



International
Labour
Organization



► **Green Employment
Diagnostics for
Just Transitions
North Macedonia**

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for Just Transitions**
North Macedonia

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► Preface

The transition towards environmentally sustainable and climate-resilient economies is one of the defining challenges of our time, with far-reaching implications for employment, labour markets and social inclusion. As countries accelerate efforts to address climate change and environmental degradation, ensuring that this transition delivers decent work for all remains central to the mandate of the International Labour Organization (ILO).

This report presents the findings of the Green Employment Diagnostic for North Macedonia. It examines the complex interactions between climate change, economic transformation and labour market outcomes. It provides an integrated assessment of physical climate impacts, transition risks and emerging opportunities, and their implications for employment, productivity, skills, poverty and inequality.

The findings underscore that climate change and the transition to a low-carbon economy will reshape labour markets across sectors and regions. While certain sectors and regions – particularly those that are carbon-intensive or climate-exposed – face significant adjustment challenges, the transition also creates opportunities for employment-rich growth in sectors such as renewable energy, sustainable construction, circular economy activities and climate-resilient agriculture. Realizing these opportunities requires coherent policies that align environmental objectives with quality employment creation, skills development and the growth of sustainable enterprises.

A central message of this report is that the green transition will not be automatically just. Without targeted interventions, it risks exacerbating existing inequalities and labour market disparities. Consistent with the ILO's just transition framework, the report highlights the importance of integrated policy approaches, including active labour market policies, skills anticipation and reskilling systems, strengthened social protection and effective social dialogue.

By generating evidence-based insights, this report aims to support policymakers, social partners and development actors in designing coherent and actionable strategies that promote full and productive employment, enhance resilience and ensure that no one is left behind in the transition. Placing decent work and social justice at the centre of the green transition is essential for achieving sustainable development and for building a more inclusive and resilient economy in North Macedonia.



Claire Harasty

Director, ILO Office for Central and Eastern Europe

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The report was financially supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), on behalf of the Federal Ministry of Economic Cooperation and Development (BMZ).

► Executive summary

Climate-related physical risks (such as rising temperatures, droughts and extreme weather events) and the global transition to a low-carbon economy are already impacting key sectors of North Macedonia's economy. This report provides a comprehensive analysis of how these forces affect sectoral performance, labour market inequality and poverty in North Macedonia, and offers targeted policy recommendations. Unlike previous studies, which focused mainly on agriculture and coal-based energy, this assessment broadens the scope to include vulnerable sectors such as construction, automotive manufacturing and the metal industry. These are vital to the economy but often overlooked in climate impact analyses. The report moves beyond a focus on potential job losses to examine how workers may transition between occupations and sectors, where new green jobs are likely to emerge, and how labour mobility can support the transition. It therefore highlights both the risks and opportunities of the green transition. By integrating physical climate risks, transition risks and transition opportunities for the vulnerable sectors identified, the report analyses the labour market, poverty and inequality, climate change consequences and opportunities. The report delivers value-added insights to guide evidence-based policymaking for a just transition in North Macedonia. *The sectoral analysis provides foundations for the short-term, medium-term and long-term policy recommendations presented in Chapter 5.*

Several economic sectors were identified as highly vulnerable to climate change and the green transition. Energy production (especially coal-based electricity production) and mining are at risk because of both physical climate impacts and stringent policy targets (for example, North Macedonia's Enhanced NDC of 82 per cent greenhouse gas (GHG) reduction by 2030). Agriculture is already suffering from more frequent droughts, extreme weather and floods, while industries such as basic metals, construction and automotive manufacturing face rising costs and competitive pressures from carbon pricing mechanisms (EU CBAM).

These vulnerabilities threaten significant job losses if unaddressed. For instance, coal mines and thermal power plants employ thousands of workers, who could be displaced as North Macedonia aligns with EU climate neutrality goals and targets presented in Enhanced NDC. Agriculture models predict a dramatic shift in the growing season for wheat and maize, with significant decreases in yield. This threatens agricultural jobs. In the metal industry and construction, stricter emissions standards and extreme weather disruptions could lead to layoffs, hitting predominantly male workforces in specific regions.

Climate change impacts and transition risks could exacerbate poverty and inequality. Poor and marginalized groups have fewer resources with which to adapt. Rural areas are especially vulnerable because of their reliance on climate-sensitive agriculture. Job losses in industrial centres (for example, in mining towns or manufacturing hubs) would increase poverty and inequality, particularly among low-skilled male workers and older employees, who may struggle to find new jobs. Notably, because women are underrepresented in

the most affected sectors, job losses will disproportionately affect men. Women could nevertheless face indirect impacts through household income loss and limited new opportunities if skills gaps persist.

Despite these challenges, there are significant green growth opportunities. North Macedonia can create new jobs in renewable energy (solar, wind, hydro improvements), sustainable agriculture, energy-efficient construction, electric vehicle production and circular economy activities. For example, investment in solar and wind farms can absorb some workers transitioning out of coal; climate-smart agriculture and irrigation can boost rural employment; and adopting green technologies in manufacturing (such as electric vehicle components and recycling) can generate higher-value jobs for the future. Realizing these opportunities requires proactive policies and this report provides value-added insights for policymakers.

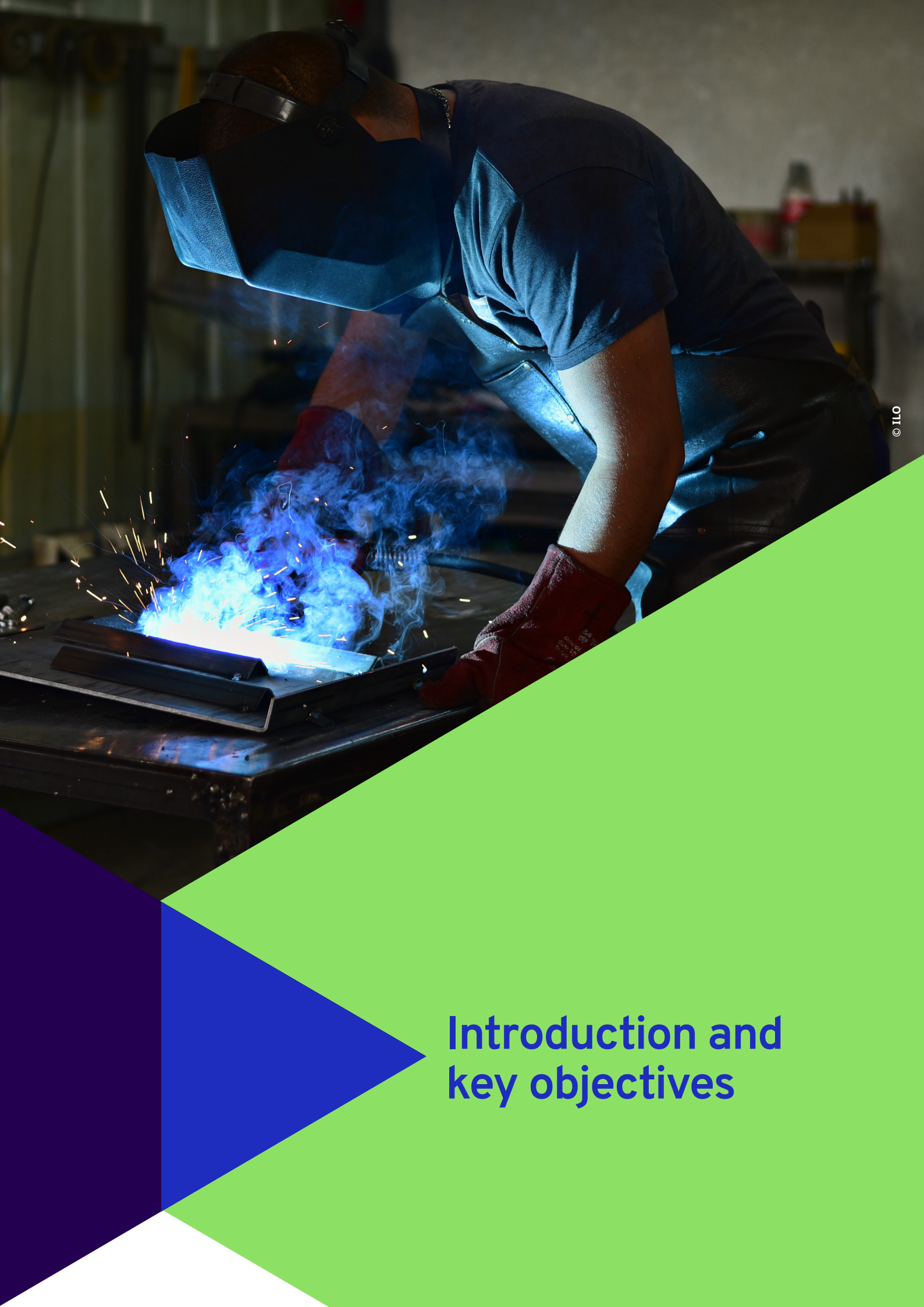
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► List of abbreviations

Abbreviation	Full expression
AD	Joint stock company (Акционерско друштво)
AI	Artificial intelligence
AQAIR	Air Quality Index Ranking
BAU	Business-as-usual
CAP	Common Agricultural Policy
CBAM	Carbon Border Adjustment Mechanism
CEMBUREAU	European Cement Association
CH ₄	Methane
CO ₂	Carbon dioxide
COVID-19	Coronavirus disease 2019
CPF	Country Partnership Framework
CRU	Climate Research Unit
ECOFIN	Economic and Financial Affairs Council
EGSS	Environmental goods and services sector
ERP	Economic reform programme
ESG	Environmental, social and governance
ESM	Power Plants of North Macedonia (Elektrani na Severna Makedonija)
ETS	Emissions trading system
EU	European Union
EU-CBAM	European Union Carbon Border Adjustment Mechanism
EUR	Euro
EV	Electric vehicle
FAO	Food and Agriculture Organization
FYR	Former Yugoslav Republic
GAS	Natural gas
GCF	Green Climate Fund
GCI	Green Complexity Index
GCP	Green complexity potential
GDP	Gross domestic product
GHG	Greenhouse gas
GINI	Gini coefficient
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
H ₂	Hydrogen
HPP	Hydropower plant
ICCO	International Cocoa Organization

Abbreviation	Full expression
IDR	Issuer default rating
ILO	International Labour Organization
IoT	Internet of things
IMF	International Monetary Fund
IRENA	International Renewable Energy Agency
IWRM	Integrated water resources management
JSC	Joint stock company
KPMG	Klynveld Peat Marwick Goerdeler (audit firm)
MKD	Macedonian denar
MW	Megawatt
NDC	Nationally determined contribution
NDS	National development strategy
NECP	National energy and climate plan
NER	National energy resources
NES	National employment strategy
NO ₂	Nitrogen dioxide
OECD	Organisation for Economic Co-operation and Development
PAM	Policies and measures
PM ₂	Particulate matter (2.5 micrometres or less)
PPE	Personal protective equipment
Q1, Q2, Q3	Quarterly references
REK	Mining and Energy Combine
R&D	Research and development
S20, S80, S80/S20	Income inequality indicators
SILC	Survey on income and living conditions
SMTK	Standard International Trade Classification
SME	Small and medium-sized enterprises
TEC	Thermal energy complex
TF	Transition Fund or TF Capita
TPP	Thermal power plant
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USAID	United States Agency for International Development
USD	US dollar
UTMS	University of Tourism and Management in Skopje
WHO	World Health Organization



Introduction and key objectives

► Introduction and key objectives

Climate and environmental changes are critical global challenges with far-reaching effects on economies and labour markets. Understanding the complex interactions between the labour market, climate change and environmental issues is becoming a challenge for governments.

This report analyses how climate change and transition to a greener economy may be affecting the economy and labour market of North Macedonia identifying key risks for employment, incomes and equity, as well as potential opportunities for decent and inclusive green job creation.

The report was prepared through application of the guidelines set out in the International Labour Organization's (ILO) "Green Employment Diagnostics for Just Transitions". These guidelines were designed to augment existing employment diagnostic methodologies, by integrating climate change and environmental transition considerations, thereby helping countries understand and address their implications for economic structures, labour markets and inequality. Developed in alignment with the ILO's "Guidelines for Employment Diagnostics in Times of Continuous Change", these guidelines provide policymakers, social partners and other relevant stakeholders with a direction for identifying underlying trends, challenges, risks and opportunities associated with specific climate change impacts on the labour market, and are aimed at informing policy formulations that enable full and productive employment for all.

The primary objective of this study is to assess the key risks and opportunities posed by climate change and green transition in North Macedonia, their impact on various sectors and workers, and how to respond to them by ensuring a just transition. By employing the ILO's Green Employment Diagnostics, the study seeks to:

- identify the vulnerability of the most affected industries and occupations in North Macedonia to climate-related disruptions;
- examine the emergence of new green industries and changing skill requirements;
- understand the economic, labour market, poverty and inequality implications resulting from these changes;
- formulate appropriate policies to mitigate negative effects and maximize opportunities.

The report delves deeper than merely estimating potential job losses. It provides a comprehensive overview of job transitions, emerging green employment prospects, and labour mobility between sectors, emphasizing both the challenges and the opportunities presented by the green transition. Furthermore, while earlier studies focused predominantly on agriculture and coal-based energy, this assessment takes a more comprehensive approach, expanding its focus to encompass vulnerable sectors such as construction, automotive manufacturing and the metal industry. These are key pillars of the economy that are frequently neglected in climate impact evaluations.

1. Structure of the study

This study on North Macedonia is organized into four main sections. **Chapter 2 outlines the study's approach, methodology and limitations**, including how the ILO Green Employment Diagnostics guidelines were applied. **Chapter 3 provides a profile of North Macedonia**, elaborating on economic developments, with a focus on the labour market, poverty and climate-related context. The analysis covers the policy landscape in relation to climate adaptation and mitigation, employment, skills development and social protection. **Chapter 4 comprises** an in-depth analysis of the dynamics of the economy, the labour market and poverty related to climate change. **Chapter 5** presents policy recommendations based on the previous chapters.

2. Overview of the approach

Step I: Profiling North Macedonia's characteristics

In the initial step, we present the climatic and environmental, economic, labour market and inequality characteristics of North Macedonia. Country profiling is an initial step to understanding the country's unique context and challenges. It highlights the key characteristics and lays the groundwork for effective decision-making in subsequent steps. This step serves as a basis for prioritising the questions that will be addressed in the subsequent phases of the study.

Step II: Building on the knowledge acquired in Step I, the dynamics of North Macedonia's economy, labour market and poverty/inequality are examined. This analysis has three main dimensions:

- the physical impacts of climate change (risks and opportunities) and their effects/consequences (and their domestic/regional localization);
- the risks associated with the green transition and their economic implications: analysis of the country's commitments to reducing greenhouse gas emissions; risks arising from national and international responses to physical climate risks and dependence on natural resources);
- the opportunities presented/offered by the transition (adaptation and/or mitigation); their implications for the economy and key sectors, the labour market, and the factors of poverty and inequality are then systematically examined.

Step III: In the final step of the approach, the information and lessons gathered in steps I and II are used to identify a range of short-, medium- and long-term policy recommendations

3. Methodology

In accordance with the guidelines set out in the Green Employment Diagnostics, this report develops an understanding of North Macedonia's climate–economy–employment nexus. Our research involved an extensive review of online published reports and studies from reputable international organizations, as well as strategic documents prepared by domestic institutions, with a focus on the following: the World Bank's 2019 Macedonia Disaster Risk Profile, North Macedonia's Climate Public Finance Review, Regional Western Balkans Countries Climate and Development Report, the OECD's Labour Markets Transition in the Greening Economy: Structural Drivers and the Role of Policies, the ILO's report The Impact of Heat Stress on Labour Productivity and Decent Work, and the International Monetary Fund's (IMF) report on climate change: Challenges and Policies, Nationally Determined Contribution (NDC), as well as the National Employment Strategy 2021–2027, the Economic Reform Programme, the Tax Reform Strategy 2021–2025, and the 2023 Communication on EU Enlargement Policy.

Complementing our analysis of international reports, we sought information from reports published by relevant government ministries within North Macedonia, including the Ministry of the Environment and Spatial Planning, the Ministry of Finance, the Ministry of the Economy and Labour, the Ministry of Social Policy, Demography and Young People, and the Ministry of Agriculture and Rural Development. Those documents include: the Enhanced National Determined Contribution (NDC), the National Employment Strategy, the Economic Reform Programme, the Tax Reform Strategy 2021–2025, the National Energy and Climate Plan (NECP) and the long-term strategy on climate action and action plan.

Phase one was prepared mainly through desk research, based on data obtained from relevant government institutions and international organizations.

The primary data collection was carried out within the project to collect in-depth information (qualitative data) from key stakeholders. In particular, two consultancy meetings were held in the second phase of the project, involving all stakeholders: policymakers, workers' representatives (trade unions) and employers' organizations and representatives. In addition, a questionnaire was submitted to several companies in the sectors identified as vulnerable to climate change risks.

On 30 October, a key consultancy meeting was held as part of the International Labour Organization's (ILO) Project on Green Employment Diagnostics for Just Transition. Trade union leaders, representatives of employers' associations, and policymakers from the Ministry of the Economy and Labour (the former Ministry of the Economy) and the Ministry of Social Policy, Demography and Young People (the former Ministry of Labour and Social Policy) gathered to discuss the critical topics on climate adaptation, the labour market impact of climate change and adaptation, and sectoral opportunities for growth. In order to have a more fruitful discussion, prior to the meeting, a matrix with the relevant critical issues related to climate change within the key economic sectors was shared with the participants, along with the main discussion questions. The future of sustainable job creation, strategies to protect vulnerable sectors, and innovative approaches to support Macedonia's green transition were all considered and debated by the participants.

An additional consultancy meeting was held on 18 November with several companies that are members of the Macedonian Employers' Organization. They were selected to represent the key sectors that the study found to be most vulnerable to climate change. The companies included: Vitaminka Prilep and Socotab, representing the agriculture and food and tobacco industries; JSC Liberty, representing the production of basic metals industry; and JSC Granit and JSC Cementara from the construction industry.

As part of the field research, two questionnaires were sent to the Macedonian Employers' Organization (with 27 questions) and distributed to several targeted companies in the sectors identified as vulnerable to climate change.

A detailed explanation of the selection of the vulnerable sectors is provided in Section 3.6.

4. Country profile

North Macedonia is a landlocked country located in the south-central Balkans with a total land area of 25,220 square kilometres (World Bank, 2020).¹ It is bordered to the north by Kosovo and Serbia, to the east by Bulgaria, to the south by Greece, and to the west by Albania. The capital city is Skopje.

This geographical positioning grants North Macedonia a strategic placement within the Balkan Peninsula, at a major junction of communication routes, in particular, the great north–south route from the Danube River to the Aegean formed by the valleys of the Morava and Vardar rivers, and the ancient east–west trade routes connecting the Black Sea and Istanbul with the Adriatic Sea.²

The population of North Macedonia, according to the last census (2022), is 1.83 million, of whom 58.4 per cent are Macedonians, 24.3 per cent Albanians, 3.8 per cent Turks, 2.6 per cent Roma and 1.3 per cent Serbs. According to the World Bank, population density has been steadily declining, falling from 80 people per square km in 2001 to 73 people in 2023.³

The Republic of North Macedonia is a candidate country for EU membership. The first intergovernmental conference on accession negotiations with North Macedonia took place in July 2022. At the same time, the first step in the accession negotiations process was taken with the launch of the analytical examination of the EU *acquis*, known as the “screening”.⁴

The Republic of North Macedonia, as a Western Balkan Contracting Party of the Energy Community, committed itself to working towards the 2050 climate neutrality target, which is an economy with net zero greenhouse gas emissions. This is at the heart of the European Green Deal, which applies to the EU Member States.

¹ World Bank: “North Macedonia Overview”, 18 September 2024, <https://www.worldbank.org/en/country/northmacedonia>.

² Encyclopaedia Britannica: “North Macedonia”, Encyclopaedia Britannica, 18 October 2024, <https://www.britannica.com/place/North-Macedonia>.

³ World Bank: “Population Density (People per sq. km of Land Area) – North Macedonia”, <https://data.worldbank.org/indicator/EN.POP.DNST?locations=MK>.

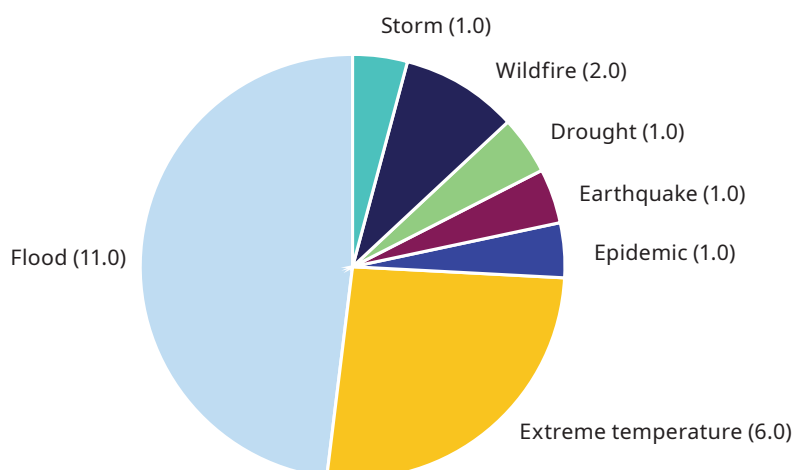
⁴ Screening, or analytical examination of the EU *acquis* (the body of EU law), is the preparatory stage of accession negotiations. The screening process is broken down into 35 chapters, grouped into six clusters. It is vital because it forms the basis for the bilateral negotiations between the EU and the various candidate countries.

As a candidate for European Union (EU) membership, the Republic of North Macedonia is obliged to transpose the EU legal framework into its national legal system.⁵ Importantly, this includes the 2030 Climate and Energy Framework and the 2050 Long-term Strategy/ European Green Deal.

4.1. Climate change / Environmental context

Studies⁶ attribute the frequent occurrence of extreme weather events and natural disasters at the global level and in North Macedonia to climate change. Certainly, other factors cannot be excluded. The Republic of North Macedonia is exposed to several geophysical and climate-related hazards, some of which are increasing in frequency and magnitude. As a small and landlocked country, it experiences similar climate conditions to other countries on the Balkan Peninsula.

 **Figure 1. North Macedonia, average annual occurrence of natural hazards, 1990–2020**



Source: World Bank, <https://climateknowledgeportal.worldbank.org/country/north-macedonia>.

As Figure 1 shows, based on historical data presented by World Bank,⁷ the greatest risk to North Macedonia is posed by floods, followed by extreme temperatures. The most devastating flood in North Macedonia since it gained independence in 1991 occurred in 1995 and caused nearly 400 million US dollars (US\$) in damages. More recently, flooding in 2004 affected over 100,000 people. Flooding in the Skopje region in 2018 led to 22 casualties and more than 1,000 people were evacuated.

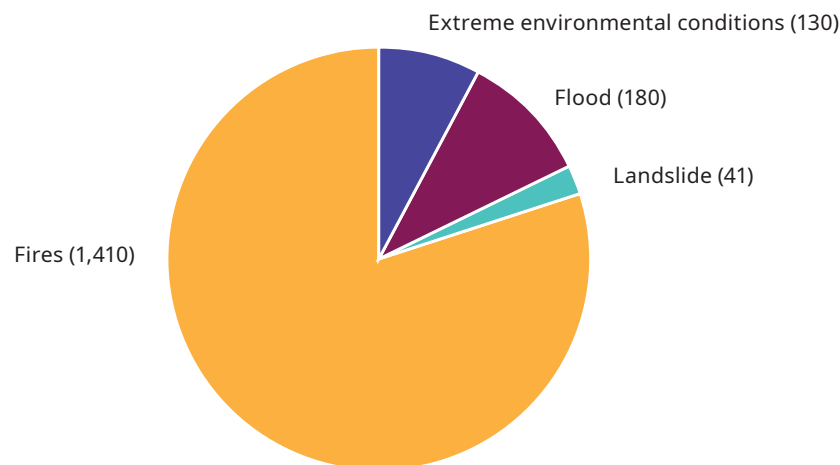
⁵ European Commission: “2030 Climate and Energy Framework and 2050 Long-Term Strategy (European Green Deal)”, https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en

⁶ Newman, Richard, and Ilan Noy: “The Global Costs of Extreme Weather That Are Attributable to Climate Change”, in *Nature Communications*, Vol. 14, No. 6103 (2023). <https://doi.org/10.1038/s41467-023-41743-6>. Robinson, Alexander, Johannes Lehmann, David Barriopedro, Stefan Rahmstorf, and Dim Coumou: “Increasing Heat and Rainfall Extremes Now Far Outside the Historical Climate”, in *NPJ Climate and Atmospheric Science*, Vol. 4, No. 45 (2021).

⁷ World Bank: “North Macedonia”, Climate Change Knowledge Portal, 15 November 2024, <https://climateknowledgeportal.worldbank.org/country/north-macedonia>.

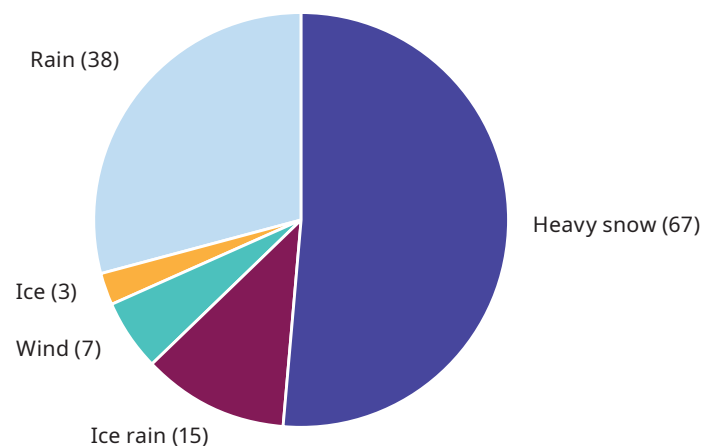
This research by the World Bank is confirmed by the research done by the Centre for Climatological Changes in North Macedonia, supported by the Swedish Government.⁸ As can be seen in Figure 2, most of the registered disasters in North Macedonia in the period 2005–2022 were caused by fires, followed by floods.

 **Figure 2. Registered natural disaster events, 2005–2022**



Source: Centre for Climatological Changes, North Macedonia.

 **Figure 3. Extreme environment conditions event, 2005–2022**



Source: Centre for Climatological Changes, North Macedonia.

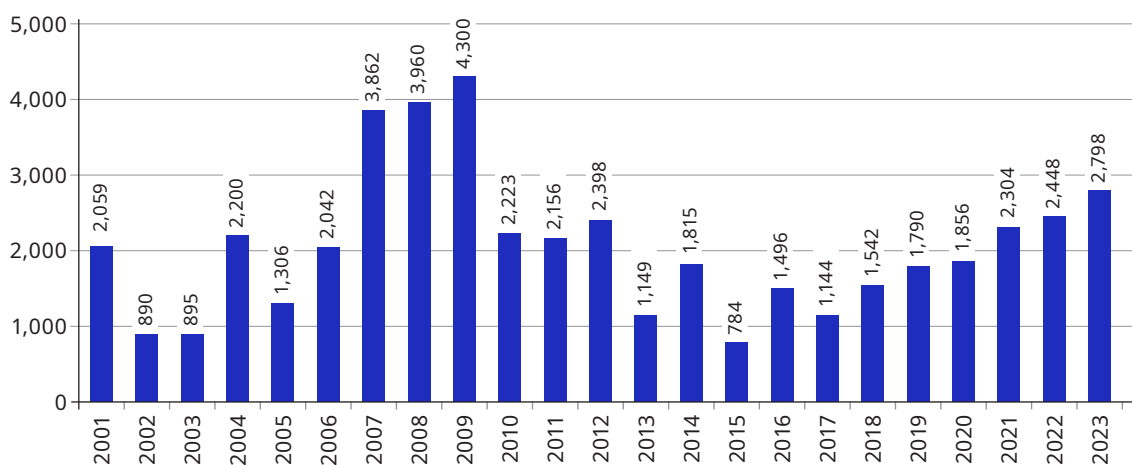
Regarding reported or estimated damage, unfortunately there are no data for most registered natural disasters. Of the total number of records (1,763 for the period 2005–2023), 1,427 or 81 per cent do not include the amount of damage. From the registered data, the total amount of damage for the period 2005–2023 is MKD 5.1 billion or €83 million. The largest single

⁸ Analysis of Natural Disasters in the Republic of North Macedonia (2005–2023), https://drive.google.com/file/d/1KK0YZ-9RiSo2NUMoF_bpX7jUHjGqvdd3x/view.

amount of registered damage is MKD 1 billion (or €16.2 million) for an event registered on 9 September 2012, a fire in a mixed forest in Selnik, Delchevo, when an area of 490 hectares was burned. As most reported natural disasters are without registered damage, however, the actual damage at national level is much higher than what was reported.

Data from the Global Forest Watch⁹ show that, from 2001 to 2023, Macedonia lost 48.0 kha of tree cover (see Figure 4), equivalent to a 6.1 per cent decrease in tree cover since 2000 (due to fires but also exploitation).

 **Figure 4. Tree cover lost, 2001–2023**



Source: Global Forest Watch.

The local regulation represented in the Forest Management Programme highlights the forest use plan, cultivation plan, protection plan and infrastructure maintenance. The programme includes preventive measures against fires, plant diseases and pests, as well as biological measures to protect land from erosion.

