Next Step: TRANSITION

NEw competences for workers' representatives in a Sustainable Energy Transition

Literature Review

Deliverable 2.1

Project partners:

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TABLE OF CONTENTS

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ABBREVIATIONS

Art.	Article
CO2	Carbon dioxide
e.g.	exempli gratia = for example
et al.	et alii = and others
EU	European Union
ibid.	ibidem = in the same place
ICT	Information and communication technologies
IGBCE	Industriegewerkschaft Bergbau, Chemie, Energie (Mining, Chemicals and Energy Trade Union (in Germany))
ILO	International Labour Organisation
IRENA	The International Renewable Energy Agency
LMLC	life-of-mine/life-of-community
OHS	Occupational Health and Safety
p.	page
pp.	pages
STEM	Science, technology, engineering, and mathematics
UN	United Nations
USA	United Nations of America
WHO	World Health Organisation
WP	Work Package

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LIST OF FIGURES

LIST OF TABLES

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EXECUTIVE SUMMARY

This literature review presents the current state of the art of research in the field of just energy transition. Its primary focus lies on the differing interpretations of "just" in energy transitions and trade unions' positioning and strategies towards a just energy transition. As this project is dedicated to trade unions' attitudes and role in just energy transitions, the literature review aims to build a link between the different topics and the trade unions' work.

After a short introduction showing the legal context of the energy transition and the current energy mix in the European Union (EU), the first section about just transition presents the three main interpretations of the concept, which are called "job-focused", "environment-focused", and "society-focused". All of these concepts understand "just" differently. This part also shows the trade unions' approaches to just transition, some common measures for different target groups, and current debatable issues in the just transition discussion. The second main section concerns the continuum of strategies trade unions use to approach energy transitions. Their role in this transition process as well as their struggles are also a part of this section. Trade unions can have a more proactive or reactive attitude to energy transitions and often face the so-called "job-versus-environment dilemma" when they have to decide whether they support the energy transition at the expense of job losses.

Occupational health and safety has always been one of the focal emphases of trade unions. Therefore, the third chapter illustrates occupational health and safety issues with renewable energies, particularly wind, solar, hydrogen, and biomass energy, as these are considered the primary renewable energy sources. Current studies show that workers' and communities' health and safety risks are still under-researched and that companies often do not see the need to adapt risk assessment measures to renewable energies.

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Gender diversity is dealt with in the fourth chapter because gender-responsive policies are missing in the energy transition and because gender diversity brings benefits to the transition. The last chapter is about digitalisation, another megatrend which also influences the energy transition. Since digitalisation significantly impacts jobs and working conditions, it is another topic that trade unions have to deal with. They face a similar dilemma as they need to decide whether to support the digital transformation proactively. The literature review closes with some final remarks on the just transition debate and the current development in the energy transition, especially in the face of the Russian-Ukrainian war with its consequences on European energy security.

This literature review builds the theoretical background to the whole project and influences the other deliverables, such as WP 1.3 Interviews, WP 2.4 Survey, and WP 3.1 E-learning session. The content of this review is used in developing the interview guides and conducting the interviews. The questions in the survey are also based to a part on the following theories and concepts. Lastly, this work will be presented in the e-learning session about sustainability, which will be held for a large group of trade unionists.

The institutional framework report accompanies this literature review, and together they build the whole theoretical background of this project.

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1. INTRODUCTION

The Paris Agreement is one of the major international policies for climate change adopted by the United Nations (UN) in Paris in December 2015 (United Nations, n.y.) and contains the goal to keep the temperature increase at 1.5°C to limit the global effects of climate change (Paris Agreement, 2015, Art. 2). The European Commission approaches this goal in the European Green Deal, adopted in 2019 (The European Green Deal, 2019). In Europe, the current political approach has achieved a 23% reduction in greenhouse gases from the years 1990 to 2018 (The European Green Deal, 2019, p. 4). In 2018, only a third (32,4 %) of Europe's electricity was generated through renewable energy sources, meaning that Europe is still heavily reliant on nuclear power, gas, coal and lignite as energy sources (Galgóczi, 2019, p. 8).

However, European countries depend on coal at different levels and follow different strategies and deadlines to finish their dependency, as Figure 1 points out. While most countries aim to stop coal mining between 2022 and 2038, some countries in the Eastern part of the continent, such as Bulgaria, Croatia, Czech Republic, Greece, Poland, Romania and Slovenia, do not yet have a coal phase-out strategy. Poland even plans to expand their coal mining activities (Galgóczi, 2019, p. 21).

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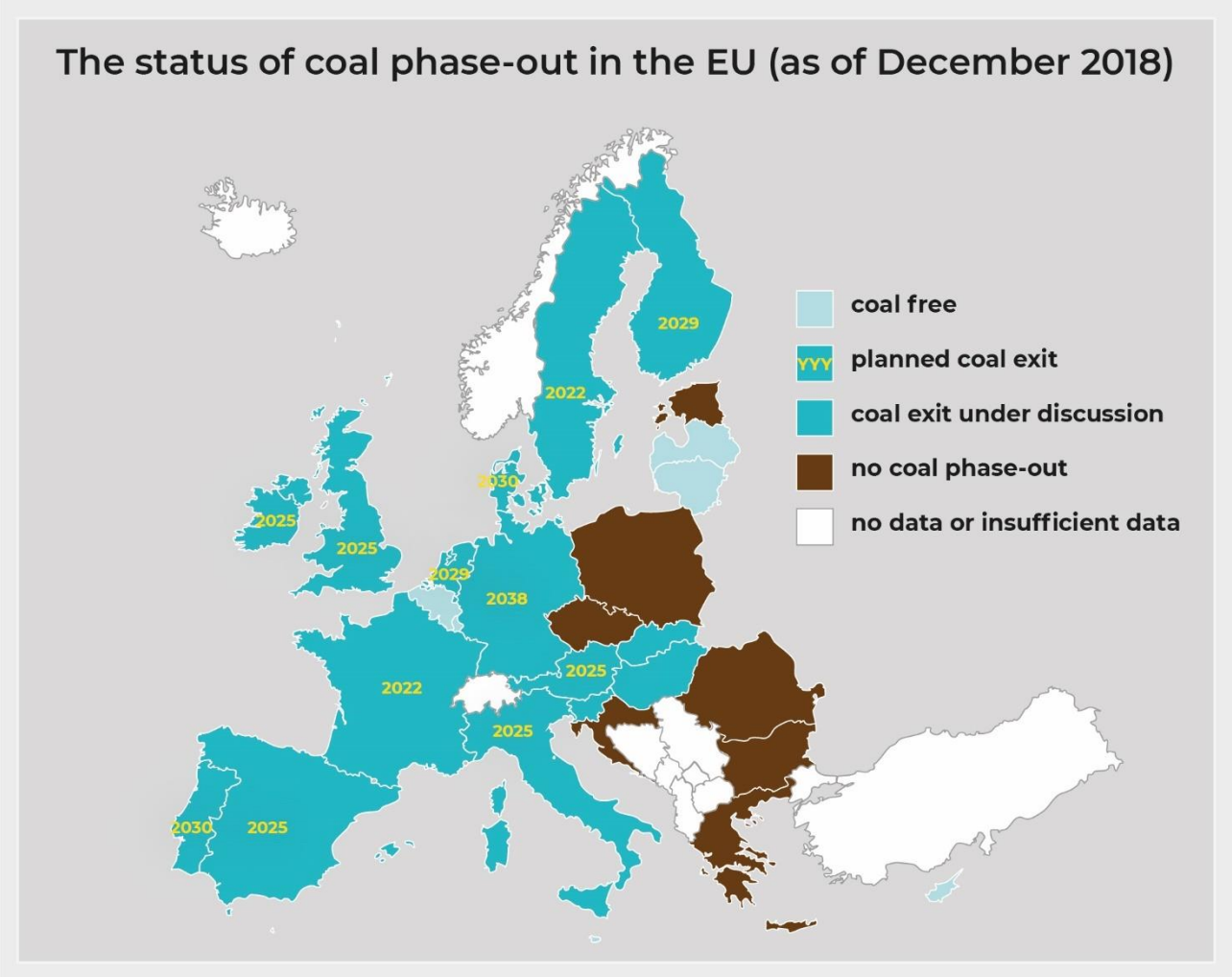
Figure 1: The status of coal phase-out in the EU (as of December 2018) (Europe Beyond Coal, 2018 and national sources, in Galgózci, 2019, p. 21, own elaboration)



According to the European Commission, an unchanged continuation of the current measures would only reduce emissions by 60% by 2050, suggesting that interventions are inevitable in the coming years (The European Green Deal, 2019, p. 4). The International Renewable Energy Agency (IRENA, 2022) considers electrification and efficiency as the main factors for a stronger reduction of emissions. The expansion of renewable energy, hydrogen and sustainable biomass, as well as a change in society's energy production and consumption, are compulsory (p. 16).

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Such a shift is an energy transition which happens when "state and non-state actors seek to reduce their reliance on finite fossil fuels for energy, electricity and transport, expand their use of renewable energy and diversify their energy mixes to ensure universal energy access, longer-term energy security and enhanced climate resilience" (Bridge et al., 2013; Sovacool, 2016, both as cited in Johnson et al., 2020, p. 1). One "environmentally-oriented energy transition" of the industry is called decarbonisation, which aims to reduce climate-damaging emissions (Sovacool et al., 2021, as cited in Mandelli, 2022, p. 8) by "replacing carbon-intensive technologies and practices with low-carbon ones across several economic activities" (Green & Gambhir, 2020, as cited in ibid.), like renewable energy produced by the sun or the wind (Carley & Konisky, 2020, in Wang & Lo, 2021, p. 1).

Apart from changes in the generation, distribution, storage, and usage of energy (IPCC, 2011; IPCC, 2019, both in García-García et al., 2020, p. 1), such an energy transition has also social, political and economic implications (Miller et al., 2013, in ibid.). The adjustment of an energy transition with the handling of these implications is entailed in the concept of a "just energy transition" (García-García et al., 2020, p. 1). Figure 2 illustrates the evolution of this concept over three layers, starting from a transition to a more sustainable socio-ecological system to an energy transition for a more decarbonised and diversified energy mix as a next step, to the inclusion of issues of justice in the energy transition (García-García et al., 2020).

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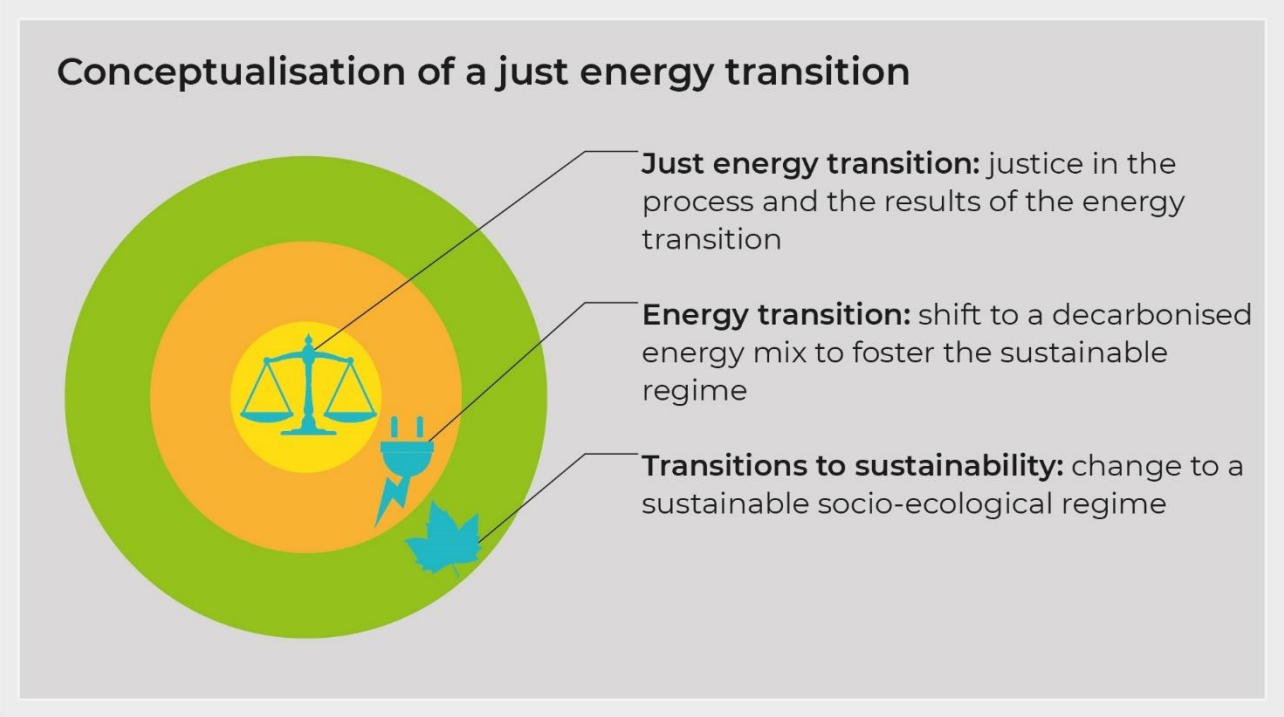
Figure 2: Conceptualisation of a just energy transition (García-García, 2020, p. 3, own elaboration)



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2. JUST TRANSITION

This chapter explores the concept of a just energy transition to a greater extent and presents its different interpretations. The focus is on what "just" implies in these transition processes. It starts with the historical evolution of the concept.

