



ROUND TABLE ON SUSTAINABLE DEVELOPMENT

**Preparing automotive workers  
for a climate-neutral transport future:  
Who leads, who pays?**

**Background note prepared for the  
42<sup>nd</sup> Round Table on Sustainable Development  
24 November 2021**

This background note was prepared by the Round Table on Sustainable Development (RTSD) secretariat, under the responsibility of Connie Hedegaard, RTSD Chair, and supervision of Sigita Strumskyte, RTSD Co-ordinator, with substantive contributions from Kilian Raiser, Sara Ramos Magaña, Amelia Smith, Dimitra Xynou and Helene Bendig. It benefitted from advice and comments from numerous OECD experts from the Environment Directorate, Directorate for Employment, Labour and Social Affairs, Directorate for Education and Skills, Economics Department, International Transport Forum and Centre for Skills. The reasoning and opinions expressed herein do not reflect the official views of the OECD nor the governments of its member countries.

The 42<sup>nd</sup> Round Table on Sustainable Development is financially supported by the European Climate Foundation. Their contribution is gratefully acknowledged.

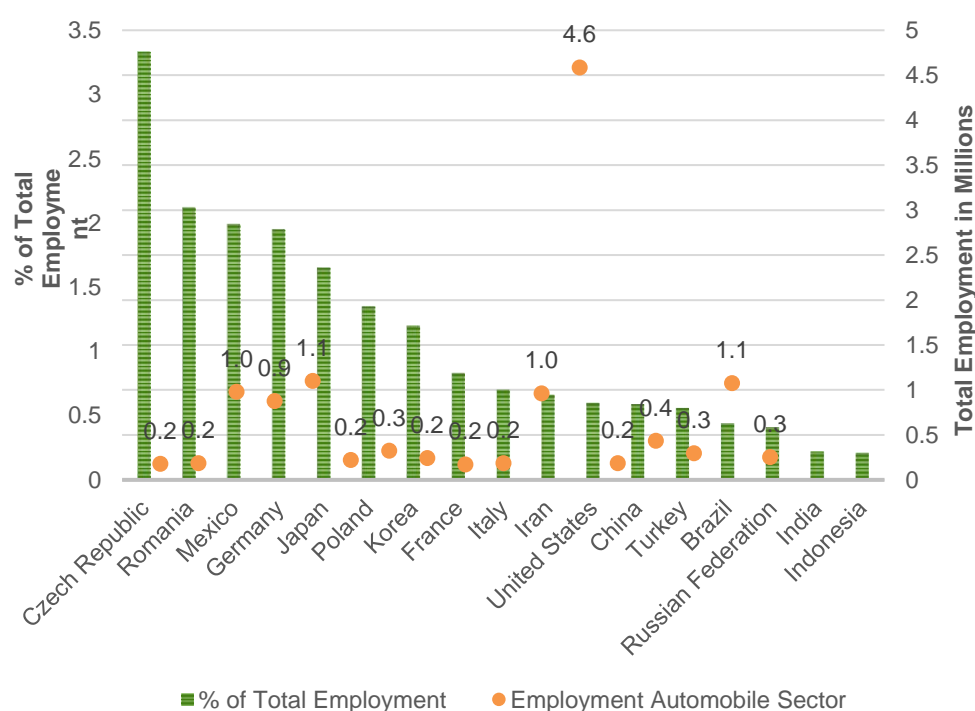
## Introduction

The transition to net zero will affect most economic sectors and the necessary adjustments will have consequences for millions of workers worldwide, shifting employment patterns and affecting jobs in high-emitting sectors. At the same time, growth of the green energy and infrastructure sectors, and the continued development of low- and zero-carbon technologies, are forecast to create millions of jobs.

One of the main sectors facing these socio-economic challenges is transport. The transport sector accounts for 24% of global CO<sub>2</sub> emissions from fuel combustion, with most coming from passenger vehicles including buses and taxis. Without immediate action, its share could reach 40% by 2030 (IEA, 2020<sup>[1]</sup>). To reach net-zero targets by 2030, the scale and pace of change in the automotive industry will be immense: 60% of all passenger vehicle sales will need to be electric vehicles, compared with 6% today (IEA, 2021<sup>[2]</sup>).

The transport sector is of major economic importance, with an annual turnover equivalent to the world's sixth largest economy (Masoumi, Kazemi and Abdul-Rashid, 2019<sup>[3]</sup>). Globally, around 14 million workers are directly employed in vehicle manufacturing (ACEA, 2020<sup>[4]</sup>). For instance, in Germany, Mexico and Romania, direct employment in the automotive sector represents around 2% of total employment, and in the Czech Republic as much as 3.3% (Figure 1). Furthermore, vehicle manufacturing is the centre of a much larger industrial and services ecosystem. In Europe alone, the automotive industry employs 2.6 million workers in manufacturing jobs, while total employment in the sector including services (direct and indirect jobs) is 13.8 million (European Commission, n.d.<sup>[5]</sup>).

**Figure 1. Jobs in the automotive sector, percentage of total employment (2019)**



Note: Data represents direct employment in the manufacturing of motor-vehicles, trailers and semi-trailers as accorded by ISIC Rev. 3 #34.  
Source: OECD, World Bank.

Decarbonisation of the transport sector, along with changes in mobility patterns and ongoing automation and digitalisation of vehicle manufacturing, will have major impacts on employment in the automotive industry. Many jobs will be displaced, require new skills, or disappear entirely. Affected workers will face real consequences in terms of re-employment, potential earnings lost, and skills downgrading, even after finding new jobs (OECD, 2018<sup>[6]</sup>). At the same time, new jobs will be created, but not necessarily by the same companies or in the same countries, regions and cities as today.

Governments thus face an urgent triple challenge: 1) supporting displaced auto workers and facilitating their redeployment through reskilling, active labour market policies and financing arrangements; 2) providing the necessary social protection to workers and communities unable to adapt to the transformation of the automotive industry; and 3) ensuring that higher education and vocational education and training (VET) systems are adequate to prepare workers for new jobs, including those emerging in the green economy. The green transformation will also disproportionately affect certain regions and demographics, requiring careful consideration of regional policies, multi-level governance and international co-operation.

Failure to address these challenges adequately and at an appropriate pace will hinder the objectives of a just transition, and could potentially lead to industrial, social and even political unrest, which in turn could slow the adoption of climate policies. More positively, achieving decarbonisation of passenger transport will bring additional benefits such as improved air quality and noise reduction in urban areas, thereby improving health, well-being and labour productivity (Neidell, 2017<sup>[7]</sup>; Chen and Zhang, 2021<sup>[8]</sup>; OECD, 2019<sup>[9]</sup>).

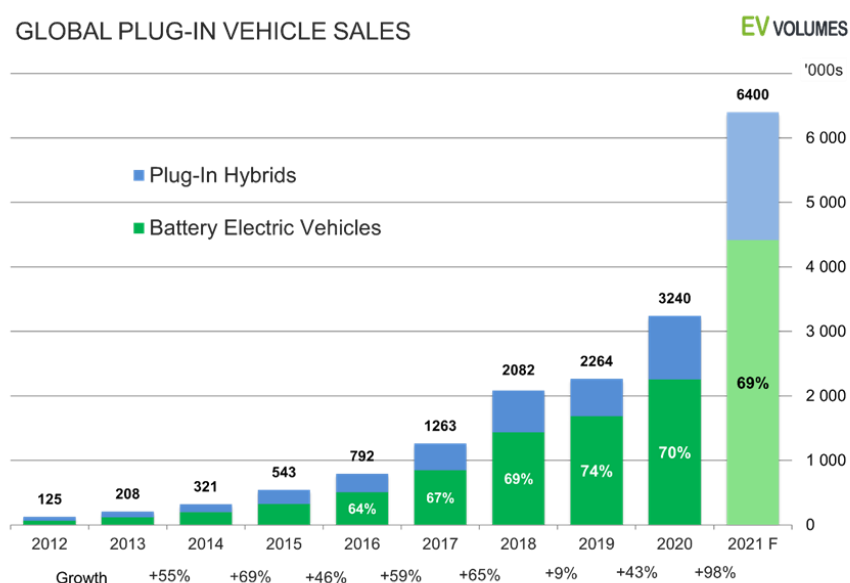
This paper outlines the ongoing transformation of passenger vehicle transport and provides an overview of initiatives taken by governments and the private sector to facilitate the net-zero transition in a manner that supports employment, re- and up-skilling and innovation. It provides background on the principles of a just transition, and highlights existing and planned initiatives aimed at supporting displaced auto workers and fostering innovation in order to align the automotive sector with climate objectives. The concluding section offers a framework for analysing the different elements of just transition programmes and raises a number of questions for debate.

## **Transformation of the automotive sector: decarbonisation and other factors**

Ambitious climate commitments by governments, an increasingly climate-aware public and major technological breakthroughs are accelerating the transformation of the automotive sector. More stringent climate and emissions policies, as well as changes in transport patterns and urban planning, will be key drivers of the number and type of vehicles constructed and how they are used.

Decarbonisation of the automotive sector will rely on the rapid growth of new technologies such as electric vehicles (EVs), which in turn will require clean electricity generation to ensure a real cut in emissions. EVs currently represent 6% of global vehicle sales, but are expected to grow rapidly in the coming decade (see Figure 2).

Figure 2. Growth of electric vehicles (EVs)



Note: Bars represent the total number of EV sales, with green sections accounting for battery EVs and blue for plug-in hybrids. Percentages shown in the bars depict the share of EV sales that are battery EVs. Percentages below years represent the percentage increase in EV sales (both battery and hybrid) compared to the previous year.