Based on the data from the Centre for Climatological Changes, in North Macedonia the top 11 municipalities (out of 84) experienced 47 per cent of all tree cover loss between 2001 and 2023. Makedonski Brod municipality has the most tree cover loss at 3.44 kha compared with an average of 578 ha.

The IMF publishes the Climate-Driven Hazard & Exposure index,¹⁰ which is a global, open-source risk assessment for crises and disasters. The index measures the extent of physical risks from climate change impacts on a scale from 0 to 10 (where 0 is the lowest and 10 the highest risk). The Republic of North Macedonia's index value is 2.8, which puts the country in the moderate risk group (between 2 and 4).

⁹ Global Forest Watch. Country Dashboard: North Macedonia, 2025, <https://www.globalforestwatch.org/dashboards/country/MKD/?map=eyJjYW5Cb3VuZCI6dHJ1ZX0%3D>.

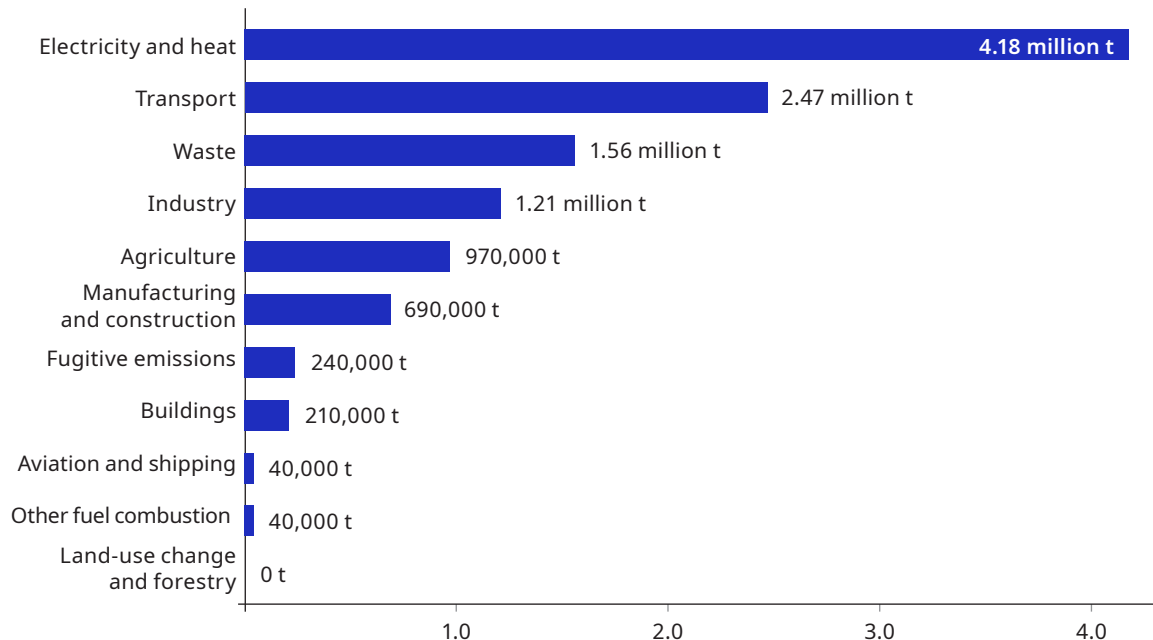
¹⁰ International Monetary Fund: Climate Change Indicators Dashboard, 2025, <https://climatedata.imf.org/pages/fi-indicators#fr2>.

North Macedonia is the 32nd most polluted country in the world based on the Air Quality index, measured by AQAIR. In 2023, the average PM2.5 concentration in North Macedonia was 5 times the WHO annual air quality guideline value, which makes North Macedonia the second most polluted country in Europe after Bosnia and Herzegovina. The most important North Macedonian law that covers air quality is the Law on Air Quality, which is accompanied by many rulebooks.

There are several internationally used indicators related to pollution. One such indicator, “Our world in data”,¹¹ shows that greenhouse gas emissions in the Republic of North Macedonia in 2022 amounted to 8.58 million tonnes or 4.1 tonnes per capita (76 per cent carbon dioxide, 19 per cent methane and 5 per cent nitrous oxide). In Europe, the average greenhouse emissions amounted to 6.8 tonnes per capita (77 per cent carbon dioxide, 17 per cent methane and nitrous oxide 6 per cent). A sectoral analysis of the pollution (Figure 4) shows that most of the pollution (36 per cent) is produced by the Electricity and heating sector, followed by Transport.

National policies for pollution control available on the webpage of the Ministry of Environment and Spatial Planning and Government are outdated (latest programme/policy is for 2019), and the Government needs to update and show a commitment to pollution reduction.

 **Figure 5. Greenhouse gas emissions by sector, 2023, North Macedonia**



Source: Our world in data.

¹¹ Global Change Data Lab: Our World in Data. United Kingdom: Global Change Data Lab, n.d., <https://ourworldindata.org/>.

Regarding the country's preparedness for a low-carbon transition, the IMF does not publish data on North Macedonia. The European Commission in the 2023 Communication on EU Enlargement Policy considers North Macedonia to be moderately prepared for the climate changes. Local authorities (municipalities) issued a green bond for the first time in 2023 in the amount of €10 million to support environmental projects.¹² The intention was to collect funds and support green projects. However, there is no official report regarding the projects supported with the green bond. Furthermore, no announcement has yet been made that another green bond will be issued in the near future.

Mealy and Teytelboym (2022) have attempted to understand the scale of North Macedonia's opportunities for manufacturing the kind of goods needed in a low-carbon economy. To that end, they constructed a new data set listing environmental benefits, a novel measure for green production capabilities (for example, switching to renewable electricity, such as wind or solar electricity production), mapping new export opportunities, and describing key implications for green industrial policies. In essence, the so-called Green Complexity Index (GCI) aims to capture the extent to which countries can competitively export green, technologically sophisticated products. It can then be used to help estimate which countries are likely to be leaders and laggards in the green economy. North Macedonia is ranked 59th on the GCI, the second lowest in Europe after Albania. This means that the potential for green job creation is relatively low. Green Complexity Potential (GCP), another index constructed by the same authors, measures a country's average relatedness to green complex products in which it is not yet competitive. Thus, while the GCI allows us to rank countries in terms of their current estimated green production capabilities, the GCP provides an indication of which countries are best positioned to expand their green production capabilities into new green products in the future. Similarly to their GCI ranking, North Macedonia is ranked 58th on the GCP, meaning that both the current state and the future expansion possibilities for green production represent a challenge.

4.2. Economic context

Based on the World Bank Country Partnership Framework (CPF) 2024–2028, the Republic of North Macedonia is an upper middle-income country that has made relatively good progress in reforming its economy over the past decade, but also faces various challenges and opportunities in its pursuit of sustainable development. More efforts are still needed to generate economic growth and improve living standards. GDP amounted to US\$ 11.5 billion (2015 constant prices) or US\$ 6,350 per capita, which represents only 18.6 per cent of per capita GDP in the European Union as a whole. The grey or shadow economy is still a major burden for the country, amounting to 16.7 per cent of value added in 2021,¹³ based on data from the State Statistical Office. According to the Ministry of Finance, the informal economy accounts for around 30 per cent of North Macedonia's GDP or 4.32 billion euros (€) in 2023. The large grey economy is one of the main obstacles to accelerating the development of the Macedonian economy.

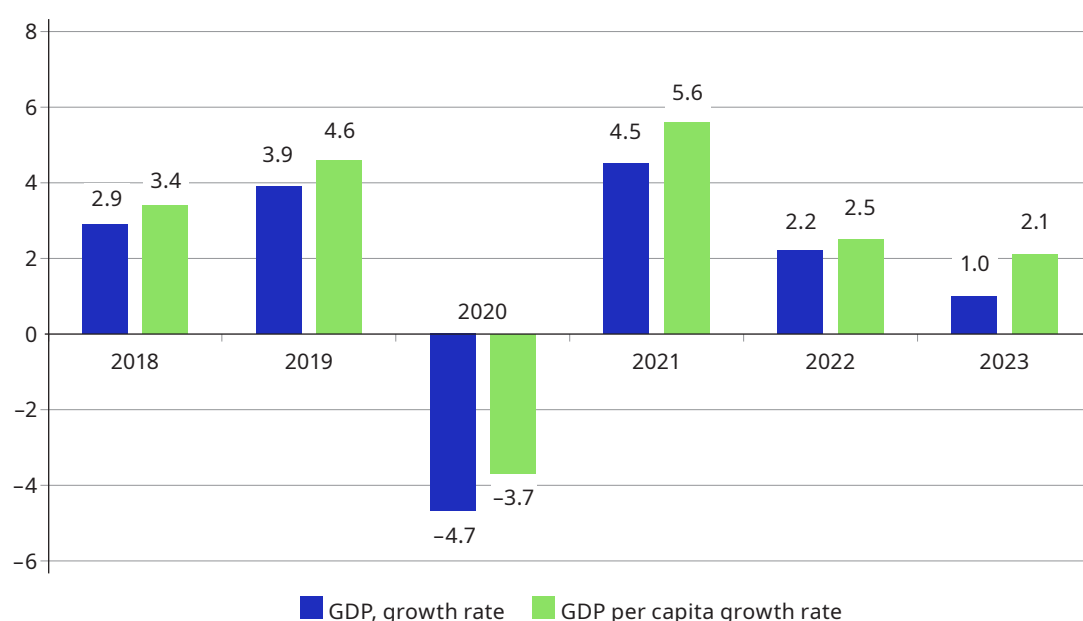
¹² Ministry of Finance of the Republic of North Macedonia. Report on Green Bonds, <https://finance.gov.mk/реализирани-аукции-од-хартии-од-вредн/>.

¹³ State Statistical Office of North Macedonia.

In October 2024, Fitch Ratings assigned North Macedonia a BB+ Long-Term Foreign-Currency Issuer Default Rating (IDR) with a Stable Outlook. A BB+ rating is below investment grade, indicating that while the country is not at immediate risk of default, it is considered a higher credit risk. This means that if green jobs growth is to be supported through loans, borrowing costs will be relatively high due to higher interest rates associated with the country's credit risk.

Figure 6 presents the Macedonian economic growth figures in the past five years. In 2020, the economy contracted by 4.7 per cent because of the global Covid-19 pandemic. While the economy partially recovered the following year (4.5 per cent real growth rate in 2021), the economic growth in subsequent years was very modest, at 2.2 per cent in 2022 and 1 per cent in 2023. The latest available data do not show promising results for 2024 (the real growth rate in Q1 2024 amounted to only 1.2 per cent). Cumulative GDP growth in North Macedonia in the period 2020–2023 was 3 per cent, much lower than the average cumulative growth in the Western Balkans of 10.9 per cent (World Bank, spring 2024).¹⁴

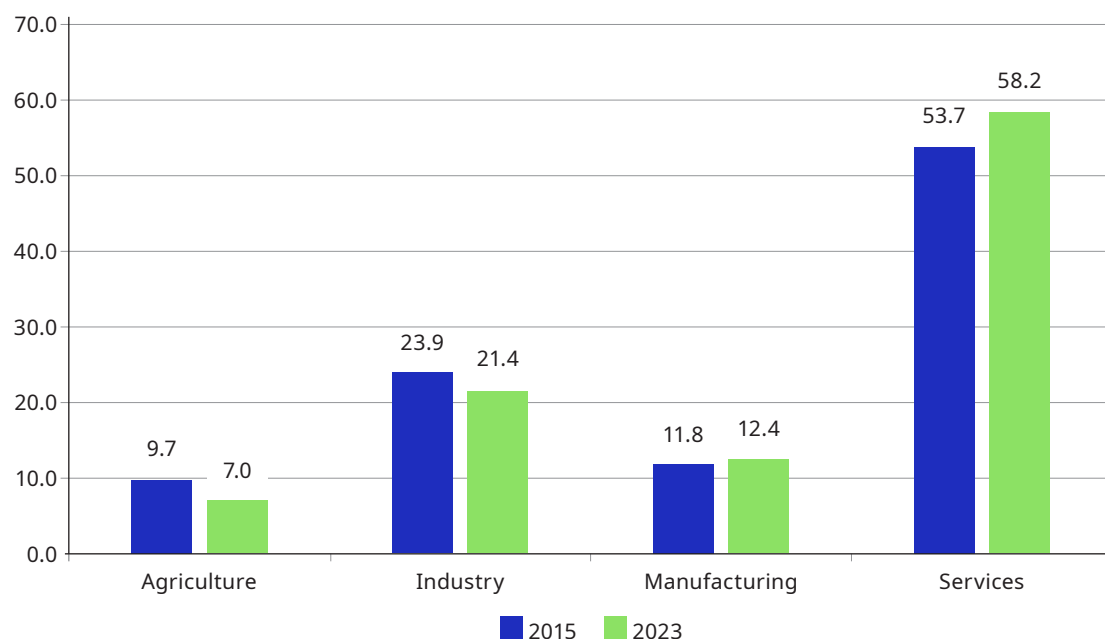
 **Figure 6. GDP annual growth, and GDP per capita annual growth**



Source: World Bank.

Services are the largest GDP contributor, as Figure 7 shows. The figure also shows that the importance of services is increasing, such that their contribution to GDP increased by 4.5 percentage points (p.p.) during the period 2015–2023. On the other hand, the contribution of agriculture to GDP shrank to only 7 per cent of GDP (by 2.7 p.p.), indicating the continuing decline of agricultural production. Furthermore, industry registered a 2.5 p.p. decline in its contribution to GDP. This trend is expected to continue, with the service sector generating more employment opportunities, while jobs in agriculture are likely to decline further.

¹⁴ World Bank: Western Balkans Regular Economic Report No. 25: Invigorating Growth, Spring 2024.

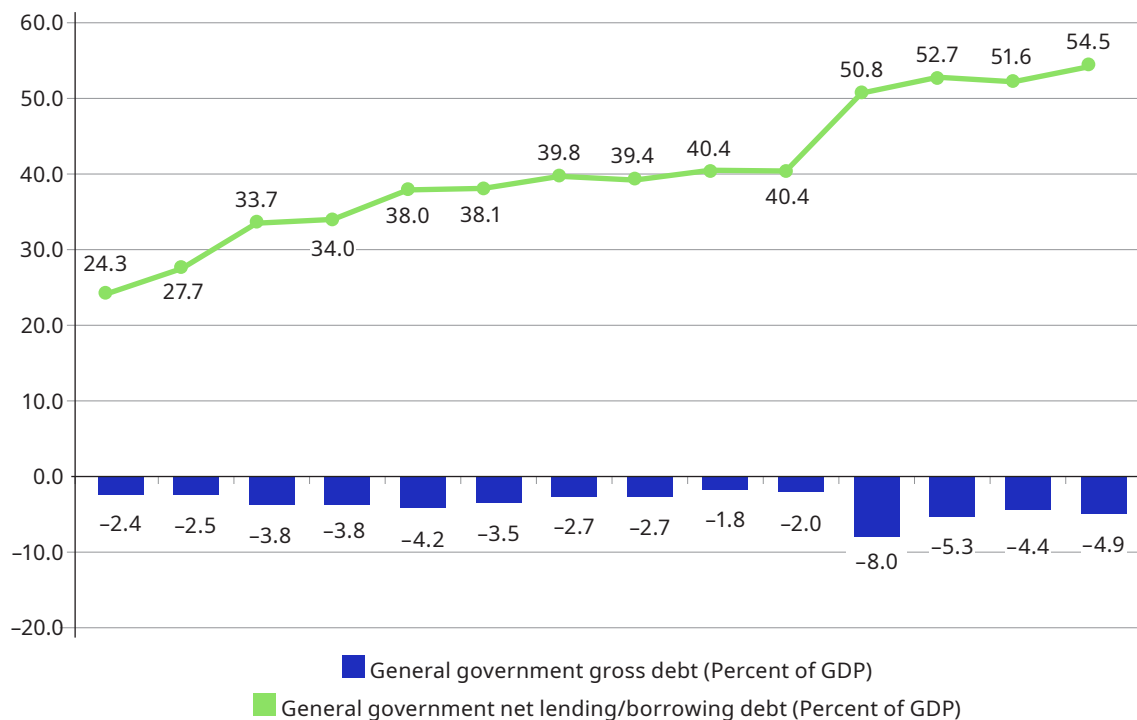

Figure 7. Sectoral contributions (% of GDP)


Source: World Bank.

Inflation fell to 3 per cent in July 2024, from a peak of 19.8 per cent in October 2022, reflecting base effects and tighter monetary policy.

Analysis of North Macedonia's debt sustainability presented in Figure 8 shows a continuous increase of the country's public debt. In 2010, general government gross debt amounted to 24.3 per cent of GDP, reaching 54.5 per cent in 2023, a significant increase. As North Macedonia is a candidate country for EU accession, the Maastricht criterion of 60 per cent public debt is considered to have been achieved and shows that debt sustainability is not critical. This leaves some room (fiscal space) for introducing climate-related projects. However, the Government should be very careful about issuing new debt, ensuring it is used for productive purposes that bring higher growth in the future and hence ensure repayment of the debt from the investment. The largest investment is needed in infrastructure. Infrastructural quality in North Macedonia is very low (ranked 74 by the Global Quality Infrastructure index, the fourth worst in Europe, after Albania, Bosnia and Herzegovina, and Montenegro). New debt should be used to finance infrastructure projects, which should take into consideration the greening of the economy/country.

Figure 8. General government gross debt and general government net lending/borrowing



Source: IMF. [% of GDP]

In summary, based on historical data, the greatest risk posed to North Macedonia from climate and environmental change is from floods, followed by extreme temperatures. With regard to the economy, services are gaining further importance, such that their contribution to GDP increased by 4.5 percentage points (p.p.) in the period 2015–2023. On the other hand, agriculture’s GDP contribution shrank to only 7 per cent (by 2.7 p.p.), Analysis of North Macedonia’s debt sustainability shows that the Government should issue new debt for productive purposes, such as infrastructure.

4.3. Labour market context

According to the State Statistical Office, the estimated size of North Macedonia’s total labour force in 2023 amounted to 791,647 (age 15+). Out of that labour force, 688,296 or 45.4 per cent were categorized as employed and 103,351 or 13 per cent as unemployed. The inactive population was 723,460 or 47.7 per cent of the working-age population. Table 1 provides an overview of North Macedonia’s key labour characteristics.

 **Table 1. Key labour characteristics of North Macedonia, 2023**

Key indicator	Data
Total size of working-age population	1,515,107
Total size of labour force	791,647
Labour force participation rate disaggregated by age and gender (%)	Men: 61.5
	Women: 42.5
Youth unemployment rate (ILO standard 15–24 years of age, %)	29.7
Employment distribution by key economic sectors (%)	Agriculture: 7.8
	Industry: 31
	Services: 61.2
Percentage of informal labour	9.7
Monthly minimum wage, local currency	MKD 26,243

Source: ILO database.

The labour force participation rate in North Macedonia is quite low at 65.5 per cent, with a large gender gap. While 76.5 per cent of working-age men participate (are active) in the labour market, only 54.3 per cent of women do so. For adult women (25–64) low participation rates are due primarily to household and care responsibilities – a significant percentage of all inactive women are engaged in care duties (Mojsoska-Blazhevski, 2018).¹⁵ The participation rate of young people is 44.7 per cent (15–29 years of age), the main reason for which is their involvement in education.

Labour force participation is positively related to educational attainment: people with tertiary education are over twice as active as those with primary education. For women, this ratio almost doubles, because women with tertiary education are four times more active than women with a primary education or less. The difference is also very pronounced for young people – 83 per cent of tertiary educated young people participate in the labour market compared with only 22.5 per cent of low-skilled ones.

The structure of employment in the past decade has followed the structural shift of the economy (Figure 9). There is a declining share of workers in agriculture, a stable proportion employed in manufacturing and a rising share engaged in services.

According to Eurostat data on the environmental goods and services sector (EGSS),¹⁶ 181 persons were employed in the environment sector in 2022 (latest available data), which represents a decline compared with 2021 (23,853 persons were employed in North

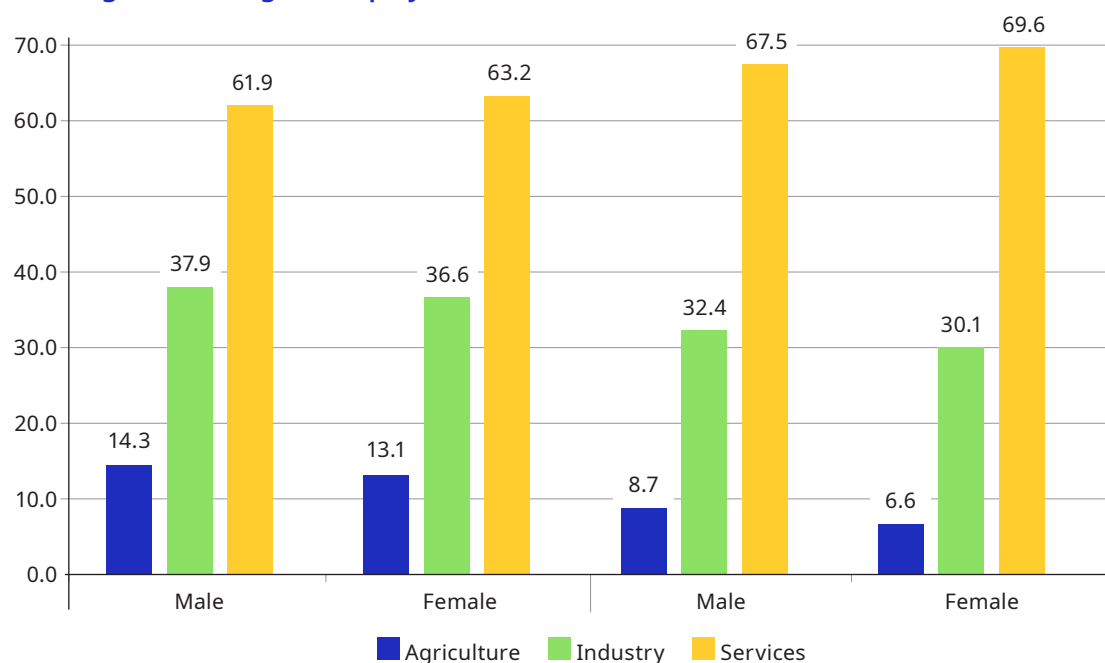
¹⁵ Mojsoska Blazhevski, Nikica: Trends in Labor Markets in FYR Macedonia: A Gender Lens (Washington, DC, World Bank Group, 2018), <http://documents.worldbank.org/curated/en/986351530094208973/Trends-in-labor-markets-in-FYR-Macedonia-a-gender-lens>.

¹⁶ The environmental goods and services sector (EGSS) accounts report on the economic sector that generates environmental products, that is, goods and services produced for environmental protection or resource management.

Products for environmental protection prevent, reduce and eliminate pollution or other forms of degradation of the environment. They include measures undertaken to restore degraded habitats and ecosystems. Examples include electric vehicles, catalysts and filters to decrease pollutant emissions, wastewater and waste treatment services, or noise insulation.

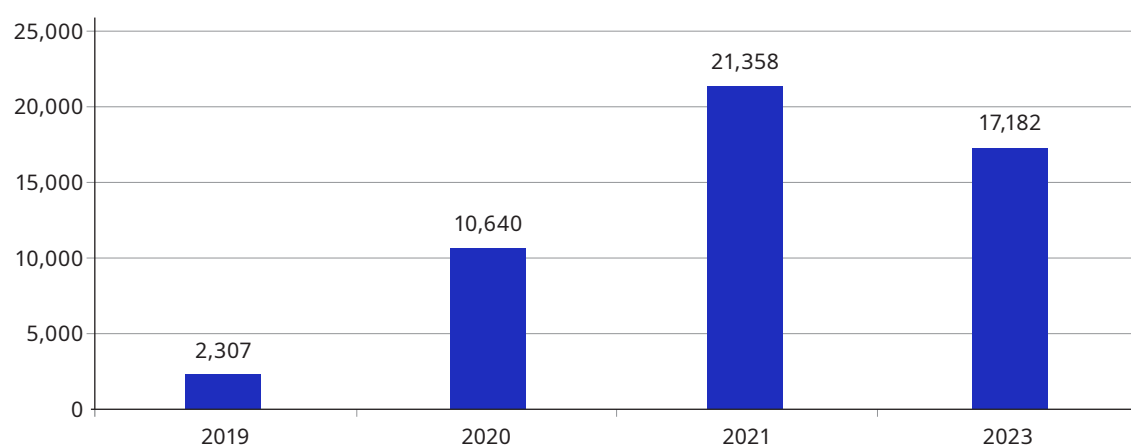
Macedonia's environment sector in 2021).¹⁷ In 2022, 2.5 per cent of all employed persons in North Macedonia were working in this sector.

 **Figure 9. Change in employment structure**



Source: State Statistical Office.

 **Figure 10. Number of persons employed in environmental sector, North Macedonia, 2019–2022**



Source: Eurostat.

¹⁷ There is no longer a Eurostat time series for this indicator for North Macedonia. Data go back to 2019, when the number of employed persons in the environment sector was about 1,000.

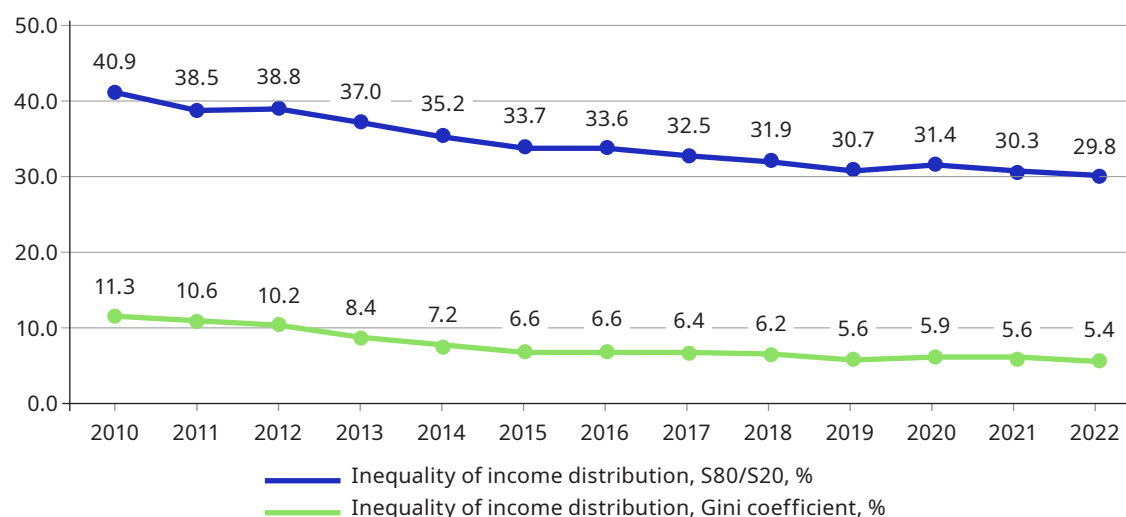
5. Poverty and inequality context

North Macedonia had a poverty headcount ratio of 2.7 per cent of the total population at national poverty lines in 2019 (a 7.1 percentage point decline compared with 2009), as indicated by World Bank estimates.¹⁸

Income disparities declined in North Macedonia in the period 2009–2019, but further progress is still needed. In 2019, the Gini¹⁹ coefficient (World Bank²⁰) amounted to 33.1, which is better than those of some EU countries (for instance, Romania stands at 34.8, Bulgaria 40.3, Latvia 34.5 and Lithuania 35.3) but worse than most. This coefficient indicates a **moderate level of income inequality**. This means that while there is some disparity in income distribution, it is not as extreme as in countries with higher Gini coefficients. North Macedonia's Gini coefficient is similar to those of other Balkan countries: Serbia stands at 33.1, Montenegro 34.3, and Bosnia and Herzegovina 33, while Albania is the best performer with a Gini coefficient of 29.4.

The inequality of income distribution index (S80/S20), published by Eurostat, represents the ratio of total income received by the 20 per cent of the country's population with the highest incomes (top quintile) to that received by the 20 per cent with the lowest incomes (lowest quintile). The inequality of income distribution index (S80/S20) in North Macedonia in 2021 was 5.6.

Figure 11. Gini coefficient and inequality of income distribution S80/S20 (%)



Source: World Bank and Eurostat.

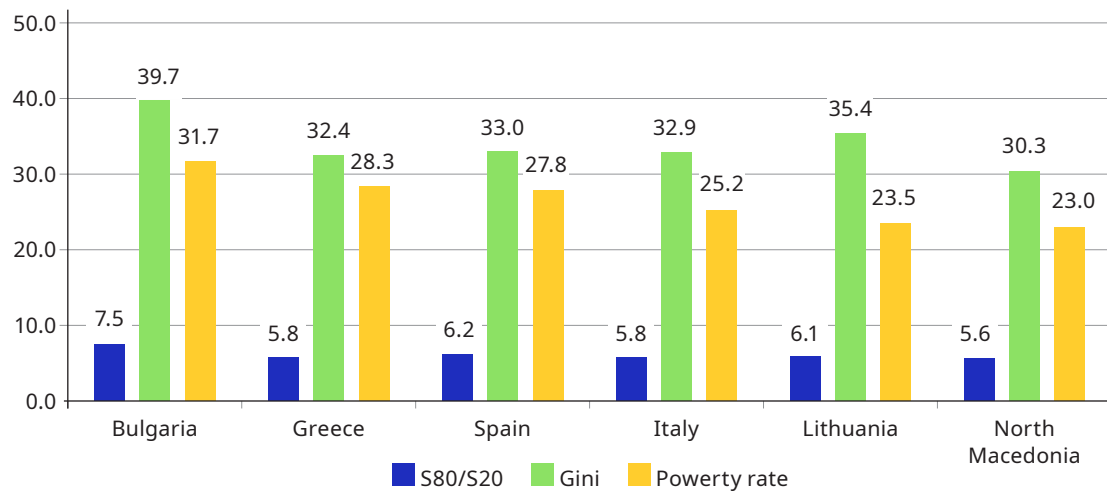
¹⁸ World Bank: Poverty Headcount Ratio at \$2.15 a Day (2017 PPP) (% of population), <https://data.worldbank.org/indicator/SI.POV.DDAY>.