2.1 History of the just transition concept

The idea of the so-called Just Transition originated in the 1970s in the United States of America (USA) through Tony Mazzocchi's, a trade unionist from the Oil, Chemical and Atomic Workers' Union, initiative to combine environmental and social issues. After noticing the negative consequences of the fossil, chemical and nuclear industries for the environment and the workers' health, Mazzocchi fought for decent jobs and better health and livelihoods for workers and communities. In 1997, the birth of the Just Transition Alliance brought the trade union movement closer together with community-focused environmental justice groups. While in decline in the USA, the concept gained importance in other parts of the world, such as Europe, where the Spanish green think tank Sustainlabour Foundation developed training sessions for unionists, reports, case studies and policy recommendations (Morena et al., 2018, pp. 6-8).

Therefore, just transition has become the trade unions' contribution to international climate discussions. They focused primarily on the in these discussions under-represented social consequences, especially labour-related ones such as job loss and reduced job quality. Since the beginning of 2010, Just Transition got established as a global term in climate change debates as UN organisations, governments, non-governmental organisations, businesses, indigenous and feminist groups, and others started to use it. The mentioning of just transition in the Preamble of the Paris Agreement is seen as the concept's legitimisation to be used by different stakeholders

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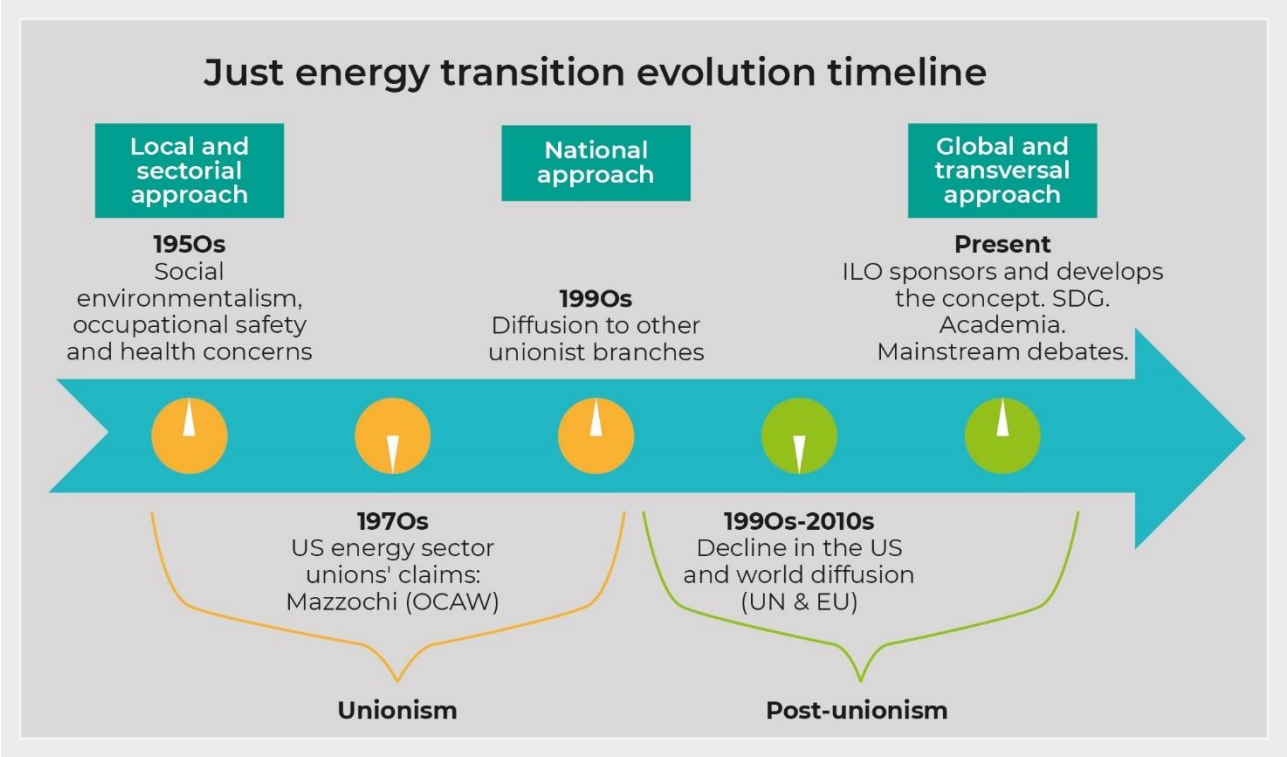
(ibid., pp. 8-10). It is written in the Paris Agreement that all Parties agree to "*[t]ak[e] into account* the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities" (Paris Agreement, 2015, Preamble, emphasis in the original). However, while just transition is still mainly associated with trade unions on an international level, as more and more different groups use the term for their objectives, just transition is nowadays associated with different things by different groups (Morena et al., 2018, pp. 9-10). Figure 3 illustrates the described historical evolution of the just transition concept.

Figure 3: Just energy transition evolution timeline (García-García, 2020, p. 3, own elaboration)



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2.2 Definition of just transition

Making the economies ecologically sustainable leads to fundamental changes in labour as new green jobs will be created, and existing jobs within carbon-intensive industries adapted or vanished. Also, new skills and practices must be learned to deal with the new tasks and requirements. While these decarbonisation processes happen differently in different sectors and regions, the labour consequences can be positive or negative. While positive developments are welcomed, workers confronted with negative consequences are sceptical about the green transition as they fear the disadvantages for themselves and their communities (Sharpe & Martinez-Fernandez, 2021, p. 1).

Aiming at preventing or mitigating these mentioned negative consequences and disadvantages for some groups of people during decarbonisation, different actors try to include social aspects into this process. Such a process can be called just transition. Generally, the concept includes the major objective of achieving positive outcomes for people and communities which suffer negative consequences of the decarbonisation process, such as decent employment and social protection (ibid., p. 2). The “Guidelines for a Just Transition to Environmentally Sustainable Economies and Societies for All”, developed by the International Labour Organisation (ILO) in 2015, point out that the decarbonisation process is in need of “a country-specific mix of macroeconomic, industrial, sectoral and labour policies that create an enabling environment for sustainable enterprises to prosper and create decent work opportunities by mobilising and directing public and private investment towards environmentally sustainable activities” (ILO, 2015, p. 6, as cited in ibid., p. 1). Shortly, just transition should result into an inclusive society with no emissions, high equality and decent jobs (ILO, 2015, in Galgóczi, 2022, p. 8).

Respectively for the energy sector, the term is called just energy transition. García-García and colleagues (2020, as cited in Wang & Lo, 2021, p. 6) define a just energy transition as

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> […] a long-term technological and socio-economic process of structural shift that affects the generation, distribution, storage and use of energy and causes rearrangements at micro (innovation), meso (social networks, rules and technical elements) and macro (exogenous environment) levels, while also ensuring that the desired socioeconomic functions can be accomplished through decarbonised and renewable means of energy production and consumption, safeguarding social justice, equity and welfare.

Consequently, main issues of just transition consist of training and skill development, investment in new activities, social protection, development policies, production processes, flexibility and organisation of work (Molina Romo, 2022, p. 20).

However, it remains often unclear what is specifically meant by both "transition" and "just" as the interpretation depends on the actors' objectives and ambitions and the socio-economic conditions of each country (Galgóczi, 2022, pp. 7-8).

2.3 Differences between just transition interpretations

In general, approaches for just transition vary in different forms and dimensions. While the so-called "affirmative" initiatives aim at keeping the current financial and economic framework, "transformative" approaches seek fundamental adaptations and reforms of this current dominant status quo (Fraser, 2005, in Galgóczi, 2022, p. 8). According to Stevis and Felli (2020, in ibid.), just transition practices also differ in scale, scope, and depth. Scale refers to the geographical and temporal orientation of policies, scope to the different groups of people comprised by the initiatives, and depth to the possible components of just transition. Another distinction between just transition measures whether they have a narrow or broad objective. Narrow scopes have a reactive function to only address urgent, local and short-term social influences of decarbonisation processes. On the contrary, having a broad scope, these measures have a preventive function and aim for long-term, widespread, forward-looking and transformative changes (Mandelli, 2022, p. 15).

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Research shows that there exist three main approaches to just transition, which are "job-focused", "environment-focused", and "society-focused". Broadly speaking, the focus on jobs deals with the consequences of just transition on workers, mainly on securing employment and high-quality working conditions. The approach, with its main focus on the environment, aims at boosting a sustainable natural environment. The "society-focused" approach looks at the consequences of decarbonisation for workers, communities and society as a whole. All approaches have in common that they ask the same and principle question: "justice for whom?" (Krawchenko & Gordon, 2020, p. 2; Molina Romo, 2022, p. 7).

2.3.1 Job-focused just transition

In more detail, the "job-focused" interpretation of just transition originated in the original idea of just transition back then in the 1970s in the USA. Promoters of this approach foster the idea of including unions, workers and communities in the debates of transitions in respective industries (Krawchenko & Gordon, 2021, p. 1). This approach is classified as a reactive approach and consists mainly of temporary income support, retraining, and financial support for communities (Mertins-Kirkwood, 2018, in ibid.). For the energy sector, more precisely, such initiatives are "job retraining and education programmes for displaced miners, funding to assist miners with relocation, and funding for miner pensions" (Morena et al., 2018, p. 13). Despite their importance for the workers and the prevention of riots by the workers, these initiatives do not focus on the problem's origin. Such measures can, therefore, be categorised as low-scale (Stevis & Felli, 2020, in Galgóczi, 2022, p. 8). The term "just", in this regard, refers to job creation, which here stands for the replacement of former jobs with new jobs. At the same time, however, questions of job access or opportunities and the negative environmental consequences of the industry are not addressed (Morena et al., 2018, p. 13).

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2.3.2 Environment-focused just transition

Scholars who combine just transition with other justice concepts, mainly environmental justice, climate justice and energy justice, refer to just transition as an integrated framework of justice (Wang & Lo, 2021, p. 8). The idea of environmental justice has its origin in the environmental justice movement, which aims at fighting for disadvantaged groups who disproportionally suffer from damage to the environment (Mohai et al., 2009, in ibid., p. 3). Supporters of this movement claim that "all citizens should be equally involved in the development, implementation, and enforcement of environmentally just policies" (Heffron & McCauley, 2018, as cited in ibid.). The environmental justice movement works together with different movements to include several social justice issues, such as occupational health and safety, indigenous land rights, or public health. These groups form partnerships with labour unions, environmentalists, and civil rights groups to achieve their goals (Schlosberg & Collins, 2014, in ibid.).

Transferred to just transition in the energy sector, the "environment-focused" just transition's aim is a complete shift to an economy without any carbon emissions. The transition focus lies on a sector's production methods and consumption behaviour (Meadowcroft, 2009; Newell & Mulvaney, 2013, both in Krawchenko & Gordon, 2020, pp. 2-3). Hence, for a just outcome, workers from carbon-intensive industries have green jobs, and communities use low-carbon solutions. Collaboration with trade unions and international organisations is important for this process (Stevis & Felli, 2014, in ibid.), because it is necessary to convince workers and communities of the necessity of climate protection and help them find green jobs. The ILO (2018, in Sharpe & Martinez-Fernandez, 2021, p. 12) define green jobs as jobs with decent work standards which improve the environment by reducing energy and raw material consumption, greenhouse gas emissions, waste and pollution, rebuilding ecosystems, and helping enterprises and communities to adapt to climate change. Additionally, jobs in research and development of new technologies, bio-products production, energetic efficiency, and energy-efficient construction industry are also considered green (Valenti et al., 2016,

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p. 416). One important characteristic of green jobs is that they need to be decent, which means that these jobs are adequately paid, are compliant with worker rights and high safety regulations, and provide the right to organise in trade unions (UNEP/ILO/IOE/ITUC, 2008, in Molina Romo, 2022, p. 7). Critically viewed, advocates of this approach might underestimate the communities' and workers' strong bond with coal and fossil-fuel regions and might therefore face greater resistance than expected (Evans & Phelan, 2016, in Krawchenko & Gordon, 2020, p. 3). Moreover, they might also not consider the workers' lack of skills for fulfilling the new green jobs as well as the successful implementation of green jobs in these specific regions (Krawchenko & Gordon, 2020, p. 3).

2.3.3 Society-focused and transformative just transition

The third interpretation of just transition, the so-called "society-focused" just transition, compromises the most wide-ranging portfolio of solutions because this approach does not only support workers and communities but also society at large. Hence, advocates aim for a system-wide transformation (Bennett et al., 2019, in ibid.). This approach focuses on environmental and energy justice and reaches for universal equity and justice at different levels, such as national, sub-national or global. Examples are the help for marginalised communities suffering disproportionate harms of resource development on a (sub-)national scale, and the fight against energy poverty in developing countries on a global scale. Mainly social justice organisations and international organisations such as the ILO use this interpretation of just transition (Delina & Sovacool, 2018; McCauley et al., 2019; Pai et al., 2020, all in ibid.).