Source: [www.ev-volumes.com](http://www.ev-volumes.com).

Rapid technological innovation in battery production, which accounts for up to 50% of the cost of EVs, is contributing to growing demand (PwC, 2019<sub>[10]</sub>). The cost per kilowatt-hour of battery power has decreased by a factor of ten over the past decade, from about USD 1 000 to around USD 100. EVs are thus becoming increasingly competitive, with car manufacturers setting ambitious emissions reduction targets. Volvo, Mazda and Nissan have pledged to sell only EVs by 2030, General Motors by 2035, and Honda by 2040. Toyota and Volkswagen have set carbon neutrality targets for 2050, and others, including Daimler/Mercedes-Benz and Ford, are investing heavily in their EV architectures.<sup>1</sup>

Government policies are further accelerating this trend. The European Union's Fit for 55 package, announced in July 2021, includes a proposal for phasing out internal combustion engine vehicles by 2035. China has made similar plans, mandating that EVs make up 50% of vehicle sales by 2035, with the other 50% to consist only of hybrid vehicles (IEA, 2021<sub>[11]</sub>). The United States has outlined plans calling for 50% EV sales by 2030 (White House, 2021<sub>[12]</sub>). Similar policies exist globally.<sup>2</sup> Meanwhile, other countries with major vehicle manufacturing sectors, such as Brazil, lack clear guidance from government in terms of domestic production and sales of EVs (Ferreira, Tsai and Boareto, 2021<sub>[13]</sub>).

For now, many large automakers and auto manufacturing countries have opted to stick to their own unilateral emissions reductions targets rather than committing to more concerted global efforts. At the 2021 Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26), over 100 national governments, regional authorities and companies (including Volvo, General Motors and Ford) signed the Glasgow Declaration on Zero-Emission Cars and Vans, a non-binding pledge to end the sale of internal combustion engines by 2035 in leading markets and 2040 worldwide. Fifteen countries also agreed to a separate pledge to work toward 100% zero-emission sales of new trucks and

<sup>1</sup> See corporate communications from [Volvo](#), [Mazda](#), [Nissan](#), [General Motors](#), [Honda](#), [Toyota](#), [Volkswagen](#), [Daimler](#) and [Ford](#) for more detail.

<sup>2</sup> For a useful overview see (IEA, 2021<sub>[91]</sub>).

buses by 2040. However, the United States, China, Germany, South Korea and Japan declined to sign, as did four of the world's largest car companies (Volkswagen, Toyota, Renault-Nissan and Hyundai-Kia). Among the reasons given by carmakers was a reluctance to formally commit to EVs in the absence of equal commitments from governments to ensure the necessary charging and grid infrastructure (Reuters, 2021<sup>[14]</sup>).

Decarbonisation of road transport will also require significant development of infrastructure such as rapid charging stations, and reducing the carbon footprint of elements necessary for electric vehicle components, in particular batteries, which require a much higher input of minerals than combustion engines. Other technologies will also be necessary. Although EVs are poised to become the primary low-carbon solution for decarbonising passenger vehicles in the short term, hydrogen powered vehicles offer a promising solution to decarbonising larger vehicles such as freight trucks (Box 1).

Growing digitalisation is also set to affect the entire automotive supply chain and bring automated vehicles to roads, which could facilitate car sharing and other transport services that will reduce demand for car ownership (PwC, 2018<sup>[15]</sup>; Gao et al., 2016<sup>[16]</sup>). In addition, a growing number of national, regional and city authorities are redesigning their transport systems to improve accessibility – e.g. through street redesign, spatial planning creating proximity, and policies to mainstream shared mobility – transforming the functioning of systems through a well-being lens. (OECD, 2021<sup>[17]</sup>). Recent reports of the Corporate Partnership Board of the International Transport Forum show that up to 9 out of 10 conventional cars could become redundant in certain shared mobility scenarios (International Transport Forum, 2015<sup>[18]</sup>). Vehicle demand will also be affected by changes in mobility patterns as teleworking becomes increasingly common (Fleming, 2020<sup>[19]</sup>).

### Box 1. Hydrogen-powered vehicles

Demand for hydrogen has risen more than threefold since 1975. A growing number of countries are implementing policies that directly support investment in hydrogen, with the majority of these targeting the transport sector. With declining costs in renewable electricity, interest in electrolytic (green) hydrogen is significantly increasing (OECD, 2021<sup>[17]</sup>). The use of green hydrogen has gained particular interest as a means to decarbonise long-haul transport, providing a viable low-carbon solution for larger vehicles such as trucks, but also shipping and aviation, where few other low-carbon fuel options exist. Although developments remain at a preliminary stage, in the medium term green hydrogen could play a major role in the transport sector.

Developing hydrogen-based transport will depend on the cost of fuel cells and refuelling stations and will require large-scale investments to scale up technologies and infrastructure. This will likely result in similar challenges for the transport sector as those generated by the shift to EVs. Manufacturing hydrogen-powered vehicles will require new production processes and supply chains, resulting in significant employment shifts. The need for new infrastructure for producing and transporting hydrogen and refuelling hydrogen-powered vehicles will open new employment opportunities, however these will also require new skills and training (IEA, 2019<sup>[20]</sup>).

This paper focuses primarily on the challenges faced by a shift to electric vehicles, but its findings – that the transition requires careful consideration of socio-economic outcomes and the policies and measures needed to mediate risks – apply equally to a shift towards hydrogen-powered transportation.

Source: OECD.

## Socioeconomic opportunities and challenges of decarbonisation of the automotive sector

### ***New jobs will be created, but some existing jobs will relocate or disappear***

Automotive sector employment has been heavily affected by the global COVID-19 recession. Recent decline in demand for new vehicles has put an estimated two million jobs at risk globally (IEA, 2021<sup>[11]</sup>).

Nonetheless, the rapid increase in electric vehicle sales is giving rise to positive projections. Analyses generally point to positive net employment increases in the automotive sector overall, with direct job growth driven by expanding production of EVs, batteries, electrical parts and machinery, and indirect job growth from the development of charging station infrastructure and of domestic and electricity grids. (Jaeger et al., 2021<sup>[21]</sup>). Hydrogen and other low-emissions fuels will also require new re-fuelling infrastructure.

However, employment effects will not be uniform across sectors or regions and will also depend on how future production is structured – for example, whether battery production remains largely outsourced by automobile manufacturers, as is largely currently the case, or can be brought in-house (ITF, 2021<sup>[22]</sup>).

A study by Boston Consulting Group finds that the total labour input required to produce an electric car is similar to that required for an internal combustion engine (ICE) vehicle. The number of labour hours required over the manufacturing process is about the same for EVs and ICEs, though the distribution of labour value changes across the automotive value chain. As EVs take hold in the market, the value added in automotive manufacturing will shift from automakers to tier one suppliers, particularly battery cell makers (Küpper et al., 2020<sup>[23]</sup>). It has also been estimated that constructing and maintaining EV charging infrastructure could create twice as many jobs as combustion engine vehicle manufacturing per USD1 million (Jaeger et al., 2021<sup>[21]</sup>).

Reflecting these factors, a recent estimate by the International Labour Organization (ILO) and United Nations Economic Commission for Europe (UNECE), under a scenario where half of vehicles produced across all UNECE Member States are fully electric by 2030, projects that net employment in the automotive industry and other sectors related to green transport could increase by close to 10 million jobs in 2030, 0.2% higher than in a business-as-usual scenario (UN and ILO, 2020<sup>[24]</sup>).

On the other hand, other studies project a decline in vehicle manufacturing jobs globally. A report on the Japanese automotive industry suggests that the rise of EVs will threaten over 84 000 jobs by 2050 – primarily in vehicle manufacturing and second-tier parts suppliers – which is more than 10% of total jobs in auto parts production (Nikkei Asia, 2021<sup>[25]</sup>). Germany's National Platform for the Future of Mobility (NPM), an advisory council for the government, estimates that, under pessimistic assumptions whereby the domestic industry cannot maintain competitiveness and relies heavily on foreign imports, for example for batteries, gross employment in the automotive sector may shrink by as much as 400 000 jobs by 2030 (NPM, 2020<sup>[26]</sup>).

Electric vehicle manufacturing requires less demand for assembly and factory workers, putting many in the industry at risk of redundancy. The World Economic Forum projects that almost 20% of jobs in the automotive industry are at risk of displacement (World Economic Forum, 2020<sup>[27]</sup>). Parts manufacturers for combustion engines are particularly at risk, as EVs require only a fraction of parts compared to ICEs. Dominated by small and medium-enterprises (SMEs), this part of the value chain is less resilient to change, and may be unable to adapt to changing technologies and production processes (ILO, 2020<sup>[28]</sup>). EVs have fewer parts that are subject to wear and tear, and do not require routine services such as oil or fuel filter changes, reducing the need for repairs and service. Thus, country-specific employment effects will depend critically on the extent to which battery production contributes to local job creation and the type of support offered for the transition.

### ***The need for reskilling, and skills shortages***

Irrespective of the net impact on jobs, the transition to EV manufacturing will generate new job profiles and skills and sharply reduce the need for others. Already, demand is significantly growing for data analysts, process automation and ICT specialists, and engineers. In South Korea, three major battery producers are currently facing skills shortages (Yang, 2021<sup>[29]</sup>). Leaving such skills shortages unaddressed could significantly slow decarbonisation of the transport sector.

The World Economic Forum estimates that more than 50% of jobs in the automotive sector will require new skills profiles in the future. Despite re- and up-skilling initiatives, only 44% of displaced workers are expected to be successfully reskilled (World Economic Forum, 2020<sup>[27]</sup>).