¹⁹ The Gini coefficient is a measure of income inequality within a population. Essentially, it helps us to understand the distribution of wealth and how evenly or unevenly it is spread among people in a given society. The lower the Gini coefficient, the more equitable the income distribution; a higher Gini coefficient indicates greater inequality.

²⁰ World Bank: Gini Index (World Bank Estimate), <https://data.worldbank.org/indicator/SI.POV.GINI>.

Figure 12 presents a comparison with some EU countries (poor performers). As the figure shows, the poverty rate and the inequality of income distribution measured through the Gini coefficient and S80/S20, is better in North Macedonia than in the selected countries.

 **Figure 12. Gini coefficient and poverty rate – comparative analysis**

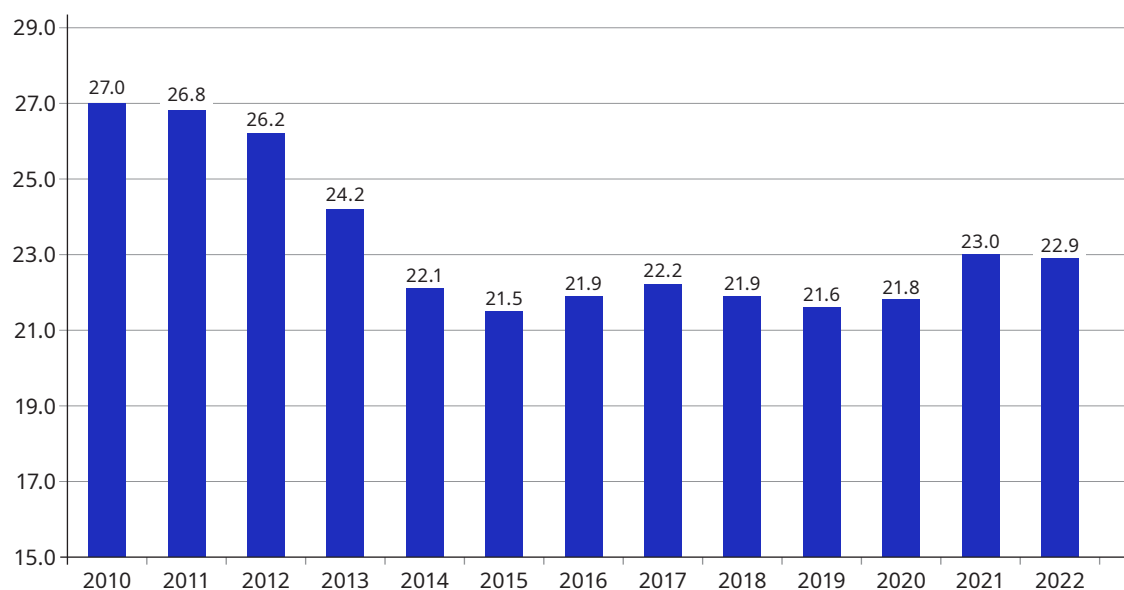


Source: Eurostat.

The latest available data on poverty in North Macedonia are for 2022. The State Statistical Office, based on the Survey on Income and Living Conditions, which is carried out in accordance with EU recommendations, calculates Laeken poverty indicators. The source for poverty calculations is income, and the poverty threshold is defined at 60% of median equivalised income. According to the data, the at-risk-of-poverty rate in the Republic of North Macedonia in 2022 was 22.9 per cent.

Figure 13 shows the poverty rate in Macedonia since 2011. The figure shows that after five years of modest, but continuous decline (2010–2015), the poverty rate was stable in the period 2015–2020. In 2021, the impact of Covid-19 is evident with a 1.2 percentage point poverty increase compared with 2020. In 2022, poverty remained almost the same.

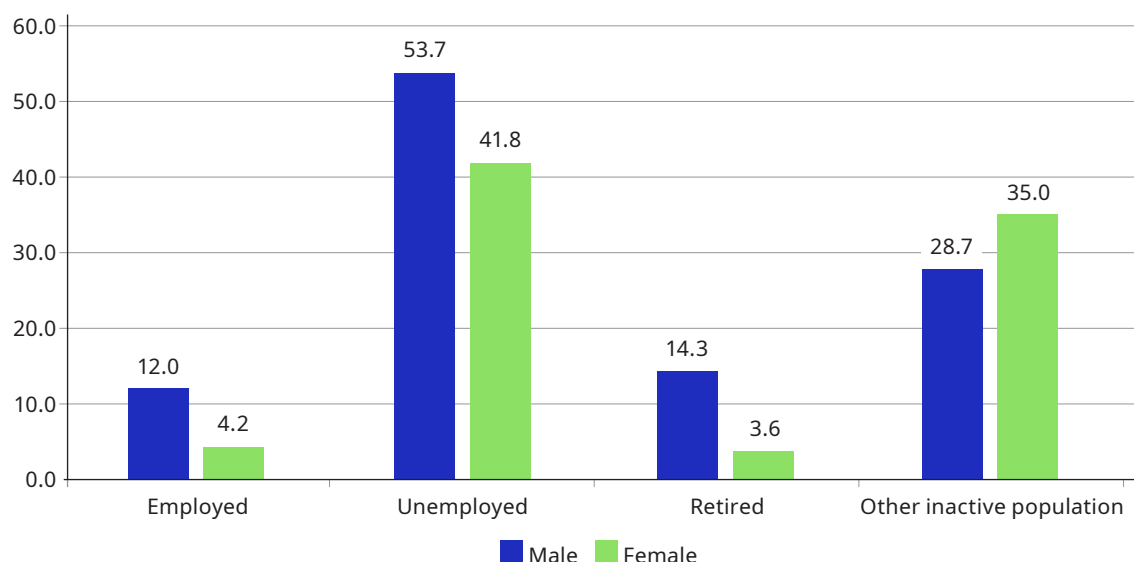
 **Figure 13. At-risk-of-poverty rate, % of population**



Source: State Statistical Office.

Poverty among the active population in North Macedonia, calculated on the basis of the at-risk-of-poverty rate, is higher for males than for females (Figure 14). However, the poverty rates for the inactive population are higher for females.

Figure 14. At-risk-of-poverty rate by most frequent activity status and by gender in 2022 (%)



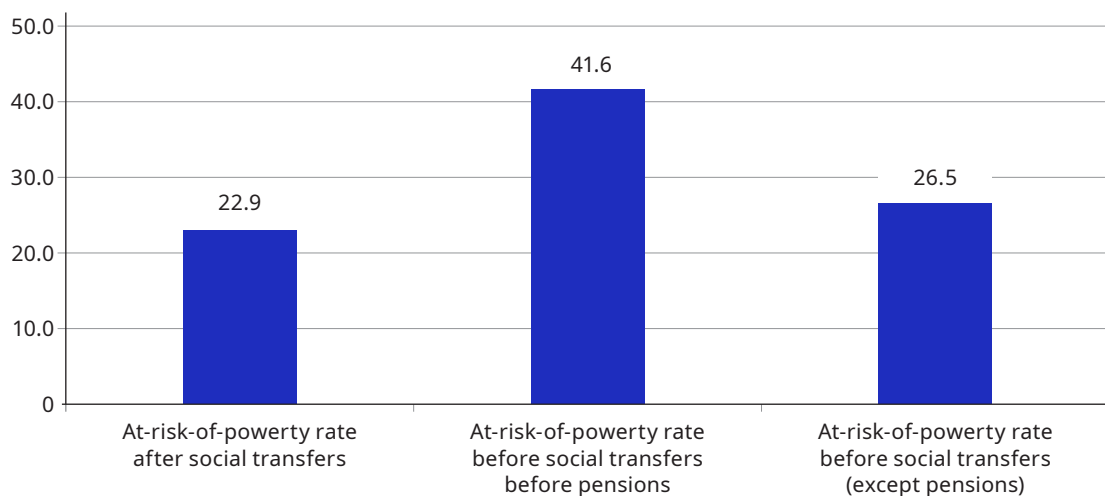
Source: State Statistical Office.

This disparity in poverty rates between the active and inactive populations in North Macedonia can be attributed to several socio-economic factors:

- 1. Employment patterns:** Men are more likely to be part of the active workforce, often in lower-paying or unstable jobs, which increases their risk of poverty despite being in work. Women, on the other hand, may have lower workforce participation, but could benefit from social safety nets or family support, especially in the western part of the country, where the Muslim population makes up the majority.
- 2. Gender roles and inactivity:** Among the inactive population, women often face higher poverty rates due to their limited access to resources, lower pensions or reliance on family income. Traditional gender roles may also limit their financial independence.
- 3. Sectoral employment:** Men might be employed in sectors more vulnerable to economic fluctuations, such as construction or manufacturing, leading to higher poverty risks during downturns.
- 4. Social support systems:** Women in the inactive population may have less access to social benefits or savings, especially if they are not part of the formal workforce.

These trends highlight the importance of addressing gender disparities in employment opportunities, wages and social support systems. Furthermore, the poverty rate is different before pensions and social transfers.

 **Figure 15. Poverty rate before social transfers and pensions (%)**



Source: State Statistical Office.

Figure 15 shows the poverty rate before social transfers and before pensions, as well as before social transfers but after pensions. The at-risk-of-poverty rate before social transfers and pensions is almost twice its level after social transfers and pensions. However, the biggest reduction is achieved after pensions (reduction to a 26.5 per cent poverty rate), while after social transfers the poverty reduction is only 3.6 percentage points.

The disparity in poverty reduction between pensions and social transfers in North Macedonia can be explained by several factors:

- *Pensions as a primary income source:* Pensions often represent a significant portion of income for retired people, who might otherwise have no earnings. This direct financial support substantially reduces poverty rates among the elderly population.
- *Coverage and impact:* Pensions typically have broader coverage and higher monetary value than social transfers. They are designed to provide long-term financial stability, whereas social transfers may be more targeted and limited in scope.
- *Demographics:* North Macedonia has a relatively high proportion of elderly people, who rely on pensions. This demographic factor amplifies the impact of pensions on overall poverty reduction.

Social transfer limitations: Social transfers, while helpful, may be smaller in scale and targeted at specific groups, such as families with children or the unemployed. Their limited reach and lower amounts result in a smaller reduction in poverty rates.

Finally, Figure 16 shows poverty rates by household type. Single parent households with dependent children are at the highest risk of poverty, followed by households with three or more children, while households with three adults have the lowest poverty risk.

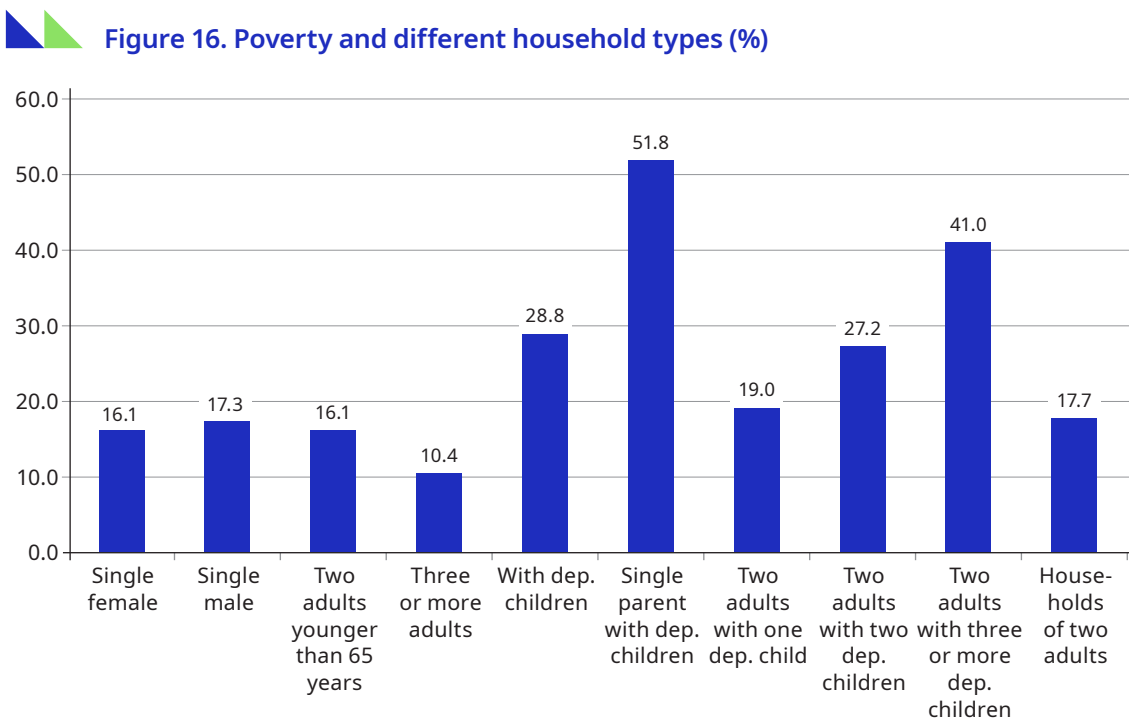
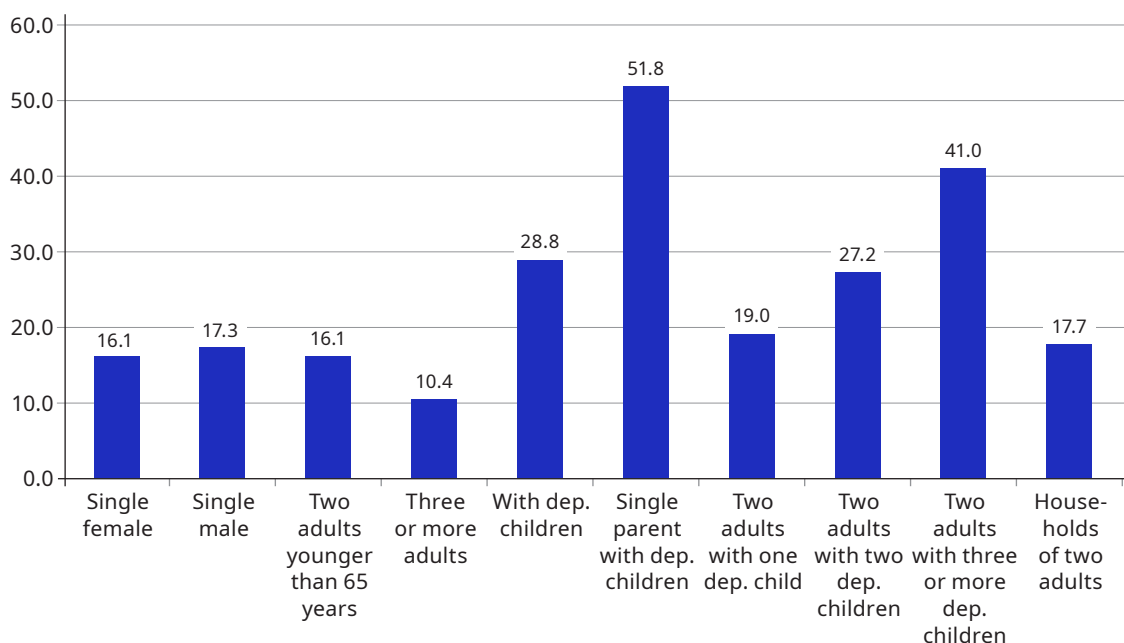


Figure 16. Poverty and different household types (%)



Source: State Statistical Office.

Between 2009 and 2019, North Macedonia experienced a decline in poverty and income inequality: the national poverty headcount fell to 2.7 per cent and the Gini coefficient improved to 33.1, which is comparable to regional peers but still higher than most EU countries. However, by 2021, the at-risk-of-poverty rate had risen to 23 per cent, partly because of the socio-economic impact of Covid-19. Gender and activity status reveal disparities: poverty is higher among economically active men and inactive women, reflecting a structural labour market and social support imbalances. Pensions play a significantly greater role than social transfers in poverty reduction, highlighting the system's reliance on retirement benefits. Finally, household composition strongly affects poverty risk, with single-parent families and those with three or more children facing the greatest vulnerability.

6. Review of the national policy landscape of the climate-economy-employment nexus

The Republic of North Macedonia ratified the Paris Agreement in November 2017, and submitted its intended **Nationally Determined Contribution (NDC)** in August 2015 and enhanced NDC in April 2021. The focus of the initial NDC is on climate change mitigation, particularly on CO₂ emissions from fossil fuel combustion, which accounts for almost 80 per cent of total GHG emissions in the country. The following sectors have the dominant share: energy supply, buildings, and transport.

North Macedonia announced enhanced nationally determined contributions to global efforts to achieve GHG emissions reductions as follows:

- In 2030, a 51 per cent reduction in greenhouse gas emissions compared with 1990 levels.
- In 2030, an 82 per cent reduction compared with 1990 levels, expressed in net emissions.

Social aspects of the relevant “policies and measures” (PAMs) are addressed by calculating **newly created jobs**, introducing gender indicators in some PAMs aimed at making them more gender-responsive, and organizing a virtual youth consultation on the enhanced NDC, designed to ensure that the voices of young people are expressed. The Enhanced NDC envisages that policies and measures would bring new jobs, amounting to almost 8,000 in 2030 and 10,000 in 2035, with a dominant contribution from energy efficiency PAMs of 77 per cent. The PAMs with the highest share in the number of new domestic green jobs are: retrofitting of existing residential buildings (42 per cent), construction of passive houses (21 per cent) and solar thermal collectors (8 per cent). Poverty in North Macedonia is not analysed in the NDC report.

The **National Employment Strategy** (NES) 2021–2027 is aimed at addressing both the short-term labour market consequences of the Covid-19 pandemic, and the structural challenges affecting employment growth. The timeframe for implementation of the National Employment Strategy is from 2021 to 2027, in line with the programming cycle of the Government of the Republic of North Macedonia and the European Union. However, climate changes affecting jobs are not analysed. Poverty and inequality are analysed only to a modest extent; only at-risk-of-poverty rates before and after social transfers are discussed.

The National Development Strategy (NDS) 2024–2044 is a leading document that defines the main development goals, strategic areas and priorities for the accelerated, inclusive, balanced, gender-equal and sustainable development of North Macedonia. The NDS identifies key challenges and national priorities, especially bearing in mind North Macedonia’s aspirations to join the EU by 2035. This document addresses climate change in North Macedonia. It is considered to be a multidimensional challenge with a significant impact on people’s health, productivity, ecological balance and macroeconomic stability. Natural disasters such as floods, prolonged drought periods and fires are just one aspect of the predicted changes, which necessitate mitigation and adaptation policies. Adaptation to climate change and successfully addressing environmental issues is one of the key areas the strategy addresses. The NDS has already been adopted by the Government, and its adoption by the Parliament was expected by the end of 2024. The National Development Strategy does not analyse the consequences of climate change for the labour market and poverty in North Macedonia.

The Economic Reform Programme (ERP) is the most important strategic document in the economic dialogue with the European Commission and the EU candidate countries. This document is prepared every year and serves as preparation for participation in the economic and fiscal supervision of EU Member States, in other words, for future inclusion in the European Semester for the coordination of economic policies in the EU. The document presents the medium-term macroeconomic and fiscal framework, as well as structural reform measures, while chapter 2 provides the implementation status of

the recommendations from the Joint Conclusions of the Economic and Financial (ECOFIN) dialogue. Climate change policies are part of the programme. Structural reforms to strengthen resilience to climate change and reduce environmental pollution are sequenced in the following reform measures:

- Promotion of renewable energy sources.
- Improvement of energy efficiency.
- Establishing wastewater collection and treatment infrastructure in accordance with EU requirements.
- Establishing an integrated and financially self-sustainable waste management system.

The programme analyses the job market consequences of climate change, but mainly for the purpose of new job creation. Poverty is not addressed in relation to climate change.

The Tax Reform Strategy 2021–2025 is a national document prepared by the Macedonian Government. The document tackles only the taxation of polluters; it is not focused on climate change. The main goal of the strategy is to ensure a fair, efficient, transparent and modern tax system that will be based on modern digital technologies and innovations in taxation, in order to achieve accelerated, inclusive and sustainable economic growth. Tax incentives for reducing carbon footprints are envisaged, whereas employment and poverty are not covered.

The National Energy and Climate Plan (NECP) covers the period from 2021 to 2030 and lays down the pathway for achieving the 2030 targets. Like the Energy Strategy, the NECP also takes a holistic approach and addresses the five main dimensions of the Energy Union in an integrated way, recognizing the interactions between the different dimensions. These include: decarbonization, energy efficiency, energy security, the internal energy market dimension and the research, innovation and competitiveness dimension. The NECP does not address the effects of climate change on the labour market, but energy poverty is addressed.

Long-term strategy on climate action and action plan towards green, low carbon and climate-resilient development, based on the best available information and in the context of North Macedonia's EU accession. Implementation of the measures proposed in this strategy, which is needed to meet the emissions reduction objectives, will require cumulative capital investments of €35 billion in the period 2020–2050. These investments created the highest number of green jobs in 2035: 10,000 green jobs, which represents 2.7 times more jobs than the current number of employees in coal powered plants in the Republic of North Macedonia.

The Just Transition Roadmap, which presents the way forward, is a combination of pathways aimed at addressing the needs identified in the coal dependent regions. The following pathways are laid out:

- Clean Energy Pathway.
- Private Investment and Start-up Economy Pathway.

- Green and Smart Infrastructure Pathway.
- Skills Development Pathway.

To support employment in coal-dependent regions effectively, an integrated approach is essential. This approach should include vocational counselling alongside robust upskilling and reskilling programmes, tailored to meeting the career transition needs of workers impacted by coal phase-out, as well as those already unemployed. Subsidy schemes can complement these measures, easing the transition and actively supporting people in finding new opportunities. Programmes could be designed to cater to both immediate needs and longer-term career changes, ensuring comprehensive coverage. However, the Roadmap falls short of addressing the consequences of inequality, an aspect that warrants thorough analysis to ensure fair and equitable outcomes for affected communities.

There are several ongoing projects in North Macedonia that focus on supporting job creation through climate change initiatives. These include:

1. Green Climate Fund (GCF) Country Programme²¹: This project focuses on laying the foundations for transformative climate finance. It aims to strengthen the capacity of the National Designated Authority and relevant partners to access climate finance. The project addresses key climate change priorities in sectors such as energy, transport, water resources, agriculture, waste, biodiversity, health, forestry and cultural heritage. The focus is not on employment and poverty, however.
2. Social Aspects of the Energy Transition: This initiative is part of North Macedonia's National Energy and Climate Plan. It aims to create green job opportunities and ensure a just transition for workers and communities affected by the shift to a low-carbon economy. The plan includes measures to support new businesses, provide training opportunities and enhance job security. This document focuses mainly on the shift to a low-carbon economy – changes in relation to poverty are not being assessed.
3. Developing Human Capital for Climate Change Adaptation and Mitigation: Implemented by GIZ in cooperation with the National Designated Authority, this project focuses on building capacity for sustainable human capital development. It aims to create a supportive environment for climate change mitigation and adaptation in sectors such as health care, education, labour and social protection. The project includes training public administration staff, mainstreaming climate change in education, and creating an *enabling environment for climate-smart employment*. It does not address inequality issues.

These projects are part of North Macedonia's efforts to tackle climate change while promoting job creation and sustainable development.

²¹ Green Climate Fund North Macedonia. <https://www.greenclimate.fund/countries/north-macedonia>.

The above analysis points to several key challenges and gaps in the implementation of climate-related policies and programmes in North Macedonia:

- **Limited integration of labour market impacts:** existing strategic frameworks insufficiently address the implications of climate change for employment and labour market dynamics. There remains significant room for more refined and data-driven analysis of how climate policies affect job creation, displacement and skills development across sectors.
- **Inadequate consideration of climate-induced poverty and vulnerability:** while certain policy documents, such as the NECP, acknowledge energy poverty, the broader socio-economic impacts of climate change – particularly on low-income, marginalized and vulnerable populations – have been largely underexplored. A more holistic approach is needed to assess and tackle the intersection of climate change, poverty and inequality.
- **Narrow sectoral focus in strategic planning:** current strategic programmes concentrate predominantly on the agricultural sector and coal-based electricity production. Other high-impact sectors, such as the metal industry, construction and manufacturing, are frequently overlooked in climate and employment analyses. Expanding sectoral coverage is essential in order to develop a more comprehensive and inclusive green transition strategy.

Taking into consideration the above analysis and the gaps identified in reports, strategies and available analytical studies for North Macedonia, the present report adds value by providing a comprehensive and forward-looking assessment of the labour market implications of climate change in North Macedonia. Building on desk research, an online survey of employers' organizations and consultations with social partners, it identifies the most climate-vulnerable sectors of the economy.

Unlike previous studies, which focus primarily on agriculture and energy, this report expands the analysis to include **construction, automotive and spare parts manufacturing**, and the **metal industry**, sectors vital to the country's economic structure but often overlooked in climate-related assessments.

Importantly, the report goes beyond assessing potential job losses by mapping **job transitions, employment creation and labour mobility across sectors**. In doing so, it highlights both the risks and the opportunities of the green transition, providing practical insights to support just transition policies and guide evidence-based decision-making.

 **Table 2. Policy landscape analysis for North Macedonia**

Thematic pillar	Key policy determinants	NEP-National Employment Strategy	National Development Strategy 2024–2040	National Energy and Climate Plan (NECP)	Economic Reform Programme 2024–2026	Long-term Strategy on Climate Action and Action Plan (2050)	Tax Reform Strategy 2021–2025	Just Transition Roadmap
Climate/ environmental dynamics	Mitigation strategies							
	Adaptation and resilience strategies							
	Specific mention of green jobs or employment–environment linkages							
Labour market/ employment dynamics	Social protection							
	Sustainable/ resilient enterprises							
	Skill development							
	Green employment projects/ programmes							
	Social dialogue							

 Key policy determinants covered extensively

 Key policy determinants covered

 Key policy determinants not covered

7. Summary of insights from the country profile, and identification of vulnerable sectors

The Country Profiling section provides an overview of North Macedonia's economic and environmental context, highlighting its exposure to climate-related risks and socio-economic challenges. North Macedonia, a landlocked country in the Balkans, is a candidate for EU membership and has committed to aligning with the EU's climate and energy policies, including the 2050 climate neutrality target. The nation is highly vulnerable to climate change; for example, floods and extreme temperatures pose a significant threat. Additionally, the country ranks among the most polluted in Europe, with high greenhouse gas emissions, primarily from the energy and transport sectors. Despite policies aimed at climate adaptation, challenges remain in implementing effective mitigation strategies and transitioning to a low-carbon economy.

The policy assessment in this section reveals gaps across the climate and labour market pillars. This highlights a need to formulate policies that effectively address these issues in North Macedonia.

Based on the Country Profile, we can identify the sectors of employment most at risk from the physical impact of climate change. Furthermore, for the purpose of this project, we used a three-step method to identify and select the economic sectors most prone to climate change risks, and which will have a strong impact on the Macedonian economy. In the first step, we identified several vulnerable sectors based on the country's most frequently occurring climate change risks and natural disasters. In the second step, we also took into consideration the importance of these sectors for the overall economy (GDP), for exports and their share in total employment. Hence, for each of the identified sectors, the following indicators were calculated:

- contribution to GDP of the selected industry sectors in the Macedonian economy,
- exports, as a percentage of total exports,
- employment in these sectors.

The third step is based on the two workshops (discussion meetings) held with the social partners to further streamline the choice of sectors that will be analysed in more detail in this report. The questionnaire results were also taken into consideration. **Based on this three-step analysis** we selected the following sectors that are likely to be the most vulnerable to climate change (including quantitative thresholds):

- Energy production (electricity, gas, steam and air conditioning supply), with 12 per cent participation in the industrial sector, and the extractive sector (metal extraction), with 9 per cent participation in the Industrial Production Index, and representing 3.3 per cent of total exports in 2024. Together these two groups account for 1.92 per cent of total employment.
- Agriculture and food, which make up 14 per cent of total exports and 5 per cent of GDP (only agriculture), as well as accounting for 7.8 per cent of the labour force (5 percentage points male and 2.8 percentage points female).

- Production of basic metals, contributing 8.3 per cent to total exports in 2024 (groups 67, 68 and 69, SMTK classification) and accounting for 4.1 per cent in the Industrial Production Index (Group 24).
- Construction and construction materials, which makes up 7.3 per cent of total employment, and 5.8 per cent of GDP.
- Production of machinery, vehicles, and equipment (the largest sector), which accounts for 24 per cent of industrial production (groups 24, 25, 26) and 29.7 per cent of total exports.

Discussions with social partners and survey results

Productive discussions were held with social partners in Skopje in September 2025. The social partners emphasized the worrying situation in the energy sector, which will bear the brunt of the impact of climate change on jobs. They stressed that as most of the electricity in North Macedonia is produced from coal, and more than 6,000 people are employed in this sector, job losses are possible unless adequate policies are implemented immediately and on a medium-term basis.

