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Beneath the curves: central banking in the era of environmental labour market disruption

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Policy report

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Glossary

Beveridge curve: illustrates the inverse relationship between job vacancies and unemployment, indicating the efficiency of the labour market in matching workers to jobs.

Employment multipliers: measure the total number of jobs created directly, indirectly and through induced effects as a result of an increase in demand or activity in a particular sector or industry.

Green and pollution-intensive ('brown') jobs: given the international scope of this report and associated data challenges in emerging markets and developing economies (EMDEs), 'top-down' sector-level definitions are used at the 2-digit ISCO-88 level as opposed to a 'bottom-up' approach based on occupation-level definitions of green or pollution-intensive jobs (Vona et al., 2019).

Hysteresis: refers to structural factors that cause temporary shocks to unemployment that have long-term 'scarring' effects.

Labour demand: the number of workers that employers are willing and able to hire at a given wage rate under specific economic conditions.

Labour productivity: measures the amount of economic output produced per unit of labour input, i.e. the output per worker.

Labour supply: the total number of hours that individuals are willing and able to work at a given wage rate, influenced by structural factors such as demographics, skills and preferences.

Non-Accelerating Inflation Rate of Unemployment (NAIRU): the level of unemployment at which inflation remains stable.

Okun's law: the statistically observed relationship between changes in unemployment and gross domestic product (GDP) growth. It is used by central banks to gauge how much growth is needed to reduce unemployment and calibrate monetary policy.

Phillips curve: the original curve depicts the short-term inverse relationship between inflation and unemployment, suggesting that lower unemployment leads to higher inflation and vice versa. The validity and shape of the curve have been extensively debated, but extensions of the original curve still form a bedrock of central bank assessments and modelling.

Summary

Climate change, environmental degradation, and the accelerating transition to a low-carbon economy are reshaping global labour markets. These forces are altering both the demand for and supply of labour, with far-reaching implications for central banks. As institutions that closely monitor labour market dynamics to guide monetary policy, central banks will increasingly need to account for the disruptions caused by environmental pressures. Physical climate impacts and nature degradation are likely to reduce labour productivity and limit work capacity in vulnerable sectors — particularly in emerging markets and developing economies (EMDEs). At the same time, the growing need for climate mitigation and adaptation investments may tighten labour markets by increasing demand for skilled workers, while displacing those employed in pollution-intensive industries. This report addresses a critical gap in current analysis by exploring how environmental risks intersect with central banks' mandates through the labour market. It aims to equip central banks with the insights needed to integrate these evolving risks into their policy frameworks and operational decisions.

Central banks routinely integrate employment considerations into their mandates and operations

Our review of 114 central bank mandates highlights the varying degrees to which employment considerations are embedded in their objectives, policy and operational frameworks. Of these, 52 are tasked with supporting the government's broader economic policy; 30 have explicit mandates focused on supporting economic growth or development; and 32 central banks have mandates to promote conditions conducive to economic or employment growth. Notably, 15 central banks explicitly reference employment in either their primary or secondary mandates. Despite these differences in mandates, all 114 central banks actively monitor and assess labour market statistics and dynamics to inform monetary policy decisions. They employ a range of analytical tools to forecast inflation, gauge the gap with full employment, and anticipate shifts in the business cycle.

Labour market dynamics are increasingly shaped by environmental pressures

- While the low-carbon transition may directly affect only a modest share of workers (estimated at 1–2.5%), it is expected to result in net employment growth due to the higher labour intensity of clean technologies. However, the transition may also create uneven impacts across sectors and regions, particularly between pollution-intensive and low-carbon industries. These **distributional effects** could lead to localised unemployment and social disparities, especially in economies with rigid labour markets.
- Even under scenarios where global warming is limited to 1.5°C or 2°C, **climate change** is projected to significantly reduce labour productivity and impair workers' ability to perform in heat-exposed sectors such as agriculture and construction.
- **Environmental degradation** poses additional risks, particularly for workers whose livelihoods depend on ecosystem goods and services. Loss of these services could lead to job displacement, increased labour supply, slackening markets in rural areas, and shifts in migration patterns.

3.4 billion workers face varying degrees of exposure to pollution, climate and nature-related risks

An estimated 3.4 billion workers in 182 countries around the world can be categorised into three environmentally vulnerable groups: pollution-intensive (81.7 million), climate-exposed (1.17 billion), and nature-dependent (1.16 billion). To assess their exposure to environmental risks, we use three labour-weighted exposure indices: climate transition risks, physical risks and ecosystem vulnerability. The results show that climate-related transition risks are concentrated in advanced economy labour markets that are reliant on pollution-intensive industries, whereas physical climate risks and ecosystem vulnerability are mostly concentrated in African, Asian and Latin American labour markets. Combined with demographic trends and restrictive immigration policies, these effects could lead to a tightening of labour markets in advanced economies and a slackening of labour markets in emerging economies.

Central banks in slackening labour markets may need to more actively stimulate employment

In slackening labour markets, central banks with clear development objectives may need to take a more active role in stimulating employment by supporting credit towards priority employment-intensive sectors. This may form part of a broader role of supporting structural economic transformation, especially in EMDEs where the labour market is still dominated by low-productivity economic sectors exposed to climate change or nature degradation, such as subsistence agriculture. Debates over the trade-offs between price stability and full employment may be less relevant here due to the tangible and potentially growing slack in the labour market in these countries, and correspondingly weakening Phillips curves.

High transition risks in advanced economies are increasing price volatility and reducing matching efficiency

Advanced economies facing high transition risks may experience increased price volatility and poorer matching efficiency in the labour market due to labour shortages and the imbalance between the greater demand for workers in low-carbon industries versus falling demand for those in pollution-intensive economic sectors. Environmental risks therefore imply structural changes in the labour market, which central banks will need to adjust their policies to. Such mismatches could manifest in several ways: an outward shift in the Beveridge curve, a decline in productive capacity, a rise in the natural rate of unemployment, and a weakening in the Okun coefficients as the relation between growth and employment wanes. These potential effects underscore the need for central banks to more closely integrate environmental risks into their existing monetary policy frameworks and operations.

Implications for central banks

- In economies that are highly reliant on ecosystem goods and services or that face high exposure to physical climate effects, central banks may need to implement policies that offset environmental risks by stimulating demand for labour.
- Climate-driven productivity losses could be a source of price instability in climate-exposed economies.
- Labour markets with high exposure to transition risks face increased price volatility and poorer matching efficiency.
- Environmental risks also imply structural changes to the labour market, which central banks will need to adjust their policies to.
- Structural factors could limit the effectiveness of various tools that central banks already use in their operational frameworks.
- Closer coordination and support for fiscal policymakers may be required.

Policy options

Depending on the integration of employment in their mandates and operational frameworks, central banks will need to respond in different ways to environmental risks to labour demand and supply.

- **Stronger integration of environmental risks for employment into core monetary policy frameworks** — Failure to integrate employment risks into central bank frameworks could undermine policy credibility and effectiveness, eroding trust in central banks if they appear overly focused on inflation control or financial stability, while neglecting labour market impacts.
- **Improving monitoring and analysis of labour market trends** — By enhancing models and scenario analyses, or by extending efforts to collect survey data from enterprises and other market participations.
- **Strengthening monetary-fiscal coordination** — By improving data availability and research on social impacts, raising awareness of environment-related labour market risks, and providing bespoke technical assistance for specific policies, to enable governments to design proactive strategies and implement necessary reforms that address structural labour market challenges.
- **Clarifying developmental objectives** — Employment objectives can serve as a focused and practical alternative to inflation targeting to address labour market vulnerabilities and support structural transformation.
- **Directing credit and subsidising lending in EMDEs** — In EMDEs that face increasing slack, development mandates could be given greater importance or clarified to focus on employment creation, giving central banks in these jurisdictions greater flexibility to implement tools such as credit allocation methods, interest rate ceilings, credit guarantees, and other direct and indirect policies to encourage bank lending to high employment-generating uses.
- **Focusing the financing of small- and medium-sized enterprises (SMEs)** — SME financing should ideally combine a focus on sectors or subsectors with high potential for jobs with high value-added and productivity.
- **Improving financial inclusion** — Improved access to financial services not only mitigates environmental risks but can support structural economic transformation by decreasing informal employment.
- **Extending pandemic crisis response knowledge to climate change events** — The recent COVID-19 pandemic revealed several examples of central banks playing a crucial role in protecting jobs in the event of sudden and rapid falls in output, which could be extended to extreme weather events caused by climate change.

1. Introduction

This report addresses a gap in the analysis of how climate change and environmental degradation affect central bank objectives via the labour market, exploring how environmental factors may disrupt employment and, in turn, central bank policy and operations. By shedding light on the employment risks posed by environmental change, this report aims to equip central banks with the insights needed to navigate a rapidly evolving economic landscape.

Employment is a critical macroeconomic indicator for central banks. For the US Federal Reserve (Fed) or the Reserve Bank of Australia (RBA), maximising employment is an explicit monetary policy objective. For the European Central Bank (ECB), the Reserve Bank of India (RBI), and others, employment is linked to their primary or secondary mandates to support price stability or developmental objectives. Most, if not all, central banks closely monitor and assess labour market performance to inform and calibrate monetary policy decisions related to price stability using Phillips curves, the Beveridge curve, or by measuring the output gap relative to the 'natural rate' of unemployment.

Going forward, environmental pressures will reshape labour markets in ways that affect central bank policies and operations. Climate change, environmental degradation, and the transition to a low-carbon economy will place pressures on labour demand, supply and productivity. While investment needs in climate mitigation and adaptation are likely to 'tighten' labour markets by reinforcing the demand for high-skilled labour, they may also 'slacken' them by displacing workers from polluting industries. Moreover, the increasingly intense and frequent physical impacts of climate change — rising temperatures, extreme weather events, and collapsing ecosystems — could disrupt labour productivity and capacity in climate-exposed or nature-dependent sectors, especially in emerging markets and developing economies (EMDEs).

Labour market dynamics shaped by climate change and environmental policies present significant implications for central banks. As guardians of price and financial stability, central banks must anticipate how climate and environmental shocks to employment could ripple through macroeconomic and developmental channels. For institutions mandated to maximise employment, poor labour market performance or mounting inequalities could erode their credibility, undermining their ability and credibility to enact policies critical for guaranteeing price and financial stability, and for managing environment-related risks.

There is a notable gap in the analysis of how climate change and environmental degradation affect central bank objectives via the labour market. While systemic financial risks — such as stranded assets and their cascading effects — have been extensively studied (Caldecott, 2018; Monasterolo, 2020; Battiston et al., 2021), the employment-related risks of environmental change have received far less attention. This report addresses this gap by exploring how environmental factors may disrupt employment and, in turn, central bank policy and operations.

Central banks have several options to mitigate environment-related employment risks. As a review of policies reveals, even central banks without explicit employment mandates have integrated employment considerations into their monetary policy frameworks and strategies. They regularly monitor and assess labour market performance — including through the use of enterprise surveys — which can be used to provide insights and support fiscal policymakers to develop and implement structural reforms to the labour market that address supply side issues. A number of central banks, particularly in EMDEs, have gone further to stimulate labour demand by extending credit to labour-intensive small- and medium-sized enterprises (SMEs), and expand financial inclusion to businesses and households to support employment creation. In addition, all central banks have a responsibility to prop up aggregate demand during economic crises to protect jobs.

The remainder of the report is structured as follows:

- **Section 2** explores why employment is of interest to central banks and how they integrate employment into their monetary policy frameworks.
- **Section 3** maps the labour market pressures arising from the low-carbon transition, climate change and nature loss using existing literature and evidence.
- **Section 4** evaluates country-level vulnerabilities to these pressures, identifying potential labour market imbalances related to these factors.
- **Sections 5 and 6** explore implications and policy options for central banks.
- **Section 7** concludes with recommendations and future research avenues for central banks to mitigate and manage environmental risks to labour markets.

2. Why is unemployment of interest to central banks?

Employment is a longstanding objective of monetary policy, especially for central banks with dual or development-oriented mandates. While central banks cannot influence structural features of the labour market, they can stimulate labour demand through quantitative easing or using targeted policies. Additionally, irrespective of their mandate, all central banks use analytical tools that rely on labour market indicators — such as Phillips curves, Beveridge curves, output gap estimates or NAIRU — to forecast inflation and calibrate monetary policy decisions.

Employment is a longstanding objective of monetary policy. Most, if not all central banks monitor and analyse employment, unemployment or other labour market indicators to inform and calibrate monetary policy decisions. Labour market indicators provide critical insights on domestic inflationary pressure, volatility in the real economy, and the transmission of monetary policy. There are also broader economic and societal benefits of full employment, such as innovation, productivity, prosperity and societal cohesion (RBA, 2024): "unemployment lies at the root of all our major social problems" (Lisa D. Cook, Governor of the Fed, 2023).

Monetary policy cannot influence labour supply or structural features of the job market. The level of 'full employment' is not fixed and evolves over time depending on structural factors, such as higher female labour force participation driven by societal changes and childcare reforms, skills mismatches and frictions, immigration, changes in birth rates, or increased life expectancy. Underutilisation and part-time work have also increased as a result of a shift to greater employment shares in services industries and labour market reforms that have made it easier for firms to adjust the working hours of their employees (Bishop et al., 2016).

However, monetary policy can influence demand for labour through monetary easing or tightening. By slowing demand when it exceeds supply, monetary policy can ensure that a strong labour market can be sustained. By reducing the severity and duration of economic downturns and preventing them from becoming deep and protracted, monetary policy can contribute to keeping the average level of employment as high as possible and thereby limit the extent to which workers lose their jobs causing costly scarring effects. When the economy operates away from full employment, it causes large and persistent social and economic costs. One spell of unemployment can reduce workers' earnings for several years afterwards. Long-term 'structural' unemployment can also lead people to lose skills and in the worst case to leave the labour force altogether, so-called 'hysteresis'. Furthermore, central banks can use targeted refinancing operations to steer credit towards employment-intensive sectors.

Central banks analyse (un)employment by performing assessments on how far away the economy is from full employment. Model-based estimates provide a broad guide of how the labour market stands relative to full employment. These assessments can be derived from labour market data, survey measures, liaison with businesses, and model-based estimates. Indicators include the number of job advertisements, job vacancies, and survey data of firms' employment intentions to gauge labour demand. Labour supply indicators primarily include labour force participation rates (i.e. the employment-to-population ratio). An imbalance between labour demand and supply can be inferred from unemployment rates,[1] the number of vacancies relative to the number of unemployed people (i.e. the Beveridge curve), or survey data which reports the extent to which

[1] Medium-term or youth unemployment tends to reflect cyclical labour market conditions. Long-term unemployment and underutilisation rates reflect structural factors.

labour is a constraint on the output for firms. In some cases, price indicators such as wage growth can also indicate whether a labour market is experiencing over- or under-supply. For example, the Reserve Bank of New Zealand (RBNZ) monitors a range of 44 indicators, four of which have been assessed to have a particularly strong relationship with inflationary pressure (RBNZ, 2024).[2]

Employment and inflation (the Phillips curve)

The main tool that central banks use to inform monetary policy objectives related to inflation targeting is the Phillips curve. The original Phillips curve suggests that there is an inverse relationship between the rate of unemployment and the rate of price or wage increases (Phillips, 1958). The relationship suggests that slack labour markets exert downward pressure on wages and prices, producing a trade-off between the two. The potential trade-off implies that central banks can use monetary policy to move the economy to any desired level of unemployment as long as they accept the resultant trade-off with inflation, or vice versa.

The original Phillips curve has been challenged for being "theoretically fragile and empirically elusive" (Stark, 2008), notably during periods of stagflation, during which both unemployment and inflation rise (Lucas and Sargent, 1978). Friedman (1968) first suggested that the inverse relationship was only a short-term phenomenon. Phelps (1968) introduced the concept of a 'flat' Phillips curve over the long run, under which the trade-off weakens and unemployment eventually gravitates towards a 'natural rate' (Friedman, 1968; Modigliani and Papademos, 1975), regardless of inflation.[3] Lucas (1972) critiqued the Phillips curve by showing that the results depended on the nature of the monetary policy regime. In the 1990s, a revival of interest in the Phillips curve emerged through the improved forecasting performance of 'generalised Phillips curve models' comprising, in lieu of unemployment, other economic activity indicators (Stark, 2008). New Keynesian Phillips curves (NKPCs) also emerged that relied more heavily on rational expectations of future inflation (Roberts, 1995; Gali and Gertler, 1999). Finally, the observance of 'non-linear' (Ball and Moffitt, 2001) or concave (Stiglitz, 1997) Phillips curves has suggested that policies aimed at reducing unemployment may have less of an inflationary impact when unemployment is already high or that the same policy action may have different effects depending on the stage of the business cycle. Furthermore, the observation that unemployment rises faster than it falls has been used as a justification for adopting a strongly pre-emptive posture to prevent inflation from rising again.

Despite ambiguity surrounding the Phillips curve, central banks continue to consider tight labour markets as a potential driver of high inflation through the 'wage–price spiral'. Central bankers frequently refer to the potential of a self-reinforcing 'wage–price spiral' as a reason for not reducing policy rates as they fear that high economic output and associated demand for labour will embed inflationary pressures over the medium term. Variations of the Phillips curve are therefore still used to forecast inflation as part of central banks' price stability mandates and are widely seen as an inexorable channel of the effect of monetary policy on inflation (Mankiw, 2001). The Bank of Canada alone has produced close to 50 technical reports and working papers dealing with the Phillips curve or variations thereof (Fortin, 2010).

However, inflation–employment trade-offs only manifest themselves under certain circumstances, requiring different monetary policy responses. In the short to medium term, the objectives of price stability and full employment are often complementary. Short-term demand shocks typically result in little or no conflict because a fall in demand reduces employment as well as inflation, meaning that central banks face a 'divine coincidence' in which they can lower the policy rate to counter the fall in the level of activity and inflation, or raise it in the event of a positive demand shock.

