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A Global and Inclusive Just Labor Transition: Challenges and Opportunities in Developing and Developed Countries

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A Global and Inclusive Just Transition: Challenges and Opportunities in Developing and Developed Countries' Labor Markets

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Abstract

This research identifies challenges and opportunities for achieving an inclusive just transition to a low-carbon economy in the labor market, a just labor transition (JLT). We conduct a comparative analysis of JLT policies between developed and developing countries. These countries face common challenges in achieving a JLT to ensure quality jobs, compensation for displaced workers, and the need for governmental intervention. In assessing developing countries, we recognize the heterogeneity among these countries, so we focus on a sample that allows us to characterize the labor market within the transitioning sectors. We identify both challenges and potential avenues for creating new employment opportunities, facilitating skill retraining, and ensuring the integration of communities within a JLT. Many of these countries are in the initial phases of a just energy transition, and notably, we also explore the nascent just energy transition partnership efforts. Further, we describe the opportunities and lessons drawn from advanced economies' experiences and the recent efforts of developing countries that could help achieve a global and inclusive JLT. These findings demonstrate some key steps many countries can take towards beginning and achieving their JLT destination. Finally, we construct and present a Just Labor Transition Progress Scale, which measures where countries are in terms of their progress in policy and impact within their job markets. This tool will be particularly useful for research and policy-making practitioners.

Key Words

Just Transition, Just Labor Transition, Labor Markets, Climate Policies, Environmental Regulation, Energy Transition

JEL Classification Numbers:

J24, Q58, H23

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Contents

1 Introduction **7**

2 Literature Review: From many transitions to a just transition **10**
2.1 How does just "energy" transition differ from other transitions? . . . 10
2.2 What is the "Just Transition"? . . . 11
2.3 Economic Labor Market's Literature . . . 12
2.3.1 Jobs and Environmental Regulation . . . 12
2.3.2 Green Jobs vs. Brown Jobs . . . 14

3 Developed Countries and a Just Labor Transition **16**
3.1 A Comparative Analysis of Developed Countries . . . 16
3.1.1 Australia . . . 16
3.1.2 Germany . . . 17
3.1.3 Netherlands . . . 17
3.1.4 New Zealand . . . 18
3.1.5 Poland . . . 18
3.1.6 United Kingdom . . . 19
3.1.7 United States . . . 20
3.2 Just Labor Transition Challenges in Developed Countries . . . 21

4 Developing Countries and a Just Labor Transition **24**
4.1 State of the Just Transition in Developing Countries . . . 24
4.1.1 Argentina . . . 24
4.1.2 Colombia . . . 25
4.1.3 India . . . 25
4.1.4 Indonesia . . . 25
4.1.5 Nigeria . . . 26
4.1.6 South Africa . . . 26
4.1.7 Vietnam . . . 27
4.2 Just Labor Transition Challenges in Developing Countries . . . 27
4.3 Just Energy Transition Partnerships (JETPs) . . . 29

5 Advancing Just Labor Transition Policy **32**
5.1 Labor Market and Education . . . 33
5.2 Social Protection . . . 33
5.3 Regional Development/ Economic Diversification . . . 34
5.4 Climate Finance . . . 35

6 Evaluating the Just Labor Transition Journey: the Just Labor Transition Progress Scale **37**
6.1 Method Description . . . 37
6.2 Results . . . 38
6.2.1 Just Labor Transition Progress Scale: Developed Countries . . . 39
6.2.2 Just Labor Transition Progress Scale: Developing Countries . . . 41

7 Conclusions and Future Perspectives **44**

References **45**

A Appendix: JLTPS Next Steps **52**

List of Figures

1.1 Countries Analyzed 7
6.1 Just Transition Progress Across Countries 39

List of Tables

3.1 Summary of JLT Lessons from Developed Countries 23
4.1 Summary Statistics of JLT Challenges in Developing Countries 28
4.2 Current Just Energy Transition Partnerships 30
5.1 Scope of Just Labor Transition Action 32
6.1 The Just Labor Transition Progress Scale 38
6.2 The just transition Progress Scale for 7 Developed Countries 40
6.3 The Just Labor Transition Progress Scale for 7 Developing Countries 42

1 Introduction

The call for justice is increasingly resonating across societies worldwide in the context of climate change. The 2023 United Nations COP28 conference is an example of this, where almost all stakeholders (governments, private sector, and civil society) mentioned the issue of just transition in their pre-COP28 position statements. Actions on justice issues related to energy and climate change are taking place at the international, national, and local levels. Indeed, the issue of a just transition is becoming one of the key driving forces for change when planning national and local economic policy.

The term "just transition" is concerned with a number of key issues that include for example: the flow of financing from the global north to the global south; energy poverty and security; the increase in energy costs for low-income groups; the equitable distribution of the benefits and risks from the clean energy transition; and resource mining. However, in this paper, the primary objective is to focus on the labor market aspect of the economics of the just transition. Hence, the emphasis is on achieving a just transition within labor markets, which will be referred to as the Just Labor Transition (JLT).

This study is comparative in nature, whereby we assess the labor policies of 14 different countries, seven developing (Argentina, Colombia, India, Indonesia, Nigeria, South Africa, and Vietnam) and seven developed (Australia, Germany, Netherlands, New Zealand, Poland, United Kingdom, and the United States) countries - see Figure 1.1 for the countries analyzed. As a result, this comparative political economy research offers an original insight into an under-researched area of the just transition in terms of the labor markets.

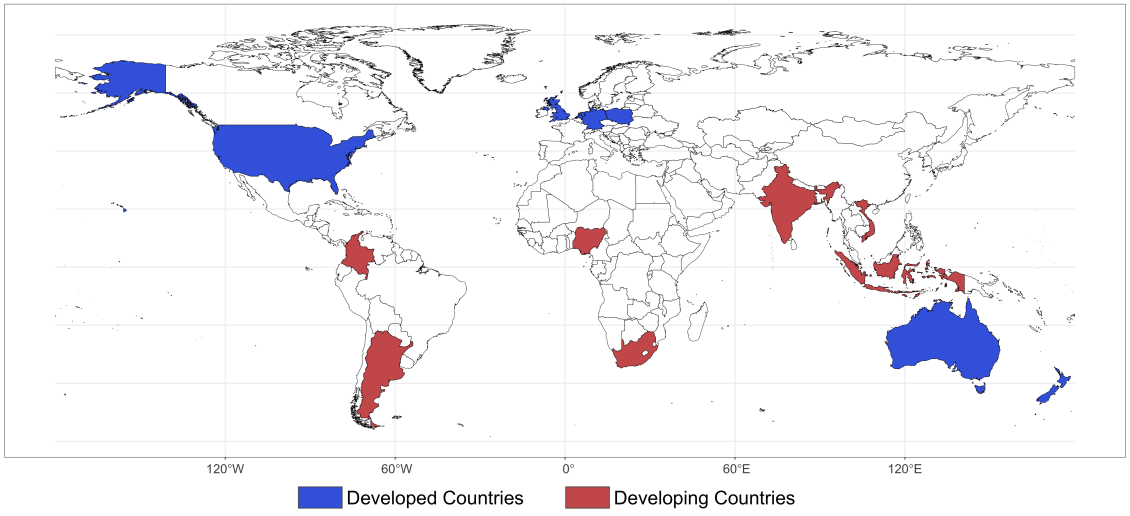

Figure 1.1: Countries Analyzed

There is growing research in the area of the JLT and our research adds to this literature but with a clear focus on the JLT progression of the countries worldwide. The aim is to begin to explore the success of labor policies and assess whether they are meeting the objectives of the just transition. We conduct the research here with a qualitative approach. An original contribution is our advancement of a qualitative tool for assessing the policy progress of the countries on the JLT

– we call this a Just Labor Transition Progress Scale (JLTPS).

To underscore the necessity for further scholarly exploration in JLT, the paper delves into the nature of a just (energy) transition, drawing comparative analyses with other transitions that would accompany adverse labor market shocks, such as digital transformation or trade liberalization, which have been scrutinized within the literature on labor economics (inc. issues such as the scale of layoffs and workforce reallocation). A comprehensive review of previous literature on the labor market implications of environmental regulations is presented, encompassing methodologies ranging from reduced-form analyses to general equilibrium approaches. The literature section also examines the employment and wage effects and recent studies addressing transitions from "dirty" to "green" jobs.

In addition, the paper analyses the early development of the Just Energy Transition Partnerships (JETPs) concept, designed to assist developing nations in attaining just transition policy objectives through financial mechanisms established in collaboration with international partner countries. Informed by analyses of historical experiences and current conditions in the energy transition landscape, the paper concludes by advancing actionable measures for JLT planning. The research overall contributes a timely exploration and research analysis of progress made around jobs and, in effect, labor policy in the context of how developed and developing countries are meeting their obligations under the 2015 Paris Agreement (which mentioned specifically the just transition) and the United Nations (UN) Sustainable Development Goal, No. 8 on decent work and economic growth.

This paper also aligns with the continued and widely accepted evidence from the Intergovernmental Panel on Climate Change (IPCC). Given the IPCC's latest assessments and reports that detail the escalating impacts of global warming and its far-reaching consequences. It is imperative to prioritize a transformative approach that aligns with the findings and recommendations of the IPCC. Therefore, advancing on JLT is a prime economic policy. Thus, the comparative methodology used in this research across 14 countries allows us to first draw comparative insights from firstly advanced economies that underwent energy transitions, particularly those marked by declines in mining activity within coal-rich communities. The research highlights the diverse contexts of energy transitions across several nations. Special attention is accorded to the strategies employed by these nations to mitigate labor market impacts, including job and income losses. Secondly, the subsequent focus shifts to assessing the present status and challenges associated with JLT in developing countries, where considerable heterogeneity prevails regarding industry, political structure, and general JLT progress.

Finally, we propose the Just Labor Transition Progress Scale (JLTPS), a crucial tool for evaluating and comparing the diverse journeys of countries in transitioning towards a more sustainable, low-carbon economy. The scale, meticulously applied to the seven developing and seven developed nations, provides a nuanced understanding of each country's progress on the just transition continuum. From early stages to the most advanced, the scale effectively captures nations' varying degrees of preparedness and effectiveness in managing the socio-economic implications inherent in moving away from fossil fuel-dependent industries. By distilling complex assessments into a comprehensible scale, this tool facilitates a global understanding of each country's JLT journey's challenges, successes, and unique characteristics, ultimately contributing to developing targeted and effective policies tailored to specific contexts.

Based on the JLTPS, we identify that India and Nigeria emerge as beginners, initiating their JLT journey, while Argentina, Colombia, Indonesia, and South Africa navigate the Moderate Stage. Vietnam stands out as the most advanced among developing nations. On the contrary, Australia lags

as a beginner among developed countries, Germany and the United Kingdom lead with advanced approaches, and the Netherlands, New Zealand, Poland, and the United States demonstrate varying degrees of progress. This nuanced scale distills complex assessments, offering a global perspective on the diverse challenges and successes in managing the intricate socio-economic implications of transitioning away from fossil fuel-dependent industries. The JLTPS provides a foundation for targeted and effective policies tailored to the unique contexts of each country, fostering a more equitable, just, and resilient future. As noted earlier, the JLTPS is developed here in a qualitative approach that establishes boundaries of what is included in its framework and a quantitative approach will follow in future planned research.

As we move forward, it is crucial to draw lessons from past transitions and tailor policies to address the specific challenges posed by the energy transition. The experiences of developed and developing countries provide valuable insights into crafting effective and inclusive strategies. The path ahead is complex, but it also presents opportunities to steer our economies toward sustainability while ensuring no one is left behind. By fostering a just transition, we can forge a more equitable and resilient future for all, where climate mitigation and environmental sustainability go hand in hand with social justice and economic prosperity.

The following section reviews the labor market's previous literature on environmental regulation and green jobs. Then, in Section 3 and 4, we present case studies of both developed and developing countries. Most instances of energy transitions to cleaner sources are found in developed countries while developing nations are still in the early stages of the JLT journey. In Section 5, we analyze and discuss the joint opportunities to ensure just transitions; in section 6, we introduce our JLTPS to analyze the progress on each country's JLT journeys. Lastly, Section 7 concludes and discusses the future research outlook.

2 Literature Review: From many transitions to a just transition

The global economy has experienced different forms of transitions by which modern industries replace traditional structures. Old examples are the Industrial Revolution, which transformed economies from handicrafts into mechanized manufacturing, and the rapid expansion of railroads, which stimulated heavy industries and replaced other forms of transport, such as canals. One of the most recent ongoing transitions is digital transformation that "automates" routine processes. It affects worker cohorts specialized in routine tasks within industries undergoing rapid automation. Not only for job displacements, Acemoglu & Restrepo (2022) find that the digital transition has induced relative wage declines of particular workers (e.g., routine jobs) who lose their comparative advantage.

