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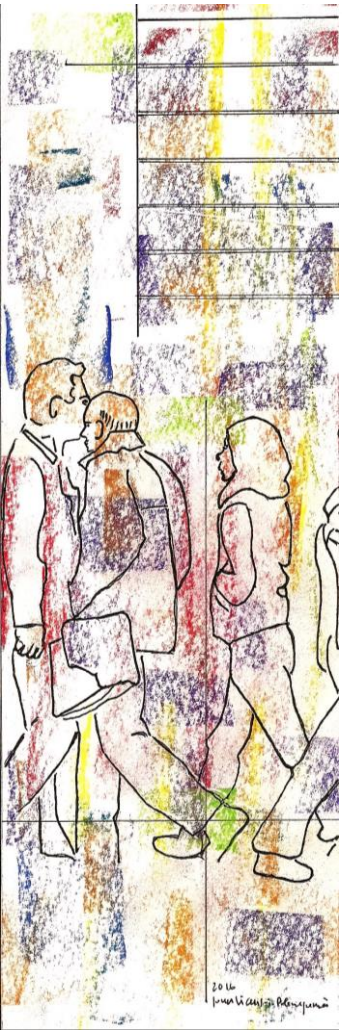

Unjust Transition.
Work and inequalities in the ecological transition

Renata Semenza
Luca Novelli

Funded by the European Union

Horizon Europe – INCASI2 Project
Marie Skłodowska-Curie Actions (MSCA)
Staff Exchanges (GA-101130456)

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Abstract

The ecological transition is a complex phenomenon that will lead to a socio-economic transition. The former incorporates the values of nature within ecosystems, while the latter is structured around class divisions and geographical divisions of labor. They involve different metrics. The integration of those two transitions is the subject of the article. Climate policies have distinct effects on different continents, countries, occupational classes, professional qualifications, and socio-demographic components. If capable of assigning weights, values, and costs in a redistributive perspective, these policies can rebalance inequalities and have a positive impact on social justice. However, if they follow market dynamics, they will reinforce existing regressive trends. The aim of this article is, considering the European context, to provide a conceptual framework that integrates the social processes generated by the ecological transition, with a focus on analyzing inequalities and labor market segmentation.

Keywords

Ecological transition, labour market segmentation, inequalities, green jobs.

Contents

1. Introduction

The ecological transformation is a process that will define the future of European and global societies. The progressive rise in temperatures, and more generally climate change, are increasingly at the forefront of the agendas of local and supranational institutions. The main initiatives are led by the European Union, which in the European Green Deal has explicitly set the goal of achieving carbon neutrality by 2050. On the employment front, in a report on the green economy, the ILO estimates that a scenario of ecological transition with investments in renewable energy, energy efficiency in buildings, and green transportation will create approximately 20.5 million jobs globally by 2030 (ILO, 2018). A similar view is expressed in another study analyzing the sectoral impacts of green investment projects related to the EU Next Generation Recovery Fund: this €200 billion economic leverage could create 2.3 million jobs (Ernst and Young, 2021). Despite these generally positive estimates regarding the social impact, significant contradictions emerge in the implementation of climate policies, undermining their social consensus. Indeed, particularly in countries with a greater dependence on fossil fuels – especially coal, such