Employment versus inflation trade-offs primarily occur during supply shocks, which cause output and inflation to move in opposite directions. If the supply shock is short-lived (e.g. an extreme weather event) or where inflation expectations remain well-anchored, central banks can look

[2] The job transition rate, the job vacancy-to-unemployment ratio (i.e. the Beveridge curve), the unemployment rate, and a survey measure of labour as a limiting factor of business production.
[3] Since the 1980s, a notable 'flattening' of the Phillips curve has been observed, attributed to better-anchored inflation expectations, the presence of global slack, and swings in commodity prices driven by rising demand from EMDEs (BIS, 2014).

through the shock. During prolonged spells, high inflation may go hand in hand with lower production and reduced consumption, reducing employment. The rise in inflation implies a higher policy rate, which would also amplify the decline in demand and therefore employment. Similarly, lower production costs will imply that the policy rate should be reduced to bring inflation gradually up to target. These decisions can cause policy dilemmas for central banks, especially if they have dual mandates: "there are times when they [the Board's main objectives of maintaining low and stable inflation and full employment] may seem at odds with one another and the Board must consider how to balance its objectives" (Michele Bullock, Governor of the RBA, 2023).[4]

Over the long term, stable inflation and maximum employment do not represent a trade-off. Low and stable inflation creates favourable conditions for households and businesses to make sound decisions about how to spend, save and invest, leading to strong and sustainable employment growth.

Calibrating monetary policy

The output gap — or the difference between actual output and potential output — can be used by monetary policymakers to estimate slack in the economy and calibrate monetary policy decisions. The presence of high unemployment may limit the extent to which a central bank can tighten monetary policy aggressively, especially if it has a mandate to maximise employment. Conversely, low unemployment rates that are close to or below the natural rate leave room for manoeuvre, as recently experienced when the Fed was able to aggressively tighten monetary policy because unemployment was at historical lows (Fed, 2024). Central banks can therefore use output gap estimates to strike a balance between the aim of maintaining stable inflation around a specific target and aiming to maintain a high and stable level of employment. For example, Norges Bank explicitly accepts that it may be appropriate for inflation to temporarily overshoot its target so that labour market conditions can improve if there are any signs that hysteresis effects have occurred following a downturn (Norges Bank, 2025a).[5]

Many central banks rely on the estimates of the NAIRU to estimate spare capacity in the labour market. The NAIRU (the 'natural rate of unemployment' or u^*, indicating the natural 'churn' or frictional unemployment that occurs in the labour market) indicates the lowest level at which the unemployment rate can be maintained without placing upward pressure on wage growth, and consequently, price inflation. It represents a type of Phillips curve that can be used to measure the 'unemployment rate gap'. If the unemployment rate is higher than the NAIRU — for instance, driven by cyclical unemployment — central banks can consider measures to stimulate the economy by lowering the cash rate target or implementing unconventional policies until unemployment has returned to its natural rate. It is important to note that the NAIRU is independent of monetary policy and influenced by structural factors, and that it changes over time as the structure of the economy evolves (Jacob and Wong, 2018; RBA, 2023; Fed, 2024).

Another tool that can be used to identify the rate of monetary policy stimulus required to reduce unemployment is Okun's law. Okun's law refers to the strong correlation that is sometimes observed between the unemployment rate and real gross domestic product (GDP). It can be used by central banks as a forecasting tool to project unemployment and predict the rate of output growth consistent with stable unemployment, or to estimate the 'sacrifice ratio' of inflation or disinflation in terms of output or employment. For the United States, a 1% deviation of output above potential is associated with a 0.3–0.5 percentage point decline in the unemployment rate (Okun, 1962; Blanchard, 2012; Ball et al., 2017).[6] Sacrifice ratios tend to cluster around 4–6% of annual GDP

[4] Full employment may also be at odds with the objective of financial stability. During extended periods of accommodative monetary policy, high employment can contribute to the build-up of leverage and imprudent risk-taking in parts of the financial system. These vulnerabilities can be exposed if monetary policy is tightened at a later point. At the same time, unemployment is the most common reason why households and firms are unable to repay debt owed to banks.
[5] Governor Ida Wolden Bache (Norges Bank, 2025a) "Our interpretation of Norges Bank's mandate is that considerable weight shall be given to employment — also at times when inflation deviates significantly from the target."
[6] Vice versa, this would imply that a one-point increase in cyclical unemployment is associated with two percentage points of negative growth in real GDP. However, the correlation fluctuates over time and between countries, and some scholars have argued that Okun's coefficients have weakened or even broken in advanced economies (Gordon, 2010; Cazes et al., 2013) or EMDEs (An et al., 2017; Bartolucci et al., 2018; Lee et al., 2020; Woo, 2023).

(Gordon, 1997; Mankiw and Reis, 2002), meaning that a reduction of inflation by one percentage point is associated with a sacrifice of 4–6% of a year's GDP. If stable, Okun's law or sacrifice ratios can be used to justify the use of monetary stimulus to reduce unemployment and facilitate the calibration of policy tools to meet certain employment targets.

The Beveridge curve acts as a key tool for monitoring labour market performance and monetary policy decisions. The curve captures the relationship between unemployment and job vacancies (Blanchard et al., 1989), indicating whether the labour market is 'tight' (low unemployment and high vacancies) or 'slack' (high unemployment and low vacancies). The position of the Beveridge curve also reflects matching efficiency in the labour market. Inward shifts indicate improved efficiency, where unemployed workers are more easily matched with job vacancies. Outward shifts signal declining efficiency, often due to mismatches between job locations, required skills, or sectoral demand. This is important insofar as shifts in the Beveridge curve help central banks anticipate changes in the business cycle, and the likely impact that monetary policy decisions can have at different stages of that cycle. For example, the RBA explicitly uses the Beveridge curve to "minimise economic cycles" (RBA, 2024) to keep inflation low and stable while maximising employment levels.

Employment mandates

Historically, central banks have played a strong role in economic or social development. Although inflation-targeting has manifested itself as the dominant monetary policy framework, central banks have historically played a more instrumental role in achieving economic or social development goals (Epstein, 2007; 2009; Goodhart, 2010; van Tilburg and Simic, 2020). This has also justified the use of unconventional monetary and non-monetary policies, such as the co-financing of large-scale economic development efforts as in the case of Korea (Epstein, 2009; van Tilburg and Simic, 2020) or the adoption of variable asset-based reserve requirements and subsidised interest rates for privileged industries deemed nationally important, as in the case of the Banque de France (Epstein, 2007). In EMDEs, many central banks still assume the role of development banks by providing capital or purchasing securities and equity of development institutions, such as industrial or agricultural development banks, or by establishing ceilings or unfavourable reserve requirements for low-priority activities (Epstein, 2007; 2009).

Most central banks still have an implicit or explicit development mandate (Dikau and Volz, 2021). This mandate generally falls into three categories:

1. **Supporting development as a by-product of low and stable interest rates and financial system soundness, which foster conditions conducive to economic or employment growth.** For instance, the South African Reserve Bank's mandate states that "The primary object of the South African Reserve Bank is to protect the value of the currency in the interest of balanced and sustainable economic growth in the Republic" (Constitution of the Republic of South Africa, 1996).
2. **Supporting the general economic policies of the government.** For example, the ECB's mandate states that "the primary objective of the ECB shall be to maintain price stability. Without prejudice to the objective of price stability, it shall support the general economic policies in the Union […]" (Statute of the European System of Central Banks and of the European Central Bank).
3. **Supporting (sustainable) economic growth and development as an explicit primary or secondary objective.** For example, the RBI's mandate states the "primary objective [of monetary policy] is to maintain price stability while keeping in mind the objective of growth" (Reserve Bank of India Act, 1934).

Of 114 central banks reviewed, 52 had a development mandate to support the general economic policies of the government (see Table 2.1). Monetary–fiscal coordination primarily takes place in the form of research, technical or advisory support on structural reforms (Benchimol and Dahan, 2023), or by acting as a go-between for finance ministries and the regulated financial sector (Epstein, 2007). Thirty central banks had a more explicit development mandate in the form of supporting economic growth or development, and 32 had a development mandate in the form of fostering conditions conducive to economic or employment growth.

Several central banks have retained an explicit employment mandate alongside maintaining low and stable inflation. As discussed below, a dual inflation-employment mandate can help central banks to calibrate their monetary policy decisions and better manage monetary policy trade-offs with respect to economic output and employment. The Fed[7] and the RBA are the two most prominent examples of central banks with dual primary mandates, with the RBA only recently reaffirming its dual objective in 2023 (see Box 2.1).[8]

Box 2.1. The Reserve Bank of Australia's dual mandate

In 2023, the Reserve Bank of Australia (RBA) elevated full employment to a 'dual mandate' alongside price stability, underscoring its importance in monetary policy. Price stability and full employment are viewed as complementary objectives. Over the long term, low and stable inflation fosters sustainable employment growth by creating a favourable environment for households and businesses. The RBA also emphasises that monetary policy responses to demand shocks help mitigate long-term scarring effects on workers and stabilise employment.

However, the RBA acknowledges short- to medium-term trade-offs when supply shocks, such as energy disruptions, simultaneously drive inflation higher while reducing economic output and labour demand. In such cases, the RBA faces the challenge of balancing employment preservation with the risks of high inflation becoming entrenched.[9]

The RBA does not set a numerical target for full employment but relies on a broad set of indicators to guide monetary policy decisions. These include job vacancies to gauge labour demand, labour force participation rates as a measure of supply, and metrics such as unemployment, underutilisation, and the Beveridge curve to assess spare capacity. Additionally, wage and productivity growth provide insights into the overall balance of supply and demand in the labour market.

Several other central banks also explicitly mention employment or unemployment as part of their primary or secondary developmental mandate (i.e. Banco Central de la República Argentina, Bangladesh Bank, Bank of Canada, Norges Bank, Bank of Papua New Guinea, Central Bank of Trinidad and Tobago), as part of their role in supporting the government's employment policy (i.e. Bank of Jamaica, Central Bank of Kenya, Central Bank of the Republic of Türkiye, Bank of England), or as part of their objective to maintain monetary or price stability that is conducive towards employment growth (i.e. Central Bank of Liberia, Reserve Bank of Malawi, Banco Central del Uruguay) (see Table 2.2).

Central banks have retained a more explicit development mandate in many EMDEs focused on financial inclusion. A key development objective for central banks in EMDEs is financial inclusion and the extension of credit and/or financial services to poor or vulnerable sections of the economy at affordable cost. Central banks, such as Bangladesh Bank, support financial inclusion through various measures, such as the agricultural sector credit policy, direct credit policies, special refinancing facilities targeted at vulnerable groups and SMEs, or by facilitating the opening of bank accounts and the use of mobile banking. In part, the financial inclusion mandate includes sub-objectives such as inducements to employment (Muqtada, 2015).

There has also been a clear development role for monetary policymakers in times of economic downturns or disasters. For example, during the 2011 Great East Japan Earthquake or the Canterbury earthquakes in New Zealand, the Bank of Japan and the Reserve Bank of New Zealand both coordinated with insurance companies and international financial institutions to spread risks (van

[7] Established by the Employment Act of 1946 and the Full Employment and Balanced Growth Act of 1978.
[8] The Reserve Bank of New Zealand had a dual mandate between 2018 and 2023, defining the employment objective as supporting the "maximum sustainable level" of employment, akin to the NAIRU (RBNZ, 2022). A dual mandate has also been debated in South Korea (Woo, 2023). A fear that making choices regarding employment would bring central banks into political waters is often cited as a reason not to introduce primary employment targets. Others have argued that there is a strong legal as well as economic argument to be made in favour of an employment mandate (Benchimol and Dahan, 2023).
[9] In practice, it has been argued that central banks with dual mandates tend to prioritise inflation over full employment in their monetary policy decisions given that it is easier to set inflation than unemployment targets (Jacob and Wong, 2018; RBA, 2023; Fed, 2024).

Tilburg and Simic, 2020). Central banks are also more likely to respond to extreme weather events or natural disasters by temporarily loosening monetary policy (Batten et al., 2016), not just with the intention of preventing downward spirals of deflation, but to cushion the negative impacts of temporary shocks. Some central banks have taken active stances to inject liquidity into the financial system by extending loan programmes, expanding asset purchases of institutions affected by the event, or by extending lending to governments or adjusting collateral frameworks to include municipal bonds (van Tilburg and Simic, 2020). A similar case for central bank interventions could be made in response to acute physical risks, as these can undermine aggregate income and employment, as seen in destroyed production capacities following extreme weather events caused by climate change (Dikau and Volz, 2021).

Table 2.1. Central banks with development objectives by category, 2025

Foster conditions conducive to economic development	Support general economic policies of the government	Explicit primary or secondary development mandate
Bank of Albania	Da Afghanistan Bank	Banco Central de la República Argentina*
Banque d'Algérie	Central Bank of Armenia	Reserve Bank of Australia*
Central Bank of Barbados	Central Bank of Azerbaijan	Bangladesh Bank*
Central Bank of Belize	Central Bank of the Bahamas	Bank of Canada*
Royal Monetary Authority of Bhutan	Central Bank of Bahrain	Banco Central de Costa Rica
National Bank of Cambodia	Banco Central de Bolivia	Banco Central de Cuba
People's Bank of China	Bank of Botswana	Banque Centrale de Djibouti
Banco Central de la República Dominicana	Banco Central do Brasil	National Bank of Ethiopia
Banco Central del Ecuador	Brunei Darussalam Central Bank	Central Bank of the Gambia
Central Bank of Egypt	Bulgarian National Bank	National Bank of Georgia
Banco Central de Reserve de El Salvador	Banque de la République du Burundi	Reserve Bank of India
Reserve Bank of Fiji	Banco de Cabo Verde	Central Bank of Iraq
Banco de Guatemala	Bank of Central African States (BEAC)	Central Bank of Jordan
Bank of Guyana	Banco Central de Chile	Bank of Korea
Bank of Japan	Banco de la República	Central Bank of Kuwait
National Bank of the Kyrgyz Republic	Banque Centrale des Comores	Bank of Mauritius
The Bank of Lao P.D.R.	Banque Centrale du Congo	Banco de Moçambique
Banque du Liban	Hrvatska Narodna Banka	Norges Bank*
Central Bank of Liberia*	Česká národní banka	Central Bank of Oman
Reserve Bank of Malawi*	Central Bank of Timor-Leste	Bank of Papua New Guinea*
Bank Negara Malaysia	Eastern Caribbean Central Bank (ECCB)	Saudi Arabian Monetary Authority
Maldives Monetary Authority	European Central Bank (ECB)	Monetary Authority of Singapore
Central Bank of Mongolia	Bank of Ghana	Swiss National Bank
Bank of Namibia	Banque Centrale de la République de Guinée	Central Bank of the Republic of China (Taiwan)
Bangko Sentral ng Pilipinas	Magyar Nemzeti Bank	National Reserve Bank of Tonga
Bank of Russia	Seðlabanki Íslands	Central Bank of Trinidad and Tobago*
National Bank of Rwanda	Bank of Israel	National Bank of Ukraine
South African Reserve Bank	Bank of Jamaica*	Federal Reserve*

Central Bank of Sudan	Central Bank of Kenya*	Banco Central de Venezuela
National Bank of Uganda	Central Bank of the Republic of Kosovo	State Bank of Vietnam
Banco Central del Uruguay*	Banky Foiben'i Madagasikara	
Reserve Bank of Vanuatu	National Bank of Moldova	
	Central Bank of Montenegro	
	Bank Al-Maghrib	
	Central Bank of Myanmar	
	Nepal Rastra Bank	
	National Bank of the Republic of North Macedonia	
	State Bank of Pakistan	
	Banco Central de Reserva del Perú	
	Qatar Central Bank	
	National Bank of Romania	
	Central Bank of Samoa	
	National Bank of Serbia	
	Bank of Sierra Leone	
	Central Bank of Solomon Islands	
	Central Bank of Somalia	
	Central Bank of Sri Lanka	
	Bank of Tanzania	
	Bank of Thailand	
	Central Bank of the Republic of Türkiye*	
	Bank of England*	
	Central Bank of West African States (BCEAO)	

*Notes: *Denotes central banks which explicitly reference employment or unemployment as part of their development mandate; note that where a central bank has multiple developmental mandates, we only list them in the 'highest' (development mandate > economic policy > foster conditions) category. No references to developmental mandates were found in the laws or statutes for the central banks of Angola, Bosnia and Herzegovina, Denmark, Eswatini, Indonesia, Kazakhstan, Lesotho, Mexico New Zealand, Nicaragua, Nigeria, São Tomé e Príncipe, the Seychelles, Suriname, Sweden, Tajikistan, Turkmenistan, Tuvalu, the United Arab Emirates, Uzbekistan and Zambia. The laws or statues for the central banks of Belarus, Eritrea, Haiti, Honduras, Iran, Paraguay, South Sudan, Syria, Tunisia, Yemen and Zimbabwe could not be reviewed.*
Source: Author's analysis

Table 2.2. Central banks with explicit primary or secondary employment mandates, 2025

Country	Central bank	Primary mandate(s)	Explicit reference to employment	Source
Argentina	Banco Central de la República Argentina (BCRA)	Price stability; financial stability	Explicit part of secondary mandate: "The purpose of the Bank is to promote — within the framework of its powers and the policies set by the National Government — monetary and financial stability, **employment**, and economic development with social equality."	Charter of the Central Bank of the Argentine Republic
Australia	Australian Federal Reserve	Price stability; full employment	Explicit part of primary mandate: "(1) The functions of the Monetary Policy Board are: (a) to determine the monetary policy of the Bank in a way that, in the Board's opinion, best contributes to: (i) price stability in Australia; and (ii) the maintenance of full **employment** in Australia;"	Treasury Laws Amendment (Reserve Bank Reforms) Bill 2023
Bangladesh	Bangladesh Bank	Price stability; financial stability	Explicit part of secondary mandate: "Whenever the Bank anticipates economic disturbances that are likely to threaten domestic monetary stability in Bangladesh or whenever abnormal movements in the money supply or in the price level are endangering such stability, it shall be the duty of the Bank-" […] "(b) to submit to the Government a detailed report which shall include as a minimum, an analysis of-" […] "(ii) the probable effects of such disturbances or movements on the level of production, **employment**, and real income in Bangladesh;"	Bangladesh Bank Order, 1972
Canada	Bank of Canada	Price stability; employment and sustainable growth	Explicit part of primary mandate: "Whereas it is desirable to establish a central bank in Canada to regulate credit and currency in the best interests of the economic life of the nation, to control and protect the external value of the national monetary unit and to mitigate by its influence fluctuations in the general level of production, trade, prices and **employment**, so far as may be possible within the scope of monetary action, and generally to promote the economic and financial welfare of Canada;"	Bank of Canada Act, R.S.C., 1985, c. B-2