2.1 How does just "energy" transition differ from other transitions?

What types of workers are vulnerable to the energy transition? First, workers with the extraction-specialized high-skill jobs such as derrick or rotary drill operators in the oil and gas sector or coal mining machine operators would be losers in the energy transition since they have limited skill premia in non-extraction sectors. While certain workers may already possess transferable skills requisite for success in the solar or wind industry, they are likely to encounter challenges associated with job retraining or relocation. Second, low-educated extraction workers may have few opportunities within the labor market. It could be challenging for ex-coal miners to be successful in the job market, as they may encounter obstacles when attempting to translate their prior work experience into viable job opportunities. In contrast, coal truck drivers may experience a relatively smoother transition, as their specialized skill set in driving may necessitate minimal on-the-job training, rendering them more appealing job candidates to alternative employers.

One recent example of the adverse labor market shocks is the decline in US manufacturing caused by Chinese import competition. The trade-exposed labor markets in the US experienced higher unemployment and lower wages due to the growth in imports from China. The US regional labor markets exposed to Chinese import competition bore approximately 44 percent of the reduction in manufacturing employment and a decrease of 0.76 logarithmic points in the mean weekly earnings over the entire span from 1990 to 2007 (Autor *et al.*, 2013). Acemoglu *et al.* (2016) estimate that the employment losses attributable to the increasing competition posed by Chinese imports during the period spanning from 1999 to 2011 fall within the range of 2.0 to 2.4 million jobs. Further, Hanson (2023) believes that these painful outcomes have to be top of mind to avoid repeating them when studying the implications of the energy transition.

The energy transition involves a fundamental shift in how societies produce and consume energy (Terzi & Fouquet, 2023). The local labor market effects of the energy transition will have the following characteristics. First, the energy transition will lead to more direct "demand" changes in fossil fuels, manifested by a phase-down of the power plants or mine closures, while manufacturing declines due to trade liberalization are caused by demand shocks associated with increasing relative factor input prices resulting from lower comparative advantage. Second, mining sectors are geographically concentrated, in that fossil fuel reservoirs are "fixed-on-the-ground", indicating that they have more immobile labor and capital than other sectors. This suggests that energy workers would have limited opportunities when they find other similar-wage jobs within their community. Moreover, community ties in fossil fuel regions are typically strong, making it harder for workers to move out for better job opportunities. It is also challenging for firms in the mining

sector to adjust to demand shocks due to the limited availability of fossil-fuel-rich lands. Third, the whole local economy in some fossil-fuel-rich communities heavily depend on their local mining industry. Typically, they are featured by the high local share of the energy sectors. Thus, the fossil fuel industry declines would heavily impact local labor markets in such resource-rich communities because the local non-mining sectors would be more linked to the dominant mining sector. For example, fossil-fuel-related supply chain sectors such as gas transportation or oil-dependent manufacturing would decline, or the service sectors (e.g., restaurants) would experience revenue losses due to increasing unemployment or even out-migration of energy workers.

The energy transition exhibits comparable attributes to the broader labor market dynamics observed in routine occupations affected by the enduring digital transformation. In the aftermath of the global financial crisis, there was a marked reduction in activities linked to fossil fuels, mirroring the substantial decline in employment opportunities characterized by high routine elements (Vandeplas *et al.*, 2022). A notable distinction arises in that the transition to clean energy can potentially affect employment across various sectors tethered to the fossil fuel extraction supply chain. In contrast, automation is likely to exert substantial displacement effects on jobs demanding lower to moderately skilled labor within the domains of agriculture and manufacturing.

In developing countries, past experiences like trade liberalization and technological change from 1960 to 1990 offer valuable insights, revealing varied effects on employment. For example, while countries in Latin America experienced high unemployment rates and increases in wage inequality, the experience in East Asian countries showed a reduction in wage inequality between skilled and unskilled labor (Wood, 1996). These differences are primarily attributed to two factors: human capital endowment and the abundance of natural resources (Mrabet, 2012). Regarding human capital, East Asian countries prioritized education and training policies before trade liberalization. In contrast, Latin American countries initially faced educational disparities, resulting in large periods of skilled labor supply adjustment (O' Connor & Lunati, 2008). Natural resources also played a role, which led Latin American economies to export more primary goods. As natural resources were often not equitably distributed in the population, this could have resulted in significant income inequality (Robbins, 1996). Notably, developed countries exhibit considerable heterogeneity, and the socio-economic characteristics of these nations influence the labor market's response to structural changes.

2.2 What is the "Just Transition"?

The concept of just transitions emerged decades ago from North American unions concerned about job losses from environmental and trade policies affecting heavy industries (Morena *et al.*, 2020). Just transition refers to the process of achieving economic and social changes necessary for sustainable development while protecting workers and communities and ensuring a more equitable distribution of benefits and risks (Rentschler & Bazaz, 2021). It involves transitioning to a more environmentally sustainable economy (and today more climate-friendly) in a well-managed way that contributes to the goals of decent work for all, social inclusion, and eradicating poverty (International Labour Organization, 2017), furthermore, as McCauley & Heffron (2018) established, just transition has different interpretations in the literature about climate, environment, and energy justice. Defining this concept well can help unite them under the umbrella of the justice required to transition to a low-carbon economy.

In recent years, just transitions have attracted attention from multilateral institutions, governments, investors, civil society, and labor groups. For example, during COP24, the *"Solidarity and just transition Silesia Declaration"* was adopted in Katowice, Poland. In this declaration, the Heads

of State that signed they: "*Stress that just transition of the workforce and the creation of decent work and quality jobs are crucial to ensure an effective and inclusive transition to low greenhouse gas emission and climate-resilient development.*" [1] Also, they highlighted the significance of ongoing efforts to ensure a fair transition for the workforce and the promotion of good employment opportunities and quality jobs, such as sharing experiences, integrating just transition considerations into climate plans, supporting developing countries in promoting sustainable economic activities and aligning the transition with the UN Sustainable Development Goals.

The International Labour Organization (ILO) discussed the concept of just transition for the first time in 2013.[2] Further, in 2015, the "Guidelines for a just transition towards environmentally sustainable economies and societies for all (International Labour Organization, 2015)" were adopted. Most recently, in 2023, ILO's International Labour Conference included a session discussing the just transition. In the International Labour Organization (2023) report, they emphasize how the transition to environmentally sustainable economies can create jobs and drive economic growth. However, realizing these benefits requires collective action and the development of inclusive policies to ensure a just transition with decent work and social inclusion.

Further, many Global South nations have included just transition frameworks in their Nationally determined contributions (NDCs) and related policies, either explicitly or implicitly (Glynn *et al.*, 2020). Nonetheless, there is a lack of consensus around the meaning and implications of the just transition concept, specifically in the developing country context, which is creating barriers to its understanding, acceptance, and introduction into policy (Cahill *et al.*, 2020).

The scope of the just transition agenda depends on how we frame approaches to it. The justice-related energy transition topics include the lack of accessible and affordable energy driven by fossil fuel industry collapses, disparities in environmental quality improvements, or preserving residents' identity and honoring their history in fossil-dependent communities. Among various issues, a pivotal aspect of the just transition approach involves substituting old jobs with new ones, making job creation a representation of fairness. Conventional approaches to the just transition can manifest as initiatives managed by energy corporations, involving programs for job training and pension systems to support affected workers in the energy sector. For example, financial support to facilitate miners' relocation and job retraining programs for displaced miners would rectify their glaringly unjust circumstances. In discussing such corporate-led shifts toward a low-carbon economy, however, we need to account for the necessity of providing job opportunities to all non-energy-sector workers who will be disadvantaged due to the transition. In addition, other labor-related issues such as the equitable distribution of jobs (pertaining to accessibility and opportunities), job quality, or within-job wage gap could be considered.

2.3 Economic Labor Market's Literature

2.3.1 Jobs and Environmental Regulation

This section will review previous literature on the effects of environmental regulation on employment to understand the potential effects of new climate and environmental regulations to achieve a green transition in the labor markets.

The available body of research regarding employment and environmental regulations can be

[1] Solidarity and just transition Silesia Declaration

[2] This year, ILO adopted a resolution and a set of conclusions on sustainable development, decent work, and green jobs. They also announced the Green Initiative.

categorized into three groups: empirical studies using reduced-form methods, general-equilibrium modeling focusing on full employment, and models that account for search frictions to measure unemployment effects.[3]

First, we review papers that use reduce-form methods, which is to estimate the direct relationship between variables of interest, focusing on empirical measurement. An important caveat is that, as Smith (2015) emphasizes, these studies focus on analyzing past regulations' effects on specific industries at specific moments, reflecting the unique circumstances prevailing in both product and labor markets during those times. Consequently, these models are limited to measuring historical outcomes. However, they are ill-suited for predicting the potential consequences of new regulations, like a carbon tax, and under novel economic conditions, tasks that can only be effectively addressed through the use of structural models.

Here are some pertinent examples of reduced-form studies that investigate the connection between labor markets and environmental regulations: Initial studies such as Berman & Bui (2001) and Morgenstern *et al.* (2002) find minimal impact on employment levels[4], but subsequent papers, found striking negative impacts of environmental regulation on labor markets. According to Greenstone (2002), during the initial 15 years of the Clean Air Act[5], approximately 590,000 jobs were eliminated within heavily regulated industries. Furthermore, Walker (2011) observed a 15% reduction in employment within polluting sectors in counties newly subjected to regulation. Additionally, Walker (2013) noted that newly regulated plants collectively suffered a loss of over $5.4 billion (USD) in earnings for the years following the policy change. In similarly focused research, Kahn & Mansur (2013) discovered detrimental impacts on employment in counties with air quality below the National Ambient Air Quality Standards, particularly within electricity-intensive industries. These effects translate to reduced jobs equivalent to what would typically occur following a 33 percent increase in electricity prices. Curtis (2014) shows that unemployed individuals who lack experience in regulated sectors face additional challenges as job opportunities within the industry diminish and wages decrease. Further, Sheriff *et al.* (2015) discovered that the 1990 ozone regulation reduced employment within power plants with no significant impact on energy generation. Also, Yip (2018) observes non-employment effects among highly educated individuals and an increase in unemployment and reallocation for those with lower levels of education in Canada. Further, Vona *et al.* (2018) find that environmental regulations have little to no impact on overall employment, but they create a gap in the demand for green skills. All the recent evidence points to climate policy's job destruction effect is limited to energy-intensive industries.

Moreover, significant endeavors have been made within the computable general equilibrium (CGE) literature to explore the connection between employment and environmental regulations. However, it's important to note that initial studies predominantly hinge on the assumption of

[3]As an alternative approach, Kuminoff *et al.* (2015) employs a partial equilibrium model centered on residential sorting, which assumes full employment and integrates considerations of welfare effects associated with job layoffs. Their findings suggest that, during a period of economic stability, the annual earnings of an average worker would decrease by $5,553 if they were to lose their job.

[4]Berman & Bui (2001) conducted a study and did not discover any compelling evidence indicating that local air quality regulations had a substantial impact on reducing employment, even when considering factors like induced plant closures and discouraged new plant openings. Morgenstern *et al.* (2002) uses a distinctive dataset at the plant level that was merged with industry-level demand data, revealing that heightened environmental expenditures typically do not result in a substantial alteration in employment. Specifically, an extra $1 million in spending prompted by the regulation leads to a mere reduction of 1.5 jobs, indicating a minimal impact on employment levels.

[5]The Clean Air Act constitutes the principal federal legislation in the US concerning air quality, designed with the overarching objective of mitigating and regulating air pollution on a nationwide scale.

full employment. [6] These studies abstract from frictional labor markets and unemployment, which is an important reallocation cost for workers.[7] Very recently, there has been growing literature on the implications of environmental policy on labor markets using search-and-matching CGE models, which are CGE models that allow for unemployment, where workers and firms search when unemployed or vacant. (E.g., Hafstead & Williams (2018), Hafstead *et al.* (2018), Aubert & Chiroleu-Assouline (2019), Fernández Intriago (2019), Castellanos & Heutel (2023), Finkelstein Shapiro & Metcalf (2023)) Generally, these papers find that the potential effects of regulation are an issue of reallocation rather than net job gains or losses. Nonetheless, there is evidence that specific industries are disproportionally affected, emphasizing the importance of just transition considerations. Even though most of these studies focused on developed economies, without considering informality a significant problem in developing countries, there have been recent efforts to remediate this fact. (Eg. Reidt (2021), Finkelstein-Shapiro & Nuguer (2023), and Fernández Intriago & MacDonald (2023)) In general, these papers find that carbon tax can achieve the reduction of emissions but significantly affects the formal sector, creating more informality, though reducing the countries' productivity and output. However, they identify that using other policy instruments, such as rebating the revenue to decrease the tax burden on formal firms, can offset the harmful effects of the carbon tax and continue achieving emissions reductions that are so important to stopping climate change.

2.3.2 Green Jobs vs. Brown Jobs

International Labour Organization (2023) underscores the potential creation of an additional 100 million green jobs globally by 2030 amid the green transition. However, this optimistic outlook is juxtaposed with the risk of approximately 80 million brown jobs facing obsolescence during the transition, with the emergence and decline of jobs being unevenly distributed and concentrated in specific regions and communities.