Alongside the shift to EVs, increasing automation and digitalisation continue to affect automotive sector employment (ITF, 2021<sup>[22]</sup>). The sector has experienced increasing robotisation in the last decade, and is the most important customer of the industrial robotic market today (Bartoš et al., 2021<sup>[30]</sup>). This trend is also behind an important shift in employment towards higher skills (Acemoglu and Restrepo, 2020<sup>[31]</sup>).

### ***Geographical shifts in production and employment***

Vehicle manufacturing has strong regional concentrations. Currently, Asian countries account for over 55% of production, led by China, where over a third of all manufacturing jobs are located (Figure 1). In Europe, central and eastern European countries have the highest share of direct automotive employment in manufacturing, with Slovakia and Romania peaking at almost 16% each, above the EU average of 8.5% (ACEA, 2020<sup>[32]</sup>).

The growth in EVs will lead to shifts in production and employment in the sector across and within countries. Europe is responsible for more than 50% of the world's exports of auto parts (ACEA et al., 2021<sup>[33]</sup>), which will be heavily affected by the move to EVs.

Battery cell production will make up a large part of new manufacturing jobs, as batteries account for up to 50% of the value of today's EVs (PwC, 2019<sup>[10]</sup>). Although battery prices are expected to continue to fall, batteries are primarily made by companies outside the traditional auto supply chain, which creates a competitive threat for legacy suppliers. Some battery suppliers have also begun to produce electric powertrains, which raises their share of the overall value of EV manufacturing, further increasing competition for incumbent manufacturers and suppliers.

Although the EU and US are increasing efforts to bolster national production of electric batteries, the sector remains dominated by Chinese manufacturers, with around 45% of the global market, followed by Japan and Korea (Gisbert and Careaga, 2021<sup>[34]</sup>; Moores, 2021<sup>[35]</sup>). China also dominates the refining of key raw materials needed for electric cars, including lithium, cobalt and rare earth metals (Koetsier, 2021<sup>[36]</sup>). In 2020, China accounted for around 80% of the global total output of the cobalt sulphate and oxides needed for battery production (UNCTAD, 2020<sup>[37]</sup>).

Even if economies with major automotive sectors succeed in producing batteries domestically, as envisaged for instance by the European Battery Alliance<sup>3</sup> and several recent private sector joint partnerships, this will take time and lead to changes in the industrial landscape as battery producers emerge in different countries and regions. The potential production and employment shifts over the next decade as a result of the accelerating move to EVs could therefore create tensions in global supply chains and trade. Supply chain workers outside of primary manufacturing countries may be especially vulnerable, as such workers are often not protected by unions and collective bargaining agreements.

---

<sup>3</sup> The European Battery Alliance, or EBA250, is a project-driven community which brings together more than 600 industrial and innovation actors, from mining to recycling, with the common objective to build a strong and competitive European battery industry. <https://www.eba250.com/>.



An issue particular to the United States is that new joint-venture EV gigafactories are being constructed in 'right to work' states rather than those with unionised manufacturing plants, which could bring downward pressure on salaries and diminish existing workers' rights and protections. The Biden administration has proposed a tax credit for consumers on 'union made' EVs which would provide a significant boost to Detroit's three automakers, General Motors, Ford and Chrysler-parent Stellantis. While foreign automakers consider such initiatives as a threat to competition (McEachern, 2021<sup>[38]</sup>), trade unions see them as a positive measure that will not only protect salaries but help to prevent massive departure of workers to other states.

Such concerns are compounded by new social and environmental challenges including significant supply chain risks linked to the use of child labour in cobalt and other rare earth mining in some countries (ILO, 2020<sup>[28]</sup>). Lithium-ion batteries used in e-cars and other consumer electronics EVs use around six times more minerals (e.g. cobalt, lithium, and nickel) than conventional vehicles and account for about half of all global demand (UNCTAD, 2020<sup>[39]</sup>). There is also an environmental risk linked to the disposal of electric batteries and an urgent need to improve their servicing, repairing and recycling. Battery repair could in itself become an important source of job growth in the EV sector, but requires specific skills, for instance in electrical engineering.

## The need for a just transition in the automotive sector

A successful green transition of the automotive sector is critical for achieving climate goals, tackling pollution, and preserving employment for millions of workers. In this regard, governments and industry face interrelated policy challenges linked to skills and investment, innovation, and employment.

Even if employment projections are ultimately of a net positive impact, effects will be distributed unequally and considerable job losses in certain areas are expected, necessitating the activation of social protection programmes and the need for active labour market policies that support the transition of displaced workers to new jobs. In particular, the emerging skills gap will require considerable re- and up-skilling opportunities for workers. Early intervention measures are particularly important, as they can facilitate the timely delivery of re-employment services and improve the chances of a smooth transition for displaced workers (OECD, 2018<sup>[6]</sup>). For example, group counselling and job-search orientation activities can be more easily organised during the notice period, particularly if the employer allows these services to be delivered at the work site.

In addition to supporting displaced workers and providing training opportunities to access emerging automotive jobs, there is a need to strengthen investment and innovation, in particular in battery technology. Some countries are considering policies and programmes to support innovation in battery technology including to reduce reliance on certain minerals and rare earths (IEA, 2020<sup>[40]</sup>). Their impact on local production and employment is highest when such actions are combined with skilling and employment programmes.

While governments clearly have a central role to play in facilitating a just transition in the automotive sector, responsibility needs to be shared with business, labour associations and other social actors. In particular, unions and industry associations need to be actively engaged in the design of plans for the green transition of the sector. The engagement of social partners is a common feature of successful transition programmes for displaced workers (OECD, 2015<sup>[41]</sup>).

## Just transition principles, policies and practices

Since its emergence in the 1970's, the concept of just transition has broadly encompassed the political imperative, policy goals, and set of practices needed to minimise the adverse effects of industrial and

economic transitions on workers, communities, and society at large (Smith, 2017<sup>[42]</sup>). At its core lie the four basic principles of rights at work, social dialogue, social protection and employment.

In the negotiations leading up to the 2015 Paris Agreement, trade unions and their allies advocated for including the notion of just transition. This was ultimately included in the preamble as a commitment of the Parties to “take into account the imperative 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<sup>[43]</sup>).

Early just transition initiatives introduced by countries have focused primarily on the coal sector, addressing structural challenges arising from national plans to phase out coal-fired energy generation.<sup>4</sup> Newer just transition initiatives have a broader focus, taking into account social and regional implications of the net-zero transition for different industrial sectors.

The EU Just Transition Mechanism (JTM), launched by the European Commission in 2020 as part of the European Green Deal, focuses on regions, industries and workers facing the greatest challenges of the net-zero transition, providing targeted support to help mobilise at least EUR 150 billion over the period 2021-2027 (European Commission, 2021<sup>[44]</sup>). Although a strategy and framework for support in the automotive sector is in the works, the focus of the JTM thus far has been on supporting workers in energy-intensive industries and coal mining (European Commission, 2020<sup>[45]</sup>). There are concerns whether its budget will suffice to cover other industries. In July 2021, a coalition of industry, trade unions, employers and environmental organisations sent a joint letter to European Green Deal Vice President Frans Timmermans encouraging the Commission “to come forward with a Just Transition framework for the automotive and wider mobility eco-system as a matter of urgency”.<sup>5</sup>

Other broader just transition frameworks include Scotland’s Just Transition Commission, an independent body made up of climate and economics experts, representatives from the energy sector and farming industry, climate NGOs and trade unions. tasked with providing practical independent advice to Ministers on how to maximise the economic and social benefits of decarbonisation while managing risks and challenges (Scottish Government, n.d.<sup>[46]</sup>) and New Zealand’s Just Transition Unit, which works in partnership with regions, sectors and communities to help manage impacts in a just and inclusive way (MBIE, 2021<sup>[47]</sup>).

### ***Just transition initiatives in the automotive sector***

In line with broader just transition frameworks that look beyond coal and heavy industry, governments are proposing or have implemented policies aimed explicitly at supporting transformation of the transport sector.

For example, the American Jobs Plan (AJP) foresees a USD 174 billion investment in vehicle electrification, including incentivising manufacturers to switch to EVs, electrifying public transit networks and supporting accompanying infrastructure developments, such as grant and incentive programs for public and private investment in charging stations (Jaeger et al., 2021<sup>[21]</sup>). The plan calls for a USD 100 billion investment in workforce development programmes, including for support for dislocated

---

<sup>4</sup> Examples include Canada’s [Task Force on Just Transition for Canadian Coal Power Workers and Communities](#); Spain’s [Just Transition Agreements](#); Germany’s [Act on Structural Change in Coal Mining Areas](#); and the US Department of Labor’s [POWER Dislocated Worker Grants and skills training opportunities](#). When China began shrinking its coal production in 2016, it established policies to mitigate adverse impacts on affected groups, providing funding for redundant workers and promoting their settlement and re-employment (He et al., 2020<sup>[100]</sup>).

<sup>5</sup> <https://clepa.eu/wp-content/uploads/2021/07/Letter-to-Mr-F.-Timmermans-Urgent-need-for-a-Just-Transition-framework-for-Europes-automotive-workforce.pdf>.

workers and sector-specific training, as well as for longer-term education, for example access to STEM training for disadvantaged groups and underserved communities (The White House, 2021<sup>[48]</sup>).

The Australian Growth Fund, established to support businesses and regions affected by the closure of the country's car manufacturing industry in 2017, included skills and training initiatives to prepare workers to transition to new jobs in high-demand sectors and occupations outside of the automotive industry. Before closing, production plants set up Transition Centres where employees could seek career guidance, opportunities for retraining and official recognition of prior learning as qualifications (OECD, 2018<sup>[49]</sup>). These were generally considered to be successful, with 63%-75% of workers undertaking some form of formal training and 82% able to find new jobs. A subsequent analysis by Australia's Productivity Commission raised the concern that beneficiaries of the assistance programme could crowd out other job seekers in the same region – highlighting that the design of re-skilling training initiatives requires a careful and comprehensive approach (Department of Education, 2019<sup>[50]</sup>).