Jamaica	Bank of Jamaica	Price stability; financial stability	Explicit part of secondary mandate: "The Bank shall carry out its functions with a view of achieving the principal objectives specified under subsection (1) and shall do so in a manner that recognizes the growth and **employment** objectives of the Government."	The Bank of Jamaica (Amendment) Act, 2020
Kenya	Bank of Kenya	Monetary stability	Explicit part of secondary mandate: "4. (1) The principal object of the Bank shall be to formulate and implement monetary policy directed to achieving and maintaining stability in the general level of prices. (2) The Bank shall foster the liquidity, solvency and proper functioning of a stable market-based financial system. (3) Subject to subsections (1) and (2), the Bank shall support the economic policy of the Government, including its objectives for growth and **employment**."	The Central Bank of Kenya Act, 2014
Liberia	Central Bank of Liberia	Price stability	Explicit part of secondary mandate: "The primary policy focus of the CBL in 2021 remains on maintaining domestic price stability through broad exchange rate stability. This objective can be achieved through the formulation and implementation of prudent monetary policy that ensures a stable macroeconomic environment to spur balanced growth as catalyst for development and **employment**. The CBL will also remain supportive of the general economic policy of the Government, in keeping with its monetary policy mandate."	An Amendment and Restatement of the Act Establishing the Central Bank of Liberia
Malawi	Reserve Bank of Malawi	Monetary stability; promoting economic growth and development	Explicit part of primary mandate: "to implement measures designed to influence the money supply and the availability of credit, interest rates and exchange rates with the view to promoting economic growth, **employment**, stability in prices and a sustainable balance of payments position."	Reserve Bank of Malawi Act (Chapter 44:02)
Norway	Norges Bank	Monetary stability; financial stability	Explicit part of secondary mandate: "(2) The central bank must contribute to high and stable production and **employment**."	Lov om Norges Bank og pengevesenet mv. (sentralbankloven)

Papua New Guinea	Bank of Papua New Guinea		Explicit part of primary mandate: "For the advantage of the people of Papua New Guinea, the objectives of the Central Bank are- (a) to formulate and implement monetary policy with a view to achieving and maintaining price stability and promoting **employment** and economic growth, especially of the non-mineral and non-petroleum sector;"	Central Banking Act, 2020
Trinidad and Tobago	Central Bank of Trinidad and Tobago	Monetary stability	Explicit part of secondary mandate: "3. (3) The Bank shall have as its purpose the promotion of such monetary credit and exchange conditions as are most favourable to the development of the economy of Trinidad and Tobago, and shall, without prejudice to the other provisions of this Act- […] (d) maintain monetary stability, control and protect the external value of the monetary unit, administer external monetary reserves, encourage expansion in the general level of production, trade and **employment**;"	Central Bank Act
Turkey	Central Bank of the Republic of Türkiye	Price stability	Explicit part of secondary mandate: "The Bank shall, provided that it shall not conflict with the objective of maintaining price stability, support the growth and **employment** policies of the Government."	The Law on the Central Bank of the Republic of Türkiye
United Kingdom	Bank of England	Price stability	Explicit part of secondary mandate: "The primary objective of the Bank of England is to maintain price stability. The Government may also set a target for the Bank of England to support the government's economic policy, including the objective of achieving high levels of **employment**."	Bank of England Act 1998
United States	US Federal Reserve	Price stability; full employment	Explicit part of primary mandate: "The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long run growth of the monetary and credit aggregates commensurate with the economy's long run potential to increase production, so as to promote effectively the goals of maximum **employmen**t, stable prices, and moderate long-term interest rates."	Federal Reserve Reform Act of 1977

Uruguay	Banco Central del Uruguay	Price stability	Explicit part of primary mandate: “The Central Bank of Uruguay will have the following main purposes: A. To obtain price stability that contributes to achieving **employment** and growth goals. B. To regulate and supervise payment and financial systems in order to promote soundness, solvency, efficiency and development.”	Organic Charter Ordered Text

Source: Author’s analysis.

3. What do we know about the impact of environmental change on employment?

Much of the existing research and empirical analysis on environment-related employment impacts is concerned with how the low-carbon transition affects the demand for labour. While important, policymakers also need to consider a growing body of evidence of the physical impact of climate change and nature loss on labour supply and productivity, especially in the context of a delayed or non-existent transition pathway.

The impacts of the low-carbon transition on employment

The aggregate effect of the low-carbon transition on labour markets is expected to be relatively modest. The green skills required for low-carbon or climate-resilient projects and activities are widely dispersed across sectors, meaning that the transition is unlikely to produce sweeping changes in employment at a macroeconomic level (Magacho et al., 2023). Existing studies described in Box 3.1 suggest that between 1% and 2.5% of workers will be directly affected over the next decade, meaning that they will either lose their jobs or be reallocated to other industries. For comparison, according to the International Monetary Fund (IMF), around 8% of workers switch jobs every year and a further 6% leave their positions (IMF, 2022). The low-carbon transition's impact on the labour market is also smaller than similar periods of economic transformation in the past, such as the rapid deindustrialisation that occurred in Organisation for Economic Co-operation and Development (OECD) countries in the 1980s and that directly affected 4% of workers (ibid.).

Box 3.1. Estimating the impact of the low-carbon transition on employment

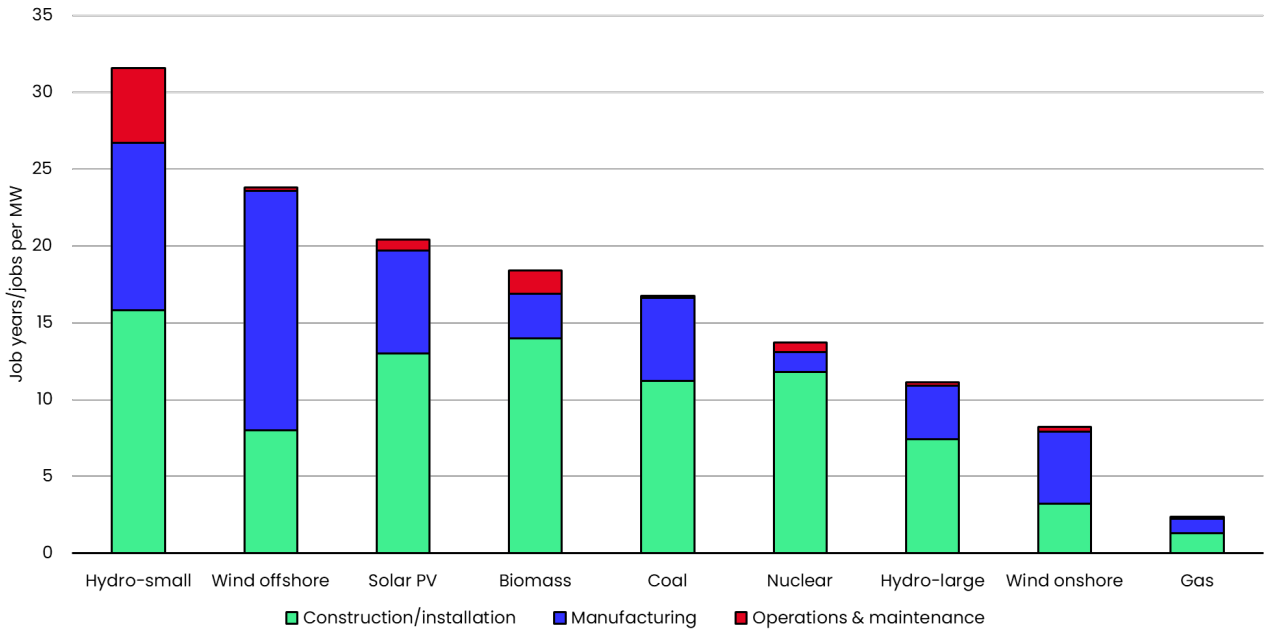
The emissions intensity of employment has declined over time due to efficiency gains and economic shifts from industrial to service sectors. As a result, only a small portion of workers are currently employed in high-emission industries like mining, manufacturing and fossil-based energy production (IMF, 2022).

Forecasts estimate that 1.5% to 2.5% of the global workforce will be affected by the net-zero transition over the next decade:

- The International Labour Organization (ILO 2018; 2019a) projects that 2% of the workforce (80 million jobs lost, 100 million created) will be affected under a 2°C scenario by 2030.
- The IMF (2022) estimates that 1% of employment in advanced economies and 2.5% in emerging markets will shift to greener activities over a decade, reflecting workforce skill disparities and higher emissions intensity in EMDEs.
- The IMF (2020) predicts that achieving net zero by 2050 will require 2% of the global workforce to change sectors over 30 years.
- Espagne et al. (2023) estimate a 1.5% employment increase by 2040 compared to baseline projections.
- Černý et al. (2024) forecast that a 100% renewable energy scenario in Europe could create 7 million jobs by 2030 and 4.1 million by 2050, representing 3% and 1.9% of the labour force, respectively.
- IRENA (2023) predicts a net gain of 33 million jobs globally under a 1.5°C scenario by 2050, with 45 million jobs created in renewables and energy transition technologies offsetting 12 million fossil fuel job losses.

Overall, the low-carbon transition will likely generate a net increase in labour demand. Renewable energy technologies tend to be more labour-intensive than fossil-based systems (Montt et al., 2018). Employment multipliers for renewable energy investments are nearly twice the size of fossil fuel investments (Rutovitz et al., 2015) (see Figure 3.1). Renewable energy investment needs also spur indirect demand for jobs in manufacturing, construction or transport due to associated building retrofits or local grid construction (Chateau et al., 2018; Botta, 2019; Fragkiadakis et al., 2023). Other sectors affected by the low-carbon transition will experience similar net positive effects. For example, when accounting for the production and assembly of battery packs and the geographic location of new battery production capacity with current internal combustion engine vehicle (ICEV) production sites, the labour intensity required for the manufacturing of electric vehicles (EVs) is larger than for ICEVs (Cotterman et al., 2024).[10]

Figure 3.1. Employment factors per MW of installed energy by fuel type



Note: Construction/installation and manufacturing jobs are represented as jobs per year/MW whereas operations and maintenance jobs are represented as jobs/MW.
Source: Author's analysis based on Rutovitz et al. (2015)

Over time, positive net increases in labour demand will diminish (see Box 3.2). The higher labour intensity of renewables is likely to decline due to technological advancements and capital efficiency gains (Malik et al., 2021; Espagne et al., 2023; NGFS, 2024). Rising productivity and declining costs will reduce labour intensity. Furthermore, operational and maintenance requirements for renewables remain lower than those for fossil fuels (Espagne et al., 2023), which will place downward pressure on labour demand as the low-carbon transition matures.

[10] If battery production capacity is located elsewhere, or policymakers do not support the reallocation of labour to EV technologies through measures such as retraining or worker reallocation, negative employment effects could still arise within countries (NGFS, 2024).

Box 3.2. Modelling techniques for estimating employment impacts

Economic models commonly used to estimate the employment impacts of the net-zero transition include Input-Output (IO) and Computable General Equilibrium (CGE) models (Malik et al., 2021). These approaches differ in their assumptions, mechanisms and capacity to capture feedback effects.

Input-Output (IO) models

IO models analyse the flow of goods and services between sectors, estimating employment impacts of energy and climate policies on macroeconomic indicators. These models assume infinite labour supply at fixed capital–labour proportions (Leontief production function), with relative prices, investment and trade treated as exogenous variables that can be adjusted for scenario analyses. Scenarios often include gradual investments in renewable energy and capital imports, allowing global employment estimates through Multi-Regional Input-Output (MRIO) models such as the ILO's (2018; 2019a) analysis of global labour demand forecasts under the International Energy Agency's (IEA) Energy Sustainability Scenario using EXIOBASE, Černý et al.'s (2024) employment growth forecasts for a 100% renewable energy scenario in Europe, or Magacho et al.'s (2023) assessment of the exposure of 189 national labour markets to transition risks using EORA-26.

While useful for scenario analysis, especially for assessing short- to medium-term impacts in economies with fixed exchange rates or shared currencies (Perrier and Quirion, 2018), IO models have notable limitations. They ignore feedback or rebound effects, such as the reduction in labour intensity over time due to technological advancements. Furthermore, by assuming infinite and inelastic labour supply, they fail to capture real-world labour market constraints like geographical and skills mismatches (Caldés et al., 2009; Ortega et al., 2015).

Computable General Equilibrium (CGE) models

CGE models incorporate endogenous investment and scarcity of inputs, including labour. Labour supply is fixed or priced dynamically through wage adjustments, allowing substitution mechanisms to reflect changes in relative prices (e.g. Cobb-Douglas functions, see Perrier and Quirion, 2018). Unlike IOs, these models can therefore capture feedback loops for climate and transition policies, including their effects on government revenues, spending and employment. Notable examples include the OECD's ENV-Linkages model (Chateau et al., 2018) or the JRC-GEM-E3 model, which was used to assess the impacts of the EU's Fit for 55 policy package (European Commission, 2020). CGE models are well-suited to analysing long-term labour market impacts in countries with flexible exchange rates.

Other modelling approaches

Additional techniques include Keynesian models (e.g. Rezai et al., 2018), Integrated Assessment Models (IAMs), which combine economic, energy and climate systems, such as E3ME-FTT (Espagne et al., 2023), or sectoral and national approaches that use traditional econometric methods relying on job multipliers and employment factors to estimate employment in specific industries or regions (IEA, 2023; Malik et al., 2021).

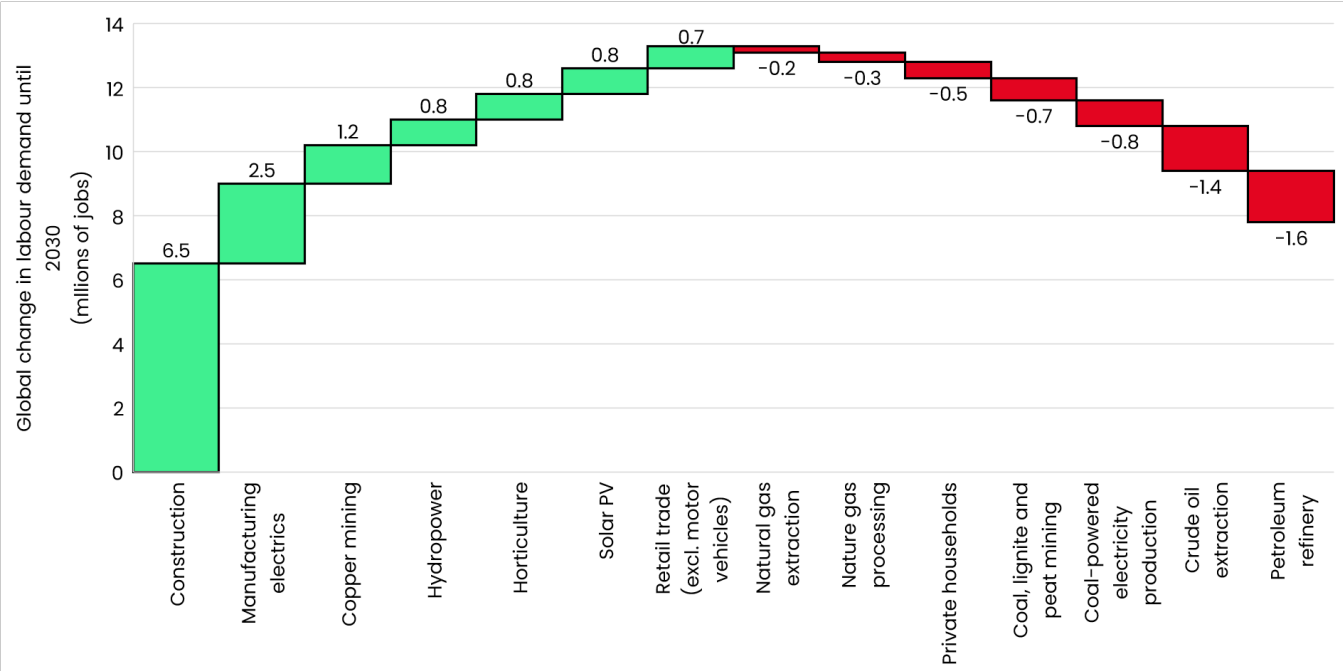
Some models, like Malik et al. (2021) and NGFS (2022), are notable because they project net employment declines due to labour productivity gains and capital cost reductions. Malik et al. (2021) estimate that energy sector jobs will drop from 20.4 million to 16 million under current nationally determined contribution (NDC) policies. NGFS forecasts significant spikes in unemployment in the medium-term in a Current Policies Scenario (3°C), driven by climate-related physical and transition risks (see Figures 3.3(a)–(d)). However, under more ambitious policy scenarios the observation that the low-carbon transition will lead to net employment gains is generally supported, which will reduce unemployment over the medium- to long-term.