The union representatives were less concerned about potential job losses in the other industrial sectors. The discussion showed that the new foreign companies operating in the industrial zones in North Macedonia are prepared and have been working hard to meet most of their obligations regarding the green transition, mainly at the behest of their parent companies, which in general are located in more advanced European economies. However, as pointed out by representatives of the employers' organization, companies that are predominantly domestically owned will face consequences from climate changes (if not properly managed).

Although the trade union representatives were less concerned about the foreign companies, one value added of this project is that we analyse climate change risks and opportunities for the most vulnerable sectors.

Table 3 presents the issues discussed with the social partners, which were also part of the survey.


Table 3. Questions discussed with social partners and covered in the questionnaire

Socio-economic dimension	Key determinants of climate change consequences	Sub-categories	Key questions
Economic implications	Physical climate risks and their effects on the economy	Physical climate risks	<i>How often do floods, fires and droughts occur in North Macedonia?</i>
			<i>What is the expected damage (with a focus on large-scale impact)?</i>
		Economy-wide and sectoral economic consequences	<i>Which sectors will be most impacted by floods, extreme temperatures, fires and drought?</i>
			<i>How will the agricultural sector be affected by these impacts? Is it through changes in input costs, a reduction in productivity, asset damage, etc?</i>
	Transition risks and their economic implications	Risks arising from global shifts to low emissions growth	<i>What is the importance of the affected sectors (food and beverages industry, metal and steel industry, cement industry, construction materials industry, energy production)?</i>
			<i>Will anticipated climate changes cause increased costs for companies?</i>
			<i>What is the country's exposure to carbon-border adjustment mechanisms (CBAMs), particularly the EU's CBAM and its possible effects on exports to the EU?</i>
		Risks associated with national commitments to reduce emissions	<i>Which sectors are expected to drive emissions reductions?</i> <i>What would be the cost for companies of adjusting to requirements for emission adjustments?</i>
	Transition opportunities and their economic implications	Unlocking gains related to transition (adaptation and/or mitigation) options	<i>What are North Macedonia's key strengths that can facilitate the exploitation of transition opportunities, such as being a low-cost producer or having a strong skills base?</i>
			<i>What are the weaknesses or challenges that North Macedonia needs to address in order to fully capitalise on transition opportunities?</i>

Socio-economic dimension	Key determinants of climate change consequences	Sub-categories	Key questions
Labour market implications	Physical risks and their labour market implications	Physical climate risks	<i>What are the specific transmission mechanisms through which floods, fires, extreme temperatures and droughts might impact the labour market, such as disruptions to infrastructure, supply chains, or productivity?</i>
	Transition risks and their labour market implications	Implications by aggregate, microeconomic and diversity characteristics	<i>How many people are currently employed in the affected sectors and what is the estimated number of jobs that may be threatened?</i> What are the mitigation measures that can be implemented in the short term? (Adaptation of work shifts, recycling, additional equipment for health and safety at work)
			<i>How are domestic emissions reductions expected to impact the labour market?</i>
	Transition opportunities and their labour market implications	Implications based on scope and skill requirements	Do you see opportunities for the Macedonian economy in the long term? For the labour market? (Jobs in waste management, renewable energy sources, recycling systems, resource recovery and sustainable product design) <i>What are the skills needs associated with realizing these transition opportunities? Are there sufficient workers with these skills in North Macedonia?</i>
Poverty and inequality implications	Physical risks and their poverty and inequality implications	Physical risks – distributional impact	<i>To what extent are the reductions in employment associated with the realization of physical climate risks disproportionately experienced by farmers?</i>
			<i>How might impacts on welfare that are not directly related to nominal income and employment be disproportionately affected by climate change, such as the potential increase in prices of goods and services disproportionately consumed by the poorest and most vulnerable?</i>
	Transition risks and their poverty and inequality implications	Transition risks – distributional impact	<i>To what extent are the reductions in (nominal) income and/or employment in carbon intensive production resulting from transition risks disproportionately affecting individuals at the lower end of the income distribution?</i>
	Transition opportunities and their poverty and inequality implications	Transition opportunities – distributional impact	<i>How do the occupational and geographic profiles of the new jobs created by transition opportunities provide employment opportunities for individuals at the lowest end of the income profile?</i>

In-depth assessment of the economic, labour market, and poverty and inequality implications

The economy of North Macedonia during the period of transition relies heavily on the growing service sector, while the industrial sector is relatively flat and the agricultural sector is in decline. This economic model is challenged by both the physical effects of climate change and the risks associated with a global transition to a low-carbon economy. In the second phase of this project, we focus on the economic, labour market and poverty implications of climate change in North Macedonia. We analyse the physical climate risks, transition risks and opportunities from climate change for the selected most vulnerable sectors. This has not been done by other strategic policy documents.



I. Electricity / energy production

► I. Electricity / energy production

I.A Physical climate risks and their effects on the economy

Climate change will have a significant impact on Macedonian electricity production. As explained in Figure 8 (Phase I), most of the electricity production in North Macedonia comes from coal, with significant greenhouse gas (GHG) emissions. The situation is similar in other countries in the region, such as Serbia and Bosnia and Herzegovina.

Variability in precipitation patterns is a significant physical climate risk. North Macedonia has nine large hydropower plants, with 571 MW installed capacity. Changes in water resource availability will result in loss of hydropower generation (the share in the generation mix of 30 per cent in the 1990s is expected to decrease continuously). Currently, hydropower plants in the Republic of North Macedonia have an average annual production of 1200 GWh, and the total installed capacity is 554 MW, or 40 per cent of the total capacity of AD ESM. However, production in recent years has been constantly less than 30 per cent compared with the maximum produced. Variabilities in precipitation patterns will be a significant risk for hydropower production.

Rising temperatures as predicted by the World Bank will be a threat to the cooling capacities of power-generating stations and impact generation and transmission (higher ambient temperatures lead to higher pressure at the steam turbine outlet, degrading powerplant performance). This will further contribute to reductions in electricity production and potential job losses.

Another challenge for the Macedonian energy sector with rising temperatures is increased demand for electricity, especially during summer days. Increased demand will cause electricity outages, which will influence the supply chains and production processes in the country.

Finally, wind power generation could degrade **during heatwaves**, as they are generally designed for conditions around 25°C. High temperatures can reduce the lifespan of battery cells and other electronic components, while also impairing the performance of the lubrication oil in the turbine gearbox. Under extreme heat, such as above 45°C, a standard wind turbine may shut down completely. Reduced electricity production and job losses are possible.

I.B Transition risks and their economic implications

The main driver of transition in this sector is the Enhanced Nationally Determined Contribution, as well as North Macedonia's candidate country status. Based on the Enhanced Nationally Determined Contribution, North Macedonia has set an ambitious target of 82 per cent net GHG emissions reduction by 2030 compared with 1990 levels. This corresponds to an absolute emissions reduction of 7.6 million tonnes CO₂-eq. in 2030 compared with business-as-usual (BAU). This shows that transition risks but also opportunities are the highest for this sector.

Coal power electricity production

Closure of thermal power plants (TPPs). Most of the electricity production in North Macedonia comes from coal, with significant GHG emissions. This means, within a reasonable timeline (probably by 2030), closure of two coal thermal power plants (TPPs), one located in Bitola (REK Bitola) and one in Kichevo (TEC Oslomej), as well as two mines: Suvodol and Brod-Negotino. Suvodol has enough coal for two years and Brod-Gneotino for ten years as currently operated. Altogether, the electricity production facilities and mines account for around 4,000 jobs, which can be lost if thermal power plants are closed. This would have a significant impact on the economy.

Higher temperatures and variations in rain patterns can reduce the efficiency of power plants, especially those that rely on water for cooling (all TPP rely on water for cooling). This can lead to reduced electricity output and increased operational costs.

Furthermore, as of 2026, electricity exports will be hit by the Carbon Measure Adjustment Mechanism (EU-CBAM), which will mean increased costs for electricity exports. As North Macedonia is a net importer of electricity, EU-CBAM will not have a significant direct impact on electricity production, but will have an indirect impact on other sectors (basic metals and cement production).

Hydropower

Hydropower still accounts for 70 per cent²² of the world's renewable generation capacity, a proportion that rises to more than 80 per cent in Europe, according to the International Renewable Energy Agency (IRENA). The sector thus has a key role to play in the implementation of the Paris Agreement.

Lower rainfall due to climate change can impact hydropower production in several ways:

1. **Reduced water flow:** hydropower relies on the flow of water to generate electricity. Lower rainfall means less water flowing into rivers and reservoirs, which directly reduces the amount of water available for hydropower generation.
2. **Decreased reservoir levels:** with less rainfall, reservoirs that store water for hydropower plants may not be replenished to their optimal levels. This can lead to a reduction in the amount of water that can be released for power generation, especially during dry seasons.
3. **Seasonal variability:** climate change can also lead to changes in the timing and intensity of rainfall. For example, earlier spring snowmelt and more intense but less frequent rain storms can disrupt the regular flow of water, making it harder to manage and predict hydropower production.
4. **Increased drought frequency:** more frequent and severe droughts can further strain water resources, leading to prolonged periods of low water availability for hydropower plants.

²² United Nations Framework Convention on Climate Change, "How Hydropower Can Help Climate Action," 21 November 2018, <https://unfccc.int/news/how-hydropower-can-help-climate-action>.

I.C Transition opportunities and their economic implications

Natural gas

Investments in transforming electricity production from coal to gas²³ can help reduce the acute pollution situation in Macedonia. Natural gas has long been regarded as a good stepping stone for a world looking to replace coal with renewable energy.

Natural gas is one of the mainstays of global energy. Where it replaces more polluting fuels, it improves air quality and limits emissions of carbon dioxide. The clearest case for switching from coal to gas comes when there is the possibility to use existing infrastructure to provide the same energy services but with lower emissions.

According to the United Nations, however, environment programme emissions of methane – the main constituent of natural gas – that occur during its extraction and transport mean that natural gas isn't as climate-friendly as was once thought. A long or slow transition away from other fossil fuels that requires lots of investment in gas infrastructure would make for a bad bridge. In many countries, natural gas has already replaced coal as the fuel of choice for electricity production, with climate and air quality benefits.

The rapid decrease in the cost of solar, wind and other renewable energy technologies makes these an even better alternative than gas in more and more locations. Where gas has a special role in the energy transition is as a back up to a renewable-based power system because gas boilers can be turned on almost instantly while starting up a coal-fired power plant takes much longer.

Given the time it takes to build up new renewables and to implement energy efficiency improvements, this also represents a potential quick win for emissions reductions. There is potential in today's power sector to reduce CO₂ emissions by up to 1.2 gigatonnes by switching from coal to existing gas-fired plants, if relative prices and regulations support it.

Switching between unabated consumption of fossil fuels, on its own, does not provide a long-term answer to climate change, but there can nonetheless be significant CO₂ and air quality benefits, in specific countries, sectors and timeframes, from using less emissions-intensive fuels.

According to the JSC ESM Macedonia investment plan²⁴ the thermo-power installation (REK Bitola 1) in Bitola will be adapted to use gas. The main prerequisite for the implementation of the project was bringing natural gas to the threshold of the Bitola Thermal Power Plant. At present, according to information from the NER, the branch of the gas pipeline

²³ International Energy Agency: The Role of Gas in Today's Energy Transitions, July 2019, <https://www.iea.org/reports/the-role-of-gas-in-todays-energy-transitions>.

²⁴ Sektor za razvoj i investicii [Sector for Development and Investments]. Капитални Проекти [Capital Projects]. AD ESM (Elektrani na Severna Makedonija), May 2022, https://www.esm.com.mk/wp-content/uploads/2022/01/20220622_Kapitalni-Proekti-ESM-mk-web.pdf.

network that runs to the Bitola Thermal Power Plant has a capacity of at least 40,000 Nm³/h. This creates the possibility of building a gas power plant with a capacity of 250MW (based on assumed efficiency).²⁵

Electricity

Opportunities in electricity production are clear: invest in renewables. However, we have identified more opportunities.

Hydropower

Hydropower electricity production can be increased through investment in new and **more efficient** plants. Hydropower is the most stable form of renewable production, as it does not depend on the sun or the wind (though the risk of lower rainfall is high). In the investment programme of the ESM²⁶ the biggest state-owned company for electricity production, the Cebren hydropower plant project, is assumed to possess possible production of 1,000 Gwh. The hydropower potential of Crna Reka for the production of electricity can be utilized immediately after Pelagoniska Kotlina, from the entrance to the canyon, in Marioski, all the way to the mouth of the river Vardar. Benefits from this project include: increasing the share of renewable sources in the production of AD ESM from 25 to around 45 per cent. North Macedonia has obligations to the European Union to meet the target for production from renewable sources in the energy balance, a target set and supported by all relevant institutions in the country. A reduction of CO₂ by around 200,000 t CO₂/year – (0.6674 t/MWh).

Solar

Investments in solar power plants. Based on the ESM investment programme, ESM in the medium term will invest in seven solar power plants around the country with a production capacity of 10–150 GWh.

One investment opportunity involves floating solar power plants or floating photovoltaics.²⁷ These are solar panel systems that float on water, rather than being fixed to land or buildings/roofs. They use the same kind of solar panels and inverter equipment to generate electricity from sunlight. In the ESM investment programme, four floating solar plants are expected to be constructed.

²⁵ Vasko Milevski and Vlatko Cingoski: "Floating Solar Power Plants – FSPP. Kozjak", in *Proceedings of the International Conference ZEMAK 2022*, pp. 197–204, ISSN 978-608-4764-14-4, <https://eprints.ugd.edu.mk/30911/1/2022%20-%201%20ZEMAK%20-%20Floating%20Solar%20Power%20Plants.pdf>.

²⁶ Sektor za razvoj i investicii [Sector for Development and Investments]. Капитални Проекти [Capital Projects]. AD ESM (Elektrani na Severna Makedonija), May 2022. https://www.esm.com.mk/wp-content/uploads/2022/01/20220622_Kapitalni-Proekti-ESM-mk-web.pdf.

²⁷ L. Micheli and D.L. Talaver: "Economic feasibility of floating photovoltaic power plants: profitability and competitiveness", in *Sciencedirect*, July 2023, <https://www.sciencedirect.com/science/article/abs/pii/S0960148123006250>.

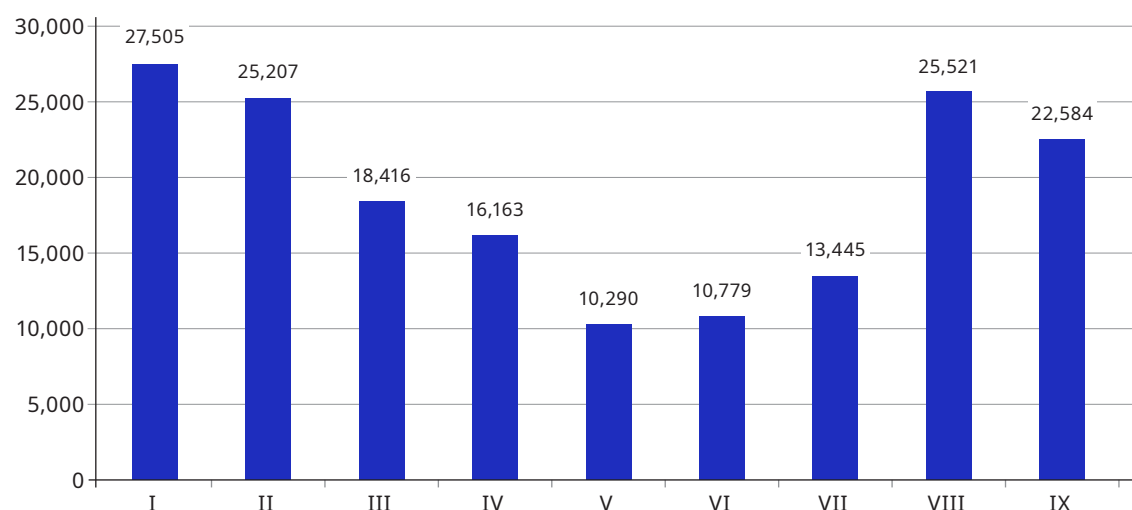
Wind

Investments in wind power plants. Based on the ESM investment programme, ESM in the medium term will invest in two wind power plants around the country, with production capacity of 10–150 GWh.

Energy efficiency

Investing in processes that save electricity is also another possibility. This involves implementing hybrid cooling systems that combine dry (air) and wet-recirculating cooling to limit water dependence and reduce electricity consumption. Finally, production of good insulation and well-positioned windows, paint on buildings and improved construction materials are great opportunities for lower electricity consumption.²⁸ The economic implications of all these investments are twofold: first, a reduction in greenhouse gas emissions and second a reduction in electricity imports (see Figure 17).

 **Figure 17. Electricity imports ('000 euros)**



Source: State Statistical Office.

²⁸ Aurore Julien: "Here Are 6 Science-Backed Ways to Keep Buildings Cool Without Air Conditioning", in *ScienceAlert*, 26 July 2019, <https://www.sciencealert.com/there-s-other-ways-to-keep-buildings-cool-without-energy-intensive-air-conditioning>.

Development of green hydrogen production

The development of green hydrogen production presents a significant opportunity for North Macedonia, in terms of both energy transition and economic growth.

Energy transition: Green hydrogen can play a crucial role in North Macedonia's transition to a low-carbon economy. By producing hydrogen through electrolysis using renewable energy sources, the country can reduce its reliance on fossil fuels and decrease greenhouse gas emissions.

Economic growth: The establishment of green hydrogen facilities can attract foreign investments and stimulate economic growth. For example, the partnership between Hydrogen Utopia International and TF Capital to develop a new hydrogen facility in North Macedonia reflects the country's potential as a strategic location for renewable energy projects.

Geothermal

Currently, geothermal energy in Macedonia is used primarily for heating and agricultural purposes, such as in thermal spas and greenhouses.²⁹ According to Popovska-Vasilevska and Armenski, geothermal energy has a wide range of possible applications, including agriculture, heating and electricity production. The authors also note that geothermal energy can contribute to reducing greenhouse gas emissions by providing a cleaner alternative to fossil fuels.

However, North Macedonia's potential for geothermal energy is still largely untapped, and most of the existing infrastructure supports traditional uses.

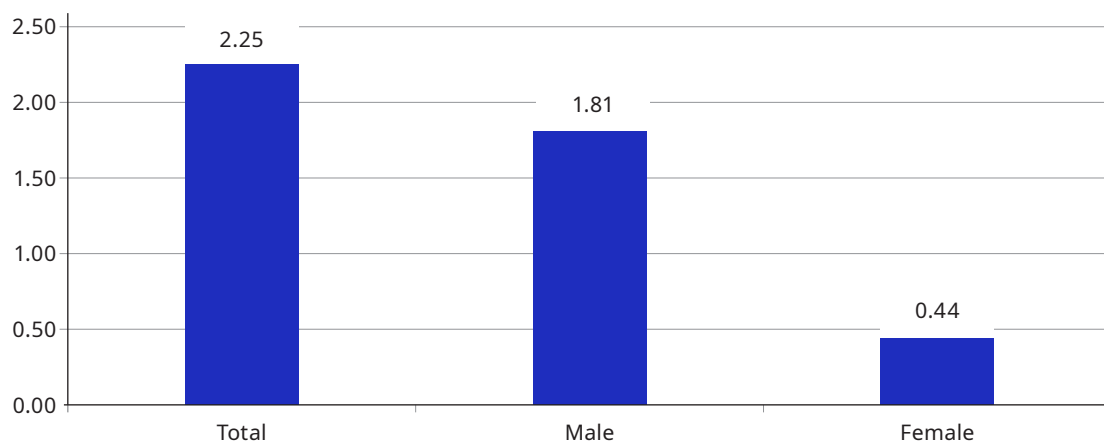
The Energy Development Strategy for the Republic of Macedonia up to 2030 and the Strategy for the Exploitation of Renewable Energy Sources in the Republic of Macedonia up to 2020 do not include any foreseen geothermal development as a prospective energy source for North Macedonia. Nevertheless, some private initiatives exist, which will probably influence changes in this sector in the near future.

²⁹ S. Popovska-Vasilevska and S. Armenski: "Geothermal Condition in Macedonia", in *Technika Poszukiwań Geologicznych Geotermia, Zrównoważony Rozwój* 55, no. 1 (2016), pp. 197–203.

I.D Physical climate risks and their effects on the labour market

Based on the available data, 2.25 per cent of total employment – around 8,900 people – in North Macedonia is in electricity, gas, steam and air conditioning supply.

 **Figure 18. Employment in electricity, gas, steam and air conditioning**



Source: State Statistical Office.

As can be seen in Figure 18, as regards gender distribution, most of the workers in this sector are male (1.8 percentage points), while female workers account for 0.45 percentage points (around 1,924 workers).

Electricity production is most vulnerable to physical climate risks, such as extreme weather events, rising temperatures and floods. These risks can disrupt production and damage infrastructure, and thus may have a negative effect on the labour market by reducing employment.

Extreme weather events can cause temporary shutdowns of production facilities, resulting in job losses and reduced working hours for employees. Extreme weather conditions may damage the electricity infrastructure, thus directly reducing employment in electricity production.

Water supply also impacts electricity production processes (as water is necessary for cooling). Thermal power plants, such as coal-fired plants, use water for cooling purposes to condense steam back into water after it has passed through the turbine. As rainfall is expected to decrease, thermal power plants may face outages, thereby reducing employment.

However, the indirect effect on the labour market will be worse if there are electricity production outages. First of all, most of North Macedonia's electricity will have to be imported, meaning higher electricity bills for companies, and thus lower wages and possible layoffs. Finally, if electricity is not available on the free market, the consequences will be very severe for the economy and the labour market as well.

I.E Transition risks and their effects on the labour market

The greatest transition risk for North Macedonia's labour market is in energy production (coal power generation), with possible job losses. Closure of thermal power plants and mining will probably have a significant impact on employment, inequality and poverty (if not properly addressed) as the Government has committed to significant reductions in greenhouse gas emissions in the NDC.

According to Perevski (2023) if the thermal power plant in North Macedonia is closed employment and unemployment rates are likely to deteriorate in similar magnitudes in both regions: the employment rate would decline by 0.9 to 1 percentage point (p.p.), while unemployment would increase by 1.7 p.p. in Pelagonija region and to 1.9 p.p. in the Southwest region. These magnitudes are not negligible, even though based on a strong and rather unrealistic assumption that everybody would transit to unemployment. The broader local economy would also be impacted to a non-trivial extent by potential TPP closures in both regions. Appreciation of the economic importance of the TPPs, particularly by TPP workers, is accompanied by strong local resistance to their closure. So, the risks are high if not properly managed.

To enable a just transition, in June 2023 the Government of North Macedonia adopted the Just Transition Roadmap, tackling development pathways during the transition, with a special focus on the two coal-dependent regions, Pelagonija and the Southwest. Given that coal-dependent regions face structural labour market challenges – including the coal-income trap, low activity and high unemployment – the Roadmap calls for an integrated approach to the transition. The total cost of the proposed Just Transition Roadmap actions ranges from €29.4 million to €44.6 million annually, depending on the mix of technology and policy drivers for emissions reduction.



Meeting with social partners

During the meeting with the social partners, union representatives expressed their highest concerns regarding the future of the large state-owned companies that produce electricity from coal and operate coalmines. They estimate that a significant number of employees will face layoffs, necessitating severance payments from the state. According to the social partners, the funds allocated for severance payments in the Just Transition Roadmap are insufficient to meet the needs of the affected workers.

Additionally, they highlighted the potential social and economic impacts of such mass layoffs on local communities, emphasizing the importance of retraining programmes and job creation initiatives to support workers in transitioning to new employment opportunities. The union representatives called for a more comprehensive approach to ensure a fair and equitable transition for all stakeholders.

I.F Transition opportunities and their effects on the labour market

However, transition risks can (if properly managed) also create opportunities. In our desk research, and in discussions with social partners, we tried to map the opportunities for the Macedonian economy as the value added of this project. The transition to a low-carbon economy is expected to create approximately 10,000 green jobs by 2035 in North Macedonia. These jobs will be in sectors such as energy efficiency, renewable energy systems and sustainable construction. This includes roles in engineering, construction and technical support.

According to the ESM investment programme hydropower plants should be constructed in the coming years. The opportunities such a project would open up include: the employment of around 1,700 people during the construction of the Cebren HPP, and direct benefits for 65,000 people from the electricity produced and indirect benefits for over 2,000,000 people (even in neighbouring countries) from peak load and balancing.

New renewables power plants (solar power plants, wind power plants) will probably open up more than 10,000³⁰ new jobs in the environmental sector (green jobs, most of them high skilled), as well as project management and maintenance.

In terms of skill development, the transition will necessitate the development of new skills and training programmes to equip workers with the knowledge required for jobs in the renewable energy sector. This includes vocational training and education in green technologies.

Job creation in the gas sector: the shift to natural gas can create new job opportunities in the construction, operation and maintenance of gas-fired power plants. This includes roles in engineering, technical support and infrastructure development.

Based on the ESM Investment Programme, ESM plans to invest in two wind power plants in North Macedonia in the medium term, each with production capacity ranging from 10 to 150 GWh. A key highlight of this initiative is the creation of new high-skilled job opportunities, particularly for engineers, in the wind power sector. This investment aims not only to boost renewable energy production but also to foster a highly skilled workforce that can drive innovation and sustainability in the energy industry.

The development of green hydrogen production presents a significant opportunity for North Macedonia, in terms of both energy transition and economic growth. This new sector for Macedonia is expected to boost local employment, offering new jobs and training opportunities as the facility is constructed and becomes operational. This venture will also put North Macedonia on the map as a significant player in the hydrogen industry, potentially attracting further investments in renewable energy.

³⁰ Republic of North Macedonia. Long-Term Strategy on Climate Action and Action Plan: Executive Summary. Ministry of Environment and Physical Planning, 2021, https://unfccc.int/sites/default/files/resource/MKD_ES_LTS_Nov2021.pdf.

I.G Physical climate risk and their effects on poverty and inequality

Mapping the risks from climate change on poverty and inequality is an additional value added for this project. According to the World Bank Country Climate Development Report, de-carbonization is expected to raise electricity prices, and North Macedonia already has a high energy poverty rate. Households in the lowest income quintile spend more than 16 per cent of their per capita income on energy. Younger households, female-headed households, urban households and pensioners tend to spend more on energy.

The following physical risks may affect poverty and inequality in North Macedonia.

Rising temperatures pose significant physical risks to electricity production from fossil fuels, which in turn can exacerbate poverty and inequality.

- **Reduced efficiency:** higher temperatures can reduce the efficiency of power plants, particularly those that rely on cooling water. This can lead to decreased electricity output and increased operational costs.
- **Increased cooling demand:** as temperatures rise, the demand for cooling increases, putting additional strain on power plants and the electricity grid
- **Infrastructure damage:** extreme heat can damage infrastructure, such as power lines and transformers, leading to power outages and increased maintenance costs.

Variabilities in participation patterns can cause flooding, which can damage infrastructure, disrupt fuel supply chains and lead to power outages. Furthermore, inconsistent precipitation patterns can create operational challenges for power plants, leading to reduced efficiency and increased maintenance costs, hence influencing employment and poverty.

I.H Transition risks and their effects on poverty and inequality

Given the physical and climate risks that have already been identified mapping the transition risks is essential in order to properly address the consequences and challenges ahead. This is another added value of the present project. Transitioning from coal to renewable energy sources involves several risks that can affect poverty and inequality. We take a detailed look at (map) these aspects, including the impact of the Carbon Border Adjustment Mechanism (CBAM), greenhouse gas (GHG) emissions reductions, and consumer preferences for cheaper energy from renewables.

Economic disruption: The transition (if not properly managed) can lead to job losses in coal-dependent regions, affecting local economies and increasing poverty levels. Workers in the coal industry may face unemployment or need to retrain for new jobs in renewable energy sectors.

Closure of such facilities is indeed on the road map for North Macedonia. Perevski (2022) estimates that the poverty rate will increase by as much as 1.7 p.p. in Pelagonija and 1.5 p.p. in the Southwest. Given that poverty has not been falling in North Macedonia in the past couple of years (due to multiple crises), further aggravations may be fairly dramatic, and the job and income losses from potential TPP closures may scar the relevant regions if not properly managed.

Furthermore, the household incomes of TPP workers tend to be higher than average in the two regions. Such households are likely to be overdependent on such incomes, in contrast to households with a broader range of income streams, including social incomes. Loss of job and income from employment in TPPs may thus severely affect the relevant households.

High electricity prices may be another big transition risk with severe consequences for poverty. As production from fossil fuels is very expensive, Energy poverty may persist as long as a substantial portion of electricity production comes from fossil fuels, creating financial strain for households.

State statistical data show that in North Macedonia, among the active population, poverty is slightly higher among men than among women. The companies that are expected to close have predominantly male workforces. An increase in unemployment among the male population is thus a major transition risk, and thus, if not properly managed, an increase in male poverty. Poverty before social transfers and pensions will increase as well (again, if not properly managed). Finally, reskilling older employees poses challenges because of their limited familiarity with modern technology, which potentially could lead to a rise in poverty among the older male population.

