REPORT ON TURKIC ECONOMIES 2025

# Green Economy Transition

**Inclusive. Sustainable. Resilient.**

Organization of Turkic States

Turkic Academy

Turkic Investment Fund

Report on Turkic Economies 2025:

# Green Economy Transition

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**Report on Turkic Economies 2025:**
**Green Economy Transition**

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# Acronyms

| | |
|---|---|
| ADB | Asian Development Bank |
| AIIB | Asian Infrastructure Investment Bank |
| AIFC | Astana International Financial Centre |
| AIX | Astana International Exchange |
| BAT | Best Available Techniques |
| BAU | business-as-usual |
| CAREC | Central Asian Regional Economic Cooperation |
| CAWEP | Central Asian Water and Energy Program |
| CBAM | Carbon Border Adjustment Mechanism |
| CCUS | carbon capture, utilization, and storage |
| CFAF | Climate Finance Action Fund |
| CIF | Climate Investment Funds |
| CO2eq | carbon dioxide equivalent |
| DFIs | development finance institutions |
| EAEU | Eurasian Economic Union |
| EBRD | European Bank for Reconstruction and Development |
| ECI | Economic Complexity Index |
| EPI | Environmental Performance Index |
| ERCNET | Turkic Economic Policy Research Centers Network |
| ESG | environmental, social, and governance |
| ETS | Emissions Trading System |
| EU | European Union |
| EXIST | Energy Exchange Istanbul |
| FAO | Food and Agriculture Organization of the United Nations |
| F-gases | fluorinated gases |
| GCF | Green Climate Fund |
| GEF | Global Environment Facility |
| GEZ | Green Energy Zone |
| GHG | greenhouse gas |
| GIS | geographic information systems |
| GNI | gross national income |
| GST | Global Stocktake |
| HVDC | high-voltage direct current |
| ICT | information and communication technology |
| IEA | International Energy Agency |
| IFC | International Finance Corporation |
| IMF | International Monetary Fund |
| IRENA | International Renewable Energy Agency |
| LTS | Long-Term Climate Strategy |
| MTP | Medium-Term Program |
| N2O | nitrous oxide |
| NDCs | Nationally Determined Contributions |
| NECP | National Energy and Climate Plan |
| OECD | Organisation for Economic Co-operation and Development |
| OIZs | Organized Industrial Zones |
| OTS | Organization of Turkic States |
| P4G | Partnership for Green Growth and the Global Goals 2030 |
| PM2.5 | particulate matter with a diameter of 2.5 micrometres or less |
| PPA | power purchase agreement |
| PPP | purchasing power parity |
| PV | photovoltaic |
| RES | renewable energy sources |
| RDI | research, development, and innovation |
| RRF | Recovery and Resilience Facility |
| SDGs | Sustainable Development Goals |
| SME | small and medium-sized enterprise |
| TEU | twenty-foot equivalent unit |
| TIF | Turkic Investment Fund |
| TITR | Trans-Caspian International Transport Route |
| TRNC | Turkish Republic of Northern Cyprus |
| UN | United Nations |
| UNCTAD | United Nations Trade and Development |
| UNDP | United Nations Development Programme |
| UNECE | United Nations Economic Commission for Europe |
| UNEP | United Nations Environment Programme |
| UNESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WMO | World Meteorological Organization |

*Note: Abbreviations used only as source-citation labels are excluded from the acronyms list.*


# Message from the President of the Turkic Academy

I am pleased to present the 2025 edition of the Report on Turkic Economies. The Turkic Academy publishes the report through the work of the Turkic Economic Policy Research Centers Network (ERCNET), in cooperation with the Turkic Investment Fund and the Organization of Turkic States. The 2025 edition is devoted to green economy transition across the Turkic World.

A report of this kind matters to the Turkic Academy because it creates space for serious analysis and a more grounded public discussion. Green transition is now part of the economic choices facing our countries. Yet the countries of the Turkic World do not face the same conditions, nor do they move at the same pace.

Resource endowments, industrial structures, and institutional capacities differ. Access to finance differs as well. Some economies have already built stronger policy frameworks. Others still face harder structural limits. This publication reflects those differences clearly, while still providing readers with a shared basis for comparison.

The report opens with a regional overview and then moves to country chapters. Read together, the chapters offer a broad picture of where Turkic economies stand today in green transition, where progress is taking shape, and where more work remains.

Another point also becomes clear across the volume. Green transition cannot be read as an energy matter alone. It reaches into production, transport, agriculture, trade, finance, urban systems, and labor markets. Any credible discussion of the subject needs to keep that wider economic setting in view.

The Turkic Academy sees the report as part of its wider contribution to research and policy dialogue across the Turkic World. Better evidence does not settle policy choices on its own, but it can sharpen judgment and support more careful decisions. It can also help researchers, public institutions, business actors, and partner organizations read shared concerns more clearly and learn from differing national experiences.

I hope the pages that follow will be useful in that spirit. The Turkic

Academy will continue to support the economic agenda of the Turkic World through research, publication, and scholarly exchange. I trust this report will add value to the ongoing discussion on green economy transition across Turkic countries.

**Prof. Dr. Shahin MUSTAFAYEV**
*President of the Turkic Academy*

# Message from the Secretary General of the Organization of Turkic States

I welcome the publication of the 2025 edition of the Report on Turkic Economies, prepared jointly by the Turkic Academy, the Turkic Investment Fund, and the Organization of Turkic States. The report addresses green economy transition across the Turkic World at a time when climate risks, resource pressure, and shifts in global markets are placing new demands on our economies. What was once treated as a longer-term policy matter now requires closer coordination and firmer collective action.

For the Organization of Turkic States, this is first and foremost a matter of common direction. Our role is to help Member States shape shared priorities, sustain political attention, and keep regional cooperation moving steadily and in an organized way. The Turkic Green Vision gave that work a clearer policy frame. It outlined common areas of action, including renewable energy, energy efficiency, clean technologies, climate-resilient infrastructure, zero-waste practices, and the responsible use of natural resources. In advancing these priorities, the OTS also draws on its 17 economic cooperation mechanisms, which provide practical platforms for coordination, implementation, and the alignment of sustainable development efforts across Member States.

The decisions adopted at the XII Summit of OTS, held in Gabala, added further depth to that agenda. They supported the Central Asia-Azerbaijan Green Energy

Corridor, welcomed efforts to strengthen green electricity cooperation, and called for greater progress under the OTS Partnership for Climate, Innovation, Green Economy and Trade. These steps matter because they show that our Member States are not treating this agenda as a statement of intent alone. They are giving it institutional form and regional direction.

In 2025, the inaugural meeting of the Turkic Green Finance Council was held in Astana, which was a landmark occasion for the Turkic World as it brought together relevant authorities to discuss a practical pathway for green and sustainable finance.

Together with UNIDO and TÜBİTAK, the OTS organized a high-level panel titled "Driving Green Innovation Through Regional Cooperation: The Role of OTS" during Cleantech Days 2025 in Istanbul. The event brought together senior policymakers, innovators, and experts from around the world to discuss cleantech, entrepreneurship, and the transition to a green economy.

A transition of this scale cannot advance through separate national efforts alone. It calls for regular consultation, closer alignment among public bodies, and the patience to carry cross-border initiatives from endorsement to implementation. That process is demanding. Still, our Member States have already shown that shared priorities can produce joint action when there is continuity and discipline. This report supports that wider effort. It provides regional discussions with a stronger analytical foundation and offers policymakers, public institutions, and partner organizations a useful point of reference.

I trust that the work presented in this report will encourage closer "green cooperation" among our Member States and support the steady advancement of a greener and more resilient Turkic World..

**Amb. Kubanychbek OMURALIEV**
*Secretary General of the Organization of Turkic States*

# Message from the President of the Turkic Investment Fund

The green economy transition will be judged by delivery. Plans, roadmaps, and public commitments all matter, yet none of them can substitute for projects that are well prepared, financed on sound terms, and carried through to completion. That is where the mandate of the Turkic Investment Fund begins. For the Fund, this agenda is not abstract. It is tied to the practical work of moving viable ideas toward real investment.

I am pleased to join in presenting the "Report on Turkic Economies 2025: Green Economy Transition," whose subject speaks directly to the Fund's mission. TIF was established to support economic development, stronger regional ties, and deeper cross-border cooperation among its Member States.

In the current setting, that mission includes support for a new generation of investments in energy, transport, logistics, industrial production, and related services. The Fund is advancing its operations on a strong institutional foundation, guided by financial soundness, prudent risk management, and long-term sustainability.

The Fund places strong emphasis on co-financing with established partners. This expands access to capital, reinforces sound project standards, and supports disciplined portfolio growth on a strong operating foundation.

As capital becomes more selective, regional institutions need to do more than state their support. They need to offer stability, coordination, and confidence. For the Turkic Investment Fund, this means helping prepare solid projects, mobilize co-financing, and bring different sources of capital together around investments that serve clear regional priorities.

Not every green project will require the same financial structure. Some can move on commercial terms. Others may need blended support to address market gaps, reduce early risk, or strengthen project preparation.

Across the full project cycle, environmental, social, and governance standards remain part of how the Fund works. They are built into project assessment and decision-making from the start.

The next task is straightforward. The shared regional priorities of the Turkic countries need to be translated into a strong pipeline of investment-ready projects. Well-prepared proposals need to move toward approved financing.

Partnerships need to produce results that can be seen in better infrastructure, cleaner production, stronger trade links, and wider opportunities for firms and communities.

The Turkic Investment Fund is ready to support that effort. Our aim is clear: to help turn shared regional priorities into finance-ready investments that can attract capital and create durable value across the Turkic World.

**Baghdad AMREYEV**
*President of the Turkic Investment Fund*

CHAPTER I

# Overview of the Green Economy Transition in Turkic Countries

Assoc. Prof. Dr. Erhan Türbedar
Turkic Investment Fund

The linear economy has shaped global growth for decades, but it is now running into clear limits. It relies on extraction, production, and disposal, and it treats GDP growth as the primary yardstick of progress even when it fails to meet human needs or stay within environmental boundaries (Sanchez-Garcia et al., 2024, pp. 1–2).

Global trends indicate that there are issues of social welfare and income inequality alongside environmental degradation. According to data from the World Bank's Poverty and Inequality Platform for 2023, 848.5 million people worldwide live in extreme poverty (World Bank, 2025, p. 5). As of 2024, data from the IMF Global Debt Database shows that global debt stood at $251 trillion, which is about 235% of the world's GDP (IMF, 2025, pp. 1–6). Moreover, wealth inequality became more extreme: Half of the world's population held only 2% of global wealth. (Chancel et al., 2026, p. 13). According to 2024 data on the environment, greenhouse gas levels have risen to levels higher than ever before (WMO, 2025). Further, it is documented globally that most countries are consuming resources more than the earth can regenerate (UNEP, 2024, p. 29). As scientists estimated, in 2019, 1 million species were at risk of extinction (IPBES, 2019, p. 207).

In response to increasingly urgent pressures, the concept of the 'green economy' has assumed a central position on the agendas of policymakers. Green economy transition involves a shift from a 'take-make-waste' economy and towards production and consumption that keep materials in use, cut pollution and emissions, and reduce pressure on natural systems. The goal of the green economy is inclusive economic development within ecological limits.

IMAGE I.1: FROM LINEAR TO CIRCULAR ECONOMY:
CREATING AND RETAINING VALUE


Source: Visualization based on established linear and circular economy models.

An inclusive green economy treats living standards and equality as part of the equation in the transition process. Economic output can be increasing while many people are still living in poverty or face higher costs and weaker services. A real transition reduces greenhouse gases as well as waste while creating better quality jobs and incomes, and access to basic services.

The green economy transition has already started in some sectors of the world's economy, and Turkic economies are considering this change at national and regional levels. The 2025 Gabala Declaration of the Organization of Turkic States (OTS) supported the development of the "Central Asia-Azerbaijan Green Energy Corridor," took note of progress in green electricity transmission and trade between Azerbaijan and Türkiye, and called for the full operationalization of "OTS Partnership for Climate, Innovation, Green Economy, and Trade" (OTS, 2025a).

The priorities set by the Turkic Green Vision, adopted on 6 November 2024, are to scale up renewable energy and clean technologies, build climate-resilient infrastructure, improve energy efficiency, advance the concept of a

zero-waste society, and safeguard natural resources and biodiversity through regional cooperation (OTS, 2024b). Within the above framework, the OTS launched the concept of the Turkic Green Finance Council to foster the development of green capital markets (OTS, 2024c).

In parallel, TIF is ready to accompany the transition toward a green economy through its financing rules. Under the TIF Strategic Roadmap for 2025–2030, the Fund supports projects in energy efficiency, renewable energy, and environmental protection (TIF, 2025a). TIF's Investment Policy also sets clear boundaries through an exclusion list, which rules out support for coal-based power generation, activities in protected natural habitats, and cross-border waste trade that can harm the environment (TIF, 2025b). Finally, TIF's Environmental, Social and Governance (ESG) Policy has linked financing to the Paris Agreement, UN Sustainable Development Goals, and other international climate and sustainability objectives (TIF, 2025c).

In addition to deploying new technologies, building an inclusive green economy depends on changes in markets and demand, shifts in what firms produce and how they produce it, and institutions and skills that can keep pace. While sectoral policies carry the vision into practice in energy, agriculture, infrastructure, and industry, long-term development plans and green economy strategies are required to set the direction.

Chapter I reviews the transition to the green economy across Turkic economies. It provides the basis for understanding the necessary economic and social conditions by identifying major drivers and sustainability challenges and determining the level of preparedness to adjust policies, investments, and institutions to support green economy transition.

Regional figures cover Azerbaijan, Kazakhstan, Kyrgyzstan, Türkiye, Turkmenistan, Uzbekistan, and Hungary. In this chapter, "Turkic economies" is used as shorthand for this set, with Hungary included as a benchmark to support cross-country comparison and consistent presentation across figures.

Figures and tables in this chapter use the latest available internationally comparable sources. The Turkish Republic of Northern Cyprus is not included in this chapter's comparative analysis due to limited data availability for the selected indicators.

## Key Messages of Chapter I

- Readiness levels for the green transition of Turkic economies divide them into three categories. The leading pack comprises Hungary and Türkiye, while Kazakhstan is at a moderate readiness level. Azerbaijan, Kyrgyzstan, Turkmenistan, and Uzbekistan show lower readiness and will need stronger foundations for transition.
- Green competitiveness and innovation are concentrated, led by Hungary on green export complexity and by Türkiye's strong performance. Türkiye also stands out in R&D and green patenting, while most other Turkic economies rely more on technology adoption.
- Power sector starting points differ across the Turkic economies, shaping the cost and speed of decarbonization. In Turkic economies where power generation still relies mainly on fossil fuels, switching transport and industry to electricity will reduce emissions only modestly unless the grid also becomes cleaner.
- Turkic economies' exports remain oriented toward markets outside the Turkic region, and buyer markets are tightening requirements for standards, traceability, and carbon performance.
- Green goods exports from Turkic economies have increased, but most exports still come from carbon-intensive products. Trade in low-carbon technologies also remains concentrated: Hungary and Türkiye account for most exports, while several other Turkic economies mainly import these technologies rather than export them.
- Environmental and resource limits can slow the green transition. In some Turkic economies, water shortages pose a significant problem. In others, the bigger issue comes from ecosystem pressure or low rates of recycling and waste recovery. Besides similarities, each Turkic economy also faces specific obstacles to green economy transition.
- Inclusion and delivery capacity shape what reforms can succeed. Where insecure or informal work remains widespread, energy pricing reform and industrial change need targeted protection and reskilling to remain workable. Near-term progress also depends on basic adoption conditions, including affordable access, install-and-maintain skills, predictable rules, and enabling infrastructure.

## I.1 Economic and social foundations of the green transition

Economic and social factors can explain the pace at which the Turkic economies can adopt cleaner growth and how the population copes with the associated costs. Growth dynamics, economic structures, and urbanization rates might reveal areas of rising energy demand as well as increased investment demand. Trade patterns also influence the degree of exposure to stricter environmental regulations in the leading export destinations, as well as the ease with which the countries can import low-carbon technology.

Similarly, income levels and employment rates have important roles to play. This is because they influence how much people need new job opportunities and how hard it feels to absorb the short-term costs of green transition, thereby affecting the speed of necessary reforms.

Section I.1 tracks three channels that carry through the chapter. Growth and urbanization set the scale and location of future energy and infrastructure demand. Trade exposure and technology access shape competitiveness as external markets tighten carbon and traceability rules. Distribution and job security shape political space for price and regulatory reform.

### What to watch in Section I.1

- Growth and urbanization determine where energy and infrastructure demand rise first, with cities carrying most of the delivery burden.
- Trade exposure and low-carbon tech access shape competitiveness as external markets tighten carbon and traceability rules.
- Distribution and job security shape how much reform space governments have when costs rise.

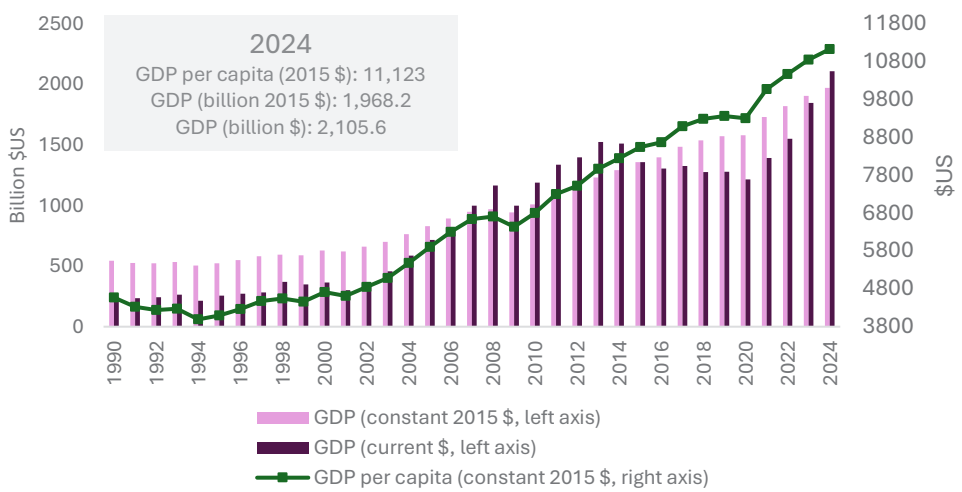
### I.1.1 Growth dynamics, structural change, and demographic trends

The pattern of growth and demographics is an essential factor that determines the speed of energy demand growth, the emerging hotspots of emissions, and the investment needs that are now emerging. Economic

growth in the Turkic economies has been upward since 1990. In constant 2015 prices, output rose from about $545 billion in the early 1990s to nearly $2 trillion by 2024. Periods of global stress left visible marks. The growth of Turkic economies slowed during the 2008–2009 financial crisis and further declined in 2020 due to the COVID-19 pandemic. By the early 2020s, recovery started, and by 2024, the combined GDP of the Turkic economies exceeded $2.1 trillion in current prices.

GDP growth alone does not capture the challenges of the green transition, as shown in the later sections of this chapter, which evaluate how changes in power mix and resource constraints affect the investment needed to meet rising demand.

FIGURE I.1: AGGREGATE GDP OF TURKIC ECONOMIES
(REAL GDP, NOMINAL GDP, AND REAL GDP PER CAPITA)




Source: World Bank data.

The average levels of GDP per capita of Turkic economies also recorded increases. In constant prices, GDP per capita rose from $4,566 in 1990 to $11,123 by 2024 (Figure I.1). Progress sped up after the mid-2000s, when stronger economic growth started to raise average incomes more visibly.

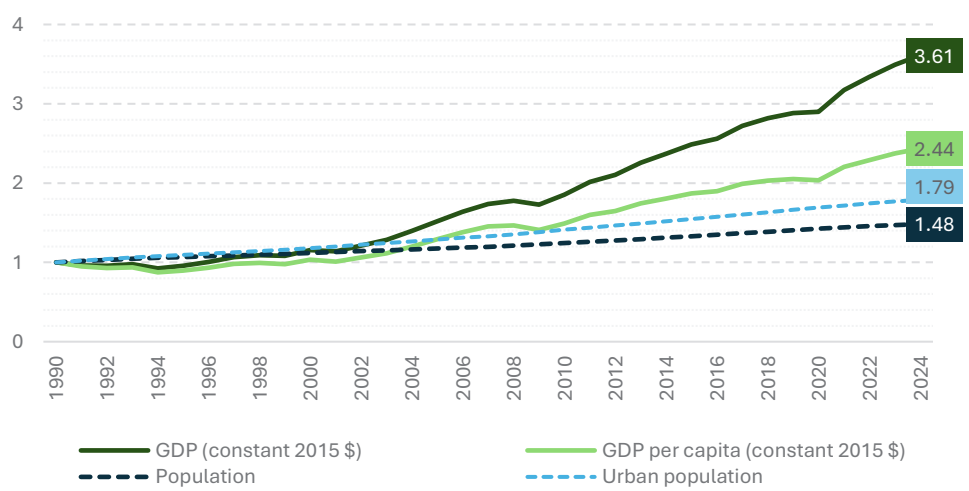
Over the same period, the total population of the Turkic economies rose from 119.3 million people in 1990 to 177 million people in 2024, an increase matched by a rise in urban population from around 65 million people to

nearly 117 million people. Yet, the urban population is rising faster than the total population, which is a sign of the rapid urbanization process.

As cities grow, they shape long-term energy use because of the buildings people live in, the transport systems they rely on, and the services cities must provide. At that point, the green transition becomes a delivery problem in cities, which is directly linked to later evidence on water stress, heat exposure, and waste system performance.

Index trends confirm a long-run expansion in output, income per capita, and urban population across 1990–2024 (Figure I.2). From 1990-2024, real production in the Turkic countries increased more than threefold; real income per capita increased 2.4 times, whereas population growth was slower at 48.3%. Cities also continued to expand. The urban population, as of 2024, was approximately 1.8 times the size of the 1990 urban population. There was steady urbanization as economic growth followed. However, the growth of the urban population was slower than that of economic output.

FIGURE I.2: RELATIVE CHANGES IN INCOME AND THE POPULATION OF TURKIC ECONOMIES
(INDEX, 1990=1)

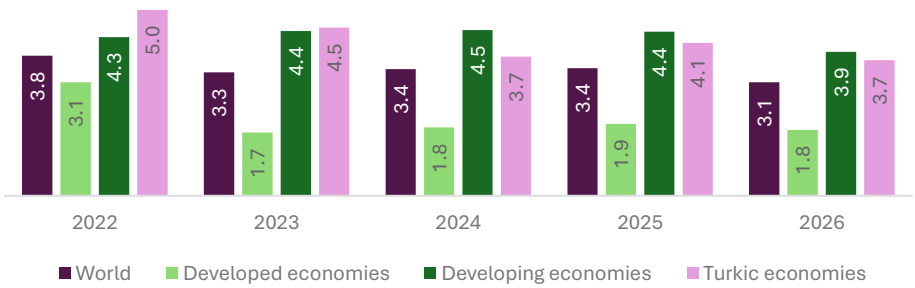



Source: World Bank data; UN World Population Prospects.

Recent real GDP growth follows the same long-term upward trend. After the pandemic, the Turkic economies recorded a strong rebound, with a growth rate of 9.6% in 2021. Growth then eased over the following years. Even with

that slowdown, Turkic economies continued to expand faster than the world average over 2022–2026 (Figure I.3).

FIGURE I.3: GDP GROWTH RATES
(REAL CHANGE IN % AGAINST THE PRECEDING YEAR)




Source: IMF, World Economic Outlook, April 2026 update.
Note: 2025 values indicate forecasts. Real GDP growth rates are computed as a weighted average, with the weights reflecting the relative importance of each country within the group's total GDP in PPP.

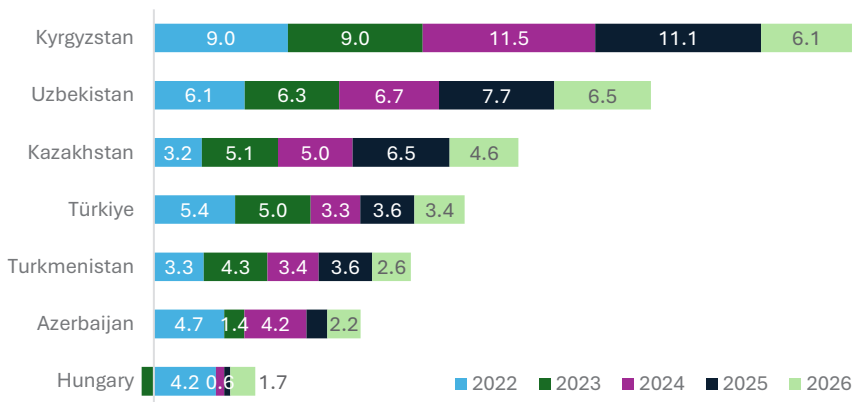
The rate of economic growth of Turkic economies remained healthy at 5% in 2022 and 4.5% in 2023. That kept the Turkic economies ahead of developed countries and the global average, and broadly in line with other developing economies (Figure I.3). The growth rate of Turkic economies became lower later, recording 3.7% in 2024 and 4.1% in 2025, and it is expected to be 3.6% in 2026.

Türkiye dominates the aggregate GDP of Turkic economies because it has the largest economy. The actual contribution made by Türkiye to the GDP of Turkic economies in 2024 was around 57%. The next highest contribution was made by Kazakhstan at around 19.3%, followed by Uzbekistan at around 13.2%.

Country-level performance still varies, as shown in Figure I.4. Kyrgyzstan had the highest real economic growth, with its growth remaining approximately at 11% in 2025. Uzbekistan's economic growth accelerated from 6.1% in 2022 to 7.7% in 2025. Kazakhstan's economic growth also accelerated from 3.2% in 2022 to 6.5% by 2025. The real economic growth of Türkiye slowed over the observed period, from 5.4% in 2022 to 3.6% in 2024, while the estimated growth remained at 3.4% in 2026. In addition, Azerbaijan's growth was more fluctuating, declining to 1.4% in 2023 and 2025, with better performance in

2024 at 4.2%. Turkmenistan recorded moderate economic growth, as indicated in Figure I.4, while Hungary was marked by low and uneven performance, including a contraction in 2023. It should be noted that faster growth in younger economies pushes up demand for housing, transport, and electricity in the near term. Slower or more unstable growth, by contrast, leaves governments with less budget room to finance the investments needed for the green economy transition.

FIGURE I.4: GDP GROWTH RATES BY ECONOMIES
(REAL CHANGE IN % AGAINST THE PRECEDING YEAR)



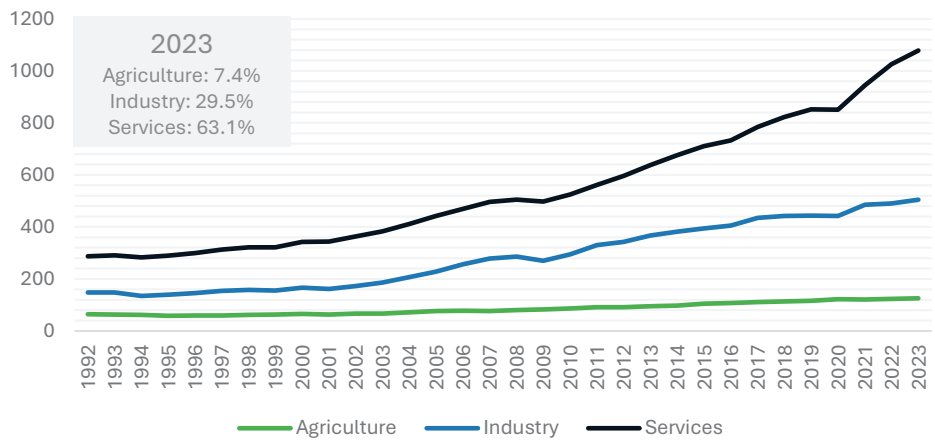

Source: IMF, World Economic Outlook, April 2026 update.

Over the past three decades, the composition of output (the sectoral breakdown of GDP) across the Turkic economies has steadily shifted toward services. In constant 2015 prices, services rose from about $287 billion in 1992 to over $1 trillion by 2023, lifting their share of GDP to 63.1%. The industry also expanded in real terms, increasing from $149 billion to about $505 billion, while its share remained at 29.5% by 2023. Agriculture grew more gradually, reaching $126 billion in 2023, and its share declined to 7.4% in the same year (Figure I.5).

A service-led economy offers room for lower-emissions growth when backed by cleaner energy and digital systems, while the continued weight of industry points to the need for green industrial policy, which necessitates targeted government action to support competitiveness and structural change while shifting production toward more sustainable, low-carbon models. The industry share in GDP also ties competitiveness to cleaner production, which becomes binding under emerging border measures discussed later in Section

I.1.2. On the other hand, agriculture appears smaller in GDP terms, yet it sits where land-use choices, water scarcity, and rural livelihoods meet, making it politically and economically challenging to ignore.

FIGURE I.5: AGGREGATE SECTORAL VALUE ADDED OF TURKIC ECONOMIES
(CONSTANT 2015 $, BILLIONS)




Source: UNCTAD Data Hub.

Demographics add another layer to the growth and sector trends described above. Population size differs widely across the Turkic economies. Türkiye and Uzbekistan stand apart at 86.1 million and 37.1 million in 2025, while the populations of other Turkic economies remain relatively smaller.

Fertility patterns also differentiate the group. Hungary, Türkiye, and Azerbaijan sit at low levels, around 1.5–1.7 children per woman, while Kazakhstan and Uzbekistan record rates around 3 or higher (Table I.1). These gaps point to different population paths ahead, with direct effects on labor supply, demand pressures, and the setting in which the green transition will advance.

Age composition further sharpens contrasts among the Turkic economies. Kazakhstan, Kyrgyzstan, Turkmenistan, and Uzbekistan have notably younger populations, with roughly 29–32% aged 0–14 and only 5–9% aged 65 and above. That structure supports labor force growth. Hungary stands apart, with 21% of its population aged 65 and above, and a much smaller youth segment (Table I.1).

TABLE I.1: POPULATION, FERTILITY, AND AGE STRUCTURE
(2025)

| | Total population in millions | Total fertility rate per woman | Share of population aged 0-14 | Share of population aged 15-64 | Share of population aged 65+ |
|---|---|---|---|---|---|
| Azerbaijan | 10.4 | 1.7 | 21% | 70% | 9% |
| Hungary | 9.6 | 1.5 | 14% | 64% | 21% |
| Kazakhstan | 20.8 | 3.0 | 29% | 62% | 9% |
| Kyrgyzstan | 7.3 | 2.8 | 32% | 62% | 6% |
| Türkiye | 87.7 | 1.6 | 21% | 68% | 11% |
| Turkmenistan | 7.6 | 2.6 | 31% | 64% | 5% |
| Uzbekistan | 37.1 | 3.5 | 31% | 63% | 6% |

Source: UNFPA, United Nations Population Fund.

Across the Turkic economies, differing population profiles mean that green economy transition strategies will need to adjust to distinct demographic pressures while staying consistent with broader structural transformation objectives. In younger and faster-growing populations, demand for housing, transport, and electricity rises quickly, so urban planning and infrastructure investment become the main pushes for avoiding high-emissions lock-in. In ageing settings, the focus shifts, and governments need productivity gains, technology upgrading, and better service delivery.

Demographic pressures and growth trajectories will continue to determine the cost, timing, and political economy of decarbonization across the Turkic economies. Green policy options are effective when they align with housing, mobility, and government service needs, and when governments strengthen planning, financing, and social protection to ensure that structural change does not leave anyone behind.

## Implications from I.1.1

- Urban populations in Turkic economies are growing faster; therefore, most new investment related to green economy transition will have to flow into cities. If cities lock in inefficient buildings and car-heavy transport, cutting emissions later will be costly.

- Growth and demographics create two green transition settings among Turkic economies. In younger, fast-growing economies, demand for housing, transport, electricity, and basic infrastructure will rise quickly. Policies need to meet this growing demand by prioritizing efficiency and low-carbon solutions from the start, while also creating jobs and building the skills the new workforce will need. In older or more volatile economies, the pressure shifts toward services and affordability. Governments will need to be more selective about new projects, concentrate on productivity upgrades, and improve how services are delivered under tighter budgets.

### I.1.2 External trade structure, market exposure, and green competitiveness of Turkic economies

The external trade structure influences how quickly an economy can adopt cleaner technologies and remain competitive as key markets tighten environmental regulations and carbon-related requirements. Indicators on trade flows, destination mix, import reliance, and the composition and sophistication of exports help track exposure to shifts in external demand, the ability to meet new standards, and the ease of sourcing the equipment and inputs needed for decarbonization.

Three trade mechanisms matter for the green economy transition. Export destination mix sets exposure to carbon and traceability rules. The export structure and complexity create the conditions for an upgrade. Import reliance for low-carbon equipment determines speed and cost.

Rising trade volumes can accelerate technology diffusion and upgrading, still they can also raise freight-related emissions and lock firms into carbon-intensive production if standards stay weak.

The trade of the Turkic economies generally increased in the last decade. Between 2011 and 2014, their exports and imports of goods and services increased. Trade trend has been declining in the middle of the 2010s, as the volumes of trade decreased and remained stifled as of 2016, and recovered in 2019, when the total exports grew to about $530 billion (Figure I.6).

In 2020, exports and imports of goods and services of Turkic economies decreased to $441.6 billion and $461.8 billion, respectively, showing disruptions to production, logistics, and demand caused by the COVID-19 pandemic. Later, the trade recovered quickly. Exports of Turkic economies had increased to nearly $697 billion and imports to over $711 billion by 2022, and then to new heights in 2023. In 2024, exports grew more slowly, reaching approximately $790 billion, while imports fell slightly to around $816 billion, which is much higher than the pre-pandemic level.

FIGURE I.6: AGGREGATE EXPORTS AND IMPORTS OF GOODS AND SERVICES IN TURKIC ECONOMIES
(CURRENT $, BILLIONS)

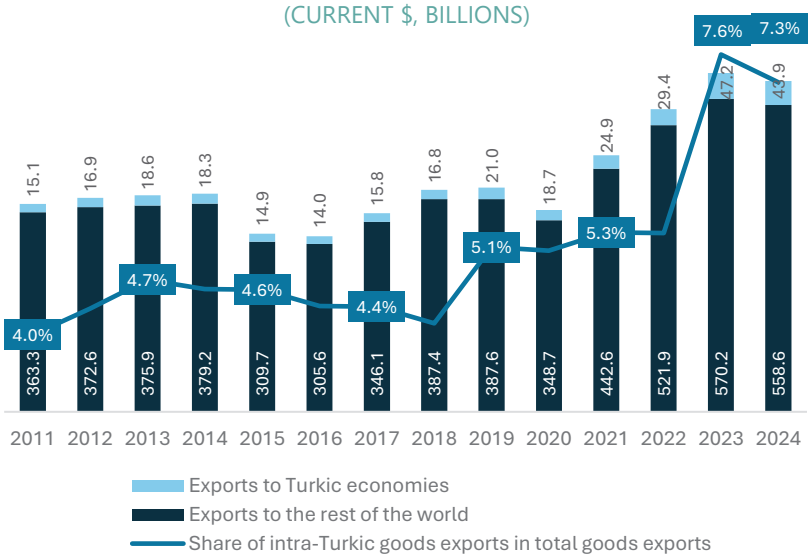

Source: IMF Data for trade in goods; UNCTAD Data Hub for trade in services. Missing Turkmenistan values were completed using simple interpolation and extrapolation based on observed growth trends in the available years, ensuring consistency with the country's historical patterns.

Exports of goods from Turkic economies remained concentrated in markets outside the Turkic geography, an aspect relevant to the green transition, as external consumers are increasing their requirements regarding product standards, traceability, and carbon performance. Exports to the rest of the world increased from $363.3 billion in 2011 to $558.6 billion in 2024.

Intra-Turkic exports also increased during the same period, reaching a high of 47.2 billion in 2023. The portion of goods exported by Turkic economies that is sold to other Turkic economies stayed within a narrow band for more than a decade, ranging from 4% to 5.3% of the total goods exports between 2011 and 2022 (Figure I.7). A clear break is evident in the year 2023, as the share of intra-Turkic exports jumped to 7.6% and then eased slightly to 7.3% in 2024. The time length suggests that there has been stronger reinforcement of intra-Turkic trade recently than gradual annual change over the longer term. Yet,

even after the jump, external, non-Turkic markets remain dominant. Therefore, the shift towards a green economy will continue to rely heavily on external demand and requirements, and compliance with external carbon and traceability requirements will set the pace for many exporters from Turkic economies.

FIGURE I.7: GOODS EXPORTS OF TURKIC ECONOMIES, INTRA TURKIC VS. THE REST OF THE WORLD
(CURRENT $, BILLIONS)




Source: IMF Data.

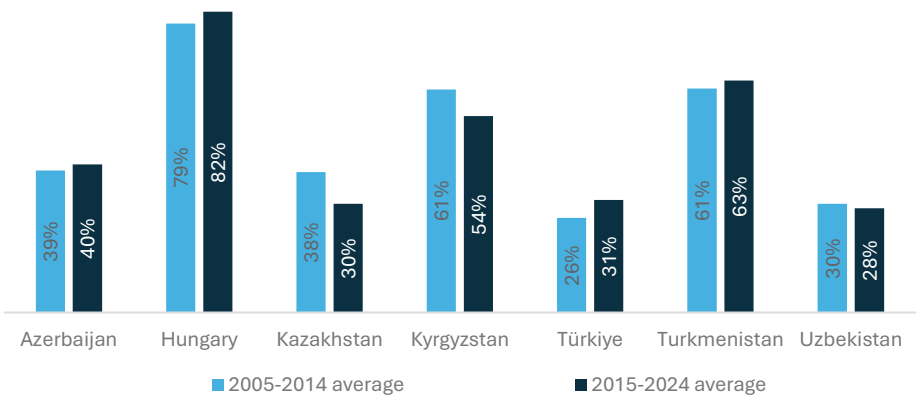
Domestic final demand met by total imports, also referred to as the import penetration rate, measures the share of total domestic final demand (the difference between GDP and net exports) that is met by imports. The penetration of imports varies substantially among the Turkic economies (Figure I.8).

Hungary is the most import-dependent economy shown in Figure I.8, whose import penetration rate increased on average from 79% in 2005-2014 to 82% in 2015-2024. The import penetration rate is also relatively higher in Turkmenistan, whose average value increased from 61% to 63% in the same period. The same value for Kyrgyzstan averaged 54% from 2015 to 2024.

Azerbaijan remained steady at around 40% regarding domestic final demand met by total imports. On the other hand, besides Kyrgyzstan, some Turkic economies, such as Kazakhstan and Uzbekistan, decreased their import penetration rate in the later period. Türkiye moved in the opposite direction,

with its import penetration rate increasing from 26% to 31%, indicating that imports became more important for Türkiye in satisfying local demand during the 2015-2024 timeframe.

FIGURE I.8: SHARE OF DOMESTIC FINAL DEMAND SUPPLIED BY IMPORTS
(PERIOD AVERAGES, PERCENT)



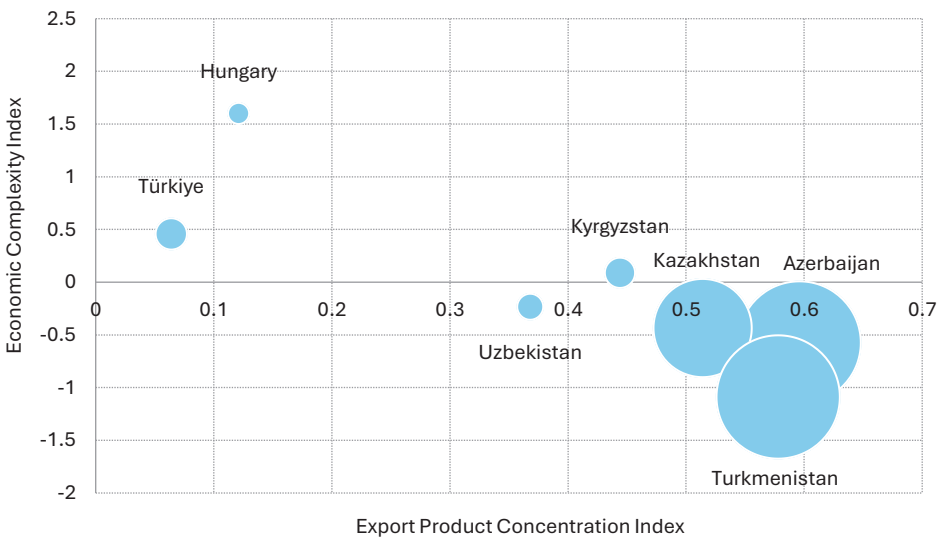

Source: UNECE Data Portal.
Domestic final demand met by total imports measures how much of a country's home-market spending is supplied by imports, calculated as imports divided by domestic final demand (GDP minus net exports). Higher values indicate greater reliance on foreign goods and services.

Regarding the green economy transition, these patterns are significant since the economy with a higher share of imports will rely more on trade channels to acquire the machinery and components associated with the green transition. Nevertheless, the degree of import penetration does not necessarily indicate weakness or strength. Small economies or those rich in mineral resources can specialize in their own production and therefore import a higher percentage of other products. Additionally, the size of the service industry is likely to influence this relationship, as services tend to be dependent on domestic labor and inputs. Later in this section, the low-carbon technology trade results show where economies already rely mainly on imports.

Figure I.9 combines three indicators to enable more advanced analysis of the trade positions of Turkic economies as of 2023. The Export Product Concentration Index ranges from 0 to 1. Values closer to 1 indicate that a country exports a limited set of goods, while values closer to 0 mean that exports are spread across a wide range of products. The Economic Complexity Index (ECI) averages around 0 globally. Positive values typically accompany more varied, knowledge-intensive exports, while negative values often reflect

simpler, commodity-based baskets. The fuel export share, represented by bubble size in Figure I.9, is the portion of goods exports that comes from fuels. A larger bubble means fuels dominate.

FIGURE I.9: TRADE STRUCTURE INDICATORS
RELEVANT TO GREEN TRANSITION EXPOSURE
(2023, BUBBLE SIZE INDICATES SHARE OF FUEL EXPORTS IN TOTAL GOODS EXPORTS)




Source: UNCTAD Data Hub for the Export Product Concentration Index (scale 0–1, where 0 indicates the most diversified export structure); Harvard Growth Lab's Atlas of Economic Complexity for the Economic Complexity Index (positive values indicate more complex and sophisticated, knowledge-intensive goods exports while negative values reflect less complex, more commodity-dependent exports); World Bank and UNECE for the share of fuel exports in total goods exports, represented by bubble size.

Hungary and Türkiye combine low concentration with positive complexity, which points to broader industrial capabilities that can support greener production and the development of new low-carbon products. Türkiye has the lowest concentration in the group, at 0.064, with a positive ECI of 0.458, and fuels account for 6.4% of its goods exports. Hungary is similar, with a concentration of 0.121 and a high ECI of 1.601, while fuels are only 3% of the country's goods exports. For the green transition, this kind of mix makes things easier in practice. Companies can adjust how they source and ship inputs, comply with stricter product rules, and clean up production step by step, without having to completely change what the country exports.

Azerbaijan, Turkmenistan, and Kazakhstan are in a higher exposure zone because their exports rely on a narrower set of goods, the complexity of which

remains negative, while their fuel dependence in exports is high. Azerbaijan's concentration is 0.596, and its ECI is -0.574, with fuels at 91.5% of goods exports. Turkmenistan exhibits a similar pattern, with a concentration of 0.578, an ECI of -1.089, and a fuel share of 92.4%. Kazakhstan is better positioned than Azerbaijan and Turkmenistan, but still heavily reliant on fuel, with a concentration at 0.514, an ECI at -0.435, and fuels accounting for 58.9% of total exports (Figure I.9). In a world that is gradually tightening climate policies and shifting investment toward cleaner energy, these profiles indicate a tougher adjustment. When most export earnings come from only a few products, countries have less room to diversify. It also becomes increasingly complex to maintain steady investment in the cleaner industry, energy, and transportation, as much depends on the performance of exports of those few products.

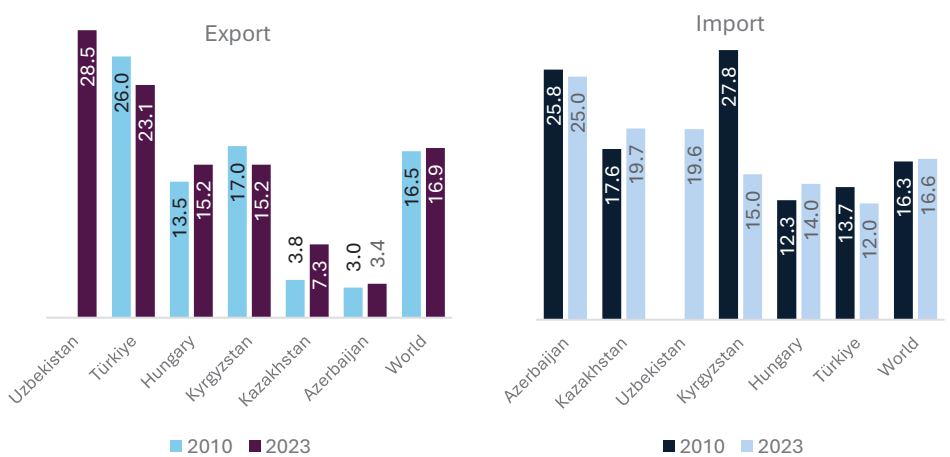
Kyrgyzstan and Uzbekistan stand in between. Kyrgyzstan has a moderate concentration (0.444), a slightly positive ECI (0.089), and a low level of fuel dependence in exports (5.9%). That suggests fuels are not the binding constraint, yet the export basket can still hinge on a few items, which can limit how fast firms can scale greener, higher-value products. Uzbekistan has a lower concentration at 0.368 and a low fuel dependence at 4.5%; however, its ECI remains negative at -0.233 (Figure I.9). In plain terms, Uzbekistan exports more than one item; however, many of its exports still fall into lower-complexity categories. For green competitiveness, the task is less about reducing fuel exports and more about moving into products and processes that require more skills, better logistics, and cleaner, more efficient production.

The time series on concentration adds one more nuance. Türkiye and Hungary stay relatively diversified across 1995–2024, which supports gradual upgrading and decarbonization tied to export markets. Azerbaijan and Turkmenistan remain highly concentrated for most of the period, which signals that diversification has not yet become durable. Kyrgyzstan exhibits significant fluctuations in concentration from 1995 to 2024, including a notable increase to 0.656 in 2024, a reminder that smaller economies can become dependent on a narrow export base, even when fuel exposure is low.

Another important indicator is BioTrade, which covers biodiversity-based goods and services that reach markets under basic sustainability practices. It often includes food, natural ingredients, fibres, wood products, and nature-

based tourism. BioTrade already accounts for a significant share of exports in several Turkic economies (Figure I.10). Uzbekistan is an exception, where BioTrade accounted for 28.5% of exports in 2023, far above the global average of 16.9%. The share of BioTrade in Türkiye's exports is also high, though it has dropped to 23.1% in 2023, after reaching 26% in 2010. Hungary increased its BioTrade share in exports from 13.5% to 15.2% during the same period, which is near the global average. Kyrgyzstan's BioTrade share in exports decreased from 17% to 15.2% in 2023. BioTrade's share of Kazakhstan and Azerbaijan remains much lower on the export side, even though both ticked up between 2010 and 2023.

FIGURE I.10: BIOTRADE AS A SHARE OF TOTAL EXPORTS AND IMPORTS
(2010 VS 2023, PERCENT)




Source: UNCTAD Data Hub.
Note: BioTrade refers to international trade in goods derived from biological resources, produced and traded in ways that support biodiversity conservation and sustainable use. In this figure, BioTrade includes food and beverages; live plants and animals; pharmaceuticals and natural ingredients; cosmetics and personal care products; natural fibres, wood and plant-based materials; and other products of plant or animal origin.

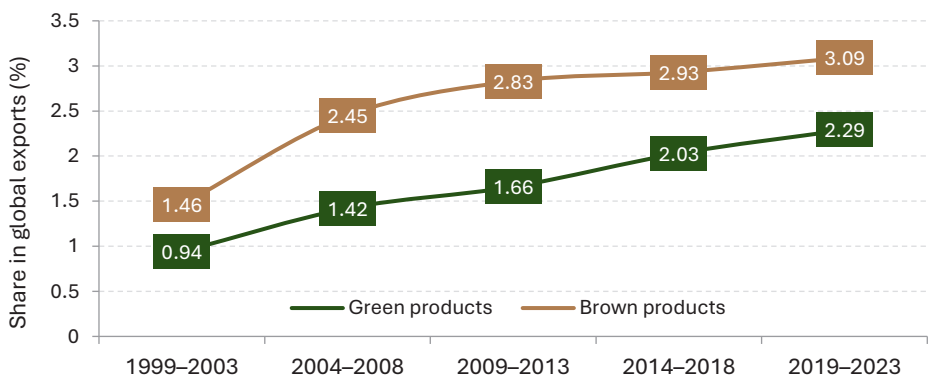
Comparing 2010 to 2023 shows that BioTrade's share in imports remained high in Azerbaijan (25.8% to 25%) and increased in Kazakhstan (17.6% to 19.7%), both figures above the 2023 global average of 16.6%. BioTrade's share in imports of Kyrgyzstan dropped sharply (27.8% to 15%), moving closer to the global level.

Economies with high BioTrade export shares, such as Uzbekistan and Türkiye, already rely heavily on biodiversity-based value chains. Consequently, protecting natural resources, good water and land management, and meeting

quality standards are already core trade policy issues, not side environmental concerns. Sections later in Chapter I document water stress and ecosystem pressure across the Turkic economies. For BioTrade-heavy exporters, those constraints can translate into direct supply risk and higher compliance costs.

