

JOURNAL FÜR ENTWICKLUNGSPOLITIK

vol. XXXIX 3/4-2023

JUST TRANSITION – A GLOBAL PERSPECTIVE

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Published by:
Mattersburger Kreis für Entwicklungspolitik
an den österreichischen Universitäten

Journal für Entwicklungspolitik (JEP)
Austrian Journal of Development Studies

Publisher: Mattersburger Kreis für Entwicklungspolitik an den österreichischen Universitäten

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MARTIN ČERNÝ, SEBASTIAN LUCKENEDER

Undermined Efforts? The Ambiguous Role of Mining Jobs in a Just Transition

ABSTRACT *In finding alternatives for workers currently employed in the fossil fuel industry, just transition policies can ultimately undermine environmental concerns and efforts to redress inequalities. For example, it is suggested to create jobs in other extractive industries to meet the material requirements of renewable energy technologies. We focus on this ambiguous role of job preservation as a key demand of just transition and review selected national transformation strategies from the Global North and the Global South. Comparing qualification requirements of coal mining jobs with other alternatives, we propose to complement current strategies with jobs outside the extractive sector value chains. Fostering these can work towards realising social and environmental goals in synergy, rather than pitting one against the other. We conclude that finding work opportunities that minimise extraction requirements and benefit local communities can help level global and regional inequalities by allowing mining regions to escape from their current positions in global value chains.*

KEYWORDS *just transition, mining, jobs, green services, global value chains*

1. Introduction

The required deep reduction in global carbon emissions can only be achieved through phasing out fossil fuels. However, if renewable energy technologies are to replace fossil fuels in the energy sector, the extraction of other materials, so-called energy transition metals and minerals (ETMs),

must rapidly increase. To stay within a two-degree climate change scenario, the total material requirement associated with mineral production is estimated to increase by up to 500% by 2050 in the electricity and transport sectors, mostly for solar photovoltaics and electric vehicles (Watari et al. 2019). Like fossil fuels, metals and minerals are exhaustible resources. Their extraction puts enormous pressure on the environment and affected societies, raising concerns about the actual sustainability of such an energy transition (Bainton et al. 2021).

The transition also raises questions about fair solutions for workers affected by the closure of entire industries. The coal mining sector, which alone accounts for 4.7 million jobs globally (Ruppert Bulmer et al. 2021), is paramount in this regard. Shifting employment from coal mining to the extraction of metals and minerals required for renewable energy technologies appears to be a handy option because it requires a similarly skilled workforce, thus reducing pressure on workers in terms of retraining (e.g. Alves Dias et al. 2018: 104). Various studies have concluded that the similarity of qualifications in sectors such as construction, manufacturing, energy, logistics and the automotive sector have made them strong candidates to compensate for job losses in the fossil fuel extraction sector (e.g. Baran et al. 2020; Oei et al. 2020; Sokołowski et al. 2022). The search for employment alternatives in other extractive sectors or their value chains as part of a just transition nonetheless creates a dilemma between sustaining jobs and moving towards a genuinely sustainable economy.

However, such a dilemma arises primarily (or perhaps only) if one considers the low-carbon transformation as simply switching from one energy source to another. According to a growing number of scholars, such a notion is arguably not enough to make a real turn towards sustainability. Empirical studies suggest, for example, that a green growth strategy (meaning continued focus on economic growth with clean fuels) has no chance to succeed in practice, in terms of greenhouse gas emissions and resource use reduction, which is why authors advocate considering alternative strategies that limit further extraction of exhaustible natural resources (e.g. Hickel/Kallis 2020; Parrique et al. 2019).

As a result, there is a need to look for employment alternatives that minimise retraining but also minimise the involvement in the value chains of the extractive sectors. Such alternatives could be found in the so-called

green services sector. The green services sector, a concept introduced by Jackson/Victor (2011), is useful in the context of just transition from an employment perspective. It proposes job creation focused on activities such as public services or labour-intensive craft manufacturing to sustain employment as we restructure to an economy without growth. The question of whether there are indeed suitable employment alternatives in these sectors that would minimise retraining requirements is addressed in this paper.

Strategies for utilising the qualifications of fossil fuel extraction workers in different sectors have implications for Global North-South relations and the international division of labour. Substituting fossil fuel extraction with other extractive activities may reinforce or exacerbate existing inequalities, as mining regions would remain resource providers in global value chains (Vikström 2020). In contrast, strategies aimed at strengthening the local economy through the green services sector may be consistent with post-development thought, i.e. the vision of economies liberated from the discourse of ‘development’ and its market-oriented principles (see e.g. Kothari et al. 2019; Escobar 1995). Particularly (but not exclusively) in the Global South, such economies organised beyond market principles – “diverse economies” (Gibson-Graham 2007: 12) or anticapitalist “pluriversal practices” seeking to delink from global commodity chains (Kaul et al. 2022: 1151) – are common. To denote a broader understanding, including various alternatives to ‘development’, we use the term in quotation marks, since as such it often refers to economic growth, the idea of a linear progress of countries through similar stages, and frequently ignores colonial heritage and global power imbalances (see e.g. Escobar 2014). In the context of this study, it is moreover useful to understand post-development as concrete utopias or already existing nowtopias rather than as an overarching criticism of the Western hegemonic ‘development’ model (Ziai 2017), since we are interested in exploring concrete employment alternatives.