as Eastern European nations – the ecological transition, and more specifically decarbonization, face significant obstacles in asserting their desirability. The employment impact of this process is the main argument put forward. Accordingly, this will particularly affect certain social groups whose income depends on "grey" activities. It is therefore not surprising that the risk of unemployment is used as an argument – perhaps the primary one – to oppose the ecological transition (Thomas and Doerflinger, 2020), particularly by radical right-wing parties (Abraham, 2019). To explain and deepen this trend, the starting assumption here is that the climate crisis and its interpretation are conditioned by an unequal distribution of power among social classes and groups, and that this inequality can be attributed to conflicts inherent the production, distribution, and accumulation of economic resources (Paprocki, 2022). Thus, while climate change is experienced differently based on the resources available, it is also true that these resources depend on the structure of inequalities, which are shaped typically by class divisions, economic geography and by socio-demographic characteristics. This paper aims to advance the understanding of the ecological transition by linking labour market theories with the growing body of research on the green transition, while also developing an argument that includes inequalities. The broader aim of this paper is to question the ecological transition, continuing a reflection that began in 2022 in the *Giornale di Diritto del Lavoro e di Relazioni Industriali* (Barbera and Semenza, 2022; Leonardi, 2023; Galgoczi, 2023). The focus of the article, rather than climate change itself, is on the social consequences of climate policies, understood in a broad sense as that subset of public policies aimed at mitigating and countering climate change through decarbonization, in the dual sense of reducing CO2 emissions and progressively phasing out coal. Social sciences in recent years have increasingly focused on green transition, decarbonization, and just transition, developing a richer empirical and conceptual debate. However, sociological literature has yet to provide an analytically and theoretically informed reflection on the relationship between the ecological transition, the labor market, and inequalities (Ding and Hirvilammi, 2024). In other words, there is a lack of a selective theory of the green labour market. This article responds to two broad research questions: *i) what impact does the ecological transition have on the occupational structure, the distribution of skills, and working conditions? ii) what are the distributive consequences, and therefore the impact, of the ecological transition on the structure of inequalities?* The hypothesis is that the ecological transition will represent an additional step in the process of fragmentation and segmentation of the labour market, through the erosion of heavy industry and mining. Conversely, the jobs created, the green jobs, require skill profiles that position them within a secondary labour market, meaning they are comparable to self-employed and professional work. Therefore, it is expected that the ecological transition will exacerbate existing inequalities in terms of skills, widening the wage gap between low-skilled and high-skilled jobs. This trend will have an impact on industrial relations, class structure, as well as on geographical, sectoral, and socio-demographic inequalities, particularly with respect to age cohorts.

2. Literature review

Although this research field is growing, limited attention has so far been dedicated to studying the systemic implications of the ecological transition on the labor market (Ding and Hirvilammi, 2024). This article aims to fill this knowledge gap by engaging primarily with three strands of literature. The first is focused on the effects of decarbonization in hard-to-abate economic sectors and industrial relations. The second centers on employment and skills in the green economy. The third, even less explored than the previous two, addresses the socio-economic perspectives in the study of the labor market, particularly segmentation theories, which are examined in relation to the ecological transition and, for the first time, discussed in these pages.

2.1. Assessing the effects of decarbonisation on labour markets.

The first relevant body of literature investigates the impacts of the ecological transition on hard-to-abate economic sectors, i.e., those activities that rely on coal for their production processes

or have a high carbon footprint (Galgoczi, 2023; Galgoczi et al., 2022; Botta, 2019; Bataille, 2019; Alves Dias et al., 2018). The green transition will indeed have its most detrimental effects on primary industries (coal, steel, energy, petrochemical, cement), that together account for 500 million tons of CO2 annually (Galgoczi, 2023) and on manufacturing industries, particularly the automotive sector, due to the process of power-train electrification. Moreover, coal-mining is the most exposed sector: even though this sector has a declining workforce, it will probably disappear in 5 to 10 years (Galgoczi, 2019). However, while these traditional sectors will undergo profound restructuring, others will expand. This is especially true for typically green sectors, such as the renewable energy industry and the circular economy (Galgoczi, 2022), which includes waste treatment and recycling: these industries are expected to grow both in terms of value added and employment volume – projections for the circular economy alone predict the creation of 1 million jobs (Triconomics, 2021). Starting from this point, economics and economic sociology have focused on the debate surrounding "green jobs," which are variously defined depending on the different conceptual dimensions of sustainability, in contrast to polluting "grey jobs" (Vandeplas et al., 2022; Bonhenberger, 2022a, 2022b). Several taxonomies have been proposed to categorize this dichotomy (CEDEFOP, 2021, 2023): the most advanced conceptualization combines four dimensions of analysis (output, tasks and activities, work-lifestyle, and outcome efficiencies) to assess in the most comprehensive way possible the environmental and ecological effects of professions (Bonhenberger, 2022b). However, the labor often is used as a sort of "conceptual *passpartout*" on which the ecological transition is expected to rest, without providing a solid knowledge base on employment prospects, and instead concealing the risks associated with this transformation (Semenza, 2022). Notably, a specific body of economic literature more precisely forecasts the aggregate effects of the ecological transition on employment, emphasizing that job creation in the green economy will quantitatively surpass the employment capacity of the current carbon-intensive production model (Marin and Vona, 2019, 2023). This literature also demonstrates how the effects of climate policies are essentially regressive, how "carbon-intensive" regions are more vulnerable to external shocks, and how socio-structural positioning negatively impacts individual behaviours, given the lesser importance that lower-income classes place on environmental issues: the "materialistic values" of those groups prevent the benefit of those sets of policies (Vona, 2023). The main limitation of these approaches lies in the operationalization of the ecological transition, which is typically considered in terms of carbon taxes or the Carbon Border Adjustment Mechanism (CBAM) and incorporated as a variable in predictive economic models. This article aims to advance the discussion on the aggregate impacts of the ecological transition by proposing an operational definition of the green transition that primarily considers the impact of decarbonization, understood in the dual sense of emancipation from coal as an energy source and raw material, and the reduction of greenhouse gas emissions, especially carbon dioxide.