From 1999 to 2023, the Turkic economies increased their share in global exports of both green and brown products. Their share of global green exports rose from 0.94% in 1999–2003 to 2.29% in 2019–2023. Over the same periods, their share of brown exports increased from 1.46% to 3.09% (Figure I.11). Green products are those with environmental benefits, whereas brown products are likely to face weaker demand as climate action intensifies.

FIGURE I.11: TURKIC ECONOMIES' SHARE IN WORLD EXPORTS OF GREEN AND BROWN PRODUCTS
(PERIOD AVERAGES, PERCENT)



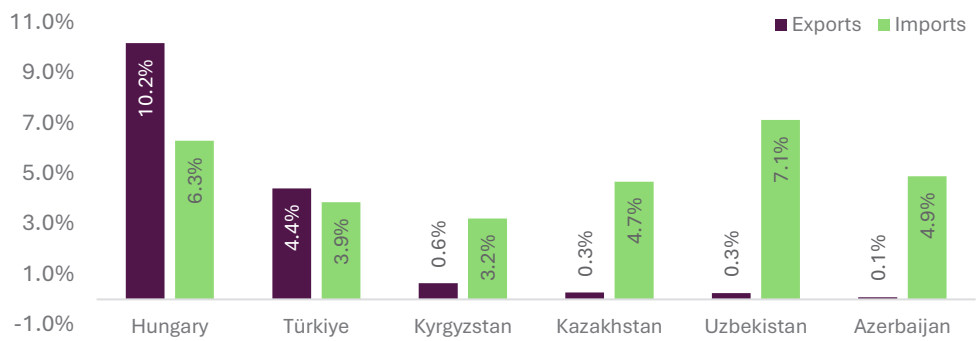

Source: Andres, P., and Mealy, P. (2023). Green Transition Navigator.
Note: Green products are defined as products with environmental benefits, and are based on a compilation of the APEC, OECD, and WTO green goods classifications. Brown products are defined as those that are likely to experience a decline in demand as the world mitigates climate change.

As illustrated in Figure I.11, the brown products sector remains the most significant component of the Turkic economies' trade profile across all periods. For the green economy transition, the outlook is encouraging for green goods; yet the continued dominance of brown exports signals that shifting the export mix remains a central challenge, especially as policies and demand increasingly favor cleaner products and production.

Solar panels, wind turbines, biomass systems, and carbon capture equipment are examples of low-carbon technologies. Hungary and, to a lesser extent, Türkiye are better positioned to provide low-carbon equipment through their

domestic industries. In Kazakhstan, Uzbekistan, Kyrgyzstan, and Azerbaijan, the transition appears to be more reliant on the availability of imported technology (Figure I.12). Among the Turkic economies, Hungary is the key exporter of low-carbon technology products. Between 2017 and 2023, the proportion of low-carbon technology products in Hungary's total exports averaged 10.2%, while their proportion in Hungary's imports was 6.3%. Türkiye, with 4.4% of its exports and 3.9% of its imports in these products, indicates both domestic production and active sourcing from abroad.

FIGURE I.12: LOW-CARBON TECHNOLOGY EXPORT AND IMPORT SHARES
(2017–2023 AVERAGE, PERCENT OF TOTAL EXPORTS/IMPORTS)




Source: IMF Macroeconomic Climate Indicators Dashboard.
Note: Low-carbon technology products refer to machines and equipment that help produce energy with reduced pollution, such as solar panels, wind turbines, biomass systems, and carbon capture equipment.

The remaining Turkic economies are more dependent on imports of low-carbon technology compared to exports. Uzbekistan has the largest share of imports at 7.1%, while exports are low at 0.3%. This indicates that Uzbekistan has a high demand for imported equipment and a low export base in low-carbon technologies. Kazakhstan (exports 0.3%, imports 4.7%), Azerbaijan (exports 0.1%, imports 4.9%), and Kyrgyzstan (exports 0.6%, imports 3.2%) all import far more low-carbon technology products than they export. If a country relies heavily on imported green equipment, the speed of the transition depends on exchange rates, shipping and logistics, and access to trade finance. That is why careful procurement planning and disciplined investment decisions matter for staying competitive.

A workable way forward is to link trade policy with industrial upgrading and investment planning. Stronger logistics and customs performance, credible traceability and emissions information, and clearer standards can lower

compliance costs for firms while supporting diversification into cleaner goods and processes. Regional cooperation can also help by simplifying rules and establishing supply chains for green transition-related inputs, while maintaining access to major external markets.

### Box I.1: EU Carbon Border Adjustment Mechanism

The EU Carbon Border Adjustment Mechanism (CBAM) extends the EU's carbon pricing logic to a set of imported products. Importers must report embedded emissions and, over time, pay an adjustment tied to those emissions.

CBAM is most relevant for Turkic exporters in covered sectors such as iron and steel, aluminium, cement, fertilisers, electricity, and hydrogen. Exposure will likely come through three channels:

First, EU importers will demand product-level emissions data that is supported by credible systems of monitoring, reporting, and verification. Companies that cannot demonstrate this may suffer higher compliance costs, longer clearance times, or weaker pricing power.

Second, if a company uses high-emissions electricity or heat, its exports will face a higher CBAM cost. That can cut profit margins or lead EU buyers to choose suppliers with cleaner production.

Third, companies that reduce their energy intensity, switch to cleaner energy sources, and improve their production efficiency can secure their market access and even gain market share as EU sourcing patterns shift to lower-emitting inputs.

For exporters affected by CBAM, emissions levels become a normal part of staying competitive in the market, not just something to report in paperwork.

Source: OECD (2025, 13 March). Dechezleprêtre, A. et al. (2025).

### Implications from I.1.2

- Concentrated, fuel-dominant export baskets have little buffer against tighter carbon and traceability rules in destination markets, so emissions measurement and cleaner production become commercial requirements for exposed exporters.
- Where the transition depends on imported low-carbon equipment, exchange rates, shipping bottlenecks, and trade finance can slow rollout and raise costs, so procurement planning becomes part of competitiveness.
- High BioTrade exposure turns water, land, and biodiversity management into an export performance issue, since resource stress can translate into supply risk and higher compliance costs.

## I.1.3 Social inclusion and distributional dimensions of the just transition

Social inclusion and distributional outcomes are crucial for the transition to a green economy because the prevailing economic model, driven by fossil fuels and narrowly focused on profit and GDP growth, has deepened inequalities. In contrast, the inclusive green economy approach explicitly prioritizes social equity and human well-being alongside environmental health when evaluating progress.

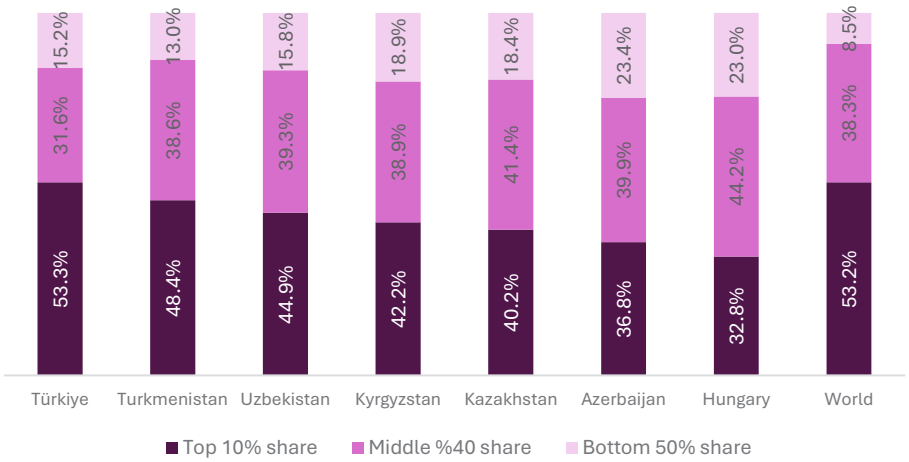
Income shares across population groups provide a quick assessment of who really benefits from GDP growth. When income is concentrated in a single segment of society, decarbonization policy packages generally require greater protection for lower-income families to make green economy reforms sustainable. As of 2024, the richest 10% of the global population holds 53.2% of the world's income, whereas the poorest half of the global population earns 8.5% of it (Figure I.13).

Türkiye is close to the global trend, where 10% of its population holds 53.3% of the national income, and the bottom 50% of the population holds only 15.2%. Turkmenistan and Uzbekistan are also more top-concentrated, with the top 10% of the population accounting for 48.4% and 44.9% of national

income, respectively, and the bottom 50% accounting for 13% and 15.8%, respectively. Among Turkic economies, Azerbaijan and Hungary appear to have relatively more equally distributed incomes (Figure I.13).

FIGURE I.13: NATIONAL INCOME SHARES HELD BY POPULATION GROUPS, TOP 10%, MIDDLE 40%, BOTTOM 50%

(2024, PERCENT)



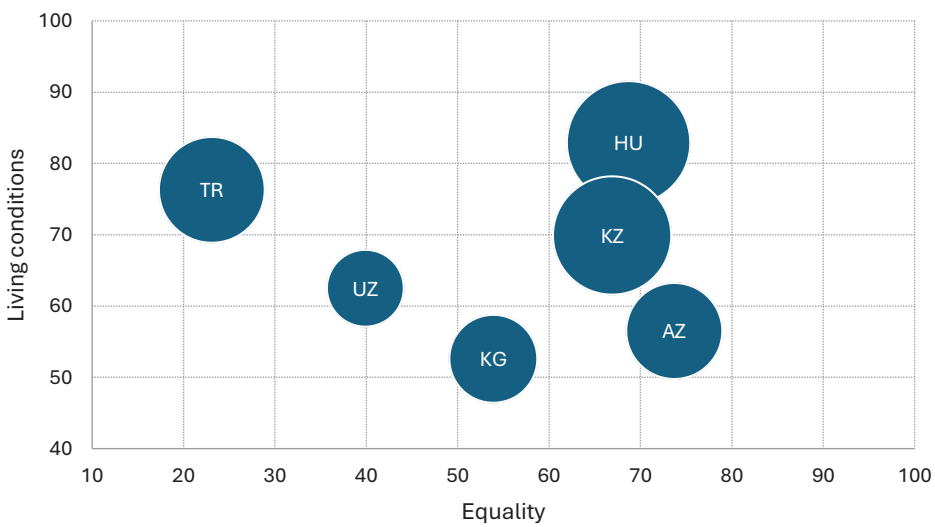

Source: World Inequality Database.

If a large share of national income goes to the top 10% of the population, reforms typically require more substantial support for lower-income households, such as targeted cash payments, a cautious approach to cutting subsidies, and affordable financing. If the bottom 50% of the population already receives a significant share of income, reforms related to green economic transition may face less resistance, but many households can still struggle if energy and transport costs rise and social support measures do not keep pace. Later parts of Chapter I discuss environmental taxes and pricing signals. Distribution shapes whether those tools can operate without triggering fast social resistance.

The 2023 scores on UNCTAD's Inclusive Growth Index provide a picture of whether economic activity translates into better living conditions and more equal access to opportunities. In the case of the green economy transition, gaps across these dimensions are crucial, as households' capacity to absorb increased energy or transportation costs and firms' ability to adapt often depend on access to basic services, affordability, and whether benefits are limited to a small group.

As of 2023, Hungary ranks at the top of the Turkic economies in terms of the Inclusive Growth Index, boasting the best living conditions score (82.9), high equality (68.7), and the best economic score (35.1). Kazakhstan is also ranked relatively high in all three dimensions, with living conditions standing at 69.9, equality standing at 66.9, and the economy score (32.3). Azerbaijan achieves the highest score in equality (73.7) but ranks moderately in living conditions (56.5) and low in the economy score (21.4). Türkiye scores highly on the living conditions (76.3), but low on the equality score (23.1), with an economy score of 25.9 (Figure I.14). Kyrgyzstan scores 52.6 on living conditions, 53.9 on equality, and only 18 on economy score, and Uzbekistan scores 62.5 on living conditions, 39.9 on equality, and has the lowest economy score (13.8).

FIGURE I.14: UNCTAD INCLUSIVE GROWTH INDEX SCORES
(2023, BUBBLE SIZE INDICATES THE ECONOMY SCORE)

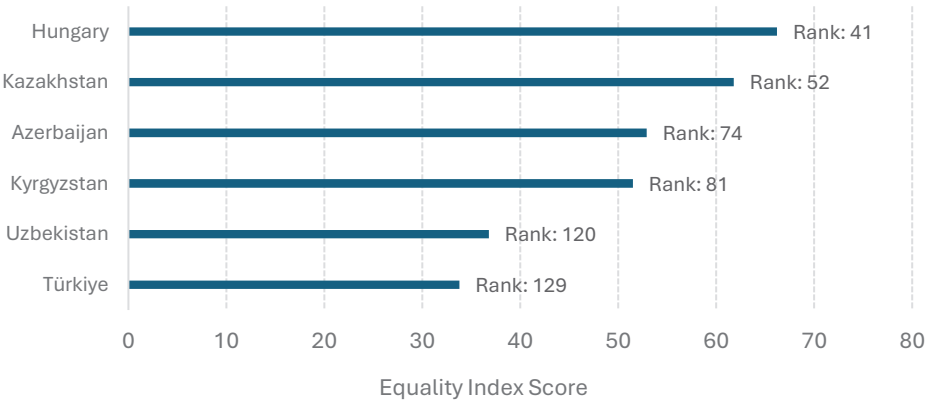



Source: UNCTAD Data Hub.
Note: The figure is based on UNCTAD's Inclusive Growth Index, which measures a country's economic well-being and inclusivity across four dimensions: economy, living conditions, equality, and environment. Bubble size reflects the economy score. Higher scores indicate better inclusivity.

The 2024 scores of the Economist Intelligence Unit's Equality Index position Hungary and Kazakhstan among the better-performing Turkic economies, with scores of 66.2 and 61.8, respectively, and rankings of 41$^{st}$ and 52$^{nd}$ out of 151 countries globally. Azerbaijan and Kyrgyzstan are positioned somewhere in the middle, between the best and worst performing Turkic economies in the Equality Index, whereas Uzbekistan and Türkiye rank lower, at 120 and 129 globally, respectively (Figure I.15). It is a broad range of scores between 33.8 to 66.2 that indicates vastly different starting points of rights and

opportunities being distributed among the people in different Turkic economies.

FIGURE I.15: EIU EQUALITY INDEX SCORES AND RANKS
(2024, RANK OUT OF 151)




Source: Economist Intelligence Unit.
Note: This index measures the degree of equality in a country by assessing rights and opportunities across social background, ethnicity, gender, and economic status. The score reflects overall equality performance, with higher scores indicating stronger equality outcomes. Countries are ranked from 1 to 151, with a lower numerical rank indicating better performance.

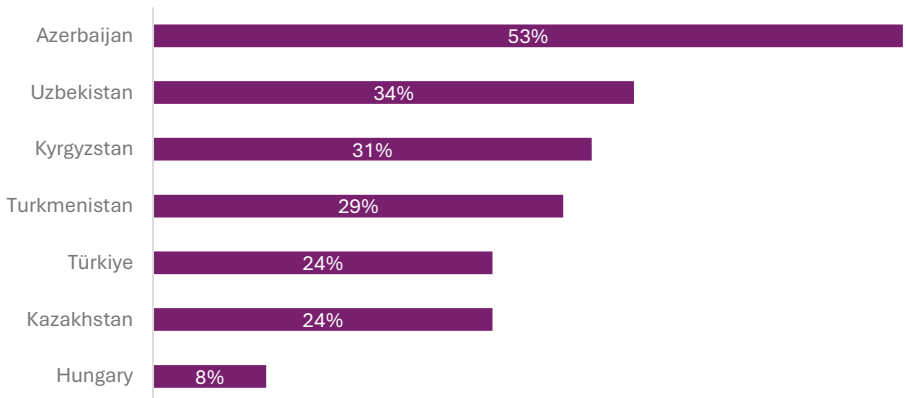
From the perspective of the green economy transition, countries with higher equality scores can find it easier to generate support for actions that necessitate collective effort.

The incidence of vulnerable employment, measured by contributing family workers and own-account workers, indicates where jobs are outside regular paid wage arrangements and how many workers lack secure contracts and insurance. For a green economy transition, a larger share in vulnerable employment typically indicates that households would experience significantly greater income risk from shocks and price changes, underscoring the need for policies that account for workers who cannot easily absorb volatility or finance new equipment and practices.

Vulnerable employment rates vary significantly across Turkic economies. Azerbaijan has the highest vulnerable employment share among Turkic economies, at 53% of total employment. Uzbekistan, Kyrgyzstan, and Turkmenistan are in a second tier, with about thirty percent of workers at risk. Kazakhstan and Türkiye both hover at 24% in 2023. Hungary records the

lowest level of vulnerable employment at 8%, indicating a significantly larger share of formal wage and salaried work (Figure I.16).

FIGURE I.16: VULNERABLE EMPLOYMENT AS A SHARE OF TOTAL EMPLOYMENT
(2023, PERCENT)




Source: World Bank Data based on ILO modelled estimates.
Note: Vulnerable employment is contributing family workers and own-account workers as a percentage of total employment.

High inequality, combined with highly vulnerable employment, raises the risk of pushback during price reform unless governments deliver compensation early and visibly. Lower inequality or lower vulnerable employment gives more room for reform sequencing; still, households need targeted support when energy and transport costs rise. The lasting impact of green economy reforms in Turkic economies depends on social inclusion. Policymakers should begin to explore options that combine climate and energy measures with clear support for households and workers, particularly those who are informal and insecure. The practical way to do this includes sharing costs in a fair manner that people will accept, providing practical training and job options as industries change, and strengthening social protection so that families receive timely help during a price rise or a weakening of local jobs.

## Implications from I.1.3

- Income distribution sets the ceiling for price reform. Where income concentrates at the top, energy and transport price measures can trigger fast resistance unless governments pair them with early, visible support for lower-income households.

- Informality shapes what support can reach. Highly vulnerable employment means many households are not covered by payroll-based systems. Compensation and transition support need channels that reach own-account and family workers, or coverage gaps will show up immediately when costs rise.

- Economies that score better on inclusion and equality can move earlier on pricing and regulatory steps, still they need targeted protection to prevent new hardship in exposed groups. Lower-scoring settings should first strengthen service access and the reliability of transfers, then tighten price signals once people see protection working.

## I.2 Environmental pressures, resource constraints, and circularity gaps

Economic transformation encounters real limits when ecosystems, water, and cities cannot sustain the load. Indicators on ecological balance, water and heat stress, waste recovery, and e-waste collection help pinpoint where natural capital is already under strain and where circularity systems still fail to capture value. A cross-country lens also matters, since similar income levels can mask very different resource risks and varying capacities to manage them.

### What to watch in Section I.2

- Water and heat are binding constraints. When withdrawals exceed renewal or when heat days rise quickly, the transition costs more, and delivery risks rise.

- Low circularity performance and poor waste collection signal weak systems for capturing value and cutting material demand.

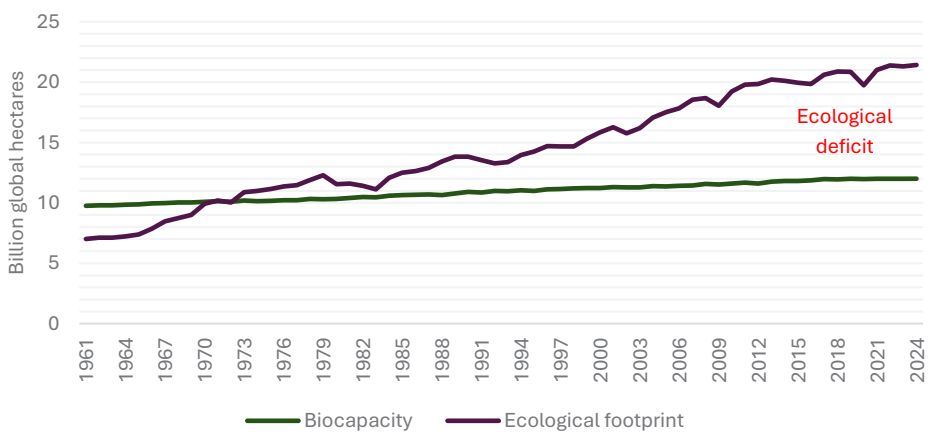
- Material intensity acts as the hidden emissions channel. Faster growth in non-metallic minerals points to construction-led pressure that later policy cannot fix cheaply.

## I.2.1 Ecological balance, biocapacity, and environmental pressure

Global demand for nature has exceeded what ecosystems can renew for decades. In the early 1970s, the ecological footprint (the amount of biologically productive land and water needed to provide the resources people use and absorb the waste they generate, usually measured in global hectares) sat relatively close to biocapacity (the ability of ecosystems to regenerate the resources people use and to absorb the waste they produce, under current management and extraction practices). Global demand then rose steadily while regenerative capacity increased only gradually (see Figure I.17).

FIGURE I.17: GLOBAL ECOLOGICAL FOOTPRINT AND BIOCAPACITY

(1961–2024, BILLION GLOBAL HECTARES)



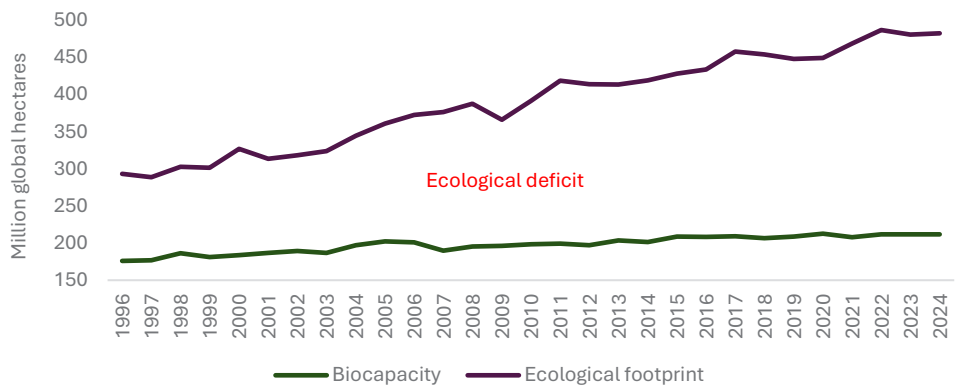

Source: York University, FoDaFo, Global Footprint Network, 2025 National Footprint and Biocapacity Accounts. Note: the last three years are estimates.

In the second half of the 1970s, the footprint surpassed biocapacity, and the gap continued to widen. By 2024, the footprint had reached above 21 billion global hectares, creating a significant ecological deficit, meaning demand exceeded nature's renewal capacity (Figure I.17). In 2024, the "Number of Earths" required to meet existing global demand was estimated at 1.78, which showed the same imbalance.

In the Turkic economies, except for Kazakhstan, due to a lack of data, the ecological footprint has remained significantly greater than biocapacity from 1996 to 2024, resulting in an ongoing ecological deficit. Compared to the biocapacity of 176 million global hectares, the footprint of the Turkic

economies in 1996 was 293.1 million global hectares. In 2024, the footprint is estimated at 482.2 million global hectares, and biocapacity at 211.8 million global hectares, creating a widening ecological deficit in Turkic economies (Figure I.18).

FIGURE I.18: AGGREGATE ECOLOGICAL FOOTPRINT AND BIOCAPACITY OF TURKIC ECONOMIES
(1996–2024, BILLION GLOBAL HECTARES)




Source: York University, FoDaFo, Global Footprint Network, 2025 National Footprint and Biocapacity Accounts. Note: The last three years are estimates. Data for Kazakhstan not available.

The constant ecological deficit in Turkic economies indicates that economic growth has been accompanied by increased strain on land, water, and ecosystems, while the regenerative capacity of nature has increased only slowly. In the context of the green economy transition, economic growth has to be less resource-intensive and more sustainable through cleaner energy, more efficient cities, and improved land and waste management.

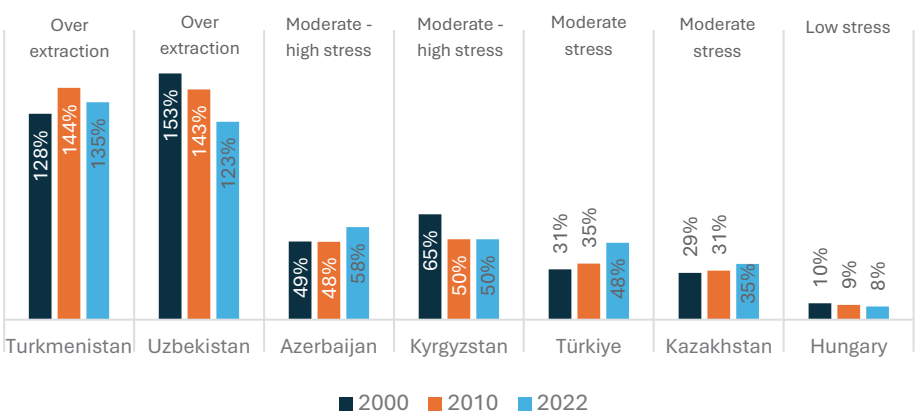
Water stress, measured as freshwater withdrawals relative to the renewable supply, is another important indicator of ecological balance. Figure I.19 shows that in Turkmenistan and Uzbekistan, the rate of freshwater withdrawals is significantly greater than the rate of renewal. In both countries, over-extraction of freshwater is present, which is far beyond sustainable use.

Azerbaijan and Kyrgyzstan appear to be in the moderate to high stress category, while Türkiye and Kazakhstan are below the high-stress mark, although the trend indicates an increasing water stress. Only Hungary is in low stress (Figure I.19). The difference between Hungary and the highest-stress Turkic economies is structural, and it will determine how quickly and at

what price more greener production models can develop without approaching water constraints.

Where freshwater withdrawals exceed renewal, economic growth and decarbonization face the same constraint. Water-intensive farming, cooling needs in power and industry, and fast-growing cities all compete for the same limited supply. Shortfalls do not stay inside the water sector. They spill into output losses, higher operating costs, and delayed investment. For high-stress economies, new industrial zones, irrigation expansion, and urban growth need to fit within a realistic water balance.

FIGURE I.19: WATER STRESS
(FRESHWATER WITHDRAWAL AS A SHARE OF AVAILABLE FRESHWATER RESOURCES, %)



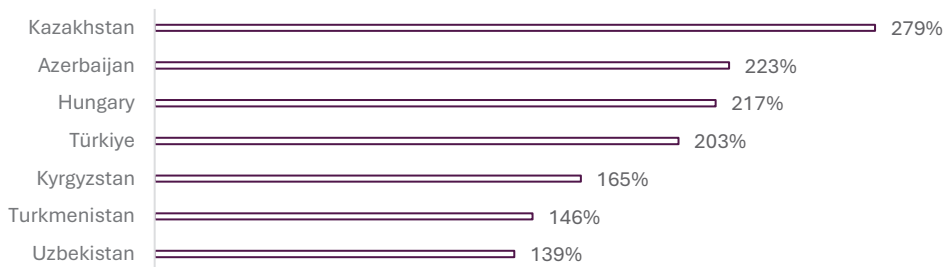

Source: FAO (2025).
Note: Higher values indicate greater water stress, reflecting a larger share of renewable freshwater withdrawn. Under UN benchmarks, stress above 50% is high, above 75% is critical, and values exceeding 100% indicate over-extraction beyond renewable supply.

Heat extremes shape the baseline conditions for the green economy transition by increasing cooling demand and raising the cost of maintaining reliable infrastructure and energy systems. The increase in extreme heat days since 1990 varies widely across the Turkic economies. Kazakhstan leads the way with a 279% rise, significantly ahead of Azerbaijan (223%), Hungary (217%), and Türkiye (203%). Uzbekistan (139%), Turkmenistan (146%), and Kyrgyzstan (165%) form a lower tier, though "lower" still means materially more frequent days above 32°C than in 1990.

The rising frequency of extreme heat tends to be first evident in electricity peaks for cooling and in higher operating costs for buildings, industry, and

public services. Those Turkic economies in the 200%+ category face a more challenging near-term tradeoff: continuing to operate systems during warmer summers while also shifting supply and demand patterns toward cleaner directions. In some Turkic economies, even the lower tier still indicates growing heat pressure, which can compound water stress by increasing evaporation and irrigation demand, thereby tightening the constraint on water-smart growth. Hotter summers also raise peak electricity demand for cooling. If utilities meet that peak with coal or gas plants, power gets more expensive and emissions rise at the same time.

FIGURE I.20: CHANGE IN EXTREME HEAT DAYS (>32°C) SINCE 1990
(2025, PERCENT, FIVE-YEAR MOVING AVERAGE)




Source: Economist Intelligence Unit.

The recovery and management of waste at the municipal level occupy center stage in the circular economy agenda. Hungary stands much better among Turkic economies in terms of this indicator. It has the highest waste recovery rate (47.3), the best waste management score (51.7), and the highest overall Environmental Performance Index (EPI) score (59.8). Hungary records the highest waste recovery rate and waste management scores among the Turkic economies in this indicator set. Kazakhstan ranks second in terms of waste recovery, at 13, which is less than a third of Hungary's (Figure I.21).

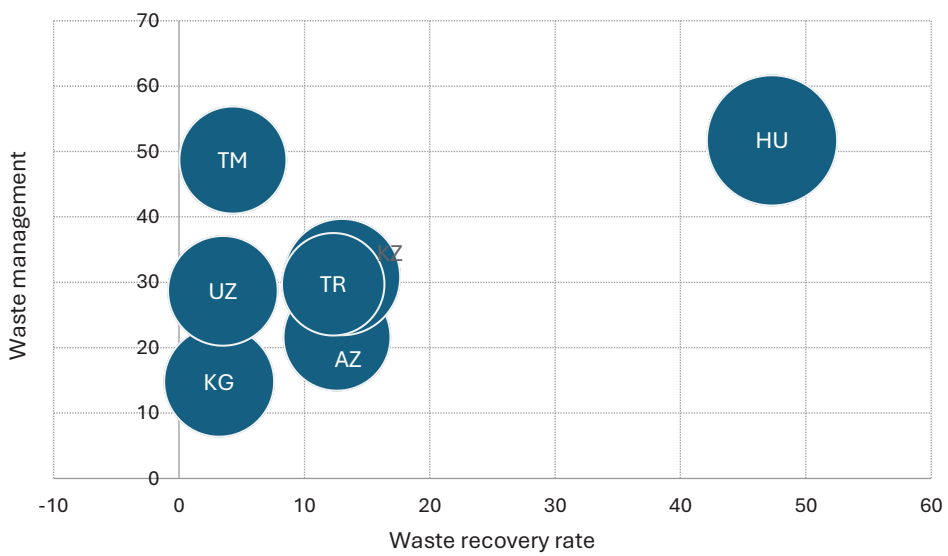
In the other Turkic economies, recovery rates are concentrated in a low band, indicating low material and energy recovery of municipal waste. Azerbaijan (12.6), Türkiye (12.3), and Kazakhstan (13) are at a similar level, whereas Kyrgyzstan (3.2), Uzbekistan (3.5), and Turkmenistan (4.3) are even lower (Figure I.21). These waste recovery rates suggest that municipal waste recovery remains limited across several Turkic economies.

The picture is a bit more complex in the waste management scores. Turkmenistan has a high waste management score (48.7), similar to Hungary's,

but its recovery rate is very low. The middle group of waste management is represented by Kazakhstan (30.8), Türkiye (29.7), and Uzbekistan (28.7), while Azerbaijan (21.6) and Kyrgyzstan (14.8) record lower waste management scores among Turkic economies (Figure I.21).

These trends are partly followed through overall EPI rankings, but not cleanly. Kazakhstan has a higher EPI score (47.8) than the other Turkic economies, whereas Türkiye has the lowest EPI (37.2). Nevertheless, the most significant gap among the Turkic economies is the recovery system that converts waste into materials and energy, which is vital to ensuring that circular economy strategies and the transition to a green economy are feasible.

FIGURE I.21: EPI WASTE MANAGEMENT AND RECOVERY SCORES
(2024, BUBBLE SIZE INDICATES THE OVERALL EPI SCORE)




Source: Block, S., et al. (2024). 2024 Environmental Performance Index.
Note: Waste recovery rate assesses the quality of municipal solid waste management by rewarding waste treatment methods that mitigate environmental impacts and recover materials and energy, thereby contributing to a circular economy. The Waste Management category assesses the magnitude of the trash problem and the country's effectiveness in managing its waste. It is based on three indicators: municipal solid waste generation per capita, controlled solid waste, and recovery of energy and materials from waste. Bubble size reflects the country's Environmental Performance Index score. Higher scores indicate more effective municipal solid waste management—through better control, treatment, and recovery of waste—whereas lower scores signal greater challenges or data gaps in waste management.

The e-waste collection performance also indicates the extent to which an economy is transitioning towards a sustainable circular economy, rather than

remaining in a linear consumption model. E-waste generated is defined as the amount of discarded electrical or electronic products (e-waste) due to consumption within the national territory in a given reporting year, prior to any collection, reuse, treatment, or export.

The amount of e-waste generated per capita is variable across the Turkic economies. Hungary is at the top of the list with 14.3 kg per capita in 2022, then Türkiye (12.7) and Kazakhstan (10.2). Azerbaijan (8.7) and Turkmenistan (7.1) have relatively lower e-waste generated per capita, whereas Uzbekistan (3.7) and Kyrgyzstan rates at 2.2 (Table I.2). The trend in electrical and electronic equipment introduced into the market is of the same order, with Hungary topping at 19.7 kg/capita, followed by Türkiye at 18.3, and then Kazakhstan at 15.8 kg/capita.

It is in the collection of e-waste that the performance of the most Turkic economies is dissatisfying. In 2022, Hungary achieved a 65% e-waste collection rate, setting a good example for other Turkic economies. Türkiye goes to 17% and Kazakhstan to 6%. Azerbaijan, Kyrgyzstan, Turkmenistan, and Uzbekistan record 0% (Table I.2).

TABLE I.2: E-WASTE GENERATION AND COLLECTION
(2022)

| | E-waste generated *(2022, kg per capita)* | EEE put on the market *(kg per capita)* | E-waste collection rate |
|---|---|---|---|
| Azerbaijan | 8.7 | 12.4 | 0% |
| Hungary | 14.3 | 19.7 | 65% |
| Kazakhstan | 10.2 | 15.8 | 6% |
| Kyrgyzstan | 2.2 | 3.4 | 0% |
| Türkiye | 12.7 | 18.3 | 17% |
| Turkmenistan | 7.1 | 13.8 | 0% |
| Uzbekistan | 3.7 | 8.1 | 0% |

Source: Cornelis P. Baldé et al. (2024). Global E-waste Monitor 2024.
Note: EEE indicates electrical and electronic equipment.

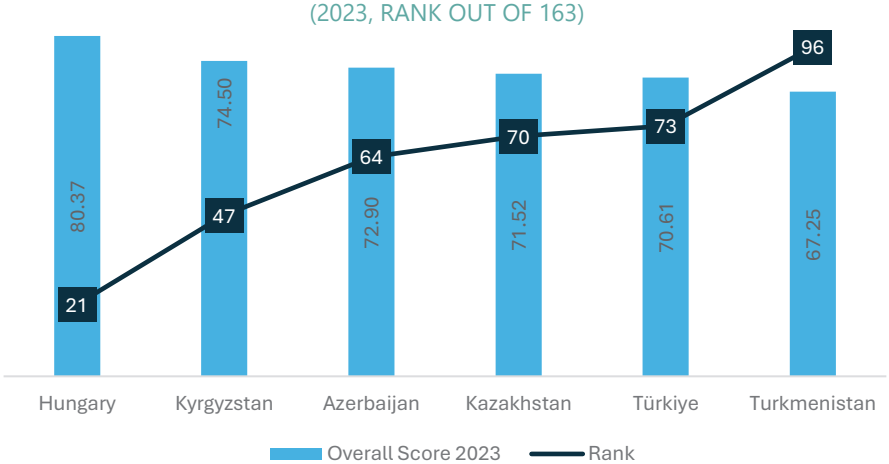
The disparity between increasing device penetration and almost zero collection capacity in most Turkic economies is a fundamental issue with the implementation of the green transition. Türkiye and Kazakhstan also produce relatively large amounts of e-waste per capita; however, they collect very little of it through reported collection.

The scores on achieving the Sustainable Development Goals (SDGs) provide a brief overview of how any country can produce global, cross-sector deliverables that are pertinent to the delivery system on which the green transition relies.

Hungary is ranked 21st out of 167 countries, with a SDG achievement score of 80.37, which places it ahead of the Turkic economies, according to the Sustainable Development Report 2025. Kyrgyzstan is next, with a score of 74.50 (rank 47). Azerbaijan (72.90, rank 64), Kazakhstan (71.52, rank 70), and Türkiye (70.61, rank 73) have close scores, whereas their ranks are within a thin band (Figure I.22). Still, the difference in the scores between Hungary and Turkmenistan is 13.12 points, with a difference of 75 places. This shows that the global rank movements reflect tight competition rather than clear performance breaks.

FIGURE I.22: ACHIEVEMENT OF THE SUSTAINABLE DEVELOPMENT GOALS, SDG INDEX OVERALL SCORE AND RANK

(2023, RANK OUT OF 163)

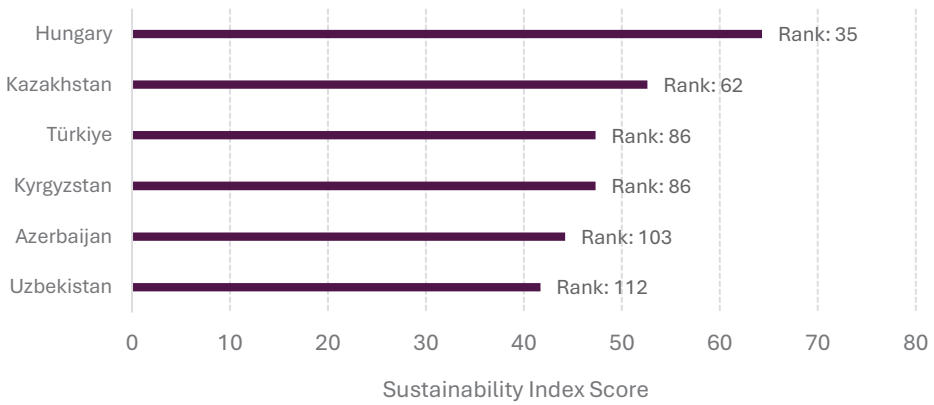



Source: Jeffrey D. Sachs et. al. (2025).
Note: The overall score reflects total progress toward achieving all 17 SDGs and can be interpreted as the percentage of SDG achievement. A score of 100 indicates full achievement of all goals. Rankings are calculated among 167 countries.

The environmental, social, and governance (ESG) factors influence investors' perceptions and the state's capacity to plan, regulate, and finance the green transition. Within the Sustainability Index of the Economist Intelligence Unit, Hungary scored the highest among Turkic economies in 2024, with a score of 64.3 and a global rank of 35. Kazakhstan has the second-best performance among Turkic economies, with a score of 52.6 (ranked 62). Türkiye and

Kyrgyzstan share the same spot at 47.3 score and are in 86th place. Azerbaijan's score was 44.2 (rank 103) and Uzbekistan's 41.7 (rank 112).

FIGURE I.23: EIU SUSTAINABILITY INDEX SCORES AND RANKS
(2024, RANK OUT OF 151)




Source: Economist Intelligence Unit.
Note: The index evaluates countries' sustainability risk across environmental, social, and governance (ESG) dimensions. Countries are ranked from 1 (best performance and lowest sustainability risk) to 151 (weakest performance and highest sustainability risk). Higher index scores indicate stronger sustainability performance.

Environmental pressures already shape the growth environment across Turkic economies. Persistent ecological deficits, high water stress in parts of Central Asia, and more frequent extreme heat raise the operating cost of cities and industry and strain basic service delivery. Governments need routine measurement and public reporting, incentives that reward lower water and energy intensity, and focused investment in municipal waste and e-waste systems where recovery remains weak.

## Implications from I.2.1

- Where freshwater withdrawals exceed renewable supply, water becomes a binding constraint on the transition. In those highest-stress settings, progress will depend less on plans and targets and more on allocation rules, irrigation efficiency, and water-smart permitting for farms and industry.

- Rising heat extremes turn the transition into a reliability problem. More very hot days push cooling demand up and raise peak electricity loads. If systems meet those peaks with carbon-heavy generation, costs and emissions increase together, and the risk of outages rises.

- Circularity gaps already look like a city delivery failure. Low municipal waste recovery and near-zero e-waste collection in several Turkic economies mean lost materials value and higher local pollution. Expanding collection, sorting, and enforcement becomes part of transition capacity, not a side environmental action.

### I.2.2 Natural resource depletion, extraction patterns, and material intensity

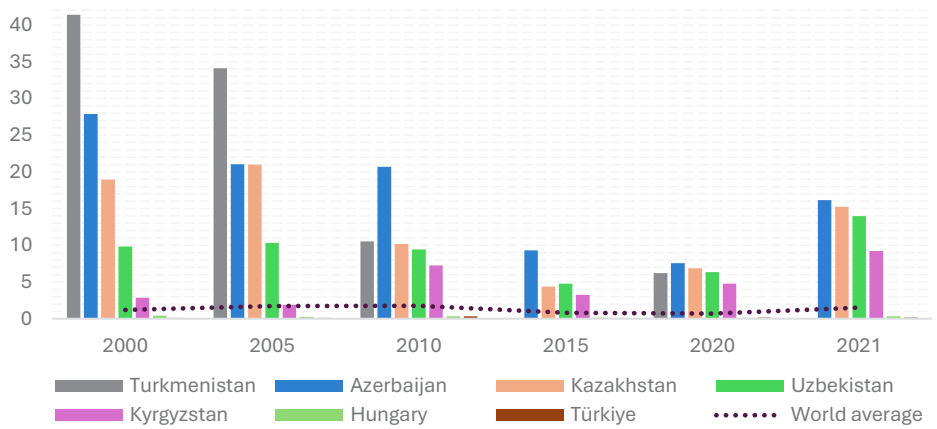
Resource extraction drives income and exports in some Turkic economies, so depletion and material intensity offer a direct indication of how exposed each economy is as it shifts toward greener growth. Looking at natural resource depletion, domestic material extraction helps distinguish between economies that rely on a take, make, waste model from those with more room to grow through efficiency, substitution, and reuse.

The fraction of gross national income (GNI) produced by natural resource depletion is a boundary that distinguishes between economies in which income continues to be based on the exploitation of forests, minerals, and energy resources, and those in which growth is based much less on the exploitation of natural capital. For the green transition, high values in this indicator flag both macro exposure and a narrower fiscal base once resource rents fade.

In 2000, Turkmenistan generated 41.4% of its GNI from natural resources, whereas the natural resources depletion rate in Azerbaijan was 27.9% and in Kazakhstan, 19%, compared to 1.2% of the world average. This ratio was lower in Uzbekistan at 9.8% of GNI, yet still significantly above the world average (1.2%). Hungary and Türkiye operate in entirely different ranges across all years shown in Figure I.24.

Between 2000 and 2020, most of the Turkic economies successfully reduced their rates of natural resource depletion. However, in 2021, the trend fluctuated once again, and this rate increased in Azerbaijan to 16.2% of GNI, Kazakhstan to 15.2%, Uzbekistan to 14%, and Kyrgyzstan to 9.2% of GNI, indicating higher depletion returns once again.

FIGURE I.24: NATURAL RESOURCES DEPLETION
(PERCENT OF GNI)




Source: World Bank, Environment Social and Governance (ESG) Data.
Note: Natural resource depletion is the sum of net forest depletion, energy depletion, and mineral depletion.

In general, the series in Figure I.24 shows volatility and a renewed pull from depletion for most of the Turkic economies in the most recent year reported, and remains multiple times above the world average, pointing to a persistent dependence on natural capital. On the other hand, Hungary and Türkiye demonstrate what a low-depletion profile looks like in practice, with depletion rates staying around 0.1% to 0.3% of GNI.

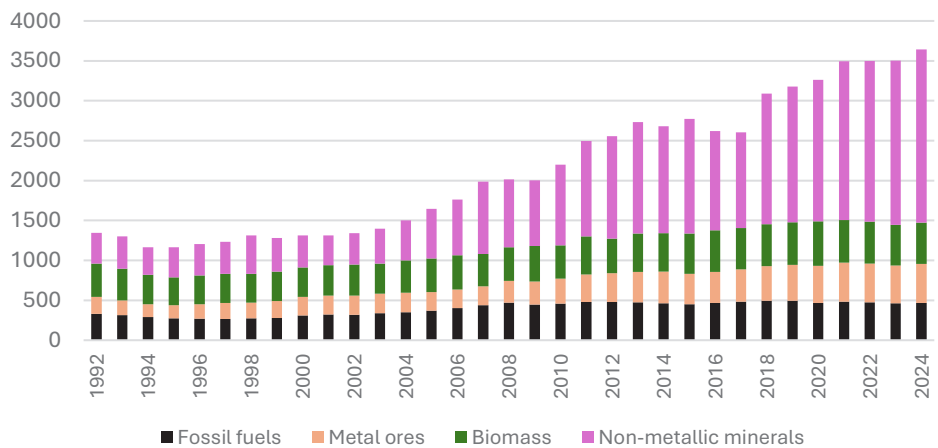
The widening discrepancy in the depletion of natural resources among Turkic economies is an indication of quite dissimilar initial conditions for financing and managing a green economy transition, particularly where extractive cycles still determine public revenues and external balances.

Most economies still run on a linear 'take–make–waste' model, which keeps pushing extraction upward and locks in emissions across construction and industry. A circular economy aims to design out waste and pollution, keep materials in use at a higher value, and restore natural systems, yet only 7.2% of materials used globally get cycled back through reuse or recycling, so the

efficiency gap remains large even before country-specific constraints enter the picture.

Material extraction across the Turkic economies increased by approximately 2.7 times from 1992 to 2024. Material extraction particularly accelerated after the mid-2000s. Almost all the growth in material extraction is driven by non-metallic minerals (Figure I.25). This is indicative of a growth model that is highly dependent on construction materials, including sand, gravel, and limestone.

FIGURE I.25: TOTAL MATERIAL EXTRACTION IN TURKIC ECONOMIES
(BY FOUR MAIN MATERIAL CATEGORIES, MILLION TONNES)

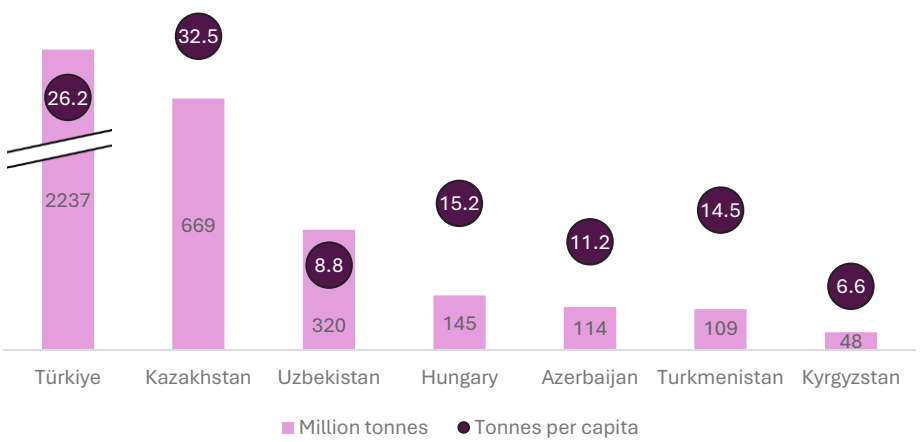



Source: UNEP IRP Global Material Flows Database.
Biomass: Crops for food and energy, bio-based materials, and wood used for energy and industrial purposes; Fossil fuels: Extracted coal, oil, and natural gas; Metal ores: Ores containing metals such as iron, aluminum, and copper; Non-metallic minerals: Materials such as sand, gravel, limestone, and other minerals used mainly in construction and industrial applications.

The other categories (fossil fuels, metal ores, and biomass) grow much more slowly and look steadier. In 1992, the total share of material extraction was almost the same for biomass and non-metallic minerals, while in 2024, non-metallic minerals had a share more than four times that of biomass (Figure I.25). For the green economy transition of Turkic economies, the binding challenge is not only energy. It is also about slowing the growth of construction materials by improving design, extending asset lifespans, and increasing the recovery of secondary materials.

At the country level, as of 2024, Türkiye dominates the market of Turkic economies by volume, with 2237 million tonnes of domestic extracted materials, followed by Kazakhstan at 669 million tonnes. Uzbekistan follows at 320 million tonnes, while Hungary (145 million tonnes), Azerbaijan (114 million tonnes), Turkmenistan (109 million tonnes), and Kyrgyzstan (48 million tonnes) sit far lower (Figure I.26).

FIGURE I.26: DOMESTIC EXTRACTION OF MATERIALS
(2024, MILLION TONNES AND TONNES PER CAPITA)




Source: UNEP IRP Global Material Flows Database.

Since totals mainly track economic size and population, it would be wrong to conclude that Türkiye is automatically the most material-intensive economy. On a per capita basis of the domestic extraction of materials, Kazakhstan's figure of 32.5 tonnes in 2024 is above Türkiye's 26.2. Turkmenistan is also worth noting: only 109 million tonnes of material extracted, but 14.5 tonnes per person. This is close to Hungary, which has a rate of 15.2 tonnes per person (Figure I.26).

The composition of domestic material extraction reveals the source of each economy's physical footprint, which in turn shapes the most challenging aspects of the green economy transition. Countries dominated by the extraction of non-metallic minerals typically have a construction-heavy material base, while those with a fossil-fuel-heavy mix point to a continued reliance on extraction-led income. Metal-ore-heavy mixes suggest a mining profile that can support industrial value chains but also brings land and water pressures that need tighter control.