How the qualification requirements of employment options beyond the value chains of extractive sectors compare to those in the coal mining sector is the primary subject of interest in this study. We are further interested in examining existing national transition policy positions and strategies with regard to their consideration of the labour market, the material

base of renewable energy technologies, and their understanding of ‘development’. Narrowing our empirical analysis to rather technical aspects, i.e. job qualifications and the resource endowments of countries and how these may influence their energy transition agendas, our contribution to studying a socio-ecologically just transition is limited in other regards. From a political economy perspective, these include, most importantly, the questions of power, energy and climate justice, and (class) interests and conflict, which are discussed and investigated in detail by others such as Newell/Mulvaney (2013) and Chancel (2020).

We provide three main contributions:

1. We present an overview of how the just transition literature considers alternatives to jobs in fossil fuel extraction, with an emphasis on the role of other extractive industries.
2. We illustrate feasible alternatives to coal mining jobs by comparing the skills, abilities, knowledge and work activities (referred to as qualification requirements) with a focus on options close to the green services sector.
3. We examine current just transition practices and suggest alternatives that can steer the economy away from the modernist ‘development’ paradigm.

In the next section, we recall the main arguments of just transition with an emphasis on employment strategies and the ambiguous role of the mining sector in them (contribution 1). In Section 3, we set the stage for contributions 2 and 3. We first classify just transition agendas based on observations from different countries and then proceed with an analysis of the proximity of the qualification requirements for coal mining jobs to those for other, particularly green, jobs. On this basis we present identified employment alternatives and our takeaways from classifying national transition agendas in Section 4. We suggest how just transition strategies could be emphasised in a way that does not place excessive demands on the retraining of workers and at the same time enables a turn towards a genuinely sustainable economy that helps to reduce both regional and global inequalities.

2. Just transition and the risks of job creation in the extractive sectors

Just transition originated in the 1970s as a demand by unions to preserve jobs in response to (and in agreement with) the downsizing of hazardous industries (see e.g. Thomas 2021). From a trade union perspective, the concept of just transition has brought a more proactive stance on the well-known “jobs versus environment dilemma” (Stevis/Felli 2015). The common denominator of the current understanding is taking advantage of the low-carbon transformation momentum in order to reduce existing inequalities (Heffron/McCauley 2018). According to Eisenberg (2018), there are essentially two conceptions of just transition at present: one that generally seeks to tackle inequalities as part of the low-carbon transformation efforts, and a “labour-driven” one that focuses on preserving employment opportunities.

However, current proposals contain only little discussion of specific employment alternatives for the jobs that are at risk due to the low-carbon transformation. General claims such as creating jobs in ‘green’ sectors (Healy/Barry 2017) or considering “the full menu [...] – not just the renewables industries” (Blankenship et al. 2022: 9) are typically made. Storm (2020: 11, 14) points towards the example of the European Union (EU) Green Deal, where new jobs shall be created in “renewable energy generation, housing stock renovation, public transportation, building and maintaining low-carbon energy infrastructures and in services”. In particular, there is a common implicit view that renewables are a substitute for fossil fuels, not only in terms of energy generation but also in terms of job creation (e.g. Cha 2017). Increased deployment of renewables is then assumed to imply “highly technical and [...] practical hands-on training and problem-solving skills”, and “[t]he current focus in [renewable energy] education globally [...] appears to be on higher education” (Lucas et al. 2018: 453).

Depending on the shape the just transition eventually takes, different jobs and qualifications will be emphasised. On the one hand, the transition can follow the path of ecological modernisation – that is, technological innovation consisting of decarbonised industrial production without

profound changes to the current economic system. On the other hand, it can imply fundamental structural changes, for example to make space for less energy- and more labour-intensive activities in line with the green services sector concept. While this concept still configures the economy around employment protection without questioning the concept of wage labour, it seeks to pursue a mode of production that fits a no-growth economy, prioritising social and environmental goals over productivity growth. Even though Jackson/Victor (2011) do not claim whether the green services concept is post-capitalist, it is hard to imagine that a system explicitly abandoning the pursuit of growth would fit into a capitalist logic, since growth is one of the structural features of capitalism (e.g. Kallis 2011). The preference for labour-intensive activities also supports the post-development perspective as a utopian (or nowtopian) proposal for alternatives to ‘development’ because of the critical stance on productivity and growth.