Transformative approaches to just transition go in the same direction. However, such an interpretation aims for a revision of the current economic and political system, which is held responsible for environmental and social crises (Hopwood et al., 2005; Healy & Barry, 2017, both in Morena et al., 2018, p. 14). Next to short-term support for workers and communities, such as job retraining or pension payments, to mitigate the consequences

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of job loss due to economic, environmental or technological transitions, advocates of this approach also want to achieve a system change. They consider a just transition "as a vehicle for the creation of new, locally based, economies constructed around principles of equality for all and local control—a more robust democracy where gender, race and class bias fades into the past" (Labor Network for Sustainability and Strategic Practice: Grassroots Policy Project, 2016, p. 32, as cited in ibid.). Other main characteristics of this view are (1) the inclusion of marginalised groups such as women, indigenous people, people of colour and people of the LGBTQ (lesbian, gay, bisexual, transgender, and queer) community, (2) the empowerment of grassroots initiatives for bottom-up projects instead of trusting in programmes from the political elite, and (3) the integration of culture, traditions, and ancestral knowledge into the just transition processes (ibid., p. 15). This just transition interpretation is therefore seen as a broad approach to just transition (Mandelli, 2022, p. 13). It also resembles what is written in the UN's Paris Agreement, saying that

> [p]arties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate (Paris Agreement, 2015, Art. 7).

Nevertheless, there only exist a few examples of how society-focused just transition can be achieved, as it is not clear how such a global transition should be managed and solved. Also, in this approach, political and cultural aspects on a regional or community level can decelerate the transition process. And secondly, as other huge social problems, such as gender and racial inequalities or poverty reduction, play a vital role in this interpretation of just transition, a clear assessment of the successful implementation of measures and clear just outcomes is challenging (Krawchenko & Gordon, 2020, p. 3).

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Despite the lack of clear plans, transformative and society-focused interpretations of just transition are considered the ideal outcome of just transition by different scholars and organisations (see, for instance, Stevis & Felli, 2015; Healy & Barry, 2017; McCauley & Heffron, 2018; Heffron & McCauley, 2018, all mentioned in Morena et al., 2018, p. 15).

2.4 Examples of just transition measures

Just transition actions can be different on different levels. Policies for a "job-focused" just transition, on the one hand, need to entail measures to create green jobs in traditional and emerging sectors. On the other hand, they must reduce the negative consequences of job losses and decarbonisation processes of the industries for workers and communities (van der Ree, 2019, in Sharpe & Martinez-Fernandez, 2021, p. 5). Workers from carbon and fossil-fuel-dependent industries, for example, can be compensated by company- or government-financed redundancy benefits, retirement plans, intra-company replacements, or early retirement bridging. Funds for education, training and reskilling activities and relocation can help workers find jobs in low-carbon industries (Galgóczi, 2022, p. 9). When defining skill needs, a special focus should be put on specific target groups such as women and young people. On-the-job training and other forms of skill acquisition should be integrated into formal training and accreditation systems to facilitate skill development (Sharpe & Martinez-Fernandez, 2021, p. 8). Successful job reskilling can be found in Spain and the United Kingdom. In Spain, former power plant workers were trained to be able to rebuild the existing infrastructure. In the United Kingdom, trade unions proposed that offshore gas and oil platform workers should be coached to find jobs in the offshore green energy sector (Metta et al., 2022, p. 64). Investment into the replacement of old technologies with low-carbon ones is necessary to guarantee the usability of the location. Moreover, in the case of mass dismissal, job counselling, coaching, mediation, and other social services for workers and their families are helpful support. Innovation partnerships, worker transfer schemes and community-based public investment are other examples of how workers can be helped during a just transition (Galgóczi, 2022, p. 9).

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Examples of community support are public investment in economic infrastructure, innovation, education and training institutions. As part of comprehensive decarbonisation planning, investment in local public goods is necessary to fund social, cultural and environmental projects. In terms of companies, investment and funding for new equipment and low-carbon technologies let companies modernise their plants to keep running their business. When a coal phase-out is already decided, compensation payments by the government are an option for companies to finance the transformation (ibid.). For a successful greening of the economy, the support of green entrepreneurship, especially for women and young entrepreneurs, is another important puzzle piece. Furthermore, micro, small and medium-sized companies need financial support from specific business resilience programmes to implement necessary adaptations to green their businesses (Sharpe & Martinez-Fernandez, 2021, p. 8).

These examples illustrate that despite the urgency of the climate crises, the impacted companies, industries, workers and communities need time to transform industries, institutions, and infrastructure and to reskill workers to successfully install these fundamental changes that these transitions bring with them (Muttitt & Kartha, 2020, in Wang & Lo, 2021, p. 7). It is particularly important to understand how communities react to these energy transitions as their resistance would slow down the pace and reduce the scale of energy transitions (Olson-Hazboun, 2016, in ibid.). Especially the level of unemployment influences the workers' attitude towards energy transition, as a study in Germany has shown. Therefore, fair compensation is seen as an important trust-building measure (Groh & Möllendorff, 2020, in ibid.). Apart from fair compensation, seeing advantages, investment into health care, and clear political commitment are further necessary for workers' acceptance and a successful just transition (Smith, 2020, p. 36).

2.5 Further debates on just transition

Despite the benefits that a just transition entails for the economy, the environment and society, it is clear that achieving a just transition is highly complex because reducing

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carbon emissions to zero while achieving equitable and just conditions and mitigating the consequences of climate justice for the current and the next generations is challenging (Newell & Mulvaney, 2013, in Galgóczi, 2020, p. 370).

Supporters of just transition are convinced that environmental protection and economic growth go hand in hand because more jobs can be created in an environmental-friendly economy (Stevis & Felli, 2015, in Wang & Lo, 2021, p. 3). Similarly, White (2020, in ibid.) points out that the labour-oriented concept of just transition has already been influenced by different socialist, climate justice, environmental justice, feminist and decolonial groups and therefore expanded the meaning of justice, opened the opportunity for new partnerships for a just transition, and introduced different technical, cultural, political and economic knowledge into the just transition debates. However, Kalt (2021, in ibid.) argues that a worker-centred just transition concept might reduce the pace of just transition processes. He also illustrates that based on the influences of labour and climate movements on the job versus climate debates in the past, just transition has developed into a compromise because climate movements were not able to get the support from labour unions, while labour unions kept being closely tight with the fossil-fuel industry to secure high-paying industrial jobs. Consequently, the risk exists that due to the job versus environment conflict, the concept of just transition might not lead to major changes. The concept itself also loses clarity as it is used differently by a wide range of trade unions and international organisations with differing strategies (White, 2020, in ibid., p. 8). Nevertheless, at its core, the just transition concept exists to confront the job-versus-environment conflict and motivate to consider social justice implications of environmentally oriented transitions, and can therefore be defined in the context of decarbonisation as “a fair and equitable process of moving towards a post-carbon society” (McCauley & Heffron, 2018, p. 8, as cited in Mandelli, 2022, p. 12).

As mentioned earlier, all approaches have in common that they ask the same and principle question: “justice for whom?” (Krawchenko & Gordon, 2020, p. 2; Molina Romo, 2022, p. 7). The European Green Deal states that a just transition should leave nobody

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behind (The European Green Deal, 2019, p. 16). Hence, the question is which interpretation of just transition is actually just. Maintaining the current economic and political status quo is considered unjust because the current circumstances are responsible for different kinds of injustice (Healy & Barry, 2017, in Morena et al., 2018, p. 29). Therefore, a "progressive interpretation of climate justice [is needed] to overcome exclusionary approaches and rectify the many injustices that result from climate change" (ibid.). Consequently, for Morena et al. (2018, p. 29), "[o]nly a transition that challenges systems of exclusion and discrimination, and seeks to improve prosperity and well-being for all, can be considered a truly Just Transition".

Some critique about the different interpretations of just transition has already been presented. In general, neither a universally agreed-upon definition of just transition nor a framework exists for everyone to have a clear idea of the intention, objectives, strategies and measures to achieve a just transition (Henry et al., 2020, in Wang & Lo, 2021, p. 2). Even though there is not necessarily a conflict between environmental, labour, and social objectives as the main objective is decarbonisation, conflicts can occur because concrete measures for the transition happen in work settings influenced by capital-labour relationships. Moreover, even with the help of industrial relations, just transition initiatives often only focus on certain groups, whereby inclusive policies for more target groups are missing. The focus, therefore, keeps on lying on "just transition for us" instead of "just transition for all" (Galgóczi, 2022, p. 14). Especially in the energy sector, decarbonisation processes can involve the danger of "creat[ing] new injustices and vulnerabilities, while also failing to address pre-existing structural drivers of injustice in energy markets and the wider socio-economy" (Sovacool et al., 2019, as cited in Wang & Lo, 2021, p. 2). Besides, Krawchenko and Gordon (2021, p. 13) found out in their comparative case study that most initiatives for decarbonisation are reactive as governments, companies, and other actors failed to design measures to proactively address these transitions. This is a main criticism of coal transition policies.

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3. TRADE UNION STRATEGIES

Trade unions play a vital role in transitions of any kind, impacting companies and their workers. The same is the case for a just transition in the energy sector in Europe. Normann and Tellmann name the two main questions for explaining the role of trade unions in the just transition debate and process: "How do trade unions position themselves in the context of sustainability transitions, and what role does the concept of a just transition play in establishing trade unions as a force for continuity or change?" (2021, p. 423). The next part aims to find answers to these two questions by presenting trade unions' work and their role in decarbonisation, their strategies and objectives, and their struggles.

3.1 Trade unions' work and their role in decarbonisation

Workers join trade unions to increase their power against their employers because trade unions' work consists of negotiating conditions such as tariffs, job security, health and safety for the workers in the companies. They can also impact public policies in favour of their members' interests (Berkhout, 2013, in Normann & Tellmann, 2021, p. 422). But at its core, as membership organisations, trade unions' main objective is to represent their members' interests, which are jobs and decent working conditions (Thomas & Dörflinger, 2020, p. 393).

As previously mentioned, decarbonisation has and will have positive and negative consequences, affecting countries, regions and sectors unevenly (ILO & IILS, 2011, in Thomas & Dörflinger, 2020, p. 386). Even though there are not yet sufficient research studies about job creation and job loss due to decarbonisation, it is expected that the total number of newly created jobs in green industries will exceed the number of job losses in carbon-intensive industries (The European Green Deal, 2019; OECD, 2012, both

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in Thomas & Dörflinger, 2020, p. 286). As the majority of affected jobs with large CO2 emissions in older and larger workplaces are in well-unionised sectors with advantageous collective agreements, decarbonisation is an important topic for trade unions (Scheuer 2011; Schnabel 2013, both in Thomas & Dörflinger, 2020, p. 386). It is even a challenge since unions usually fight against employment reduction or job transitions, which are consequences of decarbonisation. This process is even more challenging as other megatrends, such as digitalisation and globalisation, affect workers and companies at the same time (Galgóczi, 2020, p. 372).

Due to the comprehensive consequences of sustainability transitions, trade unions have become a prominent and important stakeholder in policy issues regarding these transitions (Prinz & Pegels, 2018, in Normann & Tellmann, 2021, p. 423). By aiming for the best for workers, unions usually react positively to policy changes which improve the working conditions of their members. As different sectors are impacted differently by energy and climate policies, unions differ in their positions and strategies (Clarke & Lipsig-Mummé, 2020; Räthzel & Uzzell, 2011, both in Normann & Tellmann, 2021, p. 423). Studies have shown that unions are eager to support environmental protection policies than policies aiming for deeper industrial transformation (Räthzel et al., 2010; Snell & Fairbrother, 2011, both in Normann & Tellmann, 2021, p. 423). Applied to decarbonisation, these different interests are also noticeable because while unions of non-affected sectors fight for stricter regulations and coal phase-out, unions of affected sectors work for less drastic policy changes (Leipprand & Flachsland, 2018, in Normann & Tellmann, 2021, p. 423). Therefore, trade unions cannot be considered a homogenous group of actors (Normann & Tellmann, 2021, p. 423).