### ***Acceleration through collaboration: stakeholder partnerships***

Partnerships between stakeholders can play a crucial role in preparing a future-ready workforce (OECD, 2019<sup>[51]</sup>). Such partnerships underpin a number of just transition initiatives.

For example, the Transition Centres financed by the Australian Growth Fund referenced above were run in partnership with automobile manufacturers. Sweden's Job Security Councils, bipartite social partner bodies which cover almost all economic sectors, provide career guidance and training services. With the assistance of the Councils, 88% of laid-off Swedish workers found new employment in 2016 (TUAC, 2018<sup>[52]</sup>).

Similar partnerships have been proposed for the automobile sector. A joint partnership of European stakeholders including automobile manufacturers, universities and think tanks, unions and regions have proposed the development of an Automotive Skills Alliance (ASA) to advance re- and up-skilling in the European automobile sector (Automotive Skills Alliance, 2020<sup>[53]</sup>). Similar initiatives are being introduced in conjunction with the European Battery Alliance (EBA250), which is developing training programmes in Spain and France and aims to expand throughout Europe. The EBA Academy in Spain will train 150 000 workers from the automotive industry through programmes developed in collaboration with European companies and organisations in the transport sector (European Battery Alliance, 2021<sup>[54]</sup>). In France, EIT InnoEnergy has signed a partnership with the government to train the EV workforce through an online training program with some physical attendance at local facilities (InnoEnergy, 2021<sup>[55]</sup>).

Alongside government-funded initiatives, automobile manufacturers, industry associations and labour unions are implementing their own collaborative training programmes, including in partnership with education institutions. Examples include Tesla START, developed with colleges across North America to provide students with the skills necessary for a career in the EV sector, the Volkswagen Academy, which recently updated its curriculum to include EV manufacturing, and the SEAT electromobility Learning Center (eLC).<sup>6</sup>

Private sector actors are also partnering directly with education providers to establish training programmes. Examples include the partnership between China VIA Technologies and Shanghai Nanhu Vocational School's Autonomous Driving and Education Platform (Via Tech, 2021<sup>[56]</sup>), and an agreement between the National Polytechnic University of Ecuador (EPN) and Chinese company BYD to generate continuing education programs in technical areas related to electrical mobility and mechanical assistance (Movelatam & UNDP, 2019<sup>[57]</sup>).

Non-state actors, particularly union organisations, have also launched their own initiatives and proposals. Union leaders in the United States' public transit sector have called for a national strategy to re- and up-skill

<sup>6</sup> See corporate communications from [Tesla](#), [Volkswagen](#), and [SEAT](#) for more detail.

public transit employees such as bus mechanics (TTD, 2021<sup>[58]</sup>). The International Transport Workers Federation has partnered with Singapore's National Trade Union Congress to study how the global workforce can upgrade their skills to cope with the digital transformation (hrm Asia, 2018<sup>[59]</sup>). The International Trade Union Confederation's Just Transition Centre, in co-operation with the Swedish organisation Union to Union, recently published recommendations to help guide international development co-operation actors in integrating just transition frameworks in their climate and environmental work (Just Transition Centre, 2020<sup>[60]</sup>).

## Considerations for policy makers and other stakeholders in designing and implementing just transition strategies

Alongside re- and up-skilling of the current workforce, a just transition in the automotive sector will require a broad policy mix including social support initiatives for workers who are unable to adapt to new technologies and education programmes that meet longer-term labour market needs. Implementing and co-ordinating such a policy mix will further rely on creating and enhancing institutional arrangements that support just transition initiatives across sectors (ILO, 2020<sup>[28]</sup>).

At the 2021 United Nations Climate Change Conference (COP26) in Glasgow, 14 governments and the European Commission signed a Just Transition Declaration<sup>7</sup> that commits signing countries to, *inter alia*, "support workers, communities and regions that are particularly vulnerable to the effects of the move away from carbon-intensive economies". The Declaration reflects the International Labour Organization's 2015 Guidelines for a Just Transition<sup>8</sup>, which outline the necessary steps towards well-managed environmentally sustainable economies and societies, decent work for all, social inclusion and the eradication of poverty. The ILO will support the implementation of the Declaration through the promotion and application of International Labour Standards (ILO, 2021<sup>[61]</sup>).

The OECD's own analysis of the inequalities-environment nexus, published in 2021, recommends that policy packages for an inclusive green transition should aim at: (i) mitigating the possible regressive impact of pricing environmental externalities, (ii) investing in human capital and upgrading skills to facilitate labour reallocation, (iii) addressing systemic inequalities with sectoral and place-based policies, and (iv) ensuring efficient and responsive governance (OECD, 2021<sup>[62]</sup>). Earlier OECD work on displaced workers recommends early intervention and well-targeted support measures, particularly for older workers, and strong co-operation among social partners (OECD, 2018<sup>[6]</sup>).

Criticisms of existing just transition initiatives suggest that many lack adequate foresight and co-ordination and require embedding within broader national strategies (Krawchenko and Gordon, 2021<sup>[63]</sup>). In particular, the core re- and up-skilling, employment and social protection pillars of just transition strategies for the automotive sector need to be accompanied with investments in innovation and infrastructure development that will support the jobs of the future.

Strategic use of public resources to mobilise private capital will be integral to financing the broad policy mix necessary to ensure a just transition (OECD, 2020<sup>[64]</sup>). For instance, although private investments will need to make up the bulk of funding in the long run, studies show that government subsidies are key to developing a network of charging stations and in turn driving EV uptake (Serradilla et al., 2017<sup>[65]</sup>; Muratori et al., 2021<sup>[66]</sup>; Springel, 2021<sup>[67]</sup>). Similarly, support for innovation in battery production is critical to developing a strong domestic manufacturing sector for key components of EVs (IEA, 2017<sup>[68]</sup>).

<sup>7</sup> <https://ukcop26.org/supporting-the-conditions-for-a-just-transition-internationally/>.

<sup>8</sup> [https://www.ilo.org/global/topics/green-jobs/publications/WCMS\\_432859/lang--ja/index.htm](https://www.ilo.org/global/topics/green-jobs/publications/WCMS_432859/lang--ja/index.htm).

Businesses operating in the automotive sector can also rely on the growing market for transition finance, which is intended to facilitate emissions reduction by better aligning corporates in high-emitting sectors with climate objectives. Such finance is necessary to mitigate transition risk and incentivise low-carbon development in sectors where no viable green alternative yet exists. Existing taxonomies from both public and private finance institutions include the transport sector as a potential beneficiary of transition finance mechanisms (Tandon, 2021<sup>[69]</sup>). Private investors are also increasingly scrutinising employers' climate action plans: for example, disclosure of transition risks in the Task Force on Climate-Related Financial Disclosures now extends to workforce considerations (WSP Sweden, 2021<sup>[70]</sup>).

Transition finance is less accessible for small and medium-enterprises (SMEs), which are key suppliers of parts to traditional car manufacturers and play a considerable role within the industry (ILO, 2020<sup>[28]</sup>). Ensuring that SMEs are able to adapt to new technologies and continue to provide innovative solutions to larger transnational manufacturers will be integral to a just transition and require considerable government support. Such measures include loosening administrative hurdles and providing financial support and information (OECD, 2021<sup>[71]</sup>; ILO, 2020<sup>[72]</sup>).

Middle-income countries with high shares of employment in carbon-intensive industries face a particular challenge in ensuring a just transition. Multilateral development banks (MDBs) often play a key role in supporting government efforts in this regard, including in transnational initiatives. For example, the European Bank for Reconstruction and Development's equality and inclusion strategy focuses partly on issues of employment and skills. This includes establishing multi-stakeholder partnerships to shape training policies, as well as developing market-relevant skills standards and national frameworks to encourage skills development (EBRD, 2020<sup>[73]</sup>). A group of MDBs including the EBRD also recently set out a blueprint to support a just transition.<sup>9</sup>

Aligning training initiatives with labour market needs is a top priority (Botta, 2019<sup>[74]</sup>), and requires defining a taxonomy and monitoring the development of green skills and green jobs. Skills certification is vital to formally document the competencies and experience of displaced workers applying for other jobs.

Assisting workers during and after displacement and adequate social protection will also be necessary, especially for older workers unable to retrain or adapt to new technologies. Suggested policies include revenue recycling (OECD, 2020<sup>[75]</sup>), lump-sum compensation (Botta, 2019<sup>[74]</sup>), but also job-search training and support (OECD, 2021<sup>[76]</sup>). Such social protection policies are underused in broader just transition policy mixes (Krawchenko and Gordon, 2021<sup>[63]</sup>). Failing to anticipate and mitigate the need for social protection risks immense social consequences for communities highly reliant on the automotive industry.

Long-term education meeting the demand for future skilled workers will rely on common standards and accreditation (Sharpe and Martinez-Fernandez, 2021<sup>[77]</sup>). Here, integrated networks across industry actors, including internationally, are integral to ensuring that firms have access to future talent (Volkswagen, 2020<sup>[78]</sup>). This will also require close co-ordination with unions, both in identifying skills gaps and training options and in securing reskilling opportunities and lobbying for government support (UnionTrack, 2019<sup>[79]</sup>).