The employment impacts of the low-carbon transition may vary between countries depending on policy decisions and pre-existing factors. The speed of policy implementation, the pre-existing industrial structures and the existing skill base in the labour market, and the balance between low- and high-carbon activities will affect demand for labour (Espagne et al., 2023; OECD, 2024). Further important considerations include whether economies are currently fossil fuel importers or exporters,

whether they are endowed with critical minerals, and the magnitude of low-carbon and climate-resilient investment needs (Espagne et al., 2023). Positive employment effects may therefore not materialise within individual countries, particularly those that are currently fossil fuel exporters and which will face declining revenues and the necessity to import green technologies. In contrast, green technology exporters and critical mineral producers may see substantial economic and employment gains (NGFS, 2024).

Job losses will be concentrated in specific pollution-intensive sectors. Not all sectors will experience employment gains. Job losses in fossil-based industries will be inevitable, particularly in sectors like coal mining, petroleum refining, and fossil-based electricity generation (see Figure 3.2). Countries heavily reliant on these industries, such as Kuwait, Qatar, Russia and Australia, face significant transition risks (Magacho et al., 2023; Espagne et al., 2023). EMDEs may be more vulnerable because they have higher employment shares in carbon-intensive sectors (IMF, 2022; NGFS, 2024) and as a result of their comparatively high exposure to carbon border adjustment mechanisms (CBAMs).

Figure 3.2. Sectors most affected by the net-zero transition, scenario to 2030



Source: Author's analysis based on ILO (2018)

The uneven geographic and sectoral distribution of employment impacts raises questions about justice and equity. Aggregated estimates of the low-carbon transition's employment effects often mask significant differences in the distributional impact within countries or sectors. These uneven distributional effects — often discussed under the concept of a 'just transition' — are critical because they create political economy constraints, including for central banks. Specific groups whose jobs are disproportionately affected by climate policies often resist change more strongly than those who benefit (Godinho, 2022). Resistance may also stem from the deep political, social and cultural ties of fossil-based industries in subnational regions such as China's Shanxi province, India's Jharkand and Odisha states, South Africa's Mpumalanga province, and Germany's Ruhr region (Malik et al., 2021). This opposition, real or perceived, can undermine the acceptance and implementation of climate policies, particularly those tied to conscious, policy-induced employment changes (Brekke and Johansson-Stenman, 2008; Dechezleprêtre et al., 2022). Even modest job losses could therefore politicise environmental policies that have negative employment effects, however small.

Labour market rigidities may also result in higher job losses than predicted using aggregated econometric models (Sovacool et al., 2021; Godinho et al., 2022). Transitioning workers from pollution-intensive jobs to new occupations in green growth sectors is challenging. Workers in fossil-based industries are often geographically concentrated and face practical barriers when moving to

other jobs and regions, such as skills mismatches, lack of housing and childcare, or a reduction in wages (IEA, 2023). While green jobs typically offer higher average wages than pollution-intensive jobs (Vona et al., 2019), roles in solar, wind and hydrogen industries can pay 15–30% less than in fossil fuel extraction (IEA, 2023). Additionally, many green jobs demand highly specific skills that are already undersupplied in the current labour market. The transition can therefore lead to skill-biased technological change when low- and middle-skilled jobs are automated or offshored while demand for high-skilled labour increases (Wei et al., 2010; Markandya et al., 2016), which hollows out the labour market and reinforces inequalities. These systematic barriers complicate job reallocation and potentially result in hysteresis effects or structural unemployment even when net job creation is positive (Castellanos and Heutel, 2019).

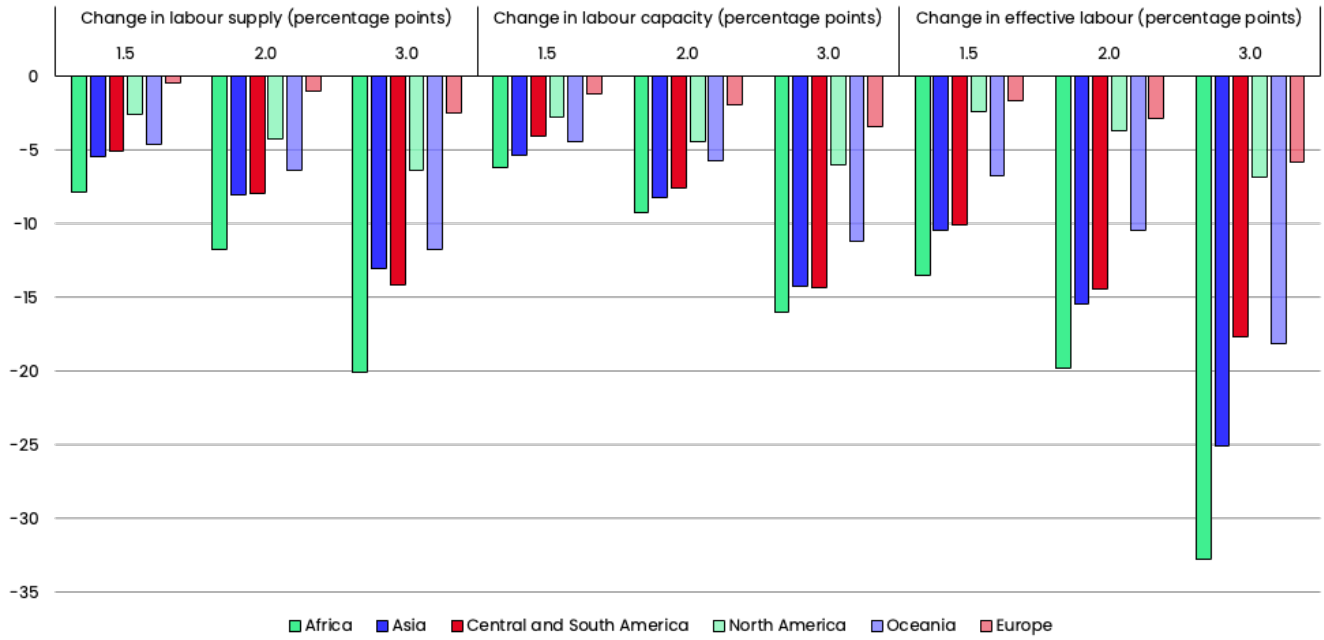
The low-carbon transition's employment effects are likely to be characterised by shocks and tipping points rather than a linear trajectory. The shift from 'brown' to 'green' jobs is likely to respond to critical tipping points such as the sudden widespread adoption of green technologies, or policy changes like bans on high-polluting goods and activities, carbon pricing mechanisms, or emission limits for vehicles (Nijsse et al., 2022; Lam and Mercure, 2022). These shocks will be exacerbated if necessary climate policies are delayed and fossil-based technologies or industries become unviable and stranded due to the increasing competitiveness of green technologies. Conversely, periods of rapid green technology adoption may create temporary booms in jobs tied to design, manufacturing or installation, followed by slower growth as maintenance and replacement take precedence (ILO, 2018; 2019a). For instance, solar photovoltaic (PV) employment has shown patterns of boom, bust and stagnation due to rapidly evolving capital cost declines (Malik et al., 2021).

The impacts of climate change and nature degradation on employment

Global warming will have significant effects on labour supply and productivity. While the literature on the employment effects of the low-carbon transition primarily focuses on labour demand, physical environmental risks mainly have implications for labour supply and productivity (see Box 3.3). Even under scenarios limiting warming to 1.5°C or 2°C, climate change drives reductions in working hours due to heat stress, absenteeism, fatigue, heat-related illnesses, injuries and cognitive impairments, particularly in sectors reliant on outdoor or physical labour (Dell et al., 2012; Dasgupta et al., 2024). Heat stress alone is projected to reduce global working hours by 2.2% by 2030, equivalent to 80 million full-time jobs (ILO, 2019b). In agriculture, mining, manufacturing and construction, heat-related declines in effective labour capacity are already significant, with losses projected to exceed 30% in high-exposure regions under 3°C warming (Dasgupta et al., 2024) (see Figure 3.4).

Figure 3.3(a)–(d). Absolute change in unemployment under NGFS climate scenarios in the US, the UK, China and India (NGFS, 2023)

Figure 3.4. Percentage-point change in labour supply outcomes by warming level relative to pre-industrial period



Note: The results are presented under a 'high' scenario.
Source: Author's analysis based on Dasgupta et al. (2024)

Environmental degradation, in part caused by climate change, further affects labour supply. Nature-dependent jobs account for 40% of global employment, equivalent to 1.2 billion jobs (ILO, 2018). Workers in sectors such as agriculture, fisheries, forestry and tourism directly rely on ecosystem goods and services such as water regulation, pollination and flood protection. Ecosystem stresses caused by environmental degradation are already disrupting the viability of work in these sectors. In agriculture, environmental degradation has forced workers to diversify or migrate (Kangalawe et al., 2017; Hove and Gweme, 2018; Trisos et al., 2022). In-country or cross-border migration could lead to reduced labour supply in rural areas that are highly exposed to physical climate effects, and increased labour supply in urban areas or countries in the Global North.

EMDEs are disproportionately exposed to physical environmental risks to the labour market. EMDE workforces are highly dependent on heat-exposed or nature-dependent sectors such as agriculture. Furthermore, informal employment, which represents up to 96% of non-agricultural jobs in some EMDEs (ILO, 2024) is more exposed to physical environmental impacts. Existing employment estimates often exclude informal labour market effects due to data constraints, thereby overlooking a significant share of at-risk workers in EMDEs (Hafstead et al., 2018). The limited adaptive capacity of informal workers can trigger spillover effects such as urban or cross-border migration (Hassler et al., 2024) or maladaptive practices such as deforestation and overexploitation of resources, further compounding and reinforcing environmental degradation.

Box 3.3 The labour market impacts of heat stress

Heat stress significantly affects labour supply, productivity and capacity through physiological and behavioural responses to high temperatures, humidity, physical exertion, and poor working conditions (e.g. inadequate hydration). These effects are most pronounced in outdoor sectors such as agriculture and construction, particularly for low-income workers in Sub-Saharan Africa, South Asia and Southeast Asia (Dasgupta et al., 2024).

The Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report highlights the substantial productivity losses caused by heat stress, particularly in sectors requiring manual labour or high cognitive effort and vigilance (Graff Zivin and Neidell, 2014). Heat stress reduces

productivity (Day et al., 2019; ILO, 2019b), increases absenteeism (Somanathan et al., 2021), raises workplace accident risks (Fatima et al., 2021), and disrupts machinery and infrastructure functioning (Benhamou and Flamand, 2023). Vulnerable groups include rural, low- and middle-skilled workers, especially in tropical and subtropical regions (OECD, 2024).

Under high-emission scenarios, labour productivity could decline by over 20% in some regions by the end of the century. Low-income countries (LICs) are particularly at risk due to prolonged and extreme heatwaves, reliance on manual labour in agriculture, mining and manufacturing, and limited adaptive capacity. For instance, extreme heat reduced GDP in India by 3.5% from 1998 to 2009 (Somanathan et al., 2021) and EU GDP by 0.3–0.5% between 2003 and 2018 (García-León et al., 2021).

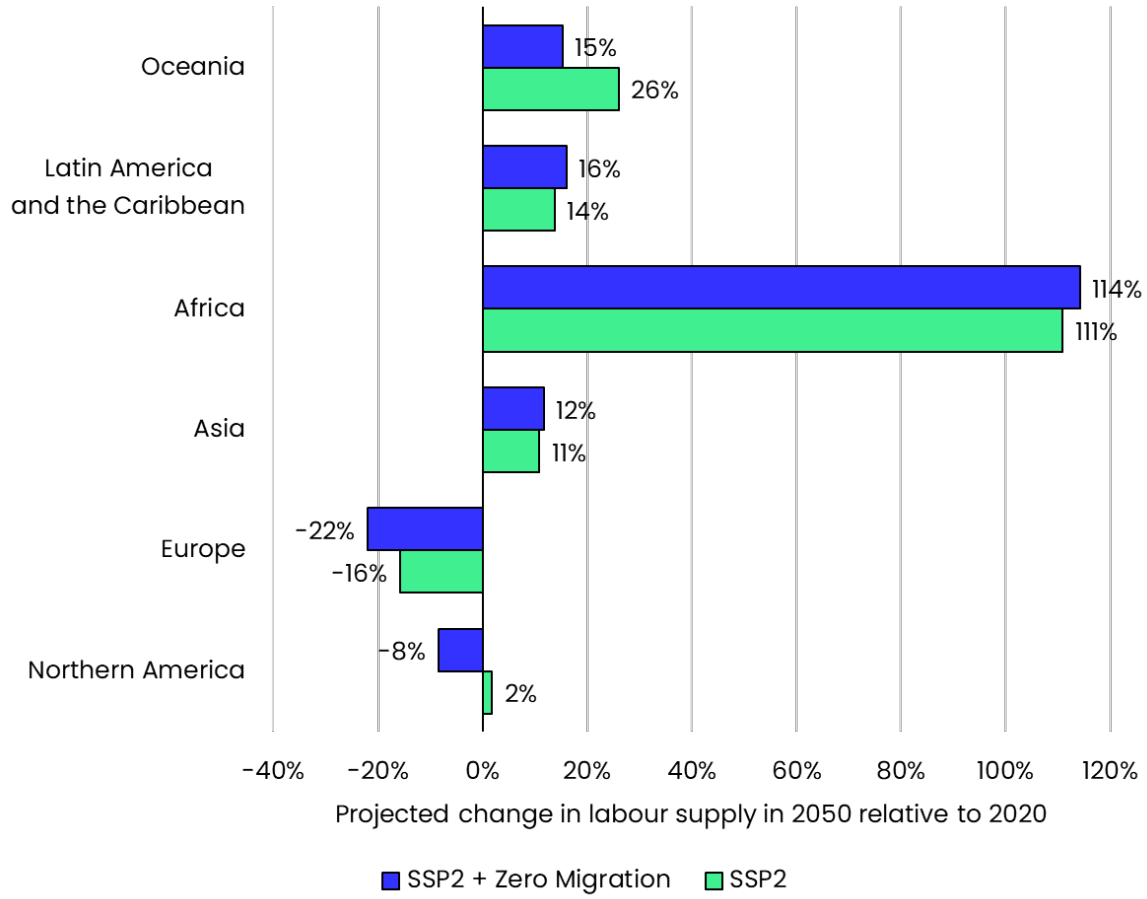
General labour market trends

Ageing populations and restrictive immigration policies are shrinking numbers of labour market entrants in OECD countries. By 2030, the EU's labour force alone is expected to decline by 13.5 million workers, with a further drop of 29.5 million by 2050 (Lutz et al., 2018) (see Figure 3.5). Coupled with increasing demand for workers in the low-carbon transition, these demographic shifts are projected to create significant labour shortages (Černý et al., 2024). Tight labour markets could prevent even moderate increases in green job demand being met, particularly under an uncertain scenario of increasing geopolitical fragmentation and protectionism in which OECD countries reshore manufacturing supply chains for green technologies. Ageing workforces also amplify heat stress vulnerabilities, as older workers (55–64 years) struggle to adapt to high temperatures, reducing productivity.

The employment impact of technological advancements — especially artificial intelligence (AI) — remains uncertain. Labour shortages may be alleviated through automation, mechanisation and digitalisation, though the overall impact on labour demand and supply remains complex. Technologies such as AI often reallocate jobs rather than eliminating them. Green jobs — which are typically high-skilled — are less susceptible to automation (Bluedorn et al., 2022; IMF, 2022). Where automation reduces labour inputs, demand is redirected towards supplying materials, energy and maintaining or replacing manufactured goods (Capellán-Pérez et al., 2019).

Technological adoption may also reinforce unequal labour markets. Technological adoption typically 'hollows out' medium-skilled jobs while increasing demand for high-skilled cognitive roles and low-skilled manual work (Degryse, 2016; OECD, 2024). These trends may exacerbate labour market dualities that are already being driven by the low-carbon transition, reinforcing insider–outsider dynamics (Lindbeck and Snower, 1988; Rueda, 2005; Gali, 2022) and fuelling economic inequality — a growing concern for policymakers such as central banks (Pereira da Silva et al., 2022).

Figure 3.5. Demographic trends by region, SSP2 (medium) and SSP2 Zero Migration scenarios, 20- to 64-year-olds by region



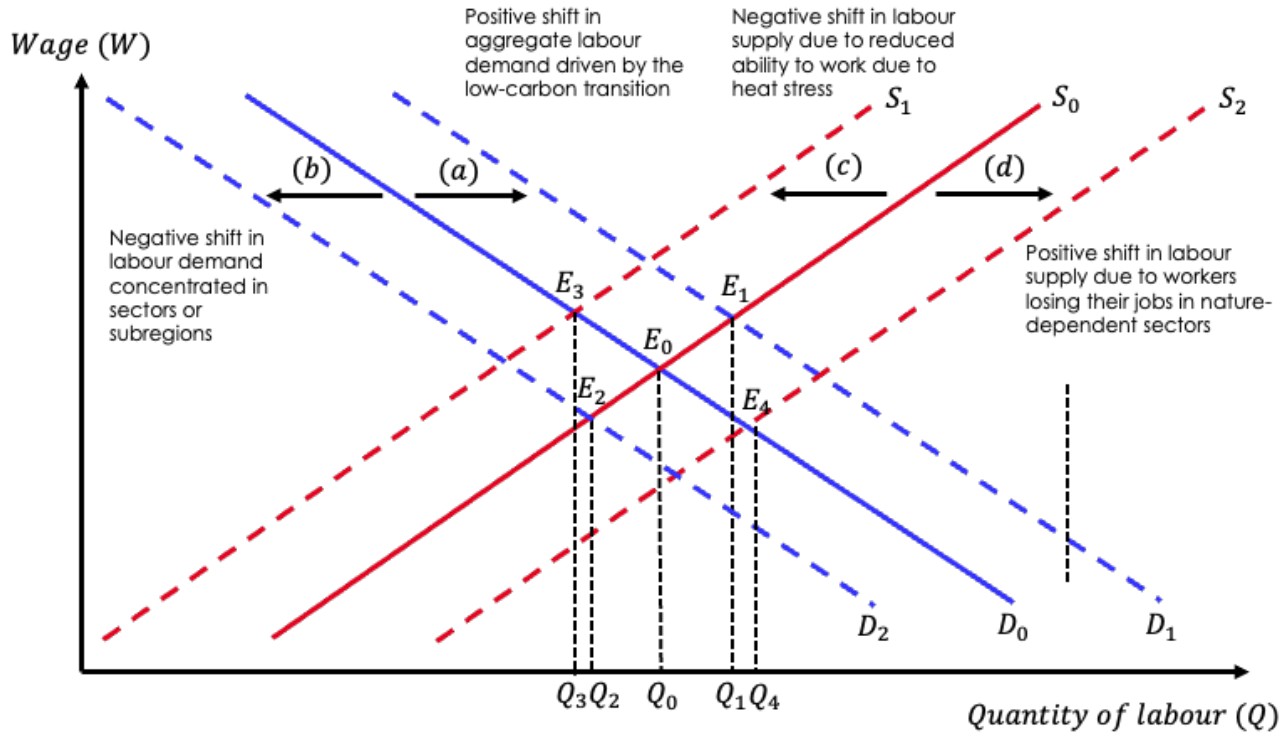
Note: SSP2 = Shared Socioeconomic Pathways 'Middle of the Road' scenario in which emissions reach net zero by 2100, temperatures rise by 2.7°C, and developing countries reach the OECD's average income levels by around 2060–2090; SSP2ZM = SSP2 Zero Migration scenario.
Source: Author's analysis based on Wittgenstein Centre for Demography and Global Human Capital (2023)

4. How exposed are labour markets to environmental risks?

Of the world's 3.4 billion workers, 81.7 million are in pollution-intensive jobs, 1.17 billion are in climate-exposed employment, and 1.16 billion are in nature-dependent occupations. Their exposure to environment-related risks depends on the emissions-intensity of the national labour market, the extent to which it will be affected by climate-driven hazards such as heat stress or extreme weather events, as well as the level of ecosystem vulnerability. Taken together, the analysis in this section shows that these environmental risks are likely to 'tighten' or 'slacken' certain labour markets.