Although there are different conceptions of just transition in union policies (see Felli 2014; Stevis/Felli 2015), the prevailing view is in line with ecological modernisation and ‘green growth’, which supposedly involves the creation of jobs (Felli 2014; Gerrard/Westoby 2021). Such a view, however, implies that efforts to transition from fossil to low-carbon energies will drive the demand for ETMs. Watari et al. (2019) estimate that the most drastic increases in the demand of the transport and electricity sectors are to be expected for copper, silver, nickel, lithium and cobalt, as well as minerals for steel production. Ecological modernisation based on ETMs however undermines efforts to redress global inequalities in the context of a just transition. It would imply a continuation of ‘development’ paths based on a strong spatial divergence between the production and consumption of natural resources and unequal exchange (Hickel et al. 2022)

While renewables may benefit cleaner production in the Global North, the ecological cost and social damage are displaced to the Global South (Sovacool 2021). Several empirical studies show that mining development affects regions unevenly and that there are more environmental and social risks and impacts in the Global South (see, e.g., Luckeneder et al. 2021; Lèbre et al. 2020). In this context, Bainton et al. (2021) call for an expanded concept of fairness in transition debates and policies, taking into consideration the displaced burdens of renewable energy technologies in the Global

South and the global inequalities founded on the legacies of colonialism and indigenous dispossession. They warn about the great risk that distributional inequalities and impacts associated with material extraction will intensify in the name of a grand (global) green narrative. However, peripheral regions within the Global North are also disproportionately exposed to hazardous impacts. The coal mining sector offers particularly obvious examples, such as in Poland, the Czech Republic, and former East Germany.

Despite the known destructive nature of coal mining, the industry frequently receives strong social and cultural acceptance from those who directly (workers) or indirectly (families, downstream and upstream businesses) depend on income from coal mines or power plants, especially if these are the only major employers in structurally disadvantaged regions. A decline in the sector thus often results in a fundamental clash of labour and environmental interests. Trade unions, key actors in a just transition, typically tend to side with the protection of existing jobs over environmental concerns in fossil fuel-dependent industries, although the positions of specific associations vary (Thomas/Doerflinger 2020). In the case of coal mining, offsetting pressure on the industry by fostering the exploration and mining of ETMs seems to be a convenient solution for employees and mining corporations alike. The mining industry has noticed this opportunity and uses it to polish its image (Vikström 2020) by, for example, utilising just transition narratives to display corporate social responsibility (Bainton et al. 2021: 626).

Both the environmental risks and the social considerations associated with extractive industries call for alternative strategies that redress regional and global inequalities while reducing material consumption. The so-called social ecological approach to just transition offers an alternative that promotes democratisation and socialisation of the means of production in order to address the inequalities on both a regional and global scale, challenging the very role of the profit-oriented capitalist logic in the low-carbon transition. The approach assumes that the capitalist system is inherently built on an unequal distribution of wealth and power both regionally and globally (Stevis/Felli 2015). The social ecological approach is thus close to the logic of the alternatives described in the green services sector concept. The shift away from a profit and productivity orientation, together with the associated socialisation and democratisation, opens up

space for an alternative conception of ‘development’, understood in the sense of ensuring well-being. Finding appropriate employment alternatives as a matter of social justice from the perspective of workers in the sectors at risk nevertheless remains a challenge. The following section first discusses existing national transformation strategies and then compares coal mining jobs with possible alternatives in terms of the proximity of their qualification requirements.

3. Evaluating the alternatives to coal jobs in a just transition

3.1 Transformation strategies in different country contexts

Coal mining and transition policies occur in different national contexts, which depend on nations’ positions in the global economy, the domestic availability of ETM resources, and the political ability and will to make a just transition happen. To compare how different national contexts influence coal phase-out strategies and labour markets, and to illustrate that the ultimate goal of reducing global greenhouse gas emissions while keeping (and improving) social standards requires international alignment of nation- and region-specific actions, we highlight three types of coal mining countries. We look at the three biggest coal producers in the EU and the second and third biggest producers in the Global South (China was left out, as it would have marked a rather specific case in itself). We classified the Czech Republic and Poland as Global North countries with reserves of ETMs, where production is currently planned or underway, and Indonesia and India as countries in the Global South that are significant coal producers and are already mining ETMs. Moreover, we identified Germany as a high-income country that produces coal and has alternative strategies based on strengthening non-mining sectors. Taking the countries as examples, we asked whether their transformation strategies contained links to 1) extraction of other ETMs, 2) activities in line with the concepts of green growth and ecological modernisation (as a modernist ‘development’ paradigm), and 3) activities close to the green services sector, possibly displaying elements of post-development utopias or nowtopias.