It is also important to consider the gender dimension of just transition programmes. Women occupy only one in five positions in oil and gas, and only one in three in renewable energy (IEA, 2021<sup>[80]</sup>). Thus, addressing barriers to female workforce participation and career development is critical. This includes in particular promoting STEM subjects in girls' education and addressing biases in the scientific research community (OECD, 2021<sup>[81]</sup>).

There is also a need to consider the implications of major industrial restructuring for communities and to consider the local and regional dimension of just transitions. This requires involving regional and local governments and ensuring good co-ordination with the national government. For example, a just mobility transition designed around accessibility rather than physical movement would serve to increase overall

<sup>9</sup> <https://www.ebrd.com/news/2021/ebd-joins-mdbs-to-support-a-just-transition-to-net-zero-economies-.html>.

well-being, reducing social inequalities in local communities, and supporting vulnerable populations (OECD, 2019<sup>[9]</sup>). Additionally, there is an important role to play for governments in supporting the creation of decent new non-automotive jobs to replace those in regions left behind by industry shifts.

The cross-border dimension of just transition needs careful consideration and calls for international co-operation, in particular within regional trade groupings (Obergassel, Lah and Rudolph, 2021<sup>[82]</sup>). This is evident in the case of the European Union, where the European Commission is playing a growing role in co-ordinating just transition policies, even if it has yet to develop a framework specific to the automotive sector.

Summarising these considerations, and in line with the integrated policy framework set out by the OECD referenced above, the following elements could be considered in just transition initiatives in the automotive sector:

Governance of just transition programmes:

- An overarching government plan for a just transition in the automotive sector, linking employment and skills initiatives with support to innovation and production of EVs, accompanying infrastructure development and the development of batteries. Where relevant, such plans would be co-ordinated at the international level, for instance within trade blocs. Multi-level governance (collaboration across level of government) and cross-ministry planning of such plans is also essential, given the strong regional concentration of the sectors affected and the multidimensional facet of the challenges involved.
- Stakeholder consultation regarding the plan and its implementation, ensuring that businesses, unions and civil society at large have the opportunity to engage.

Innovation and R&D programmes:

- Public investment to support innovation can help advance technological breakthroughs, for example in battery development. A specific focus is also needed to support SMEs suppliers to adapt to the new value chains of EVs.

Employment shifts, the skills challenge and the role social protection in just transitions:

- Clear identification of training needs and target population, to ensure that those most vulnerable to transition risks can be supported.
- Social protection programmes and active labour market policies to support displaced workers and affected households, ensuring as far as possible early intervention to speed up and smooth the adjustment process.
- Targeted and special support programmes to address mass-layoffs, involving social partners and regional authorities.
- Well-targeted training programmes to support reskilling of workers who transition to new jobs within the industry.
- Higher education and vocational education and training (VET) programmes to ensure that there is an adequate supply of well-equipped employees entering the growing green sector; development of public-private collaboration on such programmes as well as engagement with the educational and training establishment. Ensuring a gender dimension in such programmes to provide women with adequate skills and opportunities in the emerging sector.

Community policies, as often an intense green transition affects the broader community beyond directly affected workers.

Within each of these elements, a critical question is the extent to which public financing is needed and what its role should be. In addition, a just transition programme needs to have a mechanism for anticipating future challenges.

Finally, managing a just transition in the transport sector (or indeed in all sectors) is an opportunity to more fundamentally reimagine the socio-economic structures underpinning everyday life. The speed and scale necessary to achieve net-zero emissions will likely require systems that by design reduce emissions whilst also improving over-all well-being (OECD, 2021<sup>[17]</sup>). Future just transition initiatives could be an opportunity for integrating broader well-being frameworks.

## Summary and conclusions

The transition to low-emissions technologies and continuing automation and digitalisation in the automotive sector offer a major opportunity to achieve climate goals and enhance well-being and productivity, but also pose considerable socioeconomic challenges. Ensuring a just transition in the sector will require a gamut of policies that ensure that the current workforce is sufficiently prepared to take on new technologies and processes, that redundant workers unable to adapt to new technologies are provided commensurate protection, and that future demand for skills and labour is met with targeted education programs. This requires urgent engagement by all relevant stakeholders to ensure that existing policy initiatives and partnerships are expanded and new ones developed. Due to its economic, social and political importance and complexity, the automotive manufacturing and servicing sector requires a specific focus.

Against this background, participants in the 42<sup>nd</sup> Round Table on Sustainable Development are invited to consider and discuss the following questions:

- What expected impacts of the shift to electromobility are already being experienced by individual markets and countries, and what actions are car manufacturers taking to maintain leadership in the electromobility sector?
- How can policy makers best support a just transition in the automotive sector? What type and combination of measures (social protection, training programmes, infrastructure investment, innovation and R&D support, etc.) will be most effective?
- How are responsibilities to be shared between different stakeholders, including with regard to financing?

# References

- ACEA (2020), *Automotive sector: direct and indirect employment in the EU*, [4]  
<https://www.acea.auto/figure/automotive-sector-direct-and-indirect-employment-in-the-eu/>  
 (accessed on 15 October 2021).
- ACEA (2020), *Share of direct automotive employment in the EU, by country - ACEA - European Automobile Manufacturers' Association*, [32]  
<https://www.acea.auto/figure/share-of-direct-automotive-employment-in-the-eu-by-country/> (accessed on 18 October 2021).
- ACEA et al. (2021), *Urgent need for a Just Transition framework for Europe's automotive workforce*, [33]  
[https://www.acea.auto/files/Letter\\_Frans\\_Timmermans-Just\\_Transition\\_automotive\\_workforce.pdf](https://www.acea.auto/files/Letter_Frans_Timmermans-Just_Transition_automotive_workforce.pdf) (accessed on 18 October 2021).
- Acemoglu, D. and P. Restrepo (2020), "Robots and Jobs: Evidence from US Labor Markets", [31]  
<http://www.journals.uchicago.edu/t-and-c> (accessed on 19 October 2021).
- Automotive Skills Alliance (2021), *Automotive Skills Alliance*, [109]  
<https://automotive-skills-alliance.eu/> (accessed on 28 October 2021). ]
- Automotive Skills Alliance (2020), *Joint proposal for a recovery strategy to deliver and implement a sectorial up/reskilling framework for the automotive value chain maximising industry competitiveness, job retention and new job opportunities paving the way to a dedicated partnership for the automotive ecosystem within the Pact for Skill*, [53]  
[https://www.acea.auto/files/Joint\\_proposal\\_Pact\\_for\\_Skills.pdf](https://www.acea.auto/files/Joint_proposal_Pact_for_Skills.pdf) (accessed on 18 October 2021).
- Automotive World (2021), *Volkswagen: Preparing and upskilling auto workers for the EV revolution* | *Automotive World*, [94]  
<https://www.automotiveworld.com/news-releases/volkswagen-preparing-and-upskilling-auto-workers-for-the-ev-revolution/> (accessed on 18 October 2021).
- Bartoš, M. et al. (2021), "An overview of robot applications in automotive industry", *Transportation Research Procedia*, Vol. 55, pp. 837-844, [30]  
<http://dx.doi.org/10.1016/J.TRPRO.2021.07.052>.
- Benchmark Mineral Intelligence (2019), *EV battery arms race enters new gear with 115 megafactories, Europe sees most rapid growth* | *Benchmark Mineral Intelligence*, [98]  
<https://www.benchmarkminerals.com/ev-battery-arms-race-enters-new-gear-with-115-megafactories-europe-sees-most-rapid-growth/> (accessed on 18 October 2021).
- Botta, E. (2019), "A review of "Transition Management" strategies: Lessons for advancing the green low-carbon transition", *OECD Green Growth Papers* 2019/04, [74]  
<https://doi.org/10.1787/4617a02b-en>.



- Buckle, S. et al. (2020), "Addressing the COVID-19 and climate crises: Potential economic recovery pathways and their implications for climate change mitigation, NDCs and broader socio-economic goals", *OECD/IEA Climate Change Expert Group Papers*, No. 2020/04, OECD Publishing, Paris, <https://dx.doi.org/10.1787/50abd39c-en>. [104]
- Chen, S. and D. Zhang (2021), "Impact of air pollution on labor productivity: Evidence from prison factory data", *China Economic Quarterly International*, Vol. 1/2, pp. 148-159, <http://dx.doi.org/10.1016/J.CEQI.2021.04.004>. [8]
- Climate Analytics (2021), "Employment opportunities from a coal-to-renewables transition in South Korea National and provincial level employment impacts of replacing coal-fired power generation with solar, wind and storage", <http://www.climateanalytics.org/publications> (accessed on 28 October 2021). [115]
- Department of Education, S. (2019), *The Transition of the Australian Car Manufacturing Sector - Outcomes and Best Practice: Summary Report*, Australian Government, <https://www.dese.gov.au/whats-next/resources/transition-australian-car-manufacturing-sector-outcomes-and-best-practice-summary-report> (accessed on 28 October 2021). [50]
- EBRD (2021), *EBRD joins MDBs to support a just transition to net zero economies*, <https://www.ebrd.com/news/2021/ebd-joins-mdbs-to-support-a-just-transition-to-net-zero-economies-.html> (accessed on 15 November 2021). [127]
- EBRD (2020), *The EBRD just transition initiative*, <https://www.ebrd.com/what-we-do/just-transition-initiative> (accessed on 15 October 2021). [73]
- Economic Policy Institute (2021), *The stakes for workers in how policymakers manage the coming shift to all-electric vehicles*, <https://www.epi.org/publication/ev-policy-workers/> (accessed on 28 October 2021). [113]
- Edelstein, S. (2021), *Mazda plans dedicated EV platform in 2025, other EVs and plug-in hybrids before then*, Green Car Reports, [https://www.greencarreports.com/news/1132647\\_mazda-plans-dedicated-ev-platform-in-2025-other-evs-and-plug-in-hybrids-before-then](https://www.greencarreports.com/news/1132647_mazda-plans-dedicated-ev-platform-in-2025-other-evs-and-plug-in-hybrids-before-then) (accessed on 15 October 2021). [103]
- europa press (2021), *España formará unos 150.000 trabajadores de la automoción en el ámbito de las baterías*, <https://www.europapress.es/motor/sector-00644/noticia-espana-formara-150000-trabajadores-automocion-ambito-baterias-20210519101934.html> (accessed on 18 October 2021). [93]
- European Battery Alliance (2021), *Spain to implement the first EBA Academy programme*, Press Release, <https://www.eba250.com/spain-to-implement-the-first-eba250-academy-programme/?cn-reloaded=1> (accessed on 28 October 2021). [54]
- European Commission (2019), *Task Force on Just Transition for Canadian Coal Power Workers and Communities*, [https://ec.europa.eu/energy/sites/default/files/documents/task\\_force\\_on\\_just\\_transition\\_for\\_canadian\\_coal\\_power\\_workers\\_and\\_communities\\_-\\_platform\\_for\\_coal\\_regions\\_in\\_transition.pdf](https://ec.europa.eu/energy/sites/default/files/documents/task_force_on_just_transition_for_canadian_coal_power_workers_and_communities_-_platform_for_coal_regions_in_transition.pdf). [110]
- European Commission (2021), *European Skills Agenda - Employment, Social Affairs & Inclusion - European Commission*, <https://ec.europa.eu/social/main.jsp?catId=1223&langId=en> (accessed on 28 October 2021). [112]

