those in Poland or India. Of course, another key future research area is whether the concept of just transition in the UN climate policy frameworks will be enhanced, diluted or left behind.

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Appendix: Interview Questions

INTERVIEW QUESTIONS TO LABOUR, STATE, INDUSTRY

0. Introduction and aim of the study

1. Background information on the employer, workforce and union

- Where do you work?
- Which workers are you working with? Which part of the auto manufacturing process?
- Which employers are you working with?
- How do you organise different parts of the automotive/manufacturing industry workforce?
- What are the current debates/topics of trade unions in the automotive industry?

2. On EVs

- Are the firms you work with investing in EVs?
- Where?
- Are you or your trade union involved in EV investment decisions?
- Are workers involved in EV investment decisions?
- Are these investment plans or changes in EV production causing any employment threats to your members?
- To which ones?
- How are you, firms or workers embracing these changes?
- Which auto manufacturing sections/jobs are most changed? Maintenance, metal, mechanics
- Any new jobs? Electronics, assembly, battery production
- Do you work with any EV or its parts-producing plants?
- How different is the production process?

3. On just transition

- How are employment relations being influenced by changes brought by EV production?
- Are any arrangements during this change/transition discussed?
- How?
- Is any arrangement discussed related to just transition?
- How are these decided on?
- For which workers do you think the arrangements are useful?
- Is any part of the workforce excluded?

ADDITIONAL INTERVIEW QUESTIONS TO OPERATIONS AND PRODUCTION MANAGERS AT OEMS AND LARGE FIRST TIER SUPPLIERS

1. Background information on the employer, workforce and union

- Where do you work?
- Which part of the auto manufacturing process?
- Which workers are you working with?

2. On EVs

- Is your firm investing in EVs?
- Where?
- Do you work with any EV or its parts-producing plants?
- How do you organise EV manufacturing?
- How different is it compared to ICE car manufacturing?
- Has your firm developed a new design/platform for EVs?
- What advantages/disadvantages would it bring?
- How will managers and workers adapt to it?

3. On just transition

- How are these changes discussed/decided on?
- Is there any arrangement for training/relocation of workers?
- Which auto manufacturing section/jobs are most changed? Maintenance, metal, mechanics
- Any new jobs? Electronics, assembly, battery production

ADDITIONAL INTERVIEW QUESTIONS TO SUPPLY-CHAIN MANAGERS OF OEMs AND SUPPLIERS

1. Background information on the employer, workforce and union

- Where do you work?
- Main products, turnover, competitors, domestic market, export production, employment
- How many production sites and where? ICE, EVs, both?

2. GPN

- Current in-house production
- Current suppliers
- Plans for production of EV components
- EV components suppliers