Türkiye stands out as the most construction-mineral-intensive case, with non-metallic minerals accounting for 80% of domestic extraction in 2024. Hungary also leans heavily toward non-metallic minerals (61%), and Kyrgyzstan sits at 47% (Figure I.27). The mix, dominated by construction materials, raises the importance of circularity in the built environment, including longer asset life, secondary aggregates, and improved demolition waste recovery.

FIGURE I.27: COMPOSITION OF DOMESTIC MATERIAL EXTRACTION
(2024, BY FOUR MAIN MATERIAL CATEGORIES, PERCENT)

| | Biomass | Fossil fuels | Metal ores | Non-metallic minerals |
|---|---|---|---|---|
| Azerbaijan | 20% | 47% | 2% | 31% |
| Hungary | 35% | 5% | 0% | 61% |
| Kazakhstan | 13% | 30% | 42% | 16% |
| Kyrgyzstan | 28% | 6% | 19% | 47% |
| Türkiye | 12% | 4% | 4% | 80% |
| Turkmenistan | 15% | 61% | 0 | 24% |
| Uzbekistan | 21% | 14% | 36% | 29% |

Source: UNEP IRP Global Material Flows Database.

Azerbaijan and Turkmenistan sit at the other end of the spectrum, where fossil fuels account for the largest share. Fossil fuels account for 47% of extraction in Azerbaijan and 61% in Turkmenistan, while non-metallic minerals still account for 31% and 24%, respectively. Kazakhstan looks more diversified: 42% metal ores and 30% fossil fuels, with a smaller non-metallic share (16%). Uzbekistan also has a mining-led profile, with metal ores at 36% and a more balanced split between biomass (21%), fossil fuels (14%), and non-metallic minerals (29%). These differences matter because they imply different transition risks and opportunities: energy and revenue exposure where fossil fuels dominate, and permitting, tailings, and water governance challenges where metal ores take a significant share.

Different starting points shape very different green transition constraints across the Turkic economies. Azerbaijan and Turkmenistan carry the sharpest exposure because fossil fuels dominate domestic extraction, so any shift in prices or production can hit public revenue and external balances fast. Kazakhstan and Uzbekistan are closer to a mining profile, where the transition hinges on stricter land, water, and tailings controls as much as on energy. Türkiye and Hungary face a separate binding issue: low depletion but very large non-metallic mineral extraction, which puts circular construction, longer

asset life, and higher recovery of secondary aggregates at the center of the adjustment.

### Implications from I.2.2

- Policy needs to separate revenue risk from material risk. Where extraction is dominated by fossil fuels, public revenues and external balances stay tied to a global demand outlook that is likely to tighten over time. Where extraction is dominated by construction minerals, the economy risks staying on a high-throughput path that generates large waste streams.
- Non-metallic mineral extraction has risen fast in Turkic economies, so decarbonisation will depend on what happens in the built environment. Cleaner power helps, still results will also come from longer asset life, stronger design and building standards, and wider use of secondary materials.
- Safeguards should fit what each country extracts. Where mining dominates, the priorities are limiting land damage, managing tailings safely, and controlling water use. Where construction minerals dominate, the priorities are recovering demolition waste, sorting it properly, and setting standards so recycled materials can be used widely and safely.

## I.3 Readiness, pathways, and enabling conditions for the green economy transition

Readiness for a green economy transition in the Turkic economies depends less on stated ambition and more on the practical conditions that shape what can change, how fast, and at what cost. The following subsections focus on the core pathways and enablers that determine whether decarbonization can move from plans to measurable shifts in the energy mix, the emissions profile, and the economy-wide efficiency, while keeping competitiveness and fiscal stability in mind.

Policy rarely works through one tool. Countries usually combine rules and standards, price signals, and better information in a single package, shaped

by what the budget can afford and what institutions can actually implement. Since reforms affect growth, jobs, and household costs, green macroeconomic modelling can be used to test policy packages in advance, before governments commit to major reforms and investment plans.

Furthermore, delivery capacity for the green economy transition can become a binding constraint, as the transition requires new skills, new tools, and stronger public-sector leadership across ministries and levels of government.

### What to watch in Section I.3

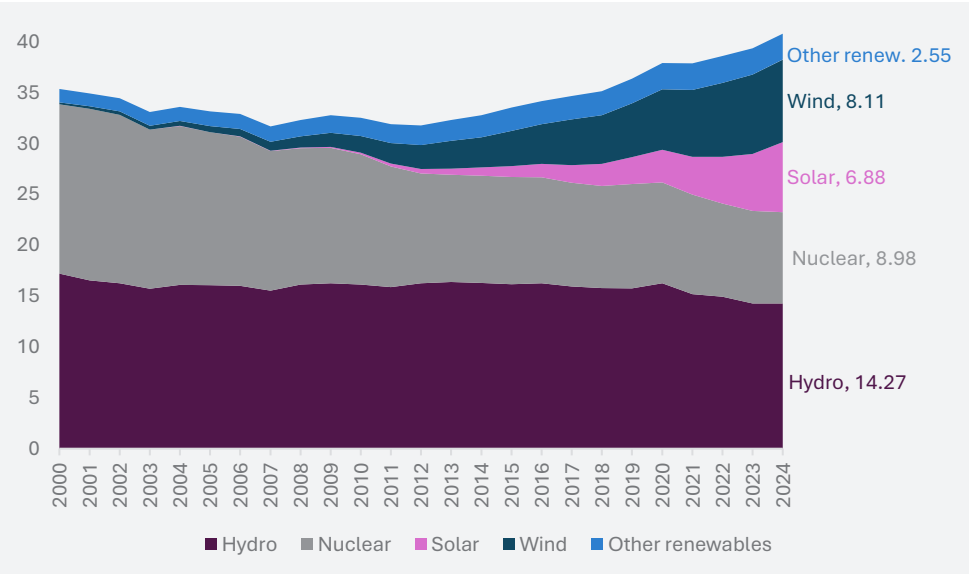
- Delivery capacity for the green economy transition will decide what is realistic. Targets matter little if countries lack the people, tools, and coordination to deliver projects across ministries and cities.
- Prices and budgets need to support the pledges. If subsidies keep fossil fuels cheap and environmental taxes remain limited, firms and households will not shift investment at the pace the targets assume.
- Electrification only helps when electricity gets cleaner. Moving cars, heating, and industry onto the grid cuts little GHG emissions if the grid still runs on coal and gas.

## I.3.1 Energy system transformation and decarbonization pathways

The share of clean fuels in global electricity generation rose from 35.4% in 2000 to 40.8% in 2024 (Figure I.28). However, the composition shifted sharply, and recent gains in global clean power came mainly from scaling wind and solar resources. Over the same period, hydro declined from 17.2% to 14.3%, and nuclear fell from 16.6% to nearly 9%. Wind and solar moved in opposite directions, with wind rising from 0.2% to 8.1% and solar from near zero to 6.9%, while other renewables remained small at 2.6% in 2024.

Electricity systems across the Turkic economies are at entirely different stages of decarbonization. The economy of Kyrgyzstan is powered primarily by clean energy sources, which accounted for over 80% of total energy generation in 2000 and 2024. Hungary managed to raise the clean generation to 73.8% in 2024. Other Turkic economies continue to rely on fossil fuels, and their

FIGURE I.28: CLEAN FUEL SHARE IN GLOBAL ELECTRICITY GENERATION
(PERCENT)

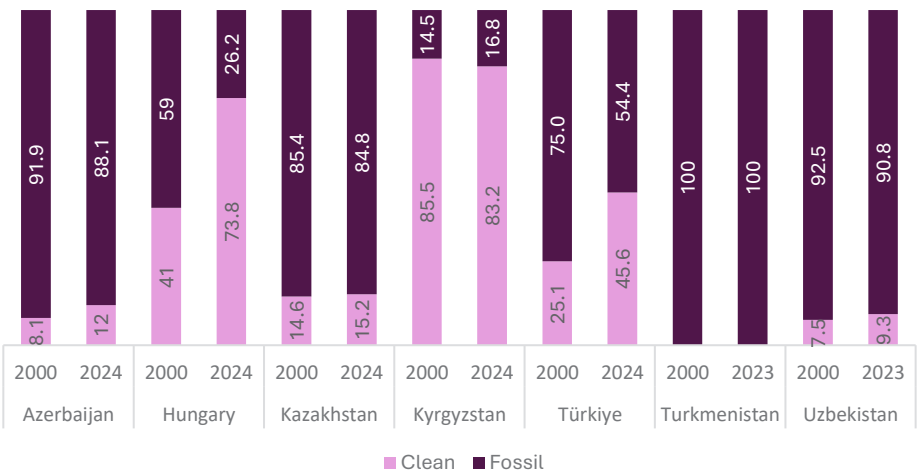



Source: Ember, Yearly Electricity Data. "Other renewables" include bioenergy, geothermal, tide, and wave energy.

electricity generation composition has changed only marginally over the two decades. Among them, only Türkiye achieved the most evident shift, raising clean electricity from 25.1% to 45.6% between 2000 and 2024, yet fossil fuels still supply 54.4% of electricity generation in Türkiye (Figure I.29). Azerbaijan, Kazakhstan, and Uzbekistan show limited increases in clean electricity shares over the period, and fossil shares remain high. In the two periods compared, the clean share in Azerbaijan increased from 8.1% to 12%, in Kazakhstan from 14.6% to 15.2%, and in Uzbekistan from 7.5% to 9.3%. In Turkmenistan, fossil fuels still account for 100% of electricity production. If the goal is to align with a world where clean power accounts for more than 40% of generation (Figure I.28), then it is clear that several Turkic economies remain well below the global clean-power share and start from low clean-generation shares.

In Turkic economies as a group, fossil fuels dominate power generation. In 2000, 76.3% of generation was comprised of gas, coal, and other fossil fuels. This had fallen to 68.7% by 2023, but the generation mix remains fossil-dominant, so the shift has not yet changed the overall model. In 2023, gas led by 37%, compared to its 2000 proportion of 36.5%. Usage of coal in power generation also rose from 28.6% in 2000 to 31.1% in 2023 (Figure I.30).

FIGURE I.29: SHARES OF CLEAN AND FOSSIL FUELS IN ELECTRICITY GENERATION ACROSS TURKIC ECONOMIES (PERCENT)

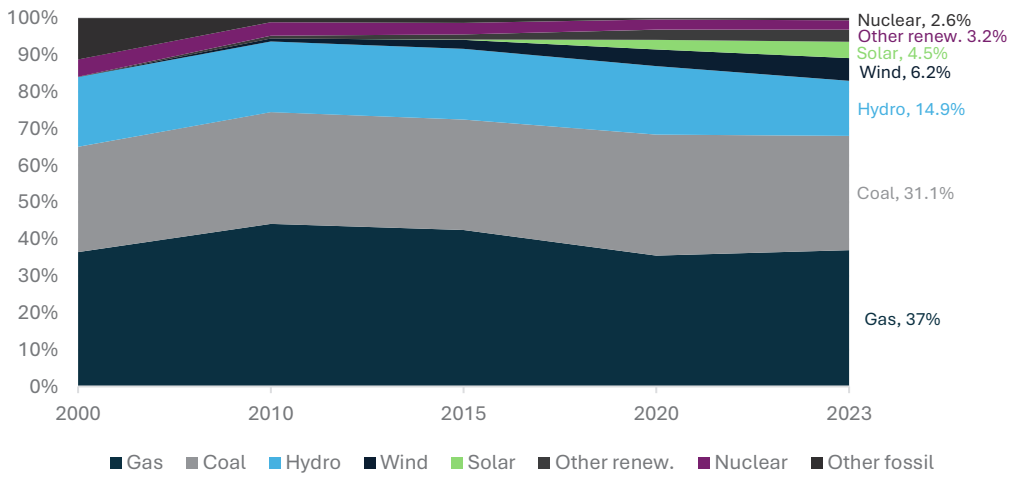



Source: Ember, Yearly Electricity Data.

Clean sources accounted for 23.7% of power generation in Turkic economies in 2000 and rose to 31.4% in 2023. The share of hydro in total power generation dropped from 18.9% to 14.9% over the same period, and nuclear fell from 4.7% to 2.6%. Wind and solar rose from 0% in 2000 to 6.2% and 4.5%, respectively, in 2023, with other renewables, which include bioenergy, geothermal, tide, and wave energy, reaching 3.2% in 2023. Although wind and solar shares have started to grow, deeper decarbonization in Turkic economies requires a more rapid scale-up of renewables, as well as a measurable reduction in coal consumption.

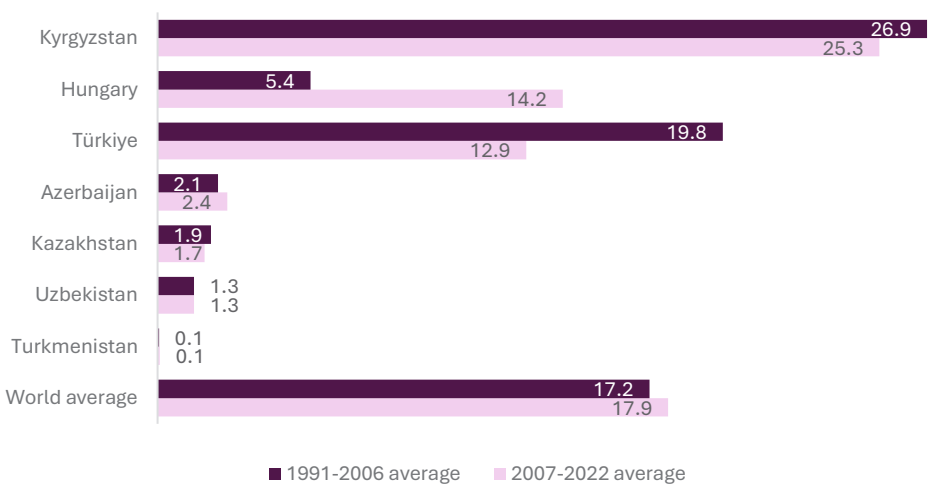
Higher clean electricity shares do not automatically translate into renewables in total final energy use, where heat and transport sectors weigh heavily. The role of renewables in end-use energy consumption in the Turkic economies remains very different, to the extent that the gaps are vast. Even though its value has slightly decreased in the two periods compared (from 26.9% to 25.3%), Kyrgyzstan leads in both periods, as shown in Figure I.31. The global average of renewable energy share in the final energy consumption remains significantly lower than the value of Kyrgyzstan, at 17.9% in the 2007-2022 period. Yet, Kyrgyzstan is the only example in the group that stays above the global average.

FIGURE I.30: ENERGY SOURCE SHARES IN TURKIC ECONOMIES' ELECTRICITY GENERATION
(PERCENT)




Source: Ember, Yearly Electricity Data. "Other renewables" include bioenergy, geothermal, tide, and wave energy.

FIGURE I.31: RENEWABLE ENERGY SHARE IN THE TOTAL FINAL ENERGY CONSUMPTION
(PERIOD AVERAGES, PERCENT)



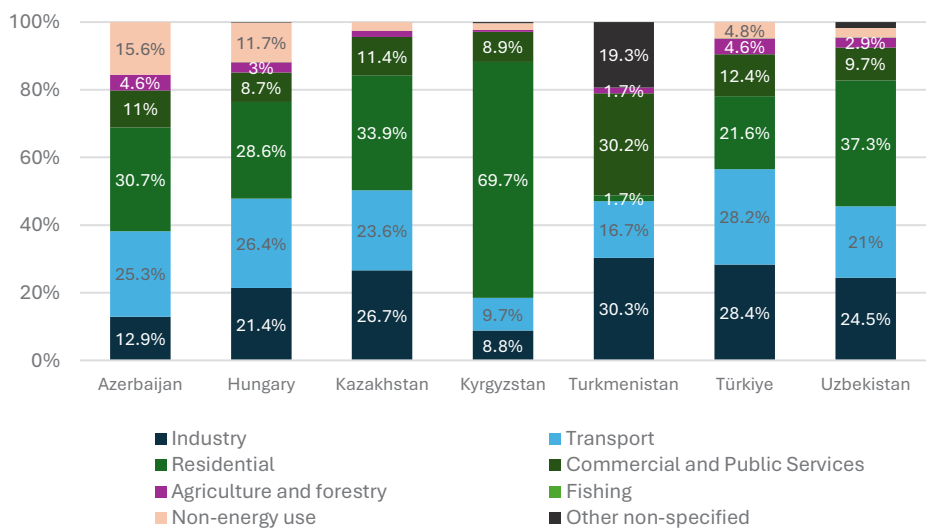

Source: World Bank and UNECE Dashboard for SDGs.
Note: The renewable energy share in total final consumption is the percentage of final consumption of energy that is derived from renewable resources.

The situation in other Turkic economies is not homogeneous, and in some instances, it is moving in the opposite direction, away from decarbonization.

Renewable energy's share of total final energy consumption in Türkiye declined from 19.8% to 12.9% in the later period (Figure I.31), remaining below the world average. On the other hand, Hungary increased its share of renewable energy in total final energy consumption from 5.4% to 14.2%. In Azerbaijan, Kazakhstan, Uzbekistan, and Turkmenistan, renewables are so limited that decarbonization will rely on transformations far beyond the energy sector, since the majority of end-use energy remains beyond the reach of renewable supplies.

Any discussion of energy efficiency should account for where total final consumption (TFC) goes across sectors. TFC captures what end users consume for buildings, transport, and production, so the sector split signals where the largest efficiency gains and electrification pressures will land during the green transition.

FIGURE I.32: SECTORAL SHARES OF TOTAL FINAL ENERGY CONSUMPTION
(2023, PERCENT)



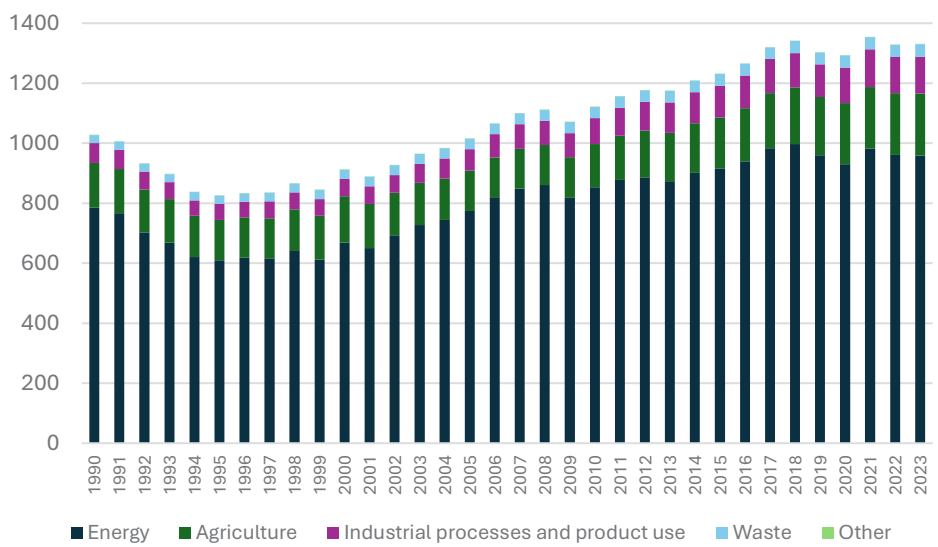

Source: International Energy Agency (IEA).
Total: Total final consumption (TFC) is the energy consumed by end users such as individuals and businesses to heat and cool buildings, to run lights, devices, and appliances, and to power vehicles, machines and factories.

The split varies sharply across the Turkic economies. As of 2023, Kyrgyzstan stands out for a building-heavy profile: residential use reaches 69.7%, while industry (8.8%) and transport (9.7%) stay small. Uzbekistan also tends toward households, with residential at 37.3%, alongside sizable industry (24.5%) and

transport (21%). Azerbaijan, Hungary, Kazakhstan and Türkiye look more balanced across industry and transport, and residential consumption (Figure I.32). In Turkmenistan industry (30.3%) and commercial and public services (30.2%) dominate, residential is only 1.7%, and "other non-specified" remains high at 19.3%, which makes any sector-focused efficiency plan risky unless the underlying uses are clarified. Further, non-energy use particularly matters for transition design in Azerbaijan (15.6%) and Hungary (11.7%), since a meaningful share of final demand sits outside direct fuel combustion.

Emissions across the Turkic economies fell sharply in the first half of the 1990s, then reversed course and climbed for almost two decades, reaching the highest levels in the late 2010s and staying elevated through 2023. Energy sector emissions drive that pattern. The energy block remains the largest segment each year, so the rise in total emissions tracks energy-related emissions more than any other category (Figure I.33).

FIGURE I.33: TOTAL GHG EMISSIONS BY SECTOR IN TURKIC ECONOMIES
(MT $CO_2$EQ, EXCLUDING LULUCF)




Source: IMF, Macroeconomic Climate Indicators Dashboard.
Note: Data excludes land-use, land-use change and forestry.

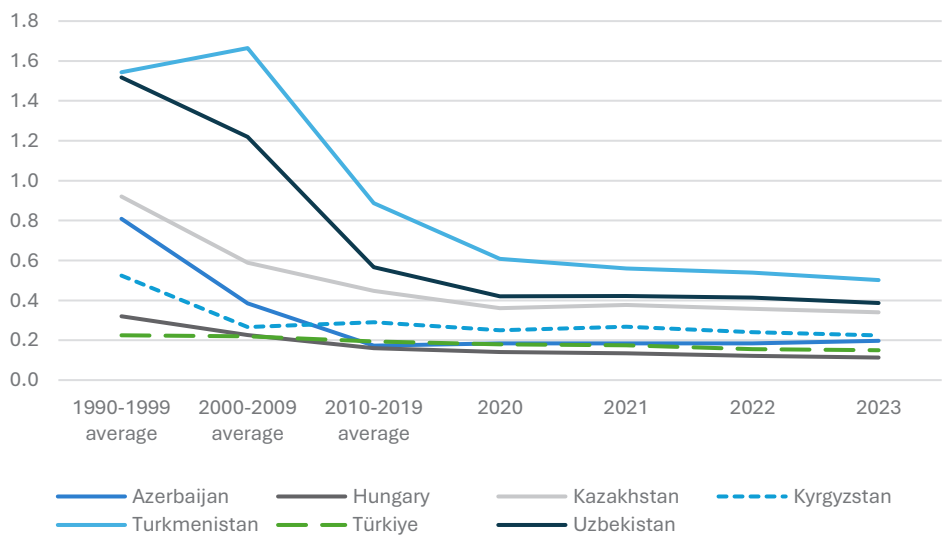
As of 2023, the energy sector accounted for 72% of total GHG emissions, far ahead of agriculture at 15.6% and industrial processes and product use at 9.3%, while waste accounted for 3.1%. Since the series excludes land use, land-use change, and forestry, 15.6% of agriculture's emissions already signal a

meaningful non-energy pillar in the transition agenda. Even if substantial reductions in emissions from agriculture, waste, or industrial processes occur, this will not change the overall trend if energy emissions remain high.

The carbon intensity of GDP has fallen across all Turkic economies since the 1990s, suggesting a broad decoupling between emissions and output over time. Still, the gap between countries remains significant, which signals different conditions for decarbonization and different likely costs of adjustment. For example, as of 2023, Turkmenistan at 0.50 emits about 4.5 times as much per unit of output as the lowest, Hungary, which is at 0.11 (Figure I.34)

FIGURE I.34: CARBON INTENSITY OF GDP

(PERIOD AVERAGES AND 2020–2023, KG $CO_2$EQ PER 2021 PPP $)




Source: World Bank.

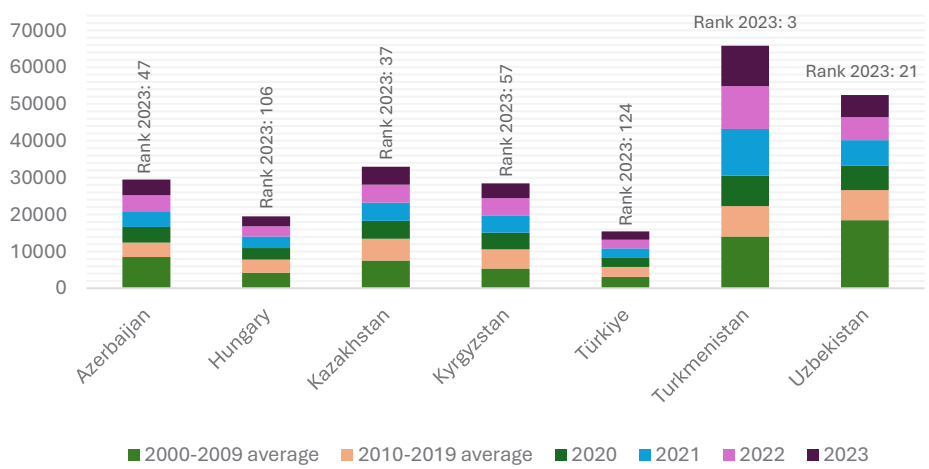
Note: This indicator shows how much $CO_2$ is emitted to produce one dollar of economic output, using total emissions from agriculture, energy, industry, and waste (excluding land-use change and forestry), and GDP measured in 2021 PPP dollars.

The carbon intensity of the GDP pattern also shifts over time. The steepest improvements occurred earlier, while the post-2020 lines flatten for most countries, suggesting that easy gains have largely been captured and further reductions will need more structural change in energy supply, industry, and end-use efficiency.

An alternative way to evaluate a country's overall energy efficiency is to look at how much total energy it needs to produce one unit of GDP, adjusted for purchasing power. Lower values usually mean the economy uses energy more efficiently, but they can also reflect what the country produces. Economies built around services tend to use less energy per unit of output than economies dominated by heavy industry.

Energy supply per unit of GDP divides the Turkic economies into different camps (Figure I.35). Turkmenistan, at 10,969 megajoules (MJ) per unit of GDP, ranks very high (3rd globally), meaning it is third globally in terms of energy intensity (more energy is needed per unit of GDP). Among Turkic economies, Uzbekistan ranks 21st, with 6,029 MJ per unit of GDP, which is still very high even after years of progress (Figure I.35).

FIGURE I.35: TOTAL ENERGY SUPPLY PER UNIT OF GDP
(PERIOD AVERAGES AND 2020–2023, MJ PER 2015 $ PPP)




Source: International Energy Agency (IEA).
Note: Total energy supply per unit of GDP measures how much energy the economy needs to produce one unit of output, using purchasing-power-parity-adjusted GDP. Ranks are global, where lower rank numbers mean higher energy intensity (more energy needed per unit of GDP). Higher-ranking numbers indicate lower energy intensity.

A middle group that is still energy-intensive according to the international criteria consists of Kazakhstan (4,857 MJ per unit of GDP; the 37th rank), Azerbaijan (4,312; the 47th rank) and Kyrgyzstan (4,019; the 57th rank). Türkiye and Hungary appear less energy-intensive than other countries globally, with Hungary consuming 2,638 MJ per unit of GDP (rank 106) and Türkiye 2,219 MJ per unit of GDP (rank 124).

High-ranking Turkic economies require greater energy-efficiency gains and structural transformation to sustain growth and reduce emissions, as each unit of production in their economies continues to demand substantial energy volumes.

Across the indicators, this subsection points to a transition that has to run on two tracks at once: decarbonizing the power supply while cutting the energy the economy needs to produce output, then carrying those gains into heating and transport, where renewables remain limited. The countries that still combine fossil-heavy generation with high energy intensity will face the steepest adjustment, because incremental shifts in the power mix will not translate into durable emissions reductions if demand stays locked into energy-intensive patterns.

### Implications from I.3.1

- Fossil-heavy power mixes paired with high energy intensity create a double task. Countries need to clean up their electricity supply and cut demand through efficiency, or emissions stay high.
- Electrifying transport and industry helps only when electricity gets cleaner, so grid clean-up needs to come early.
- Heatwaves and water stress can reduce available power. Planning needs to handle peaks and shocks, not only add generation.

## I.3.2 Climate commitments, emissions trends, and climate risk exposure

The contributions of the Turkic economies to global GHG emissions, measured in $CO_2$eq, are small (2.62% of global emissions), yet this distribution is not balanced within the group. Türkiye alone accounts for 1.09% of the world's GHG emissions, followed by Kazakhstan (0.62%) and Uzbekistan (0.43%) (see Table I.3).

A clear, cross-country comparison of the national commitments of GHG emission reduction is harder than it looks because the targets are not framed on the same basis.

Some countries use historical baselines and net economy-wide reductions by 2035, such as Azerbaijan's 40% reduction relative to 1990 (conditional) and Hungary's 66.25%-72.5% reduction relative to 1990. Kazakhstan also anchors its target to 1990, yet sets it for 2030, and splits it into 15% unconditional and 25% conditional.

TABLE I.3: NATIONAL CLIMATE COMMITMENTS
(NDC TARGETS AND NET-ZERO GOALS)

| | Share in global GHG emissions (2024) | Reduction targeted | Net-zero target |
|---|---|---|---|
| Azerbaijan | 0.11% | Achieving a 40% net GHG emission reduction level in 2035 compared to the 1990 net GHG emission level (conditional) | 2050 |
| Hungary | 0.11% | Indicative contribution of an economy-wide net reduction of between 66.25-72.5% in GHG emissions by 2035 compared to 1990 | 2050 |
| Kazakhstan | 0.62% | Reducing GHG emissions by 15-25% by 2030 compared to the 1990 baseline across the economy (15% is an unconditional target, 25% is a conditional target) | 2060 |
| Kyrgyzstan | 0.04% | Reducing net GHG emissions by 18% from the projected baseline level of net emissions in 2030 and by 16% from the projected baseline level of net GHG emissions in 2035 (Unconditional). Reducing net GHG emissions by 30% in 2030 from the projected baseline level of net GHG emissions for that year, and by 39% from the projected baseline level of net GHG emissions in 2035 (Conditional). | 2050 |
| Türkiye | 1.09% | Reducing GHG emissions by 466 Mt $CO_2$eq. compared to the BAU scenario, limiting GHG emissions to 643 Mt $CO_2$ eq. in 2035. | 2053 |
| Turkmenistan | 0.22% | Reducing 20% of GHG emissions in 2030 under the BAU scenario, relative to 2010 emissions | 2050 |
| Uzbekistan | 0.43% | Achieving a reduction in specific greenhouse gas emissions (emission intensity) per unit of gross domestic product by 50% by 2035 compared to 2010 levels. | 2055-2060 |

Source: Crippa, M. et al (2025); UNFCCC NDC Registry - Azerbaijan's Nationally Determined Contribution 3.0 (Submission date: 05/11/2025); The Nationally Determined Contribution of the European Union and its Member States (Submission date: 05/11/2025); Updated Nationally Determined Contribution of the Republic of Kazakhstan (Submission date: 27/06/2023); Nationally Determined Contribution 3.0 of Kyrgyzstan (Submission date: 02/10/2025); Second Nationally Determined Contribution of the Republic of Türkiye (NDC 3.0) (Submission date: 09/11/2025); Nationally Determined Contribution of Turkmenistan under the Paris Agreement (Submission date: 30/01/2023); Updated Nationally Determined Contribution of the Republic of Uzbekistan (NDC 3.0) (Submission date: 06/11/2025).
Note: Share in global GHG emissions includes all primary greenhouse gases — $CO_2$ (fossil and bio), $CH_4$, $N_2O$, and F-gases — expressed in $CO_2$ equivalents ($CO_2$eq) and compiled in the EDGAR Total GHG database.

Part of countries are based on baselines that change with assumed trends: Turkmenistan aims to reduce GHG emissions by 20% by 2030 relative to the business-as-usual (BAU) scenario in 2010, and Türkiye targets its 2035 outcome relative to BAU with an absolute cap limiting GHG emissions to 643 Mt $CO_2$eq in 2035.

Kyrgyzstan uses projected baselines with absolute and conditional reductions at 2030 and 2035. Once more, Uzbekistan chooses another path and aims to reduce emissions intensity per unit of GDP by 50% by 2035 (Table I.3).

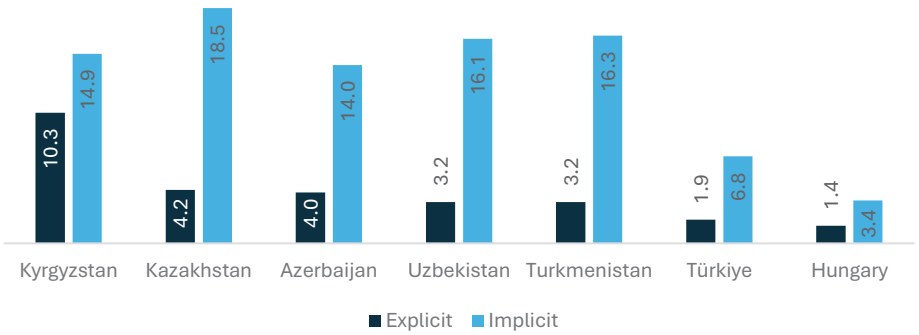
Most Turkic economies have net-zero target years in the mid-century, with Azerbaijan, Hungary, Kyrgyzstan, and Turkmenistan setting 2050 as the target. Türkiye set this target for 2053, Kazakhstan for 2060, and Uzbekistan for 2055-2060. Yet the credibility test of climate commitments would lie in whether countries translate these formats into comparable policies, investment signals, and measurable emissions outcomes.

Fossil fuel subsidies remain substantial in several Turkic economies, and their scale is difficult to reconcile with a serious decarbonization agenda. According to the IMF modeled estimates, Kyrgyzstan stands out on the explicit side, where direct budget support averages 10.3% of GDP over 2015–2025, and implicit subsidies add 14.9%. Kazakhstan, Turkmenistan, and Uzbekistan have the largest implicit subsidies at 18.5%, 16.3%, and 16.1% of GDP, respectively, while their explicit support remains lower at 4.2% in Kazakhstan and 3.2% in both Turkmenistan and Uzbekistan. Azerbaijan sits in the same range, with 4% explicit and 14% implicit support (Figure I.36).

Türkiye and Hungary operate at a much lower level. Explicit subsidies average 1.9% of GDP in Türkiye and 1.4% in Hungary, with implicit subsidies at 6.8% and 3.4%. Large explicit subsidies usually mean end users pay prices that do not cover supply costs, so energy saving becomes a hard sell, and public budgets take the hit.

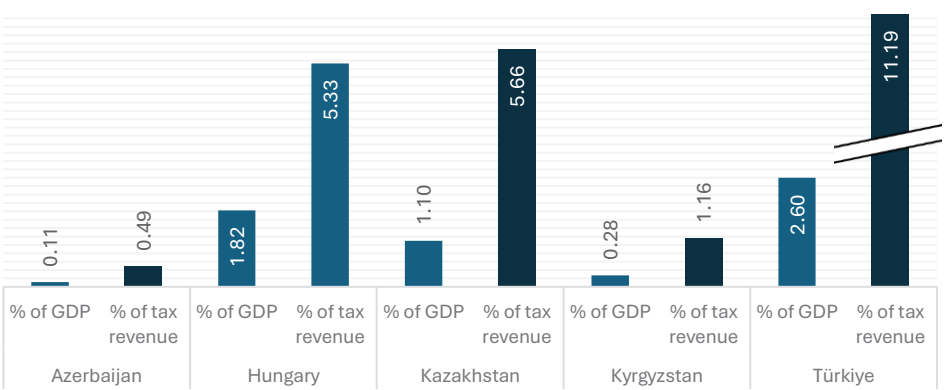
Large implicit subsidies point to a broader gap between current prices and prices that would reflect pollution costs and regular taxation, so reform later tends to be sharper and more politically painful. If a country targets emissions cuts while maintaining subsidies at these levels, the policy mix is difficult to reconcile without additional offsetting measures.

FIGURE I.36: FOSSIL FUEL SUBSIDIES
(PERCENT OF GDP, 2015-2025 AVERAGE)




Source: IMF, Macroeconomic Climate Indicators Dashboard. IMF staff modeled estimates of subsidies. IMF Fossil Fuel Subsidies Data.
Note: The figure shows explicit and implicit government support for fossil fuels (coal, natural gas, petroleum, and electricity). Explicit subsidies arise when fuel prices paid by users are lower than supply costs. Implicit subsidies capture the additional gap between current prices and socially efficient prices, reflecting environmental damages and uncollected taxes.

FIGURE I.37: ENVIRONMENTALLY RELATED TAX REVENUE
(2023, PERCENT OF GDP AND TOTAL TAX REVENUE)




Source: OECD, Environmentally Related Tax Revenue Database.
Note: Environmentally related taxes charge activities that harm the environment—such as energy use, transport, pollution, and resource extraction—to influence prices and reduce environmental damage. The figure illustrates the revenue from these taxes as a percentage of each country's GDP, indicating the extent to which governments utilize taxation to discourage environmentally harmful activities. Data for Turkmenistan and Uzbekistan not available.

Affordability also matters, especially where incomes are low, and heating and transport already strain household budgets. Cutting broad subsidies overnight can raise bills fast. At the same time, cheap energy rarely targets only vulnerable households. It often supports heavy users and energy-

intensive firms alongside families who need help the most. A workable path phases reforms in and protects households directly, for example, through cash transfers, lifeline tariffs for basic consumption, and support for home heating efficiency. This design choice can improve social acceptability and reduce the risk of backlash during reform implementation

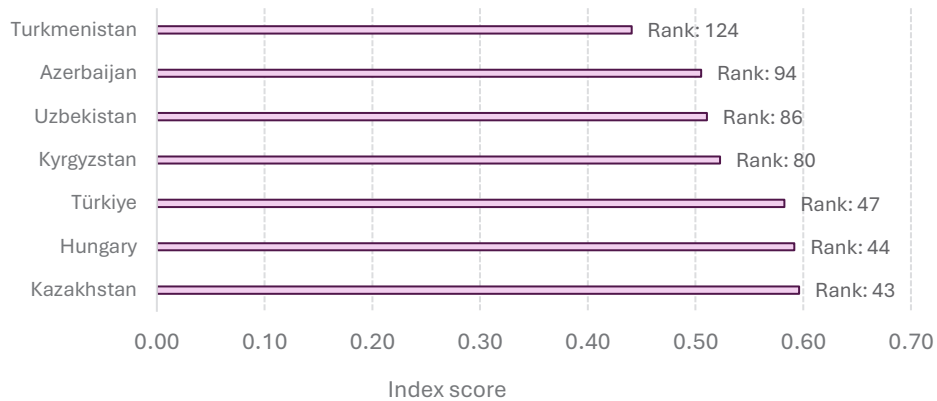
Environmental taxes carried very different weights across the Turkic economies in 2023. Türkiye sits at the high end, raising 2.6% of GDP through environmentally related taxes, which also equals 11.19% of its total tax revenue. Hungary comes next at 1.82% of GDP and 5.33% of tax revenue Figure I.37). Kazakhstan collects less on the GDP measure at 1.1%, yet environmental taxes still make up 5.66% of its tax revenue, so they matter for the budget mix even if they do not generate as much economy-wide.

Azerbaijan and Kyrgyzstan report comparatively low levels of environmentally related tax revenue on both measures. Azerbaijan collects 0.11% of GDP and 0.49% of tax revenue, while Kyrgyzstan collects 0.28% of GDP and 1.16% of tax revenue. Reading the two measures side by side helps: the GDP share signals the strength of the price signal across the economy, while the revenue share shows whether the instrument has become part of routine fiscal policy. Data for Turkmenistan and Uzbekistan are unavailable for this indicator, so the picture omits two economies where price signals could matter a lot for transition readiness.

Kazakhstan, Hungary, and Türkiye sit in a tight band on the IMF-adapted ND-GAIN measure of vulnerability and adaptive capacity (Figure I.38). Their scores range from 0.58 to 0.60, and their global ranks fall in the mid-40s (Kazakhstan: 43, Hungary: 44, Türkiye: 47). In practice, these scores suggest broadly comparable readiness to cope with climate disruptions and to mobilize investment for adaptation.

Kyrgyzstan scores 0.52 (rank 80), Uzbekistan 0.51 (rank 86), and Azerbaijan 0.51 (rank 94), while Turkmenistan drops to 0.44 (rank 124). A difference of a few hundredths does not prove that one country is meaningfully more "ready" than another. Yet, those countries ranked in the 80s to 120s have a much harder starting point for green transition than others, since climate shocks can be more severe and institutions may have less capacity to plan, finance, and deliver adaptation at scale.

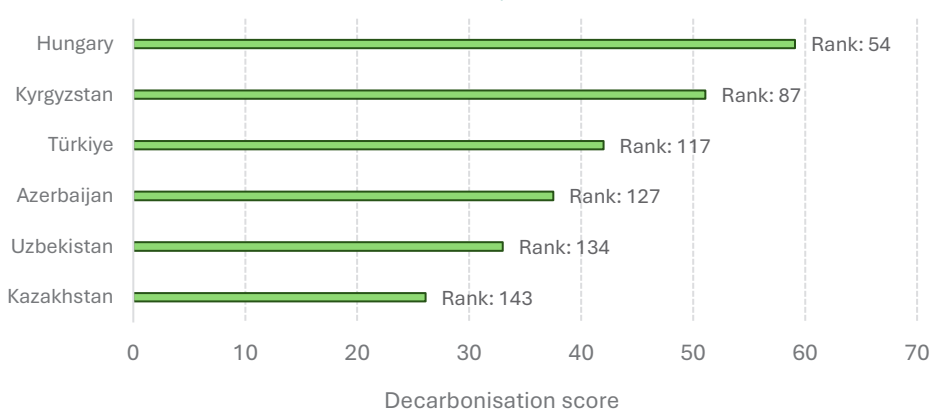
FIGURE I.38: CLIMATE VULNERABILITY AND ADAPTIVE CAPACITY IN TURKIC ECONOMIES
(2022, IMF-ADAPTED ND-GAIN INDEX)




Source: IMF, Macroeconomic Climate Indicators Dashboard, IMF-Adapted ND-GAIN Index.
Note: This index measures a country's climate vulnerability and adaptive capacity by combining exposure to climate-related risks with readiness to mobilize private and public investment for adaptation. Higher scores indicate stronger performance, lower vulnerability, and greater adaptive capacity. Countries are ranked from 1 to 187, with a lower numerical rank indicating better performance. ND-GAIN refers to the Notre Dame Global Adaptation Initiative.

The Economist Intelligence Unit recently started publishing the EIU Decarbonization Index. Progress on decarbonization is uneven across the Turkic economies, and none ranks among the global front-runners on the EIU

FIGURE I.39: EIU DECARBONISATION SCORES AND RANKS
(2024)




Source: Economist Intelligence Unit.
Note: The decarbonisation score ranges from 0 to 100, with higher scores indicating stronger progress in reducing greenhouse gas emissions and transitioning to a low-carbon economy. Countries are ranked based on this score, with 1 representing the best performance. Therefore, a lower numerical rank indicates better performance.

scale (Figure I.39). Hungary leads the group with a score of 59.1 and a rank of 54. Kyrgyzstan follows at 51.1 and ranks 87. After that, the scores drop into a lower band: Türkiye at 42 (rank 117), Azerbaijan at 37.5 (rank 127), Uzbekistan at 33 (rank 134), and Kazakhstan at 26.1 (rank 143).

A credible green economy transition path in the Turkic economies will depend on whether climate commitments translate into consistent implementation signals across pricing, fiscal policy, and investment planning. Where policy keeps fossil energy cheap and environmental pricing limited, pledges will remain challenging to deliver, even when target years look aligned on paper.

Differences in climate risk exposure and adaptive capacity also shape what is feasible, since high-impact shocks can quickly divert budgets and political attention. The practical test is whether countries can move from diverse target formats to predictable actions that cut emissions while protecting households and strengthening resilience.

### Implications from I.3.2

- Countries use different starting points as targets, making comparability of seriousness difficult. What matters in climate commitments is whether governments put the same practical signals in place regarding carbon and energy pricing, subsidy reform, investment plans that shift spending, and credible emissions measurement and reporting.

- Large fossil-fuel subsidies make decarbonization hard to deliver, because they keep energy cheap and encourage higher use. Green economy transition reform only works politically if it happens in steps and if governments protect households early and visibly, using targeted support rather than blanket subsidies.

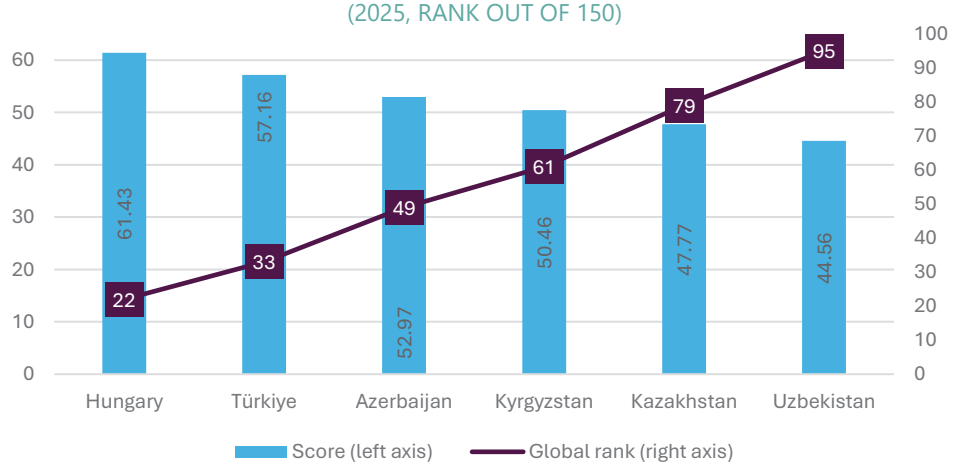
- When climate risks are high, floods, droughts, or heatwaves can force governments to spend money on emergencies. That can delay planned green investments and reforms. Therefore, readiness means investing in protection that reduces damage while keeping some budget room for shocks. If a country has no buffer, one bad year can pause the transition.

## I.3.3 Technological capabilities, innovation systems, and green growth potential

The Green Growth Index 2.0 is a composite measure of countries' progress towards sustainable, inclusive, and low-carbon growth, and their readiness to continue making that progress. It unites four areas: resource use efficiency and sustainability; protection and restoration of natural capital; green economy and opportunities; and social inclusion. The index also distinguishes among three layers of evaluation: what has been achieved, the potential for improvement, and the current transition pathway.

According to the Green Growth Index (Figure I.40), Hungary ranks 22nd globally with a score of 61.43 and is the top-ranked Turkic economy. Türkiye ranks 33rd with a score of 57.16 in 2025. Azerbaijan and Kyrgyzstan rank 49 and 61 with scores of 52.97 and 50.46, respectively. Kazakhstan and Uzbekistan rank 79 and 95, respectively, with scores of 47.77 and 44.56.

FIGURE I.40: GREEN GROWTH INDEX SCORES AND GLOBAL RANKS
(2025, RANK OUT OF 150)




Source: Global Green Growth Institute.
Note: Higher GGI scores indicate stronger green growth performance. The global rank shows each country's position out of 150 countries, with a lower numerical rank indicating better performance.

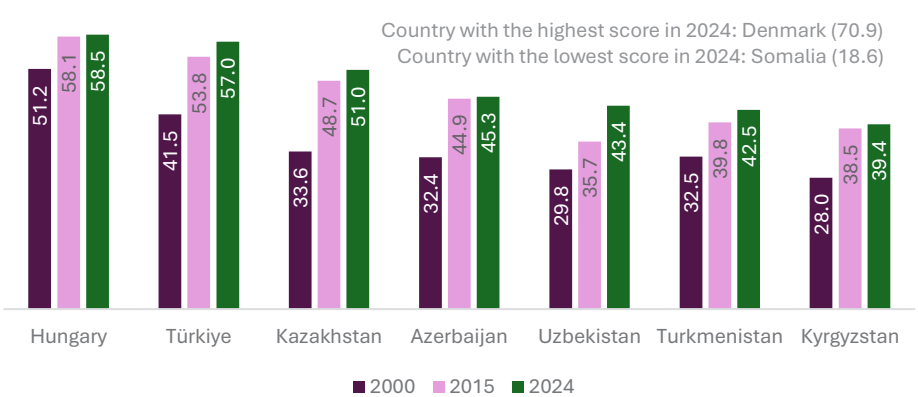
The range difference is not slight. According to the top and bottom scores, the gap is about 17 points, while the rank differential runs from 22 to 95. As such, based on this indicator, some Turkic economies enter the green

transition with a stronger measured momentum and enabling conditions, while others start from a thinner base and a larger catch-up task.

The Productive Capacities Index measures a country's ability to produce goods and services in ways that support growth and structural change. UNCTAD builds it from 42 indicators across eight areas, covering human capital, natural capital, ICT, structural change, transport, institutions, and the private sector. For the green economy transition, higher productive capacities usually mean a country can absorb new technologies faster, build competitive firms, and manage the infrastructure and policy shifts that decarbonization demands.

Scores across all Turkic economies rose between 2000 and 2024, yet they did not converge (Figure I.41). Hungary remains at the top in 2024 (58.5), with Türkiye close behind (57.0). Kazakhstan records the largest jump, moving from a low base in 2000 (33.6) to 51.0 in 2024, placing it ahead of Azerbaijan (45.3), Uzbekistan (43.4), Turkmenistan (42.5), and Kyrgyzstan (39.4). Here, the challenge of Turkic economies' transition is less about whether capacity exists and more about how quickly countries in the lower tier can close the gap while shifting investment toward cleaner production. One caution is unavoidable: for several countries, UNCTAD fills in many missing data points with estimates, so the results are helpful for broad comparisons, but gaps in scores may have meaningful differences.

FIGURE I.41: UNCTAD PRODUCTIVE CAPACITIES INDEX
(PSI SCORE)




Source: UNCTAD Data Hub.
Note: Values are UNCTAD estimates. A score approaching 0 indicates very weak productive capacities, while a score approaching 100 indicates very strong productive capacities. No economy reaches exactly 0 or 100.