- European Commission (2021), *The Just Transition Mechanism: making sure no one is left behind*, [44]  
[https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en) (accessed on 15 October 2021).
- European Commission (2020), *Overview of Investment Guidance on the Just Transition Fund 2021-2027 per Member State (Annex D)*, EU, Brussels. [45]
- European Commission (n.d.), *Automotive industry | Internal Market, Industry, Entrepreneurship and SMEs*, European Commission Website,  
[https://ec.europa.eu/growth/sectors/automotive\\_en](https://ec.europa.eu/growth/sectors/automotive_en) (accessed on 19 October 2021). [5]
- Federal Ministry for the Environment of Germany (n.d.), *Frequently Asked Questions on Germany's coal phase-out*, <https://www.bmu.de/en/topics/climate-adaptation/climate-protection/national-climate-policy/translate-to-english-fragen-und-antworten-zum-kohleausstieg-in-deutschland> (accessed on 15 October 2021). [88]
- Ferreira, A., D. Tsai and R. Boareto (2021), *The Brazilian Automotive Industry Transition: Challenges and prospects for a conversion in line with inclusive and low-emissions urban mobility*, Institute of Energy and Environment, Rosa Luxemburg Foundation,  
[https://energiambiente.org.br/wp-content/uploads/2021/06/eng\\_RosaLuxemburgFoundation\\_IEMA.pdf](https://energiambiente.org.br/wp-content/uploads/2021/06/eng_RosaLuxemburgFoundation_IEMA.pdf) (accessed on 18 October 2021). [13]
- Fleming, S. (2020), *Remote working and ecommerce could take 14 mln cars off US roads | World Economic Forum*, World Economic Forum: Sustainable Development Impact Summit,  
<https://www.weforum.org/agenda/2020/08/remote-working-online-shopping-millions-cars-off-us-roads/> (accessed on 19 October 2021). [19]
- Forbes (2021), *China Could Grab Europe's Mass Market For Electric Cars Unless EU Acts*, [83]  
<https://www.forbes.com/sites/neilwinton/2021/09/01/china-could-grab-europes-mass-market-for-electric-cars-unless-eu-acts/?sh=552ec9ee2a44>.
- Gao, P. et al. (2016), *Automotive revolution – perspective towards 2030 | McKinsey*, McKinsey, [16]  
<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/disruptive-trends-that-will-transform-the-auto-industry/de-DE> (accessed on 19 October 2021).
- Gisbert, N. (2021), *Major automakers behind gigafactory projects | CIC energiGUNE*, CIC [114  
energiGUNE Blog, <https://cicenergigune.com/en/blog/major-automakers-behind-gigafactory-projects> (accessed on 28 October 2021). ]
- Gisbert, N. and I. Careaga (2021), *Who are the big players in the gigafactories race? | CIC energiGUNE*, CIC energiGUNE Blog, <https://cicenergigune.com/en/blog/big-players-gigafactories-race> (accessed on 28 October 2021). [34]
- Government of Canada (2019), *Task Force: Just Transition for Canadian Coal Power Workers and Communities*, <https://www.canada.ca/en/environment-climate-change/services/climate-change/task-force-just-transition.html>. [111  
] ]
- He, G. et al. (2020), "Enabling a Rapid and Just Transition away from Coal in China", *One Earth*, [100  
Vol. 3/2, pp. 187-194, <http://dx.doi.org/10.1016/J.ONEEAR.2020.07.012>. ]
- Horobin, W. and T. Patel (2021), *France to Help Auto Workers Threatened by Shift to EVs, Unveils Fund - Bloomberg*, Bloomberg, <https://www.bloomberg.com/news/articles/2021-04-26/france-to-help-15-000-auto-workers-threatened-by-shift-to-evs> (accessed on [101  
] ]

- 19 October 2021).
- hrm Asia (2018), "Preparing transport workers for reskilling worldwide". [59]
- Iberdrola (2021), *Iberdrola, Volkswagen Group and SEAT S. A. strengthen their strategic alliance*, [124  
] <https://www.iberdrola.com/press-room/news/detail/iberdrola-volkswagen-group-seat-strengthen-their-strategic-alliance>.
- IEA (2021), *Global EV Outlook 2021 - Accelerating ambitions despite the pandemic*. [11]
- IEA (2021), *Global EV Outlook 2021 - Accelerating ambitions despite the pandemic*. [99]
- IEA (2021), *Net Zero by 2050*, IEA, Paris, <https://www.iea.org/reports/net-zero-by-2050> (accessed on 19 October 2021). [2]
- IEA (2021), *Net Zero by 2050 - A Roadmap for the Global Energy Sector*, [87] <https://www.iea.org/reports/net-zero-by-2050>.
- IEA (2021), *Policies to promote electric vehicle deployment – Global EV Outlook 2021 – Analysis - IEA*, International Energy Agency, Paris, <https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment> (accessed on 18 October 2021). [91]
- IEA (2021), *World Energy Outlook 2021*, International Energy Agency, Paris, [80] <https://www.iea.org/reports/world-energy-outlook-2021/people-centred-transitions> (accessed on 19 October 2021).
- IEA (2020), *Innovation in Batteries and Electricity Storage*, IEA, Paris, [40] <https://www.iea.org/reports/innovation-in-batteries-and-electricity-storage> (accessed on 28 October 2021).
- IEA (2020), *Recovery Sustainable World Energy Outlook Special Report in collaboration with the International Monetary Fund*, <https://www.iea.org/reports/sustainable-recovery>. [84]
- IEA (2020), *Tracking Transport 2020*, IEA, Paris, <https://www.iea.org/reports/tracking-transport-2020> (accessed on 28 October 2021). [1]
- IEA (2019), *The Future of Hydrogen*, IEA, Paris, <https://www.iea.org/reports/the-future-of-hydrogen> (accessed on 4 November 2021). [20]
- IEA (2019), *Transport sector CO2 emissions by mode in the Sustainable Development Scenario, 2000-2030 – Charts – Data & Statistics - IEA*, <https://www.iea.org/data-and-statistics/charts/transport-sector-co2-emissions-by-mode-in-the-sustainable-development-scenario-2000-2030> (accessed on 4 November 2021). [123  
]
- IEA (2017), *Who wants to be in charge? – Analysis - IEA*, IEA, Paris, [68] <https://www.iea.org/commentaries/who-wants-to-be-in-charge> (accessed on 19 October 2021).
- IG Metall (2021), *Ergebnis Tarifrunde Volkswagen 2021*, [119  
] <https://www.igmetall.de/tarif/tarifrunden/metall-und-elektro/ergebnis-tarifrunde-volkswagen-2021> (accessed on 3 November 2021).
- ILO (2021), *ILO welcomes COP26 Just Transition Declaration*, [http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS\\_826717/lang-en/index.htm](http://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_826717/lang-en/index.htm) (accessed on 16 November 2021). [61]
- ILO (2020), *The future of work in the automotive industry: The need to invest in people's* [28]