Channels of environmental risk transmission

Figure 4.1. Stylised labour demand curve illustrating impact of environmental risks on the labour market



Source: Author's analysis

Environmental risks manifest themselves in labour markets through three primary channels (see also Figure 4.1):

1. Climate transition risks — the low-carbon transition could reduce demand for pollution-intensive jobs and increase demand for green jobs. Although positive aggregate impacts are likely to be modest, negative sectoral or regional declines in labour demand may arise due to structural factors, leading to concentrations of labour market over- or under-supply and inefficiencies in the matching process.

2. Physical climate risks — especially heat stress — may reduce labour productivity and/or limit the capacity for workers to carry out economic activities in climate-exposed sectors such as agriculture. This can reduce the availability of workers and thereby reduce labour supply.[11]

3. Ecosystem vulnerability — such as stressed or disrupted ecosystem goods and services — could lead to significant labour market shocks, forcing workers into unemployment or driving them to migrate to other areas.

Data and methodology

To evaluate labour market exposure to environment-related employment risks, this analysis combines national labour force survey data with modelled estimates from the ILO. Labour force surveys provide employment data at the 2-digit ISIC (International Standard Industrial Classification of All Economic Activities) level, encompassing nearly 100 categories. However, these surveys are often outdated or inconsistent with ISIC classifications. In contrast, ILO modelled data offers broader comparability but is limited to the 1-digit level, categorising employment into nine economic activity groups and excluding certain countries. To ensure comprehensive coverage, this study integrates both data sources, with descriptive statistics and assumptions provided in Appendices I and II.

Industrial classifications by environmental risk exposure
Labour market exposure is categorised into three groups based on environment-related risks (see Appendix II):

1. **Pollution-intensive workers:** Those employed in fossil fuel supply chains, coke and petroleum refining, water and air transport, and industries reliant on fossil fuel inputs, such as chemicals and paper (adapted from Causa et al., 2024).
2. **Climate-exposed workers:** Workers in sectors vulnerable to extreme heat, particularly agriculture and construction.
3. **Nature-dependent workers:** Those whose activities depend directly on ecosystem goods and services, including soil renewal, water purification, and protection from extreme weather. This group includes workers in agriculture, forestry, fishing, food and beverage manufacturing, pharmaceuticals, and nature-based tourism (Daily, 1997). Approximately one-third of industrial sectors have strong ecosystem dependencies.[12]

In total, the combination of data allows us to assess exposure to environmental risks in 182 national labour markets and one regional labour market (the EU) covering 3.4 billion workers. Of these, 81.7 million are in pollution-intensive jobs, 1.17 billion are in climate-exposed employment, and 1.16 billion are in nature-dependent occupations.

Shares of pollution-intensive, climate-exposed, and nature-dependent workers

Globally, the analysis estimates that 2.4% of the workforce — equivalent to 81.7 million workers — are currently employed in highly polluting industries, placing them at heightened risk of job displacement (see Figure 4.2). This figure represents the upper bound of existing global estimates (e.g. ILO, 2018; 2019a; Espagne et al., 2023). Labour markets in countries heavily reliant on fossil fuel extraction and export are among the most exposed to climate transition risks, aligning with existing estimates. Notable examples for economies with high shares of labour dependent on fossil fuels such as oil, gas or coal include Trinidad and Tobago (8.3%), Kazakhstan (7.8%), Russia (6.7%), the

[11] The impact of physical climate risks on labour demand or supply ultimately depends on workers' adaptive strategies. Increased heat exposure is assumed to reduce labour supply as workers face temporary reductions in working hours or days due to extreme heat. Conversely, risks to nature-dependent employment may drive workers to seek alternative opportunities, increasing labour supply as they compensate for the loss of ecosystem goods and services. In practice, both heat stress and ecosystem vulnerability could also reduce demand for labour.
[12] Jobs in different sectors can be dependent on four different types of ecosystem services, including provisioning services (e.g. food and fresh water), regulating services (e.g. air quality or natural hazard protection), cultural services (e.g. aesthetic value), or supporting services (e.g. nutrient recycling and soil formation). An overview is provided in Appendix II.

United Arab Emirates (6.6%), Brunei Darussalam (6.4%), Guyana (6.1%), Libya (5.8%) and Kuwait (5.6%). There are also high shares of workers in pollution-intensive metals or minerals processing industries in countries such as Mongolia (7.7%), Belarus (7%) and Ukraine (6.8%). Lesotho's (13.2%) high share is a result of the large numbers of workers employed in the production and processing of chemicals associated with textile manufacturing.

The share of climate-exposed workers is heavily concentrated in EMDEs, especially in Africa and Asia. Of the nine countries in which the share of the labour force that is climate-exposed is over 70%, eight are in Sub-Saharan Africa (Burundi, Burkina Faso, Mozambique, Niger, Central Africa, Madagascar, Chad and Mali). Outside Africa, Laos (73%), Nepal (62.7%) and Moldova (59.7%) have high shares of climate-exposed workers in their labour forces. While the share of climate-exposed workers in India is lower (56.4%), the country is home to over a quarter (25.3% or 297.4 million) of the world's workers that are exposed to heat extremes and other physical climate effects (see Appendix III). Due to the high share of workers that are employed in agriculture, which is a sector that is both climate-exposed and directly dependent on ecosystem goods and services, nature-dependent national labour forces largely mirror those that are climate-exposed (see Appendix IV).

Exposure indices

To assess labour market exposure to the three different environmental risks, we construct three labour-weighted exposure indices. The three indices compare the shares of workers in pollution-intensive, climate-exposed, and nature-dependent sectors with three respective environmental performance indicators:

- **Per capita greenhouse gas emissions** (OurWorldinData, 2025): which indicate a labour market's exposure to climate transition risks (e.g. technological risks, market risks, or climate policy risks).
- **The Climate-driven INFORM Risk Indicator** (IMF, 2025): which assesses how exposed countries are to climate-driven hazards such as heat stress or extreme weather events. The index includes climate-driven hazard and exposure, vulnerability, and lack of coping capacity (i.e. adaptation capacity).
- **The Notre Dame Global Adaptation Initiative's (ND-GAIN) Vulnerability Score for ecosystems** (University of Notre Dame, 2025): which assesses countries' exposure, sensitivity and capacity to adapt to the impact of climate change on ecosystem services.

The indices are constructed as a simple measure which captures the share of workers who are employed in pollution-intensive, climate-exposed, or nature-dependent sectors multiplied by their exposure to environmental risks based on these measures. Results are normalised to a score of 0–100, where 100 represents the highest level of environmental exposure. For each index, we only display the 10 most exposed national labour markets, distinguishing between advanced and emerging markets (see Table 4.1).

$$Transition\ Risk\ Index_{i,t} = \sum_{s} (Share_{i,s} \times Per\ capita\ GHG\ emissions_{i,s}$$

$$Climate\ Exposure\ Index_{i,t} = \sum_{s} (Share_{i,s} \times Risk\ of\ climate\ driven\ hazards_{i,s}$$

$$Nature\ Dependent\ Index_{i,t} = \sum_{s} (Share_{i,s} \times Ecosystem\ vulnerability_{i,s}$$

Findings

Climate-related transition risks are concentrated in the labour markets of advanced economies, Europe, and the Middle East. Due to their higher per capita emissions, labour markets in advanced economies, Europe, and the Middle East are highly exposed to transition risks, which could cause large disruptions to labour demand by reducing the need for workers in pollution-intensive industries. Examples include Australia, Canada, Norway, the United States, Russia, Belarus, Brunei

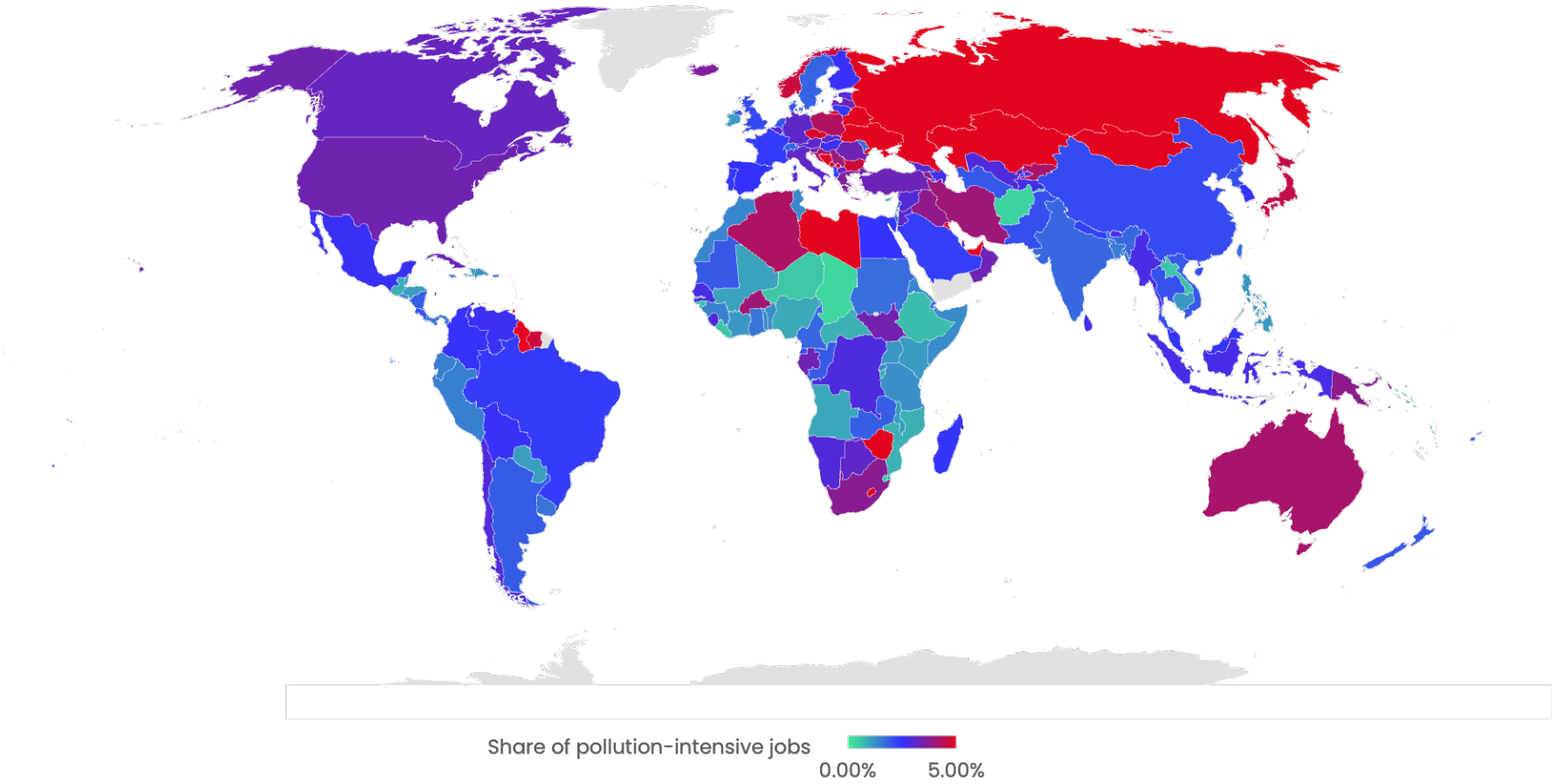
Darussalam, Qatar and Mongolia. Outside of these regions, only Trinidad and Tobago's and Guyana's labour markets are exposed to these risks. Elsewhere, national labour markets' relatively low reliance on pollution-intensive industries combined with low per capita emissions reduce the risks to workers, especially when considering that EMDEs are in a process of expanding per capita emissions and energy production to meet growth needs. Transition risks can cause higher unemployment due to falling labour demand in pollution-intensive sectors. Although growing labour demand in low-carbon growth industries can partly or fully offset this fall, structural factors may cause unemployment to rise in specific subregions or sectors where pollution-intensive economic activities and sectors are concentrated.

Climate exposure is highly concentrated in African and Asian labour markets. The 10 most exposed labour markets to heat stress and other physical climate effects are in Sub-Saharan Africa, a result of high exposure and vulnerability of informal workers, combined with low adaptive capacity. This exposes these labour markets to extreme falls in productivity and labour capacity, reducing the availability of workers in vital sectors such as agriculture. Outside of Sub-Saharan Africa, labour markets in South Asia (India, Nepal, Bangladesh), and Southeast Asia (Laos, Myanmar, Cambodia) as well as Central Asia (Afghanistan, Pakistan, Tajikistan) and the Caribbean (Haiti) are highly exposed to a fall in labour productivity and capacity due to extreme weather events caused by climate change.

Similarly, African, Asian and Latin American labour markets are most exposed to nature risks. Labour markets in countries such as Burundi, Madagascar, Chad, Nepal and Laos are most exposed to the disruption and interruption of ecosystem goods and services caused by climate change. In these countries, large and sudden shocks could cause positive labour supply shocks, causing workers in nature-dependent sectors and activities to lose their main source of livelihood. This can lead to high levels of unemployment or underemployment, as well as causing outmigration to urban areas or other regions. Compared to other countries in their region, Moldova, South Korea, Greece, Guatemala and Ecuador face higher nature risks, for instance due to relatively high shares of the workforce that depend on nature-dependent sectors such as tourism.

Broader labour market trends, especially demographic changes, could reinforce 'tightening' or 'slackening' of labour markets. Projected changes in labour supply due to demographic trends imply that advanced economies in Europe, North America and Asia will see their labour forces shrink, whereas emerging and developing economies in Asia, Latin America and the Caribbean, and especially Africa will see their labour forces grow (see Section 3, Figure 3.5). In some cases, these trends could offset some of the labour demand and supply effects that environmental risks pose, for instance for transition risks on labour demand in Russia, Japan or the EU, but in many cases they will reinforce them. Climate exposure poses a particular challenge to advanced economies which could experience labour productivity declines which reinforce labour shortages in some sectors (e.g. Causa et al., 2024), for instance in China or the United States. For emerging markets and developing economies, nature shocks could add to the high number of people who enter the labour force every year. This would lead to a further slackening of labour markets and drive unemployment and underemployment upwards. Examples include South Africa, Mexico, Indonesia, India and Turkey.