Further, Hanson (2023) emphasizes that transitioning from fossil fuel jobs to green jobs is an imminent and anticipated shock, providing a distinctive opportunity to glean insights from historical economic disruptions. Instances of job loss, often concentrated in specific regions, have historically manifested through challenges such as import competition and automation. In response to the energy transition's formidable challenges, suggested strategies involve fine-tuning unemployment insurance to local economic conditions, expanding technical and vocational training through community colleges, and coordinating effective place-based policies. Emphasizing the need for experimentation and evaluating alternative policy formulas, this approach aligns with the foresight into the industries affected and the localized nature of job displacement. A historical perspective reinforces the importance of proactively shaping policies to mitigate potential negative impacts on employment, earnings, and regional conditions during the energy transition.

Moreover, in policy discussions surrounding the labor market implications of the energy transition, considerable attention is often directed toward the direct shift from brown jobs to green jobs. Yet, recent empirical evidence challenges this narrative. For instance, a study by Curtis *et al.* (2023) focusing on the United States reveals that since 2020, only about 1% of workers leaving positions

[6] E.g., Bovenberg & van der Ploeg (1996, 1998)

[7] Hafstead *et al.* (2018) discovers that the full-employment model significantly overestimates the overall net change in jobs within the economy relative to search models. Specifically, it overestimates job impacts by a factor of more than 2.4 for a carbon tax with revenue returned lump sum and by a factor of nearly 2.7 when carbon tax revenue reduces payroll taxes, compared to the search-CGE model.

in brown industries successfully transitioned to green jobs. Notably, workers from brown jobs are more inclined to transition to similar roles rather than embrace green employment opportunities. Furthermore, research by Bergant *et al.* (2022) in the U.S. underscores that, even when geographical constraints are less prominent, green jobs exhibit systematic differences from neutral or brown-industry-related positions.

Bluedorn *et al.* (2023), drawing on micro-level labor force survey data spanning 31 countries from 2005 to 2019, observes the limited movement of individual workers from brown to green jobs. They identify a green wage premium, with workers in green jobs earning an average of 7% more than their brown jobs counterparts. This premium serves as a potential incentive for encouraging brown-to-green transitions and represents an opportunity for diverse workers to actively engage in the energy transition. Curtis & Marinescu (2022) corroborates the green wage premium by analyzing the US job postings, revealing that green jobs tend to be associated with occupations offering 21% higher pay than the average job, particularly benefiting those with lower educational requirements. This premium supports the economic viability of green jobs and highlights their potential to foster inclusivity in the evolving landscape of employment opportunities.

Colmer *et al.* (2023) documented, using linked, administrative employer-employee data for all W-2 workers in the US, that between 2005 and 2019, the US experienced significant growth in the clean energy sector, with an annual average of 2,587 clean establishments and 110,055 clean jobs, with a 200% increase in the number of clean establishments in those years and a 81% increase of jobs. In contrast, brown establishments decreased by 1.2 percent, with an annual average of 43,667 establishments, while brown employment grew by 33% to 1.18 million. Demographically, non-Hispanic white workers were over-represented in both clean and brown fuel activities, while Black workers were substantially under-represented, indicating potential disparities. They estimate a lower wage premium than Curtis & Marinescu (2022), where workers earned 16% more in clean establishments compared to brown ones. They also highlight that there have been low transition rates from brown to clean firms, with college graduates being almost twice as likely to make this shift, emphasizing potential challenges in workforce reallocation.

3 Developed Countries and a Just Labor Transition

How should we implement JLT policies in each country? As the countries have different backgrounds, such as industry portfolios and political structures, it is crucial to learn from past energy transitions. Some advanced economies, European countries in most cases, have experienced partial energy transitions away from fossil fuels. In these transitions, coal mining is the most affected industry for various reasons, including the environmental regulation that displaces carbon-intensive production or market forces driven by price competition (e.g., the Shale boom).

In this section, we introduce the recent trends in the fossil fuel industry in developed countries and how they have supported communities and individuals affected by their local mining collapses. Some policy initiatives implemented or planned in seven countries (US, UK, Germany, Netherlands, Poland, Australia, and New Zealand) are presented. We summarize key findings and lessons from their experience with energy transition and discuss what should be dealt with in the just transition agenda.

3.1 A Comparative Analysis of Developed Countries

3.1.1 Australia

In the mid-2010s, coal-fired power stations in Australia produced about 78% of the country's electricity, while gas-fired plants accounted for nearly 10%. To meet its carbon reduction commitments under the Paris Agreement, Australia plans to prioritize phasing out high-emission coal-fired power plants, with most to close by 2035 and all to be decommissioned by 2050. This highlights the growing importance of renewable energy in Australia's energy mix, the significant carbon emissions from coal-fired power, and the clear, evaluable targets for reducing these emissions.

In recent years, coal-fired plant closures in Australia have been marked by a lack of systematic structural adjustment policies from the government, relying instead on ad hoc and reactionary measures. There is a notable absence of comprehensive long-term planning and advance public notification. This reflects a persistent view in both public policy and industry that power plant closures are solely the responsibility of private companies. This perspective neglects communal accountability and social responsibility towards the affected workforce, local communities, and regions, and shows little concern for environmental issues. As a result, relationships are mainly contractual and profit-driven, within a minimal legislative framework.

The announcement of upcoming closures gives insufficient time for government action, even if they are willing to address the issue. The Australian government has not recognized its duty to create a comprehensive strategy for these challenges. There is resistance when companies adopt key aspects of JLT best practices, and the government has been unresponsive to local community organizations seeking help. Instead, government actions seem driven by electoral pressures, leading to poor outcomes. Australia's energy transition highlights the need for a comprehensive framework for the phased closure of coal-fired power plants. This should be supported by a well-resourced entity to oversee long-term planning, communication, coordination, and implementation. Additionally, power station companies should collaborate with stakeholders and take greater responsibility for implementing JLT measures.

3.1.2 Germany

Unlike other aging industrial areas in Europe, such as the United Kingdom, Germany managed the decline in hard coal production in the 1960s with a strong focus on social harmony. Former coal workers either took early retirement or found new employment, maintaining their socioeconomic status (Furnaro *et al.*, 2021). Germany implemented four key policies: First, the pension system allows early retirement for workers aged 50+ in underground mining or 57+ in surface mining, funded primarily by the national government since the 1960s. Second, "codetermination" in German labor law empowers workers to participate in company decisions. In the coal sector, this ensured that employees were not laid off but transitioned to early retirement or new jobs. Third, public revenue is distributed equitably across regions. Although coal mining is exempt from royalties, the decline in production has caused significant tax shortfalls for municipalities in coal regions. Fiscal equalization efforts have partially mitigated this. Fourth, structural policy (Strukturpolitik), used since the 1950s, combines industrial policies to stimulate economic activity and regional development policies to promote growth in economically declining areas.

Germany's strategy to support coal regions has relied heavily on substantial government investments and industrial policies. Initially, these policies focused on revitalizing or preserving traditional sectors, which hindered a smooth transition and led to significant public debt and budget deficits. However, the evolving role of the public sector in regional economic policies has been crucial in boosting the local economy. In addition to government efforts, the active involvement of community members in shaping and implementing these policies is essential. This local participation ensures that interventions are better aligned with regional needs, enhances societal approval, and leverages local expertise, all of which are critical for a successful transition away from coal.

3.1.3 Netherlands

In the early 20th century, Limburg in the southern Netherlands saw a rapid increase in coal mining production and workforce expansion. By 1965, about 75,000 people, over a third of Limburg's workforce, were employed in the mining sector and related supply firms. However, starting in the mid-1960s, coal production and employment declined rapidly. This decline was due to the growing difficulties Dutch coal mines faced in competing with global coal producers and the strong competition from low-cost European natural gas.

Addressing the coal industry's decline early on allowed for the gradual distribution of costs, preventing sudden and unexpected burdens. This gave the government, individuals, and businesses ample time to prepare and adjust, easing the strain on market mechanisms to absorb the newly unemployed. A key factor in successfully implementing this gradual approach was the high level of consensus among unions, mine managers/owners, and the government. This agreement on the industry's likely future and the need to significantly reduce its activities was particularly crucial.

Significant public sector investments were directed towards developing essential infrastructure, higher education, and training, along with fostering private sector innovation and entrepreneurship. This was achieved by creating clusters to revitalize specific sectors and regions. The Dutch practice of "social partnership," involving unions and collective agreements in shaping and executing socio-economic policies, was crucial during these transformations. This framework enabled workplace discussions, upward communication, and influence, effectively supporting the successful pursuit of economic diversification.

3.1.4 New Zealand

The New Zealand government's 2018 decision to stop issuing new permits for offshore oil and gas exploration has significantly affected about one-third of the nation's active exploration permits. Existing offshore permits approved before this decision can operate until 2030, and current producing offshore fields can remain operational until 2050. This phased transition allows for strategic preparation rather than an immediate industry-wide transformation. The Taranaki region will be the most affected by this change. Although the oil and gas sector employs just over 1% of the regional workforce, it is economically significant, contributing roughly one-third of the regional GDP and giving Taranaki the highest GDP per capita in the nation.

In 2018, the New Zealand government established the Just Transitions Unit (JTU) within the Ministry of Business, Innovation, and Employment to integrate "just transition" principles into its climate change policies and legislation. The JTU's main mission is to facilitate the transition process, particularly in the Taranaki region, by managing expertise and fostering partnerships. Working with the local economic development agency, the JTU conducted an extensive and inclusive dialogue to guide the region's shift to a low-carbon economy. This plan covers twelve transition-related topics, community outreach, a creative challenge, and youth engagement. The outcome was the Taranaki Roadmap 2050, a strategic blueprint co-created with various stakeholders. The roadmap outlines twelve distinct transition pathways aimed at diversifying and strengthening the local and regional economy. These pathways cover sectors such as tourism and include improvements to the regulatory framework. Some pathways also serve dual roles, impacting sectors and acting as enablers in areas like energy, infrastructure, and transportation.

While Taranaki's just transition efforts have primarily focused on economic diversification and regional development, individualized support for workers is also provided. This includes active labor market policies and retraining programs, often funded by demand-driven government services such as those from the Tertiary Education Commission and the Ministry of Social Development. Worker support is a common focus in just transition policies across advanced economies. However, it is important to note that Taranaki has not yet faced significant employment losses in the sector. A key part of Taranaki's transformation involves substantial investment in energy development, emphasizing a diverse range of renewable energy sources.[8]

3.1.5 Poland

In Poland, hard coal production has decreased by 63 percent, and mining sector employment has declined by 80 percent. While severance payments and early retirement incentives encouraged workers to exit the industry, these measures did not provide a lasting solution for former miners and their communities. During the extensive mine closures of the 1990s, which resulted in the rapid layoff of many workers, even significant severance pay could not replace a systematic approach to creating alternative employment opportunities and retraining workers.

A key aspect of Poland's energy transition is the use of European Union (EU) funds. Starting in 2007, EU funds for regional economic development began to support comprehensive programs

[8]The Patea Hydro development has stood as one of the largest renewable energy initiatives in the Taranaki region, although the potential for hydro expansion is limited. Wind technology has proven to be commercially viable in New Zealand, with two onshore wind farms currently in development within the region. It is notable that offshore wind farms have not yet been established in New Zealand. The utilization of small-scale and grid-scale solar energy remains relatively limited, with prospects for scaling up these initiatives. Additionally, the region holds untapped potential in wave, bioenergy, and geothermal energy resources.

addressing various socioeconomic challenges. These programs were managed by regional governments, reflecting a shift towards a more integrated approach to utilizing EU funds at the regional level. This approach differed from previous years when targeted programs addressed specific issues or EU funds financed specific components of broader measures. Concurrently, the national government's financial involvement in regional development initiatives decreased as they increasingly relied on the expanded availability of EU funds.

In Silesia, where most of Poland's hard coal mining operations are based, regional programs have focused on promoting economic development and diversifying away from coal production. These programs included investments in energy and transportation infrastructure, replacing old coal-based heating systems, revitalizing former mining areas, modernizing municipal infrastructure (such as renovating public buildings, improving street lighting, and upgrading sewage systems), and enhancing human capital. The Regional Operational Programs represented a shift in the EU's approach to funding regional development policies, using a "shared management" mechanism. In this approach, regional governments worked with the European Commission to plan, execute, and assess programs together. Spending plans needed to align with updated regional development strategies and EU policy objectives. The process of securing funds involved a wide range of stakeholders, including local authorities, businesses, experts, and local anti-mining protest groups, who participated in discussions about Silesia's future and the necessary policies and actions.

3.1.6 United Kingdom

The Single Regeneration Budget (SRB), which operated from 1993 to 2002, was one of the most comprehensive area-focused programs in the United Kingdom, providing investment funds to some coalfields. Evaluations of the SRB indicate it led to significant labor market outcomes, such as increasing employment by about 200,000. The SRB and similar geographically focused initiatives may have been more successful in improving social outcomes than labor-related ones. Although these projects aimed at regenerating specific areas might not completely reverse broader economic trends, they can significantly alleviate poverty by enhancing living conditions in disadvantaged neighborhoods. Improvements include better housing, community safety, physical surroundings, and educational opportunities. Community-level achievements include benefiting over 5 million students, constructing or renovating more than 300,000 homes, reclaiming 34,000 acres of land for open spaces or development, and supporting more than 100,000 community groups.