- capabilities and decent and sustainable work, <http://www.ilo.org/publns>. (accessed on 15 October 2021).
- ILO (2020), *The future of work in the automotive industry: The need to invest in people’s capabilities and decent and sustainable work*, International Labour Organization, <http://www.ilo.org/publns>. (accessed on 15 October 2021). [72]
- ILO (2015), *Guidelines for a just transition towards environmentally sustainable economies and societies for all*, International Labour Organization, <http://www.ilo.org/publns> (accessed on 15 October 2021). [105 ]
- InnoEnergy (2021), *Thousands of workers to be upskilled in France to keep the pace with the battery revolution*, <https://www.innoenergy.com/news-events/thousands-of-workers-to-be-upskilled-in-france-to-keep-the-pace-with-the-battery-revolution/> (accessed on 15 October 2021). [55]
- International Transport Forum (2015), *Urban Mobility System Upgrade*, <http://www.internationaltransportforum.org> (accessed on 15 November 2021). [18]
- ITF (2021), *Cleaner Vehicles Achieving a Resilient Technology Transition*, OECD Publishing, Paris, <http://www.itf-oecd.org> (accessed on 28 October 2021). [22]
- ITF (2021), *Decarbonising Transport Initiative*, <https://www.itf-oecd.org/decarbonising-transport>. [125 ]
- Jaeger, J. et al. (2021), *Top Takeaways on Biden’s American Jobs Plan Proposal | World Resources Institute*, WRI Commentary, <https://www.wri.org/insights/does-bidens-american-jobs-plan-stack-climate-and-jobs> (accessed on 18 October 2021). [92]
- Jaeger, J. et al. (2021), “The Green Jobs Advantage: How Climate-Friendly Investments Are Better Job Creators”, *World Resources Institute*, <http://dx.doi.org/10.46830/wriwp.20.00142>. [21]
- Jaeger, J. et al. (2021), “THE GREEN JOBS ADVANTAGE: HOW CLIMATE-FRIENDLY INVESTMENTS ARE BETTER JOB CREATORS”, <http://dx.doi.org/10.46830/wriwp.20.00142>. [118 ]
- Just Transition Centre (2020), *Just Transition in the international development cooperation context*, Union to Union, Just Transitions Centre, [https://www.ituc-csi.org/IMG/pdf/210521\\_-\\_uniontounion-jtc\\_-\\_just\\_transition\\_in\\_the\\_international\\_development\\_cooperation\\_context.pdf](https://www.ituc-csi.org/IMG/pdf/210521_-_uniontounion-jtc_-_just_transition_in_the_international_development_cooperation_context.pdf) (accessed on 19 October 2021). [60]
- Koetsier, J. (2021), *US Needs 10X More Rare Earth Metals To Hit Biden’s Electric Vehicle Goals*, Forbes, <https://www.forbes.com/sites/johnkoetsier/2021/09/29/us-needs-10x-more-rare-earth-metals-to-hit-bidens-electric-vehicle-goals/?sh=229a32673e41> (accessed on 19 October 2021). [36]
- Krawchenko, T. and M. Gordon (2021), “How do we manage a just transition? A comparative review of national and regional just transition initiatives”, *Sustainability (Switzerland)*, Vol. 13/11, <http://dx.doi.org/10.3390/su13116070>. [63]
- Küpper, D. et al. (2020), *Shifting Gears in Auto Manufacturing | BCG*, <https://www.bcg.com/publications/2020/transformational-impact-of-electric-vehicles-on-auto-manufacturing> (accessed on 18 October 2021). [23]
- L&E Global Knowledge Centre (2020), *Trade Unions and Employers Associations in Sweden*, [122 ]

- <https://knowledge.leglobal.org/employers-associations-and-trade-unions-in-sweden/> (accessed on 3 November 2021).
- Labor, U. (n.d.), *POWER Dislocated Worker Grants - Resources for Coal Miners*, [117]  
<https://www.dol.gov/agencies/owcp/dcmwc/powergrants>. ]
- Masoumi, S., N. Kazemi and S. Abdul-Rashid (2019), “Sustainable supply chain management in the automotive industry: A process-oriented review”, [3]  
<http://dx.doi.org/10.3390/su11143945>.
- MBIE (2021), *Just Transition*, [47]  
<https://www.mbie.govt.nz/business-and-employment/economic-development/just-transition/>.
- McEachern, S. (2021), *Automakers Ask To Reject EV Tax Credit For Union-Made Vehicles*, GM [38]  
 Authority, <https://gmauthority.com/blog/2021/10/foreign-automakers-ask-u-s-house-to-reject-ev-tax-credit-for-union-made-vehicles/> (accessed on 29 October 2021).
- Ministerio para la Transición Ecológica y el Reto Demográfico (2021), *Just Transition [108*  
*Agreements: Update March 2021*, ]  
[https://www.transicionjusta.gob.es/Convenios\\_transicion\\_justa/common/Folleto\\_Convenios\\_Transicion\\_Justa\\_EN.pdf](https://www.transicionjusta.gob.es/Convenios_transicion_justa/common/Folleto_Convenios_Transicion_Justa_EN.pdf).
- Moores, S. (2021), “THE GLOBAL BATTERY ARMS RACE: LITHIUM-ION BATTERY [35]  
 GIGAFACTORIES AND THEIR SUPPLY CHAIN”, *The Oxford Institute for Energy Studies Forum*.
- Movelatam & UNDP (2019), *Electric Mobility: Status in Latin America and the Caribbean*, [57]  
<https://movelatam.org/wp-content/uploads/2020/09/Report-of-Electric-Mobility-in-Latin-America-and-the-Caribbean-2019-LQ.pdf> (accessed on 15 October 2021).
- movilidadelectrica (2020), *SEAT dará formación en electromovilidad a sus empleados*, [90]  
<https://movilidadelectrica.com/seat-centro-formacion-martorell/> (accessed on 15 October 2021).
- Muratori, M. et al. (2021), “The rise of electric vehicles—2020 status and future expectations”, [66]  
*Progress in Energy*, Vol. 3/2, p. 022002, <http://dx.doi.org/10.1088/2516-1083/ABE0AD>.
- Neidell, M. (2017), *MATTHEW NEIDELL Air pollution and worker productivity*, IZA World of Labor, [7]  
<http://dx.doi.org/10.15185/izawol.363>.
- Nikkei Asia (2021), “EV shift puts engine jobs on chopping block in Japan and Germany”, [25]  
<https://asia.nikkei.com/Business/Automobiles/EV-shift-puts-engine-jobs-on-chopping-block-in-Japan-and-Germany> (accessed on 28 October 2021).
- NPM (2020), *ZWISCHENBERICHT ZUR STRATEGISCHEN PERSONALPLANUNG UND - [26]*  
*ENTWICKLUNG IM MOBILITÄTSSEKTOR*, Nationale Plattform Zukunft der Mobilität.
- Obergassel, W., O. Lah and F. Rudolph (2021), “Driving towards transformation? To what extent does global climate governance promote decarbonisation of land transport?”, [82]  
*Earth System Governance*, Vol. 8, p. 100098, <http://dx.doi.org/10.1016/J.ESG.2021.100098>.
- OECD (2021), *Building inclusive labour markets: active labour market policies for the most [76]*  
*vulnerable groups*, [https://read.oecd-ilibrary.org/view/?ref=1112\\_1112680-u38fb4etmq&title=Building-inclusive-labour-markets-active-labour-market-policies-for-the-most-vulnerable-groups&\\_ga=2.259423178.1914711613.1636980391-](https://read.oecd-ilibrary.org/view/?ref=1112_1112680-u38fb4etmq&title=Building-inclusive-labour-markets-active-labour-market-policies-for-the-most-vulnerable-groups&_ga=2.259423178.1914711613.1636980391-)

- [1573504445.1633078072](https://doi.org/10.1787/1573504445.1633078072) (accessed on 15 November 2021).
- OECD (2021), *Facilitating the green transition for ASEAN SMEs: A toolkit for policymakers*, OECD, Paris. [71]
- OECD (2021), *Gender and the Environment*, OECD, <http://dx.doi.org/10.1787/3d32ca39-en>. [81]
- OECD (2021), "The inequalities-environment nexus: Towards a people-centred green transition", *OECD Green Growth Papers*, No. 2021/01, OECD Publishing, Paris, <https://dx.doi.org/10.1787/ca9d8479-en>. [62]
- OECD (2021), *Transport strategies for net-zero systems by design*, OECD, Paris, <https://www.oecd.org/climate-change/well-being-lens/> (accessed on 19 October 2021). [17]
- OECD (2020), "Labour Market Consequences of a Transition to a circular economy: A Review Paper - Environment Working Paper No162", <http://www.oecd.org/environment/workingpapers.htm> (accessed on 15 November 2021). [75]
- OECD (2020), *Making the Green Recovery work for jobs, income and growth*, [https://read.oecd-ilibrary.org/view/?ref=136\\_136201-ctwt8p7qs5&title=Making-the-Green-Recovery-Work-for-Jobs-Income-and-Growth\\_&\\_ga=2.68363223.714562113.1634310586-1573504445.1633078072](https://read.oecd-ilibrary.org/view/?ref=136_136201-ctwt8p7qs5&title=Making-the-Green-Recovery-Work-for-Jobs-Income-and-Growth_&_ga=2.68363223.714562113.1634310586-1573504445.1633078072) (accessed on 15 October 2021). [64]
- OECD (2019), *Accelerating Climate Action: Refocusing Policies through a Well-being Lens*, OECD Publishing, Paris, <https://dx.doi.org/10.1787/2f4c8c9a-en>. [9]
- OECD (2019), *Getting Skills Right Making adult learning work in social partnership*, <http://www.oecd.org/employment/skills-and-work/adult-> (accessed on 28 October 2021). [51]
- OECD (2018), *Getting Skills Right: Australia*, Getting Skills Right, OECD Publishing, Paris, <https://dx.doi.org/10.1787/9789264303539-en>. [49]
- OECD (2018), *OECD Employment Outlook 2018*, OECD Publishing, Paris, [https://dx.doi.org/10.1787/empl\\_outlook-2018-en](https://dx.doi.org/10.1787/empl_outlook-2018-en). [6]
- OECD (2015), *Back to Work: Sweden: Improving the Re-employment Prospects of Displaced Workers*, Back to Work, OECD Publishing, Paris, <https://dx.doi.org/10.1787/9789264246812-en>. [41]
- PwC (2019), *Merge ahead: Electric vehicles and the impact on the automotive supply chain*, <http://www.pwc.com> (accessed on 18 October 2021). [10]
- PwC (2018), *Five trends transforming the Automotive Industry*, PwC, <http://www.pwc.com/auto> (accessed on 19 October 2021). [15]
- Reuters (2021), *Countries, cities, carmakers commit to end fossil-fuel vehicles by 2040*, <https://www.reuters.com/business/cop/six-major-carmakers-agree-phase-out-fossil-fuel-vehicles-by-2040-uk-says-2021-11-10/>. (accessed on 21 November 2021). [14]
- Reuters (2021), *International opposition mounts over proposed U.S. EV tax credit*, <https://www.reuters.com/business/autos-transportation/international-opposition-mounts-proposed-us-ev-tax-credit-2021-10-30/> (accessed on 3 November 2021). [121]
- Reuters (2021), *Stellantis, LGES Strike Battery Production Deal for North America | Investing News | US News*, Reuters, <https://money.usnews.com/investing/news/articles/2021-10-> [95]