The Frontier Technologies Readiness Index gauges a country's preparedness to adopt and use frontier technologies. It combines five building blocks: ICT deployment, skills, R&D activity, industry activity, and access to finance. Scores range from 0 to 1, with higher values indicating greater readiness, and ranks indicate global position.

Across the Turkic economies, readiness breaks into three tiers in 2024. Hungary sits at the top with a score of 0.73 (overall rank 39, "high"), followed closely by Türkiye at 0.70 (rank 44, "upper middle"). Kazakhstan also lands in "upper middle" at 0.58 (rank 66). The rest of the Turkic economies fall into "lower middle": Uzbekistan at 0.48 (rank 87), Azerbaijan at 0.40 (rank 104), and Kyrgyzstan at 0.39 (rank 109). For a green economy transition that increasingly depends on modern grids, industrial upgrading, and the diffusion of clean tech. The lower-middle group starts from weaker baseline conditions for rapid diffusion and scale-up of clean technologies.

TABLE I.4: FRONTIER TECHNOLOGIES READINESS INDEX
(2024)

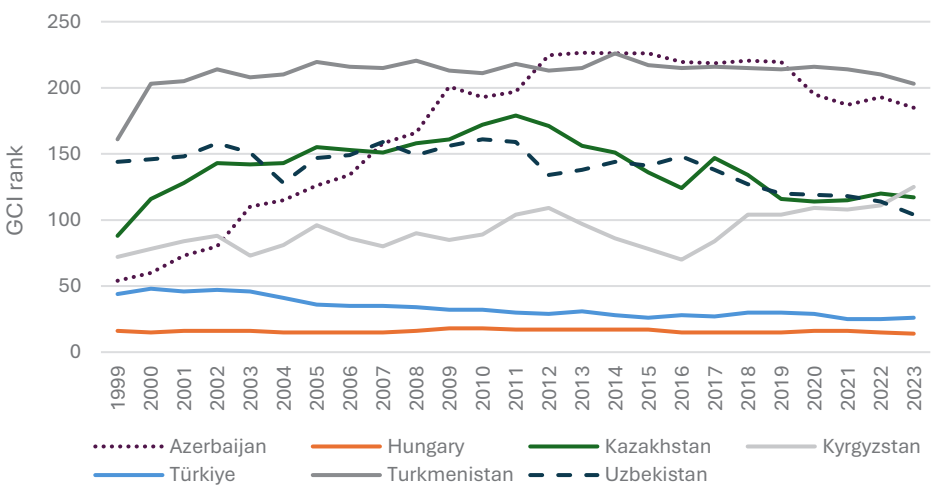
| | Total score | Overall rank | Score group | ICT rank | Skills rank | R&D rank | Industry rank | Finance rank |
|---|---|---|---|---|---|---|---|---|
| Azerbaijan | 0.40 | 104 | Lower middle | 100 | 93 | 88 | 135 | 121 |
| Hungary | 0.73 | 39 | High | 35 | 42 | 46 | 21 | 99 |
| Kazakhstan | 0.58 | 66 | Upper middle | 91 | 44 | 72 | 53 | 117 |
| Kyrgyzstan | 0.39 | 109 | Lower middle | 92 | 104 | 122 | 107 | 127 |
| Türkiye | 0.70 | 44 | Upper middle | 79 | 31 | 16 | 73 | 68 |
| Uzbekistan | 0.48 | 87 | Lower middle | 83 | 106 | 74 | 95 | 88 |

Source: UNCTAD (2025). Turkmenistan is not shown because data are unavailable.

The component ranks explain why countries land where they do. Hungary's strength comes from industry readiness (rank 21), while finance lags (rank 99). Türkiye scores well in R&D (rank 16) and skills (rank 31), yet ICT ranks lower (rank 79). Kazakhstan's profile looks uneven: skills rank relatively better (44), but ICT (91) and finance (117) pull the total down. In Azerbaijan and Kyrgyzstan, industry and finance rank lower (industry: 135 and 107; finance: 121 and 127), alongside mid-to-low ICT and skills rankings, suggesting a steeper path from adoption to scale. Uzbekistan sits between these cases, with a better overall score than Azerbaijan and Kyrgyzstan, yet skills remain an apparent bottleneck (rank 106) even as R&D and finance rank higher (74 and 88) relative to its skills ranking.

The degree of competitiveness in green exports, measured by the Green Complexity Index, clearly distinguishes the Turkic economies' performances (Figure I.42). The Hungarian economy remains one of the best globally in this index, ranking between 14 and 18 throughout the 1999-2023 period, finishing 2023 ranked 14th. The Turkish economy is also among the top performers, steadily improving its rank, rising from 44th place in 1999 to 26th in 2023. Put simply, Hungary and Türkiye already compete in global markets where green goods are part of the mainstream export mix.

FIGURE I.42: GREEN COMPLEXITY INDEX RANKS
(LOWER NUMERICAL RANK INDICATES A BETTER GLOBAL POSITION)




Source: Green Transition Navigator.
Note: This index measures countries' green productive capabilities by assessing both the diversity of green products they export and the technological sophistication of those products. The ranking reflects relative performance, with 1 representing the best outcome. Therefore, a lower numerical rank indicates stronger green capabilities.

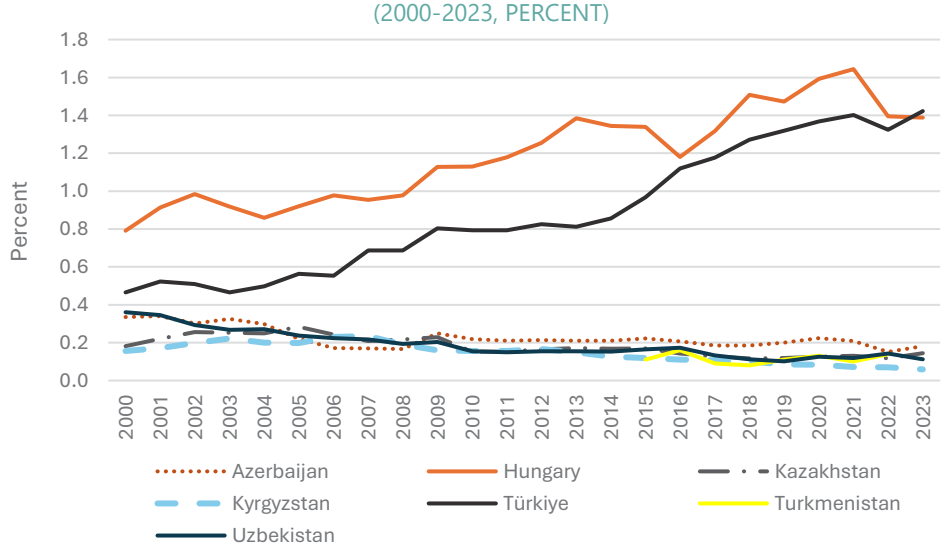
The rest of the Turkic economies are several ranks behind, and in several cases, they proceed in the opposite direction for several periods. Azerbaijan's starting rank in 1999 was 54, but its quality declined considerably in 2010 and remained at 185th place globally in 2023. Turkmenistan stays close to the bottom throughout the entire period, oscillating between ranks 200 and 226, finishing in 203rd position in 2023. If an economy ranks around 200th on this measure, it signals limited current competitiveness in green manufacturing.

Uzbekistan shows an upward trend in the Green Complexity Index over time, rising from the mid-10s in the first few years of the 2000s to 104 by 2023.

Kazakhstan deteriorated from 2010 to 2012 but then improved to 117th rank by 2023. Kyrgyzstan shows the opposite trend, with a decline from about 70-90 in the initial years to 125 by 2023. For the green economy transition, the ranking pattern matters because it signals where countries already have export capabilities to build on, and where they first need to develop the basic conditions for firms to enter and compete in green product markets.

R&D expenditures as a ratio of GDP distinguishes the Turkic economies into a smaller group that has genuine innovation capacity and a larger group in which R&D expenditures are insufficient to sustain a technology-driven green transition (Figure I.43). Hungary and Türkiye position themselves considerably above the average from 2000 to 2023. Hungary starts at around 0.8% in 2000 and increases to approximately 1.6% in 2020-2021, but eases to 1.4% in 2022-2023. Türkiye progresses steadily from around 0.5% at the beginning of the 2000s to 1.4% in the period from 2020 to 2021, and stays around that level in 2023.

FIGURE I.43: GROSS DOMESTIC EXPENDITURE ON R&D AS A PERCENTAGE OF GDP
(2000-2023, PERCENT)




Source: UNESCO. Data for Turkmenistan are estimated by UNESCO.

The rest of the Turkic economies remain grouped just below 0.3% until the end of the observed period, and some even reverse their trend. If a country expects to catch up quickly in clean technologies and upgrade its industry, very low R&D spending leaves little room to develop local solutions and makes it harder even to adapt and apply technologies developed elsewhere.

Environment-related patent counts offer a practical proxy for whether a country contributes to the development of cleaner technologies, rather than relying only on adoption. The series counts patent families filed in at least two jurisdictions, so it focuses on inventions that inventors considered worth protecting abroad. Decimals in Table I.5 appear because the OECD allocates credit across countries when inventors or applicants come from more than one country, so the totals reflect shared innovation rather than "partial patents."

From 2015 to 2022, green patenting in the Turkic economies remained small globally. The Turkic economies' share remains below 0.5% each year from 2015 to 2022, falling from 0.37% in 2015 to 0.29% in 2022, even as the global total remains above 41,000 annually (Table I.5). For a transition that depends on new solutions in energy, industry, and resource efficiency, that low global footprint signals limited contribution to the international green innovation frontier

TABLE I.5: ENVIRONMENT-RELATED PATENT COUNTS
(FAMILY SIZE ≥2, 2015–2022)

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|
| Türkiye | 104.33 | 112.15 | 151.45 | 115.92 | 107.35 | 130.18 | 144.33 | 105.42 |
| Hungary | 40.08 | 27.17 | 32.42 | 33.92 | 29.03 | 30.37 | 17.87 | 12.33 |
| Kazakhstan | 11.08 | 9.17 | 8.83 | 3.42 | 6.75 | 4.50 | 3.50 | 0.50 |
| Turkmenistan | 1.00 | .. | 1.00 | 1.00 | .. | .. | .. | 2.00 |
| Azerbaijan | 0.70 | 1.50 | 2.50 | 0.50 | 3.50 | .. | 2.00 | .. |
| Uzbekistan | .. | 1.50 | 3.50 | 0.50 | .. | 1.00 | .. | 0.50 |
| Kyrgyzstan | .. | .. | .. | .. | 2.00 | .. | 0.33 | .. |
| Turkic economies' share of global green patents (%) | 0.37% | 0.34% | 0.43% | 0.32% | 0.31% | 0.33% | 0.34% | 0.29% |

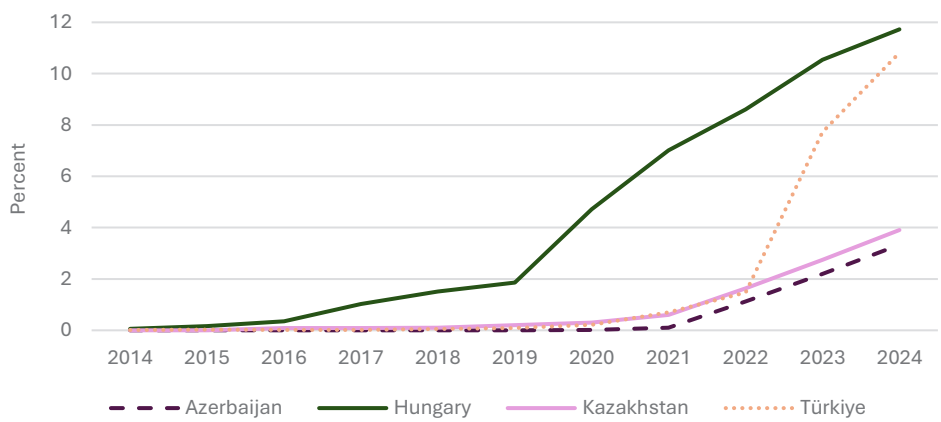
Source: OECD (2025, 12 March).
Note: The table counts green patents that were filed in at least two countries, so it focuses on inventions with international relevance. Some values have decimals because patent credit is split across countries when inventors or applicants come from multiple countries. Single-country patent families are excluded because they are more likely to be smaller and locally focused.

Inside the group of Turkic economies, the distribution is even more lopsided. Türkiye dominates the series, staying in triple digits each year and peaking at 151.45 in 2017, while Hungary sits a distant second and trends down over time, falling from 40.08 in 2015 to 12.33 by 2022. Kazakhstan moves from low double, dropping to 0.50 by 2022. The remaining economies register sporadic,

very small counts, often below 3-4. That pattern provides little basis for confident claims about the broad-based creation of green technology across the Turkic economies. Most countries will need to treat technological diffusion and adaptation as the near-term workhorse, while they build the skills, R&D systems, and firm capabilities that would show up later in patenting at scale.

The share of new electric-vehicle registrations is a useful "early signal" for the transport transition, because it captures what buyers choose at the point of sale. When the share rises, it usually means that policies, prices, access to charging, and consumer confidence have started to align.

FIGURE I.44: NEW ELECTRIC-VEHICLE REGISTRATIONS
(AS A SHARE OF NEW PASSENGER CAR REGISTRATIONS, PERCENT)




Source: Economist Intelligence Unit. Displayed economies are those with available data.

The take-rate trajectories of new electric vehicle registrations remain highly disaggregated across Turkic economies with available data. While Hungary begins first and increases its share of new electric vehicle registration cumulatively from a low point of 0.1% in 2014 to 11.7% by 2024, with a strong acceleration post-2019, Türkiye lags closer to 0% for a longer period with a strong, sudden shift from 1.5% in 2022 to 7.7% in 2023 but quickening to 10.8% in 2024 (Figure I.44). Kazakhstan and Azerbaijan take a gentler ramp. Kazakhstan increases from 0.6% in 2021 to 3.9% in 2024, while Azerbaijan increases from 0.1% in 2021 to 3.3% in 2024. The difference here is critical to readiness levels. While Hungary and Türkiye are in a domain where improvements in scaling charges, grid connections, or supply chains are no less than a pressing implementation task, Kazakhstan and Azerbaijan are in a domain where increases in take rates are feasible, but where fundamental enablers make a difference.

The evidence, up to this point, suggests that some Turkic economies are better positioned to transition to green production than others, because they have more substantial research and education infrastructure, companies capable of modernizing, or export sectors with the capabilities to sell green products on international markets. Other Turkic economies are working to build this capacity. In the near term, they will have to rely more on buying clean technologies from abroad and learning how to use them effectively.

The most practical priority is securing the fundamentals that are necessary for the success of clean technologies in practice. Countries need people with skills to install and maintain clean technologies, financing that reduces costs, public institutions that set clear rules and enforce them, and necessary supporting infrastructure for clean technologies. Once these foundations are in place, clean technologies can become everyday choices for businesses and households.

### Implications from I.3.3

- Green competitiveness among Turkic economies is uneven. Hungary and Türkiye already have much of the capacity to export greener products and develop new technology. The other economies start with less industrial and innovation depth.
- For countries with lower readiness scores, the short-term priority is less about frontier innovation and more about effective adoption and diffusion of proven technologies. That means training people to install and maintain equipment, securing finance, setting clear and stable rules, and building the basic infrastructure that lets firms and

## Concluding remarks

The evidence in this chapter points to a transition to a green economy shaped less by headline targets and more by starting conditions and execution. Readiness differs sharply across the Turkic economies, with green competitiveness and innovation concentrated in Hungary and Türkiye, and with several others needing basic foundations to be built before reforms can scale.

The binding tests are practical. Export competitiveness is moving toward product-level proof of emissions performance, and exposure is highest where carbon-intensive production meets tighter buyer rules. At the same time, several economies face hard environmental limits, including water shortages, heat stress, and low waste recovery, which can slow deployment and raise costs if planning treats them as side issues.

Energy is the pivot that links credibility, affordability, and resilience of the green economy transition. Where power generation remains fossil-heavy and energy intensity is high, countries face a dual adjustment, cleaning up supply and cutting demand, while keeping systems reliable under heat and water stress. If fiscal signals contradict pledges, especially through large fossil subsidies, reform becomes harder and more painful later, and public support becomes harder to sustain without well-targeted protection.

A first priority is to build credible product-level emissions measurement and verification in trade-exposed sectors, then use that data to drive cleaner electricity and heat in the value chains that sell into demanding markets.

A second priority is to treat power sector decarbonization and energy efficiency as a single package in the most energy-intensive economies, using a targeted approach based on where total final consumption sits across buildings, transport, and production.

A third priority is to plan for reliability under hotter summers and tighter water availability. Grid investment needs flexibility for peaks and shocks, and water planning needs to be integrated into energy and industrial rollout decisions, especially where water stress is already high.

A fourth priority is to close the circularity gap with visible delivery reforms, focused on waste recovery where performance is low. This is a practical service agenda that can reduce environmental pressure and improve credibility fast when implementation is consistent.

A fifth priority is to align fiscal policy with the transition to a green economy by phasing down broad fossil subsidies and strengthening price signals, while protecting households directly through targeted tools. This matters most where subsidies are large and where incomes are low, and adjustment costs can trigger resistance.

A sixth priority is to tailor the action agenda by readiness tier. Where green competitiveness already exists, policy should deepen innovation and export upgrading. Where the base is thinner, diffusion is the workhorse, so installing and maintaining skills, finance, predictable rules, and enabling infrastructure should lead the near-term program.

The Organization of Turkic States has already set a clear regional direction through the "Turkic Green Vision: Union for a Sustainable Future," which prioritizes green technologies, climate-resilient infrastructure, energy efficiency, Zero Waste, and the protection of natural resources and biodiversity. The practical next step is to turn those priorities into a short list of joint, bankable projects with clear owners, timelines, and monitoring.

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CHAPTER II

# Azerbaijan's Environmental and Climate Challenges within the Green Transition Framework

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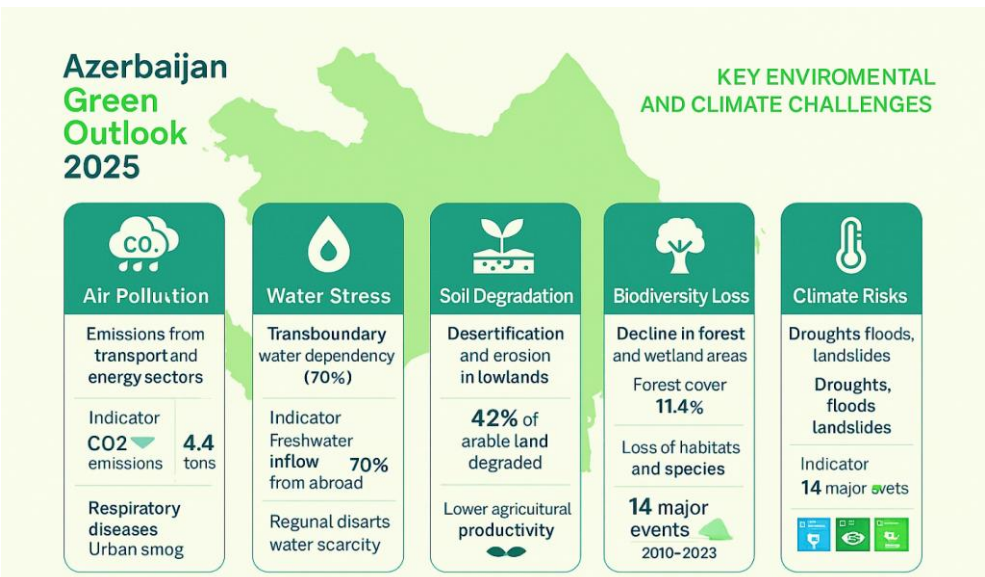
## II. 1 Overview of environmental pressures

Azerbaijan's environmental landscape reflects the dual legacy of natural resource wealth and industrial modernization. The country's economic success, largely driven by oil and gas exports, has contributed to significant ecological stress in urban, coastal, and agricultural zones. The Ministry of Ecology and Natural Resources (2023) reports that nearly 43% of Azerbaijan's land area is affected by erosion, and desertification processes are accelerating, especially in the Kura–Araz lowlands and the Nakhchivan Autonomous Republic.

Air pollution remains one of the most pressing environmental challenges in Azerbaijan. Industrial activities and transport-related emissions constitute the main sources of urban air quality deterioration in major cities such as Baku, Sumgait, and Ganja (World Bank, 2023). According to monitoring data, the average annual PM2.5 concentration in Baku exceeds 32 μg/m$^3$, far above the World Health Organization's recommended limit. Recent monitoring indicates that the average annual PM2.5 concentration in Baku was 21.4 μg/m$^3$ in 2023, which significantly exceeds the WHO safety guidelines (Mehdiyev et al., 2023). Chronic exposure to air pollutants has been strongly linked to respiratory diseases, cardiovascular disorders, and premature mortality, particularly among vulnerable populations such as children and the elderly (Manisalidis et al., 2020).

Water pollution and scarcity pose equally severe risks. The European Environment Agency (2022) indicates that only 40% of Azerbaijan's surface water meets "good ecological status." The Kura and Araz river basins—providing up to 70% of the country's freshwater—are increasingly affected by untreated wastewater discharge, agricultural runoff, and industrial waste (UNDP, 2023a). Overexploitation of these water sources, coupled with climate-induced variability, has reduced river flow and water quality, thereby limiting irrigation efficiency and drinking water availability (World Bank, 2024; UNECE, 2023).

FIGURE II.1: KEY ENVIRONMENTAL AND CLIMATE CHALLENGES IN AZERBAIJAN
(LATEST AVAILABLE DATA)




Source: Compiled by the author based on data from the World Bank (2024), UNECE (2023), FAO (2024), EM-DAT (2024), and the Ministry of Ecology and Natural Resources (2024).

According to EM-DAT (2024), the frequency of hydrological droughts in the region has intensified, further complicating the water security landscape managed by the Ministry of Ecology and Natural Resources (2024). Unsustainable land use, overgrazing, and excessive application of mineral fertilizers have contributed to widespread soil salinization and fertility loss, particularly in regions such as the Kura–Aras Lowland (Babaev, Gurbanov & Ramazanova, 2015). In the foothill and lowland regions, the combined effects of erosion, desertification, and declining vegetation cover contribute to dust storms and increased vulnerability to droughts. Furthermore, biodiversity loss

has reached alarming levels: over 260 animal and 400 plant species are listed in Azerbaijan's Red Book as endangered (Ministry of Ecology and Natural Resources, 2023).

Soil degradation and deforestation add to environmental pressures. Unsustainable land use, overgrazing, and the excessive use of mineral fertilizers have led to widespread soil salinization and fertility loss, particularly in the Kura–Aras Lowland (Babaev, Gurbanov & Ramazanova, 2015).

In the foothill and lowland regions, the combined effects of erosion, desertification, and declining vegetation cover contribute to dust storms and increased vulnerability to droughts. Furthermore, biodiversity loss has reached alarming levels: over 260 animal and 400 plant species are listed in Azerbaijan's Red Book as endangered (Ministry of Ecology and Natural Resources, 2023).

Environmental degradation also reflects social inequality. Industrial regions such as Absheron and Sumgait face cumulative ecological burdens, while rural and mountain communities experience water shortages, declining agricultural yields, and limited adaptive capacity. These disparities underscore the need for inclusive environmental governance and targeted climate adaptation programs (Tadesse et al., 2023).

From 1990 to 2025, the values reported in Table II.1 point to a visible deterioration in most of Azerbaijan's environmental indicators, driven primarily by climate change and industrial pressure. The average annual temperature has increased from 12.3°C to 13.7°C, while renewable water resources have fallen by 15%, reaching 23.8 $km^3$/year.

Land affected by erosion rose from 36% to 43%, and the number of endangered species increased from 480 to 684. Consequently, economic losses from environmental degradation have doubled, now accounting for 1.6% of the GDP. The most alarming trend is the Caspian Sea level, which has dropped to -2.8 m, posing a long-term risk to coastal infrastructure. However, positive trends are visible in the strong rise of renewables in the energy mix—increasing from 3.1% to 18.8%—and a steady, albeit modest, expansion of forest cover to 12.5%.

TABLE II.1: AZERBAIJAN'S KEY ENVIRONMENTAL INDICATORS
(PERIOD AVERAGES, LATEST PERIOD PARTLY ESTIMATED)

| | 1990-2000 | 2001-2010 | 2011-2020 | 2021-2025 | Trend/Notes |
|---|---|---|---|---|---|
| Average annual temperature (°C) | 12.3 | 12.8 | 13.2 | 13.7 | Rising by ~1.4°C since mid-20th century (UNDP, 2023a) |
| Annual precipitation (mm) | 500 – 600 | 470 – 520 | 440 – 480 | 430 – 460 | Gradual decline; droughts are more frequent in the Kura-Araz basin |
| Renewable water resources ($km^3$/year) | 28.0 | 26.5 | 25.0 | 23.8 | 15% reduction since 1990 (World Bank, 2023) |
| Land affected by erosion (%) | 36 | 39 | 41 | 43 | Expanding soil degradation, esp. in Shirvan–Gobustan–Nakhchivan |
| $CO_2$ emissions per capita (tons) | 8.1 | 6.7 | 5.9 | 6.5 | Decrease due to cleaner fuel mix, but still above LMIC average |
| Share of renewables in energy mix (%) | 3.1 | 5.5 | 7.9 | 18.8 | Significant growth after the 2021 Law on Renewable Energy |
| Forest cover (% of land area) | 11.5 | 11.9 | 12.1 | 12.5 | Stable, slight increase due to reforestation projects |
| Biodiversity – endangered species (no.) | 480 | 530 | 620 | 684 | Increasing number due to habitat fragmentation (MENR, 2023) |
| Economic loss from env. degradation (% of GDP) | 0.8 | 1.0 | 1.3 | 1.6 | Expected to reach 2% without adaptation (UNDP, 2023b) |
| Caspian Sea level change (m) | -0.5 | -1.2 | -2.3 | -2.8 | Risk of up to -9 m by 2100 (CEP, 2023) |

Source: Author's compilation based on official reports from UNDP (2023a), World Bank (2023), MENR (2023), CEP (2023).

## II.1.1 Climate change dynamics and national vulnerability

Azerbaijan's climate has warmed by approximately 1.4°C since the 1960s—faster than the global average (UNDP, 2023a). This change is characterized by more frequent droughts, heatwaves, and irregular precipitation. According to hydrological projections, the country may experience a 10–15% reduction in available freshwater resources by 2050, largely due to altered runoff patterns in the Kura–Araz basin (World Bank, 2023).

The Caspian Environmental Programme (2023) predicts a potential drop of 9–18 meters in sea level by the end of the century, which would affect coastal settlements, fisheries, and energy infrastructure. In Baku and Neftchala, saline intrusion and shoreline retreat are already observable phenomena that jeopardize economic activities and marine ecosystems.

Azerbaijan's vulnerability to climate change also stems from its semi-arid geography and dependence on climate-sensitive sectors such as agriculture and energy. Prolonged droughts reduce crop yields and pasture productivity, increasing rural poverty and internal migration. Meanwhile, extreme

precipitation events cause flash floods and landslides, particularly in mountain regions. The UNDP Climate Risk Assessment (UNDP, 2023b) estimates that climate-related disasters could reduce national GDP by 1.2–1.8% annually if no adaptation measures are taken.

In social terms, climate change exacerbates regional inequalities. Households in remote areas face rising food insecurity, while urban centers experience increased health risks linked to heat stress and air pollution (IPCC, 2022). Women, youth, and low-income groups are disproportionately affected, as they depend more heavily on climate-sensitive resources and often lack adequate financial and technical capacity for adaptation (UNDP, 2023b).

These dynamics underscore the interconnected nature of climate and development: without coordinated mitigation and adaptation strategies, environmental risks could undermine socio-economic progress and slow Azerbaijan's long-term green transition.

### II.1.2 Strategic challenges for green transition

Although Azerbaijan has made significant progress in integrating sustainability principles into national policy, several barriers continue to slow down the green transformation process. The government has introduced a strong legislative base, including the Law on Environmental Protection (1999), the Law on Environmental Impact Assessment (2018), and the Law on the Use of Renewable Energy Sources (2021). Moreover, the Azerbaijan 2030: National Priorities for Socio-Economic Development sets clear targets for decarbonization and energy diversification. Nevertheless, the practical implementation of these policies faces both institutional and structural constraints.

Institutional fragmentation and policy coordination: Environmental management responsibilities are divided among multiple agencies, leading to overlapping mandates and weak coordination. Monitoring systems for air, water, and soil quality are fragmented and underfunded, limiting data reliability (World Bank, 2023). Additionally, local authorities often lack the technical expertise to integrate environmental standards into regional development planning (OECD/EU4Water, 2023).

Economic dependence on fossil fuels: The dominance of oil and gas revenues—constituting approximately 85–90% of Azerbaijan's total exports in 2023—continues to constrain fiscal space for environmental investment and diversification (World Bank, 2023b; IEA, 2023). This structural dependence on hydrocarbon exports underlines the urgent need for introducing carbon pricing or green taxation to finance the low-carbon transition. Despite growing investment in renewables, fossil fuel-based infrastructure still defines the national energy system. Without introducing carbon pricing mechanisms or green taxation, the transition toward a low-carbon economy remains financially challenging.

Social and regional inequalities: The benefits of the green transition in Azerbaijan remain unevenly distributed. While urban centers such as Baku are better positioned to attract green investment and technological innovation, rural regions remain more dependent on climate-sensitive sectors, particularly agriculture, and face higher exposure to water scarcity and land degradation risks (World Bank, 2023a; FAO, 2024). Strengthening public participation and enhancing local institutional capacity are therefore essential to ensuring an inclusive and socially balanced green transition (UNDP, 2023b).

External dependencies and international frameworks: Azerbaijan's environmental progress is closely tied to international partnerships and compliance with global climate frameworks. The country's active role in the COP29 Presidency demonstrates its commitment to advancing regional cooperation and climate finance mechanisms. Initiatives such as the Caspian–Black Sea–Europe Green Energy Corridor offer opportunities for Azerbaijan to become a regional hub for renewable energy exchange, but their success depends on sustained international funding and technology transfer (CEP, 2023).

At this stage, Azerbaijan's green transformation requires a holistic approach—strengthening intersectoral governance, mobilizing climate finance, and building adaptive capacity at both national and local levels. The environmental and climate challenges, while formidable, also present an opportunity to redefine the country's development model toward sustainability, innovation, and regional leadership.

## II.2 National green economy policy and strategies of Azerbaijan

This section examines how Azerbaijan is integrating its green economy objectives into policy and legal frameworks designed to guide concrete decision-making. It outlines the principal decrees and legislative acts shaping renewable energy development, climate action, and environmental protection, and clarifies the institutional responsibilities of relevant public bodies across the governance system.

The section further presents the country's official targets and the strategic planning documents underpinning them, enabling the reader to assess both the scope of commitments and the associated timelines. It also reviews Azerbaijan's external partnerships that link domestic reforms to cross-border energy connectivity and climate finance mechanisms, recognizing that many large-scale investments depend on regulatory arrangements and market structures beyond national borders.

### II.2.1 Institutional and legal framework for green transition

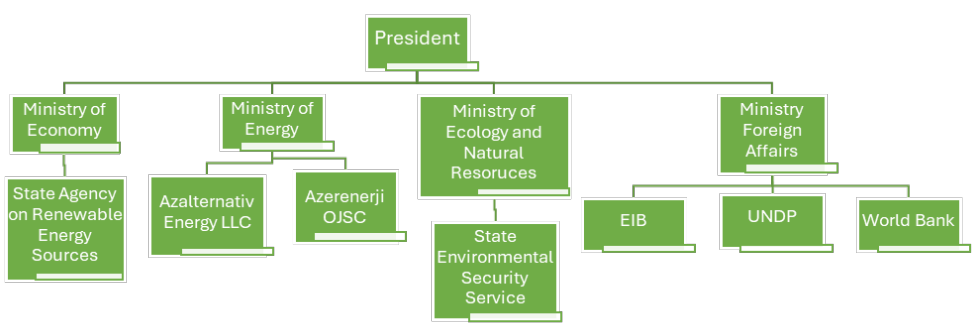
Azerbaijan's transition towards a national green economy is rooted in a comprehensive institutional and legislative transformation that redefines the country's development paradigm from hydrocarbon dependency to sustainable growth. The framework for this transformation is based on key national decrees, laws, and presidential initiatives that provide the legal foundation for renewable energy development, environmental protection, and low-carbon transition.

The Presidential Order No. 1209 (29 May 2019) on "Accelerating Reforms in the Energy Sector of the Republic of Azerbaijan" laid the groundwork for the liberalization and modernization of the energy market, emphasizing competition, innovation, and private-sector participation. This was followed by the Law on the Use of Renewable Energy Sources in the Production of Electricity (No. 339-VIQ, 31 May 2021), which regulates the economic, legal, and organizational mechanisms for renewable energy generation. The law also introduced support mechanisms such as feed-in tariffs, power purchase agreements, and grid access guarantees—key instruments that promote private investment in green energy projects (Ministry of Energy of Azerbaijan, 2024).

The institutional framework is further reinforced by the establishment of the State Agency on Renewable Energy Sources and the implementation of the Socio-Economic Development Strategy of Azerbaijan for 2022–2026, which explicitly defines the transition to green energy and low-carbon development as national priorities (MERA, 2022). These documents collectively form the backbone of Azerbaijan's energy transition, ensuring policy coherence between environmental goals, energy security, and sustainable economic diversification.

The institutional coordination of Azerbaijan's green transition involves a multi-level governance structure, as illustrated in Figure II. 2, which highlights the interlinkages among national ministries, implementing agencies, and international partners. As shown in Figure II.2, the institutional framework emphasizes a centralized yet collaborative approach, with the State Agency on Renewable Energy Sources serving as a bridge between high-level policy-setting and local implementation.

FIGURE II.2: KEY INSTITUTIONS AND DEVELOPMENT PARTNERS SUPPORTING GREEN TRANSITION IN AZERBAIJAN




Source: Author's compilation based on official reports (Ministry of Energy of the Republic of Azerbaijan, 2024).

The Azerbaijan 2030: National Priorities for Socio-Economic Development (Presidential Decree No. 246, 2021) identifies "a clean environment and green growth country" as one of the five national priorities. This policy direction integrates climate adaptation, renewable energy expansion, and sustainable infrastructure planning across all sectors, aligning national goals with the UN Sustainable Development Goals (SDGs) and the Paris Agreement (MERA, 2024; UNDP, 2023b).

## II.2.2 Strategic development vision and national targets

Azerbaijan's strategic vision for green transition emphasizes economic diversification, energy efficiency, and climate resilience. The government's policy framework aims to transform the country into a dual-energy hub—maintaining its role as a stable hydrocarbon exporter while developing renewable energy generation and export infrastructure.

The Social and Economic Development Strategy 2022–2026 sets ambitious targets: increasing the share of renewable energy in the total installed power capacity to 30% by 2030, reducing greenhouse gas emissions by 35% by 2030 and 40% by 2050 compared to 1990 levels, and achieving carbon neutrality by mid-century (MERA, 2022). The technical potential of Azerbaijan's renewable resources is vast, with 135 GW of onshore and 157 GW of offshore capacity—among the highest in the Caspian region (IEA, 2023).

According to the Offshore Wind Roadmap for Azerbaijan (World Bank & IFC, 2023), the country can install up to 7 GW of offshore wind capacity by 2040, generating over $7 billion in local value added and providing 69,000 person-years of employment. Nationally, projects such as the 230 MW Garadagh Solar Power Plant developed in partnership with Masdar (UAE), the 240 MW Khizi–Absheron Wind Power Plant implemented by ACWA Power (Saudi Arabia), and the 240 MW Shafag Solar Project (BP) in Jabrayil represent key milestones in Azerbaijan's renewable energy expansion and are expected to significantly reduce natural gas consumption and carbon emissions (Ministry of Energy of the Republic of Azerbaijan, 2024; IEA, 2023).

Over 5 MW of solar capacity has been installed across 1,500 public and residential buildings, and 38 hydroelectric plants (307 MW) are already operational in the liberated territories (Ministry of Energy, 2024).

These developments demonstrate Azerbaijan's commitment to rebuilding conflict-affected regions through sustainable, low-emission technologies. To provide a comprehensive overview of Azerbaijan's green transition targets, Table II.2 summarizes the key strategic goals defined in national policy documents and international commitments. These targets illustrate the country's integrated approach to achieving renewable energy expansion, emissions reduction, and long-term sustainability by 2050.

Azerbaijan's green transition targets envisage a substantial scale-up from the 2022 baseline to 2030 and 2050. The share of renewables in the energy mix is projected to increase from 7.9% to 30% by 2030 and to more than 50% by 2050 (MERA, 2022). In parallel, greenhouse gas (GHG) emissions are targeted to decline by 35% compared to 1990 levels by 2030, increasing to a 40% reduction target by 2050 (UNFCCC, 2024).

Offshore wind capacity is planned to expand from zero to 3–4 GW by 2030 and further to 7 GW by 2050 (World Bank & IFC, 2024). Employment in the renewable energy sector is expected to grow significantly, rising from approximately 2,000 jobs to 40,000 by 2030 and to around 69,000 by 2050 (IEA, 2023).

This signals a broader transition from energy-sector target setting toward place-based implementation and structural transformation across the liberated territories as well as the broader national economy.

TABLE II.2: STRATEGIC TARGETS FOR AZERBAIJAN'S GREEN TRANSITION
(2022–2050)

| Target area | 2022 baseline | 2030 target | 2050 outlook | Source |
|---|---|---|---|---|
| Share of renewables in energy mix (%) | 7.9 | 30 | 50+ | MERA (2024) |
| GHG reduction vs 1990 (%) | 0 | 35 | 40 | UNFCCC (2024) |
| Offshore wind capacity (GW) | 0 | 3 – 4 | 7 | World Bank & IFC (2023) |
| Employment in the renewable sector (person-years) | 2 000 | 40 000 | 69 000 | IEA (2023) |
| Green zones operational (no.) | ... | 3 | 6 | Ministry of Energy (2024) |

Source: Author's compilation based on official reports, from the MERA (2024), UNFCCC COP29 Secretariat (2024), World Bank & IFC (2023). Ministry of Energy (2024)

Azerbaijan is pioneering a National Hydrogen Strategy, developed with support from the European Bank for Reconstruction and Development (EBRD). The Low-Carbon Hydrogen Market Study (2024) identified favorable conditions for both green and blue hydrogen production, outlining pathways for domestic utilization and export through the Caspian–Black Sea–Europe Green Corridor (EBRD, 2024). These integrated efforts showcase Azerbaijan's comprehensive approach to energy transition, combining legislative reform, technological innovation, and socio-economic sustainability.

### II.2.3 International partnerships and green infrastructure integration

International collaboration constitutes the backbone of Azerbaijan's green economy strategy. The country has established strategic partnerships that link its renewable potential with European and Central Asian energy markets.

In July 2022, Azerbaijan and the European Union signed a Memorandum of Understanding on a Strategic Partnership in the Field of Energy, aiming to double the capacity of the Southern Gas Corridor (SGC) to deliver at least 20 billion cubic meters of gas annually to the EU by 2027 while also promoting renewable energy cooperation and efficiency measures (EC, 2023a). Simultaneously, Azerbaijan is advancing a parallel agenda through the Black Sea Submarine Cable (BSSC) project, connecting Azerbaijan, Georgia, Romania, and Hungary via high-voltage transmission lines supported by the European Commission. This initiative enables the export of renewable electricity directly to the EU, forming the basis of the Caspian Green Energy Corridor (IDD, 2025a).

Complementary partnerships have expanded Azerbaijan's regional cooperation. The Central Asia–Azerbaijan Green Energy Corridor (2024) and the Azerbaijan–Türkiye–Europe Corridor (2025) integrate renewable flows from Central Asia to Europe, supporting regional energy connectivity (Ministry of Energy, 2024). These projects facilitate technology transfer, investment inflows, and capacity building, contributing to both national and regional decarbonization efforts.

Hosting the 29$^{th}$ UNFCCC Conference of the Parties (COP29) in Baku marked a milestone in Azerbaijan's global climate diplomacy. The conference launched the Baku Initiative on Climate Finance, Investment, and Trade (BICFIT) and the Climate Finance Action Fund (CFAF), mechanisms designed to mobilize concessional finance for green projects across vulnerable economies (UNFCCC COP29 Secretariat, 2024). Furthermore, Azerbaijan played a leading role in the Global Energy Storage and Grids Pledge (1,500 GW by 2030) and the COP29 Hydrogen Declaration, reinforcing its status as a catalyst for green growth and sustainability in the wider Eurasian region.

To better illustrate Azerbaijan's global climate diplomacy and commitments under COP29, Table II.3 presents the flagship initiatives introduced in Baku.

These initiatives reinforce Azerbaijan's leadership role in advancing global green finance, renewable energy infrastructure, and hydrogen development.

As detailed in Table II.3, Azerbaijan's COP29 strategy moves beyond domestic policy to establish global financial and technological frameworks, specifically through the BICFIT and CFAF funds, which aim to bridge the green investment gap for developing nations.

TABLE II.3: AZERBAIJAN'S COP29 DELIVERABLES AND GLOBAL COMMITMENTS

| Initiative | Objective | Expected impact by 2030 | Global partners |
|---|---|---|---|
| Baku Initiative on Climate Finance (BICFIT) | Mobilizing concessional green finance | $10 billion investment | UNFCCC, WB, EBRD |
| Climate Finance Action Fund (CFAF) | Supporting vulnerable economies | 25 projects funded | COP29 Secretariat |
| Global Energy Storage and Grids Pledge | 1,500 GW storage / 25 million km grids | Enhanced global capacity | IEA, EU, ADB |
| Hydrogen Declaration | Boosting green hydrogen production | 50 countries endorsed | EBRD, IFC, IRENA |

Source: Author's compilation based on official reports from UNFCCC COP29 Secretariat (2024); Ministry of Energy (2024); EC (2023a, 2023b); IDD (2025a)

These initiatives collectively affirm Azerbaijan's evolving role as both a regional clean energy hub and a global advocate for sustainable development. The alignment between domestic policy reforms and international cooperation ensures that the country's transition towards a green economy will continue to serve as a model within the Turkic and broader Eurasian context.

## II.3 Ongoing and completed projects and reforms

Azerbaijan is advancing its green transition not only by setting policy objectives but also by initiating concrete projects and regulatory reforms. New investments in solar, wind, and hydropower have expanded the country's renewable energy capacity. Plans for cross-border electricity corridors have been developed, and key legal and market reforms have been adopted to support integration and investment.

However, progress remains uneven. Grid modernization requirements, the complexity of offshore wind development, financing constraints, and limited inter-agency coordination continue to slow implementation.

## II.3.1 Large-scale renewable energy projects

Azerbaijan's transition toward a sustainable green economy has accelerated over the last decade through the implementation of large-scale renewable energy projects and reforms aimed at diversifying its energy structure. The country's commitment to a low-carbon future is manifested in its target to increase the share of renewables in electricity generation to 30% by 2030 and reduce greenhouse gas emissions by 35% compared to 1990 levels (Ministry of Energy, 2024).

The flagship Garadagh Solar Power Plant (230 MW), inaugurated in 2023 in partnership with Masdar (UAE), stands as the largest solar energy facility in the South Caucasus. The project generates approximately 500 million kWh of electricity annually, saving about 110 million cubic meters of natural gas and reducing $CO_2$ emissions by nearly 200,000 tons per year. Similarly, the Khizi–Absheron Wind Power Plant (240 MW), developed by ACWA Power (Saudi Arabia), is projected to produce around 1 billion kWh annually, preventing approximately 400,000 tons of $CO_2$ emissions and saving about 220 million cubic meters of natural gas each year.

In the post-conflict regions of Karabakh and Eastern Zangazur, renewable energy serves not only as a sustainability tool but also as a driver of regional reconstruction. The establishment of the Green Energy Zone (GEZ) in these territories, supported by Japan's TEPSCO and local partners such as Azerenergy and Nobel Energy, has enabled the installation of 38 hydropower plants with a total capacity of approximately 307 MW, along with more than 5 MW of solar photovoltaic systems across residential and public facilities (Ministry of Energy of the Republic of Azerbaijan, 2024). These initiatives integrate smart grids, electric transport systems, and energy-efficient heating technologies, transforming formerly conflict-affected areas into emerging models of climate-resilient development.

Furthermore, ongoing "mega projects" across Bilasuvar (445 MW), Neftchala (315 MW), and Absheron–Garadagh (240 MW) regions—also in collaboration with Masdar—reinforce the goal of establishing over 2 GW of additional renewable capacity by 2027. These investments, valued at more than $2 billion, have attracted global energy firms such as BP, TotalEnergies, and China Gezhouba Group, reflecting growing confidence in Azerbaijan's clean energy

transition. Table II.4 lists Azerbaijan's main large-scale renewable energy projects.

TABLE II.4: KEY LARGE-SCALE RENEWABLE ENERGY PROJECTS IN AZERBAIJAN
(2023-2027)

| Project name | Type | Capacity (MW) | Partner Company | Region | Status / start Year | Estimated annual $CO_2$ |
|---|---|---|---|---|---|---|
| Garadagh Solar Power Plant | Solar PV | 230 | Masdar (UAE) | Garadagh | Operational (2023) | 200,000 |
| Khizi–Absheron Wind Power Plant | Wind | 240 | ACWA Power (Saudi Arabia) | Khizi–Absheron | Operational (2024) | 400,000 |
| Shafag Solar Project | Solar PV | 240 | BP (UK) | Jabrayil | Under construction (2025) | 180,000 |
| Bilasuvar Solar Project | Solar PV | 445 | Masdar (UAE) | Bilasuvar | Planned (2026) | 350,000 |
| Neftchala Solar Project | Solar PV | 315 | Masdar (UAE) | Neftchala | Planned (2026) | 280,000 |
| Green Energy Zone Hydro Cluster | Hydro | 307 | TEPSCO (Japan), Azerenergy, Nobel Energy | Karabakh & Eastern Zangazur | Operational (2024) | 150,000 |

Source: Author's compilation based on official reports from the Ministry of Energy (2024); World Bank (2023).

## II.3.2 Regional green energy corridors and cooperation

Regional energy diplomacy forms the backbone of Azerbaijan's green transition strategy. Through transnational partnerships, Baku is positioning itself as a renewable energy hub linking Central Asia and Europe. The Black Sea Submarine Cable Project (BSSC)—a joint initiative with Georgia, Romania, and Hungary—represents a transformative infrastructure designed to export renewable electricity from Azerbaijan and Georgia to the European continent. The project will consist of a high-voltage direct current (HVDC) cable capable of transmitting 1 GW of electricity, supported by integrated fiber-optic communication lines (EC, 2023b).

At the interregional level, Azerbaijan, Kazakhstan, and Uzbekistan have signed an agreement to establish the Central Asia–Azerbaijan Green Energy Corridor, which will coordinate renewable electricity transmission from the Caspian Basin to Europe via Azerbaijan. Similarly, the Azerbaijan–Türkiye–Europe Green Corridor focuses on exporting electricity through the Nakhchivan hub, connecting the Caspian and Central Asian energy systems with Türkiye and the EU.

The creation of the Jabrayil 330/110 kV substation and the planned 330 kV transmission line between Jabrayil and Nakhchivan, via the Zangezur corridor, are integral components of this initiative. These corridors not only diversify export routes but also strengthen Azerbaijan's role in regional electricity interconnection and trade in the green energy domain (IDD, 2025a).

### II.3.3 Institutional and market reforms supporting green transition

Azerbaijan's energy transition is supported by a comprehensive legal and institutional framework promoting renewable energy, efficiency, and innovation. Presidential Order No. 1209 (2019) laid the foundation for the liberalization of the energy market and increased private-sector participation. This was followed by the 2021 Law on the Use of Renewable Energy Sources (No. 339-VIQ), which introduced feed-in tariffs, power purchase agreements, and investor guarantees, improving predictability for foreign investors.

In 2021, the Azerbaijan 2030: National Priorities for Socio-Economic Development identified "Clean Environment and Green Growth" as one of five long-term national priorities. Complementing this, the Social and Economic Development Strategy for 2022–2026 established measurable goals for renewable integration, energy efficiency, and sustainable finance (MERA, 2022). The National Hydrogen Strategy (2024, draft) further strengthens Azerbaijan's positioning in the emerging low-carbon hydrogen market, envisioning the production and export of green and blue hydrogen in cooperation with EBRD and IFC.

TABLE II.5: KEY POLICY AND REGULATORY DOCUMENTS SUPPORTING AZERBAIJAN'S GREEN TRANSITION

| Legal/ policy document | Year | Key objective | Green component |
|---|---|---|---|
| Presidential Order No. 1209 | 2019 | Energy market liberalization | Private participation, transparency |
| Law on Renewable Energy (No. 339-VIQ) | 2021 | Regulation of RE generation | Feed-in tariffs, PPAs |
| Azerbaijan 2030 Priorities | 2021 | Clean environment and growth | SDG alignment |
| Socio-Economic Dev. Strategy | 2022–2026 | Green economy integration | 30% renewables target |
| National Hydrogen Strategy (draft) | 2024 | Hydrogen production/export | Low-carbon economy |

Source: Author's compilation based on official reports from MERA (2022), World Bank (2023a).

The market reforms shown in Table II.5 also include the adoption of a net-metering model for small-scale renewable producers and the integration of "green certificates" to track and trade clean electricity across regional markets. These developments align Azerbaijan's domestic policy with European energy standards, contributing to the EU's Green Deal objectives and fostering investor confidence through regulatory transparency (World Bank, 2023a).