During this period, stringent austerity measures were implemented, shifting the responsibility for local economic growth to local authorities and community stakeholders. This approach, prioritizing local interests with the government playing a strategic and supportive role without imposing or managing revitalization plans, was especially pronounced in England. Notable developments included (Rising *et al.*, 2021): First, the replacement of regional development agencies and government regional offices with 38 local enterprise partnerships (LEPs). These partnerships, formed by civic leaders and business figures, focused on fostering growth and highlighted the central government's considerable retreat from regional development. There was no legal framework to define the goals, authority, or administration of these partnerships, and they lacked dedicated public funding until recently. Second, the initiation of devolution deals and city-region deals, where local stakeholders created long-term growth strategies and negotiated with the UK Government for support and the extent of transferred powers.

The impact of changes in energy systems on regional economies is extensive and long-lasting. Social safety nets like early retirement, unemployment benefits, and disability payments for directly

affected workers do not address the broader repercussions of local structural changes. Comprehensive strategies tailored to each region's unique circumstances are essential. These strategies should focus on identifying rapidly growing clean energy sectors and supporting workers at various career stages.

3.1.7 United States

For many years, coal-dependent communities in the United States have experienced significant declines in local economic activity. These declines are due to the increasing use of automated mining techniques, the rising competitiveness of natural gas and renewable energy sources, and, to some extent, environmental regulations. As efforts to reduce greenhouse gas emissions and address climate change intensify, these trends are expected to accelerate and potentially extend to regions involved in oil and gas production. Policymakers are actively considering strategies to support workers and communities affected by these changes, helping them adapt and thrive in a low-emission future.

One of the coal-rich regions in the United States is Appalachia, a vast mountainous area spanning 13 states from north to south. Many communities in Appalachia have faced economic difficulties and heavy reliance on coal mining and related power generation, especially after significant declines in local manufacturing. Despite the negative impacts of the energy transition, the federal government has not been significantly involved in providing strategic planning, financial support, or coordination for an appropriate response. State-level efforts for local economic development have mostly followed a top-down approach, limiting the involvement of stakeholders within the affected communities. Moreover, the proposed local policies lack a comprehensive understanding, casting doubt on their ability to generate sufficient job demand and improve workforce quality through effective training and education. Few studies have evaluated the feasibility of transitioning the current fossil fuel workforce to viable alternative jobs. Given the diversity in workforce attributes within different energy sectors, it is crucial to consider various characteristics to properly assess the potential for successful job transitions.

In recent decades, the US has significantly moved away from coal as its main source of electricity generation. Krause (2023) reports that a one-percentage-point increase in contemporary coal-related economic shocks leads to a 2.77 percent decline in the population aged 20 to 29. Additionally, a one-percentage-point decrease in the coal sector's share of economic activity results in a 3.2 percent reduction in county-wide employment levels, a 5 percent decrease in aggregate wage earnings, and a 1.8 percent drop in average annual wages. Previous studies have shown that the decline in coal demand negatively impacts municipal tax bases (Morris *et al.*, 2021) and household finances, such as reduced credit scores (Blonz *et al.*, 2023). Hyun (2023) finds that the coal industry's decline has reduced the fiscal capacity of county and city governments in coal-dependent regions, primarily due to decreased locally generated revenues, rents, taxes, and charges. Furthermore, state-to-local intergovernmental transfers have also declined, as one of the redistribution rules for state-allocated general-purpose aids is the tax contribution of local government units. This indicates that income shocks from contractions in the local coal sector tend to reduce fiscal payments.

A key policy imperative in the United States' energy transition is supporting the existing workforce in the fossil fuel sector, including the gas and oil industry. While many studies have documented the local labor market impacts of fossil fuel production (Feyrer *et al.*, 2017; Allcott & Keniston, 2018) and provided insights into equitable energy transition policies (Cha *et al.*, 2020; Look *et al.*, 2021a), there has been limited focus on aligning the skills of current energy industry workers with new employment opportunities in regions rich in fossil fuel reserves. Greenspon

& Raimi (2022) highlight the importance of understanding the skill gaps between the fossil fuel workforce and sectors with growing job prospects offering similar wages within local labor markets. Using occupation-specific data on skill proficiencies, it has been found that fossil fuel workers often lack soft skills, particularly in communication (e.g., professional speaking) and social interactions (e.g., negotiation), which are essential for securing well-compensated, in-demand positions. Conversely, they demonstrate strong technical skills. This detailed occupational analysis is increasingly important not only for the US but also for other countries undergoing a clean energy transition, as it provides a clearer understanding of valued positions in the labor market and the skills and experiences required of the current fossil fuel workforce.

3.2 Just Labor Transition Challenges in Developed Countries

From the experience of (partial) energy transition in developed countries, we draw some lessons about just transition as follows. First, JLT policies are expected to be effective in the presence of a comprehensive framework characterized by robust, explicit, and cohesive top-down leadership, coordinated efforts, and substantial funding originating from the central (federal) government. Second, the success of JLT initiatives also hinges on the fostering of extensive and inclusive local consultations, especially through local networks capable of accessing top-down funding and coordination. Third, an adeptly structured fiscal framework interconnecting various tiers of governance assumes a key role in regional development initiatives undertaken by local governments, given that intergovernmental transfers serve as a mitigating factor for disturbances affecting regions reliant on fossil fuel activities. Fourth, it is necessary to implement not only local assistance programs, but also the existing (or potential revisions of) social security provisions (e.g., income maintenance programs) or labor regulations that will compensate impacted workers and communities. Last but not least, the realization of successful JLT efforts may necessitate an emphasis on "economic diversification" aimed at revitalizing energy communities by fostering alternative labor market opportunities not inherently linked to the clean energy sector.

Developed countries continue to grapple with several workforce challenges related to the energy transition. For instance, although the UK initiative led to increased employment, there is a lack of data on whether these jobs directly benefited local residents. Notably, the projects failed to alter local employment rates, indicating that job opportunities were unavailable to individuals residing in the targeted regions. Germany's Action Program Ruhr and the United Kingdom's National Coalfields Programme also associate job creation with environmental conservation. However, transitioning workers from coal, oil, and gas sectors to green industries is not a straightforward solution (Look *et al.*, 2021a). The skills of fossil energy workers may not seamlessly transfer to many green roles, and the compensation in the renewable energy sector might be comparatively lower. There is little research to evaluate the feasibility of aligning the current workforce in fossil energy with viable alternative employment options. Given the substantial diversity in workforce attributes, which varies within and across different energy sectors, it becomes imperative to account for multiple characteristics to assess the appropriateness of potential matches.

The energy transition in the United States is also presenting some distinctive obstacles. While the local experts in coal-rich communities have a deeper understanding of their specific situations, there is still a notable lack of trust in the federal government across the region (Raimi *et al.*, 2021). This underscores the necessity for economic development initiatives to not only operate from a grassroots perspective but also to be perceived as originating from local entities and organizations. Look *et al.* (2021b) highlights that within the context of a just transition, it is relatively straightforward

to identify fossil energy workers, but those engaged in energy supply chains and sectors indirectly impacted (e.g., energy-intensive manufacturing) might pose a greater identification challenge. Given that coal communities often grapple with elevated poverty rates and substance abuse issues, comprehensive assistance such as childcare facilities and substance abuse therapy for transitioning workers could significantly create conducive conditions for success within workforce development initiatives.

Local stakeholders also have different interests regarding just transition (Hiebert, 2023). Regulatory bodies emphasized the significance of gathering and assessing shared data pertinent to an equitable energy transition, alongside securing regulatory endorsement for the just transition as a pivotal mechanism in shaping pathways for companies to prioritize equitable transition considerations. Utility companies and businesses identified opportunities to implement novel approaches to stakeholder communication while also highlighting persisting challenges, including the market's tendency towards short-term gains and regulatory frameworks that are not aligned with JLT objectives. Institutional investors regarded the just transition framework as paramount for the enduring sustainability of utility firms and the broader economy. Investors conveyed the necessity for heightened and inclusive engagement with stakeholders, both on their part and for companies. Additionally, they acknowledged the importance of harmonizing utility incentives with JLT targets and enhancing the collection and disclosure of data pertaining to equity and labor indicators relevant to the energy transition. Table 3.1 summarizes the lessons from the experience of the energy transition of developed countries.

Table 3.1: Summary of JLT Lessons from Developed Countries

Country	(Partial) Energy Transitions	Key Lessons
Australia	Coal production has decreased by 10% between 2019 and 2023.	1) Energy transition should be supported by a well-resourced entity to manage long-term planning, communication, coordination, and implementation. 2) Power station companies should collaborate with stakeholders and take greater responsibility for implementing Just Transition measures.
Germany	From 1985, Coal production has decreased by 80% decline to 2023. Oil production has seen a reduction of roughly 50% since the early 2000s.	1) Significant government investments (e.g., pension reform) and regional economic policies are essential for revitalizing the local economy. 2) Actively involving community members in shaping and implementing these policies makes the energy transition more successful by better aligning interventions with regional needs, enhancing societal approval, and leveraging local expertise.
Netherlands	Coal production had begun to decline rapidly by the 1960s and all coal mining operations were ceased by 1974.	1) Addressing the coal industry's decline early on allowed for a gradual distribution of individual and public costs, preventing sudden and unexpected burdens. 2) The high level of consensus (the Dutch practice of "social partnership") among unions, mine managers/owners, and the government was crucial in effectively implementing this gradual approach and related strategies.
New Zealand	Coal production has decreased by 50% from 2008 to 2023. Oil production also peaked at 72,000 barrels per day in 2007 but had dropped dramatically to 5,000 barrels per day in 2022.	Instead of an immediate industry-wide transformation, it is important to strategically develop a roadmap with twelve distinct transition pathways to diversify and strengthen the local and regional economy.
Poland	Coal production in 1990 was approximately 215 million metric tons but has decreased by nearly 60% by 2023	1) The use of EU funds for regional economic development began to support comprehensive programs managed by regional governments, reflecting a shift towards a more integrated approach at the regional level. 2) Regional governments collaborated with the European Commission to plan, execute, and assess programs together. Securing funds involved a wide range of stakeholders, including local authorities, businesses, and experts.
United Kingdom	Coal production was 292 million metric tons in 1913 and dropped to just 0.5 million metric tons in 2023, reflecting a near-complete phase-out of coal mining activities. Oil production has decrased approximately 2.65 million to 723,000 barrels per day from 1999 to 2022.	1) Geographically focused initiatives can significantly reduce poverty by improving living conditions in disadvantaged neighborhoods through better housing, community safety, physical surroundings, and educational opportunities. 2) Shifting the responsibility for local economic growth to local authorities and community stakeholders allows policies to better address each region's unique circumstances.
United States	Coal production had dropped significantly to roughly 600 million short tons, marking a decline of about 50% from the peak level in 2008.	1) A top-down approach to local economic development may limit stakeholder participation within affected communities and lack insight into local job demand and workforce quality through effective training and education. 2) Understanding the skill gaps between the fossil fuel workforce and sectors with growing job prospects offering similar wages within local labor markets is crucial. 3) As the fossil fuel industry phases out, local tax bases would also decrease significantly.

Notes:

4 Developing Countries and a Just Labor Transition

Just transition policies must take into account the unique characteristics of each nation. This principle is acknowledged in UNFCCC negotiations and enshrined in the Paris Agreement through differentiated responsibilities and capabilities. Therefore, it is necessary to adapt response strategies, like just transition plans, in accordance with the capabilities and priorities of specific countries. Similarly, the practicalities of the just transition in developed countries will differ from those of developing countries (Glynn *et al.*, 2020). In particular, developing countries often possess larger informal sectors, high unemployment rates, limited social protection, and exhibit a "resource curse".

It's important to note that the category of "developing countries" is far from uniform, encompassing varying levels of wealth, institutional quality, energy dependency, and different transitions. In this study, we focused on seven countries spanning three global south regions, including Argentina, Colombia, India, Indonesia, Nigeria, South Africa, and Vietnam. These countries have implemented and proposed several policies related to climate change and the transition to a low-carbon economy. However, they are in an early stage of development.

4.1 State of the Just Transition in Developing Countries

The countries analyzed have incorporated the concept of just transition into various agreements, alongside setting ambitious emissions' reduction goals. The following section summarizes the current status of these countries and their endeavors in preparing for a just transition. It underscores significant challenges given the economic and social realities of each country.

4.1.1 Argentina

Argentina has integrated principles of just transition into its domestic policies through its Nationally Determined Contributions (NDCs) under the Paris Agreement. This entails reconciling worker interests with environmental considerations during the shift toward a more environmentally sustainable economy. Argentina's second NDC adheres to equitable principles in line with the 2015 ILO just transition Guidelines, aiming to protect workers' rights and alleviate socio-economic repercussions. Key measures encompass collaboration among governmental, private, and civil society entities, including trade unions and NGOs. Establishing inter-institutional bodies and active involvement with social partners signifies an all-encompassing approach to the concept of just transition (PAGE, 2021). Argentina has a carbon tax of 5 USD/tCO_2e that is estimated to cover 20% of the country's GHG emissions. However, significantly higher carbon prices are required for Paris compatibility of at least USD 40–80/tCO_2 by 2020 and USD 50–100/tCO_2 by 2030 (Stiglitz *et al.*, 2017).