- [18/stellantis-lg-energy-to-form-battery-production-jv](#) (accessed on 18 October 2021).
- Rushe, D. et al. (2021), *How the supply chain crisis is affecting six big economies | Supply chain crisis | The Guardian*, The Guardian, <https://www.theguardian.com/business/2021/oct/02/how-the-supply-chain-crisis-is-affecting-six-big-economies> (accessed on 20 October 2021). [107]
- Scottish Government (n.d.), *Just Transition Commission*, <https://www.gov.scot/groups/just-transition-commission/>. [46]
- SEAT (2020), *New SEAT e-mobility training centre*, <https://www.seat.com/company/news/company/seat-new-electromobility-training-centre.html> (accessed on 15 November 2021). [128]
- Serradilla, J. et al. (2017), “An evidence-based approach for investment in rapid-charging infrastructure”, *Energy Policy*, Vol. 106, pp. 514-524, <http://dx.doi.org/10.1016/J.ENPOL.2017.04.007>. [65]
- Sharpe, S. and C. Martinez-Fernandez (2021), “The Implications of Green Employment: Making a Just Transition in ASEAN”, *Sustainability*, Vol. 13/13, <http://dx.doi.org/10.3390/su13137389>. [77]
- Smith, S. (2017), *Just Transition A Report for the OECD*, Just Transition Centre, <https://www.ituc-csi.org/just-transition-centre> (accessed on 29 October 2021). [42]
- Springel, K. (2021), “Network Externality and Subsidy Structure in Two-Sided Markets: Evidence from Electric Vehicle Incentives”, *American Economic Journal: Economic Policy*, Vol. 13/4, pp. 393-432, <http://dx.doi.org/10.1257/pol.20190131>. [67]
- Statista (2021), *Countries’ share of global lithium-ion battery production capacity | Statista*, <https://www.statista.com/statistics/1249871/share-of-the-global-lithium-ion-battery-manufacturing-capacity-by-country/> (accessed on 18 October 2021). [97]
- Tandon, A. (2021), “Transition finance: Investigating the state of play: A stocktake of emerging approaches and financial instruments”, *OECD Environment Working Papers*, No. 179, OECD Publishing, Paris, <https://dx.doi.org/10.1787/68becf35-en>. [69]
- Tesla (n.d.), *Tesla Start | Tesla*, <https://www.tesla.com/careers/tesla-start> (accessed on 19 October 2021). [102]
- The Frontier Post (2021), “The South Korean battery giants face skills shortage that could jam electric highway”, <https://thefrontierpost.com/the-south-korean-battery-giants-face-skills-shortage-that-could-jam-electric-highway/> (accessed on 15 October 2021). [89]
- The Frontier Post (2021), “The South Korean battery giants face skills shortage that could jam electric highway”, <https://thefrontierpost.com/the-south-korean-battery-giants-face-skills-shortage-that-could-jam-electric-highway/> (accessed on 15 October 2021). [106]
- The White House (2021), *FACT SHEET: The American Jobs Plan | The White House*, Statements and Releases, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/> (accessed on 18 October 2021). [48]
- Transport and Environment (2021), *Letter to Frans Timmermans*, <https://www.transportenvironment.org/wp-content/uploads/2021/08/Letter-to-Mr-F.-Timmermans-Urgent-need-for-a-Just-Transition-framework-for-Europes-automotive-workforce.pdf> (accessed on 15 October 2021). [96]

- TTD (2021), "TRANSIT UNIONS ANNOUNCE FIVE KEY POLICIES TO PROTECT, PROMOTE WORKERS AS U.S. MOVES TO ZERO-EMISSION VEHICLES", [https://ttd.org/news-and-media/transit-unions-announce-five-key-policies-to-protect-promote-workers-as-u-s-moves-to-zero-emission-vehicles/?link\\_id=0&can\\_id=ef2a9437f860621408a15ef4d34bdbbe&source=email-transit-unions-announce-five-key-policies-to-protect-promote-workers-as-us-moves-to-zero-emission-vehicles&email\\_referrer=email\\_1153779&email\\_subject=transit-unions-announce-five-key-policies-to-protect-promote-workers-as-us-moves-to-zero-emission-vehicles](https://ttd.org/news-and-media/transit-unions-announce-five-key-policies-to-protect-promote-workers-as-u-s-moves-to-zero-emission-vehicles/?link_id=0&can_id=ef2a9437f860621408a15ef4d34bdbbe&source=email-transit-unions-announce-five-key-policies-to-protect-promote-workers-as-us-moves-to-zero-emission-vehicles&email_referrer=email_1153779&email_subject=transit-unions-announce-five-key-policies-to-protect-promote-workers-as-us-moves-to-zero-emission-vehicles) (accessed on 15 October 2021). [58]
- TUAC (2018), *The Swedish Job Security Councils - A case study on social partners' led transitions - TUAC*, News - Innovation and Digital Economy, [https://tuac.org/news/the-swedish-job-security-councils-a-case-study-on-social-partners-led-transitions/#\\_edn4](https://tuac.org/news/the-swedish-job-security-councils-a-case-study-on-social-partners-led-transitions/#_edn4) (accessed on 28 October 2021). [52]
- UNCTAD (2020), *COMMODITIES AT A GLANCE Special issue on strategic battery raw materials*, UNCTAD, Geneva. [39]
- UNCTAD (2020), *Demand for raw materials for electric car batteries set to rise further: UNCTAD report* | UNCTAD, Press Release, <https://unctad.org/press-material/demand-raw-materials-electric-car-batteries-set-rise-further-unctad-report> (accessed on 19 October 2021). [37]
- UNFCCC (2015), *Paris Agreement*. [43]
- UN and ILO (2020), *Jobs in green and healthy transport Making the green shift*, International Labour Organization, United Nations Economic Commission for Europe. [24]
- UnionTrack (2019), "How Unions Can Help Reskill Workers for the Future", <https://www.uniontrack.com/blog/unions-reskill-workers> (accessed on 15 October 2021). [79]
- van der Ree, K. (2019), "Promoting Green Jobs: Decent Work in the Transition to Low-Carbon, Green Economies", *Revue internationale de politique de développement* 11, <http://dx.doi.org/10.4000/poldev.3107>. [86]
- Via Tech (2021), *Cultivating Tomorrow's Auto Industry Talent - VIA Headway*, Press Releases, <https://www.viatech.com/en/2021/03/auto-industry-talent/> (accessed on 18 October 2021). [56]
- Volkswagen (2020), "Fraunhofer study: Employment at Volkswagen in 2030", <https://www.volkswagenag.com/en/news/stories/2020/12/fraunhofer-study--employment-at-volkswagen-in-2030.html> (accessed on 15 October 2021). [78]
- Volkswagen Newsroom (2021), *Way to Zero: Volkswagen presents roadmap for climate-neutral mobility*, <https://www.volkswagen-newsroom.com/en/press-releases/way-to-zero-volkswagen-presents-roadmap-for-climate-neutral-mobility-7081> (accessed on 15 November 2021). [126]
- Volvo Cars Global Media Newsroom (2021), *Volvo Car Group and Northvolt to join forces in battery development and production*, <https://www.media.volvocars.com/global/en-gb/media/pressreleases/283261/volvo-car-group-and-northvolt-to-join-forces-in-battery-development-and-production> (accessed on 3 November 2021). [120]
- White House (2021), *FACT SHEET: President Biden Announces Steps to Drive American Leadership Forward on Clean Cars and Trucks*, <https://www.whitehouse.gov/briefing-room/statements-releases/2021/08/05/fact-sheet-president-biden-announces-steps-to-drive-american-leadership-forward-on-clean-cars-and-trucks/> (accessed on 15 October 2021). [12]



- World Bank (2018), *Managing Coal Mine Closure: Achieving a Just Transition for All*, [116  
]  
<https://documents1.worldbank.org/curated/en/484541544643269894/pdf/130659-REVISED-PUBLIC-Managing-Coal-Mine-Closure-Achieving-a-Just-Transition-for-All-November-2018-final.pdf>.
- World Bank (n.d.), *Just Transition for All*, [85]  
<https://www.worldbank.org/en/topic/extractiveindustries/justtransition> (accessed on 15 October 2021).
- World Economic Forum (2020), *The Future of Jobs Report 2020*, [27]  
<https://www.weforum.org/reports/the-future-of-jobs-report-2020> (accessed on 15 October 2021).
- WSP Sweden (2021), *The Transition to a Zero-Carbon Society*, <https://www.wsp.com/en-SE/insights/net-zero-can-we-have-winners-without-losers> [70]  
(accessed on 15 October 2021).
- Yang, H. (2021), *Battery giants face skills gap that could jam electric highway* | Reuters, Reuters, [29]  
<https://www.reuters.com/business/autos-transportation/battery-giants-face-skills-gap-that-could-jam-electric-highway-2021-10-04/> (accessed on 20 October 2021).