### II.3.4 Integrated water–energy–climate adaptation: Outcomes and future perspectives

Azerbaijan's green transition policy recognizes that water security, energy efficiency, and climate resilience are mutually reinforcing components of sustainable development. To address these interlinked challenges, the government adopted the National Program on Efficient Use of Water Resources (2022–2026), developed with the support of FAO, UNDP, and UNEP. The program promotes the modernization of irrigation systems, the reduction of water losses, and the introduction of climate-smart agriculture technologies through the Green Water Fund, which provides financial incentives for private-sector engagement in water-efficient innovations.

Pilot projects in the Kur–Araz lowlands have demonstrated the program's effectiveness, achieving approximately a 40% reduction in water losses through the application of drip irrigation and precision agriculture. These interventions contribute directly to the UN Sustainable Development Goals 6 (Clean Water and Sanitation) and 7 (Affordable and Clean Energy), reinforcing the link between environmental protection and economic productivity.

Complementing water initiatives, the National Forestry Development Program (2021–2030) aims to increase forest cover from 11.4% to 13% by 2030, thus enhancing carbon sequestration, biodiversity restoration, and ecosystem stability. The combined implementation of water and forestry programs strengthens Azerbaijan's adaptive capacity to climate change and supports a broader low-carbon transition.

By 2025, these integrated reforms and infrastructure projects have yielded significant outcomes: renewable energy capacity has surpassed 1,800 MW, accounting for nearly 19% of total electricity generation; 2,000 new green jobs have been created in construction, engineering, and renewable maintenance; and annual $CO_2$ emissions have been reduced by approximately 0.5 million

tons. Furthermore, cumulative foreign direct investment in renewables now exceeds $2.5 billion, reflecting growing global confidence in Azerbaijan's sustainable growth model.

Despite these achievements, challenges persist. The modernization of the national grid remains essential to accommodate variable renewable energy sources, while offshore wind projects face logistical and financing constraints. Strengthening institutional coordination among ministries and regulatory agencies, along with scaling up access to climate finance mechanisms such as the Green Water Fund and the Climate Finance Action Fund (CFAF), will be vital to sustaining long-term progress.

Azerbaijan's experience demonstrates that integrating water, energy, and climate policies can transform sectoral initiatives into a unified framework for national resilience and sustainable growth. This model positions Azerbaijan as a regional leader in the Turkic and Eurasian green transition agenda, showing how environmental protection, economic diversification, and social inclusion can advance simultaneously.

## II.4 Best practices and flagship initiatives

The examples below illustrate how Azerbaijan has translated its green transition strategy into concrete regional initiatives. These include the development of green energy zones in Karabakh and Eastern Zangazur, cross-border electricity corridor projects, COP29 as a platform for climate finance and international partnerships, and large-scale renewable energy projects linked to emerging technologies.

Taken together, these cases reflect a coherent trajectory in Azerbaijan's green transition model, in which project implementation, external engagement, and policy adjustments increasingly align in the same strategic direction.

### II.4.1 The green energy zones: Integrating reconstruction and sustainability

One of the most innovative elements of Azerbaijan's green transition is the creation of Green Energy Zones (GEZ) in the liberated territories of Karabakh and Eastern Zangazur, linking reconstruction with environmental modernization. Initiated under the Presidential Order of May 3, 2021, this

concept aims to support recovery in conflict-affected areas as self-sufficient, low-emission, and smart-energy ecosystems. The model—initially designed with technical support from Japan's TEPSCO—integrates solar, wind, and hydropower generation with smart grids, energy-efficient buildings, and electric mobility infrastructure (Ministry of Energy, 2024). To date, 38 small hydropower plants (307 MW) have been reconstructed, and solar panels exceeding 5 MW have been installed across over 1,500 residential and public buildings. International cooperation has been critical to this success: while TEPSCO provided the initial feasibility planning, private investment and project implementation are currently led by global and local partners, including BP, Nobel Energy, and TotalEnergies (Ministry of Energy, 2024; MERA, 2024)."

The Shafag Solar Power Plant (240 MW) in Jabrayil and Ufug–Shams Solar Power Plants (50 MW each), launched during Baku Energy Week 2025, exemplify the integration of renewables into industrial operations, expected to reduce emissions from the Sangachal terminal by 50%.

The Green Energy Zones thus serve as pilot laboratories for sustainable regional governance, combining energy transition with smart urban planning, local employment, and climate-resilient infrastructure. The GEZ model is now considered by the UNDP and the OECD as a "replicable framework for green recovery in conflict-affected settings" across Eurasia (UNDP, 2024).

### II.4.2 The Caspian–Black Sea Green Energy Corridor

Azerbaijan's leadership in regional energy cooperation is best exemplified by the Caspian–Black Sea–Europe Green Energy Corridor, launched in December 2022 through a Strategic Partnership Agreement with Georgia, Romania, and Hungary (EC, 2023b). The project aims to export renewable electricity generated in Azerbaijan and Georgia to Europe through a high-voltage direct current (HVDC) submarine cable under the Black Sea, with a capacity of 1 GW.

This corridor—supported by the European Commission—is strategically aligned with the EU's REPowerEU Plan and the European Green Deal. In 2025, Bulgaria formally joined the initiative, while discussions with Kazakhstan and Uzbekistan expanded the scope to include Central Asian renewables. The project has been presented as a major cross-border interconnection project,

strengthening energy connectivity between the South Caucasus and Europe (IDD, 2025a).

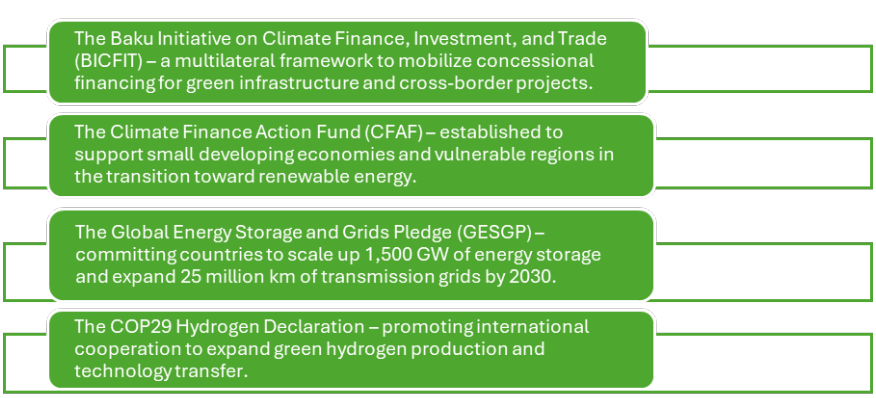
Besides electricity transmission, the corridor integrates digital connectivity via optical fiber cables and envisions long-term exports of green hydrogen. This dual-purpose design reflects Azerbaijan's approach to sustainable diplomacy—where energy diversification is coupled with technological modernization and digital transition.

### II.4.3 COP29 Baku: Climate leadership and global partnership platform

Hosting the 29th United Nations Climate Change Conference (COP29) in 2024 in Baku marked a major milestone in Azerbaijan's international climate engagement. The event not only highlighted Azerbaijan's regional leadership but also institutionalized several flagship mechanisms, which are shown in Figure II.3.

Azerbaijan designated 2024 as the "Year of Solidarity for a Green World," aligning domestic messaging with the COP29 agenda (UNFCCC COP29 Secretariat, 2024). The conference also provided an institutional platform for public-private partnerships (PPPs), leading to agreements exceeding $3 billion in potential clean-energy investments. Through COP29, Azerbaijan transformed from a policy implementer into a policy shaper—facilitating global consensus on just energy transition, green finance, and climate equity.

FIGURE II.3: COP29 INITIATIVES AND PLEDGES ADVANCED WITH BAKU'S LEADERSHIP AND FACILITATION




Source: Authors' visualization based on UNFCCC COP29 Secretariat documentation.

## Concluding remarks: The Azerbaijan model for green transition

Azerbaijan's transition toward a green economy is characterized by a strategic pivot away from reliance on traditional hydrocarbons toward a diversified, innovation-driven energy paradigm. The flagship projects discussed throughout this chapter—ranging from industrial-scale solar and wind installations to pioneering floating PV systems—are not merely infrastructure developments; they represent the practical execution of the Azerbaijan 2030 vision. By integrating renewable energy with ecological restoration and private-sector investment, the country is demonstrating a pragmatic balance between sustainability and national economic security.

TABLE II.6: LESSONS AND TRANSFERABLE PRACTICES FROM AZERBAIJAN'S GREEN TRANSITION

| Key lessons/ practice | Description | Relevance and transferability | Source |
|---|---|---|---|
| Integration of Green Recovery and Post-Conflict Development (GEZ Model) | Reconstruction of liberated territories in Karabakh and Eastern Zangazur integrates renewable energy, smart infrastructure, and eco-industrial zones. | Demonstrates how post-conflict recovery can drive innovation and regional sustainability. | UNDP Azerbaijan (2024b) |
| Multilateral Diplomacy for Clean Energy Corridors | Development of Black Sea, Central Asia–Azerbaijan, and Türkiye–Europe energy corridors integrating electricity, trade, and digital links. | Provides a replicable model for cross-border green cooperation and energy connectivity. | EC (2023b); UNFCCC COP29 Secretariat (2024) |
| Public–Private Partnerships and Legal Modernization | Implementation of feed-in tariffs, power purchase agreements (PPAs), and liberalized energy laws (Law No. 339-VIQ, 2021). | Enhances investor confidence and encourages foreign capital participation in renewables. | Presidential Decree No. 1209 (2019); Ministry of Energy (2024a) |
| Climate Finance Mechanisms and COP29 Model | Establishment of the Baku Initiative on Climate Finance (BICFIT) and the Climate Finance Action Fund (CFAF) under COP29. | Serves as a replicable financial framework for developing nations seeking equitable green funding. | UNFCCC COP29 Secretariat (2024); World Bank (2023a) |

Source: Compiled by the author based on official documents and international reports, including UNDP Azerbaijan (2024), EC (2023b), UNFCCC COP29 Secretariat (2024), Presidential Decree No. 1209 (2019), Ministry of Energy of Azerbaijan (2024), and World Bank (2023a).

The transition is reinforced by a synergy between domestic legislative reforms, such as the Law on Renewable Energy (2021), and proactive international diplomacy. The development of regional green energy corridors and the

engagement during COP29 underscore Azerbaijan's ambition to bridge the gap between national climate action and global energy connectivity. As summarized in Table III.6, the lessons derived from this process provide a replicable framework for other resource-rich or post-conflict nations seeking to align socio-economic recovery with the goals of the Paris Agreement.

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CHAPTER III

# Kazakhstan's Path to a Green Economy: Policies, Investments, and Innovation

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## Introduction

In the context of global transformations and increasing climate risks, the transition to a green economy has become a key direction of sustainable development. Kazakhstan, endowed with substantial natural resources and a favorable geo-economic position, is an important participant in regional green growth efforts. In recent years, the country has demonstrated consistent progress in strengthening its institutional framework, developing green finance mechanisms, and integrating environmental priorities into national economic policy.

This chapter aims to provide a comprehensive understanding of the political, economic, and institutional foundations of Kazakhstan's strategic vision for green economy transition, the mechanisms for financing and investing in sustainable projects, and the prospects for international and regional cooperation, including with the Turkic states. Amid deepening integration processes within the Organization of Turkic States (OTS), special importance is attached to developing joint approaches to clean energy, introducing innovative technologies, and promoting Environmental, Social, and Governance (ESG) principles in economic practice.

The chapter is structured into three main subsections: the first examines Kazakhstan's strategic vision and institutional foundation for the green transition, including the key priorities and targets set out in national legislation. Particular attention is given to coordination mechanisms and the role of government bodies, research institutions, and specialized agencies in shaping and implementing the country's green agenda.

The second section focuses on the development of green finance and on stimulating investments in sustainable projects. It analyzes the instruments of green bonds, the support mechanisms provided by the AIFC Green Finance Centre,[1] pilot issuances of sustainable financial instruments, and Kazakhstan's participation in international ESG initiatives. Special attention is given to programs for the development of green projects supported by financial institutions such as the European Bank for Reconstruction and Development (EBRD), the World Bank, the Damu Entrepreneurship Development Fund, and the Development Bank of Kazakhstan, as well as to regional and Turkic cooperation in the financial sector.

The third section of the Chapter examines the key directions of Kazakhstan's energy transition and the development of renewable energy sources (RES). It analyzes the achieved results and target indicators for increasing the share of renewables, introducing low-carbon technologies, and improving energy efficiency, as well as the prospects for Kazakhstan's participation in international and regional clean energy initiatives. This section also outlines areas of cooperation with Turkic countries in technology transfer, joint infrastructure construction, and participation in global climate networks, including the ERCNET platform.

## III.1 Strategic vision and institutional framework of the transition

The development of a green economy is one of the priority areas of sustainable development in Kazakhstan. The transition to an environmentally oriented model of growth is regarded as a key element in modernizing the economy and enhancing its competitiveness. In recent years, the country has implemented large-scale measures to establish an effective system of natural resource management, improve energy efficiency, and ensure the rational use of resources.

The green economy in Kazakhstan encompasses a broad range of objectives, including the development of RES, the improvement of water and land

[1] The AIFC Green Finance Centre (GFC) is an organization operating within the framework of the Astana International Financial Centre (AIFC). It is responsible for developing policies and instruments to promote sustainable and green finance in Kazakhstan and Central Asia. It is the only company in Central Asia accredited by the International Capital Market Association (ICMA) and the Climate Bonds Initiative (CBI) in its field.

resource management, the modernization of communal infrastructure, and the introduction of clean technologies in industry and transport. An important component of this process is the development of new approaches to public planning based on the principles of environmental sustainability and economic efficiency.

One of the key goals of the green transition is to reduce the economy's dependence on traditional extractive industries and to stimulate innovative sectors that ensure long-term growth with minimal environmental impact. To achieve these objectives, Kazakhstan is developing a green finance system, introducing modern environmental regulatory standards, and encouraging private investment in sustainable projects.

Implementing a green growth policy requires close coordination among the state, the business community, and scientific institutions. In this context, creating favorable institutional conditions, improving legislation, and strengthening corporate environmental responsibility are particularly important. The consistent development of the green economy contributes to enhancing national security, improving the population's quality of life, and establishing a solid foundation for the country's sustainable economic growth.

### III.1.1 National priorities and target benchmarks of the green transition

The transition of Kazakhstan to a green economy model represents a strategic direction of state policy aimed at ensuring sustainable economic growth, improving the efficiency of natural resource use, and reducing the environmental burden on the ecosystem. The key areas of the green transition include enhancing resource efficiency, modernizing infrastructure, developing RES and clean transport, improving waste and water management, and promoting organic agriculture. The implementation of these priorities is accompanied by programs designed to achieve the Sustainable Development Goals (SDGs), while challenges remain related to the need for modernization of existing systems and attracting sufficient investment.

Kazakhstan is consistently pursuing a green growth policy, aligning its national priorities with international commitments. The signing and ratification of the Paris Agreement on 2 August 2016, at the United Nations

Headquarters in New York, marked a new stage in the country's climate policy. Kazakhstan was among the first nations to ratify this agreement (Law of the Republic of Kazakhstan, 2016).

To implement the provisions of the Paris Agreement, the state has adopted key strategic documents defining the long-term trajectory of the green transition. On 10 June 2024, the President of the Republic of Kazakhstan introduced amendments to the Concept for Transition to a Green Economy, strengthening the focus on the integration of environmental and economic objectives (Presidential Decree of the Republic of Kazakhstan, 2024).

On 19 April 2023, the Government of Kazakhstan approved the updated Nationally Determined Contribution (NDC) through Resolution No. 313, outlining the country's national plans to fulfill its commitments under the Paris Agreement. With the support of the United Nations Economic Commission for Europe (UNECE) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the SDG 7 Roadmap was developed to align energy policy with measures aimed at achieving universal access to modern energy sources (UNECE & UNESCAP, 2025). The roadmap includes scenarios and recommendations to shape a national energy policy aligned with the objectives of carbon neutrality and sustainable development.

An important strategic document in this regard is the Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan by 2060, approved by Presidential Decree No. 121 of 2 February 2023. It defines a comprehensive set of measures aimed at transforming economic, technological, and social processes, providing a scenario for the gradual reduction of emissions and the development of low-carbon technologies (Presidential Decree of the Republic of Kazakhstan, 2023). As part of its implementation, a roadmap covering the periods up to 2030 and 2060 is being developed to systematically coordinate national efforts and ensure continuity in achieving the established goals.

On 27 September 2024, the Concept for the Development of Hydrogen Energy until 2030 was approved, setting out the goals, key principles, and performance indicators for the hydrogen sector, along with an Action Plan for its implementation (Ministry of Energy, 2024).

In addition, Kazakhstan participates in the Energy Transition Mechanism of the Asian Development Bank (ADB), which provides for the accelerated decommissioning of coal-fired power plants and their replacement with clean energy facilities. Significant attention is given to the introduction of Best Available Techniques (BAT) in industry. Since September 2023, 16 BAT Reference Documents have been approved for sectors such as cement and steel production, oil and gas extraction, energy, and energy efficiency. These measures aim to reduce the negative environmental impact of industrial activities and achieve the target indicators for environmental quality.

At the same time, Kazakhstan has consistently developed its climate policy, strengthening the legal and institutional framework. Since 1992, when the country signed the United Nations Framework Convention on Climate Change (UNFCCC), several key milestones have been achieved:

- 1995: The Convention was ratified by the Parliament of the Republic of Kazakhstan.
- 1998: Kazakhstan declared its intention to voluntarily assume commitments to reduce emissions. The First National Communication of Kazakhstan under the UNFCCC was published.
- 1999: Kazakhstan signed the Kyoto Protocol.
- 2008: Kazakhstan voluntarily undertook quantitative commitments to stabilize greenhouse gas emissions at the 1992 level for the period 2008–2012.
- 2009: Kazakhstan ratified the Kyoto Protocol (under which, as a developing country, it had no binding obligations) and announced quantitative commitments for the post-2012 period to reduce greenhouse gas emissions by 15% from the 1992 level by 2020 and by 25% by 2050.
- 2015: Kazakhstan submitted its first Nationally Determined Contribution (NDC), under which it committed to reduce greenhouse gas emissions by 15–25% by 2030 compared to 1990 levels economy-wide (15% unconditional target, 25% conditional target subject to international support).
- 2016: The Kazakhstan Emissions Trading System (KAZ ETS) was suspended until 2018. The Paris Agreement was signed and ratified.
- 2021: The Environmental Code of the Republic of Kazakhstan was updated, with specific chapters devoted to state regulation of greenhouse

gas emissions and removals. For the first time, the concept of climate change adaptation and corresponding measures for its implementation were formally introduced.

- 2023: Kazakhstan adopted its updated Nationally Determined Contribution (NDC) and approved the Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan by 2060.
- 2024: The Concept for the Development of Hydrogen Energy in the Republic of Kazakhstan until 2030 was approved.

Overall, Kazakhstan has established a comprehensive strategic planning framework for the green economy, combining international commitments, national initiatives, and sectoral reforms. The implementation of these measures contributes to the formation of a low-carbon and competitive economy, enhances the country's investment attractiveness, and supports the achievement of long-term sustainable development goals.

### III.1.2 Coordination mechanisms and key institutions

The implementation of the green transition policy in the Republic of Kazakhstan relies on a comprehensive, systematic institutional framework that ensures coordinated action among government bodies, businesses, and the scientific community. The established system of public administration in the field of the green economy is aimed at creating a sustainable mechanism for integrating strategic planning, regulatory governance, and the practical implementation of measures to promote the environmental modernization of the national economy. The coordination of these processes is carried out through the interaction of key institutions whose activities are focused on integrating the principles of sustainable development into the country's socio-economic policy.

The central body responsible for defining and implementing policy in the field of the green economy is the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan. Its activities cover a wide range of tasks, from the rational use of natural resources and the protection of biodiversity to the regulation of pollutant emissions and the improvement of waste management. The Ministry also plays a coordinating role in ensuring the country's compliance with international sustainable development commitments, working closely with relevant UN agencies and international

financial institutions. Within its structure operate specialized subordinate organizations, including the RSE "Zhasyl Damu," which implements projects on waste utilization and recycling, the development of environmental monitoring infrastructure, and the introduction of low-carbon technologies.

An important element of institutional coordination is the Council for the Transition to a Green Economy, operating under the President of the Republic of Kazakhstan[2] (Presidential Decree of the Republic of Kazakhstan, 2014). This body serves as a strategic advisory center, ensuring interagency coordination of plans, reviewing regulatory initiatives, and overseeing the implementation of state policy in sustainable development. Meetings of the Council, chaired by the Prime Minister, help form a unified position among government bodies and regional akimats (local administrations) on issues of decarbonization, energy efficiency, and the rational use of natural resources. The Council includes representatives from central ministries, research institutions, and expert communities, ensuring a comprehensive, scientifically grounded approach to addressing the tasks of the green transition.

A special role in advancing the green agenda is played by the Astana International Financial Centre (AIFC) and its structural division, the AIFC Green Finance Centre (GFC). This organization serves as a platform for promoting sustainable finance principles and developing mechanisms to attract investment into environmentally significant projects.

[2] The composition of the Council for the Transition to a Green Economy under the President of the Republic of Kazakhstan includes: the Prime Minister of the Republic of Kazakhstan (Chair); the Deputy Prime Minister of the Republic of Kazakhstan (Deputy Chair); the Minister of Ecology, Geology and Natural Resources of the Republic of Kazakhstan (Secretary); the Minister of Energy of the Republic of Kazakhstan; the Minister of Health of the Republic of Kazakhstan; the Minister of Industry and Infrastructural Development of the Republic of Kazakhstan; the Deputy Head of the Presidential Administration of the Republic of Kazakhstan responsible for socio-economic affairs; the Minister of National Economy of the Republic of Kazakhstan; the Minister of Education and Science of the Republic of Kazakhstan; the Minister of Finance of the Republic of Kazakhstan; the Minister of Culture and Sports of the Republic of Kazakhstan; the Minister of Justice of the Republic of Kazakhstan; the Minister of Agriculture of the Republic of Kazakhstan; the Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan (by agreement); the Chairman of the Board of JSC "National Company Astana EXPO-2017" (by agreement); the UN Resident Coordinator and UNDP Resident Representative in Kazakhstan (by agreement); the Director of the United Nations Environment Programme (UNEP) for Central Asia (by agreement); the Chair of the Presidium of the Association of Environmental Organizations of Kazakhstan (by agreement); the Chairman of the Board of the Coalition for a Green Economy and G-Global Development (by agreement); the Executive Director of the Kazakhstan Waste Management Association "KazWaste" (by agreement); the Director of the Green Academy Research and Education Center (by agreement); the Chairman of the Board of the Association of Environmental Organizations of Kazakhstan (by agreement); and the Head of the International Green Technologies and Investment Projects Center (IGTIPC) (by agreement).

In 2024, the Centre launched the regional report "State of Sustainable Finance in Central Asia," which highlighted that the AIFC Green Finance Centre serves as the primary verifier and methodological center for green financial instruments in Kazakhstan, ensuring transparency and compliance with international standards. The Centre also implements the Green Project Database initiative - a digital database of sustainable and environmental projects designed to increase investor awareness and stimulate the growth of the green investment market. In addition, the Centre actively develops training programs for the financial sector; for example, in January 2024, a series of webinars was held on implementing ESG standards and evaluating sustainable projects.

The scientific and analytical community also makes a significant contribution to the implementation of Kazakhstan's environmental policy. The leading centers of expert and research support include the Economic Research Institute JSC under the Ministry of National Economy of the Republic of Kazakhstan, the Kazakhstan Institute for Strategic Studies under the President of the Republic of Kazakhstan (KAZISS), as well as research units at leading national universities. Their activities focus on developing methodological foundations for green planning, preparing forecasting scenarios, indicators, and analytical reports that serve as the basis for policymaking. Within the framework of international cooperation, these institutions participate in projects of the UNDP, UNECE, and the UN ESCAP, facilitating the adaptation of best sustainable development practices to Kazakhstan's national context.

Thus, Kazakhstan has developed a multi-level system for managing the green economy that combines state regulation, financial and investment support, and scientific expertise. The coordinated interaction among ministries, interagency councils, specialized agencies, and research institutions enables the development of a comprehensive, institutionally robust model of the green transition, focused on achieving carbon neutrality, enhancing resource efficiency, and ensuring the long-term competitiveness of the national economy.

## III.2 Development of green finance and investment promotion

In recent years, Kazakhstan has demonstrated steady progress toward a green economy model, combining climate objectives, institutional reforms, and the

development of new financial instruments. A key focus has been on establishing a green finance market to support the country's energy transition, industrial modernization, and the development of environmentally safe technologies.

According to OECD (2023) estimates, developing countries face a chronic deficit in adaptation and climate finance; existing financial flows cover only about 30–35% of the needs required to achieve the Paris Agreement targets. Kazakhstan is no exception: as stated in the ADB report "Kazakhstan 2023–2027: Accelerating Resilient and Sustainable Growth for All" (2023), the country will require around $610 billion in investment to meet its emission reduction commitments and achieve carbon neutrality by 2060, equivalent to 270% of its 2022 GDP - a cumulative investment requirement through 2060. This estimate is confirmed in the AIFC & GIP (2024) report, which analyzes the total investment needs of Central Asian countries (see Table III.1). The scale of this challenge cannot be met solely through public resources, making the development of private and market-based financing mechanisms a top priority of Kazakhstan's economic policy.

According to the ADB (2023), green finance mechanisms play a key role in Kazakhstan's transition toward a carbon-neutral economy. The ADB intends to support the government of Kazakhstan in establishing green financial platforms, expanding access to long-term climate finance, and integrating sustainable investment planning principles. The strategy highlights that Kazakhstan, while remaining an energy-intensive economy, must gradually transition to low-carbon, climate-resilient growth without compromising its socio-economic development (ADB, 2023).

TABLE III.1: CLIMATE FINANCE NEEDS IN CENTRAL ASIAN COUNTRIES

| | Required financing (billion $) | The country's GDP (billion $, 2022) | Ratio to GDP (percent) |
|---|---|---|---|
| Kazakhstan | 610 | 225,5 | 270% |
| Kyrgyzstan | 10 | 11,5 | 87% |
| Tajikistan | 2 | 10,5 | 19% |
| Turkmenistan | - | 56,5 | - |
| Uzbekistan | 94 | 80,4 | 117% |

Source: ADB (2023), AIFC & GIP (2024); World Bank (2025).

The study by Rakhymzhan et al. (2024), "Navigating Kazakhstan's Sustainable Economic Future: A Study of Tech Innovation, Infrastructure and Resource Management," confirms that investments in environmentally sustainable

infrastructure - including renewable energy, transport, and smart cities - show the strongest correlation with the development of the green economy ($\beta = 0.298$; $p < 0.05$). Such investments create favorable conditions for introducing sustainable practices in the public sector and provide long-term competitive advantages within the Resource-Based View framework. The report emphasizes the need for financial sector reforms and the implementation of de-risking tools to attract a larger volume of private capital into sustainable infrastructure.

The formation of a sustainable financial architecture in Kazakhstan is based on a consistent institutional framework. Since 2013, the country has implemented the Concept for Transition to a Green Economy, which outlines key goals such as improving energy efficiency, increasing the share of RES to 15% by 2030, and reducing the carbon intensity of the economy. Subsequent documents - the Environmental Code (2021) and the Strategy for Achieving Carbon Neutrality by 2060, approved in 2023, approved in 2021 - provided the legal basis for these goals. This Strategy was built upon the foundational Doctrine of Carbon Neutrality until 2060 published in 2021.

As noted by Imangali and Bekturganova (2024), Kazakhstan's institutional structure combines strategic planning, state incentives, and the development of market-based mechanisms, distinguishing it from most Central Asian countries, where the green transformation remains fragmented. The study also points out that the key economic mechanisms of the green transition include tax incentives and subsidies for companies implementing environmentally friendly technologies, financing of R&D, and the development of green public procurement and green finance mechanisms. These instruments ensure a balance between economic motivation and corporate environmental responsibility.

One of the key elements of the new financial ecosystem is the Astana International Financial Centre (AIFC) and its division, the AIFC Green Finance Centre, which has been operating since 2018. These institutions have provided the infrastructure and regulatory framework necessary to attract investment into sustainable projects. According to Daniya and Tang (2024), the establishment of the AIFC marked a "turning point" in Kazakhstan's transition from a donor-based to a market-based model of climate finance. The Centre developed the national taxonomy of green finance, introduced ESG disclosure standards for issuers and investors, and in 2020, launched the first issuance of

green bonds on the Astana International Exchange (AIX) in cooperation with UNDP.

TABLE III.2: INTERNATIONAL CLIMATE FINANCE FLOWS TO CENTRAL ASIAN COUNTRIES BY INSTRUMENT
(2000-2021)

| | Total funding (million $) | Share of debt instruments | Share of grants | Equity and shares in collective investment vehicles |
|---|---|---|---|---|
| Kazakhstan | 4481 | 94.5% | 3.5% | 2% |
| Kyrgyzstan | 1358.1 | 55% | 45% | - |
| Tajikistan | 2355 | 37% | 63% | - |
| Turkmenistan | 88.2 | 21% | 79% | - |
| Uzbekistan | 9182 | 97% | 3% | - |
| TOTAL | 17464.3 | 85.1% | 14.8% | 0.1% |

Source: OECD (2023).

According to the latest data from AIFC & GIP (2024), Kazakhstan received $4.48 billion in international climate finance between 2000 and 2021, accounting for about one-quarter of all inflows to Central Asia. Of this amount, 94.5% was in the form of debt instruments, 3.5% in grants, and 2% as equity participation (see Table III.2). This structure reflects Kazakhstan's transition to a more mature financing model, based on loan and bond mechanisms, and demonstrates the growing interest of international financial institutions in national projects.

International development institutions remain key partners in Kazakhstan's green transition. According to AIFC & GIP (2024), the main donors of climate finance in Central Asia include EBRD, the World Bank, ADB, and the EIB. Data from EBRD (2024) indicate that Kazakhstan is among the largest recipients of the Bank's investments in Central Asia; however, the volume of green investments is estimated at around €1.25 billion within the 2017–2022 program, primarily directed toward the energy and transport sectors. These findings support Abazov (2025), who concludes that in Kazakhstan, "the transition to a green economy already has both institutional and financial dimensions," distinguishing it from neighboring countries where climate finance remains predominantly grant-based.

Alongside international loans, domestic mechanisms of sustainable finance are also actively developing. According to the AIFC & GIP (2024) report AIFC Green Finance Centre (2024), Kazakhstan has issued its first green and sustainable bonds totaling around $1.2–1.3 billion, including corporate and

municipal placements, as well as sustainability-linked bonds tied to energy-efficiency and emission-reduction indicators. As noted by the EBRD (2024), these instruments not only facilitate the mobilization of funds on preferential terms but also enhance transparency in their utilization, which is particularly important for international investors.

Academic research further confirms the effectiveness of green financial mechanisms. Yesbergen et al. (2024) observe that the introduction of investment and tax incentives has increased the share of renewable energy and boosted foreign direct investment in environmental sectors. Rakhymzhan et al. (2024) identify a statistically significant correlation between the introduction of innovative technologies, growth in public spending on environmental infrastructure, and GDP dynamics. Using hybrid techno-economic modeling, Zhakiyev et al. (2024) conclude that implementing the Emissions Trading System (KAZ ETS) and developing green finance could reduce $CO_2$ emissions by 15–20% by 2030.

According to Xenarios et al. (2024), Kazakhstan remains the only country in Central Asia operating a national emissions trading system (KAZ ETS), which covers the largest energy and industrial enterprises. This creates additional demand for green investment instruments, as companies seek to reduce the cost burden associated with emissions. At the same time, Poberezhskaya & Bychkova (2024) emphasize that the successful implementation of climate commitments requires coordination among financial institutions, government agencies, and businesses, not merely a regulatory framework.

The regional context further strengthens Kazakhstan's importance. Studies by Yuzbashiyeva et al. (2025) and Quliyev (2025) suggest that Kazakhstan has relatively strong institutional and financial preconditions for green economic development. Compared with some neighboring economies where climate investments remain largely grant-funded, Kazakhstan appears to have greater scope to develop market-based debt instruments.

Thus, the development of green finance in Kazakhstan is characterized by a comprehensive approach that combines institutional reforms, market mechanisms, and international partnerships. The established ecosystem includes:

- Regulatory framework: Concept for the Transition to a Green Economy, Strategy of Carbon Neutrality, Environmental Code, and ETS;
- Infrastructure: AIFC and AIX, Green Finance Centre, and national taxonomy;
- Financial instruments: green, social, and sustainability-linked bonds;
- International partnerships: EBRD, World Bank, ADB, and Green Climate Fund (GCF).

This system provides a solid foundation for attracting the capital necessary to achieve structural decarbonization of the economy and meet strategic goals for 2030 and 2060. At the same time, data from the Bureau of National Statistics of the Republic of Kazakhstan show that in 2024, crude oil and crude oil products accounted for approximately 52.5% of total exports, underscoring the continued dependence of the export structure on hydrocarbons. Such a structure makes the country vulnerable to external shocks and underscores the need for economic diversification through green investments and technological innovation.

## III.2.1 Green bonds and sustainable finance instruments

The development of the green bond market in Kazakhstan is a key component of the country's national policy for sustainable growth and the establishment of a regional hub for green finance in the Eurasian region.

The transition to a low-carbon economic model is impossible without expanding long-term investment capital, while green bonds and other ESG instruments serve as the main channel for attracting private funds to environmentally oriented projects. According to Xenarios et al. (2024), the introduction of green finance through the AIFC platform since 2018 has become a central element in attracting investments and promoting ESG principles within Kazakhstan's corporate sector.

### III.2.1.1 Formation of the AIFC institutional platform

A key role in the development of Kazakhstan's green finance infrastructure belongs to the Astana International Financial Centre (AIFC) and its specialized division, the AIFC Green Finance Centre (GFC), established in 2018 with support from the AIFC, UNDP, and EBRD. As noted by Daniya and Tang (2024),

the GFC's activities have become an instrument for the structural modernization of Kazakhstan's capital market, enabling the issuance of the first green and sustainability bonds on the Astana International Exchange (AIX).

The AIFC serves simultaneously as a regulator, methodological center, and advisor to issuers. Under its guidance, the National Taxonomy for Green Finance was developed, aligned with the ICMA Green Bond Principles and the EU Taxonomy Regulation, ensuring the comparability of Kazakhstan's issuances with international markets (AIFC & GIP, 2024). At the same time, ESG disclosure requirements were introduced in 2023 for public companies, approved by the Agency for Regulation and Development of the Financial Market.

The ADB's partnership framework aligns with Kazakhstan's national initiatives, including the AIFC's work, and focuses on expanding public-private partnerships (PPPs) in green and renewable energy. The Bank provides advisory support in the preparation and structuring of investment projects in solar, wind, and hydropower, as well as in energy storage systems. In addition, the ADB implements non-sovereign investment programs to reform the electricity and district heating sectors, develop green mortgage finance, and promote energy-efficient urban projects. These measures complement the AIFC's activities and lay the foundation for the inflow of international private capital into Kazakhstan's sustainable economic sectors (ADB, 2023).

According to Rakhymzhan et al. (2024), the AIFC has become the institutional foundation for promoting private-sector green initiatives, ensuring transparency and control over the targeted use of funds. The study by Yesbergen et al. (2024) shows that introducing investment and tax incentives through AIFC mechanisms has significantly increased inflows of foreign direct investment into green sectors, including renewable energy, environmentally friendly construction, and waste management.

### III.2.1.2 Dynamics and structure of the green bond market

According to the AIFC & GIP (2024) report, the total volume of sustainable finance in Kazakhstan as of May 2024 reached $1.389 billion, including $366 million in green bonds, $535 million in sustainability-linked bonds (SLBs), $226 million in sustainability bonds, and $178 million in social bonds (see

Table III.3). This makes Kazakhstan the largest market for sustainable instruments in Central Asia. For comparison, Uzbekistan's market volume is estimated at $1.316 billion, though it is dominated by SDG bonds rather than market-based ESG instruments. This confirms that Kazakhstan's model, developed through the AIFC, has already become one of the more developed sustainable finance platforms in the region.

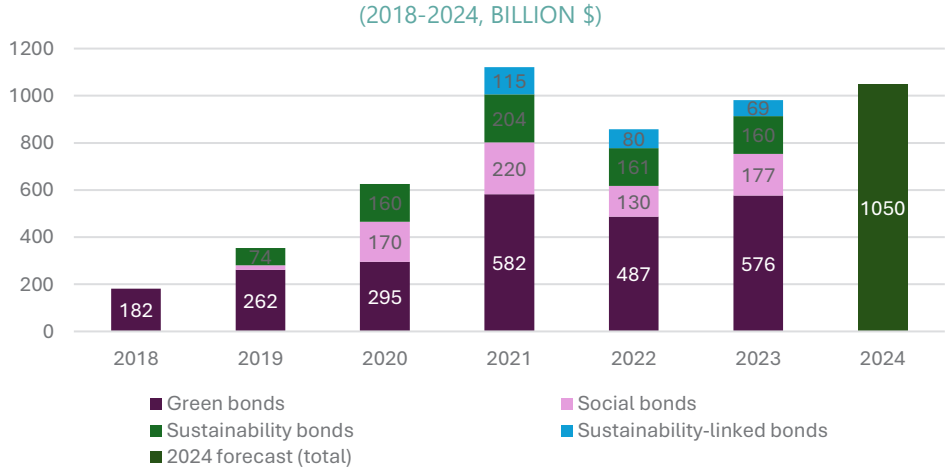
TABLE III.3: SUSTAINABLE FINANCE MARKET INSTRUMENTS IN CENTRAL ASIA
(MILLION $, AS OF MAY 2024)

| | Kazakhstan | Kyrgyzstan | Tajikistan | Uzbekistan |
|---|---|---|---|---|
| Green bonds | 366 | 1 | 10 | 441 |
| Green loans (labelled) | 84 | .. | .. | .. |
| Social bonds | 178 | 0.9 | .. | .. |
| Sustainability bonds | 226 | .. | .. | .. |
| Sustainability-linked bonds | 535 | .. | .. | .. |
| SDG bonds | .. | .. | .. | 875 |

Source: AIFC & GIP (2024).

The growth of Kazakhstan's domestic market aligns with the global trend in the volume of sustainable bond issuance, which increased from $214 billion in 2018 to $982 billion in 2023, with a forecast of $1.05 trillion for 2024 (see Figure III.1). This comparison is important, as the AIFC has designed its regulatory framework in alignment with global standards, such as the ICMA

FIGURE III.1: GLOBAL SUSTAINABLE BONDS ISSUANCE BY TYPE
(2018-2024, BILLION $)




Source: AIFC & GIP (2024) based on S&P Global.
Note: 2024 data are forecast.

Green Bond Principles and the EU Taxonomy - rather than operating "in the vacuum" of a purely national market.

At the same time, in the global sustainable bond market, green bonds account for the largest share, about 60% of total issuances. Kazakhstan's integration into this rapidly expanding segment of the global market enables the country to diversify its capital sources and integrate into international sustainable investment value chains.

National pilot issuances of green bonds were carried out with the support of the AIFC Green Finance Centre and EBRD between 2020 and 2023. The study by Daniya and Tang (2024) notes that in August 2020, the UNDP, in cooperation with the AIFC Green Finance Centre, launched Kazakhstan's first green bond issuance, marking the beginning of the national market for green debt instruments. Later, the ADB issued two ESG bond offerings totaling $32.5 million, while the Damu Fund issued bonds worth $2.4 million. For every $1 of donor funds allocated by the UNDP for subsidization, $175 of private investment was mobilized - demonstrating the high multiplier effect of green bonds. According to EBRD (2024), Kazakhstan became one of the first countries in Central Asia to issue corporate bonds with targeted use of proceeds for projects in renewable energy, energy-efficient construction, and waste management. Market estimates show that the average yield of these issuances was 30–50 basis points lower than comparable traditional instruments, indicating strong investor confidence in the green segment.

These results are confirmed by Zhakiyev et al. (2024), who demonstrated that implementing green finance mechanisms and the Emissions Trading System (KAZ ETS) could reduce $CO_2$ emissions by 15–20% by 2030 without slowing macroeconomic growth. Thus, the development of the bond market not only supports the fulfillment of Kazakhstan's climate commitments but also establishes a new growth driver for the national financial system.

### III.2.1.3 Financial structure and institutional sources

According to AIFC & GIP (2024), the total volume of international climate finance mobilized by Kazakhstan between 2000 and 2021 amounted to $4.48 billion - about four times greater than that of Kyrgyzstan and Tajikistan. The majority of funds (94.5%) were in the form of debt instruments, while grants accounted for 3.5% and equity investments accounted for only 2%. This

structure reflects Kazakhstan's transition to a market-based financing model and its relatively strong creditworthiness, which enable the issuance of national green bonds.

Kazakhstan is also an active participant in the Green Climate Fund (GCF). According to the Fund, three national projects are being implemented with a total value of $173 million, while $4.3 million has been approved for Readiness Programmes, of which $1.5 million has already been utilized (AIFC & GIP, 2024). This demonstrates Kazakhstan's high institutional capacity to receive and effectively manage international climate finance (see Table III.4).

As noted by AIFC & GIP (2024) and the ADB (2023), a country's ability to convert external financial flows into market-based instruments is a key indicator of the maturity of its national financial system. In Kazakhstan, this process is taking place through the AIFC, where external resources from the Green Climate Fund, EBRD, ADB, and the World Bank are used to create pilot issuances, providing a "demonstration effect" and reducing risks for private investors.

TABLE III.4: GREEN CLIMATE FUND FINANCING AND READINESS SUPPORT IN CENTRAL ASIAN COUNTRIES

| | Number of projects | Total GCF funding (million $) | Approved support for Readiness, (million $) | Readiness support disbursed (million $) |
|---|---|---|---|---|
| Kazakhstan | 3 | 173 | 4.3 | 1.5 |
| Kyrgyzstan | 4 | 73.8 | 4.3 | 3.5 |
| Tajikistan | 6 | 91 | 5.1 | 3.0 |
| Turkmenistan | - | - | 3 | 2.4 |
| Uzbekistan | 5 | 130.2 | 2.2 | 2.0 |
| Total | 18 | 468 | 18.9 | 12.4 |

Source: AIFC & GIP (2024); Green Climate Fund.

### III.2.1.4 ESG integration and corporate transformation

The AIFC is actively promoting Environmental, Social, and Governance (ESG) standards at the corporate governance level. In 2023, the Centre approved ESG disclosure guidelines for all issuers, which became a mandatory requirement for listing on the Astana International Exchange (AIX). According to Imangali and Bekturganova (2024), the introduction of ESG reporting has enabled companies to access institutional investors in the European Union and the United Kingdom, which, in turn, has encouraged large enterprises to

transition toward more environmentally responsible production standards. At the same time, as Yesbergen et al. (2024) show, excessive increases in environmental taxes may reduce companies' motivation to implement clean technologies. An inverse relationship was identified between fiscal burden and innovation activity, indicating the need for a balanced policy that directs a portion of environmental tax revenues toward funding green innovation and clean-tech startups.

The study by Poberezhskaya and Bychkova (2024) notes that Kazakhstan has made comparatively strong progress in integrating the climate agenda into public administration. The formation of ESG infrastructure through the AIFC and state-owned enterprises, primarily Samruk-Kazyna and the Development Bank of Kazakhstan, creates a synergistic effect between public and private initiatives.

### III.2.2 Regional context and international engagement

Kazakhstan's role as a financial center for sustainable development extends beyond its national jurisdiction. According to Yuzbashiyeva et al. (2025), Kazakhstan and Türkiye are among the OTS members with more developed infrastructure for green bond issuance and servicing. In several other regional economies, project pipelines and market infrastructure remain at an earlier stage. This creates scope for Kazakhstan, through the AIFC platform, to contribute to regional bond market development in Central Asia.

As emphasized by Abazov et al. (2025), Kazakhstan is increasingly linking its domestic green finance development to broader regional cooperation. Its infrastructure, regulatory framework, and financial platform may help channel investment into projects across Central Asia. According to the ADB (2023), this approach may improve resource allocation and support the implementation of Nationally Determined Contributions (NDCs).

The development of the green bond and ESG finance market in Kazakhstan demonstrates the country's shift from policy declarations to practical financing instruments for sustainable development. The main achievements include:

- Infrastructure development – The AIFC and AIX provide the legal and regulatory platform for green instruments.

- Pilot issuances – The first corporate and municipal bond placements in renewable energy and energy efficiency (2020–2023).
- ESG integration – Mandatory reporting for issuers, national taxonomy, and adoption of ICMA and EU Taxonomy standards.
- Regional influence – Expanding the AIFC's role in sustainable finance across Central Asia and neighboring regional frameworks.

Kazakhstan has thus entered the stage of a fully functioning market for sustainable financial instruments. As highlighted by Daniya and Tang (2024), this has led to the emergence of a new model of economic growth, where financial innovation serves as a mechanism for achieving environmental and social objectives. This model provides a stable foundation for the long-term transformation of Kazakhstan's economy and strengthens its role in the global ESG investment system.

### III.2.2.1 Support for green projects by international institutions

The development of Kazakhstan's green economy and its transition to a low-carbon model would be impossible without the participation of international financial institutions. According to OECD (2023), global climate finance flows remain concentrated in developed countries, while developing economies face a persistent "adaptation capital gap." In Kazakhstan, this gap is being bridged through active cooperation with multilateral development banks, international funds, and regional initiatives, including the Green Climate Fund, EBRD, ADB, the World Bank, and the EIB. These institutions not only provide financing but also contribute to the institutional strengthening of Kazakhstan's climate governance, data standardization, and corporate disclosure practices.

According to AIFC & GIP (2024), Kazakhstan is among the largest recipients of climate finance in Central Asia, with total inflows from 2000 to 2021 amounting to $4.48 billion, equivalent to 26% of all regional inflows. The main donors are the EBRD, the World Bank, and the ADB.

The EBRD is a key partner in financing infrastructure and energy projects. Under its Green Economy Transition program, focused on energy modernization, renewable energy development, and sustainable transport, Kazakhstan became one of the Bank's largest investment recipients in the

region. The total volume of the Bank's climate-related investments in Kazakhstan is estimated at €1.25 billion. Among implemented projects are:

- the Zhanatas Wind Power Plant (100 MW), developed jointly with CITIC Construction (China) and the Kazakhstan Investment Development Fund;
- the Burnoye Solar and Kapshagay Solar stations, as well as waste management and energy-efficient construction projects.

The EBRD also implements the Green Economy Financing Facility in Kazakhstan, which provides credit lines to local financial institutions for subsequent lending to individuals and SMEs. Funds are allocated to climate mitigation and adaptation projects in line with the Bank's GET strategy, aimed at reducing greenhouse gas emissions and improving energy efficiency. In its pilot phase, the total portfolio of Central Asian projects amounted to $170 million, of which $30 million was implemented in Kazakhstan between 2020 and 2023. At the next stage, the program approved additional financing of about $340 million, including up to $150 million for Kazakhstan (AIFC & GIP, 2024).

The ADB focuses on low-carbon infrastructure and urban development projects. The Bank has allocated over $600 million to support Green Cities Programs and modernize water and utility systems, including projects in Astana, Almaty, and Shymkent. The ADB also advises the Ministry of Energy on decarbonization and the deployment of RES. According to ADB (2023), several Green Cities projects remain in the preparation stage.

The World Bank supports Kazakhstan in climate planning, agricultural reform, and emissions management. According to AIFC & GIP (2024), under the Climate Resilient Infrastructure Program, pilot projects have been implemented for the construction of energy-efficient schools and hospitals, along with research initiatives in carbon management and sustainable agricultural practices. As emphasized by Yesbergen et al. (2024) and Rakhymzhan et al. (2024), the involvement of international institutions has allowed Kazakhstan not only to mobilize financial resources but also to improve governance quality, implement transparent procurement systems, and integrate ESG reporting in state-owned enterprises.

### III.2.2.2 Kazakhstan's participation in the Green Climate Fund

The Green Climate Fund (GCF) serves as a central mechanism for implementing the Paris Agreement in the area of decarbonization financing. Kazakhstan has cooperated with the GCF since 2017 and is one of the most institutionally prepared countries in the region. According to AIFC & GIP (2024), three GCF projects are being implemented in Kazakhstan, totaling $173 million, including programs on climate-resilient agriculture, energy efficiency improvement, and utility system modernization. Additionally, $4.3 million has been approved under the Readiness Support program, of which $1.5 million has already been utilized.

For comparison, Uzbekistan is implementing five GCF projects worth $130.2 million, and Kyrgyzstan has four projects totaling $73.8 million. Kazakhstan has three approved GCF projects totaling $173 million. This suggests a distinct portfolio profile, with Kazakhstan's GCF engagement concentrated in fewer, larger-scale, and more capital-intensive initiatives. Kazakhstan's programs are cross-sectoral and aimed at structural transformation in energy, agriculture, and infrastructure.

According to OECD (2023), Kazakhstan's high rate of GCF fund utilization is explained by the presence of a national climate finance operator - the AIFC Green Finance Centre, which ensures project verification and reporting in line with international standards. Kazakhstan is considered one of the more institutionally prepared countries in the region to access GCF funds and participates in consultations for the Central Asia Climate Resilience Initiative (CACRI). This mechanism has strengthened Kazakhstan's climate readiness, with pilot green economy projects already contributing to reduced $CO_2$ intensity and improved industrial energy efficiency.

### III.2.2.3 Thematic areas of international financing

According to AIFC & GIP (2024), around 80% of international climate finance flowing to Kazakhstan is directed toward climate change mitigation, and 20% toward adaptation. The largest investment volumes are concentrated in energy, transport, industry, and water management, consistent with international ICMA Green Bond Principles.