3.2 Different strategies applied by trade unions for just transition

Trade unions' struggle between job and climate protection is present, and as the reduction of CO2 emissions becomes more strictly regulated, the trade unions' job-versus-environment dilemma will gain depth (Thomas & Dörflinger, 2020, p. 384). A call

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for just transition represents an opportunity to find a solution for this conflict between jobs and climate mitigation (Normann & Tellmann, 2021, p. 423). Trade unions' primary motivation for fostering a just transition is the protection of workers and local communities from the negative impacts of the transition process (Mayer, 2018; Snell, 2020, both in ibid.). Just transition offers them a constructive position towards transition where they can put their focus primarily on employment, retraining and regional development (Galgóczi, 2019, in Normann & Tellmann, 2021, p. 423). Trade unions need to find answers to workers' main questions about a just transition, which are: "What are the new jobs? How do I get from here to there? And what does 'just transition' mean for me and my colleagues, and my community?" (Smith, 2020, p. 35). Consequently, it is especially important for unionists to inform their members and ask their opinions and increase their awareness of the challenges due to decarbonisation and the possible impact of the trade union. By increasing their members' knowledge and engagement, they secure their support for their actions (Metta et al., 2022, p. 73)

There are three types of ideal-typical trade union strategies: opposition, hedging, and support. The trade unions applying the first strategy, opposition, are against climate change mitigation and refuse to implement any emission-reducing policies. These unionists deny the scientific evidence of climate change and the need for decarbonisation policies. Therefore, they do not or just to a small extent implement transition-related employment measures. One example of the opposition strategy is the coal miners' unions in Poland which consistently reject EU climate policies and defend Poland's strong reliance on coal-based power generation (Thomas & Dörflinger, 2020, pp. 384, 388-389). This attitude illustrates that decarbonisation is not yet prioritised by all trade unions in Europe (Metta et al., 2022, p. 72).

The second strategy, hedging, means that trade unions accept the scientifically-proven climate change and support decarbonisation policies. However, they only want to minimise regulation, use gradual approaches to save costs, and refuse to proactively address transition-related employment implications (Meckling, 2015, in Thomas &

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Dörflinger, 2020, p. 390). Even though the hedging strategy can be considered an attempt to balance both employment and environmental protection objectives, employment is always the number one priority. This attitude might be the reason for unions mostly reacting to and not proactively planning for decarbonisation (Thomas & Dörflinger, 2020, pp. 393-394).

Support is the name of the third strategy. Unions following this strategy are eager to implement decarbonisation policies and apply a proactive approach to transition (ibid., p. 391). One example of the support approach is the "Just Energy Transition Statement", which was signed in 2017 by the participants of the European social dialogue in the energy sector, which were Eurelectric on the employer's side and EPSU and IndustriAll Europe on the union's side. The objective of such a joint statement is to influence EU policies (Upchurch et al., 2009, in ibid.). Another example is the signing of the "Social and Ecological Pact" by several French unions and social and environmental non-governmental organisations in 2019. This pact claims for the introduction of carbon taxation, the end of the construction of combustion engine cars, and social support to mitigate the ecological transformation's implications on employment (Thomas & Dörflinger, 2020., p. 392). Figure 4 illustrates these three ideal-typical trade union climate strategies.

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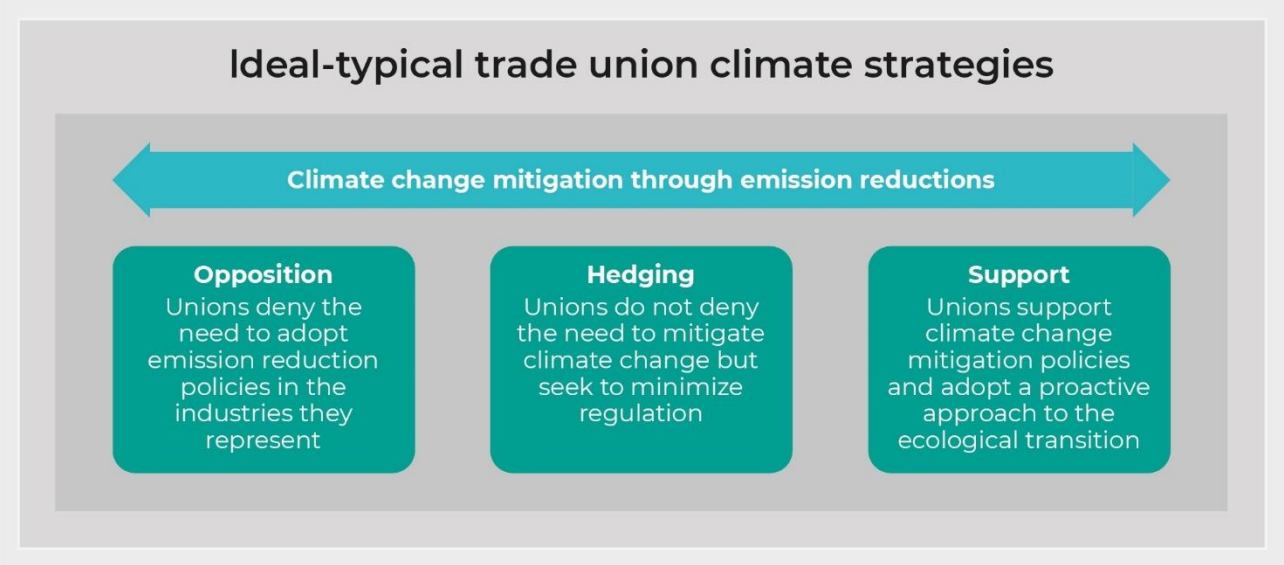
Figure 4: Ideal-typical trade union climate strategies (Thomas & Dörflinger, 2020, p. 393, own elaboration)



Nevertheless, these strategies can be seen as a continuum of strategies because the application of one of these strategies depends on the impacted sector. For instance, even within the same European trade union, IndustriAll Europe, they used the hedging strategy for the steel sector and the support strategy for the energy sector (Weber, 1968, in Thomas & Dörflinger, 2020, p. 394).

In addition, a study about Belgian trade unions' support for promoting transitions towards sustainable development identified seven different types of attitudes that trade unions can have (Creten et al., 2014). The following table shows these seven types with a description and an attached degree of proactivity:

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Table 1: Scale of attitudes towards sustainable development transitions (Creten et al., 2014, p. XIII, own elaboration)

Type of attitude	Description	Degree of proactivity
Dark green' attitude	Transitions to sustainable development mean environmental improvement, which is a trade union priority.	Proactive attitude
Win-win attitude	Transitions to sustainable development produce simultaneous benefits for companies, trade unions and the environment. Trade unions are actively involved in pursuing such transitions.	Proactive attitude
Corrective attitude	Transitions to sustainable development are inevitable. Trade unions prepare for them and strive to make them 'right' transitions.	Rather proactive attitude
Big jumper day attitude	Trade union attention to sustainable development can only be marginal, as it is not a core business of a trade union.	Reactive attitude
Careless attitude	Sustainable development is not a trade union task, it is the business of employers and the government.	Reactive attitude
Ostrich attitude	Sustainable development is not important, it is a passing fad.	Reactive attitude
Resistant attitude	Attention to the environment is at the expense of jobs, so trade unions oppose it.	Proactive attitude

Proactive attitudes consist of trade unions' positioning of sustainable development as their priority due to its environmental improvement or due to its simultaneous benefits for companies, trade unions and the environment. Trade unions are then eager to be involved and co-design the transition. On the contrary, trade unions show a reactive attitude when they marginalise the importance of sustainable development or even do not consider it a task for trade unions. At the very end of this spectrum is the total resistance of trade unions with the aim to stop any transition measures in order to protect jobs (Creten et al., 2014, p. XIII). Nevertheless, even when applying a proactive strategy, the trade unions' underpinnings of this strategy "range from more defensive,

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neutral/instrumental to opportunistic interpretations of the possible impact of decarbonisation. In practice, trade union strategies are a mix of all three interpretations [...]" (Metta et al., 2022, p. 63). Exemplary attitudes are protecting workers' rights and jobs due to the fear of job loss and relocation of production plants (defensive), welcoming investment to mitigate the effects of international competition despite possible job loss (neutral), and improving workers' working conditions, revitalising collective bargaining, engaging with other industries, and developing new competencies for the workforce (opportunistic) (ibid.).

The study has shown in more detail that several of these seven types of attitudes have been present in the two trade unions of this case study. Individual attitudes depend on the employee's position in the trade union and on the trade union they belong to. Another result is that sustainable development transitions are more supported when direct benefits in terms of employment, working conditions or other social priorities of the unions can be achieved (Creten et al., 2014, pp. XIII-XIV).

Unfortunately, as decarbonisation is a long-term process, the outcomes for workers are, in many cases, unclear until the end of the process. Even when trade unions proactively engage in negotiations for employment security and guarantees, the success of these negotiations will only be seen in the future. One example of an unsure outcome are reskilling programmes to enable workers to find new jobs (Metta et al., 2022, p. 69).

3.3 Trade unions' objectives, resources and instruments

Trade unions follow different objectives on different levels with different strategic purposes (Metta et al., 2022, p. 64). In general, some trade unions prefer to be involved in the decision-making process on a high level due to the importance of the decisions on this level. On the other side, other trade unions search the involvement on a lower level directly at the workplace because they are closer to their core mission of representing their workers' interests via-à-vis corporate management. Besides, trade unions can shape decarbonisation initiatives and decision-making on different levels. On a macro-

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level, trade unions can collaborate to develop new and sustainable industrial models, industrial policies and decarbonisation target-setting. On a meso-level, they can design sectoral objectives and initiatives from national targets and policies. And on a micro-level, trade unions can act as valuable partners for companies to implement their decarbonisation initiatives (ibid., p. 74).

Common trade union objectives entail the provision of employment guarantees for workers with jobs affected by decarbonisation processes, the establishment of retirement or compensation schemes for fair compensation for workers losing their jobs, the offer of reskilling and job coaching programmes for workers to find employment in the green economy or new positions in the decarbonised industries, the development of programmes for better job mobility within and between sectors, and the improvement of the current working conditions. In addition to the traditional areas of trade union work, greater objectives such as regional fairness or value chain integration can be pursued by trade unions as well – depending on the institutional context (ibid., p. 64).

Decarbonisation does not belong to the original scope of trade unions' expertise. Nevertheless, implementing the European and national norms for carbon neutrality entails topics related to workers and work organisation, which fit better trade unions' competencies (ibid., p. 70). Therefore, trade unions need to invest time and human and financial resources in internal capacity building to increase expertise on decarbonisation (Eurofound, 2018, in ibid, p. 66). For instance, a trade union in Germany formed a transformation team to collect the available knowledge and forward necessary information to local trade union branches and work councils. In Finland, the trade union confederation organised internal working groups on climate policies, did research on climate change and the proposed decarbonisation plans, and provided the information to their member unions during seminars. Moreover, apart from the information exchange within trade unions and their confederations on the national level, the sharing

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of information with trade unions from abroad entails further potential to face the challenges of decarbonisation (Metta et al., 2022, pp. 66-67).

Trade unions can further use their formal and informal networks with employers, different governmental institutions, local communities, municipalities, and the broader society to collect information and influence decisions (trade unions' political power). They also have the opportunity to spread ideas and start (media) campaigns to impact public discussion (discursive power). And thirdly, trade unions can use their traditional collective actions and go on strikes or launch campaigns to achieve their objectives (ibid., p. 67).

3.4 Trade unions' struggles

It is not always easy for trade unions to engage in decarbonisation discussions and influence decisions. Debates about decarbonisation mainly turn around management and technical issues as companies and governments are the main influential stakeholders. Therefore, the consequences of these innovations and regulations for workers are not or only to a small extent part of these discussion rounds. It lies in the hands of the companies and governments to open the room for trade unions to participate in these discussions. This is the case even in countries such as Germany or Finland, where social dialogue is highly institutionalised. Therefore, this attempt is even more challenging for trade unions in countries with a lower institutionalisation of social dialogue. Due to these limitations, trade unions' involvement in decision-making for decarbonisation cannot be taken for granted (Metta et al., 2022., pp. 69-70,74).

Thomas and Dörflinger (2020, p. 392) claim that trade unions might face critique no matter their chosen strategy. For instance, unions might lose members due to potential job losses when they support strict climate change mitigation policies. Secondly, companies might blame unions for reduced profit due to emission reduction policies. And thirdly, if unions prefer employment protection over environmental protection, society might not support this strategy.

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When trade unions opt for a proactive strategy, a high level of knowledge about processes, options and possible outcomes is required. Big financial investment into human capital is necessary to achieve such a high level of understanding. The uncertainties surrounding possible outcomes complicate this intention. As most of this knowledge is gathered in the confederation of the trade unions, programmes are needed to transfer the newly-gained knowledge to sectoral and company levels. Since there only exist a few standard measures ready to be applied, many companies need to design customised plans and strategies for their individual decarbonisation process (Metta et al., 2022, p. 72).

4. OCCUPATIONAL HEALTH AND SAFETY

Occupational health and safety leads to a healthy workforce which is considered a prerequisite for sustainable development and workers' productivity. All jobs being decent, safe and healthy is necessary for high-quality work environments. The creation of new jobs, the protection of workers' health and safety at work, health services, social health protection, good working conditions, the compliance with workers' rights are all critical elements of sustainable, equitable and inclusive growth (Valenti et al., 2016, p. 421).

There is proof that occupational accidents and diseases highly influence the productivity, competitiveness and reputation of enterprises as well as the livelihood of workers and their families. Therefore, occupational accidents represent a humanitarian and economic burden with negative consequences for sustainable economic growth. Hence, the prevention of accidents and diseases at the workplace is vital and pays off (Jilcha & Kitaw, 2017, p. 373).