The Czech Republic and Poland rank among the main EU coal producers. Coal has long been the backbone of their energy industries and other downstream sectors (e.g. steel in the Czech Republic). The Czech

Republic has committed to phase out coal mining by 2033 and Poland declares to do so by 2049. Regarding ETM mining, the Czech Republic has reserves of lithium (mining is being considered), gold, tin and tungsten, but no mining has been recently underway (Sivek et al. 2019). Poland is home to deposits of a number of minerals, with copper, zinc, lead and silver being extracted recently (Uliasz-Misiak/Przybycin 2016). The mineral policy of the Czech Republic outlines the use of reserves according to the EU critical raw materials list (Sivek et al. 2019). However, it is unclear whether at least some of them are to be mined domestically. The Polish mineral policy is more explicit in this regard and also considers a wider range of extraction. It outlines the extraction of zinc and lead, tin, copper, silver, molybdenum-wolfram-copper ore, nickel ore and iron-tin-vanadium ores (Ministry of Climate and Environment 2022). However, support for extracting ETMs does not explicitly appear in the just transition plans. Thus, ETM mining is unlikely to be a core strategy for domestic job creation in the just transition. Rather, mining activities run somewhat in parallel with the efforts for just transition. Moreover, it is unlikely that ETM mining would absorb all coal mining workers, given both their numbers (13,676 in the Czech Republic and 84,324 in Poland by 2019 (Eurostat 2022)) and the geographic locations of ETM deposits, where the mismatch between coal regions and potential ETM deposits is likely to be too large. Both countries are subject to the implementation of the EU Just Transition Fund. The fund can be used for clean energy transition and energy savings, regeneration and use of disused sites, digitalisation, the circular economy, and research and innovation. In addition, the regional strategies suggest activities to stimulate regional economies such as tourism, organic farming, social services and cultural activities. Such an emphasis is to some extent consistent with the concept of green services. Yet, as a whole, the strategies still envisage the narrative of ecological modernism (electromobility, development of low-carbon technologies, etc.).

Indonesia and India are major coal producers, currently expanding their extractive industries while at the same time pledging to promote renewable energy transition policies. Besides coal sectors being central to their economies, they have substantial ETM mining already in operation and further expansion considered (see, e.g., MNRE 2020; IEA 2021; IEA 2022). These include large-scale industrial mining projects that have already operated for long time spans, such as the Grasberg copper and

gold mine in Indonesia and substantial iron ore, bauxite and zinc mining operations in India. In addition to industrial mining, informal operations are numerous and have strong environmental impacts, such as nickel mining in Sulawesi, Indonesia. Given their wealth in the natural resources required for a transition to renewable energies, these countries theoretically do have substitutes for at-risk coal jobs within the extractive sectors. Such a trajectory would, however, require an extreme expansion in order to provide employment for 416,000 workers in the Indian and nearly 240,000 workers currently employed in the Indonesian coal sector (Ruppert Bulmer et al. 2021: 86-87, 120-121). Jobs in ETM extraction furthermore do not guarantee improved labour conditions as demanded by trade unions. In India, for example, ETM mega-projects dominated by the private sector create an environment “openly hostile to worker’s rights and unionization” (Roy et al. 2019: 291) and are thus currently incompatible with the demands of just transition. Overall, India and Indonesia are currently not likely to replace coal mining with the extraction of other materials, but an expansion in the non-coal mining sector is likely to occur in addition to continued coal extraction (Dubash et al. 2018). In both cases, current policies thus prioritise managing increasing energy (and therefore also raw material) demand over designing a just transition towards renewable energies (see, e.g., MNRE 2020; IEA 2021; IEA 2022). Without specifically emphasising ‘green growth’, they remain within modernist ‘development’ paradigms, with a focus on growth and industrialisation based on expanded extractivism. This signifies a reinforcement of prevailing patterns in the international division of labour, without perspectives for a substantial energy transition.

Germany’s coal production has shrunk by approximately three quarters since 1980, and therefore employment in the sector has declined. In 2017, the country’s coal mining sector counted 13,011 employees (Eurostat 2022). In their final report, the German “Commission on Growth, Structural Change and Employment” recommended ending coal-fired power generation by 2038 at the latest, which was eventually implemented in the country’s Coal-Phase-Out Act in 2020. The commission further stresses the need for a “socially acceptable design” (BMWi 2022: 70) and gives priority to “prospects for existing, new and future-proof jobs” (ibid.: 77ff). Besides suggesting a close dialogue with and financial compensation for