Figure 4.2. Share of pollution-intensive jobs in the labour force



Source: Author's calculations based on ILO (2025a; 2025b)

Table 4.1. Exposure of national labour markets to environmental risks by region

	Transition Risk Index		Climate Exposure Index		Nature Dependency Index	
	Advanced economies					
1	Australia*	34	Latvia	9	South Korea	21
2	Canada*	24	Croatia	8	Greece	20
3	Norway*	22	Slovakia	7	Lithuania	17
4	United States*	22	United States*	7	Portugal	16
5	Iceland	17	Lithuania	7	Iceland	16
6	Czechia	15	Greece	7	Latvia	16
7	Japan	14	Australia*	7	Estonia	15
8	Finland	14	South Korea	6	Croatia	15
9	New Zealand	11	Czechia	6	Japan	13
10	South Korea	11	Austria	6	Italy	11
	Asia					
1	Malaysia	11	Laos	75	Nepal	88
2	China	8	Myanmar	64	Laos	86
3	Papua New Guinea*	7	India	61	Myanmar	65
4	Maldives	7	Nepal	59	Viet Nam	62
5	Indonesia	7	Bangladesh*	53	India	57
6	Bhutan	7	Cambodia	51	Bhutan	57
7	Thailand	4	Vanuatu	43	Cambodia	51
8	Myanmar	4	Philippines	36	Bangladesh*	49
9	Viet Nam	4	Viet Nam	34	Vanuatu	48
10	Cambodia	2	Solomon Islands	34	Solomon Islands	46
	Europe					
1	Russia	46	Moldova	50	Moldova	52
2	Belarus	31	Albania	28	Albania	44
3	Bosnia and Herzegovina	18	Bosnia and Herzegovina	22	Bosnia and Herzegovina	33
4	Ukraine	14	Romania	18	Türkiye*	29
5	Poland	14	Türkiye*	17	Romania	26
6	Bulgaria	12	Serbia	15	Serbia	24
7	Serbia	10	Russia	12	Bulgaria	17
8	Türkiye*	9	Poland	11	North Macedonia	16
9	Romania	6	Bulgaria	10	Belarus	16
10	North Macedonia	6	Belarus	10	Montenegro	16

	Transition Risk Index		Climate Exposure Index		Nature Dependency Index	
	Latin America and the Caribbean					
1	Trinidad and Tobago*	100	Haiti	63	Guatemala	56
2	Guyana	31	Guatemala	37	Ecuador	52
3	Suriname	18	Honduras	33	Haiti	47
4	Bolivia	11	Ecuador	33	Honduras	47
5	Brazil	10	Bolivia	32	Bolivia	41
6	Belize	8	Peru	31	El Salvador	39
7	Uruguay*	7	Nicaragua	29	Nicaragua	38
8	Argentina*	7	Belize	25	Peru	36
9	Chile	6	Colombia	21	Belize	32
10	Venezuela	6	Mexico	20	Colombia	27
	Middle East and Central Asia					
1	Brunei Darussalam	89	Afghanistan	82	Afghanistan	56
2	Qatar	82	Pakistan	56	Pakistan	53
3	Mongolia	77	Tajikistan	52	Georgia	48
4	United Arab Emirates	65	Mauritania	49	Armenia	48
5	Kuwait	60	Armenia	41	Tajikistan	43
6	Kazakhstan	48	Azerbaijan	39	Mauritania	39
7	Oman	30	Georgia	35	Kyrgyzstan	38
8	Libya	28	Morocco	35	Uzbekistan	30
9	Saudi Arabia	23	Iraq	34	Mongolia	30
10	Iran	18	Syria	30	Azerbaijan	29
	Sub-Saharan Africa					
1	Botswana	15	Niger	100	Burundi	100
2	Lesotho	13	Chad	100	Madagascar	95
3	Gabon	12	Mozambique	99	Chad	91
4	South Africa	11	South Sudan	93	Mozambique	78
5	Namibia	8	Madagascar	92	Tanzania	78
6	Seychelles	7	Mali	90	Mali	77
7	South Sudan	7	Burkina Faso	89	Eritrea	76
8	Equatorial Guinea	6	Burundi	86	Uganda	76
9	DRC	6	Central African Republic	85	Central African Republic	75
10	Congo	5	Uganda	83	Burkina Faso	74

*Source: Author's calculations based on ILO (2025a; 2025b); OurWorldinData (2025); IMF (2025); *indicates countries with central banks that have an explicit employment mandate*

5. Implications for central banks

This section sets out implications for central banks in labour markets that are highly exposed to environmental risks. In EMDEs where labour markets are already slack and risk being slackened further, central banks may need to take a more active role to stimulate labour demand. Environmental risks via the labour market may also affect price stability, reduce matching efficiency and lead to structural changes in the labour market, as well as weakening the effectiveness of the transmission of monetary policy to the economy.

In economies that are highly reliant on ecosystem goods and services or that face high exposure to physical climate effects, central banks may need to implement policies that offset environmental impacts on labour markets by stimulating demand for workers. Where there are clear objectives related to economic growth and development or support for government priorities, central banks with labour markets that are highly nature-dependent or climate-exposed may need to take actions to steer credit towards priority sectors that are less exposed in order to provide sustainable employment opportunities. This is part of a broader process of supporting structural economic transformation from low-productivity agricultural activities towards high-productivity manufacturing and services that is required in these countries. Failing this, productivity is likely to fall further, and unemployment or underemployment likely to rise, leading to detrimental development outcomes. This may mean that debates about the trade-offs between price stability and full employment will become less relevant in EMDEs due to the tangible and potentially growing slack in their labour markets (Muqtada, 2015).

In addition, climate-driven productivity losses could be a source of price instability in climate-exposed economies. Agricultural workers affected by the growing frequency and intensity of heatwaves will face declining productivity and capacity in climate-exposed economies, making it increasingly difficult to plant or harvest crops. Combined with yield losses, labour constraints could significantly affect food production, driving food price inflation (Lima et al., 2021). While advanced economies may also be affected by these dynamics, particularly if they are reliant on imports from climate-exposed economies, EMDEs are more exposed due to the greater importance of food in their inflation basket.

Labour markets with high exposure to transition risks face increased price volatility. Where growth in demand for jobs in low-carbon sectors outpaces the stranding of workers in pollution-intensive industries and shrinking labour forces due to demographic changes, increased tightness in the labour market may occur. This could increase inflationary pressures if labour shortages hinder responses to sudden shifts in demand, particularly for green manufacturing goods such as electric vehicles or batteries, critical minerals and associated services, leading to 'greenflation' (NGFS, 2024). Geopolitical tensions and supply chain disruptions could heighten these risks if economies face increasing pressure to onshore their green technology supply chains.

Environmental risks also imply structural changes to the labour market, which central banks will need to adjust their policies to. High exposure to transition risks is likely to impair the matching efficiency of the labour market due to skills mismatches (Consolo and Dias da Silva, 2019), sectoral and associated regional disparities in labour demand, and supply for pollution-intensive versus low-carbon industries. This will likely increase structural unemployment and lead to a higher 'natural rate of unemployment', which will need to be taken into account in monetary policy decisions. For example, if climate change causes a supply shock (e.g. reduced agricultural productivity due to a drought), central banks will need to tighten monetary policy to control food inflation. If unemployment is already high, this tightening risks long-term scarring (hysteresis) effects. This is even more of an issue for central banks that have a strong development or employment mandate.

Structural implications of environmental risks could also weaken the effectiveness of the transmission of monetary policy to the economy. Firstly, Okun coefficients could weaken if the low-carbon transition reduces matching efficiency in the labour market. This means that when stimulating economic output (e.g. by cutting interest rates), central banks may find it more difficult to transmit economic growth into reduced unemployment. Secondly, reduced productivity due to prolonged and repeated periods of heat stress could reduce an economy's productive capacity and affect the output gap that central banks use to assess spare capacity in the economy and calibrate monetary policy decisions. Thirdly, high demand for green jobs could tighten the labour market and shift the Beveridge curve to the top left, reflecting high vacancies but low unemployment. For central banks, this shift is associated with wage pressures and inflation risks. At the same time, poorer matching efficiency due to skills mismatches would shift the Beveridge curve outwards, reflecting a higher vacancy to unemployment ratio. This in turn implies higher equilibrium unemployment. These potential effects warrant closer integration of environmental risks in the calibration of monetary policy responses, and potentially targeted measures.

Closer coordination and support for fiscal policymakers may be required. Where environmental risks pose structural challenges to the labour market, active labour market policies such as job and skills training, rather than aggregate demand stimulus, would represent more effective tools to reduce unemployment. Central banks may need to play a stronger role to support governments to implement these policies based on their expertise and insights of the labour market and improve monitoring of labour market performance.

6. Policy options

Regardless of their mandate, central banks should consider stronger integration of environmental risks into their core monetary policy frameworks, improve the monitoring and analysis of labour market trends, and share this information as a public good to fiscal policymakers and other actors in the economy to support structural reforms. Where the impact of environmental risks on employment is high, central banks could consider stronger integration of employment as an objective for monetary policy or clarify broad development mandates. This would allow central banks to take more targeted measures to stimulate labour demand by steering credit towards labour-intensive parts of the economy, such as the SME sector.

Depending on the integration of employment in their mandates and operational frameworks, central banks will need to respond in different ways to environmental impacts on the labour market. Central banks possess a variety of policies and tools that can be used to mitigate environment-related employment risks. The feasibility of implementing these measures depends on the degree of a country's labour market exposure to environmental impacts and the extent to which employment is integrated into its primary or secondary mandate. Where central banks have an explicit employment or broader developmental mandate, they may find a greater need to adjust their policies to stimulate demand for labour, including by mobilising or channelling savings and patient capital, creating credit, or allocating credit directly towards productive investments and employment creation (Epstein, 2009). Where central banks have a stronger focus on maintaining price stability, environmental risks may require changes to the ways in which they integrate employment to calibrate monetary policy decisions, or generate new avenues of research on the impact of environmental risks on national labour markets. A selection of options follows.

Stronger integration of environmental risks for employment into core monetary policy frameworks

Environmental risks will cause long-term structural changes in labour markets which may necessitate adjustments to central bank policy frameworks. These shifts may influence monetary policy decisions due to a heightened risk of hysteresis, structural unemployment and cyclical unemployment, which affect variables such as the NAIRU or Okun's coefficients that central banks rely on to inform monetary policy decisions. Failure to integrate employment risks into central bank frameworks and policy decisions could undermine policy credibility and effectiveness, eroding trust in central banks if they appear overly focused on inflation control or financial stability, while neglecting labour market impacts. This could reinforce criticisms that inflation-targeting frameworks are already facing (e.g. Barmes et al., 2024), including those questioning the prioritisation of price stability at the expense of long-term employment, income equality and real wage growth (Benchimol and Dahan, 2023).

Improving monitoring and analysis of labour market trends for all stakeholders in the economy

Central banks can play a pivotal role in establishing systematic mechanisms for monitoring and forecasting labour market needs, especially in LICs where such systems are often absent (ILO, 2018; 2019a). They can provide a public good to all stakeholders in the economy by analysing employment dynamics and prospects. The RBNZ serves as an example of best-practice by publishing an indicator suite of 44 indicators in its Monetary Policy Statements, comparing these to a reference point in December 2019 when employment was at its maximum sustainable level. Enhanced models and scenario analyses can also be used to anticipate environmental risks more effectively (NGFS, 2024), including supply chain risks arising from increasing protectionism (Malik et al., 2021; Černý et al., 2024) or policy risks using IO models and vector autoregression approaches. Finally, several central banks collect valuable survey data from enterprises and other market participants, such as Banco

Central de la República Argentina's Market Expectations Survey, RBA's business liaison programme, Bank of Canada's Business Outlook Survey, or Bank of Japan's Tankan (see Appendix V).

Strengthening monetary-fiscal coordination

Central banks do not have the policies or tools to address structural factors that arise in the labour market, for instance by targeting specific groups, sectors, regions or matching inefficiencies affected by environmental risks.[13] Many of these policies and tools lie in the hands of fiscal policymakers, who can implement training and retraining programmes, reform social protection systems, introduce wage subsidies and build necessary human capital across the labour market over the long term (Campiglio et al., 2018). However, based on their critical role of providing and analysing macroeconomic data, including labour market indicators, central banks can strengthen their support for governments to design and implement policies that mitigate environmental risks to labour supply or structural factors. By improving data availability and research on social impacts, raising awareness of environment-related labour market risks, and providing bespoke technical assistance for specific policies, central banks can enable governments to design proactive strategies that address structural labour market challenges under their mandate of supporting the general economic policies of governments (see Table 2.2). For example, the Central Bank of Barbados, the Bank of Canada, and Banco de la República have produced several reports that assess the causes of unemployment and that can be used by the government to implement effective job creation or supply side initiatives. The Bank of Albania, BEAC, Danmarks Nationalbank, the ECB, the Central Bank of Oman, and the State Bank of Vietnam have supported governments' structural labour market reforms. Several central banks also have formal monetary–fiscal coordination arrangements in place, such as the National Bank of Tajikistan's Policy Coordination Instrument (PCI) or the Central Bank of Jordan's Economic Policy Council.

Stronger integration of employment as an objective for monetary policy

Central banks could take a more explicit approach to employment when adapting inflation targets "so that it can contribute to high and stable output and employment" (Norges Bank, 2025b). Several central banks reviewed in this study have already adapted their decisions to account for employment or unemployment in their monetary policy reports, statements and other public communications, including the Central Bank of Canada, Bank Al-Maghrib, Norges Bank, Sveriges Riksbank, or Banco Central del Uruguay (see Appendix V).

Clarifying developmental objectives

Especially in EMDEs where environmental risks such as nature degradation are likely to further slacken labour markets, employment objectives can serve as a focused and practical complement to inflation targeting in order to address labour market vulnerabilities and support structural transformation (Ocampo, 2002; Pollin et al., 2006; Bhattacharyya, 2012; Muqtada, 2015; ILO, 2015a). Real-targeting frameworks based on economic growth or unemployment indicators have already been proposed for economies that have struggled with high levels of structural unemployment, such as South Africa (Epstein, 2007; Pollin et al., 2006). Doing so will require improvement and expansion of the data architecture for collecting and monitoring labour market data and indicators. The RBA's efforts to clarify its welfare-oriented objectives serve as a good example of how this can be achieved in an advanced economy context. Debates around clarifying central banks' development objectives to focus on employment have also been held in South Korea (Project Syndicate, 2024), Nigeria (CBN, 2017) and Sweden (Svensson, 2013).

Targeted refinancing and support for employment

Central banks do not have the most effective instruments to address the structural changes that environmental risks imply for the labour market. Still, they do have some tools at their disposal that can support employment objectives and facilitate the labour market's adaptation to environmental challenges. Targeted refinancing operations (TROs) are one example of such tools. TROs are liquidity-providing tools used by central banks to encourage banks to lend more to specific sectors of the economy. They are instruments that central banks commonly implement to support a wide range of policy objectives, including development ones (Colesanti Senni and Monnin, 2021). Central banks could use them to support employment outcomes, for example, by targeting them at

[13] There are some exceptions, notably the US Community Reinvestment Act (CRA), which allows the Fed to encourage financial institutions to support low- and moderate-income neighbourhoods through direct policies that address specific labour market needs (Robins, 2023).

employment-intensive SMEs, thereby supporting commercial banks to on-lend to financial institutions that have experience in on-lending to cooperatives, small entrepreneurs and other businesses for productive activities. The Bangladesh Bank and the Central Bank of Sri Lanka have refinancing schemes for banks, which are partially co-financed by multilateral development banks such as the Asian Development Bank (ADB) or the European Bank for Reconstruction and Development (EBRD), to support their loans to SMEs. Central banks can also implement other credit guidance policies, such as interest rate ceilings, credit guarantees, capital reserve requirements, and capital flows regulation, to encourage bank lending to high employment-generating economic activities, including SMEs (Epstein, 2009; Bezemer et al., 2018). For example, the BEAC, the Central Bank of Timor-Leste, the National Bank of Ethiopia, and the State Bank of Vietnam provide credit guarantees for finance to SMEs, and the Central Bank of Jordan, Reserve Bank of Malawi, Nepal Rastra Bank, and the Central Bank of Sri Lanka offer subsidised interest rates.

Financial inclusion

Financial inclusion is crucial for enabling poor households affected by nature loss and climate change to invest in resilience and adaptation measures, such as increasing agricultural productivity and diversifying income sources. Limited access to finance remains a major barrier to these investments, particularly for SMEs, which account for the largest share of employment in EMDEs. Improved access to financial services not only mitigates environmental risks but can support structural economic transformation by decreasing informal employment. Alongside SME financing, central banks can support financial inclusion through regulatory and supervisory support. The National Bank of Cambodia supported expansion of microfinance institutions (MFIs) by establishing proportionate regulations that reduced reporting requirements for smaller MFIs, adjusting capital requirements and other prudential ratios, and imposing a remaining balance method for calculating interest expense to MFI loans (ILO, 2015a).

Crisis response

The COVID-19 pandemic serves as a recent example of where central banks played a powerful role in protecting jobs in the event of a sudden and rapid fall in demand. For example, the Central Bank of Kuwait (CBK) helped the government implement a guarantee scheme based on research that assessed best practices from 35 stimulus packages around the world. In addition, the CBK subsidised the costs of financing by restricting interest rates for SMEs while initiating macroprudential measures that reduced regulatory requirements and expanded banks' lending capacity (CBK, 2020). Similar approaches were adopted by Banco Central de la República Argentina, Banco Central de Chile, Banco de Guatemala, the Bank of Japan, the Bank of Mauritius, and the State Bank of Pakistan, and can be adapted to maintain aggregate output and employment during negative demand shocks caused by environmental risks, such as extreme weather events. In addition, central banks can promote the development of insurance markets where they have the mandate to do so, for instance by setting parametric insurance standards, incorporating parametric bonds into solvency frameworks, or supporting catastrophe bond issuances.

7. Conclusions

This report has found that environmental risks will likely reduce the matching efficiency, productivity and capacity of labour markets. Central banks can respond to these impacts by steering credit towards productive or labour-intensive sectors and by strengthening the integration of environment-related employment risks into their monetary policy frameworks and operations. Future lines of enquiry should explore the potential of monetary–fiscal coordination, the potential financial risks related to social dynamics, and the impact of environmental labour risks on price stability.

Environmental risks to labour markets carry three main challenges to central bank policy frameworks and operations. Firstly, although falling demand for workers in pollution-intensive industries will in part be offset by the growing need for labour in low-carbon industries, the low-carbon transition will pose a structural challenge to labour markets that are highly exposed to transition risks. This will reduce matching efficiencies and lead to a steady rise in the 'natural rate' of unemployment that central banks assess to inform monetary policy responses. Secondly, reduced labour productivity and capacity due to the increasing frequency and intensity of extreme weather events such as heatwaves will increase structural unemployment and underemployment. Additionally, climate extremes could reduce labour productivity and supply in vital industries such as agriculture, food production and construction, which could further tighten labour markets that are already experiencing shortages of workers due to demographic changes. Third, high dependency on ecosystem goods and services could expose EMDEs to environmental risks that would further slacken their labour markets.

Central banks can mitigate these risks in two ways. Firstly, they can build on their development mandates and strengthen their role in stimulating labour demand, especially by directing credit towards productive or labour-intensive sectors such as SMEs. This will form an important part of their role in driving structural economic change, especially where they already face labour market slack which is likely to increase due to their exposure to nature-related risks. Secondly, they can strengthen the integration of environment-related employment risks into their monetary policy frameworks and operations by enhancing monitoring (e.g. using enterprise surveys or indicator suites) to help identify and pre-empt imbalances, adjusting standard policy tools (such as inflation targets or output gap estimates) to environment-driven structural shifts, and deepening their support for fiscal policymakers that are primarily responsible for developing and implementing structural labour market reforms and programmes. For central banks operating in high-risk environments, focusing their development mandates on employment objectives may represent a further option.