Nevertheless, the state is going through a macroeconomic crisis that has cut its budget for tackling the climate crisis, while receiving little financial support from wealthier nations. The energy and agriculture, forestry and other land use (AFOLU) sectors are responsible for 51% and 39% of Argentina's emissions, respectively. The energy sector is significant in Argentina as it provides a rare opportunity for high paid formal labour. The AFOLU sector contributed more than 6% to the country's GDP in 2022[9]. In both sectors, only 12.8% of jobs are occupied by women (Pucheta *et al.*, 2021; Aneise, 2022).

[9]World Bank national accounts data source.

4.1.2 Colombia

Colombia is advancing a just transition through a series of comprehensive policies and strategies. The National Climate Change Policy, Climate Change Law of 2018, and the recent Climate Action Law (2021) serve as guiding frameworks, emphasizing just transition as a crucial element for carbon neutrality, climate resilience, and low carbon development (Ministerio de Ambiente y Desarrollo Sostenible, 2020). Key objectives include integrating climate change education and workforce strategy, promoting green jobs, and aligning economic diversification with the reduction of environmental impact. In addition, collaborative efforts involving the Ministry of Labor, the Ministry of Energy, and the ILO have led to the "Pact for Green Jobs, Environmental Justice and just transition in Colombia", aimed at enhancing green job promotion and skills development.

However, policies related to the low-carbon transition do not usually consider the structural problems of the labor market. In this sense, there is a risk of replicating these problems during transition. Nevertheless, the correct planning and execution of JLT of the labor force can help to reduce gender gaps, as well as increase the proportion of formal employment (García, 2023a). The proposed climate action agenda in the NDC and exogenous factors could create the following challenges: (i) job losses in extractive industries; (ii) reduced royalty revenues for regions in which extractive industries are located; and (iii) reduced consumption because of higher fuel and energy prices due to elimination of fuel subsidies and scaling up of carbon pricing (García, 2023b).

4.1.3 India

The Indian government has implemented comprehensive policies to promote renewable energy, including capacity targets, administrative improvements, and incentives for the production of domestic solar technology. Despite these efforts, ambition is still limited by coal power. India increasingly relies on coal and gas for electricity during the rising summer heatwaves, complicating its environmental goals. The National Electricity Plan (NEP2023), adopted in May 2023, conveys mixed messages regarding India's climate aspirations. It emphasizes augmenting renewable energy capacity while limiting additional coal power plants until 2027.

Addressing social and economic repercussions like job losses in the coal sector is crucial during this transition. India hosted the G20 Summit in September 2023, which focused on the United Nations Sustainable Development Goals, climate action, green development initiatives, and multilateral financing, among others. India brought multilateralism back to the center stage and amplified the voice of the global South. The process of phasing out coal-based power involves potentially disruptive structural shifts. The coal sector employs around 1.2 million people (Ward *et al.*, 2021). Although the initial phase-out may initially affect coal imports, it will eventually lead to reduced domestic coal mining, impacting employment and incomes in related regions (Aayog, 2022).

4.1.4 Indonesia

Indonesia's policy approach contributes to a just transition through the explicit inclusion of just transition principles in key documents. The updated Nationally Determined Contributions (NDC) 2021 highlights capacity-building programs addressing just transition and decent work issues in mitigation and adaptation. Similarly, the 2050 Long-Term Strategy Low Carbon & Climate Resilience (LTSLCCR) emphasizes integrating just transition concerns with ongoing development priorities. Additionally, the Low Carbon Development Initiatives (LCDIs) underline the importance of targeted policies and investments to support a just transition and prevent exclusion, with revenue allocated

for social protection programs and related investments. However, JLT principles must be integrated into policies and programs of other key sectors such as forest, agriculture, and manufacturing, as well (Lestari & Inayah, 2023; M. Chatib Basri, 2023). In addition, the Government of Indonesia and the co-leads of the International Partners Group launched the Secretariat for the JETP. The Secretariat will support the Indonesian government in achieving the JETP objectives, including, in the next six months, developing a comprehensive investment and policy plan that reflects targeted reductions in greenhouse gas emissions and support for impacted communities.

Over the past two decades, Indonesia has emerged as a growing market with a shifting economic focus from the primary to manufacturing and services sectors. Agriculture's share has declined, and the service sector now employs nearly half the workforce. Despite this shift, Indonesia's economy remains reliant on natural resources, exposing it to climate change risks. Activities tied to natural capital contribute significantly to foreign income, employment, and GDP. Primary sectors like mining, agriculture, and related manufacturing and service subsectors play vital roles in the economy and job creation (Gabriella & Simamora, 2020).

4.1.5 Nigeria

Nigeria has implemented a variety of policies to drive its energy transition and contribute to a just transition. Notable among these are the National Renewable Energy and Energy Efficiency Policy (NREEEP), the National Renewable Energy Action Plan (NREAP), and the National Energy Efficiency Action Plan (NEEAP), which provide blueprints for harnessing renewable energy and increasing energy efficiency. The Rural Electrification Strategy and Implementation Plan aims to enhance rural electrification, while the Mini-grid Regulations accelerate rural electrification through mini-grids. The Nationally Determined Contribution (NDC) outlines emissions reduction targets and climate action, and the recently launched Nigeria Energy Transition Plan charts a path toward net-zero emissions by 2060.

Nigeria may be impacted by the global move away from fossil fuels through reduced petroleum export revenue and potential job losses in the industry. Petroleum revenues contribute 80% of government income, supporting green transition investments in the short term. An estimated 150,000 to 200,000 jobs, primarily in oil and gas, could be at risk by 2050, affecting vulnerable, low-skilled workers. Despite the emergence of new jobs in renewable energy and clean cooking, regional disparities may arise, with job losses concentrated in the Niger Delta and new jobs spread across the country, especially in the north (Federal Ministry of Environment, 2022).

4.1.6 South Africa

South Africa first emphasized a just transition in its initial NDC in 2015. Since then, the nation has participated in national discussions, carried out analyses, and introduced policies addressing adaptation to climate change, including both short- and long-term impacts. The energy sector, in particular, requires significant and transformative changes that involve both economic and legal changes to combat climate change effectively (Presidential Climate Commission, 2022). In South Africa, the JETP seeks to build a strong, long-term partnership to support low-emission, climate-resilient development (Calland, 2023).

In addition, the South African government has introduced a series of policies aimed at navigating the transition to a low-carbon economy while addressing climate change challenges. Notable policies include the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which has successfully secured substantial renewable energy capacity from private producers. The

Integrated Resource Plan 2019 outlines strategies for phasing out coal power, increasing renewable energy sources, and integrating gas. The Carbon tax introduced in 2019 addresses emissions, while the just transition Framework adopted in 2022 emphasizes managing transition impacts. The Green Finance Taxonomy defines sustainable projects for financial support, and the Low Emission Development Strategy 2050 commits to achieving net-zero emissions by 2050. While these policies signify significant steps, policy implementation and enforcement challenges persist. Enhancing governance mechanisms and policy coordination are suggested to expedite progress and ensure effective implementation.

On the other hand, employment in South Africa is characterized by a significant number of direct jobs in the coal sector, employing almost 90,000 people in mines and power plants. Indirect jobs in goods and services that support the coal sector contribute to induced employment and broader economic activity. The coal sector is an input into key industries in the region, such as synthetic fuels. Additionally, South Africa also faces high levels of unemployment, particularly in labor-sending areas and among young women (Engel *et al.*, 2022).

4.1.7 Vietnam

Vietnam has initiated a comprehensive suite of policies to phasing down coal power while mitigating the socio-economic impacts on its workforce. Central to this effort is the Power Development Plan 8, which outlines a substantial reduction in coal's contribution to electricity generation from 50% to less than 30% by 2030. In addition to this, Vietnam pledged to pursue ambitious environmental objectives through its Updated Nationally Determined Contribution (NDC), with the potential to reduce emissions by up to 27% with international help by 2030. Furthermore, in December 2022, the Vietnam JETP Political Declaration served as an example of a strong international commitment to assisting Vietnam's energy transition. With $15.5 billion expenditure, the declaration marked a significant turning point in efforts to prevent new coal plants, retire aging ones, and promote the development of renewable energy sources.

Recognizing the importance of safeguarding workers, Vietnam has established policies such as the Labor Code, vocational training laws, and provisions for social insurance. These measures require employers to consult with unions and develop labor usage plans when restructuring or facing shutdowns. The Enterprise Support Law also demonstrates Vietnam's commitment to helping firms retrain and rehire workers impacted by the shift in the coal sector.

Despite these important policy pillars, a more detailed plan is required. Initiatives for retraining, economic diversification in areas dependent on coal, and strong social protection programs should all be included.

4.2 Just Labor Transition Challenges in Developing Countries

In order to better reflect the variety of developing nations, our sample incorporates countries that cover a range of factors, including (i) different levels of income[10]; (ii) fossil fuel currently undergoing transition; and (iii) varying degrees of energy dependence on fossil fuels. These factors can be associated to different labor market characteristics across countries. The table below was created based on the information from 35 papers, including policy briefs. It outlines the principal challenges these countries encounter in their pursuit of a just energy transition.

[10]Classified by the World Bank based on GNI per capita

Table 4.1: Summary Statistics of JLT Challenges in Developing Countries

Measure	Argentina	Colombia	India	Indonesia	Nigeria	South Africa	Vietnam
Source in transition	Oil	Oil and Coal	Coal	Coal	Oil	Coal	Coal
Sector (% of GDP)	1.5%	4%	1.30%	1.20%	5.80%	2.50%	2.82%
Direct jobs	65,000	150,000	1,100,000	150,000	5,000	92,000	122,000
Indirect jobs	260,000	120,000	1,000,000	-	150,000	210,000	100,000
Informal labor	45%	60%	80%	60%	78%	30%	76%
Unemployment rate	7.60%	10%	8%	17%	33%	35%	5%
Access to energy	100%	100%	99%	97%	55%	85%	100%
Fossil fuel mix	85%	70%	88%	90%	35%	94%	77%
Fossil electricity	64%	25%	77%	80%	73%	86%	49%
Location	Rural and Urban	Rural	Rural	Rural and Urban	Rural	Rural and Urban	Rural
Share of exports	Import	50%	Import	14%	89%	5%	3%
Critical minerals	Lithium	Copper	Antimony, Titanium and Copper	Nickel	Lithium, Manganese and Nickel	Chromium	Rare earth elements
Sector skills	High and low	High and low	Low	Low	Low	Low	Low
Labor unions	FASiPeGyBio, AOMA.	Sintracarbon, USO.	INMF	KSPI, KSBSI and KSPN.	NUPENG, and PENGASSAN	NUM	No labor unions for coal workers
Social Protection (% of population)	63.8%	52.5%	24.4%	27.8%	11.0%	49.3%	38.8%
Social protection expenditure (% of GDP)	17.5%	13.9%	2.4%	2.7%	1.2%	9.9%	7.0%

First, *countries transitioning away from coal* face severe employment impacts, as the coal industry is highly labor-intensive and employs large numbers of low- and semi-skilled workers. These coal jobs also tend to be geographically concentrated in specific coal-producing regions. In contrast, *countries moving away from oil* may see less disruption. The oil industry requires fewer workers overall, and its jobs tend to be more direct, highly skilled roles concentrated in both urban and rural areas. Nevertheless, the ease of transitioning for workers from coal or oil industries to green sectors in a just transition hinges on diverse factors. These factors include the workers' specific skills and experience, the characteristics of the green industries, and the extent of support and training available during the transition.

Second, it was found that *income level is related to the extent of formal employment and availability of social security coverage.* Upper middle-income countries (Argentina, Colombia, Indonesia, South Africa) have a higher share of formal employment than lower middle-income countries. Formal employment ranges from 47% in Colombia to 67% in Argentina. As a result, also tend to have higher coverage of social protection programs linked to formal employment. For example, Argentina has pension coverage of 94% while Colombia has health insurance coverage of 95% for its formal workers.

Conversely, lower-middle-income countries (India, Nigeria) have a much lower share of formal employment, ranging from 22% in Nigeria to 20% in India. This results in lower coverage of social protection programs. For example, India has pension coverage of only 9% while Nigeria has health insurance coverage of 5%. In addition, *income level exhibits a strong positive association with power access.* Upper middle-income countries, like South Africa and Colombia, have near-universal access to electricity; over 90% of the population has access. Expanding access in lower-income countries while ensuring just transitions will be a key challenge.