2.2. The segmentation theory in the light of the green transition.

The third relevant strand of literature concerns the approaches of segmentation theory to the labor market – an interpretative key suitable for explaining the mechanisms that generate inequalities within the labor market in transition. As is well known, segmentation theory offers a revision of neoclassical models of labor market functioning, which explain wage differences, career trajectories, occupational positions, and working conditions based on supply and demand mechanisms driven by institutional conditions such as productivity, technological development, and economic growth (Doeringer and Piore, 1972; Edwards et al., 1975; Lindbeck and Snower, 1988). These approaches posit that labor markets can be sub-categorized into a core labor market, composed of insiders, or a primary segment, characterized by stable, skilled, and hierarchically integrated employment, and a secondary segment, made up of outsiders, who are marked by greater employment discontinuity and typically individualized work performance. The argument is that business strategies (with internal labor markets) contribute to the

permanent regeneration of inequalities, leaving marginal groups – "non-competitive" groups – on the outskirts of the labour market, such groups being defined by ascribed characteristics such as social origin, gender, ethnicity, or migrant status. Thus, the idea is that the division within the labour market can be attributed not so much to inadequate levels of human capital, productivity differences, or qualifications, but rather to asymmetries in demand, general economic conditions, and the reproduction of formal and informal practices in workplaces (Rubery, 1994; Grimshaw et al., 2017). In general terms, the segmentation theory with which this article engages is useful for providing a conceptual framework for understanding the social processes triggered by the ecological transition. Moreover, the goal here is to align existing knowledge with a well-established interpretative framework for studying the labour market.