I.I Transition opportunities and their effects on poverty and inequality

Identifying and mapping opportunities within Macedonia's energy sectors to address poverty and promote sustainable development is another crucial focus of this project. The transition to renewable energy in North Macedonia presents significant opportunities to alleviate poverty and reduce inequality. Job losses are likely to be substantial, but job gains can outstrip these losses. By creating approximately 10,000 green jobs by 2035 in sectors such as energy efficiency, renewable energy systems and sustainable construction, the shift can provide stable and well-paying employment for many people. These jobs, including roles in engineering, construction and technical support, can help to uplift economically disadvantaged communities and provide them with a pathway out of poverty. The ESM investment programme's focus on hydropower plants, including the construction of the Cebren HPP, offers further employment opportunities. This project not only provides immediate job opportunities but also ensures long-term energy security and affordability, which can help to reduce energy poverty and improve living standards.

The development of new renewable power plants, such as solar and wind power, is expected to create more than 10,000 new jobs in the environmental sector. These high-skilled jobs, along with opportunities in project management and maintenance, can contribute to a more equitable labour market by offering training and development programmes. Vocational training and education in green technologies will equip workers with the necessary skills to thrive in the renewable energy sector, fostering economic mobility and reducing income inequality. Additionally, investments in green hydrogen production represent a significant opportunity for local employment and economic growth in North Macedonia. By boosting local employment and attracting further investments in renewable energy, the country can establish itself as a key player in the hydrogen industry. This development will not only provide new jobs and training opportunities, but also contribute to the overall economic prosperity of the region, ensuring that the benefits of the transition to renewable energy are widely shared and inclusive.

As regard to a gender analysis, new jobs in the energy sector will predominantly favour the male population. Thus, if properly managed, a reduction in male poverty can be expected. Furthermore, as newly created jobs may be better paid than the traditional jobs in TPP plants and mining, poverty before social transfers and pensions will be reduced.

If transition opportunities are properly managed, they have the potential to significantly reshape the socioeconomic landscape of North Macedonia. Through targeted investments in renewable energy and green industries, the country can tackle long-standing issues such as unemployment, poverty and inequality, especially in the regions there is electricity production from coal. In the long run, the transition to renewable energy can also reduce energy poverty and inequality by ensuring affordable and reliable access to energy, improving the quality of life for all. Finally, new skills will be required, details of which are presented in the summary table (Table 4).

 **Table 4. Summary of physical climate and transition risks and their effects on the labour market (electricity/energy production)**

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Physical climate risks	Variations in precipitation patterns	Reduction in hydropower capacity Increase dam capacities – Construction of two large projects – Cebren and Galishte Key driver Long-term Strategy for Climate Action and Action Plan	Reduction in labour demand for hydropower workers onsite as well as offsite (in technology development and construction) Around 1,700 new direct jobs and 65,000 people working indirectly	Expertise in dam construction engineering; understanding of safety regulations for dam environments; preventive maintenance techniques for dam efficiency improvements
	Rising temperatures	Threat to cooling capacities of power-generating stations Introduce hybrid cooling systems that combine dry (air) cooling and water circulation cooling to limit water dependency	Reduction in labour demand for technology development, regulatory affairs and construction Increase in demand for labour in hybrid cooling systems	Skills in engineering: understanding cooling systems: familiarity with components like radiators, water pumps, thermostats, and cooling fans Thermal management: knowledge of how to maintain optimal operating temperatures for hybrid systems
		Wind power generation could degrade during heatwaves, because they are designed for conditions around 25°C	Increase in demand for maintenance and repair workers	Mechanical knowledge: understanding the mechanics of wind turbines, including gearboxes, rotors and nacelles Hydraulics: familiarity with hydraulic systems used in turbine operations
		Increased demand for electricity during hotter summers – infrastructure allure	Increase in demand for maintenance and repair workers	Skills in data analysis: ability to analyse consumption patterns and predict peak demand periods; forecasting: skills in using predictive models for estimating future electricity needs

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Green economic transition		Closure of thermal power plant REK Bitola and substantial decarbonization. Main drivers: Enhanced NDC, Just Transition Roadmap – paths forward EU accession	Significant job losses and poverty and inequality increase (if not properly managed)	Skills improvements needed in non-formal education – based on Just Transition Roadmap
	EU-CBAM	Increased carbon pricing as the electricity sector is the highest contributor of GHG emissions. Key drivers: CBAM, regulatory changes	Possible job losses in traditional production Increased need for engineering workers, for development and use of new improved low carbon technologies	Engineering knowledge: Software skills: familiarity with simulation tools and software for designing and optimizing low-carbon solutions. Material science: understanding of sustainable materials and their applications in low-carbon technologies.
	Consumer behaviour	Consumer preference towards renewable energy reduces demand for fossil fuel-generated electricity	Possible job losses in traditional production of electricity More demand for high skilled jobs in renewable energy	Proficiency in renewable energy systems, energy storage, and carbon capture technologies.

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Green economic transition (continued)	GHG emissions reduction	Expand solar and wind power capacity to compensate for loss of hydropower capacity Key drivers: National Energy and Climate Plan and Long-term Strategy for Climate Action and Action Plan	Employment of highly skilled labour, engineers – increase in average wages in the industry	Knowledge of preventive maintenance practices in solar power systems, Repair and replacement techniques for renewables
		Threat to the cooling capacities of power plants Implement hybrid cooling systems that combine dry (air) and wet recirculating cooling to limit water dependence	Lost jobs in traditional cooling systems Employment of highly skilled labour – engineers in hybrid cooling systems	Knowledge of cooling system components; system testing procedures
		Decarbonization of electricity production Shift to natural gas Key driver: Long-term Strategy for Climate Action and Action Plan	Employment in construction of pipelines New jobs in biogas power plants	Skills in selective collection and sorting, installation of gas production plants, storage, transport and distribution
		Introduction of hydrogen production in North Macedonia	New jobs in hydrogen production – highly skilled jobs	Skills in integrating hydrogen production with renewable energy sources such as solar and wind. Process optimization: Ability to improve efficiency in hydrogen production methods



II. Agricultural and food industry

► II. Agricultural and food industry

II.A Physical climate risks and their effects on the economy

Based on FAO data on temperature changes on land in 2023, the Earth recorded its hottest land and sea surface temperatures in that year.³¹ Climate change continues to exacerbate the intensity of global temperatures, along with the likelihood of other extreme events such as droughts, hurricanes and floods. All this will impact global agricultural production and trade patterns.

The identified climatic risks have significant implications for the overall economy and its key sectors. Among these, the agricultural sector is particularly vulnerable to climate events because of its dependence on specific environmental factors, notably regular rainfall patterns and adequate temperatures.

According to the Ministry of Agriculture, it is estimated that out of North Macedonia's arable agricultural area of about 577,000 ha, irrigation is currently provided to about 400,000 ha, that is, 69 per cent of the total arable area. Because a major part of agricultural land is not irrigated extreme weather conditions can cause significant damage to the agricultural sector.

Floods, droughts and wildfires pose significant threats to the sector. As agriculture is significant to the Macedonian economy, contributing over 7 per cent of GDP, it is important to understand the effects that physical climate risks pose for the sector.

Though the country is well suited to growing a wide variety of products, including most Continental and Mediterranean crops, the agriculture sector and related rural economic activities are particularly vulnerable to changes in climate. According to the Climate Risk Profile Fact Sheet prepared by USAID, in an average year evapotranspiration is higher than rainfall, and prolonged heat waves and dry periods in 2008 and 2012 led to significant production losses. Crop modelling in the Southeast region of the country predicts a dramatic shift in the growing season for wheat and maize, with 21 and 56 per cent decreases in yield, respectively, by 2025, which could cause reduced human and livestock nutrition. Lower yields reduce labour demand in affected crops.

As water resources are expected to diminish by around 5 per cent on average (especially in the summer months, when the decrease is expected to be 17 per cent), water resource availability will affect crop yield. Regions in East and South Macedonia will experience even higher water shortages. Survey participants also responded that they expect reductions in water availability.

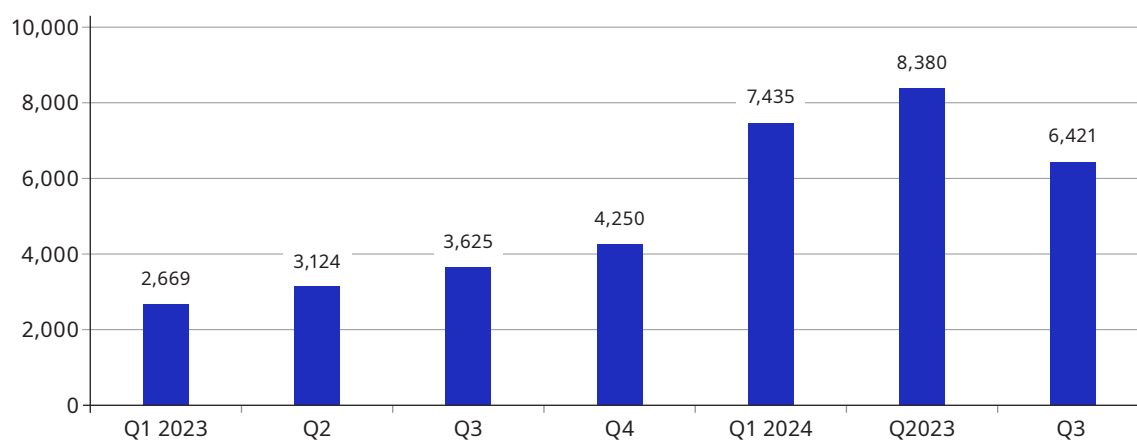
The country also suffers from severe erosion, affecting approximately 44 per cent of the country. This is mainly because of poor land management, but climate change, particularly

³¹ Temperature Change Statistics 1961–2023: Global, Regional and Country Trends. FAOSTAT Analytical Briefs No. 84, Rome, 2024, <https://openknowledge.fao.org/items/77168e8e-7eb0-4653-80e3-cdbb4b547c93>.

potential increases in extreme weather events, could lead to increased risk of erosion. Wildfires make this problem even worse.

The food industry, globally, is severely affected by climate change. West Africa, which produces about 80 per cent of the world's cocoa, has been particularly affected, causing the price of cocoa to increase by 78 per cent (Q3-2024/Q3-2023 – see Figure 19). According to a representative of the food (chocolate) industry in Macedonia (Vitaminka Prilep), the chocolate price will increase significantly in 2025, which means that producers will have higher costs and earn more, and consumers will pay and consume less.

 **Figure 19. Price of cocoa**



Source: International Cocoa Organization (ICCO)

II.B Transition risks and their effects on the economy

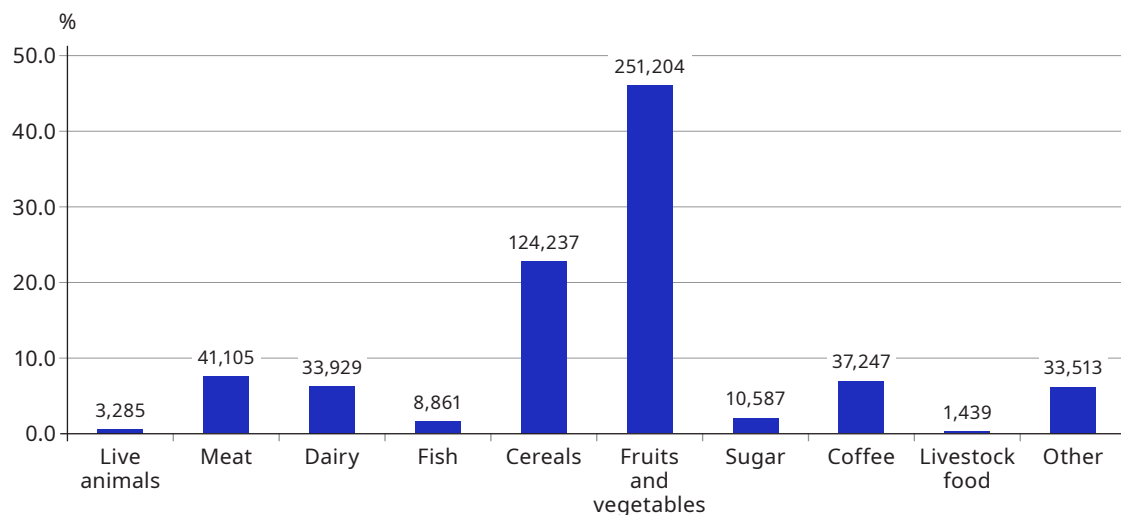
The main driver of the transition in the agricultural sector is the Enhanced Nationally Determined Contribution (NDC), as well as the Long-term Strategy for Climate Action and Action Plan.

In the field of agriculture, the transition measures envisaged in the Action Plan are as follows:

- Reduction of CH₄ emissions from enteric fermentation in dairy cows by 3 per cent.
- Reduction of NO₂ emissions from manure management on pig farms by 13 per cent.
- Reduction of N₂O emissions from dairy cow manure by 20 per cent on farms of under 50 units of cattle.
- Establishment of integrated forest fire management.
- Afforestation – conversion of land use to agricultural crops on sloping terrain (above 15 per cent).
- Contour processing of areas under agricultural crops on sloping terrain (5–15 per cent).
- Perennial grass in sloping orchards and field vineyards (>5%) Use of biochar as a charcoal sink.

As shown in Figure 20, agricultural exports in Macedonia are composed predominantly of fruit and vegetables, followed by cereals, meat and dairy products.

 **Figure 20. Food exports from Macedonia**



Source: State Statistical Office.

In our desk research, and in discussions with social partners, we mapped the risks facing Macedonian agriculture and potential production losses.

According to FAO, fruit and vegetable production will suffer less than other cultures, if appropriate measures are taken. This is important for economic policymakers, as fruit and vegetables that are more climate-change resilient make up a large part of agricultural production in Macedonia.

According to USAID, however, crop modelling in the Southeast region of the country predicts a dramatic shift in the growing season for wheat and maize, with 21 and 56 per cent decreases in yield, respectively, by 2025. This could reduce human and livestock nutrition. This will cause a decrease in Cereals exports from North Macedonia during the transition period.

Regarding meat production and exports, based on FAO projections in Europe, although consumption of meat is likely to increase by 12 per cent, and poultry production will increase slightly, pig production will decline. According to USAID, if measures are not taken, increased temperatures may also increase exposure to livestock pests and diseases.

If not managed properly, the reduction of NO₂ emissions from manure management on pig and cow farms will have negative consequences for livestock farming in North Macedonia.

Exports of fertilizers will be impacted as well. In 2023, Macedonian exports of fertilizers amounted to €56 million or 0.7 per cent of total exports. The CBAM tax will have to be paid on fertilizer exports, and thus during the transition period this will have a negative impact on production and exports.

Finally, during the transition period, changes in working hours should be implemented and work during periods of extreme temperatures should be avoided.

II.C Transition opportunities and their economic implications

Transition opportunities for Macedonian agricultural production are substantial. We have mapped them and divided them into the following groups:

- irrigation,
- heat-reducing technology,
- water management,
- diversification challenges,
- financial support through subsidies.

Irrigation

Irrigated agriculture is, on average, at least twice as productive per unit of land as rain fed agriculture, thereby allowing for more production intensification and crop diversification. Advanced irrigation practices³² are a great investment opportunity for the Macedonian agricultural sector.

Advanced irrigation management practices encompass a spectrum of strategies aimed at maximizing the efficiency and effectiveness of water use in agriculture. These practices involve the careful consideration of factors such as soil moisture, crop water needs and weather conditions to optimize irrigation scheduling and minimize water loss through runoff, evaporation and leaching.

Key components of advanced irrigation management include:

- utilizing moisture sensors and weather stations to monitor soil moisture levels and weather forecasts;
- employing crop growth stage-based irrigation scheduling to match water application with crop water needs throughout the growing season;
- implementing efficient irrigation system designs, such as drip irrigation and sprinkler irrigation, to deliver water directly to the root zone while minimizing water loss to evaporation and runoff.

³² FarmRaise: "Advanced Irrigation Management for Farming", 6 November 2024, <https://www.farmraise.com/blog/advanced-irrigation-management-for-farming>.

Heat-reducing technology

Introducing heat-reducing technology is another opportunity for agricultural producers. This will include:

- portable shade structures, and
- hydration systems with temperature controls.

Water management

Record-breaking floods and droughts in recent years, with cascading impacts on societies across the world, bear witness to growing climate change-induced disruptions in the water cycle. This means that better water management, through integrated water resource management (IWRM), and climate adaptation planning will be crucial to maintaining stable and prosperous societies.

Combining IWRM with climate change adaptation can enhance resilience and reduce climate impacts on the water cycle. This approach can help to maintain stable and prosperous societies by ensuring sustainable water use and management.³³

Diversification challenges

Expansion of crop varieties, investment in climate-resilient crops and advanced irrigation systems represent the biggest opportunity for the agricultural sector.

When it comes to diversification³⁴ of agricultural practices to include a wider range of resilient crops Shafrill et al. (2020) analyse crop diversification and a variety of relevant practices: early maturity crops, use of drought tolerant crops, abandoning crops and introduction of new crops. Furthermore, soil and water conservation techniques and use of organic/inorganic fertilizers and water harvesting, irrigation and drainage provide great opportunities for the agricultural sector.

The economic implications of the agricultural opportunities we have discussed, if properly managed and supported by government, are considerable for North Macedonia, as a major producer of fruit and vegetables.

Financial support through subsidies

Currently, agricultural subsidies are paid based on the quantity of the agricultural product produced. Low value added plants (such as tobacco) are heavily subsidised.

³³ United Nations Environment Programme: "Where Water Management Meets Climate Change Adaptation to Boost Resilience", 4 November 2022, <https://www.unep.org/technical-highlight/where-water-management-meets-climate-change-adaptation-boost-resilience>.

³⁴ "Diversification of Agriculture Practices as a Response to Climate Change in the Western Balkans: A Systematic Review", *Climate Services* 33 (2024), 100363.

The EU links the bulk of income support for farmers to two main criteria.

- Farmed hectares, not the quantities produced. Farmers have to respond to market demand in order to increase profit. Decoupling (delinking) payments from the quantity produced helps to avoid overproduction.
- Respect for the environment, plant health, and animal health and welfare, contributing to sustainable agriculture. This was referred to as 'cross compliance' up to 2022 and as an enhanced "conditionality" in the CAP 2023–2027. Farmers not complying with EU rules can see their payments reduced or stopped entirely.

Decoupling subsidies will encourage Macedonian farmers to switch to climate resilient crops.

Discussions with social partners and survey results

The representative from Socotab, the company producing hazelnuts for Nutella, showcased their investments aimed at achieving more climate-resilient production. These investments include the implementation of a state-of-the-art drip irrigation system and advanced temperature control mechanisms. Additionally, the representative emphasized that demand for hazelnuts is on the rise, presenting a substantial agro-business opportunity. However, the representative cautioned that this potential can be fully realized only if production processes are managed efficiently and designed to adapt to emerging opportunities and climate challenges.

Moreover, they highlighted the importance of sustainable practices in ensuring the long-term viability of hazelnut farming. By integrating innovative technologies and adopting climate-smart agriculture techniques, Socotab aims to enhance productivity and resilience against climate variability. The representative also mentioned that the company's efforts align with global sustainability goals, contributing to both local economic development and broader environmental benefits. They concluded by encouraging other stakeholders in the agro-business sector to adopt similar practices to harness the growing demand and create a sustainable future for the industry.

The representative from Vitaminka Prilep emphasized the importance of recycling as a critical process for mitigating transition risks. They highlighted the necessity for both companies and local municipalities to enhance their waste management practices. Improving waste management systems is essential for ensuring sustainable operations and reducing environmental impact.

The representative also pointed out exemplary waste management and landfill practices in Slovenia, which could serve as a model for North Macedonia. Slovenia's approach to waste management includes advanced recycling programmes, effective waste segregation and efficient landfill operations. These practices have significantly reduced waste generation and improved overall environmental sustainability.

Survey respondents confirmed that Macedonian agricultural producers are not prepared for climate change.

II.D Physical climate risk and their effects on the labour market

Mapping labour market risks in relation to workforce dynamics is essential for effectively addressing these challenges and fostering economic resilience. With over 87,000 people or 11.1 per cent of the country's labour force in agriculture, the physical climate risks to the sector have a direct impact on the labour market. As already mentioned, crop modelling (USAID) predicts a dramatic shift in the growing season for wheat and maize, with 21 and 56 per cent decreases in yield, respectively. Lower yields reduce labour demand in affected crops.

Productivity has also been impacted by climate change, particularly the increasingly frequent droughts which lead to reductions in yields, undermining the livelihoods of farmers and exacerbating existing socio-economic disparities in the country. Increased temperatures will decrease labour productivity, particularly in heat-exposed work for activities such as harvesting, planting and pruning, especially for crops grown in regions like the Southeast (Strumica) and the Southwest (Pelagonija).

Furthermore, extreme weather events such as floods and storms can damage crops and infrastructure, leading to additional financial losses for farmers and further reductions in labour demand. These events can disrupt supply chains, making it difficult for farmers to transport their produce to market and leading to post-harvest losses. The combined effect of lower yields and disrupted supply chains can create a volatile agricultural sector, making it harder for farmers to plan and invest in their businesses.

The increasing variability of weather patterns also poses a risk to agricultural workers, as unpredictable conditions can lead to uncertain work schedules and income instability. This can make it difficult for agricultural labourers to sustain their livelihoods, pushing them into poverty and exacerbating inequality. To mitigate these risks, it is essential for policymakers to invest in climate-resilient agricultural practices and infrastructure, such as drought-resistant crop varieties, efficient irrigation systems and improved weather forecasting.

In addition, providing training and support for farmers to adopt sustainable farming practices can help to enhance their resilience to climate change. Diversifying income sources through agroforestry, livestock rearing, and other complementary activities can also provide a buffer against the adverse effects of climate change. By addressing these challenges proactively, North Macedonia can protect its agricultural sector and ensure a more stable and secure labour market for its agricultural workers.

Discussions with social partners and survey results

Survey participants, along with a representative from the Organization of Employers of Macedonia (Socotab), confirmed that they do not expect labour layoffs as a result of climate change if the current business-as-usual (BAU) model persists. In their opinion, in the short run, companies will be able to retain the current workforce and maintain their operations without a reduction in profitability. However, they acknowledge that in the long run, the situation may change, and they cannot guarantee that there will be no layoffs.

They further explained that, while the immediate future seems secure, long-term uncertainties remain, particularly as climate change continues to pose challenges. The evolving regulatory landscape and market pressures may necessitate workforce adjustments, and companies may need to adapt their business strategies to stay competitive. This could involve re-skilling employees, adopting new technologies, or even exploring alternative business models to ensure sustainability and resilience in the face of climate change.

II.E Transition risks and their labour market implications

Analysing and mapping labour market risks in connection with workforce dynamics is important for tackling these challenges effectively and building a resilient economy.

In North Macedonia, when the transition measures envisaged in the Long-term Strategy on Climate Action and Action Plan have been completed (although it is an ongoing process), the chances are very high that many agricultural workers will exit the agricultural sector.

The main risk is lower agricultural yields, which *will reduce labour demand* in affected crop production. We have mapped the following transition risks:

- Job displacement: workers involved in traditional farming practices may lose their jobs as the sector adopts more sustainable and automated methods.
- Skill mismatch: the transition to climate-resilient and sustainable agriculture requires new skills, such as knowledge of precision farming or sustainable irrigation techniques.
- Policy changes: stricter environmental regulations may impact employment in certain agricultural activities, especially those with high carbon footprints.
- Market shifts: changes in consumer preferences towards sustainable and organic products can disrupt traditional agricultural markets.
- Economic inequality: regions heavily dependent on traditional agriculture may face economic challenges, requiring targeted support to ensure a just transition.

- Lack of funding for transition policies: in agriculture, the opportunities that have been identified show a need for more investments in irrigation systems, resilient crops, water management and the circular economy.
- Regulatory risks: **carbon pricing** – increasing carbon prices can raise production costs for farmers, especially those relying on fossil fuels for machinery and transportation.

Policy restrictions: governments may implement policies to limit greenhouse gas emissions, such as restrictions on certain farming practices or the use of specific fertilizers and pesticides.

Discussions with social partners and survey results

During discussions with the social partners, the following risks to the labour market in North Macedonia were highlighted:

- **Lack of funds:** they emphasized the urgent need for additional funds to be provided by the government for irrigation systems, resilient crops and agricultural equipment. Without these funds, the agricultural sector may struggle to sustain productivity and growth.
- **Limited access to agricultural input materials:** the availability and quality of essential agricultural input materials, such as seeds and the capacity to produce, store and utilize them, are limited. This issue is particularly pronounced among small farmers, who lack the resources to access high-quality inputs, thereby affecting their productivity and competitiveness.
- **Lack of skills in agriculture:** there is a notable deficiency in agricultural skills, especially regarding the production of resilient crops. This skills gap hampers the ability of the agricultural workforce to adopt and implement modern, climate-resilient farming practices.

If these risks are not properly managed, they will have a detrimental impact on the labour market in the agricultural sector of North Macedonia. The lack of funding, limited access to inputs and inadequate skills can lead to decreased productivity, lower income for farmers and potential job losses.

II.F Transition opportunities and their labour market implications

As employment opportunities increase outside agriculture, the rural labour market is undergoing changes, leading to an increase in real wage rates for both farm and non-farm rural labour. This shift has serious implications for the farming sector, including a scarcity of hired labour for various farm operations and a diminishing interest among young people in working in agriculture. Urgent changes are needed that allow farmers to adapt and develop while also being climate resilient and minimizing emissions. Stringer et al. (2020)³⁵ have identified several illustrative adaptation and development pathways, and exiting from the agricultural sector is one of them. They elaborate on measures, recognizing the variety of starting points of different types of farmers and the ways their activities intersect with global trends, such as population growth, climate change, rapid urbanization dietary changes, competing land uses and the emergence of new technologies. In North Macedonia, the transition to sustainable agriculture requires a more serious commitment, with financial support and policy measures to address the challenges and promote rural development. The following opportunities in job creation are envisaged:

- jobs in climate-smart farming practices, training, and development;
- jobs in R&D in the development of resilient crops;
- jobs in the development, production, distribution, and application of organic and eco-friendly fertilizers and agriculture products;
- opportunities in precision agriculture, including the use of drones, sensors and AI for monitoring and optimizing farming operations;
- jobs in integrating renewable energy solutions, such as solar-powered irrigation and biogas production, into agricultural practices;
- demand for educators and trainers to upskill workers in sustainable and technological farming methods.

In the agriculture and food production sector, new jobs are expected in R&D for developing resilient crops, hardware installation and maintenance jobs for irrigation systems and farmers specializing in growing alternative crops. Additionally, new jobs are expected in the development, production, distribution and application of organic and eco-friendly fertilizers. Finally, jobs are expected to be created in the design, manufacture, marketing and distribution of eco-friendly packaging for agricultural products.

The opportunities identified may face some risks. We have identified several risks that may jeopardize transition opportunities. They include:

- high investment costs;

³⁵ Author(s): "The Role of Renewable Energy in the Energy Transition in the Western Balkans: A Review of the Current State and Future Directions", *Environmental Science & Policy* 109 (2020): 1–11, <https://www.sciencedirect.com/science/article/pii/S1462901119305209>.

- low land ownership;
- a reluctance to produce new crops;
- a lack of agro-economics and agro-engineering knowledge.

II.G Physical risks and their implications for poverty and inequality

Poverty and inequality fell significantly during the decade preceding the Covid-19 pandemic. The poverty rate (US\$6.85 per day in 2017 in purchasing power parity terms) decreased from approximately 41 per cent in 2009 to about 19 per cent in 2019, with over 440,000 people lifted out of poverty in a decade. The decline in poverty was driven by strong growth in the incomes of those in the bottom 40 per cent of the distribution, particularly labour earnings, and pensions.

As the agricultural sector employs 11 per cent of the workforce in Macedonia, climate change may have significant negative effects on agricultural production and employment in the sector, thus increasing poverty if not properly addressed.

Based on World Bank estimates, the Polog region has one of the highest poverty rates in North Macedonia. The agricultural sector is a significant part of the local economy, and climate change impacts, such as droughts, extreme temperatures and floods, exacerbate poverty levels. The physical risks that we mapped for poverty in North Macedonia are as follows:

- Climate change may lead to water scarcity, temperature variations, intense droughts, severe fires and flooding. These factors reduce agricultural yields and damage crops, affecting food security and the livelihoods of the rural population, thus increasing poverty.
- Exposure to heat and other extreme weather conditions, more pesticide exposure because of an increase in pests and degraded air quality may significantly exacerbate poverty. Higher temperatures and resulting heat stress affect farmworker safety and productivity, which can affect earnings and their own food security.
- Health insurance is provided for agricultural workers in North Macedonia, so health care access is not an issue. However, hospital capacities are limited, and climate change, together with increased poverty, will impose a heavier burden on hospitals.

Regarding gender disaggregation, there were 452,000 poor people living in North Macedonia according to Eurostat. The distribution of poverty is equal – there were 225,000 male poor and 226,000 females. Male employment in the agricultural sector makes up 5 per cent of total employment, while women in agriculture account for 2.8 per cent of total employment, so men are in more danger of losing their jobs and falling into poverty.

Poverty data in Macedonia are not disaggregated by sector (NACE 2), so the specific impact on poverty in agriculture cannot be presented.

II.H Transition risks and their implications for poverty and inequality

Despite recent progress, more than 395,000 people were living in poverty in 2019, and about one-third of the population remained at risk of poverty if hit by a shock. Rural areas and the country's northern regions (Polog and Northeast, where three out of four people live in poverty) are at particular risk. In light of the physical and climate risks that have been identified, it is essential to map the transition risks in order to properly address the consequences and challenges ahead.