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This chapter first defines Occupational Health and Safety before taking a look at health and safety issues and risks during energy transitions and for renewable energies such as wind, solar, hydrogen, and biomass energy. It ends with energy generation's health impact on the local environment.

4.1 Definition of Occupational Health and Safety

In general, the concept of occupational health and safety (OHS) is a holistic approach towards the overall well-being of the employees at work (Amponsah-Tawiah, 2013, in ibid.). In more detail, the International Occupational Hygiene Association defines OHS as "the science of anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment" (2009, as cited in ibid.). For the World Health Organisation (WHO), this entails actions for occupational medicine, occupational hygiene, occupational psychology, safety, physiotherapy, ergonomics, and rehabilitation, among others (1995, in ibid.). Safety refers to any actions that aim to protect workers from physical injury (Hughes & Ferreit, 2008, in ibid.). Hence, OHS stands for the "promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations" (Joint ILO/WHO Committee, 1995, as cited in ibid.).

Workplace accidents can be categorised into three main areas, which are the physical workplace, the people, and the management (Makin & Winder, 2009; Dollard & Knott, 2004; Theophilus et al., 2016, all in Ifelebuegu et al., 2019, p. 1). While mechanical, structural and process design failures belong to the category of the physical workplace (Lieberman, 2011; Ifelebuegu et al., 2018, both in ibid.), lack of attention and heedlessness can be reasons for accidents caused by the workers themselves. The management perspective refers to the company's ability to make the right decision to protect their workers' health and safety (Nolan, 2011, in ibid.). Attwood et al. (2006, in ibid.) add external events to the categories for OHS risks.

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4.2 OHS and the energy transition

There do not exist clear data which confirm an improvement in OHS issues through the transition from traditional to renewable energy. There is even the possibility that the greening of the economy has negative influences on certain groups of people (Pollin et al., 2009, in Valenti et al., 2016, p. 416). The greening of the economy refers to the development and application of new technologies. Employees often need new skill sets to be able to use these new technologies. Since this development often leads to better working conditions for the employees who develop and apply these technologies, the job quality raises for these high-skilled jobs (Organisation for Economic Co-operation and Development, 2012, in ibid.).

Between May 2013 and March 2014, a survey with the title "Stakeholders' perception of the possible implications of green jobs for health and safety at work in Italy" analysed the potential impact of the transition to a green economy on OHS. Asked about the fundamental aspects of a fair and equitable transition towards a green economy, only 10% of the respondents put importance on OHS issues. Besides, only 12,7% of the respondents think that renewable energies bring new risks that cannot be managed with the current risk management framework for traditional energy sources. 38,2% are convinced that the current approaches are sufficient to deal with new risks. Other 27,3% also believe that renewable and traditional energy sources entail the same risks. 41,2% of the respondents also do not consider high health and safety risks for wind, solar photovoltaic and thermal energy. Lastly, they also think that risks during the planning phase and ad hoc risk management approaches are the main measures needed to be predicted to guarantee health and safety for workers in the green sector (ibid., pp. 419-420).

This study as well as the studies by the ILO (2011) and Schulte et al. (2010, both mentioned in ibid., p. 421) show that OHS issues are not well-addressed yet. Especially the presented survey shows that OHS is not perceived as highly important for a fair transition towards

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a green economy (ibid.). Valenti and his colleagues (2016, p. 422), therefore, demand a systematic assessment of OHS issues, compassing all stages of the product lifespan from planning over manufacture, transport, installation, operation, maintenance, and demolition to disposal. The regular exchange with different social partners is crucial to guarantee that OHS issues are integrated into the development of new technologies. Social dialogue, collective bargaining and tripartism are helpful measures to create new political ideas for OHS protection.

In addition to debates for improvement on the political level, research and development is another puzzle piece since it is necessary to analyse potential hazards in new green technologies and find alternative designs. Another important pillar is education, meaning that OHS issues need to be added to professional curricula, textbooks, accreditation, certification examinations, and specific training programmes. In general, it is necessary to make the workers in the green sector aware of the conditions for health and safety. To make all of this happen, collaboration of experts of different fields of expertise are needed such as health and safety professionals, designers, businessmen, labour representatives, environmentalists, insurance companies and politicians. Lastly, good practices for OHS risk prevention are needed (ibid.).

4.3 OHS and renewable energies

In 2018, only a third (32,4 %) of Europe's electricity was generated through renewable energy sources (Galgóczi, 2019, p. 8). As Figure 5 about the composition of electricity generation illustrates, renewable energies mainly consist of wind, solar, hydro, and biomass. All four energy types have specific OHS risks along their lifespan, which are presented in the following sub-sections.

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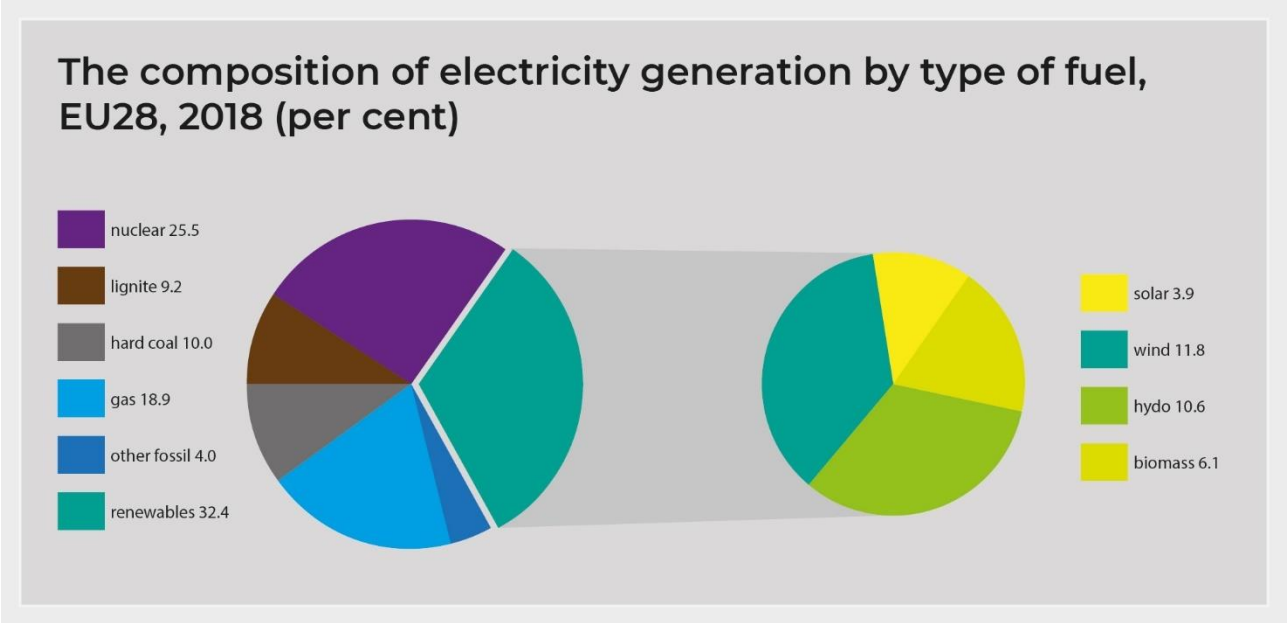
Figure 5: The composition of electricity generation by type of fuel, EU28, 2018 (per cent) (Eurostat, Agora Energiewende and Sandbag, 2019, cited in Galgóczi, 2019, p. 8, own elaboration)



4.3.1 OHS and wind energy

Workers in the wind energy sector are exposed to danger of different kinds throughout the lifespan of a wind turbine, both onshore and offshore. In both work environments, workers usually need to work at height, climb ladders and stay in awkward positions in narrow spaces for a longer period of time, which damages the joints and the back of the workers. While manufacturing wind turbines, noise, the use of chemicals, dealing with electricity, manual handling and the usage of machinery and equipment represent a potential source of harm to the well-being of a worker. During the construction of the wind turbines, workers can be hurt due to falling objects during the lifting, falls from heights, electrical and mechanical accidents, fire, explosions, noise, and dangerous substances. The weather with wind and lightning represents danger both onshore and offshore. When working offshore, there exist additional OHS risks. The staff transfer by boat and helicopter, emergency evacuations in case of fire, explosion or extreme

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weather conditions, working in extreme heat or cold, and diving operations are examples of OHS risks (European Agency for Safety and Health at Work, 2014, pp. 6-10).

The fast development of the wind energy sector has led to skill shortages on a professional level – project managers and engineers – and on the operational level – for instance, vessel crew members and electricians. Most workers entering the wind energy industry have not yet gained much experience working on wind farms and do not have much knowledge about OHS risks. One reason for the lack of knowledge could be missing industry standards for wind energy training. It is more difficult for small and medium-sized companies to offer such training and therefore have skilled and well-prepared employees. More standardised training and certifications would lead to higher workforce mobility (ibid., 2014, p. 5).

4.3.2 OHS and solar energy

The OHS risks for the solar energy sector are similar to the ones for the wind energy sector. Most OHS hazards are related to working at height, such as access issues, falling objects, falls, slips and trips due to the dangerous surfaces on the roofs. Workers risk ergonomic harm when kneeling, squatting and staying in awkward positions for a longer time and lifting heavy objects. Weather extremes are another OHS factor. Especially exposure to the sun can cause sunburn, visual impairment, and cancer. Electrical risks when installing photovoltaic systems are another OHS concern (European Agency for Safety and Health at Work, 2013, p. 4).

Skill shortage can equally be problematic in the solar energy sector. Since solar energy workers need different skills, they often lack this diversified knowledge. This is especially of concern when sub-companies with unskilled and migrant workers with little language competencies of the host country or even illegal workers are hired to install solar panels. Time pressure and precarious working conditions raise the possibility for OHS accidents (ibid.).

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The solar energy sector being very dynamic with changing technologies, equipment, substances, work practices and workers, it is necessary to regularly reassess risk management. The risk assessment is a regular process and needs a systematic monitoring and review system. To reduce OHS risks in this sector, companies need to offer training regularly, permanently monitor potential new risks, reduce the use of toxic chemicals, carefully test new materials, and design products allowing safe operations along the lifespan of the product (ibid., pp. 5-6).

4.3.3 OHS and hydrogen energy

Hydrogen is nowadays highly considered for energy storage and fuel for traffic, especially the storage of energy over a longer period of time is crucial to overcome seasonal changes in supply and demand (Wurster & Schmidtchen, 2011, pp. V-VI). Najjar (2013, as cited in Jankuj et al., 2022, p. 117) categorises "risks in hydrogen connection as physiological (frostbite and suffocation), physical (embrittlement and component failures) and chemical (burning and explosion), where the creation of flammable or explosive mixture with air is primary danger". However, embrittlement has not yet led to incidents as the pipelines are specially prepared (Wurster & Schmidtchen, 2011, p. 14).

Therefore, the focus of risk assessment lies mainly in the detection and identification of gas releases (Yang et al., 2021, in Jankuj et al., 2022, p. 117). Gas can be released when gas-carrying systems are leaky, pipes are opened for maintenance, or an explosible atmosphere is created during the implementation, maintenance, and decommissioning of facilities. Therefore, workers wear special protective equipment with dissipative clothes. An explosive atmosphere is also detected with the help of portable gas detectors (Seemann, 2022, p. 37).

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4.3.4 OHS and biomass energy

Bioenergy belongs to renewable energies. Although being renewable, its combustion still produces air pollution compared to most other renewable energy systems (Markandya & Wilkinson, 2007, in Freiberg et al., 2018, p. 1). The health impacts of biomass use and energy plants for power generation are still underrepresented in science (Freiberg et al., 2018, p. 2). OHS studies are complicated to undertake due to the different fuel types, the facility design, and the lack of scientific monitoring data (Rohr et al., 2015).

OHS issues of a biomass-fueled generation plant can be categorised into three types of primary sources of exposure: "the biomass fuel itself (pre-combustion), biomass combustion emissions (usually associated with the boiler or stack), and exposure to the resulting ash residue (post-combustion)" (ibid., p. 8546). Some of these risks can occur in multiple stages (ibid.).

For instance, there is the risk of fire through the possible ignition of dust from biomass (Liu et al., 2019, in Jankuj et al., 2022, p. 116). Such incidents are rare but can cause damage to the facility, the equipment, employees and other people in direct contact (Jankuj et al., 2022, p. 116). Also, when being stored, self-heating can lead to a fire with toxic gases and smoke (Liu et al., 2021, in ibid.). In addition, exposure to different toxic gases, fungi and different metals can all cause respiratory symptoms and diseases as well as neurotoxic suffering (Basinas et al., 2012; Jumpponen et al., 2013; Jumpponen et al., 2014; Schlunssen et al., 2011, all in Freiberg et al., 2018, p. 20). Moreover, workers can suffer from gaseous pollutants during the handling, transport, storage and agitation (Rohr et al., 2015, p. 8546).

To sum up, table 2 illustrates potential exposures per task for workers.