3. Green segmentation: an interpretative socio-economic framework for the ecological transition.

The socio-economic approaches of dualism and segmentation in the labour market provide an interpretative framework that is applicable to the effects of the ecological transition on employment and social inequalities. Our hypothesis is that, on the one hand, the reduction of the internal labour markets will be coupled with the growth of unstable job positions and individualized contracts. On an aggregate level, this will result in a reduction in the "insider" fraction of the labour market, while in the proliferation of the "outsider" segment, conversely producing further occupational fragmentation; on the other hand, in the green professions market, there will be a deeper segmentation between the highly skilled and specialized workforce and those with medium or low qualifications, leading to a greater gap in employment opportunities between high-skilled and low-skilled workers. This will translate into wage disparities and, more generally, into an increasing class divide, to the detriment of blue-collar workers. Finally, the outcomes of the transition processes will be influenced by contextual regulatory factors and political-institutional solutions (such as skills adaptation or the development of new sustainable industrial plans), all of which can strongly affect segmentation (Grimshaw et al., 2017). Two main segmentation mechanisms were individuated: the first relates to the previously discussed reduction of the insider share, while the second concerns the differences in skills and occupational structure between grey and green jobs. On the first point, the main issue is that green technologies, which will replace fossil-based ones, are less labour-intensive, meaning that, for the same level of output, they require less workforce. This is the case for steel production (Novelli et al., 2023; Mandelli and Novelli, 2022) and the automotive sector, where the shift to electric vehicles is already showing its effects on the production chain (Bauer et al., 2020). The second point concerns the skills required for new green jobs. It is expected that the new tasks will mostly involve advanced skills, typically related to design, supervision, and innovation, replacing the technical and manual tasks characteristic of grey jobs (Cedefop, 2021, 2023). These tasks align with the trend of the "autonomization" of work, where professionals do not enter dependent employment contracts with companies but, due to their high level of skills and specialization, work as "self-employed professionals or contractors," individualizing the bargaining process (Semenza and Pichault, 2019; Semenza and Mori, 2020). These two mechanisms, set against the backdrop of a decades-long crisis in industrial relations, are expected to undermine the very structure of collective bargaining, which has historically been driven by carbon-intensive sectors, such as metalworking and mining. As established in the literature, hard-to-abate industrial sectors typically exhibit higher union density, are protected by collective agreements, and offer strong social guarantees in cases of unemployment, illness, or injury (Zwysen, 2024; Galgoczi, 2023). In this regard, it is not surprising that evidence from various case studies shows that, while trade unions defend employment, they also engage in broader reflections on ecological transition, questioning its short-term objectives (Thomas and Doerflinger, 2020). While organized labor at the supranational (ILO, 2015) and European (ETUC, 2019) levels has supported the process

of ecological transition, at local dispute levels, where the occupational consequences are more visible, the contradiction between labour and the environment proves harder to resolve. More abstractly, in terms of industrial relations, the ecological transition could marginalize organized labour from one of its core sources of power – its ability to mobilize in industrial sectors – which, as previously mentioned, has already been weakened by decades of deindustrialization. Following segmentation theory (Doeringer and Piore, 1972), the green transition could, in fact, extend the area of outsiders, eroding the last remnants of "protected" twentieth-century work, which were characterized by broader organizational contexts, labour regulated by formal and informal norms, task identification, and class-based solidarity mechanisms.

4. Green inequalities.

4.1. Class inequalities

When it comes to the social impacts of climate policies, class inequalities emerge as one of the most critical and underexplored aspects in the literature. The transformations arising from a radical process of economic restructuring will, as previously discussed, have a significant impact on occupational structure and, consequently, on class structure, especially if we consider (as is customary) occupational classes as a proxy or synthetic indicator of social stratification. First, following Chancel's (2022), the climate crisis is triggered and perpetuated by the wealthiest classes: globally, the top 10% of income earners, particularly in Europe and North America, are responsible for about half of CO2 emissions. On the other hand, the European working class, according to the same study, is the only social segment that has reduced its carbon footprint over the past 30 years. Thus, while the origin of the climate crisis can be attributed to the wealthier classes, the costs of climate policies aimed at mitigating and combating climate change risk, at least in Europe, falling primarily on the working classes. In these terms, the current scenario shows some peculiarities. Indeed, in several contexts, there is an unexpected alignment between the interests of the industrial working class and those of extractivist oligopolies seeking to maintain the status quo – guaranteeing workers stable incomes and good working conditions, while ensuring profits for the latter (Hanckè and Mathei, 2020). The automotive sector stands out in this context, directly and indirectly employing more than 6% of the entire workforce across Europe (Galgoczi, 2023). Furthermore, it is well known that within public opinion, the environmental issue and its prioritization on the political agenda are influenced by citizens' socio-structural positions: lower and middle-low classes tend to view "environmental protection, nature, and climate" as less relevant than higher, more educated social strata, and, more generally, support for the ecological transition and achieving climate goals is largely defined by class affiliation (Vona, 2023; SINUS, 2023). Following an old insight, green issues remain primarily the concern of post-materialist sensibilities (Inglehart, 1977, 1990). The second aspect concerns the impact that the ecological transition will have on job protection, the increase in the number of outsiders, and the level of coverage of collective bargaining. Indeed, while the last mass employment experiences – particularly in automotive and steel – will be replaced by highly specialized profiles and supervisory and design tasks driven by new digital technologies and AI, the new green professions will fuel the trend towards more individualized contracts. This process will further erode the mass base of organized labor, dispersing the power resources historically available to sectors that have driven collective bargaining, with broader consequences for industrial relations (Zwysen, 2024; Galgoczi, 2023). The rebalancing in favor of capital will lead to a further weakening of organized labor's ability to influence the public sphere, especially in relation to working conditions and social protections linked to employment. This dynamic will have only marginal consequences for the new self-employed and high-skill professionals, given their strong bargaining power and the scarcity of these profiles. However, the situation is different for manual workers and, more generally, for workers with practical specializations. On the one hand, this workforce is already more exposed to downward competitive dynamics and will bear a higher price in the ecological transition, as many of the