In agriculture, a sector severely affected by climate change, transition risks for poverty are high and can be summarized as follows:

- **Economic disruption:** shifting to sustainable agricultural practices may disrupt existing farming methods and industries. This can lead to short-term economic instability and job losses, particularly for small-scale farmers who may lack the resources to adapt quickly. This can increase poverty.
- **Technological barriers:** adopting new, climate-friendly technologies can be costly and challenging for farmers, especially those with limited access to capital and technical expertise. This can widen the gap between large, well-resourced farms and smaller, less-resourced ones, thus increasing poverty and inequality.
- **Regulatory changes:** new policies aimed at reducing carbon emissions and promoting sustainable practices may impose additional costs and compliance requirements on farmers. This can disproportionately affect smallholders and those already struggling with low productivity and income, hence increasing poverty.

These mapped transition risks, if not properly managed, will increase poverty in North Macedonia.

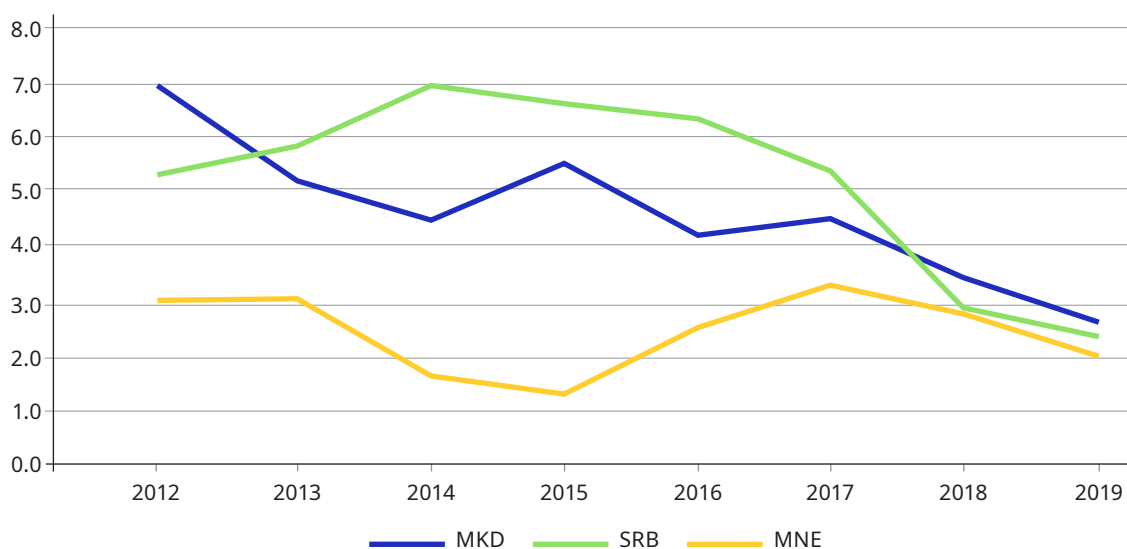
Regarding regional poverty (although no data disaggregation is available) it is obvious that poverty will increase more in agricultural regions than in industrial regions. Gender disaggregation shows that poverty risks for the male population are much higher than for the female population. Poverty before social transfers and pensions may increase if the identified risks are not properly addressed. Finally, poverty among the older male population may increase more, as re-skilling of the older population is harder than among the younger generation.

If not properly managed with the appropriate policies and recommendations all this may boost poverty in North Macedonia.

II.I Transition opportunities and their implications for poverty and inequality

The transition to sustainable and climate-resilient agricultural practices presents significant opportunities for reducing poverty and inequality in North Macedonia. As already stated, poverty is relatively high in North Macedonia, similar to levels in the rest of the region.

 **Figure 21. Poverty in Macedonia and the region (poverty gap at \$3.65 a day)**



Source: World Bank.

By adopting practices such as organic farming, precision agriculture and agroforestry, farmers can improve crop yields, enhance soil health and reduce their reliance on chemical inputs. These methods not only contribute to environmental sustainability but also increase the resilience of agricultural systems in the face of climate change. As a result, farmers can achieve greater food security and economic stability, which is particularly important for rural communities that depend heavily on agriculture for their livelihoods. Transferring jobs from traditional farming to climate resilient crops and modern farming (less water dependent with irrigation systems) represents a great opportunity for poverty reduction in agriculture.

Poverty is more prevalent in rural areas, and there are notable regional disparities. According to SILC data, in both the North-Eastern and Polog regions, poverty is close to 40 per cent, compared with a national rate of 22 per cent. In contrast, poverty rates in the remaining regions have fallen to 10–14 per cent.

We have mapped the following opportunities for poverty reduction in the agricultural sector through transformative practices and policies:

- Adoption of climate-resilient agriculture: developing and promoting drought-resistant and flood-tolerant crops can protect farmers' livelihoods and ensure stable food production, reducing vulnerability to poverty.

- Using renewable energy, such as solar-powered irrigation systems, can lower farming costs and increase income, especially in regions with limited access to conventional energy.
- Climate-focused funding programmes and subsidies can provide farmers with the resources they need to transition to sustainable practices, opening the door to higher incomes and poverty alleviation.
- Expanding agroforestry practices helps to diversify income sources, offering farmers sustainable economic opportunities while enhancing the ecological benefits.
- Farmers equipped with skills for climate-smart agriculture can boost productivity and secure better livelihoods, breaking cycles of poverty.
- Participation in carbon credit programmes can provide farmers with additional income by contributing to global efforts to offset emissions through sustainable practices.

Government support in the regions with higher poverty, in the form of increased investment in agricultural innovation and technology, can create new economic opportunities and reduce regional disparities. By providing farmers with access to modern farming tools, digital platforms and training programmes, their productivity and market access can be significantly improved. This can lead to higher incomes and better living standards for smallholder farmers and marginalized groups.

Additionally, promoting inclusive agricultural policies that address the needs of women, young people and other vulnerable populations can help to bridge the gap between urban and rural areas, fostering social equity and economic development. Through these transition opportunities, North Macedonia can build a more inclusive and resilient agricultural sector that reduces poverty and promotes sustainable growth.

Opportunities in agriculture can improve the gender discrepancy with regard to poverty as more new jobs created will be taken by the male population (though it might not always be the case). Poverty before social transfers and pensions should be reduced.

 **Table 5. Summary of physical climate and transition risks and their effects on the labour market (agriculture)**

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Physical climate risks	Increased frequency and severity of drought conditions	Lower crop yields Soil degradation: lack of moisture can cause soil erosion and loss of fertility, making it harder to sustain crop growth Livestock impact: drought reduces pasture availability and water for livestock, affecting their health and productivity Economic losses: farmers face financial strain due to reduced harvests and increased costs for irrigation and other mitigation measures	Lower yields lead to a decrease in labour demand and affect producers of cereal crops Lower impact on vegetable crops, such as tomatoes Productivity loss	
	Rising temperatures	Heat stress on livestock: animals experience reduced feed intake, slower growth rates, and lower milk production due to heat stress Increased water demand: crops and livestock require more water to cope with heat, straining already limited water resources Pest and disease proliferation: warmer climates can expand the range and activity of pests and diseases, further threatening crops	Some workers may be forced to leave heat-intensive agricultural jobs Reduced working hours: workers may need to shorten their shifts or take more frequent breaks, leading to decreased overall productivity Health risks: increased exposure to extreme heat can lead to health issues such as heat exhaustion or heat stroke Wage impacts: lower productivity can lead to reduced earnings for workers in heat-exposed sectors	

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Physical climate risks (continued)	Variabilities in precipitation patterns	Changes in water resource availability/water shortages in the sector	Reduced employment opportunities: as water scarcity limits crop production, fewer workers may be needed for planting, harvesting Increased workload: workers may face longer hours or more physically demanding tasks to compensate for reduced water availability and productivity Job displacement: farmers and agricultural workers may need to transition to other sectors or migrate to areas with better water resources	
Green economic transition	GHG emission reduction	The agriculture sector will have to undergo substantial decarbonization, based on the enhanced NDC (key driver)	Regulatory risks and loss of competitiveness can lead to job losses in agriculture	
	Increased use of modern irrigation Photovoltaic irrigation systems	Impact on traditional farming methods due to expanded use of modern irrigation, in line with the Long-term Strategy for Climate Action and Action Plan	Job losses in traditional farming Job gains in modern farming	Irrigation system knowledge: understanding of drip, sprinkler and other advanced irrigation systems, including their design, installation and maintenance Photovoltaic systems: familiarity with solar panels, inverters and energy storage systems used in PV irrigation setups

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Green economic transition <i>(continued)</i>	Promotion of low-carbon livestock farming	Opportunities in research, development and application of low-emission livestock farming methods and related supply chain roles In line with the Long-term Strategy for Climate Action and Action Plan	Job gains in modern livestock farming	Animal science: knowledge of livestock breeding, feeding and health management to reduce emissions Innovation: ability to develop new methods, such as methane-reducing feed additives or genetic improvements
			Job losses in traditional farming	
	Advances in green packaging for agri-products	Roles in the design, manufacture, marketing and distribution of eco-friendly packaging for agriculture products	Job gains	Sustainability principles: understanding eco-friendly materials, such as biodegradable, recyclable, or compostable options Technical proficiency: familiarity with design software and tools for prototyping and testing packaging solutions Branding and storytelling: creating a compelling narrative around the use of eco-friendly packaging
	Introduction of circular agriculture practices	Jobs in implementing and managing circular systems that recycle waste resources within the agricultural sector, promoting sustainability in line with the Long-term Strategy for Climate Action and Action Plan	Job gains	Skills in waste management: knowledge of composting, biogas production, and other waste recycling methods Resource optimization: skills to maximize the use of agricultural by-products and minimize waste recycling methods

	Key climate driver	Sectoral consequences – risks and opportunities	Labour market consequences	Key skills required
Green economic transition <i>(continued)</i>	Expansion of reforestation initiatives	Roles in tree planting, care and monitoring for reforestation ventures could mitigate soil erosion and enhance biodiversity	Job gains	Knowledge of tree species: understanding native and climate-resilient species suitable for the local environment Planting techniques: skills for preparing soil, planting saplings, and spacing them properly for optimal growth Pruning and maintenance: proficiency in tree care practices, such as trimming, watering and protecting against pests or diseases



III. Production of basic metals and construction

► III. Production of basic metals and construction

III.A Physical climate risks and their effects on the economy

According to Lazarov and Kochovski (2016),³⁶ the relative direct share of the basic metal industry in total value added has been declining, falling from 5.6 per cent in 2007 to 1.7 per cent in 2014. The basic metals industry had a 4.5 per cent share in industrial production in 2024, while exports amounted to €646 million or 8.2 per cent of total Macedonian exports in 2024 (67, 68 and 69 of the SMTK classification).

According to the USAID climate profile, water resources in North Macedonia are spatially diverse, with the quantity depending on precipitation and snowmelt. Increased temperatures will change rain, snowpack and snowmelt patterns, and probably lead overall to less snowpack, especially at lower elevations, and early runoff.

Water supply also impacts metal production. Fitch Ratings and CRU, in their 2020 metals and mining survey 'Emerging ESG Risks in the Metals and Mining Value Chain', named water scarcity as the greatest emerging risk to the mining and metals sector.

In the production of basic metals, water is needed to cool down the production oven, which is normally heated to 4,000 degrees. Two large companies are currently operating in Zelezara industrial complex in Skopje. These companies receive technical water from the "Rasce" spring, which also provides the population of Skopje with their drinking water. Reductions in the water supply can cause significant problems to production, as drinking water for the population will have priority.

³⁶ Darko Lazarov and Mitko Kocovski: "Empirical Estimation of the Multiplicative Effects of Steel Industry in Macedonia by Using Input-Output Model", *UTMS Journal of Economics* 7, no. 1 (2016): 25–35, <https://www.utmsjoe.mk/files/Vol.%207%20No.%201/UTMSJOE-2016-0701-03-Lazarov-Kocovski.pdf>.

Discussions with social partners and survey results

The representative from Liberty (LIBERTY Skopje, part of the Liberty Steel Group, a global steel and mining company with 200 manufacturing locations across 10 countries) explained during the meeting with employers that rising temperatures, as predicted by the World Bank and USAID in their climate reports, will lead to increased production costs.

Higher temperatures lead to increased demand for cooling, which in turn raises energy consumption. This can result in higher energy bills for businesses, particularly those with energy-intensive operations, such as manufacturing.

Increased energy demand can also strain the power grid, leading to potential outages and further economic losses. Air-conditioning is essential during the production process to cool and stabilize operations and ensure personnel safety. However, these higher operational costs may reduce profitability, potentially resulting in job losses, particularly in maintenance, operational and production roles.

In the survey of employees, it was pointed out that contingency plans should be prepared, or if already prepared, should be improved to take account of the possibly severe consequences of climate change and CBAM.

Railways are used heavily by Macedonian basic metals producers, although the condition of the Macedonian railways is poor (very low capacity and speeds). Extreme weather conditions will cause floods and destroy part of the infrastructure, which includes the railways. When railways are not functioning, metal producers use the roads and highways for transport, which significantly increases transport costs. As a consequence, production may decrease, along with temporary or permanent job losses in logistics, supply chain management and production roles.

Construction is by far the largest emitter of greenhouse gases, responsible for at least 37 per cent of global emissions.³⁷ To date, most of the environmental progress in the sector has been made on reducing the “operational carbon” of buildings, the emissions created from heating, cooling and lighting, which are projected to decrease from 75 to 50 per cent in the sector in the next few decades. However, solutions for reducing the “embodied” carbon emissions from the design, production and deployment of building materials, such as cement, steel and aluminium, have lagged far behind.

³⁷ United Nations Environment Programme: *Building Materials and the Climate: Constructing a New Future*, 12 September 2023, <https://www.unep.org/resources/report/building-materials-and-climate-constructing-new-future>.

Increased frequency and severity of drought conditions will reduce the water availability necessary to produce construction materials. Reduced water availability is critical for cooling and cleaning in manufacturing processes and can create potential operational disruptions for the cement industry and so construction as well.

Concrete is the most used material in the building sector, and the processing of cement, the binding agent in concrete, contributes 7 per cent of global carbon emissions.³⁸ Because concrete has a developed supply chain and infrastructure, it dominates the industry. Currently, less than 1 per cent of concrete is made from recycled materials. The production of factory-produced modular concrete that is designed for re-use should thus be prioritized. In Macedonia, the cement industry comprises only one company, “Cementara – Skopje”, which is a large exporter, mainly to the European Union.

Aluminium production is highly energy intensive, and because electricity is its dominant energy source, decarbonizing the electricity grid has the largest potential in this sector. Few companies in North Macedonia produce aluminium products for the domestic market or export. Other construction materials of plastics and glass.

Regarding the construction process, the expected temperature increases will reduce productivity in heat-exposed activities. A representative of the construction company Granit explained that climate change is already significantly impacting the company as projects are being delayed, while investors do not accept climate change (for example, heatwaves) as an excuse for project delays. Thus the costs entailed by project delays are covered mainly by the company.

III.B The risks and economic impact of transition for basic metals and construction

The Carbon Border Adjusted Mechanism (CBAM) is currently the main driver of transition risks in the construction sector. According to the World Economic Forum, supply shortages of the minerals used in lower-carbon technologies could delay the energy transition and cause serious social and environmental challenges if not addressed.

CBAM is also a major transition risk for the iron and steel and mining sector. In 2026 the European Union will start to apply the Carbon Measure Adjustment Mechanism (EU-CBAM) fully. For iron and steel exports to the EU, compliance with CBAM will initially involve reporting the direct and indirect emissions associated with iron and steel production in imported goods from third countries on a quarterly basis, relying on supplier information. However, from 1 January 2026, importers of iron and steel will have to buy CBAM certificates for emissions in imported iron and steel, as in the EU’s Emissions Trading System.

³⁸ Building Materials and the Climate, “Executive Summary”, <https://www.buildingmaterialsandclimate.com/executive-summary/executive-summary>.

Iron and steel exports from North Macedonia to the European Union are high (63 per cent of total exports for the period January–September 2024³⁹), which means that the economic impact will be significant and costs for domestic companies will be high.

CBAM applies to EU imports of basic metals, which are one of Macedonia's largest exports to the EU, making it a key player in the economic model.

Discussions with social partners and survey results

According to a representative of the iron and steel industry, the impact of the Carbon Border Adjustment Mechanism (CBAM) on Macedonian exports is anticipated to be substantial and will include the following:

- Local industries will need to assess their supply chains thoroughly to identify potential CBAM exposure. This includes understanding their suppliers' CBAM obligations and ensuring accurate reporting and compliance.
- Macedonian exporters will face new carbon accounting and reporting duties, which can be administratively burdensome and costly.
- CBAM will impose a carbon price on imports of high-emission goods, potentially making Macedonian products less competitive in the European market compared with those from countries with lower carbon footprints.
- The CBAM transition period will bring uncertainty for Macedonian exporters as they adapt to the new regulations. This uncertainty can affect business planning and decision-making, potentially leading to disruptions in trade.

However, it is expected that the costs incurred by importers will remain manageable. The representative emphasized that while CBAM represents challenges for the industry, it also offers opportunities for Macedonian producers to innovate and enhance their sustainability practices. By adapting to the new regulations, the industry can potentially gain a competitive edge in the European market. Additionally, the government and industry stakeholders are collaborating to ensure that Macedonian exporters are well prepared to navigate the changes brought about by CBAM.

Finally, as of 2026, as pointed out by the representative of Cementara Skopje, the cement industry (and probably other construction materials industries) will be hit by the EU's full application of the Carbon Measure Adjustment Mechanism (EU-CBAM), which will mean increased costs for the industry, which could include lower margins and lower sales.

³⁹ Source: State Statistical Office of the Republic of North Macedonia.

The European cement sector supports the introduction of the carbon border tax, provided it is properly structured. According to Isidoro Miranda, president of the European cement association CEMBUREAU, the EU industry is paying EUR 8/t more to produce cement than importers of cement and clinker to the EU. Presently, CEMBUREAU reports that Spain saw an increase of 489 per cent in cement imports between 2016 and 2020, Greece's cement imports have risen by 630 per cent from outside the region.

In the context of the CBAM, cement is defined as a complex good as it is produced from precursors such as cement clinker and possibly calcined clay, which are well within the scope of the CBAM.

The construction sector in North Macedonia is facing significant transition risks because of CBAM. As already mentioned, the cement industry is directly impacted. Based on the workshop with the Organization of Employers, the biggest cement producer, Cementara in Skopje, the company management is fully aware of the problem. As most cement is exported to EU countries (mainly through Greece), the CBAM tax will apply to EU exports.



Discussions with social partners and survey results

During the discussions with the social partners, the following risks for the construction sector were pointed out:

- reduced productivity in heat-exposed activities;
- increased risk of heat-related illnesses among workers;
- disruption of construction schedules; increased risk of damage to infrastructure and construction sites;
- reduced water availability affecting construction processes (for example, concrete production and cooling).

The construction industry is already feeling the impact of climate change. During the summer months, work shifts are adjusted and workers do not work between 11 a.m. and 5 p.m., which causes delays in construction projects. To fight the extreme weather, more PPE (personal protective equipment) must be purchased for workers in the field. This is causing unforeseen costs to rise and the profitability of construction companies is decreasing.⁴⁰

⁴⁰ Source: mse.org based on 9 months unaudited results of JSC Granit.

III.C Opportunities and economic impact of the transition for basic metals and construction

To manage the transition risks for the basic metals industry and construction, based on discussions with companies and social partners, we identified the following opportunities:

- **Encouragement of green innovation:** CBAM will incentivize Macedonian industries to adopt cleaner, more sustainable production methods. This push towards innovation can lead to the development of new technologies and processes that reduce carbon emissions, potentially opening up new markets and business opportunities.
- **Competitive advantage:** by aligning with EU carbon pricing policies, Macedonian exporters can gain a competitive edge in the European market. Companies that successfully reduce their carbon footprint will be better positioned to meet the demands of environmentally conscious consumers and businesses.
- **Attraction of investment:** the transition to a low-carbon economy can attract foreign investment in green technologies and infrastructure. Investors are increasingly looking for opportunities in sustainable and environmentally friendly projects, and Macedonia's commitment to decarbonization can make it an attractive destination.
- **Diversify supply chains** by diversifying the sources of raw materials, Macedonian exporters can reduce dependency on a single supplier or region. Strengthening relationships with local suppliers can help to create a more resilient supply chain by increasing the requirements on their suppliers, higher requirements for eco-friendly materials, ESG requirements, environmental standards and so on. This can help to mitigate risks associated with supply chain disruptions and ensure a steady flow of materials.
- **Exploring new markets:** diversifying export markets beyond the EU can help Macedonian exporters to reduce their reliance on a single market. This can provide a buffer against potential trade barriers and fluctuations in demand.
- Expansion of metal recycling and waste management.

During the transition period, construction companies will have to implement a variety of measures:

- Adoption of new working schedules, which will mean that workers will have to work from early in the morning until noon and then resume work after 5 p.m.
- Creating new or enhancing existing disaster recovery plans is also a possibility during the transition period. Companies need to be prepared for the consequences of climate changes such as flooding and heatwaves.
- Recycling is also a great transition opportunity. According to the literature, the following materials can be recycled: plasterboard aggregates, metals, plastics, glass, wood, bricks, and blocks, floor and wall coverings, insulation and packaging. Recycling should be part of a company's everyday operations, with multiple benefits for both the company and the environment.
- New cooling systems might be an option in the construction of buildings.⁴¹

⁴¹ "Sustainable Development of the Energy Sector in North Macedonia: The Role of Renewable Energy Sources and Energy Efficiency", Energy Reports 10 (2024): 1234–1245, <https://www.sciencedirect.com/science/article/pii/S2590123024010247>.

According to the World Steel Association,⁴² developing advanced steel products to enable societal transformations is the future for the iron and steel industry. Companies around the world are developing and manufacturing the advanced steel products necessary to facilitate the required transformation and adaptation of societies to achieve carbon neutrality through zero energy buildings, low-carbon energy infrastructures, electrification and more.

One example is the development of resilient metal alloys.⁴³ Infrastructure utilising new metallic materials with improved property combinations can help to address key environmental challenges in various ways. These opportunities (Cann J. et al. 2024)⁴⁴ vary from reducing quantities of required materials through property improvements or extension of functional lifetimes to increasing stability at high temperatures, allowing for improvements in efficiency.

According to the International Energy Forum, developing low-carbon steel processes is essential for the industry. Innovation in low-carbon steel production is essential to drive the de-carbonization of the industry. One of the most promising emerging techniques is hydrogen-based direct reduction. This process involves using hydrogen gas (H₂) to reduce iron ore to iron, which is then used to make steel. Unlike traditional steel production, hydrogen-based direct reduction emits only water vapour. Companies worldwide are planning hydrogen-powered steel plants, including H2GreenSteel in Spain and potentially Brazil, ArcelorMittal in Spain, Germany, and Canada, and Gravithy in France.

⁴² World Steel Association: *Climate Change and the Production of Iron and Steel*, <https://worldsteel.org/climate-action/climate-change-and-the-production-of-iron-and-steel/>.

⁴³ "The Role of Renewable Energy in Climate Change Mitigation: A Review of Recent Literature and Directions for Future Research", *Progress in Physical Geography* 45, no. 1 (2021): 3–27, https://www.sciencedirect.com/science/article/abs/pii/S0079642520300864?fr=RR-2&ref=pdf_download&rr=92e24967ad0cd0c6.

⁴⁴ Roberts, J. Timmons, and R. Daniel Kammen: "The Role of Renewable Energy in Climate Change Mitigation: A Review of Six Intergovernmental Panel on Climate Change Assessment Reports", *Progress in Physical Geography* 45, no. 1 (2021): 3–27, <https://www.sciencedirect.com/science/article/abs/pii/S0079642520300864>.



Discussions with social partners and survey results

At the organized meeting the representative of the Liberty group said that electric arc furnaces can also produce low-carbon steel, but they only work with scrap metal or steel pellets, which have already emitted CO₂ in their production. To truly reduce carbon intensity, the steel pellets used must be produced using low-carbon hydrogen. European ArcelorMittal, owned by Liberty group, is among the companies integrating this technology into their steel production.

Another opportunity for investment in water-recycling technologies, according to the UN Environment Centre for Water and the Environment, water reclamation or recycling primarily make non-potable wastewater useful, thus saving the economic and environmental costs related to establishing new water supplies. Water recycling and reuse is the process of collecting, treating and using wastewater, particularly from municipalities, industry and agriculture.

According to the JSC Liberty representative, the benefits of water recycling are as follows:

- it retains wastewater for reuse, instead of it being discharged into the environment and potentially polluting ecosystems;
- it saves energy otherwise required to extract or transport freshwater to the area. It recharges the groundwater, avoiding freshwater resource degradation and salinization.

Production of metal components for renewable energy systems is another opportunity. The global clean energy transitions will have far-reaching consequences for mineral demand over the next 20 years. This is a great opportunity for Macedonian metal producers, according to the Liberty representative.

Regarding the cement Industry, a representative of Cementara Skopje said that the company has started to produce eco cement, which will also be taxed but at a lower rate. However, construction companies in North Macedonia rarely use it.

During the meeting with the Employers' Organization, numerous positive examples were highlighted from Slovenia and other environmentally advanced countries regarding waste management and metal recycling. These examples showcased innovative approaches and successful strategies that have significantly improved waste management practices. In comparison, municipalities and companies in North Macedonia are lagging behind their European counterparts. However, this gap presents great opportunities for growth and development in waste management during the transition. By adopting best practices from these advanced countries, North Macedonia can enhance its waste management systems, reduce environmental impact and create new economic opportunities. Investment in modern waste management technologies and infrastructure, as well as increased awareness and education on sustainable practices, can further drive progress in this area.

III.D Physical climate risks and their effects on the labour market

Based on the available data, 2.1 per cent of total employment in North Macedonia is in the metals industry, amounting to around 15,000 people. The basic metals industry, including steel and aluminium production, is highly vulnerable to physical climate risks, such as extreme weather events, rising temperatures and floods. These risks can disrupt production processes, damage infrastructure and lead to supply chain interruptions. They would thus have a negative effect on the labour market by reducing employment.

In 2023, employment in the construction sector in North Macedonia amounted to 50,371 workers, representing 7.3 per cent of total employment. Gender disaggregation reveals that the vast majority of these workers are males, highlighting a significant gender imbalance within the industry.

Extreme weather events can cause temporary shutdowns of production facilities, resulting in job losses and reduced working hours for employees. Extreme weather conditions may damage the railway infrastructure – thus directly reducing employment in railways. (Currently, more than 2,000 people work on the railways in North Macedonia.)

However, the indirect effect on the labour market will be worse as the major basic metals producers use the railways to export metals, as well as to import raw materials.

Water supply also impacts metal production processes (as water is necessary for cooling). Water in the Zelezara complex (the biggest basic metals production complex) is supplied through one company, JSC Uslugi- Skopje, and the water comes from the Rasce spring, which is the main water supplier for the city of Skopje. Extreme weather conditions may bring job losses directly to JSC Uslugi Skopje, but also to the metal producers based in the Zelezara complex.

The construction industry in North Macedonia faces significant challenges as a result of physical climate risks, particularly extreme temperatures. These risks have profound implications for the labour market, productivity and overall project timelines. As temperatures rise, the productivity of construction workers decreases, especially during peak heat hours. Studies have shown that for every 1°C rise in temperature above 28°C, construction worker productivity can decrease by up to 57 per cent. This reduction in productivity not only affects the pace of construction projects but also increases the likelihood of delays and cost overruns.

Further risks include the need to avoid work during the hottest part of the day, typically from 1 p.m. to 5 p.m., and instead to schedule work during cooler morning and evening hours. This shift in work hours can help to protect workers from heat-related illnesses and maintain productivity levels, although of course it will encroach on their leisure time. Additionally, the need for more specialized equipment to protect workers from extreme heat is becoming increasingly important. This includes providing adequate shade, cooling stations and personal protective equipment designed to reduce heat stress. The

increased demand for such equipment can lead to higher operational costs for construction companies, which may impact their profitability and ability to invest in new projects.

The long-term effects of climate change on the construction industry in North Macedonia could also lead to layoffs and postponement of projects. As extreme weather events become more frequent and severe, construction schedules may be disrupted, leading to project delays and increased costs. Companies may be forced to lay off workers during periods of inactivity or when projects are postponed due to adverse weather conditions.

III.E. Transition risks and their labour market implications

We have identified (mapped) the following transition risks and their effects on the labour market.

The implementation of the Carbon Border Adjustment Mechanism (CBAM) in the short run is likely to have negative effects on employment in the basic metal industry in Macedonia. The increased costs associated with CBAM fees on exports exceeding EU emissions benchmarks could lead to a decline in production and exports, resulting in job losses in the metal industry. This is particularly true for carbon-intensive sectors such as steel and aluminium production, which may face competitive disadvantages compared with producers in countries with lower carbon footprints.

The transition to a low-carbon economy, driven by policies such as the Carbon Border Adjustment Mechanism (CBAM), presents several risks to the labour market in the basic metals industry. Industries with high carbon footprints, such as steel and aluminium production, may face increased costs due to the carbon pricing mechanism, leading to reduced production, job displacement and potential closures. Workers in these sectors may need retraining and relocation support to transition to new roles in emerging green industries. Additionally, the administrative burden of complying with CBAM regulations can strain resources, especially for small and medium-sized enterprises (SMEs), increasing the time needed to adjust and potentially leading to job losses.