The ADB (2023) notes that this mitigation bias is typical for energy-dependent countries, where energy decarbonization yields the fastest results. However, Kazakhstan is gradually moving toward a balanced model by developing projects in sustainable agriculture, efficient water use, and ecosystem management in arid regions.

These priorities align with the Strategy of Carbon Neutrality by 2060 (Imangali & Bekturganova, 2024), which emphasizes the development of energy-efficient infrastructure, the expansion of small hydropower and wind farms, and the deployment of smart grids and transport systems. International institutions support these goals by forming a project pipeline for financing through the AIFC and national development banks.

### III.2.2.4 Synergy between international and national instruments

The support of international institutions is closely integrated with domestic sustainable finance mechanisms. As noted by Zhakiyev et al. (2024), cooperation among the EBRD, GCF, and AIFC Green Finance Centre creates a "catalytic effect." External resources serve as a base for pilot projects, while subsequent scaling is achieved through domestic bond instruments. This mechanism was applied, for instance, in solar panel installation projects in southern Kazakhstan, where initial investments were provided by the EBRD and GCF, and further scaling was financed through domestic green bonds on the AIX.

According to the AIFC Green Finance Centre (2024), this blended finance model multiplies the impact of international funding and builds a sustainable domestic market, reducing dependence on grants. Kazakhstan is among the few countries in the region where this mechanism operates institutionally, thanks to the AIFC and its subsidiaries. The study by Abazov et al. (2025) confirms that this synergy between international and national instruments creates the basis for long-term impact. External funds provide an initial impulse, while domestic infrastructure consolidates results and lowers entry barriers for private investors.

Kazakhstan participates in the Green Investment Principles (GIP) related to Belt and Road investment activity, which aim to enhance the environmental sustainability of cross-border investments. Within this framework, the AIFC and EBRD are jointly developing a climate risk assessment methodology for

investors, which will facilitate the creation of transnational ESG ratings in the future.

International institutions play a strategic role in developing Kazakhstan's green economy. Their participation ensures:

- Financial support – long-term loans and investments in energy, transport, and water systems;
- Institutional development – the formation of standards, national taxonomy, and ESG disclosure practices;
- Synergy with domestic instruments – integration of GCF, EBRD, and ADB mechanisms with AIFC platforms;
- Regional cooperation – multilateral cooperation in sustainable finance across Central Asia and related regional frameworks.

As noted by Abazov et al. (2025), "international partnerships have allowed Kazakhstan to transform the climate agenda from an external initiative into a national priority, creating a financial system capable of supporting the transition to a low-carbon economy." Thus, cooperation with international institutions has become not only a source of financing but also a key driver of Kazakhstan's institutional and market transformation.

## III.3 Energy transition and development of RES

Kazakhstan's energy sector remains a core component of the national economy and a key source of export revenues, yet it is also the primary contributor to greenhouse gas emissions. According to the fuel and energy balance data published by the Bureau of National Statistics of the Republic of Kazakhstan, in 2024 renewable energy sources (excluding hydropower) accounted for around 6.2% of total electricity generation, implying that fossil fuels (coal and gas) supplied over 93% of electricity production in the country.

In this context, the transition to RES has become an integral part of Kazakhstan's long-term growth strategy and its fulfillment of international commitments under the Paris Agreement and the Strategy of Carbon Neutrality by 2060.

In the ADB Country Partnership Strategy for Kazakhstan (2023–2027), significant attention is devoted to supporting the implementation of the Strategy of Carbon Neutrality by 2060. The Bank is implementing the Energy Transition Mechanism program, which aims to accelerate the decommissioning of coal-fired power plants and replace them with hybrid and renewable generation capacities. The document emphasizes that the energy transition must be just and inclusive, taking into account the social adaptation of coal sector workers and the diversification of regional economies (ADB, 2023).

### III.3.1 Progress and target indicators in the field of renewable energy

Kazakhstan's transition to green energy is guided by clearly defined strategic benchmarks. The Strategy of Carbon Neutrality by 2060 outlines key targets to increase the share of RES in the national energy mix to 15% by 2030, 50% by 2050, and achieve a carbon-neutral energy sector by 2060 (Presidential Decree of the Republic of Kazakhstan, 2023). The Concept for Transition to a Green Economy (2013) established the core priorities: improving energy efficiency, diversifying energy generation, creating a carbon credit market, and introducing innovative technologies in industry and transport.

Daniya and Tang (2024) report that as of early 2024, Kazakhstan operated 146 renewable energy facilities, including 59 wind farms, 45 solar power plants, 39 small hydropower stations, and 3 biogas complexes with a total capacity of 2,880 MW. These figures indicate rapid growth in the domestic renewable energy sector while maintaining the strategic target of 15% renewables by 2030 and 50% by 2050, in line with the country's long-term decarbonization strategy. According to Abazov et al. (2025), in 2020, solar energy accounted for 1% and hydropower for less than 1%, underscoring a low starting base for future expansion. The country also aims to phase out new coal projects, shift toward green hydrogen production, and implement a large-scale tree-planting program of 2 billion trees by 2025. Meanwhile, grid modernization and energy storage development programs are creating favorable conditions for further renewable energy sector growth.

As noted by Rakhymzhan et al. (2024) and Yesbergen et al. (2024), Kazakhstan is actively advancing innovative decarbonization solutions, including:

- the deployment of energy storage technologies and smart grid systems;
- the development of hydrogen energy and production of green hydrogen from renewable sources;
- the modernization of heating systems and promotion of energy-efficient construction;
- the digitalization of the energy market through AIFC platforms for carbon trading.

The ADB plans to support Kazakhstan in developing smart grids and energy storage systems to enhance power supply resilience and distribution efficiency. According to Yesbergen et al. (2024), however, innovation activity in the environmental sector has significantly declined: the number of companies implementing green technologies fell from 312 in 2016 to 97 in 2022, while the share of environmental innovations in total innovations dropped from 10.8% to 3%. The authors emphasize that without tax incentives and research and development (R&D) subsidies, these trends may further weaken technological progress. The strategy also stresses that the digitalization of the energy system, including smart metering for electricity, heat, gas, and water, will become a key tool for transparency and integration of renewables into the national grid. Moreover, the ADB aims to promote green mortgage and urban financing to integrate energy efficiency standards into construction and improve urban livability (ADB, 2023).

AIFC & GIP (2024) notes that Kazakhstan emits 0.64 tons of $CO_2$ equivalent per $1,000 of GDP, exceeding the global average of 0.38 tons of $CO_2$ equivalent per $1,000. The dominance of coal and gas power plants makes the energy sector the main source of greenhouse gas emissions. At the same time, Kazakhstan is actively implementing energy efficiency measures, including modernization programs in the housing, industrial, and transport sectors, aimed at reducing energy losses and promoting a low-carbon growth model (AIFC & GIP, 2024, pp. 10–12). Xenarios et al. (2024) emphasize that Kazakhstan's renewable energy potential remains vast, with wind at 1.8 trillion kWh, hydropower at 170 billion kWh, solar at 2.5 billion kWh, and bioenergy at 35 billion kWh per year. Examples of low-carbon technologies include:

- the Zhanatas Wind Farm (100 MW) and the Burnoye Solar and Kapshagay Solar power plants, implemented with EBRD support;
- energy recovery systems in industrial enterprises;

- smart grid and intelligent metering projects in Almaty and Astana;
- heat pump and hybrid system installations in the housing and utilities sector (Xenarios et al., 2024).

Together, these measures reduce $CO_2$ emissions by several million tons annually and lay the foundation for achieving national climate neutrality goals. Abazov et al. (2025) report that over the past two decades, Kazakhstan's energy intensity of GDP has fallen by 43%, while transport sector emissions declined by an average of 1.9% per year, four times faster than the global rate. However, emissions have risen in construction (+737% in value added, with –19% energy intensity) and industry (+188% in value added, with –64% energy intensity), indicating the need for structural reforms in these sectors.

According to Xenarios et al. (2024), the main barriers remain low profitability of RES projects, a shortage of qualified specialists, and insufficient public awareness of the benefits of clean energy. The ADB (2023) document stresses that successful RES expansion requires policy coordination between state authorities, the private sector, and international partners. The Bank aims to facilitate investment opportunities in renewables to accelerate Kazakhstan's energy transition.

While earlier ADB documents referred to RES accounting for around 3% of installed capacity (as of 2020), more recent official statistics indicate substantial progress. According to the Ministry of Energy of the Republic of Kazakhstan, the share of electricity generated from renewable energy sources reached 6.43% in 2024 (7.6 billion kWh). Special attention is given to projects in solar, wind, and small hydropower, as well as to training and workforce development programs for the energy transition. Zhakiyev et al. (2024) estimated that investments in energy efficiency and renewable technologies were expected to reach KZT 6.08 trillion by 2025, and in the most optimistic scenario, where the share of RES rises to 30%, up to KZT 31.8 trillion. In this scenario, investment as a share of GDP rises to 39%, and real GDP grows at an average annual rate of 4.3%. Household incomes are projected to rise by 42–52%, demonstrating the compatibility of economic growth and decarbonization under strong carbon policies. These measures aim to develop the domestic technology market and enhance the competitiveness of Kazakhstan's energy sector (ADB, 2023).

## III.3.2 Prospects for international and regional cooperation

Kazakhstan's energy transition extends beyond the national level, as the country actively participates in international and regional initiatives to develop low-carbon energy, promote technology exchange, and strengthen investment cooperation.

According to Yuzbashiyeva et al. (2025), Kazakhstan and Türkiye are the leading members of the Organization of Turkic States (OTS) in terms of green GDP potential and energy innovation capacity. The two countries are implementing joint projects in solar and wind energy, smart energy management systems, and energy-efficient construction. Kazakhstan positions the AIFC as a potential regional platform for replicating green finance standards and practices across OTS countries. Abazov et al. (2025) emphasize that Kazakhstan is actively engaged in regional and global climate initiatives, including the Central Asian Regional Economic Cooperation (CAREC), the Central Asian Water and Energy Program (CAWEP), and the Carbon Pricing Dialogue (REdiCAP). These initiatives facilitate coordination of energy and water projects and promote the development of carbon pricing mechanisms in Central Asia. Under the EU–Central Asia WECOOP program, Kazakhstan is advancing harmonization of environmental standards with the European Green Deal and expanding participation in sustainable finance projects.

Quliyev (2025) highlights Kazakhstan's potential to lead the green transition of the Turkic states. Within the framework of regional integration, the ADB supports Kazakhstan in implementing cross-border projects under the CAREC Energy Strategy 2030. The strategy notes that the Bank promotes the development of clean energy and electricity trade among Central Asian countries while financing low-carbon transport and modernizing power infrastructure. Priority areas include the deployment of electric vehicle charging networks and the renewal of public transport fleets, which are expected to reduce the urban carbon footprint. These directions form the basis for Kazakhstan's integration into regional energy and climate cooperation frameworks (ADB, 2023).

Kazakhstan participates in several international programs, including the Green Investment Principles (GIP) for the Belt and Road Initiative and the CAREC Energy Strategy 2030, both focused on developing cross-border grids and

clean energy investment (AIFC & GIP, 2024; ADB, 2023). The country also cooperates with European partners through the Energy Charter Treaty and the Partnership for Green Growth and the Global Goals 2030 (P4G).

According to Xenarios et al. (2024), Kazakhstan requires more advanced regulatory and infrastructural conditions to accelerate renewable energy innovation. In this context, the country can leverage international knowledge-sharing platforms such as CAREC, regional climate dialogues, and carbon pricing initiatives to promote RES development. For example, Kazakhstan's participation in the Eurasian Renewable Energy Cooperation Network supports the introduction of hybrid energy systems, energy storage technologies, and digital modeling of power generation. Daniya and Tang (2024) note that international financing from the EBRD, ADB, and GCF has played a decisive role in driving structural reforms in Kazakhstan's energy sector. Their analysis shows that regional Green Economy Policy (GEP) pilot programs reduced industrial carbon intensity by an average of 7.88% between 2014 and 2022, with the greatest impact in the country's eastern and southern regions.

According to AIFC & GIP (2024), the AIFC Green Finance Centre (GFC) is expanding cooperation with the EBRD, ADB, and GCF to develop joint renewable energy financing programs across Central Asia and OTS countries. Abazov et al. (2025) report that in 2023, Kazakhstan received $148.7 million from the Green Climate Fund (GCF), while total inflows to Central Asia amounted to around $500 million. This demonstrates Kazakhstan's active role in mobilizing international investment for climate adaptation and mitigation. The country also views the sharing of technological solutions and investment models with regional partners as part of its longer-term regional cooperation strategy.

Regional energy projects may allow Kazakhstan to play a larger role in cross-border trade in green electricity. Under the CAREC 2030 initiative, the possibility of establishing a regional electricity market is being explored, enabling Kazakhstan to export surplus wind and solar power to Uzbekistan and Kyrgyzstan. According to the CAREC Energy Strategy 2030 and ADB (2023), such integration projects not only enhance the region's energy security but also accelerate the decarbonization of Central Asian economies.

## Concluding remarks

Kazakhstan's green transformation has evolved from a declarative environmental agenda into a structurally embedded development paradigm that links climate policy, financial architecture, and energy modernization into a single strategic framework. The evidence presented in this chapter indicates that the country is not merely adapting to global decarbonization pressures but is actively constructing the institutional and market foundations required for long-term structural change.

First, the transition is increasingly defined by systemic coherence. Strategic planning instruments, carbon regulation, sectoral modernization programs, and sustainable finance mechanisms are no longer operating in isolation but are gradually converging into an integrated governance model. This institutional consolidation reduces policy fragmentation and enhances predictability for investors, thereby lowering transition risks. In comparative regional terms, Kazakhstan demonstrates a relatively high degree of regulatory readiness and administrative capacity, which strengthens its ability to translate international commitments into operational instruments.

Second, the development of sustainable finance represents a qualitative shift in the country's economic model. The emergence of a domestic green bond market, the institutionalization of ESG standards, and the integration of international climate finance into market-based instruments collectively signal a movement from grant-dependent mechanisms toward a capital-market-driven model of decarbonization. This shift is economically significant; it transforms climate action from a fiscal burden into a channel for financial innovation, private capital mobilization, and diversification of funding sources. The growing interaction between domestic platforms and multilateral development banks further enhances catalytic leverage, creating multiplier effects that extend beyond individual projects.

Third, the energy transition is gradually redefining Kazakhstan's growth trajectory. Although the energy system remains carbon-intensive, measurable progress in renewable deployment, grid modernization, and efficiency improvements indicates that structural inertia is being addressed.

Importantly, macroeconomic modeling suggests that decarbonization and economic expansion are not mutually exclusive under appropriate policy

design. Investments in renewable generation, digital energy systems, and green infrastructure can generate productivity gains, stimulate technological upgrading, and reduce long-term exposure to commodity volatility. In this sense, the green transition serves not only environmental objectives but also macroeconomic stabilization and competitiveness goals.

At the regional level, Kazakhstan's evolving financial and regulatory infrastructure could support broader cooperation on sustainable investment flows in Central Asia and neighboring economies. Its institutional maturity, emissions trading experience, and capital-market infrastructure provide a foundation for cross-border cooperation in renewable energy trade, carbon pricing dialogue, and sustainable finance standardization. If managed effectively, this could support scale economies, risk sharing, and more harmonized regulatory practices.

Nevertheless, the transition remains incomplete and structurally constrained by the continued dominance of extractive industries in export revenues and fiscal income. This dependence introduces macroeconomic vulnerability and underscores the importance of accelerating diversification through innovation-intensive and low-carbon sectors. The long-term success of Kazakhstan's green economy strategy will therefore depend on maintaining policy consistency, strengthening innovation incentives, expanding private-sector participation, and ensuring that social and regional adaptation mechanisms accompany technological change.

In sum, Kazakhstan's green transition should be understood not as a sectoral reform but as a multidimensional restructuring of economic governance. Its effectiveness will ultimately be measured by the degree to which environmental objectives, financial modernization, and industrial transformation reinforce one another. The country has established the essential pillars of such a model; the next stage will require deepening their interaction to secure resilience, competitiveness, and carbon neutrality in an increasingly climate-constrained global economy.

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CHAPTER IV

# Kyrgyz Republic: Economic Performance and Green Transition

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Since 2022, the Kyrgyz Republic has consistently recorded high economic growth rates. The country's GDP grew by approximately 9% in 2022 and 9% in 2023, then accelerated to 11.5% in 2024 and remained high at around 10% in January-November 2025. These indicators confirm a distinctive feature of the current period: the economy has been expanding and maintaining a high growth rate for several consecutive years.

This overview summarizes the preliminary results of the Kyrgyz Republic's socioeconomic development for January-November 2025, analyzes the key macroeconomic trends, and assesses the factors shaping the medium-term development outlook in the context of regional integration.

Unless otherwise noted, this chapter relies on preliminary data for January-November 2025, while trade and wage indicators are reported for January-October 2025 where those are the latest available official data.

## IV.1 Macroeconomic growth and domestic drivers

In recent years, strong economic growth has been driven by a combination of domestic and external factors. In 2025, economic performance was shaped by the economy's adaptation to new external conditions, including changes in the trade and logistics environment, as well as by measures implemented by the Cabinet of Ministers of the Kyrgyz Republic to stimulate investment, develop infrastructure, and sustain domestic demand. In particular, the Cabinet of Ministers' measures to accelerate infrastructure modernization, improve the investment climate, and support business became a key driver of growth.

According to the National Statistical Committee of the Kyrgyz Republic, real GDP growth for January-November 2025 was around 10%. GDP reached KGS 1.6 trillion (approximately $18.6 billion), a historic record. Thus, the economy maintained the strong momentum it had already built up. This performance was driven by simultaneous growth in investment, expanding domestic consumption, and increased activity in key sectors.

Rising investment activity has become a major driver of development. Investment in fixed capital increased by 18.1% over the first 11 months of 2025, reaching KGS 283.2 billion, compared with the same period a year earlier. Growth in investment was supported by both domestic sources (+18.2%) and a significant inflow of foreign direct investment (+17.5%), indicating sustained investor interest in the country. The main share of capital investment, more than 80%, was directed toward the construction of transport, energy, industrial, educational, and housing facilities.

The construction sector recorded the highest growth rates, with output rising 29% year-on-year in January-November. This was linked to the implementation of infrastructure and energy projects, as well as active housing construction. Strong construction growth contributed about 2.1 percentage points to overall GDP growth, and the sector's share of the economy reached 8.6%.

Industrial production also made a significant contribution in 2025. Output of industrial goods increased by about 10% over the 11-month period. Particularly strong growth was recorded in non-extractive manufacturing industries such as pharmaceuticals, building materials, and food production, pointing to the gradual diversification of industry.

At the same time, mineral extraction increased amid favorable price conditions. The services sector, which accounted for nearly half of GDP (49.3% in the first 11 months of 2025), expanded amid rising domestic demand and higher household incomes.

The expansion of trade and transport and logistics services, with wholesale and retail trade increasing by 9.5% over the period under review, as well as growth in tourism and the hotel and restaurant business, with hotel and restaurant services rising by 15.6%, helped sustain overall economic activity.

Inflation in the Kyrgyz Republic in January-November 2025 amounted to 8.3% on a cumulative basis since the beginning of the year. Price pressures were driven primarily by higher food and fuel prices. Prices for food products and non-alcoholic beverages increased by 8.9% over the 11-month period, while tariffs for services provided to the population rose by 9.1%.

A separate factor was the increase in fuel and lubricant costs. For example, gasoline prices have risen by more than 12% since the beginning of the year, intensifying inflationary pressure.

Monetary policy was aimed at containing these processes. The National Bank of the Kyrgyz Republic kept its policy rate at an elevated level, conducted interventions in the foreign exchange market, and introduced other anti-inflationary measures. As a result, although price factors affected macroeconomic stability and real household incomes, their impact was partially offset by the policies pursued.

The average monthly nominal wage per employee, excluding small enterprises, amounted to KGS 42,919 in January-October 2025, up 19.2% from the corresponding period in 2024. Real wages, adjusted for the consumer price index, rose by 10.4%.

An increase in the growth rate of the average monthly nominal accrued wage in January-October 2025 compared with January-October 2024 was observed across enterprises and organizations in all types of economic activity.

The most significant increases were recorded in real estate activities (33.9%), construction (32.4%), professional, scientific, and technical activities (29.8%), administrative and support service activities (29.6%), public administration and defense, including compulsory social security (29.1%), human health and social work activities (24.5%), electricity, gas, steam, and air conditioning supply (22.5%), accommodation and food service activities (22.1%), other service activities (20.7%), as well as transportation and storage (18.0%).

## IV.2 External trade and regional economic integration

The Kyrgyz Republic's external trade turnover in January-October 2025 amounted to $12.8 billion and declined by 10.6% compared with the

corresponding period of 2024. In the structure of trade turnover, exports accounted for 18.8% and imports for 81.2%.

The decline in the Kyrgyz Republic's external trade in January-October 2025, compared with the corresponding period of 2024, was driven primarily by the sharp fall in exports, while imports remained broadly unchanged.

The Kyrgyz Republic's exports fell by 38.2%, amounting to $2.4 billion. Exports excluding gold declined by 21.7% and totaled $1.7 billion.

Imports into the Kyrgyz Republic stood at $10.4 billion and decreased by 0.3% compared with the corresponding period of 2024. The decline in imports was linked to reduced shipments of a broad range of goods from third countries, including automobiles, equipment, and mechanical devices.

The Kyrgyz Republic's mutual trade with the Eurasian Economic Union (EAEU) member states in January-October 2025 amounted to $4.5 billion, an increase of 1.1% compared with the corresponding period of 2024. At the same time, exports amounted to $0.9 billion and fell by 36.1%, while imports, by contrast, increased by 19.2%, reaching $3.6 billion.

Trade with third countries (outside the EAEU) amounted to $8.3 billion and declined by 15.9% compared with the corresponding period of 2024.

In the Kyrgyz Republic's total trade turnover, trade with third countries accounted for 64.7%; in exports, 61.3%; and in imports, 65.5%.

## IV.3 Structural reforms, infrastructure development, and medium-term outlook

A significant contribution to the Kyrgyz Republic's economic performance came from the administrative reform aimed at reducing bureaucracy in public administration. It included the digitalization of public services, the simplification of permit procedures, the reduction of the regulatory burden on businesses, and the introduction of risk-based supervision. In 2025, these measures were also adopted in the implementation of Presidential Decree No. 83 of the Kyrgyz Republic, dated 10 March 2025, "On Additional Measures to Improve the Efficiency and Debureaucratization of the Civil Service System of the Kyrgyz Republic." These measures not only improved the business climate

but also established the regulatory basis for the systemic transformation of state regulation under the Presidential Decree of the Kyrgyz Republic, dated 30 December 2025, "On the Further Implementation of Reforms Aimed at Improving the Efficiency and Debureaucratization of the Public Administration System of the Kyrgyz Republic."

For example, the number of statistical reporting forms required from enterprises was reduced by nearly half, from 246 to 119, directly lowering the bureaucratic burden. Such changes improve administrative efficiency and strengthen business confidence, which in turn supports economic activity.

The digitalization of public services made interactions between businesses and government agencies simpler and faster. An increasing number of permits can now be obtained online through the "Tunduk" portal, and reporting can be submitted electronically. The transition to electronic permitting and reporting procedures, along with regulatory revisions, has eliminated many unnecessary requirements. For instance, as noted above, the volume of statistical reporting required from enterprises was reduced by nearly half. In addition, steps are being taken to optimize licensing, and an audit of existing licenses and permits is underway to eliminate those that are duplicative or outdated.

In the oversight area, a risk-based approach is being introduced, with supervisory authorities moving away from blanket inspections toward selective inspections based on risk assessments of potential violations. This has reduced the number of unjustified inspections of businesses, saving entrepreneurs both time and resources.

By late 2025, the overwhelming majority of large businesses had switched to electronic invoices, which increased transparency in business transactions and broadened the tax base by bringing part of the economy out of the shadow economy. Tax revenues grew faster than GDP, suggesting the impact of measures to combat tax evasion. Overall, the administrative reform improved the conditions for doing business: administrative costs declined, with less time and money spent on approvals and reporting; entrepreneurs' rights were better protected; and launching new projects became easier.

In seeking to realize its transit potential, the Kyrgyz Republic is promoting major infrastructure projects. These include the development of international

transport corridors, the modernization of road and energy infrastructure, and the creation of "digital corridors" for data exchange. Particular note should be made of the strategic China-Kyrgyzstan-Uzbekistan railway project, which is regarded as a key element in expanding regional connectivity. The implementation of these initiatives helps reduce transport costs, enhance the country's investment attractiveness, and deepen economic cooperation. In particular, improvements in the transport network and logistics are strengthening the Kyrgyz Republic's role as a transit hub in Eurasia, linking the markets of China, Central Asia, and the EAEU member states. This reinforces the country's position in regional integration frameworks, including cooperation within the Organization of Turkic States.

## IV.4 Green economy transition of the Kyrgyz Republic

Alongside structural reforms, infrastructure development, and efforts to strengthen regional connectivity, the Kyrgyz Republic is also advancing its transition to a green economy. This transition is increasingly seen as an important part of sustainable economic growth and of progress toward the Sustainable Development Goals. Sustainable development remains one of the country's main priorities and will be pursued through concrete green economy measures and policy actions.

Therefore, in order to establish a common understanding and definition of green technologies, projects, goods, and services, and to create a favorable environment for attracting green and climate investments, including strengthening the position of the Kyrgyz Republic in the international sustainable finance market, the Resolution No. 246 of the Cabinet of Ministers of the Kyrgyz Republic "On Approval of the Pilot National Classifier, the Green Taxonomy of the Kyrgyz Republic" was adopted on 30 April 2025.

The Kyrgyz Republic, possessing a unique natural heritage and facing high environmental risks, is steadily moving along the path of sustainable development, while addressing the challenges and opportunities associated with the transition to a green economy. In this connection, the Green Economy Development Programme until 2029 was adopted and approved by Resolution No. 544 of the Cabinet of Ministers of the Kyrgyz Republic dated 1 September 2025.

In the Kyrgyz Republic, the understanding of the green economy in the national context is defined as a modern economic model of sustainable development operating at both the macro and micro levels, including the following key dimensions: the transition of the economy to energy-saving and energy-efficient technologies; measures aimed at improving public welfare and strengthening social justice; reducing environmental risks; preserving the country's natural capital and natural ecosystems; and the efficient use of resources.

In a green economy, income growth and employment are ensured through public and private interventions aimed at reducing carbon emissions and pollution, creating green jobs accessible to both women and men, creating a favorable environment for the life and health of the population, and increasing the efficiency of the use of energy, resources, and ecosystem services.

## Concluding remarks

As of the first 11 months of 2025, the Kyrgyz economy has sustained the strong growth momentum achieved in previous years. Its main achievements include maintaining double-digit economic growth despite external challenges, attracting significant domestic and foreign investment, and implementing major infrastructure projects. The economy demonstrated its ability to adapt; businesses succeeded in reconfiguring logistics and sales markets; and the state ensured conditions conducive to the development of key sectors. Construction, industry, and domestic trade all recorded strong growth, resulting in a record GDP level.

Thanks to the measures introduced by the Cabinet of Ministers of the Kyrgyz Republic, the business climate improved, while reduced bureaucracy and the digitalization of services made it easier for businesses to operate. At the same time, the country also strengthened the policy framework for its green economy transition, including the adoption of the Green Taxonomy and the Green Economy Development Programme until 2029.

CHAPTER V

# Türkiye's Green Transition: Policy Framework, Sectoral Transformation, and Strategic Priorities


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## Introduction

As one of the main challenges of our time, climate change is increasingly threatening economies and ecosystems, requiring a global response. In recent years, climate change and sustainability have been among the main pillars of policymaking, and almost all actors in the global economy have adopted the goal of achieving sustainable economic growth.

Historically, Türkiye's contribution to global GHG emissions has been less than 1%, and its per capita emissions are lower than those in OECD or EU countries. Due to its geographical location and climatic conditions, Türkiye is among the countries with high vulnerability to the impacts of climate change. As a part of the global efforts to combat and adapt to climate change, Türkiye has made ambitious climate change commitments, ratified the Paris Agreement, announced a 2053 net zero emissions target, adopted the country's first Climate Law, and incorporated green and digital transition as the main pillar of its 12$^{th}$ Development Plan (Presidency of the Republic of Türkiye, 2025).

Climate Law No. 7552 (Resmi Gazete, 2025) is a pivotal landmark in establishing the legal framework for national climate change policies and strategies in support of the transition to a low-carbon economy and its climate change mitigation and adaptation efforts. The law aims to combat climate change in line with the green growth vision and net-zero target. One

of its main milestones is the planned establishment of an Emissions Trading System (ETS), which is expected to be operated by the Energy Exchange Istanbul (EXIST). In addition, the development of a National Green Taxonomy is currently underway.

Türkiye adopted an inclusive and equitable green transition vision aligned with its sustainable development objectives. This vision emphasizes simultaneous progress in economic growth, environmental sustainability, climate resilience, and social well-being, while strengthening energy security, ensuring access to affordable energy, and enhancing climate resilience.

In line with its commitment to global climate action, Türkiye is actively pursuing the 2053 net-zero emissions target, as announced by H.E. Recep Tayyip Erdoğan, President of Türkiye, in September 2021. Green transition efforts have accelerated, particularly in the energy sector, with decarbonization policies focusing on expanding renewable energy capacity, improving energy efficiency, developing nuclear energy, utilizing natural gas as a transition fuel, and advancing innovative technologies such as hydrogen, battery storage, and carbon capture, utilization, and storage (CCUS). Furthermore, investments in critical minerals and rare earth elements have been prioritized to support the energy transition and diversify resources, making clean energy policies a matter of strategic importance.

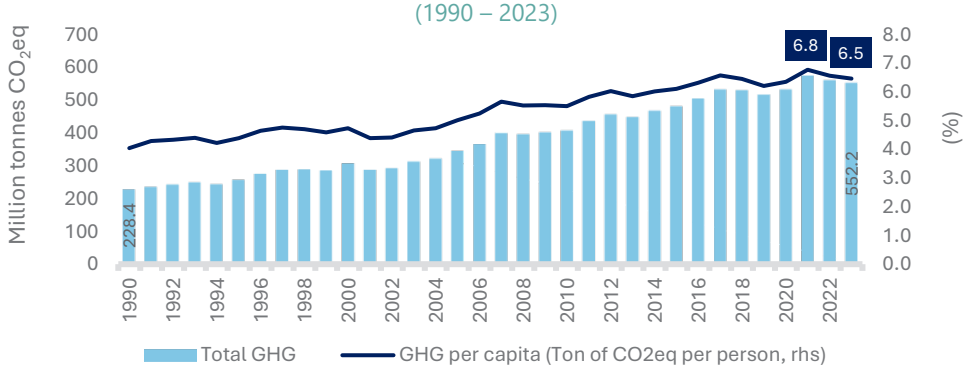
The green transition requires technological, financial, and workforce transformations across all sectors—including electricity, industry, transportation, buildings, agriculture, and waste. In this context, Türkiye aims to accelerate renewable energy investments, improve grid flexibility, scale up solutions like energy storage and alternative fuels (e.g., hydrogen), expand circular economy and resource efficiency practices in industry, support electrification and sustainable fuels in transportation, and promote low-carbon technologies in buildings, such as energy efficiency measures and heat pumps. The social aspect of the transition is addressed through employment and skills policies, ensuring a just and inclusive labor-market transformation that accounts for regional disparities.

## V.1 Greenhouse gas emissions in Türkiye and climate targets

Historically, Türkiye's contribution to global GHG emissions is less than 1%. In 2023, annual per capita GHG emissions were down to 6.5 tonnes of $CO_2$

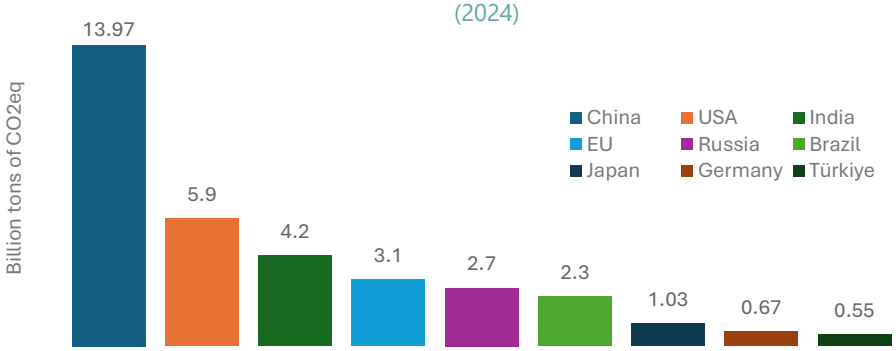
equivalent from a peak of 6.8 two years ago (Figure V.1). According to the 2023 National Greenhouse Gas Inventory, Türkiye's total greenhouse gas emissions amounted to 552.2 Mt $CO_2$eq, reflecting a 1.4% decrease compared to the previous year. With total emissions of 552.2 Mt $CO_2$eq in 2023, Türkiye ranks 15th globally in GHG emissions. China leads globally with 13.9 Gt $CO_2$eq, while the 27 EU Member States collectively emit 3.10 Gt $CO_2$eq. Within the EU, Germany has the highest emissions, reaching 670 Mt $CO_2$eq (Figure V.2).

FIGURE V.1: TÜRKİYE'S GREENHOUSE GAS EMISSIONS
(1990 – 2023)




Source: TÜİK (2025)

FIGURE V.2: GREENHOUSE EMISSIONS RELEASED BY COUNTRIES
(2024)



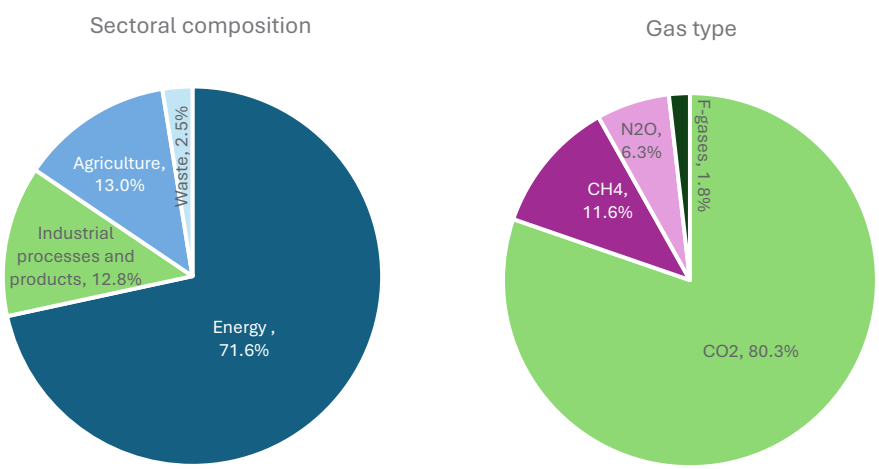

Source: Crippa, M. et al. (2025).

In 2023, energy-related emissions accounted for the largest share of total GHG emissions, representing 71.6% of total CO2-equivalent emissions. Agriculture (13%), industrial processes and product use (12.8%), and waste (2.5%) are respectively other major sources of GHG emissions in Türkiye.

Energy sector emissions reached 395.4 Mt $CO_2$eq in 2023. Within the energy sector, the energy industries sub-sector accounted for the largest share (39%), followed by transport (25.1%) and other fuel combustion activities (18.4%). Emissions from electricity and heat generation, calculated under the responsibility of the Ministry of Energy and Natural Resources, amounted to 143.7 Mt $CO_2$eq, representing 26% of Türkiye's total emissions.

In 2023, the majority of GHG emissions consisted of carbon dioxide (CO2), which accounted for 80,3% of total emissions, while methane (CH4), Nitrous Oxide (N2O), and F-gases contributed 11,6%, 6,3%, and 1,8%, respectively. A vast majority of 86,2% CO2 comes from the energy sector (Figure V.3).

FIGURE V.3: TÜRKİYE'S GREENHOUSE GAS EMISSIONS BY SECTOR AND TYPE
(2023, PERCENT)




Source: TÜİK (2025).

Türkiye has adopted a net-zero emissions target for 2053, fully aligned with global climate objectives under the Paris Agreement. This target is pursued through sector-specific mitigation policies that promote a low-carbon transformation.

Türkiye's Updated First Nationally Determined Contribution (NDC) was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat in 2023. Through this update, Türkiye raised its 2030 greenhouse gas emissions reduction target from 21% to 41% compared to the business-as-usual (BAU) scenario. In line with its climate targets, Türkiye has developed the Climate Change Mitigation Strategy and Action Plan

(2024–2030) and the Climate Change Adaptation Strategy and Action Plan (2024–2030), which are key policy documents in mitigation and adaptation efforts MEUCC, 2024a). In pursuit of its long-term low-emission development targets, Türkiye announced the Long-Term Climate Strategy (LTS) at COP 29 in Baku, Azerbaijan, in 2024, which provides a comprehensive roadmap for achieving net-zero emissions by 2053 (MEUCC, 2024b).

On the other hand, under the Paris Agreement, Parties are expected to update their NDCs every five years. As part of its continued efforts in combating climate change, Türkiye submitted its Second NDC (NDC 3.0) to the UNFCCC Secretariat in November 2025. In light of recent economic and technological developments and sectoral transformations in Türkiye, the BAU Scenario used in the INDC and the Updated First NDC have been updated to provide a more contemporary projection, replacing the previous version, which was based on 2012 data, with a new base year of 2018 data. In its Updated First NDC, Türkiye had presented a 2030 target of 695 Mt $CO_2$eq GHG emissions, corresponding to a 41% reduction from the BAU level of 1,175 Mt $CO_2$eq GHG emissions, including LULUCF. Under the new mitigation scenario, GHG emissions are projected to decrease by 466 Mt $CO_2$eq from the BAU level of 1,109 Mt $CO_2$eq, reducing total emissions to 643 Mt $CO_2$eq in 2035. The new target has been established through a rigorous, science-based process, guided by Türkiye's long-term strategies aligned with its 2053 net-zero ambition, and informed by the outcomes of the First Global Stocktake (GST) to significantly contribute to global efforts.

## V.2 Türkiye's environmental and climate perspective in the international arena and climate diplomacy

Türkiye has become an active participant in the international climate regime, guided by the principle of common but differentiated responsibilities in combating global climate change. Following its accession to the UNFCCC, Türkiye has adopted a balanced approach in climate negotiations, simultaneously safeguarding its sustainable development priorities while aligning with global climate objectives.

The ratification of the Paris Agreement in October 2021 marked a significant milestone in Türkiye's climate diplomacy. This step has reinforced the country's engagement in global climate action, in line with its 2053 net-zero emissions vision and national green transition policies.

Moreover, Türkiye's international engagement extends beyond mitigation targets. It focuses on strengthening cooperation in the green economy, renewable energy, energy efficiency, clean technology investments, and carbon markets, while developing strategies consistent with the global sustainability agenda.

Türkiye also plays a proactive role in the negotiations of the Conference of the Parties (COP) to the UNFCCC, pursuing a comprehensive and collaborative approach in climate diplomacy. Within the COP process, the country contributes to multilateral cooperation in key areas such as climate finance, technology transfer, capacity-building, and just transition.

By adopting a balanced, inclusive, and cooperative approach to climate diplomacy, Türkiye aims to contribute to global climate goals while protecting its own development priorities and policy space. This has positioned the country as an active player in global climate governance and shaped its vision toward achieving net-zero emissions by 2053. On the other hand, since its accession to the UNFCCC and the ratification of the Paris Agreement, Türkiye has committed to the principle of common but differentiated responsibilities. Within this framework, Türkiye continues to strengthen its role as a reliable actor in the international climate regime and as an active participant in the regional green transition.

Türkiye has the opportunity to strengthen its international position in global efforts to combat climate change by taking a more active role in implementing the UNFCCC, the Paris Agreement, and other international platforms. Global cooperation is crucial to accelerate the implementation of the Paris Agreement. This diplomatic positioning is reinforced by Türkiye's updated commitments under the UNFCCC framework. To this end, Türkiye has finalized its Second NDC and submitted it to the UNFCCC Secretariat in November 2025.

Due to its geographical location, economic structure, and climate diversity, Türkiye positions itself as a bridge between developed and developing countries in climate discussions. Türkiye is one of the countries that leverages the driving force of green development and the efficient use of renewable energy resources for sustainable development.

Türkiye plays an active role in global climate diplomacy. To that end, Türkiye will host the 31st United Nations Climate Change Conference (COP31) in

Antalya in 2026. As a major industrial nation and raw materials producer, Türkiye is determined to mobilize and advance global efforts to combat climate change by contributing to dialogue across different country groups while promoting fairness, inclusiveness, and transparency.

## V.3 Climate-related risks and opportunities in Türkiye

Türkiye faces increasingly complex climate-related risks, including desertification, drought, biodiversity loss, and a rising frequency of extreme weather events such as floods and wildfires, leading to substantial economic and ecological losses. These risks have systemic implications for the country's energy systems and require enhanced resilience measures across all infrastructure. Declining water levels in hydropower reservoirs reduce generation capacity and pose significant challenges to energy supply security during prolonged droughts. Extreme temperatures result in efficiency losses and operational disruptions in electricity transmission lines, while sudden storms and flooding events damage grid infrastructure, causing prolonged power outages. Moreover, wildfires threaten transmission corridors and substations, while sea-level rise and storm surges jeopardize natural gas terminals, oil refineries, petrochemical facilities, and storage infrastructure in coastal regions. Similarly, offshore wind farms and other coastal-based clean energy facilities remain increasingly exposed to climate-induced hazards.

In Türkiye, several climate-related challenges stand out that directly affect industrial development and competitiveness. The country's high dependence on fossil fuels for electricity generation makes the energy sector the largest source of greenhouse gas emissions. In addition, the industrial structure remains highly carbon-intensive, particularly in sectors such as cement, iron and steel, and chemicals, which collectively account for substantial national emissions. Many industrial sub-sectors also exhibit low levels of energy efficiency, leading to higher production costs and increased environmental pressures. Furthermore, Türkiye's foreign trade is increasingly influenced by global climate policies. The European Union, Türkiye's largest export destination, has introduced the Carbon Border Adjustment Mechanism (CBAM), which initially covers carbon-intensive products such as cement, iron and steel, aluminum, fertilizers, and electricity. As these sectors account for a significant share of Türkiye's manufacturing exports, failure to reduce emissions would result in carbon-related charges and a potential loss of competitiveness in this most strategic market.

At the same time, there are significant opportunities. The CBAM would serve as a catalyst for Türkiye to accelerate its transition toward a low-carbon economy. By developing a domestic carbon pricing system, Türkiye aims to mitigate the regressive effects of CBAM while aligning its industrial policies with the EU's climate agenda. The planned introduction of an Emissions Trading System (ETS), expansion of renewable energy, and green financing tools such as sustainable bonds and credits will accelerate the transition. In addition, the alignment with the European Green Deal offers Turkish industry a chance to modernize production, increase competitiveness, and attract new investment.

At the same time, climate-resilient and low-carbon development pathways present significant opportunities for Türkiye when aligned with its sustainable development objectives. Accelerating renewable energy deployment strengthens energy security, reduces import dependency, and supports economic diversification. Scaling up energy efficiency measures delivers cost savings, enhances industrial competitiveness, and contributes to the country's broader mitigation targets. The development and deployment of clean energy technologies foster innovation ecosystems, promote technology transfer, expand domestic R&D capacity, and create green jobs. Furthermore, the development of green finance instruments and carbon pricing mechanisms, including preparatory work for a domestic Emissions Trading System (ETS), is expected to support private-sector investment flows and the energy transition in line with Türkiye's 2053 net-zero vision )catalyzes private-sector investment flows and accelerates the energy transition in line with Türkiye's 2053 net-zero vision.

Türkiye is expanding its low-carbon generation portfolio through large-scale renewable energy projects, while making targeted investments to strengthen the resilience of electricity transmission and distribution networks. Efforts are also underway to diversify natural gas storage facilities to enhance supply security, climate-proof critical energy infrastructure, and advance geothermal and hydrogen deployment as part of an integrated clean energy innovation agenda. Moreover, initiatives are being implemented to modernize energy generation technologies and develop domestically manufactured equipment, ensuring that industrial competitiveness is maintained throughout the transition process.

Under the leadership of the Ministry of Energy and Natural Resources, the Renewable Energy Resource Area (YEKA) program is accelerating the large-

scale integration of solar and wind capacity, facilitating the decarbonization of Türkiye's power sector. In parallel, Türkiye promotes regional energy cooperation, including cross-border interconnection development, joint R&D initiatives on clean energy technologies, and coordinated positions in international climate diplomacy.

The twenty-first century has underscored the urgency of aligning economic growth with sustainable practices, making digitalization and green transformation central not only to climate goals but also to preserving competitiveness in global value chains, given the increasing demand for green technologies and consumer preferences for green products. Green transition in this regard is poised to generate new markets, jobs, and investment opportunities, while also fostering broader socio-economic benefits.

## V.4 Türkiye's climate policy framework and green economic transition perspective

Türkiye's climate policy approach is shaped at the intersection of developments in the global climate regime, national development priorities, and its sustainability vision. The country's initial steps in combating climate change were taken in 2004 with its accession to the UNFCCC. This milestone strengthened Türkiye's position in the global climate agenda and laid the foundation for the redesign of national policies in line with international responsibilities.

The adoption of the Paris Agreement in 2015 and Türkiye's ratification in 2021 marked the beginning of a new era in national climate policy. The Paris Agreement is based on the principle of common but differentiated responsibilities and respective capabilities (CBDR-RC), ensuring an inclusive climate regime for both developed and developing countries.

Türkiye's policies on combating climate change and transitioning to a green economy are embedded in a strategic framework through development plans and medium-term programs. In this context, the 12$^{th}$ Development Plan (2024–2028) serves as the primary document guiding national policies, placing sustainable development and a vision of low-carbon growth at its core. The Plan provides a roadmap that integrates Türkiye's economic growth

objectives with environmental sustainability, energy security, and green transformation strategies.

The 12th Development Plan positions climate change mitigation and green transition as central pillars of economic, social, and technological development. Its key priorities include reducing carbon intensity in energy production and consumption, expanding renewable energy capacity, implementing the hydrogen strategy, advancing nuclear energy investments, and strengthening energy efficiency policies. Furthermore, the Plan foresees strategic steps in areas such as the circular economy, resource efficiency, green finance, critical minerals, and clean energy technologies, with the aim of enhancing Türkiye's competitive position in the global green transition process.

These objectives are translated into concrete implementation tools through the Medium-Term Program (MTP). MTP integrates climate change mitigation and green transition targets with macroeconomic policies, budgetary priorities, and investment planning. Within this framework, steps are envisaged to strengthen green finance mechanisms, incentivize energy efficiency investments, expand renewable energy capacity, and foster the development of green technologies. In doing so, the long-term vision outlined in the development plan is reinforced through medium-term economic instruments and implementation strategies.

Furthermore, Türkiye adopted its first Climate Law in 2025, which lays the legal foundation of its climate change mitigation and adaptation policies, as well as green transition and environment-friendly sustainable development efforts.

Türkiye's green transition strategy is not limited to emissions mitigation and climate change mitigation. It incorporates a multidimensional approach that links climate action with energy security, international competitiveness, economic resilience, and social well-being. In practice, the green transition strategy combines sector-specific measures with cross-cutting tools such as renewable energy expansion, energy efficiency, industrial modernization, and green finance. Moreover, increasing renewable energy capacity, implementing the national hydrogen strategy, expanding nuclear energy investments, mainstreaming energy efficiency practices, and deploying carbon capture, utilization, and storage (CCUS) technologies constitute the core elements of the green transition vision. Strengthening capacities in

critical minerals, battery technologies, electric vehicle production, and recycling infrastructure is also part of Türkiye's strategic green transition.

### V.4.1 Türkiye's Climate Law

The Climate Law, which constitutes a significant milestone in Türkiye's climate change mitigation policies, entered into force on 9 July 2025. This law provides a fundamental legal framework that supports the country's low-carbon development vision in line with its 2053 net-zero emissions target.

Within the scope of the Law, a critical step has been taken toward implementing carbon pricing and market-based mechanisms. The infrastructure for the National Emissions Trading System (ETS) has been established under the Energy Markets Operation Company (EPİAŞ), and following the enactment of the Law, preparations have commenced for the system's gradual implementation. The ETS will introduce a cap on greenhouse gas emissions and enable companies to trade emission allowances, thereby making a significant contribution to Türkiye's low-carbon development objectives.

In addition, potential avenues for integration between the ETS and the European Union's Carbon Border Adjustment Mechanism (CBAM) are currently under consideration, in order to ensure that Türkiye meets its obligations under CBAM. The operationalization of the ETS will strengthen Türkiye's capacity to manage carbon costs in its export-oriented industrial sectors and support alignment with the EU's green transition policies.

The Climate Law not only establishes ETS but also paves the way for the implementation of comprehensive policies in areas such as investment in green transition technologies, energy efficiency measures, enhancement of carbon sinks, and the promotion of sustainable production and consumption models. In doing so, Türkiye has taken a concrete step toward fulfilling its national and international obligations in line with its 2053 net-zero vision, adopting a market-based, transparent, and inclusive approach in the fight against climate change.

## V.4.2 Green Deal Action Plan and prospective implications of EU CBAM and Green Deal policies for Türkiye

Türkiye's Green Deal Action Plan (2021), prepared under the coordination of the Ministry of Trade, was designed as a comprehensive roadmap to align Türkiye's economy with the European Union's Green Deal while safeguarding competitiveness and ensuring continued integration under the Customs Union. The plan was drafted through an inclusive process involving multiple ministries, public institutions, and private sector stakeholders, reflecting Türkiye's strategic objective of pursuing sustainable, resource-efficient growth. It recognizes the transformative impact of the European Green Deal on trade and industry and underscores the need for Türkiye to anticipate risks, harness opportunities, and adapt its policies to global trends.