those affected most, concrete alternatives include the fostering of the development of renewable energy technologies and infrastructure, resettlement of manufacturing and industry, and strengthening health services and tourism, as well as building up associated digital and transport infrastructure. According to Abraham (2017), Germany's deal for workers intends to provide compensation and early pension for older workers, and special retraining – including to another energy or mining job – for the younger ones. The German strategy emphasises the need for managing the consequences of the phase-out with regard to market effects and economic growth. Maintaining competitiveness, especially of energy-intensive companies, is a major goal, in addition to achieving a just transition for those employed in jobs at risk (BMW I 2022: 66). Security of supply is also an important topic for Germany. Unlike other fossil fuel extracting high-income economies such as Australia or Canada, Germany has no significant ETM deposits. Improved recycling of ETMs, which is frequently mentioned as an important pillar to address the material requirements of a renewable energy transition, will not meet this massive demand (Lèbre et al. 2020). The German strategy very clearly promotes a narrative of growth and climate action, and that these can go together. Its approach also illustrates that a country with a powerful position in global value chains can outsource the extraction of materials needed for environmental modernisation (Hickel et al. 2022).

To conclude, we propose the following clustering of the strategies. If the strategies emphasise investments into high-tech, clean energy solutions (ecological modernisation) and at the same time plan for ETM extraction, we can speak of 'mining-burdened green growth'. If they refer to ecological modernisation while not planning further extraction of ETMs, they pursue 'mining-outsourcing green growth'. If the strategies suggest simultaneous coal and ETM mining, we label them as 'mining-based mixed growth' strategies. Conversely, if the strengthening of green services sector activities prevails over the ecological modernisation approach, we can label it as 'green services-oriented post-growth'. Unlike all previous ones, this strategy might already share characteristics with post-development utopias and open up a space to change the regions' positions in global value chains by focusing on a different type of 'development' than that dependent on extractive activities. However, none of the reviewed cases was close to the

last option. In the following section, we therefore looked at possible alternatives where countries can generate jobs as part of the just transition without having to support extractive sectors in an excessive way.

3.2 Complementing the national strategies: job proximity analysis

One of our main goals was to investigate whether any of the most similar job alternatives to coal mining (in terms of qualification requirements) could potentially be labelled as ‘green’. We hence looked at jobs in the coal mining sector and compared the proximity of their qualification requirements to other jobs in order to assess which could serve as alternative employment opportunities for the workers at risk.

We focused on 12 blue collar jobs in the mining industry¹ from the O*NET 27.0 database (National Center for O*NET Development 2022). The database describes workforce and job requirements in terms of different categories. It is based on the Standard Occupational Classification (SOC) of the United States Bureau of Labor Statistics (2020) and currently includes 923 occupations. O*NET data are developed for the US labour market, which poses a certain limitation as the qualifications might be slightly different in other economies. We evaluated the proximity of the coal mining jobs to all other jobs on the basis of data on skills, abilities, knowledge, and work activities. Each job has a specific combination of scores for the categories considered, which consist of Level (0-7) and Importance (1-5). We calculated the root-mean-square deviation (RMSD) from those of the 12 extraction workers’ jobs concerned. RMSD measures the differences between values using the quadratic mean of these differences. We then added the values up to get one composite coefficient for each job (distance). Lower distances indicate closer qualification requirements, which in turn suggest lower costs for retraining.

The classification of the compared jobs was based on an adapted taxonomy of three job categories by Bohnenberger (2022: 6): green, brown, and mixed. Since we were interested in whether the jobs would be classified as (or suitable to become) green or at least mixed in a hypothetically decarbonised economy, we added two additional categories: potentially green and potentially mixed. We defined decarbonised economy as energy and resource efficient, with a high share of renewables in the energy sector

and elsewhere, electrified generation where possible, or, where not possible, based on green hydrogen and e-fuels, supplemented by carbon capture and storage (see e.g. Bataille et al. 2018; Åhman et al. 2017). We further considered the potential energy descent manifested in, for example, low-tech or ‘convivial’ technologies (i.e. autonomous and creative solutions as opposed to industrial production, see e.g. Alexander/Yacoumis 2018; Vetter 2018; Illich 1973). The epithet ‘potentially’ next to the green and mixed jobs therefore stands for a situation where the economy would already be decarbonised.

Job classification	Produces sustainable work outputs	Tasks and activities make it a sustainable occupation	Does not inhibit sustainable work-lifestyles	Entails a sustainable outcome efficiency	Prospects in decarbonised economy
Brown	✗	✗	✗	✗	None or extremely limited
Potentially mixed	✗ or (✓)	✗ or (✓)	✗ or (✓)	✗ or (✓)	Limited
Mixed	✗ or (✓) or ✓	✗ or (✓) or ✓	✗ or (✓) or ✓	✗ or (✓) or ✓	Limited
Potentially green	(✓) or ✓	(✓) or ✓	(✓) or ✓	(✓) or ✓	Promising
Green	✓	✓	✓	✓	Promising

Table 1: Job classifications used in the analysis (✓ indicates yes, ✗ indicates no, (✓) indicates potentially yes).