Future research should aim to close critical knowledge gaps around the interactions between environmental change, labour market dynamics and central bank mandates. One priority area for monetary–fiscal coordination is in the design of fiscal incentives, industrial strategies and trade policies that benefit green job creation. Central banks could support these policies through capital management techniques and prudential financial regulation that can be used to control cross-border capital flows in a way that is consistent with a national development vision. Two avenues for further analysis stand out. Firstly, financial risks driven by layoffs in carbon-intensive industries or the physical impacts of climate change or nature degradation on the labour market remain unexplored. These could create credit risks for financial institutions with concentrated exposures that may necessitate regulatory adjustments that integrate environmental risks into prudential frameworks, such as by requiring companies exposed to employment risks to develop labour force transition plans and thereby mitigate broader systemic vulnerabilities. To date, it has proved difficult to define and measure financial risks related to social dynamics, such as the 'just transition' (Calice and Demekas, 2024). Secondly, environmental labour market risks may pose challenges to a central bank's price stability mandate through their impact on wages, an area which requires further empirical research.

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Appendix I. No. of workers in carbon-intensive, climate-exposed and nature-dependent sectors (thousands, 2024)

Country	Total jobs	Carbon-intensive	Climate-exposed	Nature-dependent	Country	Total jobs	Carbon-intensive	Climate-exposed	Nature-dependent
Afghanistan	7,563	28	4,185	4,021	Liberia	2,345	14	965	944
Albania	1,270	29	544	645	Libya	1,878	109	342	204
Algeria	11,396	486	3,021	1,329	Lithuania	1,360	33	190	247
Angola	12,611	120	7,433	7,304	Luxembourg	321	7	21	17
Argentina	19,733	383	2,988	2,021	Madagascar	15,071	370	10,814	11,360
Armenia	1,250	46	740	758	Malawi	7,659	85	5,006	4,923
Australia	13,643	567	1,532	1,149	Malaysia	16,508	410	3,213	3,159
Austria	4,473	138	552	599	Maldives	249	11	50	54
Azerbaijan	5,235	141	2,259	1,946	Mali	7,708	78	5,397	5,583
Bahamas	214	4	24	40	Malta	287	5	21	30
Bahrain	833	7	202	51	Marshall Islands	12	0	0	1
Bangladesh	70,708	1,079	30,803	34,449	Mauritania	1,012	20	395	391
Barbados	133	3	16	26	Mauritius	562	10	80	111
Belarus	4,975	349	940	1,053	Mexico	56,804	1,468	11,103	15,509
Belgium	5,063	149	389	411	Micronesia	36	1	0	2
Belize	169	2	42	45	Moldova	1,898	34	1,134	1,071
Benin	4,726	60	1,559	1,627	Mongolia	1,303	100	440	449
Bhutan	401	11	203	201	Montenegro	245	12	38	36
Bolivia	5,702	147	1,970	2,545	Morocco	10,965	153	4,663	3,699
Bosnia and Herzegovina	1,207	70	313	400	Mozambique	14,136	115	10,400	10,282
Botswana	875	27	212	216	Myanmar	21,861	612	11,132	12,272
Brazil	98,713	2,334	16,695	20,825	Namibia	775	23	211	261
Brunei Darussalam	215	14	23	34	Nauru	4	0	-	0
Bulgaria	3,160	149	490	653	Nepal	7,786	179	4,883	5,980
Burkina Faso	7,906	322	6,029	6,568	Netherlands	9,376	193	673	890
Burundi	5,461	45	4,704	4,706	New Caledonia	114	5	15	7
Cabo Verde	221	5	45	43	New Zealand	2,907	58	485	325
Cambodia	9,037	105	4,141	4,951	Nicaragua	3,030	59	990	1,005
Cameroon	11,154	199	5,072	5,203	Niger	9,777	51	7,043	7,368
Canada	19,988	646	1,811	1,365	Nigeria	70,578	656	28,419	34,531
Central African Republic	1,909	16	1,374	1,379	Niue	1	0	-	0

Chad	5,541	17	3,921	4,143	**North Macedonia**	797	25	132	186
Chile	8,835	257	1,352	1,321	**Norway**	2,873	134	331	251
China	750,088	16,410	233,834	208,974	**Palestine**	1,093	35	278	203
Colombia	23,052	586	5,098	6,588	**Oman**	2,226	74	844	276
Comoros	216	5	91	87	**Pakistan**	74,450	1,572	34,367	34,462
Congo	1,896	37	675	667	**Palau**	9	0	0	2
DRC	33,181	958	18,938	20,452	**Panama**	1,882	30	444	460
Costa Rica	2,255	47	455	584	**Papua New Guinea**	3,079	116	721	591
Croatia	1,685	72	232	365	**Paraguay**	3,175	34	801	708
Cuba	5,220	170	1,173	1,154	**Peru**	17,565	259	5,764	6,923
Cyprus	639	6	78	64	**Philippines**	46,734	537	15,913	14,562
Czechia	5,166	252	565	616	**Poland**	19,237	823	3,170	3,411
Côte d'Ivoire	10,345	120	5,012	5,726	**Portugal**	4,911	120	589	960
Denmark	2,992	63	286	298	**Puerto Rico**	1,101	22	57	81
Djibouti	183	3	10	7	**Qatar**	2,008	65	675	103
Dominican Republic	4,890	59	808	1,013	**Romania**	8,082	270	2,267	2,410
Ecuador	8,482	126	3,206	3,755	**Russian Federation**	71,180	4,759	8,841	5,860
Egypt	30,528	757	10,013	8,943	**Rwanda**	4,331	59	2,831	2,613
El Salvador	2,750	39	635	1,000	**Saint Lucia**	87	1	17	23
Equatorial Guinea	523	11	308	297	**Saint Vincent**	42	1	9	8
Eritrea	1,645	23	1,099	1,067	**Samoa**	68	1	19	19
Estonia	682	20	83	103	**Saudi Arabia**	15,688	369	1,585	951
Eswatini	309	1	64	78	**Senegal**	4,969	141	1,439	1,675
Ethiopia	57,711	380	37,462	37,603	**Serbia**	3,337	132	673	828
European Union	206,741	6,182	23,733	28,261	**Seychelles**	49	2	0	8
Fiji	365	7	136	135	**Sierra Leone**	2,737	80	1,302	1,313
Finland	2,647	68	318	319	**Singapore**	3,619	51	173	191
France	28,692	687	2,901	3,106	**Slovakia**	2,745	83	346	261
French Polynesia	120	3	12	15	**Slovenia**	1,017	34	108	135
Gabon	588	20	207	184	**Solomon Islands**	366	4	148	154
Gambia	897	5	470	468	**Somalia**	2,553	34	745	774
Georgia	1,639	49	747	771	**South Africa**	17,339	644	4,439	3,877
Germany	42,592	1,328	3,356	3,505	**South Sudan**	3,782	129	2,463	2,311
Ghana	14,038	227	6,301	7,177	**Spain**	20,532	519	2,327	3,455
Greece	4,057	146	624	1,150	**Sri Lanka**	8,103	221	2,817	3,461
Guam	75	2	8	3	**Sudan**	11,085	191	5,045	4,879
Guatemala	7,045	61	2,465	3,144	**Suriname**	226	11	37	37
Guinea	4,032	58	2,565	2,535	**Sweden**	5,332	99	502	424
Guinea-Bissau	682	4	346	366	**Switzerland**	4,735	88	478	457
Guyana	253	15	54	65	**Syria**	5,013	149	1,231	820

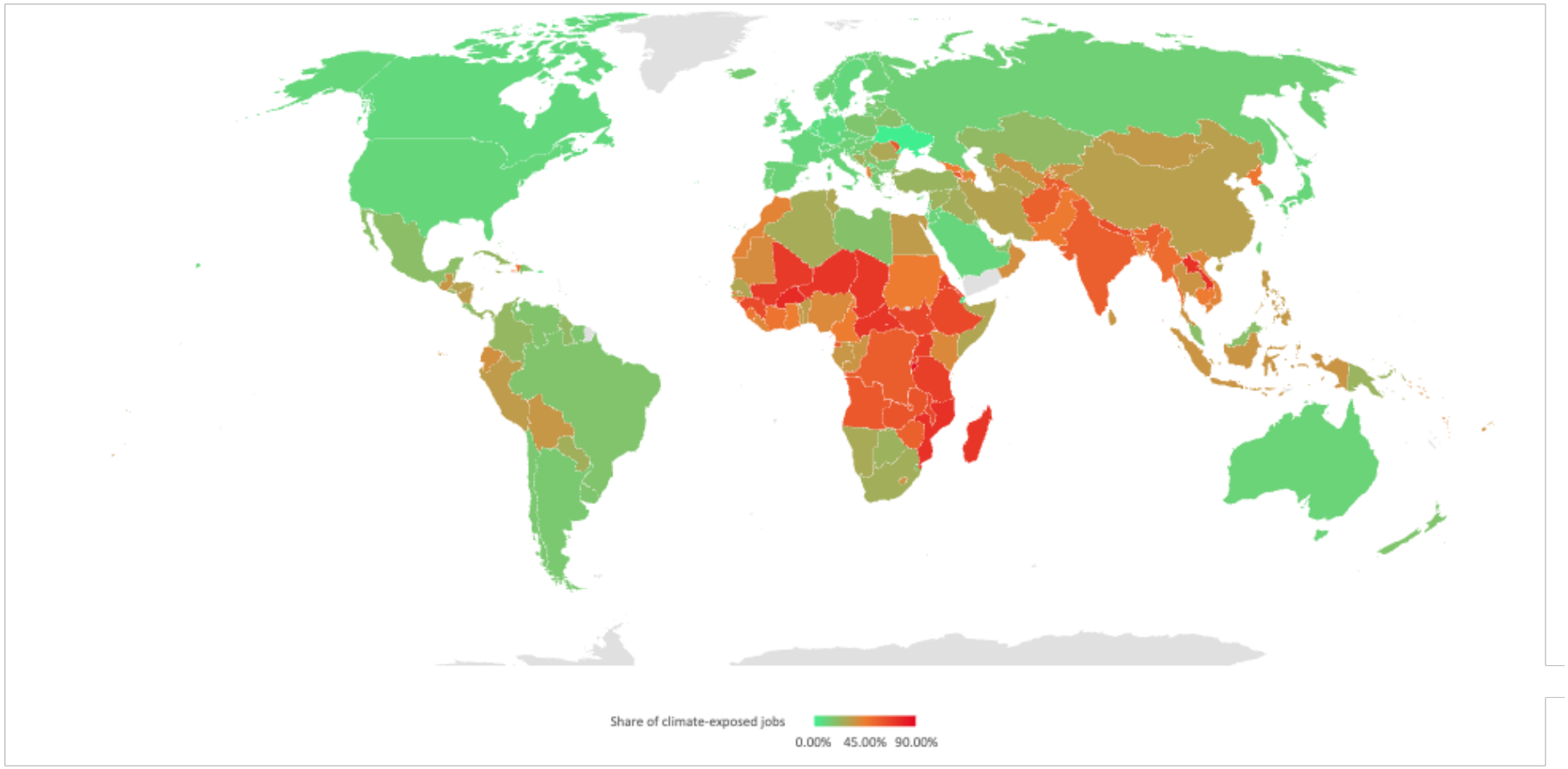
Haiti	4,389	50	2,212	2,027	**Taiwan, China**	12,045	208	1,575	1,518
Honduras	4,246	47	1,285	1,731	**Tajikistan**	2,429	66	1,367	1,113
Hong Kong	3,669	61	387	324	**Tanzania**	29,313	367	19,957	20,705
Hungary	4,966	133	654	723	**Thailand**	40,523	840	14,693	18,274
Iceland	217	8	31	35	**Timor-Leste**	570	2	254	239
India	527,422	9,387	297,385	266,326	**Togo**	2,956	38	1,027	1,321
Indonesia	133,321	3,685	47,489	55,931	**Tonga**	37	1	13	18
Iran	26,117	1,052	7,824	6,546	**Trinidad and Tobago**	650	54	183	125
Iraq	9,616	367	2,497	1,277	**Tunisia**	3,586	48	1,018	892
Ireland	2,502	28	287	342	**Türkiye**	31,150	1,030	7,212	9,788
Israel	4,053	65	266	320	**Turkmenistan**	2,030	41	595	475
Italy	23,336	727	2,568	3,611	**Tuvalu**	3	0	-	0
Jamaica	1,433	25	358	332	**Uganda**	17,707	208	12,180	12,648
Japan	66,686	3,038	6,900	8,815	**Ukraine**	16,668	1,129	61	1,687
Jordan	2,432	75	270	308	**United Arab Emirates**	6,393	421	1,271	779
Kazakhstan	8,918	695	1,905	1,349	**United Kingdom**	33,359	736	3,224	3,384
Kenya	23,353	263	9,361	9,329	**United States**	164,484	5,543	16,417	18,648
Kiribati	31	0	-	2	**US Virgin Islands**	38	1	3	3
North Korea	15,288	320	7,279	6,902	**Uruguay**	1,613	26	266	327
Republic of Korea	28,579	715	3,955	4,857	**Uzbekistan**	12,959	376	4,768	3,661
Kosovo	390	20	3	53	**Vanuatu**	130	1	63	61
Kuwait	2,368	133	390	132	**Venezuela**	10,352	273	1,802	1,471
Kyrgyzstan	2,741	115	994	1,048	**Viet Nam**	54,831	1,080	23,069	29,484
Laos	2,988	17	2,182	2,233	**Wallis and Futuna**	4	0	-	0
Latvia	890	30	138	157	**Zambia**	6,528	125	3,937	4,011
Lebanon	1,600	28	203	249	**Zimbabwe**	5,781	327	3,201	3,256
Lesotho	824	109	302	322	**ROW**	5,020	-	-	-
					World	3,404,740	81,702	1,173,539	1,164,409

Source: Author's calculations based on ILO (2025a; 2025b)

Appendix II. Data sources and assumptions for sectoral employment analysis

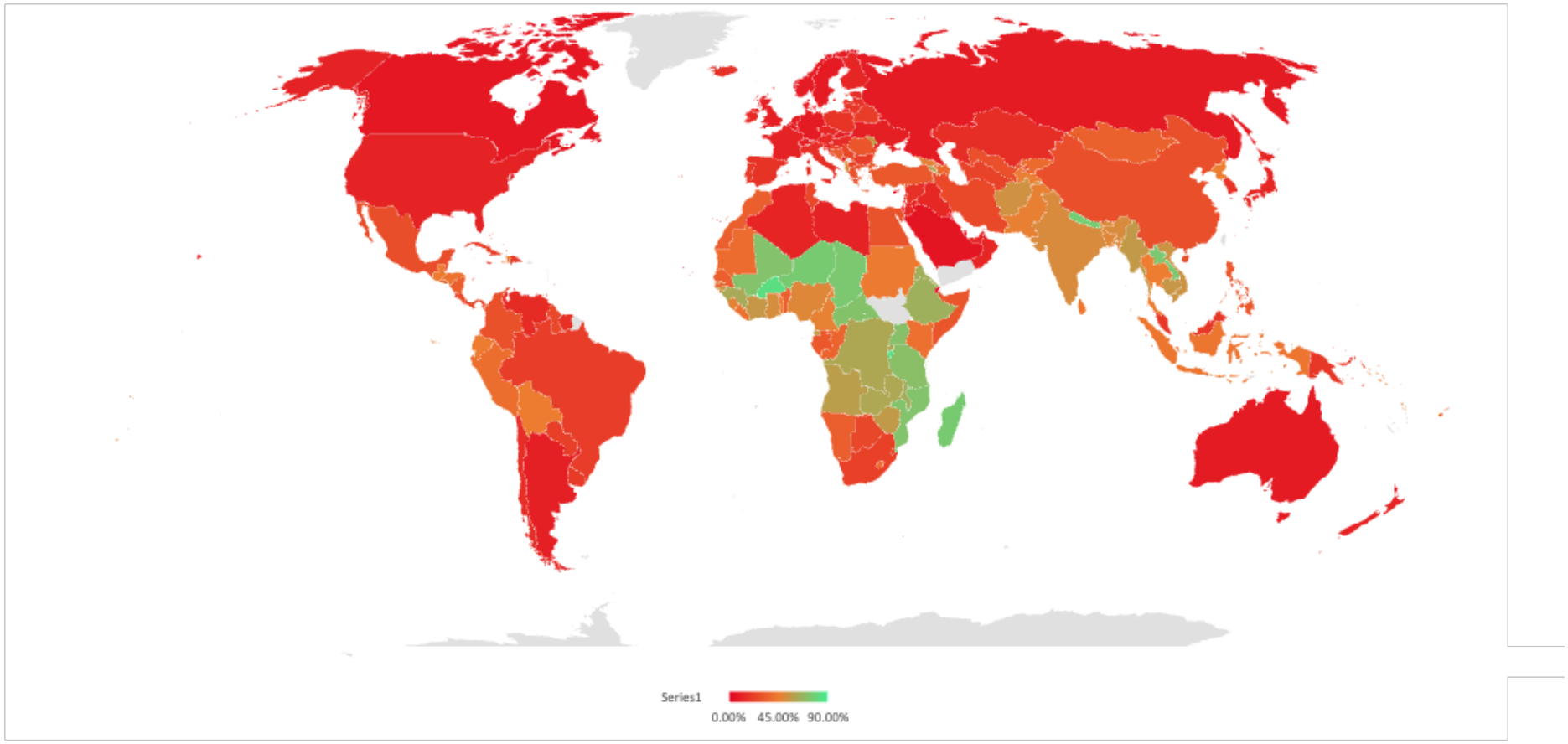
	Pollution-intensive jobs ISIC-Rev.4, 2-digit level	**Climate-exposed jobs** ISIC-Rev.4, 2-digit level	**Nature-dependent jobs** ISIC-Rev.4, 2-digit level
Economic activities	35 - Electricity, gas, steam and air conditioning supply 05 - Mining of coal and lignite 06 - Extraction of crude petroleum and natural gas 09 - Mining support service activities 07 - Mining of metal ores 08 - Other mining and quarrying 51 - Air transport 19 - Manufacture of coke and refined petroleum products 20 - Manufacture of chemicals and chemical products 50 - Water transport 24 - Manufacture of basic metals 23 - Manufacture of other non-metallic mineral products	01 - Crop and animal production, hunting and related service activities 02 - Forestry and logging 03 - Fishing and aquaculture 41 - Construction of buildings 43 - Specialized construction activities 93 - Sports activities and amusement and recreation activities	01 - Crop and animal production, hunting and related service activities 02 - Forestry and logging 03 - Fishing and aquaculture 10 - Manufacture of food products 11 - Manufacture of beverages 12 - Manufacture of tobacco products 13 - Manufacture of textiles 14 - Manufacture of wearing apparel 15 - Manufacture of leather and related products 16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials 17 - Manufacture of paper and paper products 31 - Manufacture of furniture 36 - Water collection, treatment and supply 37 - Sewerage 50 - Water transport 55 - Accommodation 56 - Food and beverage service activities 93 - Sports activities and amusement and recreation activities 79 - Travel agency, tour operator, reservation service and related activities
Sources	Adapted from Causa et al. (2024)	Authors	Adapted from Daily (1997)
Assumptions	Where LFS data is unavailable, aggregated ILO modelled estimates (ILOEST) for mining and quarrying, utilities and transport are used. It is assumed that 9.6% of all transport jobs are in pollution-intensive water and air transport.	Where LFS data is unavailable, aggregated ILO modelled data for agriculture and construction are used.	Where LFS data is unavailable, aggregated ILO modelled estimates (ILOEST) for agriculture, food and hospitality are used.