The Green Deal Action Plan defines its scope through nine strategic pillars: (1) carbon border adjustments, (2) green and circular economy, (3) green finance, (4) clean, affordable and secure energy supply, (5) sustainable agriculture, (6) sustainable smart mobility, (7) combating climate change, (8) diplomacy, and (9) awareness-raising activities related to the European Green Deal. In total, it sets out 32 objectives and 81 concrete actions, with clear institutional responsibilities and monitoring mechanisms. Each priority area is designed to strengthen Türkiye's regulatory and institutional readiness while supporting innovation, R&D, and investment in green transformation (Ministry of Trade, 2021).

Ultimately, the Action Plan aims to ensure Türkiye's smooth transition to a low-carbon, competitive economy that is deeply integrated into global value chains. By mobilizing green finance, promoting clean technologies, and reinforcing technical legislation harmonization with the EU, the plan seeks to turn the challenges of climate policy adjustments into opportunities for value-added production and trade. The overarching outcome expected is the preservation of Türkiye's export competitiveness, the deepening of its EU integration, and the acceleration of its domestic transformation towards a sustainable and inclusive development model consistent with the United Nations' Sustainable Development Goals and the EU's climate neutrality targets.

Within the framework of the Green Deal Action Plan, particular emphasis is placed on measures to mitigate the potential adverse effects of the EU's

Carbon Border Adjustment Mechanism (CBAM) on Türkiye's exports to the Union. As one of the central policy tools introduced under the European Green Deal to prevent carbon leakage, the CBAM is expected to reshape trade dynamics in the coming period. Given Türkiye's position as one of the major suppliers to the EU, it is anticipated that the country will be among those most significantly affected by this regulatory development.

The Green Deal Action Plan outlines a comprehensive set of measures to reduce the potential adverse impacts of the CBAM on Türkiye's exports. It foresees sector-specific modelling to assess the effects of CBAM on energy- and resource-intensive industries and the preparation of roadmaps to support emission reductions in manufacturing sectors likely to be covered. The plan also includes developing Türkiye's position on carbon pricing by considering EU requirements, evaluating possible support mechanisms to offset additional costs for affected industries, and strengthening systems for monitoring industrial greenhouse gas emissions (Ministry of Trade, 2021). In parallel, certification and reporting practices will be aligned with EU methodologies and standards to ensure compliance and safeguard Türkiye's trade competitiveness.

### V.4.3 Circular Economy

The circular economy is a significant policy area emphasized in the Green Deal Action Plan. Within Türkiye's climate change mitigation objectives, circular economy policies emerge as a complementary dimension of efforts to reduce carbon emissions while fostering sustainable and resource-efficient economic development. The transition to a green and circular economy is of global significance and, for Türkiye, represents a strategic priority aligned with its 2053 net-zero emission target. In this regard, key aspects of circular economy policies, such as reducing the use of natural resources, enhancing resource efficiency throughout product life cycles, strengthening waste management, and promoting reuse, recycling, and the uptake of secondary raw materials, are being closely monitored and actively integrated into national strategies.

The transition to a circular economy is also of critical importance for safeguarding Türkiye's position in international trade and global supply chains. In this context, the European Green Deal has direct implications for the free movement of goods within the Customs Union. Türkiye, therefore,

regards this process as both a roadmap for its green transformation and a decisive factor in shaping trade relations with the EU. Accordingly, Türkiye's alignment with the EU's circular economy framework is also regarded as a strategic necessity for maintaining the competitiveness of its exporting industries and for ensuring the long-term sustainability of trade integration.

In this regard, the priority sectors identified under the EU's Circular Economy Action Plan, as well as the forthcoming sector-specific eco-design requirements under the Eco Design for Sustainable Products Regulation (ESPR), together with related regulatory developments, are among the areas Türkiye is monitoring closely within the circular economy agenda.

In light of these developments, Türkiye has also taken important steps to advance its circular economy agenda. In this context, under the "Green and Circular Economy" chapter of the Green Deal Action Plan, published in 2021, relevant institutions have been carrying out efforts to integrate the circular economy approach into industrial, trade, and environmental policies

In this context, with the aim of promoting the transition to a circular economy that contributes to more efficient resource and waste management nationwide, and of strengthening Türkiye's institutional and technical capacity in line with the European Union's Circular Economy Package, the Ministry of Environment, Urbanization and Climate Change has implemented the "Technical Assistance for Assessment of Türkiye's Potential on Transition to Circular Economy (DEEP) Project" under the Instrument for Pre-Accession Assistance (IPA) Programme. Within the scope of the project, plastics, textiles, food and biomass, electronics and information technologies, batteries and vehicles, construction and buildings, as well as packaging have been identified as priority sectors. As a key output, the project foresees the publication of a comprehensive national strategy and action plan tailored to the country's specific circumstances.

In addition, efforts are also underway to align national legislation with the sector-specific regulations adopted by the European Union. In this context, work is actively being carried out by the relevant institutions to harmonize with a number of key legislative frameworks like the Eco Design for Sustainable Products Regulation (ESPR), the Construction Products Regulation, and the Batteries and Waste Batteries Regulation.

On the other hand, the EU Industrial Emissions Directive, which regulates the reduction of environmental impacts from industrial activities, has significant implications for the continuity of Türkiye's exports to the EU. In fact, in several regulations adopted or in preparation within the EU—such as the Batteries and Waste Batteries Regulation, the Construction Products Regulation, the Sustainable and Circular Textiles Strategy, and the Packaging and Packaging Waste Regulation—explicit references are made to compliance with the Directive and the application of Best Available Techniques (BATs) developed under its framework. Against this background, the incorporation of the Directive into Türkiye's national legislation represents a critical step in ensuring alignment with EU rules and supporting the green transformation of industry. To this end, the By Law on the Management of Industrial Emissions, prepared by the Ministry of Environment, Urbanization and Climate Change, was published in the Official Gazette on 14 January 2025 and will enter into force on 1 December 2025.

The activities listed in the annex of the By-law are required to obtain a Certificate of Industrial Green Transformation. These certificates are granted based on the level of compliance of the activity with the Best Available Techniques (BATs) and the corresponding BAT-Associated Emission Levels (BAT-AELs). The certification system is structured into six categories: A (100 points), B (90–99 points), C (80–89 points), D (70–79 points), E (60–69 points), and F (50–59 points). In determining BATs, the criteria taken into account include the quality and consumption of raw materials used in the processes well as the level of energy efficiency achieved.

Türkiye's transition towards a green and circular economy is not only an environmental imperative but also a strategic necessity for sustaining its trade integration with the EU under the Customs Union. The ongoing harmonization of national legislation with EU regulations, together with capacity-building initiatives and sectoral strategies, demonstrates Türkiye's strong commitment to advancing its green transformation. Moving forward, the effective implementation of these policies will be crucial for strengthening industrial competitiveness, supporting sustainable growth, and consolidating Türkiye's position within global value chains.

### V.4.4 2030 Industry and Technology Strategy

Prepared in line with the vision of the National Technology Initiative, the 2030 Industry and Technology Strategy was published in the Official Gazette on 10 May 2025 under Presidential Circular No. 2025/6. Aiming to position Türkiye among the leading countries in the production and export of high-technology products, the 2030 Industry and Technology Strategy Document sets out 20 macro targets, 5 objectives, 100 strategies, and 37 priority programs and projects (MIT, 2025). The framework of the document has been designed around the goals of transitioning to a digital economy, enabling the green transformation of industry, and ensuring deeper and more competitive integration into the global economy.

The document places sustainability-oriented strategies at the center of the industry's green transformation, with a focus on reducing carbon emissions. To this end, it foresees aligning industrial regulations with the European Green Deal, reducing the carbon footprint of industry, and ensuring compliance with the Carbon Border Adjustment Mechanism. In this direction, support instruments and international financing resources will be diversified and expanded to accelerate the transition to a green and circular economy. Investments will be increased to minimize environmental impacts in Organized Industrial Zones (OIZs) and other planned industrial areas. In addition, the adoption of technologies that enhance energy efficiency in industrial facilities will be supported, and energy management systems will be made mandatory.

The document also acknowledges renewable energy as a cornerstone of green transformation goals. Achieving 100% domestic production capacity in solar energy technologies is highlighted as a key milestone. It foresees the local production of main components of wind turbines, investments in offshore wind power, as well as increased R&D and investment support in technologies such as electrolyzers and fuel cells. Furthermore, nuclear energy investments will be accelerated to ensure industrial facilities benefit from these sources as a priority. In this context, domestic nuclear reactors will be developed, and a Nuclear Technopark will be established to enhance capacity in nuclear technologies.

Water efficiency in industry is addressed as another key dimension of green transformation. Greywater recovery systems and industrial applications that

enable water savings will be promoted, with the aim of reducing water consumption. In particular, in sectors such as chemicals, metals, and textiles, waste management systems will be modernized to support recycling and secondary raw material production. Recognizing that green transformation also entails a societal shift, training and awareness-raising programs will be organized to enhance environmental awareness in industry.

### V.4.5 Türkiye Green Industry Project

The Türkiye Green Industry Project is being implemented by the Ministry of Industry and Technology (MoIT), the Small and Medium Enterprises Development Organization (KOSGEB), and the Scientific and Technological Research Council of Türkiye (TÜBİTAK), with the aim of developing policies and strategies to accelerate green transformation in industry, intensify decarbonization efforts, and enhance environmental sustainability (TÜBİTAK, 2025a). Türkiye Green Industry Project, financed through a World Bank loan, has a total budget of $450 million and a six-year duration.

Within the scope of the project, a wide range of activities are carried out, including promotional and information meetings, training, and field visits. Under the $25 million loan component managed by the Directorate General for Industry of the Ministry of Industry and Technology, activities are conducted to raise awareness of green transformation among organizations, companies, and individuals; facilitate networking with various stakeholders; increase the national visibility of green transformation efforts; and strengthen the technical capacity of the Ministry's staff on green transformation.

Through the $250 million loan allocated to SMEs' green transformation activities, KOSGEB supports industrial enterprises in thematic areas such as renewable energy, resource efficiency, waste management, circular economy, and sustainability.

Meanwhile, with the $175 million loan dedicated to green transformation projects, TÜBİTAK provides support to all companies engaged in green innovation, including the development of new green technologies, products, or processes.

## V.4.6 Türkiye Hydrogen Technologies Strategy and Roadmap

In January 2023, Türkiye published its Hydrogen Technologies Strategy and Roadmap, outlining 13 critical policy recommendations to accelerate the country's transition towards a hydrogen economy (MENR, 2023). The strategy prioritizes the use of renewable energy sources for hydrogen production, reducing fossil fuel dependency, and establishing the necessary infrastructure for hydrogen storage and distribution. It also emphasizes support for R&D, development of local technologies, and creation of incentive mechanisms. Key targets include reducing green hydrogen production costs to below $2.4/kg by 2035 and $1.2/kg by 2053, and achieving electrolyzer capacities of 2 GW by 2030, 5 GW by 2035, and 70 GW by 2053.

Building on the Strategy, the Türkiye Hydrogen Action Plan is being prepared by the Ministry of Energy and Natural Resources in collaboration with the World Bank and coordinated by TENMAK. Phase I, covering baseline assessment and scope definition, was completed in early 2025. Phase II, focusing on the detailed plan, is underway and expected to conclude at the end of 2025. The Action Plan will cover the entire hydrogen value chain, from reducing production costs and developing infrastructure to regulation, certification, and safety standards. It will also include performance indicators and sector-specific measures, with participation from public institutions, the private sector, and civil society. The plan will serve as a roadmap for integrating hydrogen into industry, transport, and energy sectors, contributing to Türkiye's 2053 net-zero emissions target and enhancing international cooperation.

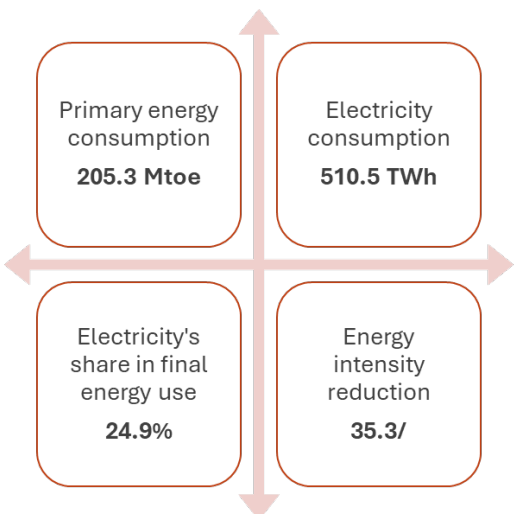
## V.4.7 Türkiye National Energy Plan (2022–2035)

At the end of 2022, the Ministry of Energy and Natural Resources published the Türkiye National Energy Plan, covering 2020–2035. The plan projects sectoral energy demand across industry, residential, services, agriculture, and transport based on indicators such as population growth, economic development, and fuel prices. It also serves as a foundation for Türkiye's 2053 net-zero target and includes recommendations for the 2035–2053 horizon.

According to the results of the Türkiye National Energy Plan, the primary energy consumption is expected to reach 205,3 Mtoe and electricity

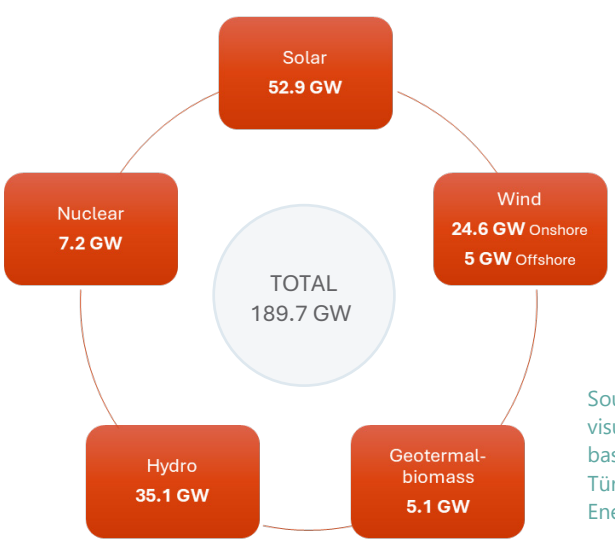
consumption to be 510.5 TWh in 2035. The share of electricity in final energy consumption is also projected to rise to 24.9% by 2035. Türkiye is also aiming to reduce energy intensity by 35.3% by 2035 (see Figures V.4 and V.5).

FIGURE V.4: KEY ENERGY PROJECTIONS FOR TÜRKİYE
(2020 – 2035)




Source: Author's visualization based on the Türkiye National Energy Plan.

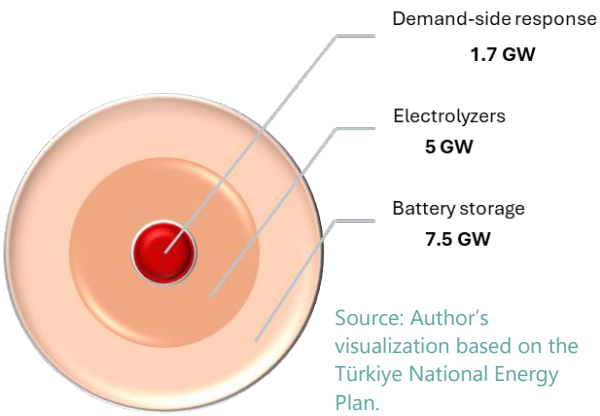
FIGURE V.5: INSTALLED POWER CAPACITY TARGETS
(2035)




Source: Author's visualization based on the Türkiye National Energy Plan.

To meet the need for flexibility, Türkiye targets increasing its battery storage capacity to 7,5 GW, electrolyzer capacity to 5 GW, and demand-side response capacity to 1,7 GW by 2035 (Figure V.6).

FIGURE V.6: FLEXIBILITY TARGETS
(2035)




Source: Author's visualization based on the Türkiye National Energy Plan.

## V.5 Energy transition and renewable energy 2035 targets

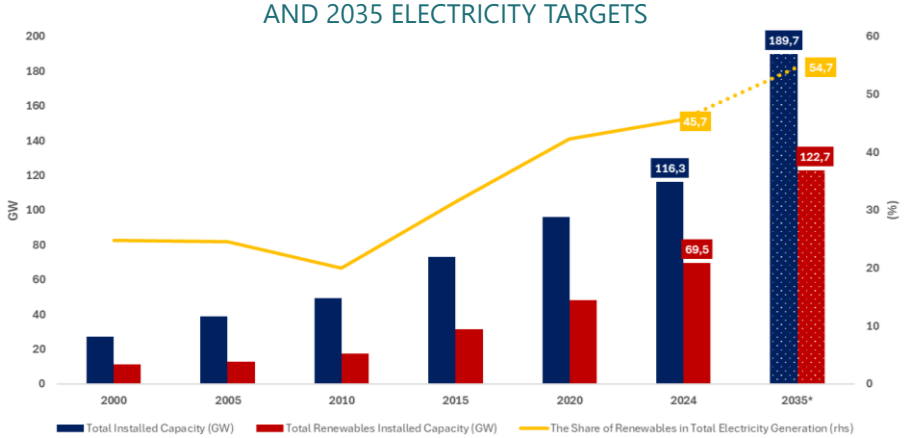
Türkiye's energy strategies and policies are based on the principles of ensuring energy supply security, diversifying energy resources, reducing energy imports by bringing domestic/renewable resources into the economy, and ensuring energy transition in line with Türkiye's 2053 net zero target. In this context, significant investments have been made, especially in renewable energy, and measures have been taken to enhance supply security.

To maximize domestic renewable potential and reduce import dependency, mechanisms such as YEKDEM, YEKA tenders, and unlicensed generation regulations have been implemented. YEKDEM support prices are updated monthly by EXIST.

Türkiye's renewable power generation capacity has grown substantially during the last two decades. According to IRENA (2024), Türkiye ranks 5$^{th}$ in Europe and 11$^{th}$ globally in renewable installed capacity. While renewables accounted for 33% of installed capacity in 2005, they reached 59.7% in 2024. In tandem with the addition of renewable capacity, the share of renewables

in total electricity generation has risen to 45.7%. The share of renewables in installed power capacity and total generation is expected to reach 64.7% and 54.7%, respectively, by 2035 (Figure V.7).

FIGURE V.7: TÜRKİYE'S INSTALLED CAPACITIES AND 2035 ELECTRICITY TARGETS




Source: Ministry of Energy and Natural Resources of Türkiye, TETC.

Under the Türkiye National Energy Plan (2020–2035), electricity demand is expected to reach 510.5 TWh, and primary energy use 205.3 Mtoe by 2035. In October 2024, the Renewable Energy Roadmap 2035 was launched, with a key target of 120 GW of combined solar and wind capacity by 2035 (from 32.7 GW in 2024), and an estimated investment need of $80 billion. On the other hand, Türkiye's renewable energy equipment manufacturing sector is well developed. Türkiye is producing renewable electricity equipment with significantly high local content ratios. The share of local content in solar PV is almost 75% and about 55% for wind, including generators, blades, towers, and hydraulics. Furthermore, turbines, generators, and power electronics are also locally produced.

## V.5.1 Energy Efficiency 2030 Strategy and the Second National Energy Efficiency Action Plan (2024–2030)

The main framework of energy efficiency efforts in Türkiye was outlined with the Energy Efficiency Law No. 5627, which came into effect in 2007. The Energy Efficiency Strategy Document (2012-2023), which was published in 2012, aimed to reduce Türkiye's energy intensity (energy consumed per unit of GDP) by at least 20% by 2023 compared to 2011. As a roadmap for the

country's efforts towards 2023, the National Energy Efficiency Action Plan (2017-2023) (NEEAP) was prepared and started implementation on 2 January 2018.

The first NEEAP included 55 actions across six sectors: buildings, industry, transport, energy, agriculture, and cross-cutting areas. The implementation of these actions was projected to require a total investment of $10.9 billion, and to yield cumulative energy savings of 23.9 million tons of oil equivalent (Mtoe), along with a reduction of 66.6 million tons of $CO_2$-equivalent greenhouse gas emissions. By the end of 2023, actual implementation resulted in an investment of $8.47 billion, achieving 24.625 Mtoe in energy savings and 68.62 million tons of $CO_2$-equivalent emission reductions. Moreover, the program contributed to the creation of approximately 45,000 green jobs.

As of 2023, Türkiye's primary energy intensity was calculated as 0.126 tep/GDP at constant 2015 prices. In 2023, primary energy intensity improved by 4.5% compared to the previous year and by 34.3% compared to 2000. Over the period 2000-2023, an annual average reduction of 1.8% in primary energy intensity was achieved.

The Second National Energy Efficiency Action Plan (2024-2030) was developed and announced to the public on 8 January 2024, with the aim of achieving Türkiye's new energy efficiency vision and strategy. This NEEAP defines 61 actions and 266 activities in 7 sectors: horizontal topics, building and services, industry, energy, transportation, agriculture, and start-up and digitalization (MENR, 2024). To reach the set targets by 2030, a total investment of $20.2 billion is expected from both the public and private sectors. Over the period 2024-2030, it is projected to achieve cumulative energy savings of 37.1 Mtoe and a reduction of 100 million tons of CO2-equivalent emissions.

### V.5.2 Sectoral decarbonization and green transition policies

Türkiye's decarbonization agenda reaches across energy, industry, agriculture and land use, buildings, waste, and the labor market effects of structural change. The policy approach is that emissions must fall while maintaining a reliable energy supply, allowing productive sectors to function,

easing pressure on natural systems, and keeping the social costs of the green transition manageable.

### V.5.2.1 Energy sector

In the course of the transition to renewable energy, the modernization of grid infrastructure, the deployment of energy storage solutions, and the use of smart grid technologies have accelerated. In this context, the Turkish Energy, Nuclear and Mining Research Agency (TENMAK) is carrying out studies to develop the Türkiye Carbon Capture and Utilization Technologies Roadmap and Implementation Plan. This initiative aims to establish a strategic framework for integrating carbon capture, utilization, and storage (CCUS) technologies into the energy sector.

Furthermore, hydrogen production and utilization have been positioned as a critical component of Türkiye's long-term energy transition objectives. At the same time, nuclear energy projects play an essential role in ensuring a low-carbon and uninterrupted electricity supply. Collectively, these policies both support achieving the 2053 net-zero emissions vision and strengthen energy supply security.

Türkiye's green transition policies are guided by a dual commitment: accelerating the deployment of renewable energy while ensuring supply security through transitional resources. In this context, natural gas will continue to play an important role in Türkiye's green transition as a bridge fuel, enabling the gradual shift away from more carbon-intensive energy sources while supporting the stability of electricity systems increasingly reliant on variable renewables such as solar and wind. As Türkiye advances toward its 2053 net-zero target, its extensive network of natural gas transit pipelines serves not only as a cornerstone of national energy security but also as a strategic enabler of regional energy cooperation among Turkic states and with European markets.

This highlights the importance of undertaking a comprehensive assessment of both the current conditions and future outlook of the aforementioned pipelines. In the medium term, they can continue to deliver natural gas as a lower-carbon option. In the longer term, they can be gradually repurposed to transport also low-carbon gases, including hydrogen and biomethane, ensuring their relevance in a decarbonized future energy system.

### V.5.2.2 Industry sector

In line with Energy Efficiency Law No. 5627, Türkiye carries out comprehensive energy management, monitoring, analysis, and projection activities targeting energy-intensive industrial sectors. As part of these efforts, industrial energy efficiency benchmarking reports are developed, which serve a dual purpose: supporting national energy efficiency targets and improving the competitiveness of enterprises.

The primary aims of industrial energy efficiency benchmarking are to monitor the current energy use of the subsectors, to compare the energy performance of a facility with similar facilities at national or international levels, and to assist in performance improvements, to help decision makers see the broad picture and assess the potential for improvement in energy efficiency.

Data collected from enterprises enables detailed, process-specific analysis of energy consumption, helping companies identify and act on their energy-saving opportunities with greater precision and impact.

As of 2025, benchmarking studies were being conducted in the iron and steel, cement, glass, textiles, sugar, ceramics, paper, and construction materials sectors. These analyses provide a strategic roadmap for enhancing energy performance across key industrial sectors and contribute to a sustainable, competitive growth model.

Within the scope of the Energy Efficiency Law No. 5627, data on energy consumption and energy management practices of not only buildings and industrial enterprises but also electricity generation facilities and organized industrial zones are collected, monitored, and reported. To ensure the efficient execution of this process, the Energy Efficiency Database (ENVER Portal) has been developed, enabling the collection of this data in a centralized and comparable manner. This provides both regular data for sectoral benchmarking studies and a robust infrastructure for monitoring and reporting on national energy efficiency policies.

### V.5.2.3 Agriculture and land use sector

Türkiye is one of the countries with high vulnerability to the impacts of climate change due to its geographical location and climatic characteristics.

Particularly in semi-arid and arid regions, desertification and land degradation pose significant risks, including reduced agricultural land productivity, loss of biodiversity, and weakened ecosystem services. In addition, extreme weather events such as droughts, floods, and landslides have increased in recent years, causing economic and social losses. To tackle these challenges, nature-based solutions that simultaneously reduce GHG emissions and strengthen ecosystem services are deemed a strategic priority in Türkiye. In that regard, the development of nature-based monitoring and decision-support technologies is crucial. In Türkiye, tools and innovations such as Graphic Information Systems (GIS), remote sensing-based monitoring tools, and AI-supported monitoring enhance data-driven land and climate management systems that measure changes in soil, water, and land use, providing strategic information for decision-makers and strengthening evidence-based management approaches in the implementation of green transformation policies.

Against this backdrop, policy responses in Türkiye focus on land restoration, carbon sinks, and climate-resilient rural infrastructure. In this context, the following actions are implemented:

- Afforestation and revegetation activities are carried out on idle lands under state ownership and control, helping to combat erosion and desertification while simultaneously creating new carbon sink areas.
- Landslide and flood control projects, particularly in the Eastern Black Sea and steeply sloped regions, reduce soil loss, protect settlements and agricultural lands, and enhance the climate resilience of communities.

These practices are directly aligned with Turkey's 2053 Net Zero Target and green transformation vision, and they provide a strong foundation for potential cooperation among the Turkic states on nature-based solutions and carbon sink initiatives.

Combating desertification, erosion, drought, and land degradation is a key pillar of Türkiye's green transformation policies. Türkiye's environmental policies also involve ecosystem-based solutions. The National Strategy and Action Plan to Combat Desertification in this regard targets land degradation, soil and water conservation, erosion prevention, and enhanced ecosystem services—reinforcing both rural development and climate resilience.

Carbon sink initiatives play a vital role in this transformation. Afforestation activities on state-owned idle lands contribute to soil protection, desertification prevention, sectoral decarbonization, and the enhancement of ecosystem services. In addition, Türkiye promotes Sustainable Land Management (SLM) practices and implements land rehabilitation and erosion-control projects. Such efforts not only improve agricultural productivity but also help preserve soil carbon. Additionally, basin-based flood and landslide control investments safeguard agricultural lands, reduce production losses, and support rural development.

Notable examples include the Upper Sakarya Basin LDN Decision Support System and the Integrated Natural Resource Management in the Eastern Black Sea Region (DOKSAY) Project, which showcase climate-resilient practices in agriculture and land use.

### V.5.2.4 Building sector

In line with Presidential Circular No. 2019/18 dated 15 August 2020 and the Energy Efficiency Law, public buildings required to appoint energy managers were tasked with achieving a 15% energy savings target by the end of 2023. Building on the success of this initiative, the target has been revised to 30% by 2030 under Presidential Circular No. 2023/15.

To support implementation, the Ministry of Energy and Natural Resources (MENR) has published the "Savings Target and Implementation Guide (2024–2030) for Public Buildings," which outlines applicable energy efficiency measures and provides three implementation models. Public institutions may:

- Use internal financing,
- Enter into energy performance contracts (EPCs), or
- Apply to the KABEV Project, jointly run by MENR and the Ministry of Environment, Urbanization and Climate Change, supported by the World Bank. Municipalities, in turn, are directed to seek support through ILBANK (Bank of Provinces).

The legal basis for EPC implementation was established by Presidential Decree No. 2850, published in the Official Gazette on 20 August 2020. The

Communiqué provides the procedural framework for public institutions to sign EPCs with durations of up to 15 years, thereby enabling long-term investments in building energy efficiency.

### V.5.2.5 Waste sector

Transition to a circular economy is regarded as a crucial and high-priority objective in Türkiye's green development vision and achieving the 2053 climate-neutral target. To that end, guided by the necessity of preparing a circular economy action plan, which is also emphasized in Türkiye's high-level policy papers such as the Green Deal Action Plan and 12$^{th}$ Development Plan, an Action plan has been developed to prevent waste generation, reduce overall waste, and enhance recycling activities, thereby accelerating the country's transition toward a circular economy. Within this framework, the National Circular Economy Strategy and Action Plan (UDESAP) has been prepared to define the duties and responsibilities of relevant institutions and organizations. The plan focuses on seven priority sectors that play a crucial role in achieving circularity: packaging, batteries and vehicles, electrical and information processing technologies, food and biomass, construction and buildings, plastics, and textiles (MEUCC, 2025).

Moreover, the National Waste Management Strategy and Plan (2025-2035), which formulates Türkiye's waste management strategies and policy framework up to 2035, has been prepared. The Plan projects municipal, recyclable, medical, hazardous, excavated soil, and construction and demolition waste quantities through 2035 and determines the facility capacities and investments required to accommodate the increased waste volumes.

### V.5.2.6 Just and inclusive transition

It is important that the green and digital transformation process, which brings with it significant challenges and opportunities in terms of socio-economic outcomes, is managed under the most appropriate conditions for all segments of society, with the "leaving no one behind" approach, as indicated in the Paris Agreement. The approach of leaving no one behind has also brought about the concept of "just transition."

Türkiye announced its net-zero emissions vision for 2053, stating that it will fundamentally change its industrial and employment policies accordingly. In this direction, the following actions regarding this issue are included in the 2024-2026 Medium Term Program (MTP):

- A needs analysis will be conducted for those employed in regions and professional groups that could be affected by the green transformation in order to realize a just transition process.
- The effects of transitioning to a green and circular economy on labor markets will be analyzed, and the competency of the workforce will be increased for the new occupations that will emerge, taking the just transition into account.

New actions will be included in the Green Deal Action Plan coordinated by the Ministry of Trade of Türkiye, in line with the goal of developing national just transition policies in Türkiye and preparing the implementation infrastructure.

The concept of just transition has been included within the scope of Climate Law No. 7552 dated 02.07.2025. Thus, the concept of just transition has been recognized as a general principle and fundamental in the fight against climate change.

Ensuring a fair and just transition without leaving no one behind is essential to achieve consistency in global green transformation efforts. In that respect, international collaboration is key to decreasing the possible difficulties that may arise and to magnify the effect of all actions taken. These efforts would greatly aid the process, as shared knowledge and experience will ensure that clean technologies and sustainable solutions are accessible and affordable to all.

## V.6. Green transition technologies and innovation in Türkiye

As part of Türkiye's European Green Deal Action Plan, coordinated by the Ministry of Trade, TUBITAK is responsible for identifying the technological needs for Türkiye's green growth targets. With the aim of carrying out this task inclusively, a "Technological Transformation/Development Specialized Working Group" was established in 2022. This group includes 13 public institutions and 27 private sector umbrella representatives.

Under the guidance of this specialized working group, a "Green Growth Technology Roadmap" has been developed for six critical sectors: Iron-steel, aluminum, cement, chemicals, plastics, and fertilizers. These sectors were prioritized due to their economic significance, foundational role in production chains, and substantial carbon emissions (TÜBİTAK, 2025b).

Technological needs for green growth in these sectors were identified using a product life cycle approach, covering raw materials, production processes, energy inputs, waste management, and post-use recovery stages. The process was moderated by umbrella NGOs, such as the Turkish Steel Producers Association (TÇÜD), Entrepreneurial Aluminum Industrialists and Businessmen Association (GALSİAD), Turkish Chemical Industrialists Association (TKSD), Turkish Plastic Industrialists Research, Development and Education Foundation (PAGEV), Turkish Cement Manufacturers Association (TURKÇİMENTO), and the Fertilizer Sector Fertilizer Manufacturers, Importers and Exporters Association (GÜİD). Sectoral focus groups, established with 371 private sector representatives and moderated by private sector umbrella NGOs, which have the capacity to represent the whole economy, facilitated this process.

Inputs from each sector were gathered through sectoral focus groups and an online questionnaire and were enriched by outcomes from the Climate Council Science and Technology Commission, "Best Available Techniques (BAT)" reference documents, and global technological trends analysis. Over 60 meetings, involving approximately 100 academics and researchers, as well as sectoral focus groups, were held to develop technological solutions to the identified needs in each sector.

In collaboration with all ecosystem stakeholders, groundbreaking research, development, and innovation (RDI) based solutions were identified to align with Türkiye's 2053 net-zero emission target and green development policy. The roadmap outlines 31 technological objectives to advance green growth for 2026, 2030, and 2035, including 72 critical products for the domestic development of green production technologies, and 189 RDI Topics to stimulate green technological production and employment in the six sectors. These RDI topics are included in TÜBITAK's Priority RDI Topics for 2024-2025, with proposals in these areas receiving additional evaluation points. Dedicated thematic calls are planned for the upcoming periods.

The World Bank's Türkiye Green Industry Project serves as the major implementation tool for the Green Growth Technology Roadmap (TÜBİTAK, 2025), prioritizing the RDI topics outlined in the roadmap through various support mechanisms.

## V.7 Green transition finance and support in Türkiye

Access to financing opportunities is one of the key elements in realizing the investments necessary for the transition to a green, resource-efficient, inclusive, and sustainable economy. Emissions mitigation actions across energy, transport, industry, and agriculture sectors, as well as adaptation and resilience measures, require substantial climate finance in the short, medium, and long term.

Türkiye has built strong partnerships with international financial institutions, international climate funds, including the Climate Investment Funds (CIF) and the Global Environment Facility (GEF), and bilateral development partners to achieve its national climate goals. Addressing the climate finance gap and securing funding from various external resources and the private sector remain top priorities for Türkiye in tackling the climate crisis.

Türkiye is one of the most successful countries in leveraging CIF financing, particularly for energy efficiency and renewable energy projects. Recently, Türkiye was recognized for its participation in two flagship CIF programs—Renewable Energy Integration and Industry Decarbonization—demonstrating the country's ambition to address climate change. Additionally, Türkiye plays a vital role as a member of the Clean Technology Fund (CTF) Trust Fund Committee, actively shaping and advancing CTF operations and initiatives.

Türkiye also engages actively with the GEF, which primarily provides grant-based financing for actions related to biodiversity, climate change, land degradation, chemical waste, and international waters. Capacity building is a crucial component of developing countries' climate actions, and the GEF plays a key role in addressing these needs. Türkiye's strong partnership with the GEF is a key enabler in building the institutional capacity required to achieve its climate objectives.

Furthermore, Türkiye places great importance on robust global cooperation in addressing climate change. Recently, Türkiye joined the Coalition of Finance Ministers for Climate Action, a platform that facilitates knowledge sharing and collaboration among Finance Ministers on climate-related issues. Türkiye recognizes the value of such global platforms in enhancing national climate actions through the exchange of best practices and experiences.

The MoTF, in close cooperation with international financial institutions and development partners, has continued to mobilize foreign financing to advance Türkiye's development goals. In recent years, particular emphasis has been placed on green finance, in line with the global development agenda. Türkiye has also mobilized significant international financing to support the green industry. In cooperation with the World Bank, more than $1 billion has been directed to firms, SMEs, and green technology ventures through initiatives such as the Türkiye Green Industry Project, the Türkiye Organized Industrial Zones Project, and the Socially Inclusive Green Transition Project. In addition, the Türkiye Industrial Decarbonisation Investment Platform, developed with the European Bank for Reconstruction and Development (EBRD), aims to provide €5 billion in financing for industrial decarbonisation investments by 2030.

In the energy sector, financing has supported renewable energy investments and energy efficiency projects. In the agriculture and irrigation sector, modernization projects have strengthened food security, enhanced water efficiency, and promoted climate-smart agricultural practices.

In the transportation sector, significant resources have been allocated to railway systems, logistics connections, and transit corridors, reinforcing Türkiye's role as a regional hub while contributing to more sustainable mobility. In infrastructure, climate-smart and resilient urban solutions have been developed, with investments in the modernization of essential services and measures that improve preparedness against climate-related risks.

In the real sector, financing has been delivered primarily through the financial sector, enabling support to exporters and SMEs. This has facilitated access to long-term and affordable financing, allowing firms to invest in modernization, strengthen value chains, and expand capacity. These resources have also contributed to the production of higher value-added goods and to more sustainable business practices, helping companies

capture new opportunities while maintaining competitiveness in international markets.

The Türkiye Green Industry Project, discussed in Section VI.4.5, is one of the principal channels through which external finance supports SMEs and green innovation. KOSGEB provides repayable support to SMEs in areas such as renewable energy, resource efficiency, waste management, and circular economy. TÜBİTAK supports green transformation through mentoring and finance for R&D activities. It offers matching grants for mentoring and reimbursable financing for green innovation projects in areas like R&D, prototype development, and efficiency improvements.

On the other hand, TENMAK provides research and innovation support to accelerate the green transition through the integrated TAGEP and TUGEP programmes. These programmes provide call-based, results-oriented funding aligned with national priorities, fostering the commercialization of research outputs and their transfer to industry.

Energy efficiency has been supported by the Ministry of Energy and Natural Resources through the Efficiency-Enhancing Project (VAP) and Voluntary Agreement (GA) grant programs. These programs aim to harness the country's potential for energy savings, replace inefficient equipment with efficient alternatives, raise awareness and improve technological capacity in energy efficiency, and expand the implementation of efficiency practices. In order to enhance effectiveness and broaden the scope of energy efficiency support programs, a recent legislative amendment has lifted sectoral restrictions on applications, increased the level of financial support tenfold, and introduced new criteria such as carbon intensity and specific energy consumption reduction, alongside the existing energy intensity reduction criterion. With this amendment, the VAP Support Program will continue, while the GA Support Program has been replaced by the Energy and Carbon Reduction (EKA) Support Program. The VAP Support Program covers grants of 30% of the investment costs for energy efficiency implementation projects submitted across all sectors, from energy production to final consumption (MENR, 2025).

On the other hand, under the Türkiye Green Export Project, Türk Eximbank has secured €1 billion in financing from international creditors, backed by a World Bank guarantee and a counter-guarantee from the MoTF. This project is designed to provide long-term financing to Turkish exporters to support

the green transition and green exports. It also aims to reduce the potential adverse effects of the EU Carbon Border Adjustment Mechanism (CBAM), thereby strengthening the international competitiveness of Turkish exporters.

Additionally, the Development and Investment Bank of Türkiye (TKYB) has secured a $200 million equivalent loan agreement under the guarantee of the MoTF from the Asian Infrastructure Investment Bank (AIIB). The purpose of the TKYB Climate and Digital Transition On-Lending Facility is to support private sector sub-projects in climate mitigation, climate adaptation, and digital infrastructure. This includes investments in renewable energy (such as wind and solar), energy efficiency, battery energy storage systems, and the decarbonization of energy-intensive industries. The facility will also finance projects aimed at expanding Türkiye's digital infrastructure, in line with the country's objective of advancing digital transformation across all sectors.

To increase private-sector awareness of financial opportunities, the Ministry of Trade publishes the "National Financing Opportunities Document for Achieving Green Transformation Targets" and updates it quarterly.

## V.8 Critical minerals and green transition

Critical minerals are at the core of the green transition and innovative technologies. They are indispensable for clean energy systems, battery production, electric vehicles, and digital infrastructures, with global demand rising rapidly.

In recent years, growing protectionist tendencies and vulnerabilities in global supply chains have led many countries to publish national strategies and build bilateral or regional partnerships on critical minerals. In line with these global developments, Türkiye published its national list of critical and strategic minerals and is currently preparing a Critical Minerals Strategy Document. Strengthening cooperation among the members of the Organization of Turkic States in this field is of strategic importance. Such collaboration would not only enhance supply security and regional value chains but also foster shared economic development and enable technological breakthroughs across all member countries.

Global demand for critical minerals in the green transition is increasing. Recently, it was discovered that the Eskişehir/Türkiye–Beylikova site, with 694 million tons of reserves, hosts the world's second-largest rare-earth element deposit. With the planned establishment of production facilities at this site, Türkiye holds the potential to become one of the world's most significant suppliers of rare earth elements, positioning itself as an important contributor to the diversification of the global value chain and thereby strengthening its role in emerging clean technology value chains.

Although Turkic states such as Türkiye, Kazakhstan, Uzbekistan, and Kyrgyzstan have abundant reserves of rare earth and other metals, additional technological and financial resources are needed to extract and process them. However, insufficient infrastructure and limitations in processing capacity prevent the region from benefiting from its mineral wealth and becoming an important actor in global supply chains. Major economies have intensified efforts to secure access to critical minerals and rare earths and impose export restrictions.

Exploring cooperation among Turkic states in the field of mining, particularly rare earth elements and critical minerals, is very important through joint ventures and investments. Thus, it is important to create trade and investment opportunities within the Turkic economies to have a secure supply chain. It is also important to ensure that joint R&D projects undertaken by Turkic states in the fields of rare earth elements and critical minerals should be supported by the relevant organisations and institutions of the Turkic states.

## V.9 Development of financial mechanisms within Turkic states

Stringent climate change policies have some significant effects on international trade in manufactured goods and provide a comparative advantage in "cleaner" industries.

The EU's recent climate policies, aimed at ambitious climate action, are likely to create adjustment pressures for countries with strong trade links to the EU market, including Türkiye. These policies may affect Türkiye's export market share in the EU, which is a key export market for Türkiye. However, implementing these measures and their conditions requires substantial

financial resources, technology transfer, and capacity building to enable trade partners to comply.

On the other hand, the EU's trade partners have diverse levels of development and capacity constraints, and access to financial resources, technical, and knowledge capacity for green transformation may not be available for SME in some countries. In the pursuit of a low-carbon economy, each Turkic economy may encounter significant financial challenges. Diversified and sustainable funding sources, such as UN agencies, the Green Climate Fund (GCF), multilateral organizations, regional development banks, and financial institutions, can play a key role in mobilizing funds for green transition projects.

It is also important to build sustainable financial markets across Turkic economies to support each country's transition to a green economy and finance their decarbonization efforts.

Turkic economies can explore innovative funding mechanisms and strategic collaborations to sustain international support for funding projects related to areas such as renewable energy, energy efficiency improvements, and low-carbon production technologies in the region.

### Box V.1: Türkiye's HIT-30 Program

The High Technology Investment Program (HIT-30), with a $30 billion commitment in incentives, is designed to establish Türkiye as a global leader in high technology. The program targets strategic sectors including electric vehicles, battery production, semiconductor manufacturing, and energy technology.

Within this framework, a $4.5 billion incentive package has been allocated to position Türkiye as a regional hub for battery production, while a $5 billion package aims to increase annual automotive production capacity to at least 1 million units.

In the field of renewable energy, the program foresees grants of up to $8,000 per megawatt for solar cell investments, with the objective of reaching 15 gigawatts of capacity. Overall, the program seeks to attract $20 billion in private-sector investment, supported by substantial grants and tax incentives that will reinforce Türkiye's economic and technological independence.

Complementing these efforts, the Advance Loans Against Investment Commitment mechanism provides ₺300 billion in favorable financing for technological and strategic investments over three years. As of the end of 2025, 238 project applications have been submitted, totaling ₺1.26 billion.

Additionally, the Foreign Direct Investment Strategy (2024–2028) has been prepared to significantly increase inflows of foreign direct investment and align them with the strategic priorities of the "Türkiye Century" vision. The program also defines more than 30 priority investment topics across eight key areas: semiconductors, mobility, communication and space, advanced manufacturing, healthy living, digital technologies, green energy, and investments complementary to the value chain.

## Concluding remarks

Türkiye enters the green transition from a demanding starting point. Its share in global greenhouse gas emissions remains below 1%, yet its exposure to drought, land degradation, biodiversity loss, floods, wildfires, and other climate shocks is high. For Türkiye, the green economy transition no longer reads as a narrow environmental agenda. It is part of a wider economic restructuring effort that links climate action with energy security, trade performance, industrial renewal, and resilience. That logic runs through the 2053 net-zero target, the updated NDC path, the 12$^{th}$ Development Plan, and the Climate Law, which together provide a firmer policy basis for the green economy transition.

Results will depend on what happens across sectors. Energy still carries the largest share of emissions, so gains in renewable capacity, grid flexibility, storage, hydrogen, and efficiency will shape much of the adjustment. Yet issues such as cleaner industrial production, circular use of materials, building

efficiency, land restoration, waste reduction, and labor market adjustment will also determine the success of the Turkish economy's green transition.

Finance remains the main constraint, despite the availability of a broad funding pipeline through public programs, international climate funds, multilateral lenders, export finance, and firm-level support. Capital needs remain large, and the same is true for technology depth, institutional coordination, and supply chain capacity in critical minerals. The regional dimension also stands out. Closer cooperation across Turkic economies on finance, technology, and mineral processing could widen scale and ease bottlenecks that no single economy can solve alone.

Nevertheless, this chapter illustrated that Türkiye has moved beyond declaration and into policy design, sector planning, and investment mobilization. The harder task now is to convert that policy base into steady, credible results.

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CHAPTER VI

# Green Economy Transition in Uzbekistan: Results, Reforms and Prospects

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## Executive summary

Uzbekistan has embarked on an ambitious and comprehensive transition toward a green economy, establishing one of Central Asia's most advanced policy frameworks for sustainable development. Over the period 2019–2025, the country enacted landmark legislation, launched transformative infrastructure programs, secured substantial international financing, and made measurable progress across energy, water, industry, forestry, and environmental monitoring.

This chapter synthesizes findings across six thematic pillars: environmental and climate challenges, national green economy strategies, key projects and reforms, flagship initiatives, international cooperation, and Turkic State partnerships. It draws on official government data, legislative records, and multilateral development bank assessments to provide an authoritative overview of Uzbekistan's green economy journey.

TABLE VI.1 UZBEKISTAN'S KEY ACHIEVEMENTS AT A GLANCE

| | | | |
|---|---|---|---|
| **1 B** seedlings planted ("Yashil Makon" Program) | **50%** GHG reduction by 2035 (updated NDC target) | **$250M** concessional financing (CIF decarbonization) | **2,000 MW** solar capacity installed PV panels |
| **10B $m^3$** water saved in 2025 (Water efficiency) | **91,412** EIA conclusions issued (2023–2025) | **1.73M ha** afforested (2020–2025 forest expansion) | **446K+** green energy certificates issued in 2025 |

Uzbekistan's 2019–2030 Green Economy Strategy (O'zbekiston Respublikasi Prezidenti, 2019), reinforced by the landmark Law on Limiting Greenhouse Gas Emissions (O'zbekiston Respublikasi, 2025, July 7) in July 2025, and an updated NDC 3.0 (National Committee on Ecology and Climate Change, 2025) that was submitted at COP-30 in November 2025, places the country firmly on a low-carbon development trajectory. Significant institutional reforms — including the establishment of a National Energy Efficiency Agency and the Green Cities platform — complement financing innovations such as green taxonomy, green budget tagging, and a domestic emissions trading system.

Uzbekistan's economy is reducing the energy intensity of its industrial sector through accelerated efficiency gains. Still, technological modernization needs to deepen, and mobilizing adequate private capital remains a priority. Even so, the breadth and pace of reform position Uzbekistan among the more active reformers in sustainable development in Central Asia.

## VI.1 Environmental and climate challenges

Uzbekistan faces a set of closely connected environmental pressures, led by climate change, water scarcity, land degradation, the Aral Sea crisis, and worsening air, water, and soil quality, all of which increasingly affect agriculture, public health, livelihoods, and long-term development.

### VI.1.1 Overview of Uzbekistan's environmental context

Uzbekistan is situated in the heart of Central Asia, a region recognized as one of the most climate-vulnerable in the world. The country faces a convergence of environmental pressures — rising temperatures, intensifying droughts, water scarcity, land degradation, and biodiversity loss — that pose growing risks to its economy, population health, and long-term development trajectory.

Average temperatures in Uzbekistan have risen by approximately 1.5°C (Mirziyoyev, 2023) over the past century, and climate projections suggest further warming of 2–4°C (WBG & ADB, 2021) by mid-century under business-as-usual scenarios. This warming trend is compounding existing vulnerabilities in a country where agriculture accounts for a significant share

of GDP and employment, and where water resources are already under serious pressure across the region.

### VI.1.2 Climate change: Core risks and vulnerabilities

Climate change represents the most pressing ecological threat facing Uzbekistan. The main climate-related risks include:

- Temperature rise and heat stress: Prolonged heatwaves are increasing in frequency and intensity, straining public health systems, reducing agricultural productivity, and increasing energy demand for cooling.
- Water scarcity: due to the decrease in water flow in the Amu Darya and Syr Darya rivers, Central Asian countries will face a high level of water scarcity by 2040 (Mirziyoyev, 2025, 4 April).
- Drought and desertification: Prolonged dry periods may cause the expansion of desert areas and degrade arable land, particularly in the Kyzylkum desert and Aral Sea region.

### VI.1.3 The Aral Sea crisis: A persistent ecological emergency

The desiccation of the Aral Sea stands as one of the 20th century's greatest environmental disasters. Once the world's fourth-largest inland sea, the Aral Sea has lost more than 90 percent of its volume (Jet Propulsion Laboratory, 2014) due to large-scale irrigation diversion beginning in the Soviet era. The exposed seabed — now spanning millions of hectares — has become a major source of dust and salt, severely impacting the health and livelihoods of communities in the Aral Sea Basin, particularly in Karakalpakstan.