Source: Own elaboration based on Bohnenberger (2022)

The resulting classification works with Bohnenberger’s (2022: 6) four dimensions of sustainable employment (sustainable work outputs, sustainable occupation, sustainable work-lifestyle of the worker and their house-

hold, sustainable outcome efficiency), but places the jobs in the aftermath of the energy transition by adding a fifth dimension (prospects in decarbonised economy). The absence of the latter means that the job directly mobilises fossil resources in one of the four categories above with zero or very limited prospects for substitution. While the brown jobs are unlikely to find a place in a truly decarbonised economy because of their inextricable links to fossil fuel value chains, mixed and potentially mixed jobs could be those linked to ETM extraction and related value chains. The classification of individual jobs into categories (brown, potentially mixed, mixed, potentially green, green) corresponds to the SOC 2018 job description (see United States Bureau of Labor Statistics 2020) and the authors' judgement. Table 1 summarises the modified job classifications.

4. Synthesis and discussion

4.1 Opportunities for just transition beyond the extractive sector: green and potentially green jobs

Comparing the qualification requirements reveals that feasible substitutes for coal mining jobs are not necessarily brown. Figure 1 shows the closest alternatives for each of the analysed jobs in the coal mining sector. While there are only four in the green jobs category, together with potential green jobs they already make up a third of all the most feasible coal mining alternatives. With the prospect of a decarbonised economy, there are therefore multiple more feasible job alternatives minimising involvement in extractive value chains than at present.

The green and potentially green jobs (note that some coal mining jobs share common closest alternatives) are listed in Table 2. The closest potentially green jobs were typically anchored in the current industrial metabolism, but can also work well in its decarbonised version. In fact, many of these jobs are key to a successful low-carbon transformation. This includes jobs that support and promote public transport (rail track laying, rail car repairing, etc.), energy production from renewables and their deployment, agriculture and environmental restoration. Potentially green jobs in the renewable energy sector, such as geothermal, hydroelectric, or biomass plant technician positions, may be interesting candidates that fit into countries' just transition strategies targeting the expansion of renewables.

Other jobs, such as those of electrical installers or electric motor repairers linked to electrification, enable electrification of renewables-based energy end-use. Insulation jobs, in turn, are consistent with energy-saving efforts. The reclamation of mining sites (which the just transition strategies also work with) is consistent with the proposed potentially green jobs aimed at removing hazardous materials. Similarly, green jobs in recycling and reclamation also correspond to the recultivation efforts.

Category	O*NET job name
Green	Forest and conservation technicians
Green	Recycling and reclamation workers
Green	Tree trimmers and pruners
Potentially green	Rail track laying and maintenance equipment operators
Potentially green	Rail car repairers
Potentially green	Electrical power-line installers and repairers
Potentially green	Biomass plant technicians
Potentially green	Electric motor, power tool, and related repairers
Potentially green	Rail yard engineers, dinkey operators, and hostlers
Potentially green	Millwrights
Potentially green	Hydroelectric plant technicians
Potentially green	Weatherisation installers and technicians
Potentially green	Geothermal technicians
Potentially green	Control and valve installers and repairers, except mechanical door
Potentially green	First-line supervisors of landscaping, lawn service, and groundskeeping workers
Potentially green	First-line supervisors of farming, fishing, and forestry workers
Potentially green	Hazardous materials removal workers

Category	O*NET job name
Potentially green	Agricultural equipment operators
Potentially green	Sawing machine setters, operators, and tenders
Potentially green	Fishing and hunting workers
Potentially green	Textile cutting machine setters, operators, and tenders
Potentially green	Moulders, shapers, and casters, except metal and plastic
Potentially green	Helpers - production workers
Potentially green	Insulation workers, floor, ceiling, and wall
Potentially green	Landscaping and groundskeeping workers
Potentially green	Textile winding, twisting, and drawing out machine setters, operators, and tenders

Table 2: Green and potentially green jobs closest to coal mining jobs.

*Source: National Center for O*NET Development (2022)*

Interestingly, we did not identify jobs in the services sector, particularly those that would fall into the care sector. The care sector is crucial to fostering the green services sector and frequently appears in countries' strategies for a just transition. Craft production, often linked to the green services sector but equally suitable for strengthening local economies in the national transition strategies, was also not found. This does not negate the need to strengthen the care and craft production sectors, especially as they possibly offer overlaps with the proposed national strategies (at least in the EU context) and the concept of a green services sector. Rather, it implies that more retraining effort is needed for them, since the match between skills for coal mining jobs and care and craft production sectors is not particularly strong.

To summarise, the job proximity analysis suggests that it is not necessary to look primarily at other extractive sectors or their value chains (approximated as brown, potentially mixed or mixed jobs) to find employment alternatives to coal mining jobs. Green and potentially green jobs with similar qualification requirements exist and can foster the transi-

tion to a low-carbon economy. The green and potentially green jobs can also work within some of the envisaged activities listed in the reviewed transition strategies. They are also quite universal regarding geography and demand for their outputs. For example, landscape and green space management, public transport infrastructure projects and maintenance of such infrastructure are relatively versatile jobs.