Third, different *countries rely on fossil fuels to varying degrees, either for domestic energy or*

as a source of revenues. Some countries like Nigeria and Indonesia depend on cheap fossil fuels to provide basic energy access, especially to marginalized communities. Transitioning to cleaner energy while retaining affordability and accessibility poses challenges. Moreover, countries like Colombia and Nigeria fund government budgets via taxes, royalties, and income from fossil fuel exports. Phasing out these revenue streams requires fiscal planning. Additionally, India depends heavily on coal for budget revenues[11] and transport. The coal industry provides taxes and royalties, while coal transport cross-subsidizes passenger railway tickets (Dsouza & Singhal, 2021).

In addition to the challenges mentioned above, developing countries face additional challenges in ensuring an inclusive just transition. *Employment in fossil fuel industries tends to be male-dominated*, while women and marginalized groups have limited roles and opportunitiesBank (2023)[12]. Furthermore, because mines are typically not located in areas with potential for producing renewable energy, geographic concentration of fossil fuel jobs in some regions means targeted transition planning and economic diversification is essential for providing alternative local livelihoods.

4.3 Just Energy Transition Partnerships (JETPs)

In developing countries, a substantial mobilization of financial resources from public and private sources, both nationally and internationally, will be necessary to achieve an equitable transition. A novel finance mechanism known as Just Energy Transition Partnerships (JETPs) aims to support countries heavily dependent on coal, where the threat of carbon lock-in is exacerbated by excessive carbon emissions (Kramer, 2023). The overall objective of the JETP is to increase access to public and private financing to meet the urgent and dramatic investment needs of the energy system. These JETP funds come from international countries called International Partner Group (IPG), multilateral banks and private financial institutions, however, multilateral development banks have a role that goes beyond financing: they can contribute to technical assistance programs for plans transition, help establish regulatory frameworks, and develop risk mitigation instruments, among others. Annika Seiler & Matthews (2023). However, the success of these programs based on the "justice" approach is also dependent on other factors specific to each country, such as the need for production diversification, value chain strengthening, and tax revenue diversification. While these announcements show real progress, as more countries have announced agreements, implementing the JETP will be the true test of their contribution.

The first JETP was announced in November 2021 for South Africa, and the funders pledged $8.5 billion in the first financing round. A year later, South Africa published its JETP Implementation Plan, which is expected to prevent up to 1–1.5 gigatons of atmospheric emissions over the next 20 years. In November 2022, a new JETP was announced in Indonesia, which aims to reduce cumulative greenhouse gas emissions by more than 300 megatons through 2030 and a reduction of well above 2 gigatons through 2060 from Indonesia's current trajectory (Perusahaan Listrik Negara, 2022). The next one was Vietnam, announced in December 2022 after a lengthy negotiation process. This Partnership will assist Vietnam in finance, technology, and capacity building. The initial fund for the next three to five years is 15.5 billion USD. Vietnam is expected to publish its JETP Resource Mobilization Plan by November 2023. The successful delivery of these ambitious targets will save

[11] India's state-owned coal company pays almost $8 billion in taxes and royalties each year to central, state, and local governments

[12] Women's labor are underrepresented in formal coal jobs and are engaged in unpaid, underpaid, devalued, invisible, and precarious labor. In Manda, India, more than 90% of women from upper caste and OBC households were engaged in unpaid social reproductive work. Half of the Dalit women were restricted to domestic duties (Nayak & Swain, 2023).

around 500 megatons (0.5 billion tonnes) of emissions by 2035. Senegal and India are meeting with JEPT donor countries for future cooperation.

A significant aspect of the South Africa JETP is the commitment to decommissioning approximately 60% of South Africa's coal fleet, equivalent to around 24 GW of capacity, by 2030, with further decommissioning planned for 2040. To oversee and coordinate this ambitious project, the South African government has established two specialized task teams: the Presidential Climate Change Committee and the Presidential Climate Finance Task Team. To support this transition, an investment of $4 billion has been allocated for just transition measures. This funding is directed explicitly towards economic diversification, skills development, and supporting regions like Mpumalanga.

Moreover, the JETP has identified three priority areas to drive the economy of the future: the electricity sector, New Energy Vehicles (NEVs), and Green Hydrogen. The Investment Plan (Sou, 2023) supports South Africa's goal of achieving a low-carbon economy and a climate-resilient society through the following interventions. It aims to create quality jobs in new sectors like electric vehicles, green hydrogen, renewable energy, and manufacturing. Additionally, it seeks to increase energy security and end load shedding through a massive rollout of new, sustainable energy sources. Furthermore, the plan addresses the risks of climate change and positions South Africa to be an important global player in the green economy of the future. Lastly, it aims to boost economic growth through more than 1 trillion of new investment in the South African economy. However, it's important to note that the just transition elements of the agreement remain to be described in significant detail.

Table 4.2: Current Just Energy Transition Partnerships

Variable	**South Africa**	**Vietnam**	**Indonesia**
Amount financed	$8.5 billion	$20 billion	$15.5 billion
Emissions prevent	1-1.5 gigatons	2 gigatons	0.5 gigatons
Time expected	20 years	28 years	13 years
Year announced	Nov-21	Nov-22	Dec-22
International Partner Group	The United States, United Kingdom, France, Germany, and the European Union	European Union, Germany, the United Kingdom, France, the United States, Italy, Canada, Japan, Norway and Denmark.	The United States, Japan, Canada, Denmark, the European Union, France, Germany, Italy, Norway, and the United Kingdom.
General Internventions	Creating quality jobs in new sectors, Increasing energy security, Addressing the risks of climate change and Boosting economic growth.	Accelerating renewables expansion, Phasing down coal power, Supporting just transition, and Developing clean energy industries.	Decarbonization of coal power plants, Expanding renewable energy, Developing green ecosystem, Skills Development and Retraining.
just transition Strategies	Redeployment through Public Programmes and through Public Employment Schemes. Mobility re-skilling, and enterprise development. Education and soft-skills training linked to experience; Networks and platforms to enhance the young voice and enable their contribution to policy.	Develop and implement educational, vocational training and re-skilling programmes. *(limited information)	Reskilling and upskilling, Creating employment and providing other forms of collaboration. *(limited information)
Current state (Oct 2023)	Plan Investment	Resource Mobilization Plan	Plan Investment

Indonesia has submitted its investment plan, which JETP partners are currently reviewing before being made public and subject to public opinion. The Indonesia JETP bases its investment priorities on five major areas: the early closure of coal-fired power plants, the improvement of transmission and distribution infrastructure, renewable energy that is controllable and constant (dispatchable), the management of variable renewable energy sources and their supply chains, and the implementation of equitable energy transition initiatives.

Likewise, Vietnam introduced a preliminary version of the Resource Mobilization Plan (JETP RMP) in August 2023. This comprehensive document delineates investment prerequisites, financial mechanisms, policy measures, and a framework for transitioning to cleaner energy provisioning. The

primary objective of the JETP-RMP is to facilitate the establishment of a robust and consistent long-term legislative structure to support the nation's green transition, which includes the deployment of pricing and regulatory mechanisms.

Some literature provides insights into the progress and main results of the existing Just Energy Transition Partnership (JETP). Houston & Ruppel (2022) focuses on formulating the International JETP between South Africa and the EU, highlighting the need to address areas of interest for the communities to achieve climate goals and energy sector objectives. Annika Seiler & Matthews (2023) emphasizes that in transitioning from coal-dependent regions, like in the case of South Africa, several critical components of a just transition are needed to mitigate the challenges, transparent and well-sequenced transition plans, accompanied by regional development initiatives and incentives for renewable energy, can help soften the impact of job losses. Lastly, achieving just transition goals hinges on the sustained engagement of all affected parties and stakeholders, highlighting the importance of transparent communication and ongoing awareness campaigns to garner enduring public support.

5 Advancing Just Labor Transition Policy

Initial suggestions have emerged from the previous sections. Below, we outline some types of actions that need to be incorporated into just transition planning. These actions can be categorized into the following dimensions based on their scope: Labor market and education, regional development, social protection, and climate finance. These suggestions are likely to resonate with numerous countries across the globe, but are most relevant to the global South, extending beyond the seven countries that have been examined.

Table 5.1: Scope of Just Labor Transition Action

Labor Market / Education	**Social Protection**	**Regional Development**	**Climate finance**
Retraining and Reskilling	Income Support	Economic Diversification	Ensuring Obligations
Entrepreneurship Incentives	Early Retirement Packages	Regional Roadmaps	Carbon Tax Revenues
Skill Transfer	Social Protection Enhancement	Policy Alignment	Stakeholder Engagement
Labor Market Mobility.		Community Engagement	Clear Timelines and Targets
Job Creation for SMEs			

In particular, aspects related to social protection and regional development require increased attention when providing recommendations for a just transition in developing countries, recognizing the significant heterogeneity among them. As presented in Section 3, a large proportion of workers in developing countries are informally employed, lacking secure contracts, benefits, or social protection. For instance, over 80% of workers in India and Nigeria work in the informal sector. It is crucial to identify these informal workers who will be affected by the energy transition to include them in social security programs since essentials like pensions, unemployment benefits, or healthcare often only cover the formal sector.

Another significant challenge faced by developing countries is the lack of adequate infrastructure to implement regional diversification strategies. The World Bank (Bulmer *et al.*, 2021) has noted in the "Global Perspective on Coal Jobs and Managing Labor Transition out of Coal: Key Issues and Policy Responses" that, in the lead-up to mine closures, investments in supportive physical and digital infrastructure are necessary. These investments should extend beyond energy to enhance connectivity through initiatives such as road construction and irrigation districts, particularly if diversification aims to promote agriculture, as recommended for Latin American countries (Saget *et al.* (2020)).

In addition to the aforementioned challenges, developing countries exhibit diverse dependencies on fossil fuels, including reliance on consumption, royalties, fiscal revenues, and public transportation subsidies, among others. For example, countries like India, Indonesia, and South Africa generate an average of 91% of their energy from fossil sources. In contrast, in countries like Colombia and Nigeria, hydrocarbon exports constitute more than half of total exports. Moreover, Indian Railways heavily depends on the coal industry for its freight revenues and profits[13]. Therefore, we place particular emphasis on regional development as one of the factors that can ensure a just transition.

[13]Coal contributes 44 percent of Indian Railways (IR) freight revenues and has an even higher share in its profits. IR's business model is based on passengers underpaying and freight overpaying.

5.1 Labor Market and Education

Providing specialized training programs to acquire new skills needed in growing sectors is a potential strategy to reduce adverse effects on workers. Several papers point out the effectiveness of these programs in countries like the U.S.[14], Australia (Chapman *et al.* (2018), Snell (2018)) and United Kingdom (Robins *et al.* (2020)).

Although developing countries are currently at an early stage of implementing a just energy transition, some successful experiences in developed countries[15] suggest that the following steps could be taken on the initiative of the government for a comparatively low cost:(i) Reforming education and training systems to establish fundamental foundational and technical skills, enabling workers to acquire new competencies and adjust. (ii) Government involvement in partnership with vocational institutions, colleges, and businesses to provide tailored training initiatives. (iii) Recognizing and monitoring the demand for green skills and devising a comprehensive strategy encompassing skills assessments, program enhancements, and effective dissemination of information to workers, enterprises, and training facilitators. The International Labour Organization (2019) adds one more initiative, which is the supervision of the quality and impartiality of training. This implies that training programs should be high-quality and prepare workers for viable employment opportunities.

Another opportunity is *skills transfer*, that is, facilitating the transfer of technology and skills from large corporations to local companies and workers. Slaughter (2002) suggests that multinational firms can stimulate demand for skilled workers in host countries through short-term and long-term activities[16]. In the literature, other instances of technology and skill transfer from major corporations to small businesses and employees can be found. Giuliani (2008) found that high-tech multinational companies in Costa Rica tend not to transfer knowledge to domestic firms, but instead transfer knowledge between foreign subsidiaries. Poole (2013) found that labor turnover can be a mechanism for the transmission of technology from multinational to domestic firms in Brazil, with positive multinational wage spillovers through worker mobility.

5.2 Social Protection

Unemployment insurance furnishes benefits to individuals searching for employment who had previously been part of the workforce and thus contributed regularly to the social security system. This system's funding typically comes from employees and employers, where the contribution is capped at a certain amount. To qualify for this benefit, the main requirement is having had an employment relationship for a minimum of 12 months within the last 30 months before experiencing unemployment. The received benefit payments are subject to taxation as well as social security and health insurance deductions. The duration of this benefit varies according to the person's employment history and age. Notably, unemployment insurance has played a significant role for coal workers, the majority of whom were employed in positions covered by mandatory social insurance (Furnaro *et al.*, 2021).

[14]Louie & Pearce (2016) assesses coal industry positions, skills, and salaries, identifies equivalent solar photovoltaic positions, and demonstrates that with a modest investment in retraining, most coal workers could transition to PV-related roles.

[15]Hägele *et al.* (2022),Stevenson & Kwok (2020)

[16]One involves short-term, firm-level activities by which individual firms interact with host country labor markets. The other involves longterm, country-level activities by which multinational enterprises collectively contribute to an overall macro environment where fiscal policy can support and drive education policy

Income support is a form of tax-funded assistance managed and disbursed by local employment offices. It is designed for individuals seeking employment, those earning insufficient incomes, or individuals ineligible for unemployment insurance. This support entails a fixed-rate allowance contingent upon an all-encompassing means assessment. In general, this form of support aids those of working age by covering health insurance expenses and providing allowances for family members and housing costs.