"dirtier" jobs will be either eliminated or automated. On the other hand, the weakening of collective bargaining will further diminish its capacity to improve social protections and labor conditions, with clear effects for those group and sectors with less bargaining power.

4.2. Geographic inequalities.

Regarding geographic inequalities, the literature offers numerous insights. The green transition will, in fact, primarily target regions characterized by heavy industry. These areas show common economic and social dynamics. They are often "sacrifice zones" (Bullard, 1990; Barca and Leonardi, 2016, 2018), where the environmental and climatic costs of global value chains converge, and where the relationship between capital and labour is characterized by "employment blackmail," or the "threat of relevant job loss as a structural cause for the production of environmental justice" (Barca and Leonardi, 2016). This concept complements the "work-health dilemma," whereby it is not possible, with current technological development, to reconcile employment with workers' health protection. Another typical feature of these industrial regions is the establishment of monopsonistic labour markets (Tomassetti, 2020). Here the labour supply is dominated by large industries, which, through various lock-in effects (Grabher, 1993; Greco and Di Fabbio, 2014), help maintain a status quo characterized by income distribution, profit accumulation, and escalating climate crisis due to emissions, and local environmental damage, with serious consequences for public health (Novelli, 2025). When it comes to the green transition, the most tangible risk is the inability to effectively address industrial unemployment, which is already a key issue in these places. According to the literature, the risk is that the green transition could produce dynamics akin to "noxious de-industrialization" (Feltrin, Mah, Brown, 2023), a "negative-sum game in which job loss (and/or its growing precariousness) and environmental degradation go hand in hand" (Leonardi, 2023).

4.3. Skills inequalities

The skills dimension is closely linked to the social impacts of the green transition. Unemployment risk for blue-collar workers is the main argument used to oppose the transition, and the radical right has politicized the issue to gather support, particularly from its "losers" (Abraham, 2019). On the other hand, the availability of technical skills is considered crucial for accelerating the transition to a carbon-neutral economy and for the green sectors. The ecological transition should, in fact, be conceptualized as a skill-transition, whose implications and inequalities go beyond specific expertise (CEDEFOP, 2021, 2023). Initially, the OECD debate focused on how most green jobs would require only a "topping-up" of existing skills. However, it also acknowledged a significant variation, particularly in terms of workers' prior experience and the characteristics of the sector they are moving into after losing their previous job (Botta, 2019 p. 17; Jagger et al., 2014). Subsequent studies reveal that the ecological transition, in terms of required skills, fits well within the segmentation theory framework. Marin and Vona (2019) highlight how an increase in energy prices – proxy for climate policies – produces significant heterogeneity among different occupational groups: "technicians" see an increase in job demand, while "manual workers" experience a decline. Moreover, it is clear that climate policies, unlike other "structural transformations," create a competitive advantage for "abstract occupations," particularly those in "technical occupations" (ISCO 3), such as "Physical and Engineering Science Technicians, Process Control Technicians, and Government Regulatory Associate Professionals" (ibid.). This article aims to integrate these findings by proposing some critical reflections. One key consideration is the quality of green jobs. While the demand for jobs is expected to shift toward highly qualified professions, this does not provide sufficient insight into the quality of employment. While technical and design skills are characterized by scarcity, leading to relatively greater bargaining power, the individualization of contracts risks producing negative effects in terms of social protection and job security.