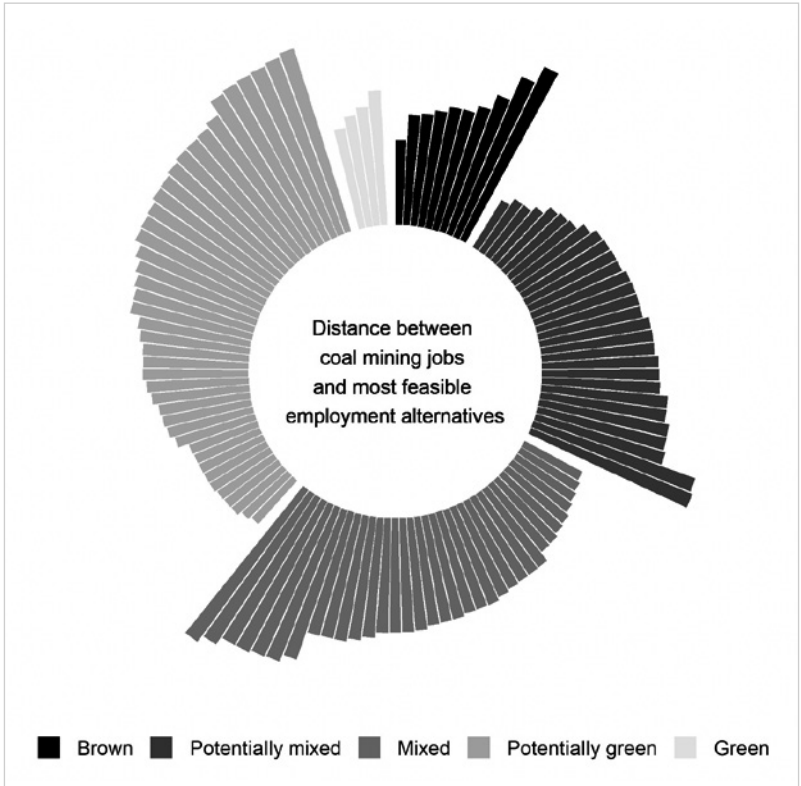


Figure 1: Schematic illustration of the 10 closest jobs for each of the 12 coal mining jobs grouped and ordered by each of the five job categories (120 observations). Higher bars indicate larger distances from the qualification profiles of the jobs in the coal mining sector. Distance is measured in terms of root-mean-square deviation (RMSD). List of jobs depicted in the figure and underlying data are available upon request from the authors.

Source: *Own elaboration*

4.2 Labour-intensive just transition: steering away from the modernist ‘development’ paradigm

Although there is space for employment alternatives beyond the value chains of extractive sectors, green and potentially green job creation strategies can be mobilised towards both ecological modernisation and the expansion of the green services sector. In this subsection, we propose how just transition can live up to its two meanings according to Eisenberg (2018), that is, as labour-driven and seeking to redress inequalities in general. We suggest how the sectoral allocation of labour can influence the ‘development’ paths of the coal mining regions and what implications this may have for their positions in global value chains.

Current national strategies follow the growth path – whether in the form of ‘mining-burdened green growth’, ‘mining-outsourcing green growth’, or ‘mining-based mixed growth’. They are clearly more oriented towards ecological modernisation, although they also contain elements of support for the green services sector. However, the growth-based approach to just transition implies the need for further extraction of ETMs and is therefore environmentally and socially questionable. Gerrard/Westoby (2021: 30) argue that it is even paradoxical, since the growth-based, capitalist system is at the root of the current inequalities, which the just transition seeks to tackle. This would suggest that if the just transition is to really address inequalities, both in a regional and global sense, while pursuing a turn towards a really sustainable economy, it should look for ways beyond green growth and ecological modernisation.

However, even the proposals for expanding the green services sector usually acknowledge the necessity of a certain – less material-intensive – level of energy production (see Jackson/Victor 2011). A minimum level of material extraction will thus also be required for ‘development’ alternatives beyond green growth to maintain industrial societies (or at least elements of them) and to achieve decent living standards for all, where renewable energy technologies are preferred over fossil energy sources. Therefore, while appreciating that technological solutions based on renewable energy sources contribute to decarbonisation, serious change is also required towards the goal of global energy descent and socially equitably implemented redistribution (Kikstra et al. 2021).