As North Macedonia is a middle-income country, developing advanced steel products to enable societal transformation may be a challenge because of funding requirements. Companies may struggle to finance the necessary adjustments to new production technologies and are likely to need financial support from the government. The lack of funding to adapt to these new technologies may contribute to a reduction in employment within the industry.

Another risk to the Macedonian economy is the lack of regulation by authorities, especially in the fields of waste management and scrap usage technologies. Without proper regulations and enforcement, industries may find it difficult to adopt more sustainable practices, further complicating the transition. Additionally, the scarcity of funding for improvements in these areas exacerbates the situation, making it harder for companies to comply with environmental standards and retain their workforce.

In the construction sector, government regulation and monitoring of heat stress is selective and many companies are not being scrutinized. This represents unfair competition.

Discussions with social partners and survey results

A representative of JSC Granit explained that the company will not lay people off, however many of them will not be able to cope with the heat and other climate changes.

Furthermore, currently most labour inspections are carried out at the major construction companies, such as Granit, while the competition (mainly informal sector) is not checked at all. This creates unfair competition. During the summer months, many workers go on sick leave, working hours are shortened and adjusted for elderly people and pregnant women, hence the costs of working on infrastructure projects are very high. The government's decisions on shortening working hours for elderly and pregnant workers are not followed by the competition.

All this indicates that government regulation and monitoring of heat stress, among other things, is not evenly applied.

Furthermore, the following risks were pointed out during the discussion with the social partners.

III.F Transition opportunities and their labour market implications

While CBAM presents transition risks, it also offers significant opportunities for the labour market in the basic metals industry. The mechanism incentivizes industries to reduce their carbon emissions, driving demand for green technologies and sustainable practices. This transition can create new employment opportunities in renewable energy, energy efficiency and environmental services. Investments in green infrastructure and the adoption of circular economy principles can stimulate job creation in construction, manufacturing and services.

Additionally, the push towards a low-carbon economy can attract foreign investment in green projects, further boosting job opportunities. To fully realize these benefits, it is essential to invest in education and training programmes that equip workers with the skills needed for green jobs, promote innovation and entrepreneurship, and foster collaboration between government, industry and civil society. By leveraging these opportunities, the labour market can thrive and contribute to a more sustainable and inclusive future.

Furthermore, the basic metals industry can play a pivotal role in developing innovative materials and processes that align with sustainability goals, creating new markets and enhancing competitiveness. By embracing a proactive approach to sustainability, the industry can drive economic growth while contributing to global efforts to combat climate change.

The future for the basic metals and construction industries through developing advanced technologies and more eco-friendly products to enable societal transformations will bring new jobs. These new jobs will include:

- Research and development (R&D) specialists: these professionals will focus on developing innovative steel and construction materials products and processes that meet the demands of a low-carbon economy. They will work on improving the properties of steel, such as strength, durability and sustainability, to create advanced materials for various applications.
- Environmental engineers: as the industry shifts towards greener practices, environmental engineers will play a crucial role in designing and implementing sustainable production methods. They will work on reducing emissions, improving energy efficiency and managing waste and recycling processes.
- Production technicians: skilled technicians will be needed to operate and maintain advanced manufacturing equipment and technologies. They will ensure that production processes are efficient, safe and environmentally friendly.
- Quality control analysts: these professionals will be responsible for ensuring that advanced steel products meet stringent quality and environmental standards. They will conduct tests and inspections to verify the properties and performance of materials.
- Supply chain managers: with the increased complexity of supply chains in the advanced steel industry, supply chain managers will be essential to coordinate the procurement, production and distribution of materials. They will work on optimizing logistics and reducing the carbon footprint of supply chains.
- Sales and marketing specialists: as new advanced steel products are developed, sales and marketing specialists will be needed to promote these products to customers and industries. They will focus on highlighting the benefits of sustainable steel solutions and expanding market reach.
- Training and development coordinators: to ensure that the workforce is equipped with the necessary skills for the transition, training and development coordinators will design and implement training programmes. They will focus on upskilling workers in areas such as green technologies, advanced manufacturing and environmental compliance.
- Project managers: project managers will oversee the implementation of new technologies and processes in the steel industry. They will coordinate efforts across different departments, manage budgets and ensure that projects are completed on time and within scope.

III.G Physical climate risks and their effects on poverty and inequality

The impacts of climate change have already significantly affected livelihoods and living conditions, especially those of the poorest and most vulnerable.⁴⁵ They will continue to undermine development for the foreseeable future.⁴⁶ Physical climate risks, such as extreme weather events, rising temperatures and floods, pose significant challenges to the basic metals industry in Macedonia. These risks can disrupt production processes, damage infrastructure and lead to supply chain interruptions. For instance, extreme weather events can cause temporary shutdowns of production facilities, resulting in job losses and reduced working hours for employees. Additionally, rising temperatures can affect the health and safety of workers, leading to increased absenteeism and lower productivity. The physical damage to critical infrastructure, such as railways, can further exacerbate these challenges by disrupting the transportation of raw materials and finished products, potentially leading to job losses in both the transport sector and the basic metals industry. These disruptions can disproportionately affect low-income workers and exacerbate existing inequalities, as those with fewer resources are less able to cope with the economic impacts of climate-related disruptions.

The average net wage in the basic metals industry in December 2024 was 44,000 denars in group 24 (“manufacture of basic metals”), and 35,688 denars in group 25 (“manufacture of fabricated metal products, except machinery and equipment”). The average wage in Macedonia in December 2024 for industry as a whole was 43,587 denars, which shows that the metals industry is close to the national average. In the construction sector, the average wage was below the national average (38,000 denars).

Average wage data in the construction and basic metals industries shows that these sectors can be vulnerable to climate change as wages are relatively low, and further increases in the costs of production can contribute to wage cuts (or depress wage increases), thus boosting poverty.

Extreme weather conditions may damage railway infrastructure, thus directly reducing employment in railways, thereby exacerbating poverty. (As already mentioned, more than 2,000 people work on the railways in North Macedonia.) Most of railway workers work in the Skopje region, which has the lowest poverty rates (according to the World Bank). Furthermore, damaged railways would entail huge cost increases for the metal industry.

Damaged infrastructure can contribute to an increase in poverty in the Skopje region (where two major companies are located, Makstil JSC and Liberty JSC), as well as the Vardar region. IGM Kavadarci is located in the Vardar region, a company with more than 1,000 employees in the metals industry. Laying people off will increase poverty in this region.

⁴⁵ Elizabeth Mattiuzzi and Eileen Hodge: “Climate-Related Risks Faced by Low and Moderate-Income Communities and Communities of Color: Survey Results”, 1 December 2021, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4678546.

⁴⁶ Intergovernmental Panel on Climate Change: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. H.-O. Pörtner, D.C. Roberts, M. Tignor et al., Cambridge: Cambridge University Press, 2022.

Regarding gender disaggregation, most of the people employed in the basic metals industry and construction are males, which shows that climate change will not have any significant impact on gender equality.

Water supply disruptions may also impact metal production and construction processes, thereby decreasing employment in these sectors and increasing the poverty rates in Skopje region and Vardar region.

III.H Transition risks and their effects on poverty and inequality

We have identified the following transition risks and their effects on poverty.

Stricter emissions regulations and carbon pricing increase operational costs, potentially leading to job losses in traditional metal production. This may increase poverty (if not properly addressed). Companies must invest in cleaner technologies, which may displace workers lacking the necessary skills, hence further increasing poverty.

The transition to a low-carbon economy, driven by policies such as the Carbon Border Adjustment Mechanism (CBAM), entails several risks to the labour market in the basic metals industry in Macedonia, hence to poverty and equality. Industries with large carbon footprints, such as steel and aluminium production, may face increased costs due to the carbon pricing mechanism, leading to reduced production, job displacement and potential closures.

The greatest risk of poverty is posed by reluctance of industry to adjust to climate change and CBAM, which lead to increases in unemployment and poverty.

The reluctance of industry to take action may be caused by:

- lack of engineering knowledge;
- lack of funding for adjustments.

If the knowhow and funds are not available to the basic metal industry and construction, adjustments in response to climate change and CBAM will be jeopardized. Workers in these sectors may need retraining and reallocation support to transition to new roles in emerging green industries.

Market shifts: demand for low-carbon and recycled metals is growing, favouring companies that adapt quickly. If Macedonian companies do not adjust, job losses – and thus poverty – may increase. Furthermore, the transition to more energy-efficient and renewable-powered production methods creates skill mismatches, which may also increase poverty. Another risk is disruption in the supply chain affecting transport of raw materials and finished goods. This disruption may increase operational costs, reduce profitability and hence cut jobs and increase poverty.

An unsuccessful transition from fossil fuels to renewables for energy supply in metal manufacturing processes is another risk to the industry.

Gender disaggregation reveals potential risks of increasing male poverty, as the basic metals industry predominantly employs men. Regional poverty may rise in the Skopje region, where JSC Makstil and JSC Liberty are located, even though this area currently has the lowest poverty rates. Other regions at risk of increased poverty include the Vardar region (location of IGM Kavadarci) and the South-eastern region (location of Dojran Steel). Furthermore, if not properly managed, poverty before social transfers may increase. Re-skilling older employees can be challenging due to their limited experience with contemporary technologies, which may contribute to increased poverty rates among the older male population.

III.I Transition opportunities and their effects on poverty and inequality

While CBAM and the broader transition to a low-carbon economy present risks, they also offer significant opportunities for the labour market in the basic metals industry in Macedonia. The mechanism incentivizes industries to reduce their carbon emissions, driving demand for green technologies and sustainable practices. This transition can create new employment opportunities in renewable energy, energy efficiency and environmental services, thus reducing poverty. Additionally, the push towards a low-carbon economy can attract foreign investment in green projects, further boosting job opportunities. To fully realize these benefits, it is essential to invest in education and training programmes that equip workers with the skills needed for green jobs, promote innovation and entrepreneurship, and foster collaboration between government, industry and civil society.

Enhancing the country's infrastructure through extensive construction projects can significantly boost employment in the construction sector. By focusing on eco-friendly materials, such as eco-cement, we can not only improve infrastructure's resilience to climate change but also promote environmental sustainability. The use of these materials will drive the demand for their production, thereby creating more job opportunities in the construction materials industry, thus reducing poverty.

Furthermore, increased employment in construction can contribute to poverty reduction by providing stable income sources for a larger number of workers. Investing in sustainable infrastructure projects and adopting green building practices can stimulate economic growth and create a ripple effect, improving the overall standard of living. This approach ensures that the benefits of infrastructure development are not only immediate but also long-lasting, fostering a more resilient and sustainable future for North Macedonia.

Circular economy: emphasizing recycling and reusing metals can enhance sustainability and reduce dependency on raw materials in North Macedonia. Thus it can create more jobs and reduce poverty. Programmes supporting small-scale recyclers or informal sector workers can provide stable incomes and improve livelihoods. Recycled materials can sometimes be less expensive than newly extracted ones, which could make basic goods more affordable for low-income populations.

By leveraging these opportunities, the labour market can thrive and contribute to a more sustainable and inclusive future. Furthermore, the basic metals industry and the construction sector can play a pivotal role in developing innovative materials and processes that align with sustainability goals, creating new markets and enhancing competitiveness. By embracing a proactive approach to sustainability, the industry can drive economic growth while contributing to global efforts to combat climate change.

Encouraging partnerships between academia, industry, and government can also foster research and development, leading to breakthroughs in low-carbon technologies. These opportunities can help to reduce poverty and inequality by creating new, well-paying jobs and promoting economic growth in a sustainable manner.

Effective management of climate change presents significant opportunities for the metal industry, particularly in regions with existing infrastructure and skilled workforces (Skopje and South-eastern regions). The basic metals sector, which is male-dominated, can leverage these opportunities not only to mitigate potential economic risks but also to drive growth and innovation, thus reducing poverty, especially among the male population. Finally, poverty before social transfers and pensions can be reduced if the proposed actions are taken and well managed.

 **Table 6. Summary of physical climate and transition risks and their effects on the labour market (production of basic metals and construction)**

	Key climate driver	Sectoral implications, risks and opportunities	Labour market implications	Skills required
Physical climate	Increased frequency and severity of drought conditions	Reduced availability of water critical for cooling and processing in metal manufacturing	Reduced water availability may lead to decreased production capacity, resulting in layoffs or reduced hiring in the sector	Skill shifts: workers may need to adapt to new technologies or processes designed to minimize water usage, requiring reskilling or upskilling Innovation: development of water-efficient technologies and processes to mitigate the impact of scarcity
		Productivity impact: operational delays: insufficient water can disrupt cooling systems, leading to equipment overheating and production halts	Higher operational costs may reduce profitability, leading to potential job losses	
		Loss of water in Skopje region where biggest producers are located	Job reductions: decreased water availability can lead to production slowdowns or shutdowns, resulting in layoffs or reduced hiring Productivity impact: operational disruptions: insufficient water can disrupt cooling systems and other water-dependent processes, leading to equipment failures and production delays	

	Key climate driver	Sectoral implications, risks and opportunities	Labour market implications	Skills required
Physical climate (continued)	Extreme weather events (floods, storms)	Disruption in the supply chain affecting transport of raw materials and finished goods	Temporary or permanent job losses in logistics, supply chain management and production role	
			Increased demand for emergency response and repair jobs	
	Rising temperatures	Increased operational costs due to higher energy consumption for cooling and stabilizing manufacturing processes	Job losses	
		Reduced productivity in heat-exposed activities	Potential job losses due to reduced productivity and absenteeism	
		Increased risk of heat-related illnesses among workers	Increased need for health and safety roles	Increased need for health and safety roles
		Disruption of construction schedules	Job losses due to project delays and potential damage	
			Increased demand for emergency repair and restoration jobs	
Green economic transition	Decarbonization (EU CBAM inclusion)	Higher costs for high-emission metal production, affecting competitiveness in the EU market due to carbon tariffs Currently there is no strategy in North Macedonia to indicate the path forward with CBAM. Key driver: enhanced NDC	Potential job losses in high-emission production facilities	

	Key climate driver	Sectoral implications, risks and opportunities	Labour market implications	Skills required
Green economic transition <i>(continued)</i>		Transition to low-carbon production processes (e.g., electric arc furnaces, renewable energy integration)	The shift to low-carbon technologies creates demand for skilled workers in areas such as renewable energy, energy efficiency and advanced manufacturing Green jobs: opportunities arise in sectors such as solar and wind energy, battery storage and recycling of materials Jobs in green metallurgy, R&D, low-carbon technology implementation and compliance auditing	Workforce reskilling programmes. Needed in: Energy efficiency: skills to optimize energy use and reduce waste in manufacturing Engineering knowledge: proficiency in operating and maintaining electric arc furnaces and other low-carbon technologies Research and development: ability to innovate and improve low-carbon technologies
	Efficiency in processes and maximise use of scrap	Increased emphasis on resource efficiency Invest in scrap usage In line with the Long-term Strategy for Climate Action and Action Plan	Jobs in scrap operations	Material science: understanding the properties of scrap materials and how to repurpose them effectively Process optimization: skills to improve manufacturing processes to minimize waste and maximize resource efficiency
	Implementation of circular economy practices	Increase in recycling and reduction of waste in metal manufacturing in line with the Long-term Strategy for Climate Action and Action Plan	Increase in jobs related to recycling, resource management, and sustainable product development	Workforce reskilling programmes. needed in: Life cycle assessment: ability to assess the environmental impact of products and processes from design to disposal Circular design principles: expertise in designing products for durability, reuse and recyclability

	Key climate driver	Sectoral implications, risks and opportunities	Labour market implications	Skills required
Green economic transition <i>(continued)</i>	Implementation of climate-resilient building standards	Changes in building design and construction – in line with the Long-term Strategy for Climate Action and Action Plan	Potential job losses in traditional construction methods	
			Increased demand in climate-resilient construction roles	Material science: understanding climate-resilient materials, such as those resistant to high temperatures, moisture, or corrosion Modelling and simulation: using tools such as GIS (Geographic Information Systems) and BIM (Building Information Modelling) to predict climate impacts and optimize designs
	Expansion of renewable energy installations	Increased construction of renewable energy infrastructure In line with the Long-term Strategy for Climate Action and Action Plan	Increased demand in renewable energy construction	Electrical engineering: understanding power systems, grid integration and renewable energy technologies such as solar panels, wind turbines and battery storage Construction skills: proficiency in site preparation, equipment installation and structural assembly for renewable energy projects



IV. Production of machinery, vehicles and equipment

► IV. Production of machinery, vehicles and equipment

IV.A Physical climate risks and their effects on the economy

Production of machinery and equipment comprises three industrial groups: 27 manufacture of electrical equipment, 28 manufacture of machinery and equipment, and 29 manufacture of motor vehicles, trailers and semi-trailers. All together they make up 24.8 per cent of industrial production and 28 per cent of exports. Most of exports from North Macedonia are directed to Germany (47 per cent in 2023).

As the world warms, companies in this sector are under increasing pressure to decarbonize their products – everything from small air conditioners to huge mining equipment – and to reduce the adverse effects of their operations on the climate. The machines they manufacture operate directly and indirectly in industrial processes that account for most of the greenhouse gas (GHG) emissions responsible for global warming. Consequently, their customers, too, will have to reduce the greenhouse gases they emit, including those from the machinery they use in their own operations.

For machinery makers, three factors are critical (Rees R. et al., 2020⁴⁷): first, the emergence of new, more economically viable technologies will force them to rethink and update their product portfolios. Second, increasingly stiff regulations will force them to take action to reduce their impact on the climate. And third, investors will demand climate-friendly changes in how they do business. According to KPMG,⁴⁸ in general, 55 per cent of manufacturing industries can be classified as steel-intensive. With a 12 per cent share of steel in intermediate goods, the automotive industry also plays a crucial role in raw material markets.

Increased frequency and severity of drought conditions will eventually reduce the availability of water critical for cooling and cleaning in manufacturing processes. Potential operational disruptions are inevitable in the manufacturing of motor vehicles and equipment. Reduced operational capacity could lead to job losses in affected facilities, particularly in roles such as assembly line workers and maintenance staff.

Rising temperatures will cause increased operational costs due to higher energy consumption for cooling and process stability. This will be significant in the summer months. Increases in the prices of machines and vehicles will be inevitable.

⁴⁷ Simon Rees et al.: "Climate Disruption and the Path to Profits for Machinery Makers", Boston Consulting Group, 27 October 2020, <https://www.bcg.com/publications/2020/how-machinery-makers-can-mitigate-climate-disruption>.

⁴⁸ KPMG: "How Should the Automotive Industry Prepare for CBAM?", 19 October 2023, <https://kpmg.com/be/en/home/insights/2023/10/sus-how-the-automotive-industry-should-prepare-for-cbam.html>.

Extreme weather events (floods, storms) will cause disruption in the supply chain, affecting the transport of raw materials and finished goods, and potential damage to infrastructure. Infrastructure is essential for the big producers of vehicles in Macedonia. Most of the companies located in the technological industrial zones are connected with highways, railways and airports. Damage to infrastructure will be a significant problem for those companies, which are mainly export oriented.

IV.B Transition risks and their economic implications

It is expected that CBAM will have a significant impact on the production of goods by both intra-European industrial companies and foreign manufacturers. Naturally, the question arises of how the automotive industry will be affected by the planned CBAM measures, as one characteristic of the automotive industry is its resource-intensive production processes.

As of October 2023, the emission certificate price in the ETS is in the range of €90 to €100 per tonne of CO₂ and has more than doubled in the past two years. With the introduction of CBAM and the expansion of the ETS to include the «Building» and «Transport» sectors, it is possible that the certificate price will continue to rise in the long term. The gradual reduction of free emission certificates will also contribute to increasing price dynamics. Producing one tonne of steel emits 1.8 to 2.5 tonnes of CO₂ and producing one tonne of aluminium generates approximately 1.7 tonnes of CO₂. If the additional production costs due to rising CO₂ prices resulting from the expansion of the ETS and the introduction of CBAM are passed on to consumers, we can expect automobile prices to increase in the coming years, hence a decrease in sales and production of vehicles.

Therefore, it is likely that CBAM will accelerate the transformation of the automotive industry toward lower-emission manufacturing methods and technologies. While this transition may be costly in the short term, sustainable investments are expected to pay off for automakers in the long term due to the increasing cost of carbon emissions.

Another transitional risk is the **shift to renewable energy sources**. Companies will have to invest in renewables if they want to be competitive on the market through the process of transition from fossil fuels to renewables for energy supply in transport equipment manufacturing processes. This process might be very expensive and increase companies' operational costs.

The **adoption of electric vehicles (EVs)** in North Macedonia faces several significant challenges. One of the primary obstacles is the lack of a comprehensive charging infrastructure. Although some charging stations are available, they are not widespread enough to support a large-scale transition to EVs.⁴⁹ This limited infrastructure can deter potential buyers who are concerned about the convenience and accessibility of charging their vehicles.

⁴⁹ EVN Macedonia: Charging Station Map. There are 43 charging stations constructed by EVN. Locations can be found at: <https://emobility.evn.mk/charging-stations/ChargerMap.aspx>.

Another major challenge is the high cost of electric vehicles. The prices of EVs in North Macedonia are relatively high, and there are currently no substantial tax breaks or incentives to make them more affordable for consumers. This financial barrier can discourage many people from considering EVs as a viable option, especially when compared with traditional internal combustion engine vehicles.

Additionally, the lack of government incentives and support for EV adoption further exacerbates the situation. Without policies that promote the use of electric vehicles, such as tax breaks or subsidies, the transition to a more sustainable transportation system will be slow and difficult. Addressing these challenges will require coordinated efforts from both the government and the private sector to develop the necessary infrastructure and provide financial incentives to encourage the adoption of electric vehicles.

Finally, one of the primary risks of the transition to a low-carbon economy, driven by requirements to reduce greenhouse gas (GHG) emissions and the implementation of the Carbon Border Adjustment Mechanism (CBAM), is the potential relocation of production facilities to countries with less stringent climate policies. Companies in the machinery and equipment industry may find it more cost-effective to move their operations to regions where GHG emission regulations are less strict, avoiding the additional costs associated with compliance and carbon taxes. Moreover, the departure of major companies can have a ripple effect on the local economy. Small and medium-sized enterprises (SMEs) that rely on business from larger manufacturers may also suffer, leading to further job losses and economic decline.

Discussions with social partners and survey results

Representatives of the social partners have expressed their primary concerns regarding electricity production from coal located in the Southwest region. They highlighted that the machinery, vehicles and equipment industry is predominantly foreign-owned. Companies generally meet environmental requirements because of regulations imposed by their parent companies. Additionally, it was noted that these companies are not unionized, leading to a lack of comprehensive information about their internal practices and employee conditions. There is also a growing worry that these companies might relocate their production facilities to countries with less stringent environmental regulations, potentially leading to job losses and economic instability in North Macedonia. This potential exodus could have a ripple effect on the local economy, affecting small and medium-sized enterprises (SMEs) that rely on business from these larger manufacturers. The representatives stressed the urgent need for government intervention to ensure that these companies remain in North Macedonia, protecting both the environment and the labour market.

IV.C Transition opportunities and their economic implications

The **transition to production of electric vehicles (EVs)** presents significant economic opportunities. As EV adoption increases, the demand for fossil fuels is expected to decrease, leading to reduced greenhouse gas emissions and improved air quality. This shift can result in substantial public health benefits, including lower healthcare costs associated with respiratory and cardiovascular diseases. Additionally, the EV market is poised to create numerous jobs in manufacturing, battery production and charging infrastructure development.

From a macroeconomic perspective, the widespread adoption of EVs can stimulate economic growth by reducing dependency on imported oil and promoting energy security. If North Macedonia invests in EV technology and infrastructure it can position itself as a leader in the global green economy, attracting investments and fostering innovation. Furthermore, the lower operating and maintenance costs of EVs compared with traditional internal combustion engine vehicles can lead to significant savings for consumers and businesses.

The production of engineered components for renewable energy systems presents significant transition opportunities with far-reaching economic implications. As the global demand for renewable energy sources such as solar, wind and hydro continues to grow, there is an increasing need for specialized components that can enhance the efficiency and reliability of these systems. This demand creates a substantial market for manufacturers of engineered components, driving innovation and technological advancements in the industry.

Another opportunity is the production of equipment to **enhance circular economy practices**, which offers a pathway to sustainable economic growth by minimizing waste and maximizing resource efficiency. By designing products for longevity, reuse and recycling, businesses can reduce their environmental footprint and lower production costs. This approach can lead to the creation of new markets and business models, such as product-as-a-service and remanufacturing, which can drive economic growth and job creation.

The production of hydrogen vehicles presents significant economic opportunities for North Macedonia. As the global demand for clean energy solutions increases, investing in the hydrogen vehicle industry can position North Macedonia as a key player in the green technology market. This transition can stimulate economic growth by attracting foreign investments, fostering innovation and creating new job opportunities across various sectors, including manufacturing, research and development, and infrastructure development.

The implementation of the **Carbon Border Adjustment Mechanism (CBAM)** aims to level the playing field for domestic industries by imposing a carbon tax on imported goods that do not meet stringent emission standards. This policy can drive **innovation in low-carbon technologies** and encourage industries to adopt more sustainable practices. By aligning carbon pricing across borders, CBAM can reduce carbon leakage and promote global efforts to combat climate change.

Companies located in technological zones have a great chance to invest in innovative low-carbon technologies and be competitive on the market.

IV.D Physical climate risks and their effects on the labour market

Production of machinery and equipment is the biggest sector. It is responsible for more than 50 per cent of Macedonian exports, and rates above 25 per cent in the Industrial Production Index). The consequences for the labour market are significant.

Increased frequency and severity of drought conditions will eventually lead to reduced water availability, which is critical for cooling and cleaning in manufacturing processes. Given that the production of machinery, vehicles and equipment constitutes a significant portion of Macedonian industry, the impact on the labour market could be substantial. Water scarcity may force companies to curtail production or invest in costly water-saving technologies, potentially leading to job losses or reduced working hours for employees.

Regarding regional employment, most companies are located in the Skopje region, where the employment rate is among the highest in the country. However, some companies are also situated in the Polog region, where employment rates are the lowest. In this area, the economic impact of climate-related disruptions could be even more pronounced, exacerbating existing employment challenges and increasing the vulnerability of the local workforce.

Moreover, the shift in labour demand due to climate risks may necessitate reskilling and up-skilling of workers to adapt to new, more sustainable manufacturing practices.

Rising temperatures will lead to increased operational costs for manufacturing industry due to higher energy consumption for cooling and maintaining process stability. This impact will be particularly significant during the summer months when temperatures are at their peak. As a result, the prices of machinery, vehicles and equipment are likely to increase, reflecting the higher production costs. The production of machinery, vehicles and equipment is a major industry in North Macedonia, employing a substantial workforce. The increased operational costs and subsequent rise in product prices could lead to several risks for the labour market. Companies may face financial strain, potentially leading to job cuts or reduced working hours as they attempt to manage higher expenses. Additionally, the increased costs could make Macedonian products less competitive in the global market, potentially reducing demand and further impacting employment levels.

Extreme weather events (floods, storms) will cause disruption in the supply chain affecting the transport of raw materials and finished goods, and potential damage to infrastructure. Infrastructure is essential for the big producers of vehicles in Macedonia. The impact on the labour market could be severe, as supply chain disruptions can lead to production halts or slowdowns, resulting in temporary or permanent job losses. Workers may face reduced hours or layoffs as companies struggle to maintain operations amidst the challenges posed by extreme weather. Additionally, the need for repair and reconstruction of damaged infrastructure can divert resources away from regular business activities, further straining the labour market.

IV.E Transition risks and their effects on the labour market

The transition to the **production of electric vehicles (EVs)** as well as parts **for renewable energy systems** in North Macedonia presents several risks that could impact the labour market. One of the primary risks is the potential disruption to the existing automotive supply chain. As the industry shifts from traditional internal combustion engine vehicles to EVs, suppliers and manufacturers may face challenges in adapting to new technologies and processes. This transition could lead to temporary job losses or reduced working hours for workers who need to be re-skilled or up-skilled to meet the demands of EV production.

Another significant risk is the financial burden associated with establishing the necessary infrastructure for EV production. This includes investments in new manufacturing facilities, equipment and training programmes for workers. The high costs involved may strain companies' financial resources, potentially leading to layoffs or reduced hiring. Additionally, the lack of government incentives and support for the EV industry could further exacerbate these challenges, making it difficult for companies to compete in the global market.

The consequences for the labour market could be substantial. Workers in the traditional automotive sector may face job insecurity as companies transition to EV production. The need for specialized skills in EV manufacturing could create a skills gap, leaving some workers unemployed or underemployed.

Implementation of the Carbon Border Adjustment Mechanism (CBAM) presents several transition risks that could impact the labour market in North Macedonia, specifically for employees in the machinery, vehicles and equipment industry. Potential job losses are possible for companies unable to adapt to the new carbon pricing regulations. Companies that cannot afford to invest in cleaner technologies or improve their carbon efficiency may struggle to remain viable, leading to layoffs or reduced working hours. The need for reskilling and up-skilling of workers to meet the demands of a low-carbon economy could also create challenges, as some workers may find it difficult to transition to new roles or industries.

Finally, potential relocation of production facilities to countries with less stringent climate policies represents a significant risk to the labour market in Macedonia. Companies in the machinery and equipment industry may find it more cost-effective to move their operations to regions where GHG emission regulations are less strict. This relocation may lead to significant job losses in North Macedonia, particularly in regions heavily dependent on the machinery and equipment industry.