Appendix III. Map of climate-exposed labour markets



Source: Author's calculations based on ILO (2025a; 2025b)

Appendix IV. Map of nature-dependent labour markets



Source: Author's calculations based on ILO (2025a; 2025b)

Appendix V. Examples of employment considerations in central bank policies

Type of policy	Central bank	Example
Integrating employment into monetary policy frameworks	Bank of Albania	Regularly monitors and reports unemployment as part of quarterly monetary policy report
	Central Bank of Armenia	Executive Monetary Policy Statement explicitly refers to unemployment in its decision to reduce interest rates (CBA, 2025)
	Reserve Bank of Australia	Monitors full employment in its Statement of Monetary Policy and regular bulletins
	Bank of Botswana	Monitors unemployment as part of Monetary Policy Reports
	Bank of Canada	Monthly economic monitor of labour market performance and analysis of drivers of unemployment as part of monetary policy report (BoC, 2024)
	People's Bank of China	Monitors unemployment as part of quarterly monetary policy reports
	Banco de la República	Monitors unemployment as part of Monetary Policy Report
	Central Bank of Egypt	Regular references to unemployment in Monetary Policy Committee's press releases
	Magyar Nemzeti Bank	Monitors and reports unemployment at monetary council meetings
	Reserve Bank of India	Monitors unemployment and employment indicators as part of MPC meetings
	Bank of Japan	Uses employment data to help inform its policy decisions, including interest rate decisions
	Bank of Korea	Monitors unemployment as part of its monetary policy decisions
	National Bank of the Kyrgyz Republic	Monitors unemployment in its Monetary Policy Report and its Financial Stability Report
	Central Bank of Lesotho	Monitors unemployment in quarterly reviews and as part of its MPC statements
	Bank of Mauritius	MPC assesses unemployment as part of its decisions
	Central Bank of Mongolia	States that the "main objective of monetary policy is concerned with maintaining price stability in the long-run by taking into account of short run influences on the economy and employment rate" (Central Bank of Mongolia, 2025)
	Bank Al-Maghrib	Explicitly referenced employment as part of the reason for its decision to cut interest rates (Bank Al-Maghrib, 2025) and uses the NAIRU in its Monetary Policy Reports
	Banco de Moçambique	MPC assesses unemployment as part of its decisions
	Norges Bank	Assesses unemployment as part of its monetary policy decisions and issues staff memos on assessing employment in Norway (Ellingsen et al., 2024)
	Bank of Papua New Guinea	Monitors employment as part of quarterly bulletin

	Banco Central del Paraguay	Explicitly referenced unemployment in its decision to maintain its policy rate in February 2025
	National Bank of Romania	Monetary Policy Committee uses unemployment to inform its decision-making
	National Bank of Rwanda	Monitors unemployment as part of its Monetary Policy Report
	Sveriges Riksbank	Follows flexible inflation targeting approach, which means it does not always prioritise inflation if it harms employment
	Bank of England	Monitors and assesses unemployment as part of Monetary Policy Reports
	Federal Reserve	The Federal Open Market Committee (FOMC) determines appropriate stance of monetary policy with respect to employment objectives and potential impact on the economy
	Banco Central del Uruguay	Uses unemployment and employment to inform monetary policy
Monitoring and reporting labour market trends	Banco Central de la República Argentina	Monitors labour market performance using Market Expectations Survey (REM)
	Reserve Bank of Australia	Conducts business surveys as part of its business liaison programme, as well as monitoring various labour market indicators
	Bank of Canada	Monitors labour shortages and intensity of labour shortages using Business Outlook Survey
	Reserve Bank of New Zealand	As part of its Monetary Policy Statements, RBNZ publishes indicator suite of 44 indicators compared to a reference point in December 2019, when employment was at its maximum sustainable level
	People's Bank of China	Monitors employment expectations as part of urban depositor survey report
	Danmarks Nationalbank	Monitors labour market statistics in semi-annual survey and analyses it to provide information about its tightness (e.g. Danmarks Nationalbank, 2025a), as well as projecting employment as part of a quarterly-updated macroeconomic cyclical model (Danmarks Nationalbank, 2025b)
	European Central Bank	Monitors unemployment rates and other labour market statistics and tools, such as the Beveridge curve. Forecasts unemployment using a survey of professional forecasters.
	Bank of Japan	Runs enterprise survey called 'Tankan' that asks businesses to rate employment conditions as excessive, adequate or insufficient
	National Bank of Romania	Provides fiscal projections and macroeconomic forecasts, including on employment. Monitors survey of employment expectations and Beveridge curve as part of its Inflation Report.
	Monetary Authority of Singapore	Conducts labour market expectations survey
	South African Reserve Bank	Monitors unemployment in quarterly bulletins, conducts research on hysteresis (Viegi and Dadam, 2023), as well as employment expectation survey of how firms and experts view the Phillips curve (Reid and Siklos, 2022)

	Sveriges Riksbank	Forecasts labour market conditions to help finetune its policies and inform fiscal policymakers. Analyses matching efficiency and conducts extensive research on the Beveridge curve and other aspects of the labour market
	Central Bank of Trinidad and Tobago	Monitors labour market statistics as part of quarterly labour force survey and uses employment to inform monetary policy as reported in monetary policy reports. Monitors the Beveridge-Nelson filter and the NAIRU in its monetary policy reports and annual economic survey
Monetary–fiscal coordination	Bank of Albania	Provides support to the government's structural reforms aimed at improving the labour market (Sejko, 2024)
	Central Bank of Bahrain	Coordinates with Ministry of Finance to implement policies that align with national economic goals
	Bank of Canada	Produced reports on the causes of unemployment (BoC, 2024; Arseneau and Ducharme, 2024)
	Central Bank of Barbados	Conducts research on the causes of unemployment to inform the Government (Warner, 1998)
	Bank of Botswana	Supports government in broader development strategies and policies aimed at creating jobs (IMF, 2024a)
	Banco de Cabo Verde	Support for economic reforms aimed at reducing unemployment and the development of strategic plans (AfDB, 2002)
	Bank of Central African States	Support for economic and industrial reforms and policies by Economic and Monetary Community of Central Africa (CEMAC) states (World Bank, 2024)
	People's Bank of China	Coordinates with government initiatives aimed at promoting job creation
	Banco de la República	Assesses effectiveness of government labour market policy (Medina et al., 2023), conducts research on unemployment and employment growth dynamics, and submits labour market report (BDR, 2025)
	Danmarks Nationalbank	Provides recommendations on fiscal and structural policies, including those that address unemployment such as measures to support firms that hire long-term unemployed (Danmarks Nationalbank, 2022)
	European Central Bank	Supports national fiscal policies and structural reforms (Masuch et al., 2023)
	Central Bank of the Gambia	Collaborates with government agencies to develop policies that stimulate job creation, such as the GAMJOBS programme (Sillah, 2024)
	Central Bank of Jordan	Central bank governor sits on the Economic Policy Council, which prepares programmes such as Jordan's Equitable Growth and Job Creation Programme
	Bank of Korea	Support for government policies aimed at job creation, such as Korean New Deal (ILO, 2020)
	National Bank of the Kyrgyz Republic	NBKR plays a role in implementing policies aimed at ensuring employment and creating productive jobs as part of the National Development Strategy of the Kyrgyz Republic
	Bank Negara Malaysia	Has various programmes in place to support good jobs and skills development. Has made the case for labour market policy reforms in Malaysia (BNM, 2024)
	Bank of Namibia	Supported development of SME Financing Strategy for the Cabinet recently. The Strategy comprises three facilities namely the Credit Guarantee Scheme aimed at addressing the lack of collateral faced by SMEs,

		the Venture Capital Fund which is designed for growth-oriented SMEs, as well as the Mentoring and Coaching Programme for SMEs
	Banco Central de Nicaragua	Contributes towards the Ministry of Labor's efforts to improve labour market access and job placements (ILO, 2015b)
	Central Bank of Oman	Collaborates with the Ministry of Manpower to improve wage protection systems and employment stability
	National Bank of Rwanda	Coordinates with government to implement programmes such as the National Employment Programme
	National Bank of Tajikistan	Government has Policy Coordination Instrument (PCI) which coordinates policy with NBT
	Bank of Thailand	BOT has a soft loan programme that works with government credit guarantees scheme to provide liquidity to SMEs and households. During COVID-19 it supplemented this programme by subsidising interest rates and suspending principal payments. BOT has also worked with government to implement targeted income transfers and incentives measures to support employment
	Central Bank of Trinidad and Tobago	Supports the government's just transition policy
	State Bank of Vietnam	Works with government on structural reforms and social protection programmes that improve the functioning of the labour market, including promoting skills development and addressing issues around labour market flexibility
	Central Bank of West African States	BCEAO governor recognises various levers to job creation: monetary policy efficiency, financial education programs, enabling electronic money issuers and instant payment regulations; entrepreneurship policies; and infrastructure investment (digital connectivity) as well as public–private coordination (AFI, 2024)
Clarifying development objectives	Bank of Korea	Monetary Policy Board member argues that BOK is taking more proactive measures to support employment, e.g. by working with relevant ministries to devise macroprudential measures to stabilise the housing market, and that the BOK has increasingly channelled its resources towards addressing problems such as the dearth of quality jobs, including by identifying potential policy responses and considering how to incorporate them into its operations (Project Syndicate, 2024)
	Central Bank of Nigeria	Monetary policy report acknowledges debates around the need to expand the primary mandate of the bank to include unemployment (CBN, 2017)
	South African Reserve Bank	Debate over mandate of the SARB (Vermeulen, 2020)
	Sveriges Riksbank	Former central bank governor has argued that mandate is to support price stability with the highest sustainable rate of employment (see Svensson, 2013)
Directed credit and subsidised lending	Bangladesh Bank	Credit policies in part aimed at supporting job creation, such as adjusted interest rates and directed credit
	National Bank of Cambodia	Credit allocations and credit ceilings for certain sectors — e.g. to support employment in the agro-industrial sector or to encourage lending to productive sectors (ILO, 2015a)
	Reserve Bank of India	Credit allocation policies (Priority Sector Lending) for micro, small and medium-sized enterprises (MSMEs) in rural areas and towards the employment-intensive agriculture sector

	Central Bank of Jordan	Raises borrowing limits for specific sectors such as tourism and trade, and directs credit to high-priority sectors
	Nepal Rastra Bank	Directed credit policies: 15% of credit from bank loan portfolios to be allocated to MSMEs by 2027, and to lend 15% to agriculture sector and 10% to energy sector by 2024
	Central Bank of Nigeria	'100 for 100' Production and Productivity (PPP) Program aims to stimulate investment in key sectors to support job creation by offering cheaper credit and foreign exchange to manufacturers in priority sectors. Also targets agriculture and renewable energy
	Central Bank of Oman	Recommends floor of 5% of commercial banks' loan portfolios to SMEs
SME financing	Bangladesh Bank	Has refinance schemes for banks against their loans to SMEs, which are co-financed by multilateral development partners such as the International Development Association (IDA) and ADB. Also formed the SME and Special Programs Department to enhance investment in the sector
	Banco Central do Brasil	Promotes community development banks, partly with the aim of generating productive employment
	Bank of Central African States	Support for SMEs, including through the use of a guarantee fund (IMF, 2024b)
	People's Bank of China	Targeted lending towards SMEs in rural sectors
	Central Bank of Timor-Leste	Credit guarantee scheme provides access to finance for MSMEs, thereby supporting job growth
	Central Bank of Egypt	Lending target of 25% of banks' total loan portfolio towards MSMEs, with a minimum credit floor of 10%
	National Bank of Ethiopia	Facilitates access to credit for SMEs, e.g. using credit guarantee systems, one-stop-shop services and business development support (Yitbarek, 2017)
	Central Bank of Iraq	Partners with ILO to provide loans to entrepreneurs and MSMEs with aim of creating jobs (ILO, 2023). Bank Lending Strategy facilitates registration of informal start-ups, provides bank lending services and credit guarantees
	Central Bank of Jordan	Extends subsidised lending for SMEs
	Central Bank of Libya	Directs credit towards MSMEs
	Reserve Bank of Malawi	Subsidises interest rates for MSMEs
	Bank Al-Maghrib	Provides support to SMEs through African Development Bank
	Nepal Rastra Bank	Concessional credit programme for SMEs and agriculture which offers stable subsidised interest rates (not above 2% of base rate) for lending to SMEs in eligible productive sectors such as information and communications technology (ICT), tourism and agro-based industries
	Central Bank of Sri Lanka	The CBSL helps to increase access to finance for SMEs by coordinating and implementing schemes such as interest subsidies, credit guarantees and refinancing. The CBSL's Regional Development Department (RDD) provides credit supplementary services to help create employment opportunities

	Bank of England	Term Funding Scheme (TFSME) encourages banks and building societies to lend to SMEs by providing cost-effective source of funding
	State Bank of Vietnam	Encourages credit expansion to SMEs by providing loan guarantees with the aim of job growth
Financial inclusion	National Bank of Cambodia	Encouraged banks and MFIs to expand their networks to deepen financial markets, and to support expansion of socially minded MFIs by establishing regulations such as lower capital requirements and prudential ratios (ILO, 2015a)
	National Bank of Ethiopia	Supports digital lending and insurance to promote job creation
	Reserve Bank of Fiji	Developed a National Financial Inclusion Strategy (NFIS) to extend finance to MSMEs to create jobs (RBF, 2022)
	Central Bank of the Gambia	Developed a NFIS to extend finance to MSMEs and create jobs (CBG, 2011)
	Central Bank of Sudan	The Microfinance Unit in the CBOS works with other organisations to create employment opportunities for young people by requiring commercial banks to set aside a share of their credit for micro-finance projects
Crisis response	Banco Central de la República Argentina	Temporarily lowered reserve requirements on bank lending to SMEs, easing provisioning needs during COVID-19 pandemic
	Banco Central de Chile	Provided liquidity provision for SMEs during COVID-19 (Garcia, 2021)
	Eastern Caribbean Central Bank	Emphasises need for policies to build resilience against extreme weather events to safeguard employment, including finance for SMEs (Ramdewar, 2018)
	Banco de Guatemala	Collaborated with government to provide fiscal support (e.g. subsidies and subsidised loans and grants) to SMEs and households during COVID-19 (IMF, 2021)
	Bank of Japan	Special programme to support financing of SMEs in response to COVID-19
	Bank of Mauritius	Took proactive measures during COVID-19 to counter the plummeting inflows of foreign exchange in tourism sector by selling to the market with a reference to 'saving jobs' (BoM, 2020). Provided temporary relief to businesses through the Special Relief Programme, offering low-interest loans to those affected by COVID-19
	State Bank of Pakistan	Supported businesses with sales turnover of up to Rs 2 billion with 40% first loss on principal portion of disbursed portfolio through SBP Refinance scheme
	Bank of Zambia	Resilience and Stability Facility (RSF) provides financial support to businesses, particularly SMEs in agriculture, to help them weather economic challenges and create jobs
Other (direct financing, prudential	Banque de la République du Burundi	Directly supports public works programme (World Bank, 2000)
	Reserve Bank of India	Supports schemes such as Swarna Jayanti Shahari Rozgar Yojana (SJSRY) to provide employment opportunities in urban areas by issuing directives and guidelines to regulated entities

guidance, digitalisation)	Bank of Jamaica	Uses Central Bank Digital Currency (JAM-DEX) to facilitate government payments as part of employment generation programme
	Banque du Liban	Circular 331 encourages banks to invest in start-ups and other incubators in the knowledge economy to create productive jobs
	Central Bank of Nigeria	Provides guidelines to banks on unemployment
		The MAS supports the Smart Nation initiative by developing a strong talent pool in FinTech. It launched an Industry Transformation Map to create jobs in the financial services sector
	National Bank of Ukraine	Collaborates with EBRD to support the reintegration of veterans into the workforce
	Federal Reserve	Community Reinvestment Act (CRA) requires Federal Reserve and other federal banking regulators to encourage financial institutions to meet credit needs of the communities in which they do business

Source: Author's analysis

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