The mandatory public retirement insurance known as the *statutory pension* encompasses all employees, except civil servants, self-employed individuals, and individuals engaged in certain professions who are covered by separate public plans. This statutory pension system operates under a pay-as-you-go model, where contributions from the working populace fund the current pensions. The pension amount is calculated based on the duration of contributions, the individual's age, and their average income. No minimum or maximum pension sum is stipulated. Special provisions are available for disabled pension recipients and dependents.

In addition to the statutory pension, there are supplementary occupational and private pensions available, although they are not obligatory. These pension options operate on a capital-based model, wherein contributions are gathered and invested within individual accounts. In response to the diminished public support for the statutory pension in recent times, the national government encourages individuals to save for their retirement within these plans by offering direct subsidies and tax advantages. Occupational pensions are private retirement plans offered by companies, grounded in occupational categories.

5.3 Regional Development/ Economic Diversification

Securing energy stability stands as a paramount concern throughout the energy transition. Consequently, nations with significant reliance on fossil fuels for their domestic energy consumption have the potential to boost their renewable energy sectors and further optimize the efficient use of these resources (International Energy Agency (IEA) (2022)). These endeavors will foster a wide spectrum of job opportunities, increasing demand for green jobs. One approach to facilitate that is identifying key green, indirectly green, and non-green occupations within various sectors and geographic regions. Moreover, it can be supplemented with an activity/task-based framework to encompass processes essential for promoting sustainability, even if they extend beyond the boundaries of green sectors (Partnership for Action on Green Economy (2023)). However, the mining sector is often the primary industry in coal regions, where people have similar jobs and professional training (Saget *et al.* (2020)). This makes economic diversification and the ability to find employment in other sectors challenging. Strategic planning and policies that focus on human beings can help coal regions achieve a just transition from a coal-based economy to a knowledge-based one. For example, in the Ruhr region in Germany, a vocational training company facilitated a successful transition to the job market after the closure of coal mines. Together, the regional government, company management, and local worker representative committees developed a reemployment strategy for each affected worker (Galgóczi, 2019).

To forecast the demand for green skills in the context of the energy transition, we can draw insights from previous studies that have examined both the winners and losers of this shift. Some studies include some developing countries in Europe and Asia. For example, Markandya *et al.* (2016) estimate the employment impacts from the transformation of the EU energy sector. The countries that benefited most in terms of employment were Poland, Germany, Hungary, Italy, and Spain because they had the largest increases in renewable energy and natural gas use in their

electricity and heat generation mix between 1995 and 2009. The sectors that saw the largest job gains were business services, electricity and gas supply, construction, transport, and wholesale trade, due to the expansion of gas-fired power plants. The analysis also shows positive spill-over effects on employment in major trading partners like Russia and China. Regarding Latin American countries, according to Saget *et al.* (2020), the creation of new green jobs primarily consists of mid to low-skilled roles within sectors such as agriculture, construction, manufacturing, transport, and technical installation/maintenance. To address this shift, potential avenues for enhancing skills include apprenticeship programs for on-the-job training in green construction, manufacturing, and maintenance, as well as programs to upgrade business skills for green entrepreneurship and innovation, these can help workers start new eco-friendly companies.

Another opportunity to diversify the economy can be found in countries with abundant critical metals and minerals needed for the energy transition. *Countries with large reserves of critical minerals*, such as lithium, cobalt, and rare earth elements, can take advantage of these reserves to grow their mining industries for the extraction of these materials as well as their clean technology manufacturing sectors, which include the production of minerals and batteries.

Numerous strategies aimed at supporting resource-dependent regions encompass initiatives directed at enhancing the living conditions of local residents. These initiatives involve urban development and revitalization, alongside the promotion of cultural, leisure, and recreational activities. These policies induce enhancements in social well-being and overall quality of life to stimulate regional economic development. For instance, supporting living conditions can positively impact the public perception of mining areas, thereby mitigating the emigration of businesses and the workforce.

In more recent years, *economic diversification* within distressed regions has gained prominence as a mechanism to foster social cohesion. This is particularly significant given the shared sentiment among some groups who are likely vulnerable to the energy transition and residents in such regions, who often perceive themselves as having been neglected. In particular, the participation of women in the labor force within the fossil fuel industry was notably lower compared to the overall average. Given that, governments need to put forward recommendations such as the introduction of specialized training programs tailored to the requirements of women or the development of pathways for women to engage in industrial-technical occupations.

5.4 Climate Finance

The *carbon pricing*, such as carbon tax or cap-and-invest programs, generates revenue that can be used to support worker transition efforts. They could be earmarked to finance certain activities, for example, green re-skilling of workers or the development of sustainable productive projects in regions affected by the transition.[17] However, in the developing countries analyzed (Argentina, Colombia, South Africa), the price is relatively low, between 3.3 and 9 US$/Ton eq CO2.

Stakeholder Engagement ensures active collaboration and partnership among multiple stakeholders, including national governments, citizen groups, private sector entities, MDBs, UN agencies, and other development partners. Creating and maintaining a socially inclusive planning process is crucial for a just transition. This leads to better outcomes and significantly reduces the risk of social conflict and resistance to change. Stakeholders, including marginalized groups, should be given the chance to influence how risks and opportunities are defined, the vision for transition, the principles that guide planning, and the strategies prioritized for promoting future livelihoods.

[17]For example, the state of Washington designed its cap-and-trade program as cap-and-invest such that it reinvests its revenue to foster green investments.

Achieving a just transition in developing countries will require significant *capital mobilization*, from both public and private sources, both domestically and internationally. Capital mobilization can be achieved domestically by enhancing regulations and institutions, fostering collaborations between the public and private sectors, and drawing investments into emerging markets, technologies, and enterprises, including small and medium-sized businesses. On an international level, capital can be mobilized through mechanisms like the Paris Agreement. This agreement mandates developed nations to offer assistance to developing countries in achieving their climate objectives. This aid encompasses financial support, the building of capabilities, and the transfer of technology. Just Energy Transition Partnerships is one of the mechanisms that has drawn the most interest from developing nations. The first three nations to receive funding are South Africa, Indonesia, and Vietnam. However, the nations must effectively direct funding toward communities that depend on fossil fuels, which requires the strengthening of institutions.

6 Evaluating the Just Labor Transition Journey: the Just Labor Transition Progress Scale

The JLT Progress Scale (JLTPS) is a clear and structured approach to analyzing the progress of selected countries in their JLT efforts. The aim is to provide a systematic and comparative assessment, aiding policymakers and stakeholders in understanding the development of JLT policies and practices. It will align with national commitments to create just transition pathways that have been advocated at both the UN COP27 and COP28 and where in COP29 there will be further developments.

6.1 Method Description

Our method to analyze the 14 selected countries and their progress for a JLT is expressed through the JLTPS. Previously, similar scales have been used successfully in policy-making owing to their clarity and medium to long-term focus.

The methodology of the JLTPS allows us to analyze the progress over time of countries in their efforts for a just transition, ensuring that the actions implemented align with the principles of procedural justice and recognition justice; and in addition, based on a review of policies, NDC Commitments, and laws approved within each country under analysis related to just transition. The classification of a country in a particular stage is determined by the following actions:

- **Procedural Justice:** Analyzes whether implemented policies and mechanisms facilitate active and continuous participation of local communities and marginalized groups in decision-making processes related to the energy transition.

- **Recognition Justice:** Evaluates whether policies recognize and address existing social, cultural, economic, and political inequalities, and if they respect different worldviews and knowledge systems.

- **Review of Policies, NDC Commitments, and Approved Laws:** Reviews national policies, commitments in Nationally Determined Contributions (NDCs), and approved laws that address the just energy transition. This includes analyzing the implementation and effectiveness of these policies and legal commitments in promoting a just transition.

The detailed and regular evaluation of these factors allows for a deeper understanding of the challenges and successes of each country on their path to a just transition. Our JLTPS provides a comprehensive and adaptable tool to analyze and compare countries' progress in just transition efforts (seeTable 6.1 below). We define five stages of progress of the JLTPS that includes: (1) Beginner, (2) Moderate, (3) Intermediate, (4) Advanced, and (5) Peak. These offer a progressive framework that allows for nuanced evaluation of a country's journey towards achieving a JLT.

Table 6.1: The Just Labor Transition Progress Scale

Rank	Color Code	JLT Journey Progression	JLT Experience
5		Beginner	The country is at the early stages of the JLT journey. Some initial 'steps' have been taken.
4		Moderate	The country is beginning to implement some JLT policies and there is a moderate progression visible.
3		Intermediate	The country is at a more developed stage of the JLT journey where there is a mix of progression, regression and neutrality.
2		Advanced	The country is at an advanced stage of the JLT journey where there is a high rate of implementation and some early examples of successful JLT policy actions and/or results.
1		Peak	This is the highest score and demonstrates that the country is on track to achieve a just transition; it can be where the country is where it should be given its JLT journey and experiences.

6.2 Results

Based on the comprehensive analysis conducted in the preceding sections, our evaluation of countries on the JLT Progress Scale illuminates the intricate dynamics of their just transition journeys. Delving into the nuanced landscape of both developing and developed nations, our assessment reveals a diverse tapestry of efforts and challenges as they navigate the complex path towards a just transition.

In developing countries, our scrutiny identifies India and Nigeria as novices in their just transition endeavors, embarking on the initial steps of this transformative journey. Meanwhile, Argentina, Colombia, Indonesia, and South Africa are in a moderate stage, signifying more advanced progress with distinctive policies and strategies. Vietnam emerges as the vanguard among developing nations, demonstrating an increasingly advanced stance in its commitment to a just transition.

Shifting our focus to developed countries, Germany and the United Kingdom emerged as trailblazers with an advanced approach, placing a pronounced emphasis on social harmony and inclusive policies amidst the decline of coal-related industries. The Netherlands adopts an intermediate to advanced stance, implementing comprehensive area-focused programs to manage the decline of coal mining. Conversely, Australia lags in its JLT journey, characterized by a beginner stage and a notable absence of comprehensive planning for coal-related closures.

In unveiling these disparities, our grading system sheds light on the varying degrees of preparedness and effectiveness countries exhibit in managing the intricate socio-economic implications of transitioning away from fossil fuel-dependent industries. This nuanced perspective provides a foundation for deeper insights into the challenges and successes encountered on the diverse paths toward achieving a just transition.

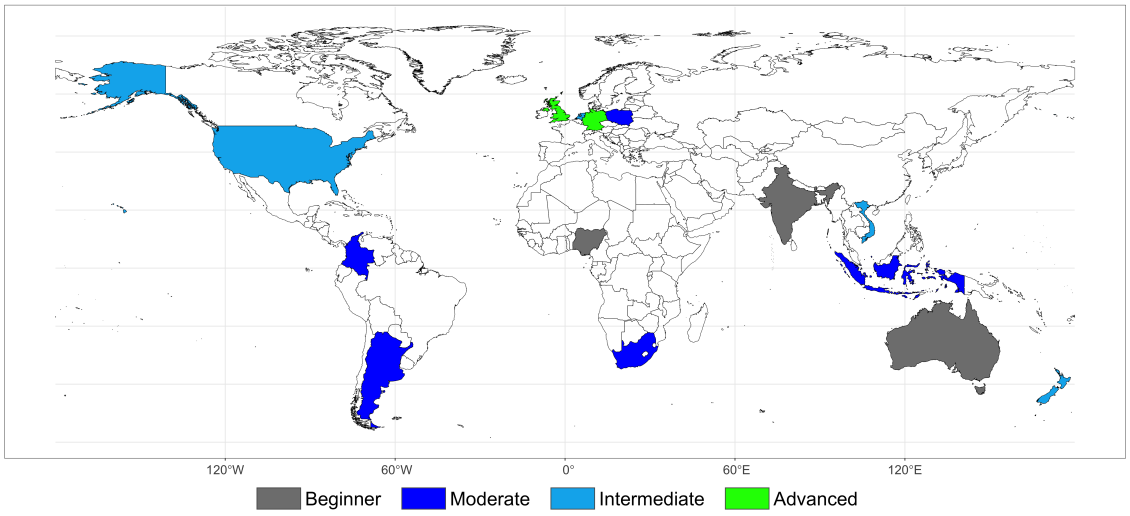

Figure 6.1: Just Transition Progress Across Countries

6.2.1 Just Labor Transition Progress Scale: Developed Countries

In table 6.2, we present the results visually for the seven developed countries we analyzed:

Australia appears to be at a beginner to intermediate stage on the JLT Progress Scale. It faces challenges in its energy transition, particularly in addressing the closure of coal-fired power stations. The country relies on ad hoc measures, and there is a notable absence of comprehensive long-term planning and advanced notification to the public. The government's response appears reactive, and there is a need for a more proactive framework for the phased closure of coal-fired power plants. Comprehensive planning should include consideration for the affected workforce, local communities, and environmental impact.