IV.F Transition opportunities and effects on the labour market

The transition to the production of electric vehicles (EVs) presents significant opportunities for employment in North Macedonia. As the demand for EVs increases, there will be a corresponding need for a skilled workforce in manufacturing, battery production and the development of charging infrastructure. This can create numerous job opportunities across various sectors, stimulating jobs and reducing unemployment rates. Additionally, the growth

of the EV industry can lead to the establishment of training and education programmes, helping workers to acquire the skills they need to participate in this emerging field.

The production of engineered components for renewable energy systems offers promising labour market opportunities. As global demand for renewable energy sources, such as solar, wind and hydro, continues to grow, there will be an increasing need for specialized components that enhance these systems' efficiency and reliability. This demand can lead to job creation in manufacturing, research and development, and supply chain management. By investing in this industry, North Macedonia can develop a skilled workforce and promote innovation, driving economic growth and improving employment prospects.

Implementing circular economy practices presents significant labour market opportunities by focusing on sustainability and resource efficiency. Businesses that design products for longevity, reuse and recycling can reduce their environmental footprint and lower production costs. This approach can create new markets and business models, such as product-as-a-service and remanufacturing, generating job opportunities in sectors such as repair, refurbishment and recycling. By promoting circular economy practices, North Macedonia can support sustainable economic growth and create a resilient labour market.

The production of hydrogen vehicles represents a promising employment opportunity in North Macedonia. As the global demand for clean energy solutions increases, investing in the hydrogen vehicle industry can create numerous job opportunities across various sectors, including manufacturing, research and development, and infrastructure development. By establishing a robust hydrogen vehicle industry, North Macedonia can attract foreign investments, foster innovation and create a dynamic and resilient labour market.

Implementation of the Carbon Border Adjustment Mechanism (CBAM) can drive innovation in low-carbon technologies and encourage industries to adopt more sustainable practices. This policy can create job opportunities in sectors related to clean technology development, implementation and maintenance. By promoting low-carbon industries, North Macedonia can create a skilled workforce and support sustainable economic growth, enhancing employment prospects and reducing unemployment rates.

In summary, opportunities for North Macedonia are high and new jobs can be created in the following areas:

- electric vehicle manufacturing, R&D, low-carbon technology implementation and compliance auditing;
- waste management, recycling systems, resource recovery, and sustainable product design;
- battery production, EV assembly, electronics, and software development;
- process engineering, operations and maintenance of energy-efficient technologies for transport equipment;
- R&D, production and installation of components for energy-efficient public transit systems (for example, trams and buses).

IV.G Physical climate risks and their effects on poverty and inequality

The long-term impacts of disasters on communities' well-being and prospects depend not only on direct impacts (asset losses), but also on the range and robustness of household and individual coping mechanisms, including accessibility of financial services (for example, social transfers, formal and informal post-disaster support, savings, insurance and access to credit). Households that lack access to these services will struggle to cope with shocks, and could fall into chronic poverty as a result (Carter and Barrett 2006).

The increased frequency and severity of drought conditions pose significant risks to the machinery, vehicles and equipment industry, with far-reaching implications for poverty and inequality. Droughts can lead to reduced water availability, which is critical for cooling and cleaning in manufacturing processes. As a result, companies may face increased operational costs and potential disruptions in production, which can have a direct impact on employment and income levels.

In countries or regions where the machinery, vehicles and equipment industry is a major employer, such as North Macedonia, the effects of drought-induced disruptions can be particularly severe. Workers in these industries may face job insecurity, reduced working hours or even layoffs as companies struggle to maintain operations amidst water shortages. This can exacerbate existing poverty levels and widen the gap between rich and poor, as low-income households are more vulnerable to economic shocks.

Extreme weather events, such as **floods and storms**, can disrupt supply chains, affecting the transport of raw materials and finished goods. This disruption can result in delays and increased costs for manufacturers, particularly those in the vehicle production industry. The need for repair and reconstruction of damaged infrastructure can divert resources away from regular business activities, further straining the labour market. Workers in these industries may face job insecurity, reduced working hours or even layoffs as companies struggle to maintain operations amidst these challenges.

The increased frequency and intensity of extreme weather events can exacerbate existing poverty levels and widen the gap between rich and poor. Low-income households are more vulnerable to economic shocks and may lack the resources to cope with the immediate impacts of climate-related disruptions.

IV.H Transition risks and their effects on poverty and inequality

In North Macedonia, many of the new companies located in the technological industrial zones are producing equipment and spare parts for diesel vehicles. The risk is high, as diesel vehicles will soon be banned in developed countries. Thus, adjustments are necessary, as the consequences for employment will probably be significant.

The transition to the **production of electric vehicles (EVs)**, as well as parts **for renewable energy systems** in North Macedonia presents several risks that could impact the labour market and hence poverty and inequality. As the industry shifts towards producing EVs and renewable energy components, suppliers and manufacturers may face challenges in adapting to new technologies and processes. The consequences for poverty and inequality could be substantial. Workers in traditional manufacturing sectors may face job insecurity as companies transition to producing EVs and renewable energy components. The need for specialized skills in this new industry could create a skills gap, leaving some workers unemployed or underemployed.

Potential relocation of production facilities to countries with less stringent climate policies represents significant risk to the labour market in Macedonia and hence in terms of poverty. Companies in the machinery and equipment industry may find it more cost-effective to move their operations to regions where GHG emission regulations are less strict. This relocation can lead to significant job losses in North Macedonia, particularly in regions heavily dependent on the machinery and equipment industry.

Implementing advanced recycling technologies might be costly and inaccessible in poorer regions, leading to unequal benefits, thus representing a risk for employment and poverty reduction.

Gender disaggregation data reveal that implementation of the Carbon Border Adjustment Mechanism risks increasing male poverty, as the machinery, motor vehicles and equipment sector employs predominantly men. Regional poverty may rise in the Skopje region, where most of the new, foreign-owned companies are located, but also in the Southwest and Southeast regions, where other foreign-owned companies are located. Reskilling older employees can be challenging because of their limited experience with modern technologies, which may contribute to increased poverty rates among the older male population. Finally, if not properly managed, poverty before social transfers may increase.

IV.I Transition opportunities and their effects on poverty and inequality

Transition opportunities for the Macedonian economy to reduce poverty are substantial. All the opportunities described in the previous section offer significant potential to reduce poverty in North Macedonia, as vehicle production is a labour-intensive sector, which can employ a significant quantity of workers, thus decreasing poverty. By investing in the electric vehicles industry, North Macedonia can develop a skilled workforce, promote innovation and provide employment opportunities that will contribute to poverty reduction. The government can attract and support investments in EV vehicles through various channels.

By promoting circular economy practices, North Macedonia can support sustainable economic growth and create employment opportunities that help lift people out of poverty. By establishing a robust hydrogen vehicle industry, North Macedonia can attract foreign investments, foster innovation and create a dynamic and resilient labour market that provides stable income sources and improved living standards for its citizens.

Another transition opportunity is the use of recycled and sustainable materials in vehicle production to reduce the environmental impact and align with circular economy principles. This can lead to job gains and poverty reduction in North Macedonia.

As EVs become more common, the demand for specialized spare parts and maintenance services will grow, creating new business opportunities. Leading companies that manage and reduce environmental risks in their supply chains will benefit from lower costs and better reputations, giving them a more competitive edge today and more resilience for the economy of tomorrow, increasing employment and reducing poverty.

The vehicle production sector is predominantly male-dominated, offering a significant opportunity to reduce male poverty if climate change adaptation strategies are implemented effectively. Regionally, poverty reduction is most promising in areas with a skilled labour force, such as the Skopje region, though other regions could also benefit from well-managed climate-related opportunities. By integrating gender-responsive and regional strategies, sustainable development goals can be advanced while reducing disparities.

 **Table 7. Summary of physical climate and transition risks and their effects on the labour market (production of vehicles, machinery and equipment)**

	Key climate drivers	Sectoral implications	Labour market implications	Skills needed
Physical climate risks	Increased frequency and severity of drought conditions	Reduced availability of water critical for cooling and cleaning in manufacturing processes	Job losses in affected facilities, particularly in roles such as assembly line workers	
	Rising temperatures	Increased operational costs due to higher energy consumption for cooling	Job losses, particularly in production roles	
	Extreme weather events (floods, storms)	Disruption in the supply chain	Job losses in logistics, supply chain management, and production roles	
Green economic transition	Electric vehicle (EV) transition	Demand for EVs could disrupt traditional supply chains	Job loss in traditional vehicle production	
		Demand for EVs could increase vehicle production However, there is no updated Industrial policy	New jobs in EV production, New jobs in research and development	Workforce reskilling programmes needed in: electrical and electronics: understanding electric motors, battery systems and power electronics is crucial, as these components replace internal combustion engines and fuel systems Software and programming skills: with EVs relying heavily on software for operations and diagnostics, workers need skills in embedded systems, programming and data analysis

	Key climate drivers	Sectoral implications	Labour market implications	Skills needed
Green economic transition <i>(continued)</i>	Development of green hydrogen machines	Increase in high value-added machinery production. Not supported by government industrial policy	New jobs in hydrogen production New Jobs in research and development	Chemical process knowledge: understanding hydrogen production methods, such as electrolysis and the chemical properties of hydrogen is crucial
				High-Voltage Electricity Expertise: Skills in handling high-voltage systems and electrical safety are vital for working with hydrogen machines
	Expansion of energy-efficient transport technologies	Increase of high value-added vehicles production Not supported by government industrial policy	New jobs in energy-efficient transport technologies	Advanced manufacturing techniques: skills in automation, robotics and additive manufacturing (3D printing) are increasingly important for producing energy-efficient components
				Renewable energy integration: knowledge of integrating renewable energy sources, such as solar panels or wind turbines, into transport systems can be a significant advantage
	Innovation in lightweight and high-strength materials for transport equipment	Increase of high value-added spare parts and materials production	New jobs in research and development	Skills in renewable energy technologies, installation and system maintenance

	Key climate drivers	Sectoral implications	Labour market implications	Skills needed
Green economic transition <i>(continued)</i>	Enhancement of recovery and recycling processes for production of machinery and vehicles	Improvements in recycling technologies, enhance product lifecycle management in line with the Long-term Strategy for Climate Action and Action Plan	New jobs in recycling technologies for production of machinery and vehicles	Materials identification and sorting: workers need to understand how to identify and separate recyclable materials, such as metals, plastics and composites, for efficient processing
				Knowledge of recycling technologies: familiarity with machinery used in recycling, such as shredders and balers, is essential for handling end-of-life products



Policy recommendations

► Policy recommendations

The final step comprises policy recommendations derived from the research presented in the preceding sections of this report. The proposed policy measures are categorized into three groups: short-term, medium-term and long-term actions. Each policy measure outlines the responsible institution, the relevant sector and the basis for the recommendation, whether it originates from desk research on various vulnerable sectors, proposals made by social partners or analysis of online survey data. Furthermore, we elaborate whether the policies are presented in any of the national strategic documents, and the type of proposal (regulation, training, campaign). Finally, we assess the impact on the Macedonian economy if the policy recommendation is implemented.

Short-term measures

1. Introduce policies for reducing vulnerability to heat stress and promoting adaptation to minimize heat-related productivity losses

Relevant sectors: Agriculture, construction and other heat-exposed sectors.

To combat rising temperatures, especially in predominantly outdoor sectors, this policy suggests three key actions:

- Work shift adjustments: shift work schedules to avoid peak heat hours (typically 1–5 p.m.), minimizing heat-related illnesses and boosting productivity.
- PPE for heat protection: equip workers with breathable, cooling attire to maintain health and efficiency.
- Training programmes: educate employees and managers in recognizing and preventing heat stress symptoms.

Basis of the proposed measure: Construction sector analysis. Measure suggested by a representative of the biggest construction company, Granit JSC Skopje.

Responsible institution: Ministry of Economy and Labour of the Republic of North Macedonia.

Mode: Regulation and training.

Impact on the Macedonian economy: While businesses may face initial costs, healthier, more resilient working conditions lead to long-term retention and supply of labour. Furthermore, it is expected that productivity will improve.

2. Shift to decoupled subsidy payments

Relevant sector: Agriculture.

Decoupled subsidies allow farmers to choose crops based on market demand, not subsidy distortions. This indirectly encourages climate-resilient farming, such as drought-tolerant crops.

Basis of the proposed measure: This measure was proposed by the World Bank, and implemented by the EU Common Agricultural Policy. Furthermore, this proposal was supported by the social partners and employee organizations, as currently food exports are declining and food imports are increasing. Agricultural producers are not motivated to produce climate resistant crops.

Responsible institution: Ministry of Agriculture, Forestry and Water Economy of the Republic of North Macedonia.

Mode: Regulation.

Impact on the Macedonian economy: Increase in agricultural production. More sustainable agricultural employment and entrepreneurial opportunities, especially among young people in rural areas.

3. Expand support for agricultural diversification and smart farming technologies

Relevant sector: Agriculture.

Encourage farmers to shift to climate-resilient crops such as **millet, quinoa and sweet potatoes**, and to invest in training in digital farming solutions (for example, IoT, precision farming).

Basis for the proposed measure: This measure was proposed by the authors and supported by the social partners. This measure is also part of the Long-term Strategy for Climate Action and Action Plan.

Mode: Subsidies.

Responsible institution: Ministry of Agriculture, Forestry and Water Economy of the Republic of North Macedonia.

Impact on the Macedonian economy: Supports employment, especially for tech-savvy young people; makes farming more appealing and sustainable.

4. Launch public awareness campaigns on climate adaptation practices

Relevant sector: Agriculture and selected industries.

Raise public knowledge about climate risks and encourage sustainable practices, especially targeting vulnerable groups such as rural women and young people.

Basis for the proposed measure: During the meetings with social partners, it was emphasized that currently Macedonian agricultural producers (but also producers in other sectors) and workers, are not fully aware of the consequences of climate change. This measure is also part of the Long-term Strategy for Climate Action and Action Plan.

Mode: Campaign.

Responsible institution: Ministry of Environment and Physical Planning.

Impact on the Macedonian economy: Informed communities can take proactive steps, reducing long-term socio-economic vulnerability.

5. Strengthen enforcement of environmental and labour regulations, particularly heat-related workers' rights

Relevant sector: Construction.

Enforce non-selective control measures for workplace safety – especially heat-related protections – to prevent exploitative practices and ensure fair competition.

Basis for the proposed measure: Proposed by a representative of the biggest construction company. Not envisaged in other strategic documents.

Mode: Law enforcement.

Responsible institution: Ministry of Economy and Labour.

Impact on the Macedonian economy: Better working conditions will reduce turnover and improve labour productivity.

6. Improve early warning systems for floods, droughts and wildfires

Relevant sector: Infrastructure.

Invest in early warning technologies for climate disasters, aligning with UNESCO disaster risk reduction principles.

Basis for the proposed measure: Proposed by social partners. Not envisaged in other strategic documents.

Mode: Investment .

Responsible institution: Crisis Management Centre.

Impact on the Macedonian economy: Creates jobs in civil engineering and tech, while also saving lives and assets.

7. Initiate preparation of a new industrial policy (post-2020)

Relevant sector: Industry.

Design a forward-looking strategy that integrates green technologies (renewables, EVs, carbon-neutral solutions) to guide industry transformation.

Mode: Strategic document.

Basis for the proposed measure: During the discussions with social partners, it was pointed out that Macedonian industrial policy prepared by the Ministry of Economy and Labour is outdated, and no other document has been prepared. Not envisaged in other strategic documents.

Responsible institution: Ministry of Economy and Labour.

Impact on the Macedonian economy: Limited in the short term, transformative in the long term for economic resilience and job creation, thus poverty reduction.

8. Allocate more funding for severance and reskilling in coal-dependent regions

Relevant sector: Energy transition.

Support workers impacted by the transition, particularly in coal-heavy areas such as Bitola, with financial assistance and retraining programmes.

Basis for the proposed measure: The main concern of union representatives was the coal transition process. They emphasized and insist that higher severance payments will be necessary, as well as more reskilling.

Responsible institutions: Ministry of Social Policy, Demography and Youth and Ministry of Economy and Labour.

Mode: Financial allocation.

Impact on the Macedonian economy: Smoothens labour transitions, protects livelihoods and fosters inclusive economic transformation.

9. Create contingency plans across all sectors

Relevant sectors: Cross-sectoral.

Develop robust, scenario-based plans to respond to climate-induced disruptions. Should involve local governments, businesses and civil society.

Basis for the proposed measure: This proposal was the result of the online survey prepared with employee organization.

Mode: Strategic documentation.

Responsible institution: Government of North Macedonia and municipalities.

Impact on the Macedonian economy: Enhances systemic resilience, reducing social and economic shocks.

Medium-term measures

1. Initiate green public and private procurement

Relevant sector: Green finance.

Prioritize purchasing from companies with low environmental footprints. This helps to mainstream eco-standards and promotes green SMEs.

Basis for the proposed measure: Proposed by the employers' organization. This measure is also part of the Long-term Strategy for Climate Action and Action Plan.

Responsible institution: Ministry of Finance.

Mode: Regulation.

Impact on the Macedonian economy: Growth of "green" job sectors and market shift toward sustainable goods and services.

2. Facilitate greater usage of eco-cement

Relevant sector: Construction.

Develop a roadmap with Cementara Skopje and the Ministry of the Environment to integrate low-emission cement into major construction projects.

Basis for the proposed measure: Proposed by the Union of Employers, a representative of Cementara JSC Skopje, the single cement producer in North Macedonia. Not envisaged in other strategic documents.

Responsible institution: Ministry of Environment and Physical Planning.

Mode: Regulation and programme.

Impact on the Macedonian economy: Boosts demand for green construction jobs and reduces emissions in a traditionally carbon-heavy sector.

Long-term measures

1. Establish a long-term green skills development and workforce transition strategy

Relevant sectors: Renewable energy, construction, manufacturing, waste management, agriculture.

To address emerging skills needs linked to climate change and the green transition, this policy proposes:

- Skills anticipation: develop forward-looking assessments of green and transition-related skills demand using labour market and sectoral data
- Education and training reform: adapt vocational education, higher education and adult learning programmes to emerging green occupations and technologies.
- Targeted reskilling: support reskilling and upskilling for workers in declining or carbon-intensive activities.

Basis for the proposed measure: Labour market and skills analysis highlighting skills mismatches and limited preparedness for green sector expansion.

Responsible institution: Ministry of Education and Science, in cooperation with the Ministry of Economy and Labour and the Employment Service Agency.

Mode: Strategy development, education and training reform.

Impact on the Macedonian economy: A more adaptable workforce enhances productivity, supports sectoral transformation and reduces long-term unemployment risks during the green transition.

2. Promote structural transformation towards green and climate-resilient sectors

Relevant sectors: Renewable energy, sustainable construction, circular economy, climate-resilient agriculture.

To unlock long-term employment and productivity gains, this policy suggests:

- **Targeted investment incentives:** support private and public investment in sectors with high green job creation potential.

- **Value chain development:** strengthen domestic supply chains and local value addition in green sectors.
- **SME support:** provide technical assistance and financing to small and medium enterprises adopting green technologies and practices.

Basis for the proposed measure: Economic and sectoral analysis identifying green sectors as key drivers of future employment growth.

Responsible institution: Ministry of Economy and Labour, in cooperation with the Ministry of Finance and the Ministry of Environment and Physical Planning.

Mode: Investment policy, industrial policy and financial incentives.

Impact on the Macedonian economy: Accelerates job-rich growth, increases competitiveness and supports a shift towards more resilient and sustainable economic activities.

3. Strengthen just transition mechanisms for workers and regions affected by environmental transitions

Relevant sectors: Energy, mining, industry and regionally concentrated activities.

To mitigate inequality and social risks linked to the green transition, this policy proposes:

- **Just transition planning:** develop place-based transition plans for affected regions and sectors.
- **Income and employment support:** combine income protection with active labour market policies for displaced workers.
- **Social dialogue frameworks:** institutionalize dialogue at national and regional levels to manage transition processes.

Basis for the proposed measure: GED findings on regional and sectoral vulnerabilities and potential inequality impacts of climate and environmental policies.

Responsible institution: Ministry of Social Policy, Demography and Youth, in cooperation with the Ministry of Economy and Labour and local authorities.

Mode: Social policy, active labour market policies and social dialogue.

Impact on the Macedonian economy: Reduces social and regional disparities, facilitates labour reallocation and strengthens social cohesion during structural change.

4. Build a modern Lindfield facility in Skopje

Relevant sector: Environment.

The existing facility requires modernization to meet new waste and emissions standards. A new Lindfield would support recycling, circular economy practices, and job creation.

Lead: City of Skopje and Ministry of the Environment and Physical Planning.

Mode: Infrastructure project.

Basis for the proposed measure: Proposed by the representative of the Ministry of Social Policy, Demography and Youth. This measure is also part of the Long-term Strategy for Climate Action and Action Plan.

Mode: Investment.

Responsible institution: Ministry of Environment and Physical Planning, City of Skopje.

Impact on the Macedonian economy: Promotes long-term green job growth and reduces urban environmental risks.



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Appendix

 **Table 8. Summary of proposed measures**

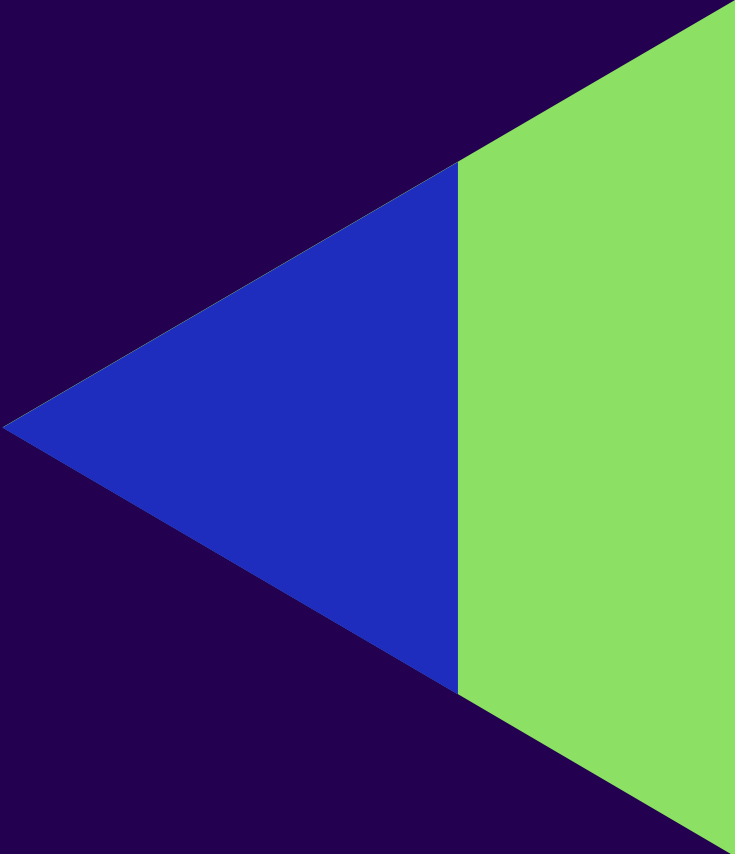
Time frame	Recommendation	Relevant issue / sector	Description	Responsible institution	Mode of delivery	Impact on labour market and poverty
Short-term measures	Introduce policies for reducing vulnerability to heat stress and promoting adaptation to minimize heat-related productivity losses	Agriculture, construction, and other heat-exposed sectors	Work shift adjustments: implementing policies that adjust work shifts to avoid the hottest parts of the day, typically from 1 p.m. to 5 p.m., can help to protect workers from heat stress Personal protective equipment (PPE): providing workers with appropriate PPE designed to reduce heat stress, such as lightweight, breathable clothing and cooling vests, can help to maintain comfort and productivity Training and awareness programmes: implementing training programmes to educate workers and supervisors about the signs and symptoms of heat-related illnesses, as well as preventive measures, is crucial	Ministry of Social Policy, Demography and Youth	Regulation and training	Higher costs for companies, but Improved working conditions – more labour supply
	Shift to decoupled subsidies payments.	Agriculture	Decoupled subsidies are not linked to the production levels or prices of specific crops. This helps to reduce market distortions and allows farmers to make production decisions based on market signals rather than subsidy incentives Climate-resilient crops will be signaled by the market	Ministry of Agriculture	Regulation	Increase in employment

Time frame	Recommendation	Relevant issue / sector	Description	Responsible institution	Mode of delivery	Impact on labour market and poverty
Short-term measures (continued)	Expand support to investments in diversification of agricultural practices and provide training on smart farming technologies	Agriculture	Subsidies for climate-resilient crops (millet, quinoa, sweet potatoes) Training in smart farming technologies	Ministry of Agriculture	Subsidies	Positive impact
	Launch public awareness campaigns on climate adaptation practices, especially targeting vulnerable populations	Agriculture/ selected industries	Public awareness campaigns can equip communities with the knowledge and tools needed to adapt to changing climatic conditions. This includes understanding how to implement sustainable agricultural and industrial practices, conserve water and prepare for extreme weather events	Ministry of the Environment and Physical Planning	Campaign	Positive impact
	Strengthen enforcement of environmental regulations, as well as health stress and similar workers' rights. Enforcement should be non-selective	Construction sector	Government regulation and monitoring of heat stress is selective and many companies are not being monitored, creating unfair competition	Ministry of Social Policy, Demography and Youth	Law enforcement	Improved working conditions
	Improve early warning systems for floods, droughts and wildfires in line with UNESCO disaster risk reduction	Infrastructure improvements	As the climate changes, more floods, extreme weather conditions, fires are expected. Early warning systems should be improved	Crisis Management Centre of the Republic of North Macedonia	Investment in early warning systems	New civil engineering jobs

Time frame	Recommendation	Relevant issue / sector	Description	Responsible institution	Mode of delivery	Impact on labour market and poverty
Short-term measures (continued)	Initiate preparation of new industrial policy (previous one dates back to 2009–2020)	Improve strategic planning	Industrial policy should include a new normal, which is investment in renewables, carbon neutral technologies, electric vehicles etc. This document should give strategic directions for Macedonian industry	Ministry of the Economy and Labour	Strategic document preparation	No impact in short run Positive impact in long run
	Allocate more funding for severance payments and reskilling programmes for workers in coal-dependent regions affected by the Just Transition Roadmap.	Financial support for possible lay-offs	As closure of thermal power plant is a government commitment more funds should be secured	Ministry of Social Policy, Demography and Youth	Financial allocation	Improved financial support for redundant workers.
	Create contingency plans	All sectors	Contingency plans are pre-prepared plans describing when and how a land manager, business or organization will deal with actual and potential threats to the environment. Contingency planning for climate change specifically refers to the plans made in preparation for current and future risks, related to the changing climate	Government and municipalities	Strategic documentation	More secure environment

Time frame	Recommendation	Relevant issue / sector	Description	Responsible institution	Mode of delivery	Impact on labour market and poverty
Medium term measures	Initiate green public and private procurements	Green finances	When government agencies, municipalities and public enterprises procure goods, they should prioritize companies that emit fewer greenhouse gases and adhere to strict European environmental standards	Ministry of Finance	Regulation	Increase in green vacancies
	Facilitate greater usage of eco-cement	Construction	Cementara Skopje (The Cement Factory) has recently begun producing eco-cement. In collaboration with the Ministry of the Environment, a strategic plan should be developed to increase utilization of this environmentally friendly cement.	Ministry of the Environment and Physical Planning	Regulation and programme	Increase in green jobs
Long-term measures	Establish a long-term green skills development and workforce transition strategy	Renewable energy, construction, manufacturing, waste management, agriculture	Develop a forward-looking skills system to support the green transition, including: (i) skills anticipation systems using labour market and sectoral data; (ii) reform of vocational, higher education and adult learning to integrate green skills; (iii) targeted reskilling and upskilling programmes for workers in declining or carbon-intensive sectors.	Ministry of Education and Science, in cooperation with Ministry of Economy and Labour and Employment Service Agency	Strategy development; education and training reform	Enhances workforce adaptability, supports productivity growth, facilitates sectoral transformation and reduces long-term unemployment risks

Time frame	Recommendation	Relevant issue / sector	Description	Responsible institution	Mode of delivery	Impact on labour market and poverty
Long-term measures (continued)	Promote structural transformation towards green and climate-resilient sectors	Renewable energy, sustainable construction, circular economy, climate-resilient agriculture	Support a shift towards high-potential green sectors through: (i) targeted investment incentives; (ii) development of domestic value chains and local value addition; (iii) technical and financial support to SMEs adopting green technologies and practices.	Ministry of Economy and Labour, in cooperation with Ministry of Finance and Ministry of Environment and Physical Planning	Investment policy; industrial policy; financial incentives	Drives job-rich growth, increases competitiveness and accelerates transition towards resilient and sustainable economic activities
	Strengthen just transition mechanisms for workers and regions affected by environmental transitions	Energy, mining, industry, regionally concentrated sectors	Ensure an inclusive transition through: (i) place-based just transition plans; (ii) income support combined with active labour market policies; (iii) strengthened social dialogue at national and regional levels.	Ministry of Social Policy, Demography and Youth, in cooperation with Ministry of Economy and Labour and local authorities	Social policy; active labour market policies; social dialogue	Reduces inequalities, supports labour reallocation, and strengthens social cohesion during structural transformation
	Build a modern Lindfield	Environment	Current Lindfield in Skopje needs to be modernized	City of Skopje – Ministry of the Environment and Physical Planning	Project	Increase in green jobs



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