The social ecological approach to just transition (rejecting the profit-seeking capitalist logic, democratisation and socialisation of the means of production) offers a perspective for addressing socially equitable energy descent. According to this approach, perpetual growth does not necessarily lead to the levelling of inequalities. It therefore builds ground for a reduction of production and its relocalisation (Stevis/Felli 2015: 39). Limiting growth is no longer a problem for maintaining decent living standards if accompanied by a more equitable production distribution. Relocalisation and reduction of overall production also suit the creation of jobs in labour-intensive (but less energy and material-intensive) green services. For example, several occupations listed in Table 2 may work well in an economy based on labour-intensive craft production instead of mass industrial production: farming, textile production, forestry professions, and millwright. Hence, labour-intensive production emphasises the efficient use of resources and respect for planetary boundaries rather than cost efficiency, as would be the case in mainstream (neoclassical) economics. This view is close to the ecological economics perspective.

Shifting away from the focus on labour productivity and mass industrial production could facilitate labour contributing to local welfare rather than the demand of the extractive industries and global value chains. The social ecological approach thus moves just transition towards post-development by rejecting the central elements of the modernist ‘development’ paradigm. This could open the space to community and subsistence work (activities necessary for the functioning of society, but often unpaid), which is central to post-development utopias and nowtopias. The ‘development’ implications of alternative job preservation strategies thus lie not only in changing the positions of regions in global value chains (from resource exporters to more localised economies), but also in terms of shifting the role of human labour that can be mobilised for specific post-development utopias.

5. Conclusion

Reviewing the selected national transition strategies of coal mining countries and analysing the closest green and potentially green jobs, we

explored the feasible and sustainable employment trajectories in a just transition and whether the green services sector and post-development elements resonate. All country strategies inspected for this study follow growth pathways. However, just transition in the form of green growth does not adequately address global and regional inequalities and is based on an increased extraction of ETMs. It is therefore necessary to look for ‘development’ alternatives that build the well-being of societies (covering social, economic and environmental conditions) on principles other than growth or productivity gains. Proposals close to post-development, such as the concept of a green services sector (labour-intensive production in the care or craft sector) or community economies, offer inspiration. In the job proximity analysis, we identified some of the jobs that can potentially pull the economy in this direction without escalating workforce retraining requirements. The most promising alternatives are linked to recycling, renewable energy and public transport infrastructure. While it is not realistic to replace all mining, it is therefore possible to build upon numerous employment alternatives that do not exacerbate the problem and keep employment outside the value chains of extractive activities.

Technological solutions based on renewable energy sources are necessary to counter global climate change, but we also need to consider the issue of scale (energy descent) and distribution. While locally targeted, just transition strategies need to consider their impacts along global value chains so as not to miss out on the global inequalities associated with extractive activities and the dynamics of global capitalism. This particularly applies to countries currently pursuing ‘mining-outsourcing green growth’ transition agendas. Opening up opportunities for work close to the green services sector and democratising and socialising the means of production in line with the social ecological approach offers a ‘development’ alternative allowing for energy descent without compromising global and local social equity. In this way, just transition can bring the economy closer to post-development by focusing on work activities relevant to local communities, while reducing dependence on resource extractivism.

- 1 Continuous mining machine operators; derrick operators, oil and gas; earth drillers, except oil and gas; excavating and loading machine and dragline operators, surface mining; explosives workers, ordnance handling experts, and blasters; helpers – extraction workers; loading and moving machine operators, underground mining; rock splitters, quarry; roof bolters, mining; rotary drill operators, oil and gas; roustabouts, oil and gas; service unit operators, oil and gas.

Acknowledgements

Martin Černý has been supported by the project “The challenges of a sustainable society through the lens of the humanities and social sciences” (MUNI/A/1460/2021) by the Grant Agency of Masaryk University, Czech Republic.

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ABSTRACT Ein gerechter Übergang zu erneuerbaren Energien heißt Alternativen für jene zu finden, die derzeit in fossilen Industrien beschäftigt sind. Dies kann gegenläufig auf Umwelt- und Verteilungsaspekte wirken, beispielsweise, wenn Betroffene der Kohle- lediglich in andere Bergbauindustrien wechseln. Wir analysieren diese zweideutige Rolle des Arbeitsplatzzerhalts als zentrale Forderung eines gerechten Übergangs anhand nationaler Transformationsstrategien aus dem Globalen Norden und Süden. Wir vergleichen Qualifikationsanforderungen von Arbeitsplätzen im Kohlebergbau mit Alternativen und schlagen vor, die Aufmerksamkeit auf Bereiche außerhalb der Wertschöpfungsketten des Rohstoffsektors zu lenken. Dies würde helfen, globale und regionale Ungleichheiten auszugleichen, indem es Bergebauregionen ermöglicht, ihren Positionen in globalen Wertschöpfungsketten zu entkommen. Beschäftigungen im Primärextraktionsektor zu minimieren und an den Bedürfnissen lokaler Gemeinschaften auszurichten bietet Chancen, soziale und ökologische Aspekte in Synergie zu berücksichtigen, anstatt sie gegeneinander auszuspielen.

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