4.4. Socio-demographic inequalities

The jobs most at risk in the ecological transition process predominantly concern the male workforce employed in hard-to-abate

sectors. For this reason, the economic resources and professional retraining policies aimed at new green occupations will primarily target male-dominated sectors. In this regard, feminist perspectives highlight the absence of a substantive vision of gender equality within the ecological transition framework (Fredman, 2023), which should address the structural forces that perpetuate occupational, and wage disadvantages rooted in cultural stereotypes, biases, and stigma. On the other hand, occupational and skills-based approaches, as shown, attempt to measure and describe green jobs, converging on the idea that the jobs being created, and those that will be generated in the near future, should not only be of good quality—meaning highly qualified and professionalizing—but also potentially more open to achieving a better gender balance in their distribution (Botta, 2019). However, because the green sector is structurally linked to the parallel digital transition and relies on technical, scientific, and engineering skills, it will be impacted by the significantly lower number of women graduating in STEM fields (around a third of the total at the European level), and thus by the occupational segregation women face in related sectors and roles. Occupational segregation, particularly horizontal segregation – where female employment is concentrated in only a few sectors – remains a significant feature of European labour markets. The green transition requires skills and knowledge in sectors where gender inequality is notable (EIGE, 2023). In addition to the gender dimension, it is also useful to reflect on the intergenerational dynamics within the labour market. The ecological transition will be influenced by the significant imbalances in labour markets, marked by structural changes and more recent dynamics related to demographic shifts and the types of labour input provided by different segments of the workforce. In summary, in the post-industrial capitalist model and the service economy, labour is no longer distributed equitably across the population. European economies are experiencing a chronic labour shortage, due to the lack of technicians and population ageing. Considering that the ecological transition, along with the digital transition, is skill-intensive, the question arises as to what the prospects of the ecological transition are in labor markets that are not dynamic and poorly suited to absorbing more qualified labour.

5. Conclusions

This article aims to deepen the social implications of the ecological transition, particularly its effects on labour markets, by addressing two key research questions: i) What impact does the ecological transition have on occupational structure, the distribution of skills, and working conditions? ii) What are the distributive consequences and, therefore, the impact of the ecological transition on inequality structures? The central hypothesis is that the ecological transition, understood as decarbonization, will represent a further step in the segmentation of the labour market through two mechanisms. First, there will be a decrease in professions in heavy industry and mining; second, the green jobs created will fit into a secondary labour market with dynamics typical of self-employment. These two aspects will have an asymmetric impact on the pre-existing inequalities. The ecological transition will incur higher costs for low-income working classes, who will be more affected by industrial unemployment and increased costs due to climate policies. Furthermore, the ecological transition will negatively impact collective bargaining, further eroding the power resources available to organized labour, with consequences on employment conditions and social protections. Geographically, the regions most affected will be the "sacrifice zones," with the risk of exacerbating processes of "harmful de-industrialization." In terms of skills, due to the skill-intensive nature of the process, the gap between low-skilled and high-skilled jobs will widen, generating a worsening for the former. Finally, regarding socio-demographic inequalities, the ecological transition does not seem capable of mitigating the gender gap and will produce differentiated effects depending on the ability of national labour markets to absorb younger workers. More generally, this article suggests integrating the theme of the social impacts of the ecological transition, which manifest through the intensification of specific inequalities (across regions, economic sectors,

social classes, socio-demographic groups, and levels of skill and education). Ignoring the inequalities that are being created in the planning of climate policies would be a grave mistake, opening the field for a "green backlash" (Boquillon, 2024), advocating for the delaying or abrogation of climate policies. Instead, as the objective must be to have a transition which is just and left no one behind, a further step is required to ensure its social performance. At the European Level, several policy measures have been adopted, including the Just Transition Fund and the Social Climate Fund; at the state of the art, however, it is necessary to adopt incisive industrial policies, capable to stimulate employment. In this sense, it is useful to go beyond a "mythical" narrative of the ecological transition, analyzing the socio-economic inequalities and distributive conflicts it may provoke – and is provoking. The aim of this article is thus to propose a framework for incorporating the themes of ecological transition into the debate of economic and labor sociology, as the transition will have decisive repercussions on production structures, the qualification system, economic geography, and the conflict between capital and labour.

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