Germany has demonstrated an advanced approach to energy transition, focusing on social harmony during the decline of hard coal production. Policies include early retirement options and codetermination, empowering workers in decision-making processes. The government has played a significant role in regional economic policies, with notable investments and the use of structural policies to aid coal regions. However, challenges include substantial public debt and budget deficits resulting from initial interventions hindering a smooth transition.

The Netherlands has adopted an intermediate to advanced approach in managing the decline of coal mining, particularly in the Limburg region. A gradual approach allowed for the distribution of costs associated with the decline, preventing sudden burdens. Stakeholder collaboration and significant government investments, guided by cluster policy, have been key. However, challenges remain in providing lasting solutions, and there is a need to balance revitalization of traditional sectors with a smooth transition.

New Zealand has taken an intermediate to advanced approach in responding to changes in oil and gas exploration, notably with the establishment of the just transitions Unit. Collaborative efforts and inclusive planning involve diverse stakeholders, resulting in initiatives like the Taranaki Roadmap 2050. The country emphasizes economic diversification, with a focus on renewable energy sources. Support mechanisms for workers include retraining programs, acknowledging the importance of worker-centric policies.

Table 6.2: The just transition Progress Scale for 7 Developed Countries

Country	Color Code	JLT Journey Progression	JLT Experience
Australia		Beginner	Facing challenges in addressing coal-fired power plant closures, ad hoc measures, and limited governmental planning.
Germany		Advanced	Social harmony-focused transition, early retirement options, and governmental involvement in regional economic policies.
Netherlands		Intermediate	Gradual approach to coal decline, stakeholder collaboration, and significant government investments. Use of cluster policy and attention to regional dynamics.
New Zealand		Intermediate	Establishment of the just transitions Unit, collaborative efforts, and inclusive planning in response to oil and gas exploration changes.
Poland		Moderate	Reduction in hard coal production, EU funds, and regional programs for economic advancement and diversification. Challenges in providing lasting solutions.
United Kingdom		Advanced	Comprehensive area-focused programs (e.g., Single Regeneration Budget) and initiatives for regenerating areas affected by coal declines.
United States		Intermediate	Anticipated trends in energy transition, active policymaking, and strategies to aid impacted workers and communities. Ongoing efforts for a low-emission future.

Poland has implemented intermediate measures in its energy transition, with a gradual 63 percent reduction in hard coal production and an 80 percent decline in mining sector employment. European Union (EU) funds play a key role, managed through regional programs. These initiatives focus on economic advancement and diversification, including infrastructure development, energy efficiency, and human capital enhancement. Challenges persist in providing lasting solutions for impacted workers and communities.

The United Kingdom demonstrates an advanced approach to energy transition, notably through comprehensive area-focused programs such as the Single Regeneration Budget. These initiatives have led to positive outcomes, including increased employment and improvements in living conditions in underprivileged neighborhoods. However, challenges exist in ensuring that job opportunities benefit local residents, and there is a need for continued focus on long-term growth strategies.

The United States adopts an intermediate approach to energy transition, particularly in regions reliant on coal. Anticipated trends include declines in economic activity due to automated mining techniques and competition from natural gas and renewable energy sources. Policymakers are actively deliberating strategies to aid affected workers and communities. Challenges include a

lack of comprehensive understanding of state-level policies and the need for enhanced workforce development initiatives to match emerging job prospects.

6.2.2 Just Labor Transition Progress Scale: Developing Countries

In table 6.3, we present the results visually for the seven developing countries we analyzed:

Argentina is currently in a moderate state on the JLT Scale. It has integrated principles of JT into its domestic policies through its Nationally Determined Contributions (NDCs) under the Paris Agreement. This entails reconciling worker interests with environmental considerations during the shift toward a more environmentally sustainable economy. Argentina's second NDC adheres to equitable principles in line with the 2015 ILO Just Transition Guidelines, aiming to protect workers' rights and alleviate socio-economic repercussions. Key measures encompass collaboration among governmental, private, and civil society entities, including trade unions and NGOs. Establishing inter-institutional bodies and active involvement with social partners signifies an all-encompassing approach to the just transition concept.

Colombia is also at a moderate state on the JLT Progress Scale, advancing a just transition through a series of comprehensive policies and strategies. The National Climate Change Policy, Climate Change Law of 2018, and the recent Climate Action Law (2021) serve as guiding frameworks, emphasizing just transition as a crucial element for carbon neutrality, climate resilience, and low carbon development (Ministerio de Ambiente y Desarrollo Sostenible, 2020). Key objectives include integrating climate change education and workforce strategy, promoting green jobs, and aligning economic diversification with the reduction of environmental impact. In addition, collaborative efforts involving the Ministry of Labor, the N Ministry of Energy, and the ILO have led to the "Pact for Green Jobs, Environmental Justice and d Just Tansition in Colombia" to enhance green job promotion and skills development.

India is at the beginner stage, just putting the building blocks in place for a just transition. NGOs are discussing and advancing the just transition, but there has been limited specific attention on the just transition specifically. Jobs are a key worry for the coal sector (1.2 million workforce), but some clear actions are needed.

Indonesia is at the moderate stage; its policy approach contributes to a just transition by explicitly including just transition principles in key documents. The Updated Nationally Determined Contributions (NDC) 2021 highlights capacity-building programs addressing just transition and decent work issues in mitigation and adaptation. Similarly, the 2050 Long Term Strategy: Low Carbon & Climate Resilience (LTSLCCR) emphasizes integrating just transition concerns with ongoing development priorities. Additionally, the Low Carbon Development Initiatives (LCDIs) underline the importance of targeted policies and investments to support a just transition and prevent exclusion, with revenue allocated for social protection programs and related investments.

Nigeria is at the beginner stage and has put some steps in place to have a JLT. It includes Nigeria's Energy Transition Plan, which charts a path toward net-zero emissions by 2060. However, the focus on 'justice' is sometimes unclear. There are mentions of justice and equity at different times, but these disappear in some implementation plans.

South Africa is at the moderate stage as it has laws and policies to try and achieve a just transition. It could probably receive a higher progress score, but there are questions about the degree of successful implementation. South Africa first emphasized a just transition in its initial NDC in 2015. Since then, the nation has participated in national discussions, conducted analyses, and introduced policies addressing adaptation to climate change, including both short- and long-term

Table 6.3: The Just Labor Transition Progress Scale for 7 Developing Countries

Country	Color Code	JLT Journey Progression	JLT Experience
Argentina		Moderate	Integrated principles of just transition into domestic policies, aligning with equitable principles. Collaboration among governmental, private, and civil society entities, including trade unions and NGOs. Establishing inter-institutional bodies and active involvement with social partners signifies an all-encompassing approach to the concept of just transition.
Colombia		Moderate	Advancing a just transition through comprehensive policies and strategies. Key frameworks include the National Climate Change Policy, Climate Change Law of 2018, and the Climate Action Law (2021). Objectives include integrating climate change education and workforce strategy, promoting green jobs, and aligning economic diversification with the reduction of environmental impact. Collaborative efforts with the Ministry of Labor, the Ministry of Energy, and the ILO led to the "Pact for Green Jobs, Environmental Justice, and just transition in Colombia."
India		Beginner	Just starting the building blocks for a just transition. Limited specific attention to the just transition, with concerns about jobs in the coal sector.
Indonesia		Moderate	Contributing to a just transition through the explicit inclusion of principles in key documents. The Updated Nationally Determined Contributions (NDC) 2021 and the 2050 Long Term Strategy emphasize integrating just transition concerns with ongoing development priorities. The Low Carbon Development Initiatives (LCDIs) highlight the importance of targeted policies and investments to support a just transition.
Nigeria		Beginner	Taking steps toward a just transition, including the Nigeria Energy Transition Plan. However, the focus on 'justice' is not always clear in implementation plans.
South Africa		Moderate	Implementing laws and policies to achieve a just transition, with questions about the degree of successful implementation. Emphasizing a just transition since its initial NDC in 2015, South Africa participates in national discussions and introduces policies addressing adaptation to climate change. The Just Energy Transition Partnership seeks to support low-emission, climate-resilient development.
Vietnam		Intermediate	Recognizing the importance of safeguarding workers through policies such as the Labor Code, vocational training laws, and provisions for social insurance. Measures require employers to consult with unions and develop labor usage plans during restructuring. The Enterprise Support Law demonstrates Vietnam's commitment to helping firms retrain and rehire workers impacted by the shift in the coal sector.

impacts. The Just Energy Transition Partnership (JETP) in South Africa seeks to build a strong and long-term partnership to support low-emission, climate-resilient development.

Lastly, Vietnam is at the intermediate stage. Recognizing the importance of safeguarding workers, policies such as the Labor Code, vocational training laws, and provisions for social insurance have been established. These measures require employers to consult with unions and develop labor usage plans when restructuring or facing shutdowns. The Enterprise Support Law also demonstrates Vietnam's commitment to helping firms retrain and rehire workers impacted by the shift in the coal sector.

7 Conclusions and Future Perspectives

The escalating climate crisis demands more immediate policy action on the just transition worldwide. No longer is there the opportunity to delay and take more evidence-based policy risks. The focus on the labor market can bring immediate benefits and growing literatures show that there are more green jobs and innovative policy can capture these (Heffron, 2024). Indeed in order to realize a just transition, the perception in society of who is responsible and accountable needs to shift to decision-makers in order that they act in accordance with the transition (Heffron *et al.*, 2024).

This paper in this context makes three key contributions to the literature. First, it offers JLT literature a comparative approach of 14 countries and their JLT progress. Second, it draws the key lessons for JLT policy success from these countries for innovative and impactful policies, and also those that have not been so successful. Third, it advances a framework, the JLT Progress Scale (JLTPS) that permits the comparative analysis of different countries and allows for a more systematic analysis of their progress in terms of advancement in the JLT. In this paper the boundaries of this JLTPS are explored from a qualitative perspective and future research will aim to focus on a quantitative data perspective.

There are many policy recommendations within the research, however, in time there will be further access to data to explore whether policy actions have been successful or at the very least impactful to communities in society suffering from inequalities. Through ensuring that justice principles such as procedural, and distributive are strongly present within policy frameworks is vital to achieving accelerated change for a just transition. Given the potential of the job market to contribute to improving the lives of workers both formally and informally, the JLT principles should be a priority focus. Indeed, part of the objective of this research is to contribute to the just transition pathways that have become a key action for many countries to establish and implement at COP29 and in future COPs.

As a result, our findings hold significant implications for policymakers. By adopting the actions outlined in this paper and utilizing the JLTPS as a benchmark, policymakers can design and implement more effective and targeted just transition strategies. Future research should explore ways to tailor these strategies to the specific needs of the countries in different stages of development and further refine the JLTPS to include a quantitative analysis on top of the current qualitative one for a broader global application. The utilization of such policy tools as JLTPS can create a more equitable and sustainable future for all by prioritizing a JLT.

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A Appendix: JLTPS Next Steps

The regular provision of updates and improvements based on the evolving landscape of JLT policies and practices can enhance the tool's relevance and effectiveness in policy formulation and evaluation. To this end, a series of steps has been established to ensure the ongoing updating and improvement of the tool. The primary objective is to incorporate a qualitative analysis from diverse and reliable secondary databases, enabling the association of specific variables with the various principles of justice and climate policies adopted by countries, as following:

1. **Climate law and policy documents using semantic search**
    - Climate Policy and Laws of the World (Source: https://climatepolicyradar.org/)
2. **Recognition justice**
    - Youth unemployment rate (Source: OECD)
    - Education attainment (percentage of population with at least some secondary education) (Source: UNDP)
    - Gender inequality in workforce participation (Source: World Economic Forum's Global Gender Gap Report)
    - Proportion of informal employment in total employment (%) (Source: ILO)
    - Coverage of social protection and labor programs (% of population) (Source: World Bank)
    - Social protection index (SPI) (Source: Asian Development Bank)
3. **Procedural justice**
    - Indigenous people (%) (Source: Indigenous Navigator)
    - Voice and Accountability Index (Source: WGI, World Bank)
    - Voter turnout (%) (Source: International IDEA)
    - Regulatory Quality Index (Source: WGI, World Bank)
    - Control of Corruption Index (Source: WGI, World Bank)
4. **Distributive justice**
    - Access to electricity (% of population) (Source: World Bank)
    - Investment in social safety nets (Source: World Bank)
    - Unemployment rate (Source: World Bank)
    - Gini index (World Bank estimate) (Source: World Bank)
    - Human Development Index (HDI) (Source: UNDP)
    - Education index (component of the Human Development Index) (Source: UNDP)
    - Number of green jobs created (Source: OECD, ILO)
    - Percentage of workforce undergoing reskilling/upskilling programs (Source: OECD, ILO)
    - Rate of decline in jobs within high-carbon sectors (Source: OECD, ILO)

With a comprehensive database, we aim to create standardized indicators for each key principle of justice. Utilizing this information for the 14 selected countries, we can strengthen the tool's capacity to classify the status of the fair labor transition. This enhanced framework will enable policymakers and stakeholders to better understand and address the multifaceted challenges and opportunities inherent in achieving a just transition.