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Table 2: Typical power plant tasks and exposures (Rohr et al., 2015, p. 8550, own elaboration)

Job Type	**Tasks**	**Potential Exposures**
Trucker	Transport of biomass to site (road/rail) Loading and discharge of material Transport of ash	Biomass dust and bioaerosols generated during biomass loading and discharge Ash dust generated during loading and discharge Diesel exhaust from vehicles
Fuel handling plant operative	Transport of biomass through the site Storage of biomass Fuel preparation (milling etc.)	Biomass dust and bioaerosols generated during biomass handling and milling Off-gases from storage Direct contact with moldy biomass
Cleaner	Removal of dust deposits from plant	Generation of airborne biomass dust, bioaerosols and ash through disturbance of deposits Potential for direct contact with moldy biomass
Maintenance engineer	Maintenance of plant equipment during normal operation	Generation of airborne biomass dust, bioaerosols and ash through disturbance of deposits Potential for exposure to combustion gases
Outage contractor	Repair of plant items during shutdown periods (particularly within the boiler)	Generation of airborne biomass dust, bioaerosols and ash through disturbance of deposits Direct contact with ash deposits within the boiler (often confined spaces)
Ash handling plant operative	Removal of ash from the boiler Transport to storage	Direct contact with ash
Other plant personnel	Various	Fugitive dusts from fuel and ash handling plants Combustion gases

Furthermore, a study by Juntarawijt (2013, as cited in Freiberg et al., 2018, p. 20) found that “living near a biomass power plant increased the risk of respiratory disorders and skin complaints”. Another study by Sovacool et al. (2015, in ibid.) points out that the risk of death for workers through the production and distribution of biomass is fourth highest compared to other energy forms.

There are different measures to prevent occupational health and safety risks in biomass power plants in place, which consist of:

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technology controls and measures (e.g., isolation of the fuel reception hall, crushers, and screens; enclosure of conveyors; control rooms for supervision of unloading fuel trucks; automated fuel sampling; automatic cleaning systems for fuel trucks), worker training on the correct handling of biomass and resulting ashes, improvement of the quality of fuels, and protective clothing (e.g., hoods) and respirators (Rohr et al., 2015; Laitinen et al., 2016, both as cited in Freiberg et al., 2018, p. 21).

In general, when occupational health impacts of energy generation are compared, biomass energy generation is similar to the fossil fuel industry and comprises more negative consequences on workers than wind and solar energy during extraction, generation, and distribution (Rohr et al., 2015; ILO, 2012; Sumner & Layde, 2009, both in ibid., p. 22).

4.4 Health impact of energy generation on the local environment

Energy generation does not only have health and safety impacts on workers but also on the communities around the mines and factories.

Kirsch and his colleagues (2012) developed their "The life-of-mine/life-of-community (LMLC) conceptual framework (see figure 6), which helps map health impacts at different levels from worker to region to the life cycle stages of a mine. The framework incorporates short-term and long-term implications.

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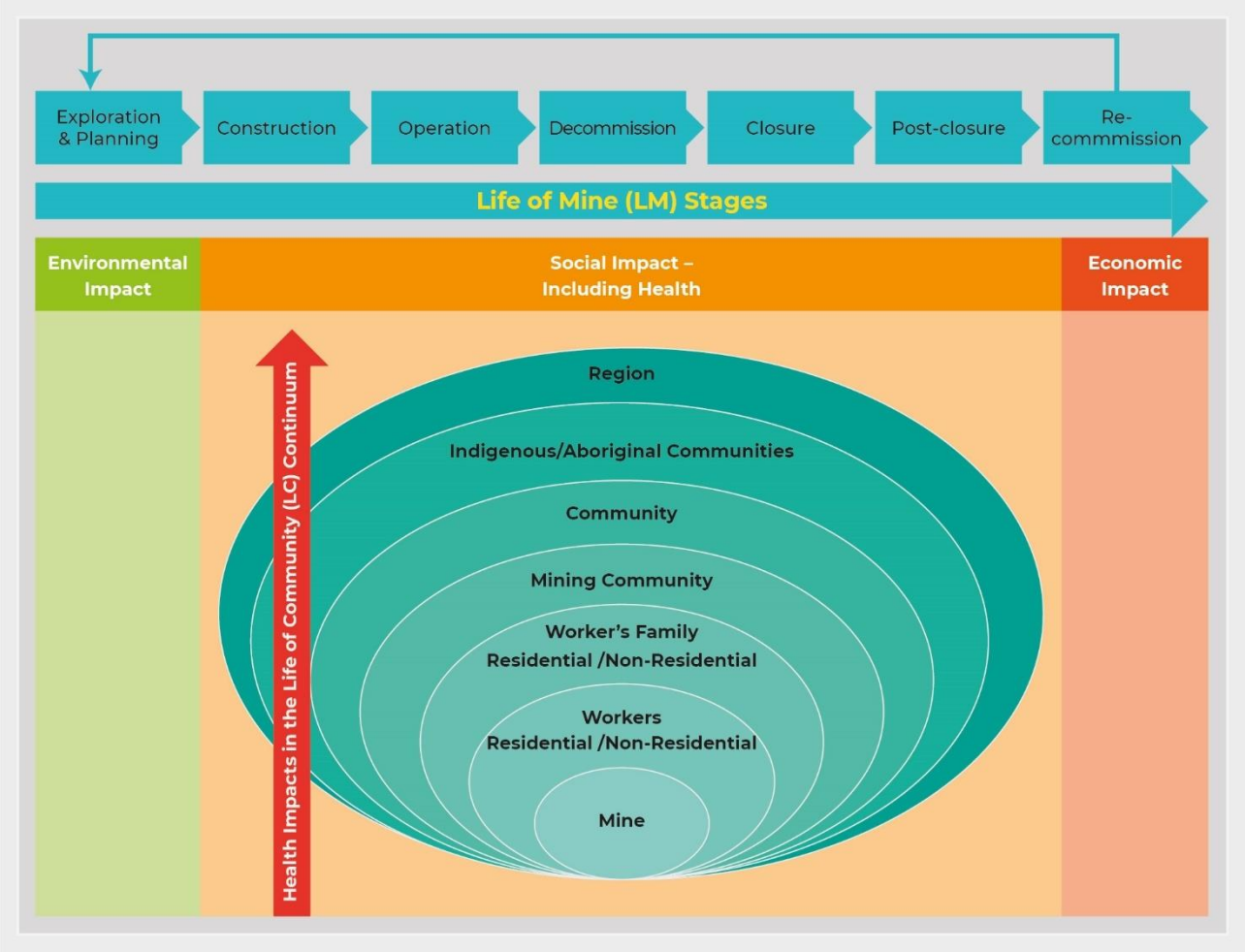
Figure 6: The life-of-mine/life-of-community (LMLC) conceptual framework (Kirsch et al., 2012, p. 2, own elaboration)



This framework was used by Kirsch et al. (2012) to categorise publications about community health in relation to mining. The following graph (see figure 7) shows the differing amount of publications for the different categories. It can be clearly seen that researchers' focus has mainly lied on health impacts for mining workers in both the planning and operation phases, but health impacts for communities have been underrepresented in research (ibid., p. 5).

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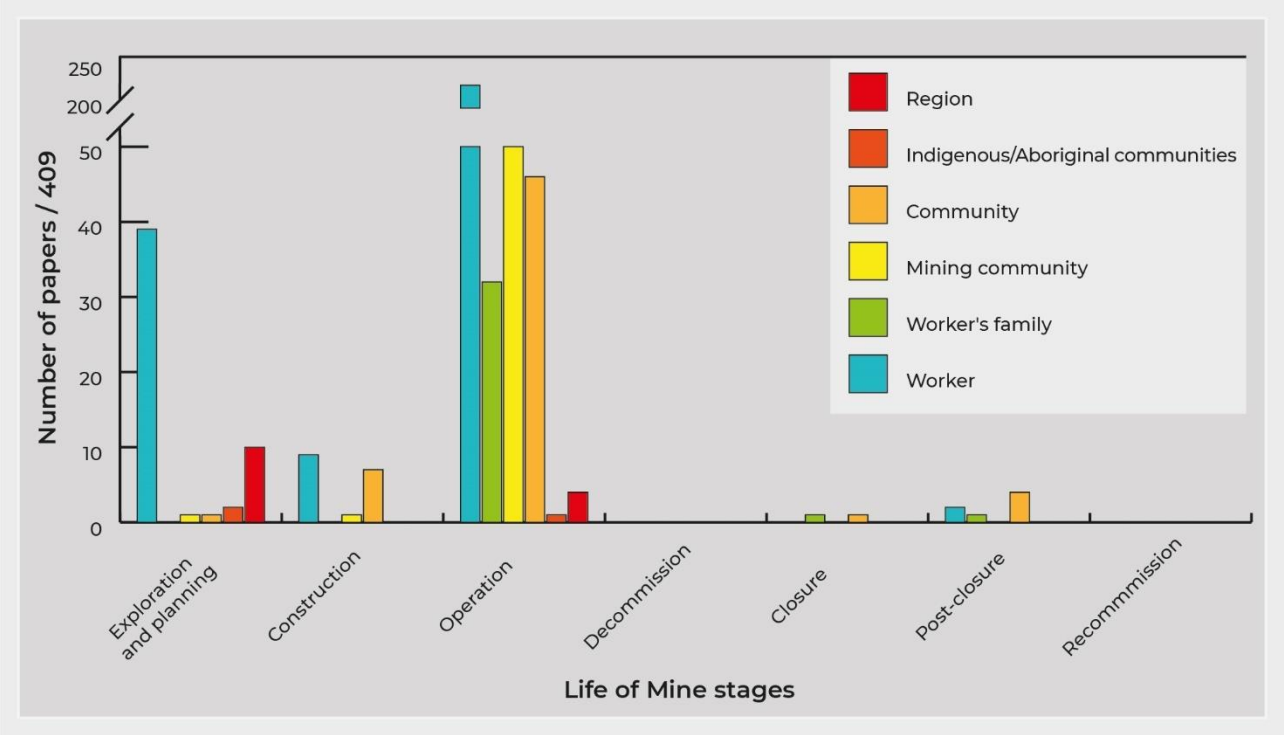
Figure 7: Distribution of community health publications within the life-of-mine/life-of-community framework (Kirsch et al., 2012, p. 5, own elaboration)



Mining communities can suffer negative health impacts from mining activities at different levels. First, the population's health can be affected by environmental exposures to polluted air, water, and soil as well as noise. Second, mining disasters and pit closures can cause mental health problems (Stephens & Ahern, 2002, p. 29). And third, research on the relation between health and residential proximity to coal mining in West Virginia (USA) found that health risks entail "higher rates of cardiopulmonary disease, chronic obstructive pulmonary disease, hypertension, lung disease, and kidney disease" (Hendryx & Ahern, 2008, as cited in Kirsch et al., 2012, p. 5), 16% higher probability of low birth weight infants (Ahern et al., 2011b, in ibid.) and "significantly higher male and female mortality rates for chronic heart, respiratory and kidney disease" (Hendryx, 2009, as cited in ibid.).

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Some major mining companies invest in health programmes for communities, including social welfare provision, the treatment of infectious diseases, rural health services, and the improvement of sport facilities (ibid., p. 6). In Germany in 1991, the former mining company in the Ore Mountains in Saxony launched an environmental remediation programme, which involved "clean-up of contaminated areas, radioactive waste confinement, installation of mine water treatment plants, and rebuilding the landscape and villages" (IAEA, 2014, as cited in Carvalho, 2017, p. 72). These measures were needed to reduce the population's exposure to radiation and radioactive waste (Carvalho, 2017, p. 72).

5. GENDER DIVERSITY

Parts of society, which are marginalised in terms of social, economic, cultural and institutional aspects, such as workers with low income, a low skill set and informal jobs, in particular, are more negatively impacted by climate change (ILO, 2018, cited in Sharpe & Martinez-Fernandez, 2021, p. 12). Women are often also more vulnerable to climate change due to their lack of financial resources to adapt to the new conditions and missing opportunities to be employed in the green economy (Sharpe & Martinez-Fernandez, 2021, p. 12).

This chapter first defines gender equality in energy transitions. It then illustrates the gender dimension in low-carbon transitions and the benefits of gender diversity in the energy sector. The last part looks at present obstacles for women to be employed in the energy sector.

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5.1 Definition of gender equality for energy transitions

It is written in the UN' Paris Agreement (2015, Preamble) that "[p]arties should [...] respect, promote and consider their respective obligations on human rights [...] as well as gender equality, empowerment of women and intergenerational equity." In this context, a part of a just transition in the energy sector concerning gender and social inequalities refers to questions about energy users and their social context. Hence, energy transition processes "must ensure fairness via equal distribution, full recognition of rights and labour contributions, equal participation in decision-making procedures, and equal capabilities in renewable energy outcomes" (Newell & Mulvaney, 2013; Healy & Barry, 2017, both as cited in Johnson et al., 2020, p. 2).

Gender equality in relation to sustainable development and energy transition can be defined as

> the capability to overcome socio-economic disadvantage in the domains of work, well-being and access to resources, such as energy. Gender equality in policy processes also means equal participation in decision making at multiple levels. This includes supporting agency, power and voice in energy planning institutions and building deliberative forms of democracy that can debate energy transition goals and values in inclusive ways; and assuring space for citisen collective action. Gender equality ultimately also requires the realisation of all human rights (Eriksen et al., 2015, p. 7, cited in Lieu et al., 2020, p. 3).

Even though gender equality is one main principle of the EU, the European Green Deal does not entail a clear demand or objective in relation to gender or sex but only mentions the term vulnerable citizens, which does not have a clear legal definition. Consequently, the Green Deal does not emphasise measures to achieve gender equality (EIGE, 2017, in Carroll, 2022, p. 2).

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5.2 The gender dimension of low-carbon transitions

In general, the differing roles and identities related to men and women cause gender inequalities in labour markets regarding roles, occupations and sectors. Women face these inequalities in recruiting, training and internships for green jobs as they already do now for the existing jobs (ILO, 2015, in Sharpe & Martinez-Fernandez, 2021, p. 11). Moreover, as women often have more insecure and less unionised jobs, the possibility is higher that they suffer from less financially supported job losses during structural changes. Due to differing financial resources, responsibilities for care work and unionisation, women have fewer opportunities to make politicians aware of their interests and demands and, in turn, influence transition policies (Lieu et al., 2020, in Walk et al., 2021, p. 1).

The research by Walk and her colleagues shows that "during and after a transition, more women entered the labour market, mainly taking up precarious and low-paid jobs in the service sector" (2021, p. 19). Such labour changes are also possible in sustainability transitions in the future, whereby it is essential to improve the service sector's working conditions (ibid).

In general, there is a lack of research on the gender dimension of greening (Sharpe & Martinez-Fernandez, 2021, p. 12). Until now, researchers have mainly studied the differences in energy use, especially household energy use, between men and women in developing countries (Räty & Carlsson-Kanyama, 2010, in Pearl-Martinez & Stephens, 2016, p. 9). However, female labour and decision-making in the energy sector are not in the researchers' focus. Only some studies have been published about women in the renewable energy workforce (Baruah, 2015, in ibid.).

Sharpe and Martinez-Fernandez (2021, p. 12) call for "[g]ender-responsive policies for green jobs and skills [...] to ensure women have equal access to these jobs". For a successful design of gender-sensitive policies, both more women and more experts in gender aspects are needed in decision-making processes (Kronsell, 2013, in Walk et al., 2021, p. 18). New policies should focus on the improvement of the working conditions in

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the service sector and establish new well-paid green jobs for both men and women (Walk et al., 2021, p. 3). Furthermore, due to women's double duty of going to work and of managing activities in the household and child care, it is vital for researchers to "inform policymakers [about] the availability of care services in carbon-intensive regions and the extent to which missing support infrastructure prevents women from planning their own careers" (ibid.). Walk and her colleagues (2021, p. 3) also suggest that more research should be done about women's "main interests, needs, [...] concerns [...] and the kinds of activities and forms of organisation they choose" to make politicians aware of them, increase the visibility of women's activism, and raise the inclusiveness of transition processes. To achieve these goals, researchers need to learn more about how women can access funding and the decision-making elite to present their concerns and integrate them into policies (ibid.).

5.3 Gender diversity in the energy sector and its benefits

Gender diversity stands for the "representation of women and men in a specific organization, sector, or community" (Herring, 2009, as cited in Pearl-Martinez & Stephens, 2016, p. 8). Several industry analyses indicate that gender inequalities are especially prominent in the energy sector (Ernst & Young, 2015; Herring, 2009, PWC, 2015, all in ibid.). Numbers from the USA and Canada give the impression that gender diversity is higher in the renewable energy sector than in the fossil fuel industry but still lower than in other economic sectors (Emmons Allison et al., 2019, cited in Johnson et al., 2020, p. 1). In industrialised countries, women represent 20-25% of the renewable workforce. Still, they are mainly employed in the administrative and public relations department (International Renewable Energy Association, 2013, in Pearl-Martinez & Stephens, 2016, p. 9).

The study by Ernst & Young illustrates that "[w]ithin energy organizations, gender diversity is found to be most advanced in consumer services and consumer goods, while power and utility entities are less gender diverse, and infrastructure entities lag the

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farthest" (2015, as cited in ibid., pp. 8-9). In the United States of America, women are the least likely to accompany business leadership positions in the energy industry, and 61% of energy companies do not have women on their board of directors at all (GMI Ratings, 2012, in ibid., p. 9).

Pearl-Martinez and Stephens (2016) state that energy transitions can cause greater inequality if gender diversity is not intentionally prioritised (p. 8). They further highlight that

> [g]reater understanding of the gender gap in energy-related industries, as well as more widespread acknowledgement of the positive potential of gender diversity in this sector, would likely promote more sustainable energy practices, accelerate energy innovation, expand opportunities for women, and encourage greater social engagement in energy-system change (ibid.).

Such environmental benefits due to gender diversity are documented in academic studies about environmental profit caused by female leadership (ibid., p. 10). Female board members tend to proactively fund the introduction of renewable energy technologies to reduce emissions to a greater extent than their male colleagues (CRB, 2012, in ibid.). Other studies have also shown that women in industrialised countries "are more likely than men to express environmental concern, support environmental protection, and enact pro-environmental behaviors" (Kennedy & Dzialo, 2015; McCright & Xiao, 2014, both as cited in ibid.). Also, on a political level, countries with more women in their parliaments tend to do more for the reduction of CO2 emissions (UNDP, 2011, in ibid., p. 10). Pearl-Martinez and Stephens also mention that "[m]ore intentional engagement and inclusion of women throughout the energy sector has huge potential to change community awareness and participation in energy-related issues and decisions" (2016, p. 11). In general, during the energy transition, women have the opportunity to "contribute to the development of a more creative, innovative, and

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dynamic community-oriented energy industry that is more responsive to social and cultural change" (ibid., p. 13).

5.4 Obstacles to female employment in the energy sector

A lack of diversity in organisations is often grounded in "a confluence of social, economic, and cultural factors including uneven access to education and training as well as conscious and unconscious bias and assumptions" (Fine & Handelsman, 2012, as cited in ibid., p. 11). Concerning bias, Mang-Benza (2020, as cited in Carroll, 2022, p. 5) refers to the term "gender blindness" when talking about the missing gender dimensions of the energy transition and states that the energy sector, which is highly male-dominated, overlooks and does not specifically intend to include women and their interests and viewpoints.

In relation to the workforce in the energy sector, gender diversification can be increased in three job areas in particular, which are (1) engineers and technicians, (2) construction, installation and manufacturing, and (3) public- and private-sector leadership (Pearl-Martinez & Stephen, 2016, p. 11). Even though girls and boys are equally interested in careers in the field of science, technology, engineering and mathematics (STEM) and are equally successful in these subjects at school, they lack role models and mentorship to pursue a STEM career at university and beyond (GSRI, 2012, in ibid.). A study on technical education for women in STEM in 120 countries by the United Nations Educational, Scientific and Cultural Organization (UNESCO) found that "the assumptions and biases against women's abilities [are] identified as factors that affect negatively their interest, willingness and confidence to engage in STEM subjects and subsequent job opportunities" (Chavatzia 2017; Huyer 2015, both as cited in Vangchuay & Niklaus, 2021, p. 182). Girls were even made to think that talent for STEM subjects is not normal for women. One respondent said that the energy sector is "rooted in the fact that women do not tend to gravitate towards studying STEM subjects" (Vangchuay & Niklaus, 2021, pp. 182-183). However, nowadays, women and men are equally represented among STEM

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university students in the 144 countries analysed by the International Renewable Energy Association (IRENA) in 2019. Nevertheless, the women in this study perceive gender roles and biases, as well as cultural and social norms, as the main barriers to entry into the STEM job market (IRENA, 2019a, in ibid., p. 183). Women's abilities for these jobs are still questioned even when they have the same STEM qualifications and work experience as their male colleagues (Baruah, 2016, cited in ibid.). Another barrier to entering a company or climbing the career ladder are the "preferences for the same gender, race, nationality, class or background as the dominant ones in the organization", which is strengthened by the lack of gender diversity at the leadership level (GWNET, 2020, as cited in ibid., p. 184).

Other barriers for women are their family responsibilities, work-life balance and the lack of affordable childcare, which cause women to stop their employment at the mid to senior employment level (ILO, 2018b, in ibid.). Some answers from survey respondents from a study by Vangchuay and Niklaus represent these struggles: "Energy projects need a period of continuous time that no women can guarantee they won't pause in a project [due to pregnancy]"; "[There are fewer women in energy jobs because they do] not have the flexibility required by some roles"; "Many roles [in the renewable energy sector] also involve significant travel and nights away from home", "[After maternity leave] it's difficult to compete when they (male colleagues) work 5 days/week whilst I work 3 (days) … however the expectations (in terms of job performance) are the same" (2021, pp. 186-187).

Furthermore, women also suffer from a gender pay gap in the renewable energy sector, which can be based on (1) women's larger concentration in lower-paying, non-technical and administrative jobs and junior positions; (2) women's comparatively weaker negotiating positions; (3) their tendencies to compromise work for family obligations, such as parenting and caregiving; (4) the attitudes and values of employers, and (5) pay discrimination (IRENA 2019a, in ibid., p. 191).

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Consequently, Walk and her colleagues (2021, p. 22) suggest six questions that researchers need to answer for a successful gender-just transition:

1. How can women's interests be better integrated into low-carbon transition processes?
2. How can working conditions be improved in female-dominated sectors?
3. How can care work be distributed more fairly (within families and within society)?
4. What non-economic effects (e.g., identity loss, conflicts, domestic violence) do transitions have on carbon-intensive regions, and how do these affect women differently than men?
5. How can the restructuring of local employment opportunities be designed to lead to more gender equity?
6. How can the different, intersecting life situations (age, class, race) of women affected by low-carbon transitions better be taken into account?

6. DIGITALISATION

Digitalisation is considered a "megatrend heralding a fundamental transformation of both industry and services, and with this is a new world of employment and a radical shift in the conditions under which work is performed" (Haipeter, 2020, p. 242). Technological innovations have the potential to protect the industry through modernisation and the environment through the reduction of emissions. Implementing new technologies to reduce emissions does not cause the closing of companies, but job losses due to higher productivity are possible. Hence, technological innovations do not have a solution to the job-vs-environment dilemma. In more detail, such transformations heavily influence employment, the employees' working conditions and their interests' representation (ibid.). Therefore, a technological and social transformation must happen simultaneously and be intertwined (Räthzel & Uzzell, 2011, p. 1219).

The following parts cover the definition of different terms, digitalisation's influence on the energy sector and its impact on jobs. This chapter also looks at success factors for a

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successful digital transformation as well as the consequences of the flexibilization of working time and place through digitalisation.

6.1 Definition of digitalisation, Industry 4.0, digital transformation

Digitalisation, digital transformation and Industry 4.0 are terms with differing meanings. Digitalisation is the conversion of analogue information into a digital format with the help of digital tools such as software, machines or platforms (Irniger, 2017; Hirsch-Kreinsen, 2018a, both in Niewerth et al., 2021, p. 432). Industry 4.0, in contrast, refers to a structural change in the entire work environment (BMAS, 2015, in ibid., p. 433) and to the idea of developing a new production system based on digital and global Internet-based interconnection of industrial production with the help of modern technology (Hirsch-Kreinsen, 2018a, in ibid.). As Hänisch (2017, in ibid., p. 439) points out, the usage of digital technologies has the potential to improve work, production, and problem-solving processes and in turn, positively impact the creation of value and profitability of organisations and support the human work. Besides changing work processes, digitalisation also leads to new products and services by reorganising tasks (Bauer & Hofmann, 2018; BMAS, 2015, both cited in ibid., 437).

Digital transformation, however, is considered a change of structures, business models and processes due to the usage of digital technologies (Schallmo, 2016, in ibid., p. 440). A digital transformation is, therefore, a consequence of digitalisation and a necessary and inevitable adaption to the digital environment and new customer demands. This process is also needed to develop new business fields (Digital Enterprise AG, 2016; Gartner & Heinrich, 2018, both in ibid.). Digital transformation's objective is to use the full potential of digital technologies along the entire supply chain (Schallmo, 2016, pp. 3-4, cited in ibid, pp. 440-441).

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6.2 Digitalisation in the energy sector

Digitalisation and decarbonisation are two current transformation processes which bring about a profound change in the industry. While digitalisation represents the next development step of information and communication technologies, decarbonisation is a political decision to reduce CO2 emissions (Stiftung Arbeit und Umwelt der IGBCE, 2022, p. 8).

Digitalisation has numerous effects on energy systems. It helps "push worldwide energy systems and grids with efficiency, competitiveness, transparency and sustainability [...] [and] digital technology would increase interconnection, intelligence, performance, reliability and sustainability of energy systems around the world in the coming decades" (Popescu, 2020, p. 306). Managers also often need to invent new business models because the current models are outdated and no longer in use. This change represents a challenge in the energy sector since the power systems are "often based on massive and sustainable infrastructure and physical assets" (ibid., pp. 306-307). Moreover, improvements in data analysis and networking through cheaper sensors, more data from sensors, data storage, and new markets allow a greater digitalisation of energy and accelerated the decarbonisation process (Kitter et al., 2017; Tagliapietra et al., 2019, both in Akberdina & Osmonova, 2021, p. 2). Digitalisation has moved forward "the transition from a multi-directional to a decentralised energy system, in which all sources of demand are actively involved in balancing supply on a scale [...] [and they] blur the distinction between traditional providers and consumers and open up opportunities for both" (Hossein Motlagh et al., 2020, in ibid.).

Overall, the objective of a digital transformation in the energy sector is to "provide all the consumers with access to a more efficient, reliable, and cost-effective energy system" (Akberdina & Osmonova, 2021, p.1). Akberdina and Osmonova (2021, p. 1) also point out that the necessary changes for a digital transformation happen in people's minds and not in the industry. Hence, it is vital to "assist individuals and companies in finding

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solutions to accelerate the transformation of the energy sector into a renewable energy dominated sector, while electrifying the use of sectors to achieve deeper decarbonisation" (Arabzadeh et al., 2020, as cited in ibid.). Still, the digital transformation's pace, scale and impact on the workforce cannot be anticipated and depend on regional, national and industrial contexts (Popescu, 2020, p. 307).

6.3 Impact of digitalisation on jobs

The workplace is considered the "most significant site for engaging with digitalisation" (Haipeter, 2020, p. 243) because the employees use these new technologies, which can improve workers' security, expand or reduce employees' autonomy, or even displace them (ibid.). The increased value chain efficiency associated with digitalisation requires "comprehensive engineering and physical infrastructure building activities" (Popescu, 2020, p. 307). Still, jobs already including automated parts (e.g. daily routine, repetitive physical exercise) might even be more automated. While all employees need more knowledge about information and communication technologies (ICT) to operate the new technologies, digital infrastructure employees require specific ICT skills (e.g. encryption, information security). Besides these hard skills, organisational, communication and collaboration skills become more necessary when using new technologies for teamwork (ibid.).

While some authors such as Popescu (2020) and Kagermann (2014, in Haipeter, 2020, p. 245) expect an increasing demand for skills for employees, other researchers such as Brynjolfsson and McAffee (2016, in ibid.) predict "a polarisation between simple and highly skilled activities" (Haipeter, 2020, p. 245). Even though it cannot be detected clearly how forms of organisations will develop due to the new skill requirements, some possible scenarios exist (Niewerth et al., 2021, p. 449). Hirsch-Kreinsen (2015, as cited in ibid., p. 450), for instance, foresees that all future organisational forms will be between two poles, "a polarised organisation" and "a swarm organisation". In the first case, the workforce is divided into two groups according to their tasks, qualification and

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placement. One group comprises employees with standardised tasks such as process controlling or monitoring. These employees do not need specialised skills due to their limited scope of action. Their number has also decreased due to new technologies. The development of new and more complex tasks requires highly-skilled experts, and the increase in such tasks demands an increase in employees (Hirsch-Kreinsen, 2015; Ittermann & Niehaus, 2018, both in ibid.). In the opposite scenario, only high-qualified employees are needed because all tasks for low-qualified employees have been completely automated. There are no precise tasks, work is more flexible, and the team solves problems with their individual competencies (Hirsch-Kreinsen, 2015, in ibid.). In general, the new organisational forms differ in the extent to which positions with low qualifications are replaced by machines, the intermediate qualification level disappears, and more experts are needed to handle complex tasks (Hirsch-Kreinsen, 2015, in ibid, p. 453).

The technological innovations for both digitalisation and decarbonisation require employees to be open and willing to adapt (Stiftung Arbeit und Umwelt der IGBCE, 2022, p. 5). It is assumed that numerous tasks will change or disappear due to digital transformation while new qualifications and competencies will also be required from employees (Niewerth et al., 2021, p. 492). Over the last few years, simple and easy-to-learn tasks have continuously been reduced while tasks for monitoring and operating have increased. Also, analytical and strategic thinking, teamwork and a sense of responsibility have become crucial skills (Stiftung Arbeit und Umwelt der IGBCE, 2022, pp. 5-6). Georg, Guhlemann and Katenkamp (2018, p. 358, as cited in Niewerth et al., 2021, p. 492) call this phenomenon “erosion of multiple qualifications” (Erosion zahlreicher Qualifikationen (German, in the original)). Especially employees with no or low qualifications are in high need of training as they will be the part of the workforce most affected by the transformation. The statistics say that this part, however, is the one that participates in training the least compared to their high-qualified colleagues (Ressel, 2017, in ibid., p. 498).

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Introducing new technologies and the fear of knowledge gap, job loss, and technical overextension can be terrifying for employees (Müller et al., 2019, in ibid., p. 456). Such changes for the organisation and the workforce can lead to conflicts, which can be called socio-technical fields of tensions (Hirsch-Kreinsen, 2015; Block et al., 2015, both in ibid.). If these tensions are not solved, employees might lose access to these innovations and become resistant. Companies also risk not using their workforce's full potential and successfully using technological innovations (Niewerth et al., 2021, p. 456). Consequently, companies need an organisational culture which supports their employees systematically to take over new tasks (Stiftung Arbeit und Umwelt der IGBCE, 2022, p. 6).

6.4 Codetermination for a successful digital transformation

As is the case for decarbonisation, trade unions face a similar dilemma. They have to decide whether they support the introduction of digital innovations for the new opportunities or try to prevent their introduction due to possible risks to the employees' jobs (Edwards & Ramirez, 2016, in ibid., p. 9). Trade unions often find it challenging to gather vital information to make decisions. Their actions also depend on their resources and capabilities (Lévesque & Murray, 2010, in Haipeter, 2020, p. 243).

Researchers suggest engaging with the employees right from the beginning of the transformation to evaluate the advantages and disadvantages for them individually (Müller et al., 2019, in Niewerth et al., 2021, p. 458). Works councils then can deal with the employees' fears and conflicts. Hence, codetermination helps detect and consider such socio-technical fields of tension (Niewerth et al., 2021, p. 458). Bromberg and her colleagues (2019, in ibid., pp. 473-474) present five approaches to better integrate works councils and the workforce into digital transformation: (1) create transparency about current and future measures, secure a continuous exchange of information between management and works council, promote codetermination from the beginning; (2) design the transformation process with the employees from early on to gain their expert knowledge and deal with their fears; (3) build a group with representatives from the

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management and the works council to react together to challenges; (4) build special groups to react to changes; and (5) build a commission to mediate in case of conflicts between all parties.

6.5 Flexibilisation of working time and place

Technological innovation, mainly the development of information and communication technologies, is one reason for an increased flexibilisation of work. Mobile working is one significant aspect of this ongoing trend. Technologies such as the Internet, notebooks, smartphones, VPN connections, and online collaboration and meeting software allow employees to work from home, in trains, at the customer, in cafés or other places instead of only their company offices. Hence, they are independent of time and place to work, thanks to digitalisation (Maschke et al., 2014, in ibid., p. 484). Consequently, the boundaries between mobile and fixed working places and between working time and free time become blurred (Minssen, 2017, in ibid.). Since these fixed working places and times disappear, the employees gain a higher degree of flexible work organisation (Niewerth et al., 2021, p. 485). It is estimated that future digital innovations might further blur these boundaries (Minssen, 2018, in ibid.).

This flexibilisation of working time and place strongly influences employees' working conditions. On the one hand, it is generally evaluated as positive when employees have more freedom to control their daily working life more independently and adapt their working life to their private life. Such free spaces can motivate people and improve their work-life balance (Maschke et al., 2014; Minssen, 2017; Maschke, 2016, all in ibid.). On the other hand, mobile working has led to more psychological stress (Carstensen, 2015, in ibid.), mainly caused by the perceived need to be always reachable when working mobile, which in turn does not allow employees to get their heads free from work (Minssen, 2017, in ibid.).

Moreover, since employees working from home or elsewhere struggle to prove their performance compared to their colleagues in the office and be visible to the company,

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they perceive increased pressure to perform (Maschke et al., 2014; Carstensen, 2015, both in ibid., p. 486). This pressure to perform can cause psychological impairment such as burnout or stress (Fergen, 2016, in ibid., p. 508) as well as reduced sleep quality and limited regenerative capacity (Ahlers, 2018, in ibid.). In addition, employees working from home, in hotel rooms or in other public places often do not use ergonomically-supportive equipment (Fergen, 2016, in ibid.), which can lead to muscle and skeletal injuries (Niewerth et al., 2021, p. 508).

7. FINAL REMARKS

The research around just energy transitions points to several challenges related to implementing a just transition, which touch on different spheres and need to be established in policy design (Akgüç et al., 2022, p. 7). One insight is that the social dimension must be more central to the European Green Deal, as the previous climate protection measures would otherwise lead to increased social inequality (ibid., p. 1). Just transition should not be understood as an add-on to climate policy but "needs to be an integral part of a sustainable development policy framework" (Galgóczi, 2019, p. 26). While policy concepts in the field of environmental protection are legally differentiated and effective, there is a lack of such concretisation in the case of just transition (Akgüç et al., 2022, p. 2). Akgüç and her colleagues (2022, p. 1) criticise the European Council's recommendations for being too undifferentiated and the EU's Just Transition Fund for being insufficient to absorb the consequences of the transformation. Negative social impacts of decarbonisation measures need to be addressed through targeted instruments by involving workers, citizens and stakeholders in social dialogue (ibid., p. 7).

Coal mining plays a special role in decarbonisation, as it accounts for 0.15 per cent of all jobs in the EU that are at risk of erosion in the near future (Alves Dias et al., 2018 in Akgüç et al., 2022, p. 3). Yet 90 per cent of all coal jobs span ten regions in Europe (Akgüç et al.,

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2022, p. 3). Nevertheless, researchers criticise that the Just Transition Fund has so far focused primarily on changes in coal mining areas, while other areas affected by decarbonisation have received too little attention (ibid., p. 6). According to Tubiana and her colleagues (2022, p. 6), European policy will "have to evolve towards multi-vector coordination and integration, and a multi-level (i.e., European, regional, national and local) decision-making system". At the same time, a new policy framework with an incorporated decentralised decision-making process is required due to the more decentralised energy system in the future. Within this framework, measures will be decided dependent on local circumstances in terms of, for example, electricity generation or storage (ibid.).

Furthermore, labour markets are central to the energy transition, as they are constantly changing, especially in young industries, and therefore require specific skills to be acquired by workers (Wei et al., 2010; Del´ Anna, 2020; Aldieri & Vinci, 2018, all in Gatto, 2022, p. 2). Therefore, the qualification of workers must be supported by the EU, which is not limited to retraining, but also refers to the exchange of successful practices and human resources at the national and international level (Tubiana et al., 2022, p. 4). In this context, the green energy transition has the potential to empower vulnerable groups by creating sustainable enterprises and jobs that result in socio-economic integration. This is especially beneficial in rural and emerging regions, as it can boost their development, benefiting poor, unemployed and vulnerable people (Gatto & Drago, 2021; Naumann & Rudolph, 2020, both in Gatto, 2002, p. 2). In this regard, aspects of gender and age must also be taken into account (Akgüc et al., 2022, p. 3).

Many countries are still too little concerned with the changes in the energy sector, even if there are efforts in this regard (Child et al., 2018, in Gatto, 2022, p. 2). A lack of awareness, interdisciplinary and technical knowledge, and disinformation are currently still barriers that need to be broken through (Overland, 2019, in ibid.). Hence, the positive "impact of renewables take-off on green jobs and entrepreneurship is not always guaranteed" (Wei et al., 2010; Del´ Anna, 2020; Aldieri & Vinci, 2018, all as cited in ibid.).

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Moreover, the Russian war in Ukraine has revealed many European countries' strong dependence on fossil fuels from Russia, which now face the problem of a lack of supply as Russia's response to European sanctions (Steffen & Patt, 2022, p. 2). In detail, this problematic situation is an eye-opener on different issues such as: "reliance on fossil fuels; reliance on energy imports; reliance on energy imports from a single country; reliance on imports from non-democratic countries; and cost-ineffective energy systems" (ibid.). Consequently, the EU's political activity on climate policy, new technologies and renewable energies has become more important, thus boosting the fossil fuel phase-out (ibid.).

Lastly, recent events, such as the Covid-19 pandemic, the energy crisis, and the Russian war in Ukraine, may have an impact on the EU's energy goals and shift the focus of many nations to energy security (Berahab, 2022, Pianta, 2021, Matúš Mišík, 2022, all in Gatto, 2022, p. 1). The war "ha[s] direct repercussions on the worldwide geopolitical stability and global food and energy security and poverty" as well as prices of electricity, oil and gas and thus on the global energy transition (Phillips, 2022; Kalkuhl et al. 2022, Collins et al., 2022; Matúš Mišík, 2022, as cited in ibid., p. 3). This awakens either the option to continue to rely on or return to carbonised energy or to move forward with the green transition (ibid.). Such events should be used to take those actions that advance a "more resilient energy and ecological transition" (Hainsch et al., 2022 in ibid., p. 1) and ensure "access to more reliable and affordable energy supply in the medium and long term" (Tubiana et al., 2022, p. 2).

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