Uzbekistan has been a founding member and consistently active leader in international efforts to address the Aral Sea crisis through the International Fund for Saving the Aral Sea (IFAS), having previously chaired the organization during 1997–1999 and 2013–2016 (Agency of IFAS, n.d.). National mitigation measures include large-scale afforestation of the dried seabed, investment in water-saving technologies in the Aral Sea Basin, and establishment of the Aral Sea International Innovation Centre to develop science-based solutions for ecological restoration.

Key statistic: By 2025, the total area covered by protective forest plantations on the dried Aral Sea bed and the surrounding Aral Sea Basin region has reached 2.59 million hectares — a landmark achievement in one of the world's most challenging ecological restoration efforts.

### VI.1.4 Air, water, and soil quality challenges

Beyond climate change, Uzbekistan confronts significant air, water, and soil quality challenges. Rapid industrialization and urbanization, combined with an aging industrial base, have resulted in elevated concentrations of particulate matter (PM2.5), sulfur dioxide, and nitrogen oxides in major urban centers, particularly Tashkent.

Water quality is under pressure from agricultural runoff containing pesticides and fertilizers, industrial discharges, and inadequate wastewater treatment infrastructure in smaller cities and rural areas. Soil salinization remains a serious challenge: excessive irrigation without adequate drainage has led to the salinization of large areas of agricultural land, reducing productivity and requiring costly reclamation.

Uzbekistan's participation in COP-30 (Belém, Brazil, November 2025) marked a significant milestone: the country submitted its updated NDC 3.0, committing to reduce greenhouse gas emissions per unit of GDP by 50 percent by 2035. This higher level of ambition signals Uzbekistan's commitment to aligning its development trajectory with the Paris Agreement's temperature goals.

## VI.2 National green economy strategies, policies & institutions

Uzbekistan's green economy agenda is supported by a growing set of strategies, laws, institutions, and financing tools. Since 2019, the country has moved from broad policy commitments toward a more structured implementation framework, including presidential initiatives, green economy programs, climate and water legislation, dedicated coordination bodies, and new instruments for green finance.

## VI.2.1 Presidential leadership and the year of environmental protection

Uzbekistan's green economy agenda is driven at the highest political level. By Presidential Decree, 2025 was officially declared the 'Year of Environmental Protection and Green Economy' — the annual national priority set by President Shavkat Mirziyoyev. This declaration was backed by a comprehensive state program developed through one month of public consultation that engaged more than 11 million citizens (President of the Republic of Uzbekistan, 2025, January 27), yielding over 100 accepted proposals. UN agencies and international organizations confirmed their readiness to partner in implementation.

At the Abu Dhabi Sustainability Week summit in January 2025, President Mirziyoyev outlined Uzbekistan's energy achievements to heads of state and government (Mirziyoyev, 2025, January 14): over the preceding five years, nearly $20 billion of foreign investment was attracted to the energy sector and 9.6 GW of modern generation capacity was commissioned — including 14 solar and wind plants totaling 3.5 GW and two energy storage systems of 300 MW. More than 50 large-scale projects worth over $26 billion and totaling 24 GW are currently under implementation with foreign partners. By 2030, the share of renewable energy sources is planned to reach 54 percent of total electricity generation. The President also announced Uzbekistan's potential to produce 500 GW of solar, 100 GW of wind, and 10 GW of hydroelectric energy, and invited global scientific centers to collaborate with the Green University on research and innovation.

Vision for 2025: The 2025 state program set concrete targets: green components in investment projects to reach 50% within 5 years; economy-wide energy efficiency to double; at least 30% of urban areas to be greened; 100% of agriculture to adopt water-saving technologies; green share of production and infrastructure projects to reach 15% in 2025, 30% by 2027, and 55% by 2030 President of the Republic of Uzbekistan (2025, January 27). A total of 400 large industrial enterprises were mandated to undergo energy audits and introduce energy-saving technologies. $300 million in resources were to be mobilized from the EBRD, World Bank, and other organizations to support low-carbon projects.

In the multilateral arena, Uzbekistan has become more active in shaping regional and multilateral green economy cooperation. A trilateral green energy agreement with Kazakhstan and Azerbaijan, signed at COP-29, is intended to support future green energy exports toward European markets, reviving elements of the historic Silk Road through energy interconnectivity.

### VI.2.2 The 2019–2030 Green Economy Transition Strategy

The cornerstone of Uzbekistan's green economy framework is the Strategy for Transitioning to a Green Economy for the Period 2019–2030, approved by Presidential Resolution No. PR-4477 on 5 October 2019. This strategy establishes the overarching framework for transforming the national economy in accordance with sustainable development principles, positioning green transition as a vehicle for modernization, competitiveness, and ecological risk reduction. The strategy encompasses a wide range of objectives and instruments:

- Gradual reduction of the energy intensity of GDP through sectoral efficiency programs.
- Development of low-carbon energy through accelerated deployment of renewable energy sources.
- Rational use of water and land resources through water-saving technologies and improved land management.
- Climate change adaptation through sectoral National Adaptation Plans (NAPs).
- Introduction of economic mechanisms to incentivize resource efficiency, including green taxation and market-based instruments.
- Expansion of renewable energy projects and modernization of energy infrastructure.
- Development of investment attraction mechanisms and improvement of the regulatory and legal framework.

### VI.2.3 Legislative and regulatory framework

Uzbekistan has substantially strengthened its environmental legal framework during 2019–2025, enacting landmark legislation and regulatory instruments. Key developments include:

Law on Limiting Greenhouse Gas Emissions (O'zbekiston Respublikasi, 2025, 7-iyul): This landmark law establishes the legal basis for regulating greenhouse gas emissions in Uzbekistan. Its key provisions include:

- Establishment of fundamental principles for limiting greenhouse gas emissions.
- Regulation of activities related to greenhouse gas emissions, their reduction, and absorption.
- Introduction of a system for monitoring, reporting, and verification (MRV) of greenhouse gas emissions.
- Definition of ownership rights over reduced greenhouse gas emissions.
- Delineation of state authority competences in the field of emissions limitation.
- Procedures for state accounting of greenhouse gas emissions.
- Legal framework for carbon trading — both domestically and on international markets.
- Foundation for implementing Uzbekistan's obligations under the Paris Agreement.

Under this law, the Ministry of Economy and Finance was designated as the competent authority for regulating greenhouse gas emissions, operating the carbon unit registry, and participating in international and domestic carbon markets.

While the Law provides the general framework, the detailed regulation of carbon market mechanisms is further developed under Presidential Decree No. PD-110 "On measures for participation in the international carbon units market" (7 July 2025). In particular, the decree introduces a structured system for the issuance, registration, and circulation of carbon units and regulates their participation in international carbon markets. According to the decree, carbon units generated in Uzbekistan are distributed as follows:

- 20% are reserved for meeting Uzbekistan's nationally determined contribution (NDC) and are not subject to international transfer;
- 80% may be transferred or sold on international carbon markets, including under Article 6 of the Paris Agreement.

For carbon units generated under projects with state participation, the allocation and management of these units are determined by the Cabinet of Ministers.

Under this decree, a Carbon Market Advisory Working Group has been established, comprising sectoral experts, to evaluate carbon credit project proposals and assess their potential impact on the country's international climate change commitments. Additionally, the Ministry of Economy and Finance (as the Designated National Authority, DNA) has developed a draft Regulation on the Procedure for Participation in International Carbon Markets, which is currently pending approval.

New Water Code (O'zbekiston Respublikasi, 2025, July 30): In parallel with the GHG Emissions Law, Uzbekistan adopted a new Water Code on 30 July 2025, entering into force on 31 October 2025. The Code consolidates all water use legislation, introduces legal definitions of water bodies, water facilities, hydraulic structures, and water users. Water bodies are recognized as state property and a national treasure, while water facilities may be publicly or privately owned. This landmark legislation provides an updated and unified legal framework for water resource management — a critical component of Uzbekistan's green economy, given its water-scarce geography and the agricultural sector's dominant water use.

Law on Ecological Expertise, Environmental Impact Assessment, and Strategic Environmental Assessment (O'zbekiston Respublikasi, 2025, February 24): This law modernizes Uzbekistan's environmental review system, establishing procedures for state and public ecological expertise, environmental impact assessment (EIA), and strategic environmental assessment (SEA). The law enshrines principles of legality, objectivity, public participation, openness, and transparency. Between 2023 and 2025, a total of 91,412 state ecological expertise conclusions were issued, and 3,800 public hearings were conducted for Category I and II activities.

Presidential Resolution on Green Economy Reforms (O'zbekiston Respublikasi Prezidenti, 2022, December 2): In particular, the resolution:

- Approved the National Program for Transition to a Green Economy and Green Growth up to 2030, including concrete national targets on emissions reduction, renewable energy expansion, energy efficiency, water conservation, and greening measures.

- Strengthened institutional arrangements, designating responsible state bodies and establishing coordination mechanisms to ensure effective implementation of green economy policies.
- Approved a detailed Action Plan up to 2030, defining specific measures, timelines, and responsibilities for ministries and agencies.
- Moreover, the 'green energy certificates' system was introduced, linking production to environmental accountability and expanding market access for domestically produced goods in international markets. It also established the framework for carbon trading to incentivize enterprises to reduce their carbon intensity.

## VI.2.4 Institutional architecture

Uzbekistan has developed a multi-institutional architecture to coordinate green economy implementation, as shown in Table VI.2. It brings together institutions responsible for policy coordination, energy efficiency, green project development, climate monitoring, ecological restoration, and specialist training. This structure reflects a gradual move from broad policy commitments toward dedicated institutions with clearer roles in implementation, financing, monitoring, and capacity building.

TABLE VI.2: KEY INSTITUTIONS SUPPORTING UZBEKISTAN'S GREEN ECONOMY IMPLEMENTATION

| Institution | Role | Established |
|---|---|---|
| National Energy Efficiency Agency under the Cabinet of Ministers | Coordinates energy saving policy; manages energy efficiency project portfolio; attracts private investment | 2025 |
| Climate Council under the President | High-level policy coordination on climate change; oversees NDC implementation | 2024 |
| Center of Green Economy Projects (MoEF) | Manages green economy project pipeline; operates as a working body for MoEF on carbon trade and MRV; coordinates with IFIs | 2023 |
| Aral Sea International Innovation Centre | Science-based ecological restoration; international R&D partnerships | 2018 |
| Hydrometeorology Service Agency (Uzhydromet) | Environmental and climate monitoring; GHG inventory; BTR preparation | Restructured 2020 |
| Central Asian University for Environment & Climate Change (Green University) | Training specialists in circular economy, ecology, and waste management | 2023 |

## VI.2.5 Green financing mechanisms

Uzbekistan has pioneered a suite of green financing instruments to mobilize investment for its low-carbon transition:

National Green Taxonomy (O'zbekiston Respublikasi Vazirlar Mahkamasi, 2023): A national green taxonomy has been introduced to establish unified criteria for classifying environmentally sustainable projects with the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan on 25 October 2023. This instrument creates a methodological basis for investment selection, enhances transparency of financial decisions, and ensures comparability of national approaches with international practice. The taxonomy is aligned with OECD standards and provides the foundation for green bond issuance and green lending.

Green Budget Tagging (Ministry of Economy and Finance of the Republic of Uzbekistan, 2025): The Green Budget Tagging (GBT) mechanism is being introduced to identify and classify budget programs and projects according to their contribution to sustainable and low-carbon development goals. Drawing on international practice from OECD countries, GBT enables systematic incorporation of climate parameters in budget allocation and public investment planning, increases fiscal policy transparency, and allows assessment of the volume of budget funds directed toward climate objectives.

Thematic Bond Market and Green Finance (Global Green Growth Institute, 2026): Uzbekistan has emerged as a Central Asian frontrunner in sovereign thematic bonds, having issued a series of green and SDG-labeled bonds on international markets since 2021. Between 2021 and 2024, Uzbekistan issued sovereign international bonds totaling $1.2 billion under 'Sustainable Development Goals' and 'Green' categories. In a landmark issuance in 2023, Uzbekistan placed the first 'green' sovereign bonds in the CIS, denominated in Uzbek Soum (4.25 trillion UZS), alongside $660 million in Eurobonds. The EUR-denominated sovereign international bonds carry a formal 'Green' designation under Uzbekistan's SDG financing program — with proceeds directed to water-saving technologies, waste management, and similar priority initiatives.

In early 2025, Uzbekistan placed its next round of sovereign international bonds totaling approximately $1.5 billion, achieving total investor orders of

$4.2 billion — demonstrating strong international confidence in Uzbekistan's economic and green reform agenda. These issuances are assessed by Sustainalytics as an independent verifier, with UNDP supporting the project selection process. Reports on fund utilization continue to be published following international standards.

In the domestic market, the Uzbekistan Mortgage Refinancing Company (UzMRC) issued the first commercial green bond under newly legislated national green bond standards. The Global Green Growth Institute, working with Uzbekistan since 2019, mobilized over $1 billion in sustainable and green bonds in partnership with Uzbek banks — making it one of the largest climate finance mobilization efforts in Central Asia. Agrobank issued green bonds on the London Stock Exchange and published its first Green Bonds Allocation and Impact Report in September 2025.

The Entrepreneurship Development Company (EDC), a state-owned financial institution, has set a target of directing 35% of its funding to green projects by 2026 — using the National Green Taxonomy as an investment screening tool. State-owned financial institutions as a whole provide approximately 70% of all loans across the Uzbek economy, giving them significant leverage to redirect capital flows toward green investments.

Green Energy Certificates: A system of green energy certificates — confirming that products are manufactured using renewable energy sources — was developed and operationalized. In 2025 alone, over 446,000 green energy certificates were issued and circulated, providing market signals for clean production and supporting access to international markets for Uzbek exporters.

Financing Milestone: Through the EBRD's Green Economy Financing Facility (GEFF) Phase III, $200 million in credit funds have been directed to local banks for green lending to business entities — supporting energy efficiency upgrades, renewable energy installation, and clean technology adoption across Uzbekistan's private sector.

## VI.3 Key projects, reforms, and achievements

Uzbekistan's green economy reforms are increasingly reflected in concrete projects, financing arrangements, and sector-level results. International and bilateral partners have supported work on climate finance, decarbonization, energy efficiency, emissions trading, and green industrialization, while national programs have advanced solar deployment, energy savings, afforestation, and water resource management. These efforts show how policy commitments are being translated into practical measures across the economy.

### VI.3.1 International financial institution partnerships

Uzbekistan has established comprehensive partnerships with leading multilateral development banks and international agencies to finance and technically support its green economy transition. These partnerships span climate finance, decarbonization, energy efficiency, and emissions trading systems.

World Bank Partnerships: The iCRAFT (Innovative Carbon Resource Application for Transformation) project, implemented by the Ministry of Economy and Finance in partnership with the World Bank, has delivered significant results. In 2022-2023, as a direct result of energy tariff reforms supported by the project, Uzbekistan reduced total greenhouse gas emissions by 10 million tons of $CO_2$ equivalent. A portion of these reductions — 1 million tons — was directed toward international carbon unit trading, mobilizing $15 million in the two tranches of results-based financing.

Furthermore, Uzbekistan applied to the Climate Investment Fund's (CIF) Industrial Decarbonization Program and was ranked among the top six countries selected globally. This unlocks the potential to attract up to $250 million in concessional financing to support low-carbon industrial transformation.

In the gas sector, the 'Eliminating Gas Leaks in Uzbekistan' project, developed jointly with the World Bank and the Ministry of Economy and Finance of the Republic of Uzbekistan, aims to significantly reduce methane and technical losses from existing infrastructure. Project pre-implementation documents — including the Environmental and Social Commitment Plan (ESCP),

Environmental and Social Management Framework (ESMF), Labor Management Procedures (LMP), and Stakeholder Engagement Plan (SEP) — have been completed.

Additionally, the World Bank supported the development of Uzbekistan's Long-Term Low-Carbon Development Strategy (LTS), providing strategic analysis and pathways to decouple economic growth from greenhouse gas emissions, in line with the Paris Agreement.

Asian Development Bank (ADB) Partnerships: Under the Green Policy-Based Lending (Green PBL) program — 'Accelerating Climate Change Adaptation for Green, Inclusive and Sustainable Economic Growth' — ADB mobilized $250 million in budget support financing in 2024, with a further $250 million planned for 2026. This program supports a package of policy reforms across climate adaptation, renewable energy, water resources, and green finance.

ADB also supported the preparation of Uzbekistan's 'Export Diversification Strategy' report, to prepare for the European Union's Carbon Border Adjustment Mechanism (CBAM), and produced a comprehensive report on establishing an Emissions Trading System (ETS) in Uzbekistan, providing institutional and regulatory options for a domestic carbon market.

French Development Agency (AFD) Partnerships: In cooperation with the French Development Agency (AFD), Uzbekistan is implementing the Green Economy Policy Loan Program, which provides budget support for advancing green economy reforms.

Between 2021 and 2024, a total of €375 million in budget support and €6.1 million in grant funding were mobilized under this program. In addition, a further €200 million is planned to be disbursed during the 2025–2026 period.

Separately, technical assistance of €1.5 million is being provided to support reforms in Uzbekistan's energy policy and to develop new areas of cooperation for sustainable development under the Energy Policy and Climate Support Credit Program financed by AFD.

European Bank for Reconstruction and Development (EBRD) Partnerships: The 'Advancing Uzbekistan's Decarbonization Strategy and Green Economy Transition' project channels $200 million in EBRD credit resources through local banks under Phase III of the Green Economy Financing Facility (GEFF).

This facility supports business entities in adopting green technologies — including renewable energy installation, energy efficiency upgrades, and clean production processes — across Uzbekistan's private sector.

United Nations Partnerships: In partnership with UNDP, UNECE, and the ILO, Uzbekistan is implementing a $400,000 program on 'Supporting a Just Energy Transition in Uzbekistan', addressing social dimensions of the energy transition, including job creation and worker retraining.

UNDP is also co-financing the $500,000 'Green Economy Partnership' (PAGE) program, supporting development of a National Emissions Trading System and climate finance monitoring and evaluation frameworks.

Jointly with UNDP, Uzbekistan developed a Green Development Finance Assessment report and a Green Finance Strategy Concept, conducting comprehensive analysis of existing financial flows directed toward green development priorities and identifying needs and opportunities for additional financing.

German International Cooperation (GIZ) Partnerships: The GIZ-implemented 'Promotion of Private Sector and Economic Advice for Green Industrialization' project is providing practical support for industrial green transformation. Key activities include:

- Providing practical assistance to Mekhmash and Navoiyazot enterprises in preparing CBAM-compliant reports for European buyers.
- Conducting resource efficiency and cleaner production assessments in 89 industrial enterprises across 8 provinces (Tashkent, Fergana, Namangan, Andijan, Jizzakh, Bukhara, Khorezm, and Kashkadarya).
- Based on assessment results, achieving a 10 percent reduction in greenhouse gas emissions in 47 enterprises over one year.

Resource Savings from GIZ Assessments: Energy savings: 6.3 million kWh | Water savings: 82.4 thousand $m^3$ | Raw material savings: 1,054 tons | GHG emission reductions: 17.3 tons $CO_2$ equivalent.

### VI.3.2 Bilateral partnerships

Uzbekistan has complemented its multilateral cooperation with strategic bilateral partnerships:

- Japan: The first official meeting of the Joint Crediting Mechanism (JCM) Joint Committee was held, with rules and guidelines approved for project implementation. A seminar for more than 150 representatives of the government and private sector was held on JCM opportunities in Uzbekistan, with more than 15 major Japanese green energy and industrial companies participating.
- Hungary: A bilateral agreement on cooperation in the field of climate change was signed between the Governments of Uzbekistan and Hungary.
- Korea: Through GGGI and KOICA, $8.5 million in grant funding (2026–2030) is planned to support implementation of the Paris Agreement and Article 6 bilateral actions with Korea.
- Germany: The GIZ partnership covers green industrialization, CBAM compliance support, and $N_2O$ emissions reduction in the chemical sector. A bilateral cooperation has been established between the governments of Uzbekistan and Germany under Article 6 of the Paris Agreement.
- France: Technical cooperation through Expertise France covers fossil fuel subsidy reform, green buildings, and carbon taxation.

### VI.3.3 Energy efficiency achievements

The establishment of the National Energy Efficiency Agency under the Cabinet of Ministers represents a structural milestone in Uzbekistan's energy governance. The agency coordinates unified state policy on energy efficiency, provides methodological support, conducts energy audits, and builds an energy-efficiency project portfolio across the economy's key sectors.

Sectoral energy efficiency improvements include:

- Energy sector: Reducing technological losses in grid infrastructure; modernizing generation capacity; digitalizing energy accounting systems.

- Housing and communal services: Updating engineering systems; improving building energy performance; introducing modern energy saving standards.
- Agricultural sector: Rational use of water resources; improving pump station energy efficiency.
- Public sector: Optimizing energy consumption; developing energy passports for facilities; modernizing social infrastructure.

TABLE VI.3: UZBEKISTAN'S 2025 ENERGY SAVINGS TARGETS BY ENERGY RESOURCE

| Energy Resource | 2025 Savings Target | How Achieved |
|---|---|---|
| Natural Gas | 4.4 billion $m^3$ | Differential tariffs, energy-efficient equipment, and technical measures |
| Electricity | 6.0 billion kWh | Solar PV installation (923 MW in 2025), grid repair, and reactive compensation |

Uzbekistan has achieved remarkable momentum in renewable energy deployment. As of the end of 2025, the total installed capacity of solar photovoltaic panels nationwide reached 2,000 MW, with 4,943,700 liters of solar water heaters installed. These installations have generated 2.8 billion kWh of electricity and saved 850 million cubic meters of natural gas annually.

TABLE VI.4: UZBEKISTAN'S SOLAR ENERGY DEPLOYMENT AND SAVINGS RESULTS

| Indicator | Figure |
|---|---|
| Total solar PV capacity installed (end-2025) | 2,000 MW |
| Total solar water heaters installed (end-2025) | 4,943,700 litres |
| Annual electricity generated from solar PV | 2.8 billion kWh |
| Annual natural gas savings from solar water heaters | 850 million $m^3$ |
| Solar PV installed in 2025 alone (actual vs 784.9 MW target) | 1,026.5 MW (131% of target) |
| Solar water heaters installed in 2025 (actual vs target) | 1,738,500 liters (145% of target) |

In 2025 alone, the installation target of 784.9 MW was exceeded, with actual installations reaching 1,026.5 MW (131% of the target). Solar water heater installation also exceeded targets at 145%.

A particularly innovative initiative is the Mahalla Solar Program (PR-12, January 2025), which deploys small-scale photovoltaic stations in community neighborhoods (mahallas). In its initial phase, 18 pilot projects with a total capacity of 3.9 MW were completed by "Yashil Energiya" Ltd, and plans for 2026 envisage the construction of solar stations in 903 disadvantaged

mahallas with a combined capacity of approximately 270 MW, generating 115 million kWh annually and creating 2,709 jobs for low-income families.

### VI.3.4 Yashil Makon: The national tree planting initiative

The Yashil Makon ('Green Space') national program represents one of Uzbekistan's most visible and impactful environmental initiatives. Since its launch, over 900 million seedlings, saplings, and cuttings have been planted across the country, with a year-by-year breakdown shown in Table VI.5.

As a result of the "Yashil Makon" program and related afforestation efforts, Uzbekistan's green coverage has reached 14.1 percent of the national territory. The program has been particularly active in combating desertification and dust storms, with large-scale planting and vegetation restoration carried out in arid and degraded areas, especially in the Aral Sea Basin.

TABLE VI.5: TREES PLANTED UNDER UZBEKISTAN'S YASHIL MAKON PROGRAM

| Season/Year | Trees planted |
|---|---|
| Autumn 2021 | 86 million |
| 2022 | 203 million |
| 2023 | 220 million |
| 2024 | 227 million |
| 2025 | 266.5 million |

### VI.3.5 Water resource management

Water resource management is a critical component of Uzbekistan's green economy agenda, given the country's water scarcity challenges and dependence on transboundary rivers. In 2025, Uzbekistan achieved savings of 10 billion cubic meters of water through multiple pathways:

- Expanding cultivation of water-efficient crops and additional agrotechnical measures: 3 459 million $m^3$ saved.
- Introduction of water-saving irrigation technologies and laser land leveling: 2 910 million $m^3$ saved.
- Canal lining, irrigation network repair and reconstruction: 2 981 million $m^3$ saved.

- Introduction of information-communication and digital technologies in water management: 650 million $m^3$ saved.

Uzbekistan has also made significant advances in digital transformation in the water sector. Between 2021 and 2025, the following smart water management devices were installed: 13,272 smart water monitoring units on irrigation facilities, 12,441 "Diver" automated groundwater monitoring devices, 1,896 online flow monitoring systems on pump stations; and 106 major water infrastructure objects were fully automated.

During the 2025–2026 autumn–winter season, land preparation for salt leaching was carried out on 624.9 thousand hectares across the Republic. Of this, salt leaching was fully completed on 52.2 thousand hectares of highly saline land, 259 thousand hectares of moderately saline land, and 313.6 thousand hectares of slightly saline land.

## VI.4 Flagship initiatives with innovative and regional relevance

Uzbekistan's flagship initiatives show how the green economy agenda is being applied in practice. They cover carbon market readiness, restoration of the Aral Sea region, scientific innovation, protection of desert ecosystems, green skills development, stronger climate commitments, cleaner industrial production, and low-emission transport. Several of these initiatives also have regional relevance, as they address shared challenges in Central Asia, including water stress, desertification, emissions reduction, and sustainable connectivity.

### VI.4.1 iCRAFT: Innovative carbon resource application for transformation

The iCRAFT project — implemented with World Bank support — represents Uzbekistan's most sophisticated climate finance initiative to date. The project introduces modern carbon resource management instruments and integrates climate parameters into state planning systems and investment policy.

iCRAFT activities encompass the formation of an emissions measurement, reporting, and verification (MRV) system; the improvement of climate reporting procedures; and the creation of conditions for Uzbekistan's

participation in international carbon markets and climate financing mechanisms. Particular emphasis is placed on strengthening the institutional capacity of state bodies and developing coordination among sectoral structures.

The project's implementation contributes to the development of a modern carbon management system, increases the investment attractiveness of low-carbon projects, and strengthens Uzbekistan's position on the international climate agenda. To date, iCRAFT-supported reforms have generated verified emissions reductions of 10 million tons of $CO_2$ equivalent, while $15 million has been mobilized from the two tranches of international carbon trading.

## VI.4.2 Aral Sea restoration: A practical case for regional learning

Uzbekistan's efforts to address the ecological crisis in the Aral Sea have garnered international recognition and serve as a model for large-scale ecosystem restoration under extreme conditions. The Aral Sea region — particularly Karakalpakstan — faces the most severe environmental conditions in Central Asia: salt and dust storms from the exposed seabed, salinized soils, polluted water, and degraded ecosystems.

TABLE VI.6: ANNUAL AFORESTATION OF THE DRIED ARAL SEA SEABED

| Year | Area Planted (thousand ha) |
|---|---|
| 2019 | 461 |
| 2020 | 703 |
| 2021 | 353.5 |
| 2022 | 107.1 |
| 2023 | 127.8 |
| 2024 | 112.5 |
| 2025 | 115 |

The Aral afforestation program has planted drought and salt-tolerant species — primarily Haloxylon — across the dried seabed, creating living windbreaks that stabilize salt dust and begin ecological recovery. Annual planting figures since 2019 are presented in Table VI.6. The cumulative total of protective forest plantations in the Aral Sea Basin now stands at 1.98 million hectares — a world-leading achievement in environmental restoration under extreme arid conditions.

### VI.4.3 Aral Sea International Innovation Centre

Established in October 2018 under the President of Uzbekistan, the Aral Sea International Innovation Centre (ASIIC) serves as the scientific and innovation hub for addressing ecological challenges in the Aral Sea Basin. The Centre has signed cooperation agreements and memoranda with over 70 foreign and domestic organizations.

Key infrastructure assets include: the "Samanbay" scientific-production site (24.3 ha) in Nukus district, specializing in experimental and trial research; the "Muynak" scientific-production site (106 ha), focused on testing salt and drought-tolerant plants; and a laboratory complex with a plant seed gene bank worth 12.4 billion sums, completed and commissioned in 2024.

ASIIC is currently implementing 20 local and international projects with a combined value of 23.9 billion sums, targeting improvements in living standards, salt and drought-resistant crops, resource-saving technologies, and ecosystem restoration. Key international partners include UNDP, ICBA (UAE), the Xinjiang Institute of Ecology and Geography (China), GIZ (Germany), GGGI, KOICA (Korea), and JICA (Japan).

### VI.4.4 UNESCO World Heritage: Turan Deserts designation

In September 2023, at the 45$^{th}$ session of the UNESCO World Heritage Committee in Riyadh, Saudi Arabia, the transboundary natural site 'Temperate-Zone Turan Deserts' (encompassing territories of Uzbekistan, Kazakhstan, and Turkmenistan) was inscribed on the UNESCO World Natural Heritage List. Uzbekistan's portion encompasses over 2 million hectares, including the Aral Sea Basin and the Ustyurt Plateau.

This inscription subjects the territory to the protections of the 1972 Convention on the Protection of the World Cultural and Natural Heritage and opens opportunities for international cooperation in the effective management of the site and the conservation of its unique flora and fauna, including the Saiga antelope, whose local populations remain a conservation concern.

Additionally, Uzbekistan became the first Central Asian country to register its centuries-old and relic trees on the international MonumentalTrees.com

registry, with over 30 trees listed — including a 1,500-year-old Sharq Biota in Jizzakh, a 1,160-year-old Chinar plane tree in Samarkand, and a 1,000-year-old juniper in Tashkent province.

### VI.4.5 Green University: Building human capital for sustainability

The Central Asian University for Environment and Climate Change Studies — the 'Green University' — was established under the Ministry of Ecology and operates on the 'Hub and Spoke' model. It is linked to 14 Green Technical Colleges (Yashil texnikumlar) across all regions of Uzbekistan, operating on a dual-education model combining theoretical study with practical industrial training.

In the 2025/2026 academic year, 1,080 admission places were approved in 'ecology and environmental protection' and 'waste processing and management' specializations, with 796 students enrolled. The Green University also launched a 'Circular Economy' educational track — the first such program in the region.

### VI.4.6 NDC 3.0: Ambitious climate commitments

Uzbekistan has officially submitted its Updated Nationally Determined Contribution 3.0 (NDC 3.0) under the Paris Agreement on climate change. In line with its national circumstances and capacities, the country has committed to achieving a 50 percent reduction in specific GHG emissions (emissions intensity) per unit of GDP by 2035, compared to 2010 levels.

Uzbekistan is scaling up with key commitments that will redefine its development trajectory:

- Expanding renewable energy;
- Greening cities and homes;
- Restoring ecosystems;
- Managing waste sustainably;
- Decarbonizing transport;
- Mainstreaming nature-based solutions (NBS) as one of the priority approaches;
- Embedding gender equality and social inclusion dimensions in climate action.

NDC 3.0 was developed through a broad stakeholder consultation process involving ministries and agencies, international financial institutions, UN agencies, civil society organizations, the private sector, and youth representatives. The NDC was published on the UNFCCC portal in both Russian and English.

Transparency Commitment: Uzbekistan submitted its first Biennial Transparency Report (BTR) to the UNFCCC Secretariat on 31 December 2024, covering the 1990–2022 GHG inventory and fulfilling obligations under the Paris Agreement's Enhanced Transparency Framework (ETF).

## VI.4.7 Green industrial chemistry: Chemical sector transformation

Uzbekistan's chemical sector — represented by Uzkimyosanoat JSC — has made significant strides in green transition during 2019–2025. Energy savings achieved substantially exceeded targets as indicated in Table VI.7:

TABLE VI.7: ENERGY SAVINGS IN UZBEKISTAN'S CHEMICAL SECTOR

| Year | Natural Gas Saved (mln $m^3$) | Achievement vs Target | Electricity Saved (mln kWh) | Achievement vs Target |
|---|---|---|---|---|
| 2022 | 32.3 | 154% | 27.8 | 204% |
| 2023 | 21.2 | 106% | 18.9 | 144% |
| 2024 | 59.7 | 319% | 20.5 | 160% |
| 2025 | 78.2 | 435% | 30.8 | 249% |
| TOTAL (2022-2025) | 191.4 | — | 98.0 | — |


A landmark green chemistry achievement is the launch of a 'Green Hydrogen' production project at Maxam-Chirchiq JSC. Under Presidential Resolution PR-82 (February 2024), ACWA Power's subsidiary 'ACWA Power UKS Green $H_2$' is implementing a project comprising a 52 MW wind power station and green hydrogen production. All equipment has been installed and construction completed. The project plans to produce 16,000 tons of green ammonia annually at Maxam-Chirchiq — making Uzbekistan one of the first countries in Central Asia to produce industrial-scale green ammonia.

In the phosphate chemicals subsector, a flagship waste valorization project converts phosphogypsum — a large-volume industrial byproduct — into sulphuric acid at a planned capacity of 400,000 tons per year, processing 1.4 million tons of wet phosphogypsum annually. With an investment of $140 million, this project exemplifies the circular economy principle and addresses a major industrial waste challenge in the Tashkent region.

Within the framework of the project, negotiations are underway with leading companies worldwide on technological solutions. In particular, proposals from companies such as HQC Company and Shandong Shengri Group (China) have been studied, and the production costs have been analyzed.

Today, Uzkimyosanoatloyiha JSC has developed a Feasibility Study (FDS) for the project, which aims to optimize production costs and introduce advanced technologies (for example, the experience of Shandong Lubei Enterprise Group).

The phosphogypsum processing project will not only diversify the chemical industry's raw material base but also serve as an example of introducing the principles of “clean production” by addressing the problem of technogenic waste in the region.

## VI.4.8 Green transport transition: Results and prospects

As part of Uzbekistan’s transition to a green economy, the transport sector has undergone significant modernization to reduce emissions and increase the share of eco-friendly public transport. Between 2019 and 2025, a total of 4,682 modern buses and electric buses were purchased nationwide, comprising 4,020 buses and 662 electric buses. This initiative aims to reduce the negative impact of motor vehicles on atmospheric air while increasing the attractiveness of public transport.

In Tashkent, 526 electric buses now operate across 44 routes, serving 360,000–400,000 passengers per day. Reforms have reduced bus intervals from 18–20 minutes to 8–10 minutes, while daily passenger flow increased by 215.3% to 1.4 million (up from 650,000). The share of public transport in total passenger volume rose from 18% to 38.5%, and average transport speed increased from 18 km/h to 21 km/h. Additionally, 96 electric buses were procured for Samarkand and 40 for Andijan.

The first BRT (Bus Rapid Transit) system in Uzbekistan was launched on Shota Rustaveli Street in October 2025, featuring dedicated bus lanes. Results include a 40% increase in bus trips (from 2,069 to 2,868), a doubling of passenger numbers to 300,000 (from 150,000), a 32% reduction in travel time (from 25 to 18 minutes), and improved bus speeds from 18.5 km/h to 23.6 km/h, with intervals shortening to 7 minutes. Additionally, 1,521 km of bicycle lanes have been constructed nationwide.

The metro system has also expanded, with line length growing from 38 km to 70.8 km and the number of stations increasing from 29 to 50 between 2016 and 2026. New rolling stock acquisitions have reduced train intervals from 7 to 5 minutes, and daily ridership has reached 870,000. In the railway sector, electrification has reached 53%, with modern electric trains like “Afrosiyob” and “Jaloliddin Manguberdi” replacing diesel locomotives.

These reforms support the strategic objectives outlined in Presidential Resolution No.PR-4477 and are aligned with the 2030 green economy targets, contributing to reduced carbon emissions, lower fuel consumption, and improved urban environmental quality.

## VI.5 Environmental monitoring and governance

Uzbekistan has also strengthened the governance side of its green economy agenda through better monitoring, digital tools, public access to environmental data, and stronger accountability mechanisms. Recent reforms cover air quality, hydrometeorology, waste management, ecological ratings for cities, industrial pollution controls, and forestry expansion, giving state institutions a clearer basis to track environmental risks and respond more systematically.

## VI.5.1 Digitalization of environmental monitoring

Uzbekistan has systematically developed its environmental monitoring infrastructure, combining expanded physical monitoring networks with advanced digital platforms:

*Monitoring Networks*

- Automatic weather stations transmitting to WMO database: 79 stations.
- Hydrometeorology and agrometeorology stations and posts: 392 total.
- Meteorological stations: 88 units.
- Avalanche monitoring stations: 7 units.
- Hydrology posts: 143 units.
- Agrometeorology posts: 40 units.
- Meteorological radar network: 7 units.
- Ambient air pollution monitoring stations: 66 points.
- Environmental monitoring facilities: 800 objects (1.3x increase since 2020).
- Automated monitoring network share: 73%.

*Digital Platforms Deployed*

- gis.uznature.uz — Unified geoinformation data platform for environmental monitoring.
- tozamakon.eco — Billing system for household waste collection and removal services, with GPS tracking of more than 4 500 waste vehicles.
- eco-service.uz — Unified automated information system for environmental impact assessment.
- fund.uznature.uz — Electronic system for tracking compensation payments, violations, and related fees.
- yashilmakon.eco — Portal for tree planting monitoring and control of illegal tree felling.
- gov.uz/eco — Ecology Portal for public information and environmental awareness.
- monitoring.meteo.uz and data.meteo.uz — Geoportals for real-time air quality and hydrometeorological data visualization.

- greencities.uz — Platform for urban ecological passport ratings, covering Nukus, Tashkent, and all provincial capitals

### VI.5.2 Ecological passports and green cities

Under Presidential Decree PD-106 (July 2024), ecological passports were developed for Nukus, Tashkent, and all provincial capitals based on 2024 data. These passports integrate environmental quality indicators across air, water, soil, green space, and waste management dimensions, and serve as the basis for calculating ecological ratings for cities and districts. The greencities.uz platform makes these ratings publicly accessible, promoting competitive improvement among local governments.

### VI.5.3 Polluter pays principle and industrial accountability

Resolution No. 783 of the Cabinet of Ministers (November 2024) introduced amendments to the economic mechanisms of environmental protection, strengthening industrial ecological liability and raising environmental pollution fee rates. This formalized implementation of the 'polluter pays' principle in Uzbekistan's regulatory framework creates stronger financial incentives for enterprises to reduce emissions and invest in cleaner technologies.

Between 2021 and 2025, state environmental monitoring covered the following number of enterprises: 685 (2021), 777 (2022), 813 (2023), and 737 (2024–2025). Control work encompasses atmospheric emissions (monthly), wastewater (quarterly), and soil pollution (twice yearly). By 2025, monitoring coverage had increased by 7.6% compared to 2021 levels.

### VI.5.4 Forestry expansion

Uzbekistan's forestry sector has implemented an ambitious program of forest establishment, restoration, and commercial development during 2020–2025:

- Afforestation and shrub coverage expansion: 1,731,000 hectares over the past 5 years.
- Seed reserves accumulated: 9,388 tons of seeds suited to local soil and climate conditions.

- Nursery capacity: 700.4 million seedlings grown across 1,300 hectares of nurseries.
- Protective forest belts established in desert and foothill zones: 15,227 hectares.
- Medicinal and food plants harvested: 49,286 tons of raw materials; 136,079 tons of agricultural produce.
- Land reclaimed from degraded status: 34,566 hectares reintroduced into productive use.
- Foreign investment in forestry: $69.3 million mobilized and utilized during the period.

## VI.6 Sector-specific green economy initiatives

Uzbekistan's green economy reforms are also being applied within specific sectors where environmental pressures and efficiency gains are most visible. In oil and gas, construction, and land reclamation, the focus has shifted toward cleaner production, lower energy use, updated technical standards, reduced emissions, and better soil and water management. These measures show how national green economy priorities are being translated into sector-level reforms.

### VI.6.1 Oil and gas sector: Greening energy production

Uzbekneftegaz JSC — Uzbekistan's national oil and gas company — has joined the Caspian Methane Emissions Accelerator initiative in 2025 to develop cooperation between the Republic of Uzbekistan and Turkic countries on the transition to a green economy, and has implemented a comprehensive program of ecological modernization, including:

- Deployment of 30 MW total solar photovoltaic capacity and 113,900 liters of solar water heaters across company facilities.
- Modernization of the Bukhara Oil Refinery (BNOZ): Transition to full Euro-5 standard fuel production, processing over 1 million tons of AI-92 and AI-95 high-octane petrol annually.
- From September 2025, complete cessation of Euro-2 standard AI-80 petrol production, transitioning to cleaner fuels.

- Utilization of flare gases at Bukhara Oil Refinery (BNOZ): 443.6 tons of fuel gas were utilized instead of being burned off, saving 1,267,429 $m^3$ of natural gas in 2025.
- Atmospheric emissions in 2025 were 70,200 tons below established standards.
- Yashil Makon program contribution: 407,9 trees planted in 2025, achieving 117% of the plan.
- From September 2023, the LDAR (leak detection and repair) program for finding and eliminating methane leaks throughout the entire upstream and downstream processes is being used.

### VI.6.2 Green buildings and construction standards

The Ministry of Construction and Housing & Communal Services has incorporated green standards into building regulations. Key achievements include:

- Revision of QMQ 2.01.04 'Construction Thermal Engineering' and SHNQ 2.01.18 'Energy Consumption Norms for Heating, Ventilation and Air Conditioning of Buildings and Structures' to enhance energy efficiency requirements.
- Presidential Resolution PR-100 (March 2025) set binding targets for the next 5 years of building energy efficiency, including: reducing household gas consumption by at least 20% through local boiler installation and alternative technologies in multi-story buildings; incentivizing the installation of energy-efficient appliances.
- Development of a 'Green Building Assessment and Certification' procedure (in final regulatory approval).
- Adoption of updated standards for autoclave-cured aerated concrete, gas-concrete blocks, foam insulation panels, and fiber-reinforced concrete.
- Introduction of SHNQ 2.04.15-23 'Photovoltaic Stations (Systems)' and integration of solar energy requirements into residential building design standards.
- Adoption of 'Green Standards for Individual Green Housing Construction' and 'Green Standards for Multi-Apartment Buildings' — establishing

methodologies and criteria for design, construction, and operational assessment.

- Development of SHNQ 2.01.05-24 'Natural and Artificial Lighting' incorporating smart lighting system requirements and energy-efficient lamp standards.

### VI.6.3 Meliorations and soil improvement

Addressing soil salinization — a critical agricultural and environmental challenge — Uzbekistan has implemented extensive reclamation works during 2020–2025:

- Construction and reconstruction of 2,398 km of open and 1,003 km of closed underground collector networks.
- Installation of 360 hydraulic structures, 322 vertical drainage wells, 9 melioration pump stations, and 46 monitoring wells.
- Saline leaching operations on 739,200 hectares during the 2020–2025 autumn-winter seasons.
- Monitoring of groundwater levels and mineralization through 27,377 control wells.

*Net results:*

- Salinized areas reduced by 95,100 hectares; severely and moderately salinized irrigated lands reduced by 85,100 hectares;
- Problematic groundwater zones reduced by 359,200 hectares;
- Total: 895,776 hectares returned to productive agricultural use;
- Automated groundwater monitoring: 12,390 Diver monitoring devices installed, with 75% continuously transmitting data.

## VI.7 Cooperation with Turkic states on green economy

Uzbekistan's green economy cooperation with Turkic states is developing through both multilateral and bilateral channels. The agenda covers practical areas where the member states share similar needs, including renewable energy, energy efficiency, water conservation, climate finance, carbon markets, industrial adaptation, digital monitoring, and human capital

development. This cooperation gives Uzbekistan an opportunity to share its own reform experience while also supporting wider regional responses to climate and resource pressures.

### VI.7.1 Framework for Turkic state green cooperation

Uzbekistan has been actively developing green economy cooperation with Turkic states within the framework of the Organization of Turkic States and bilateral channels. Cooperation spans sustainable energy, climate policy, resource efficiency, and investment attraction. Multilateral cooperation focuses on developing low-carbon development strategies and implementing projects in renewable energy, energy efficiency, and sustainable infrastructure.

A concrete practical result of this cooperation is the 'Closing Climate Finance Gaps in Central Asia' project being implemented with GGGI, supported by GIZ and UKFCDO grants for 2025–2026. The project has hosted presentations for the banking sector, concluded cooperation memoranda, and identified participating pilot banks — including the Business Development Bank (BDB), which is considering issuing sustainable Eurobonds in 2026.

### VI.7.2 Specific Proposals for Turkic State Cooperation

Uzbekistan has developed a comprehensive set of proposals for deepening Turkic State cooperation across five thematic areas:

*Water conservation*

- Exchange of best practices on water-saving technology deployment and development of common approaches.
- Reduction of water losses in irrigation systems through infrastructure modernization, improved operation, and updating technical norms.
- Coordination of economic incentives and institutional measures to support rational water use.
- Expansion of low water-demand agrotechnology in agriculture and popularization of approaches to increase water productivity.
- Strengthening cooperation on ecosystem resilience — addressing erosion, salinization, and drainage challenges — to protect water resources.

*Developing cooperation on carbon markets and climate finance*

- Expanding cooperation on carbon credit trading under Article 6 of the Paris Agreement.
- Implementing joint carbon projects and mobilizing green bonds and grants.

*Greening industry and adapting to environmental requirements for access to external markets*

- Adapting to the requirements of the European Union's Carbon Border Adjustment Mechanism (CBAM).
- Introducing emission reporting systems in exporting enterprises and certifying green products.

*Human capital development*

- Coordination of training and retraining programs for water management specialists, considering climate change impacts.
- Joint training courses and internships for technical and management cadres in water accounting, operation, dispatching, monitoring, and analysis.
- Expanding academic cooperation, internships, and exchange of educational courses among scientific organizations and educational institutions.
- Formation and introduction of unified competency standards for modern water management.
- Systematic organization of scientific-practical forums and specialist dialogue to attract young cadres and develop innovative thinking.

*Digitalization*

- Strengthening the role of digital monitoring and accounting in water resource management, improving data quality.
- Coordinating approaches to data collection, processing, and analysis to ensure transparency in water accounting and distribution.
- Gradual integration of existing information systems, creating data exchange standards and harmonization.
- Enhancing drought and water scarcity risk assessment and forecasting using remote sensing and satellite data.

- Developing data analytics and digital decision-making culture for cybersecurity, data protection, and evidence-based governance.

*Renewable energy and energy efficiency*

- Exchange of 'best practices' on distributed SRES (rooftop solar, solar water heaters) with standardized technical requirements and calculation methodologies to accelerate regional programmed rollout.
- Joint training programs and certification systems for energy auditors and efficiency specialists across enterprises and social sector facilities.
- Joint pilot projects on energy storage, reactive power compensation, SCADA, and digital dispatching solutions to ensure grid stability with growing SRES share.
- Activation of cooperation platforms for climate finance instruments (grants, concessional credit, guarantees, results-based financing) and carbon market readiness and MRV system harmonization.
- Formation of a joint 'adaptation portfolio' for increasing energy infrastructure resilience to climate risks, including grid modernization and regional projects reducing losses and improving resource efficiency.

## VI.7.3 Uzbekistan's experience as a regional model

Uzbekistan's achievements in deploying distributed renewable energy provide a practical model for Turkic State partners. In 2023–2024, 971.8 MW of solar panel capacity was installed; in 2025, the 923.7 MW target was exceeded at 117.6%, bringing total installed solar PV capacity to 1,895.5 MW. Over 2023–2025, solar water heater installations totaled 4,840,000 liters.

These practical results — achieved through targeted incentivization of distributed SRES across households, social sector, and business entities; differential tariffs; and systematic technical and organizational measures — can serve as a replicable model for Turkic State partners undertaking similar transitions.

Future priority actions in Turkic State cooperation include: developing a joint 'technical standards and methodologies' package for distributed SRES; implementing joint training programs and certification systems for energy auditors; conducting joint pilot projects on grid stability with high SRES

penetration; and establishing a permanent 'Green Energy and Energy Efficiency' working group within the Turkic States framework.

## VI.8 Opportunities

Uzbekistan's green economy agenda creates several practical opportunities for the next stage of reform. These opportunities are linked to carbon markets, green hydrogen, export competitiveness under new environmental trade rules, and eco-tourism based on natural heritage. Each area builds on reforms and projects already underway.

### VI.8.1 Strategic opportunities

Uzbekistan is well-positioned to capture several significant opportunities in the coming years:

International carbon markets: Uzbekistan is positioning carbon market mechanisms as a strategic instrument for achieving its nationally determined contribution (NDC) under the Paris Agreement. The legislative framework established under Presidential Decree No. PD-110 enables the country to participate in international carbon markets, including mechanisms under Article 6, and provides the basis for the transfer of internationally transferred mitigation outcomes (ITMOs) and the application of corresponding adjustments.

International cooperation plays a key role in this approach. Uzbekistan is actively developing bilateral cooperation on carbon market mechanisms under Article 6 with Japan (JCM), Korea, Germany, and Hungary.

By scaling up climate projects, Uzbekistan aims to both meet its domestic NDC commitments and leverage international carbon markets to mobilize additional financing, technology transfer, and expertise for low-carbon development.

Green hydrogen economy: The pilot green hydrogen project at Maxam-Chirchiq demonstrates proof-of-concept for green ammonia production using wind energy. As global demand for green hydrogen and its derivatives grows — particularly in the context of European decarbonization and CBAM implementation — Uzbekistan's renewable energy resources and existing

chemical industry infrastructure position it as a potential future green hydrogen exporter.

CBAM compliance and export market access: The European Union's Carbon Border Adjustment Mechanism (CBAM) is creating new competitive dynamics for Uzbek exporters, particularly in sectors with high carbon intensity, such as steel, aluminum, and fertilizers. Companies already engaging with CBAM reporting — with GIZ support — are ahead of the curve. Systematic CBAM compliance across export-oriented industries can be positioned as a competitive advantage, protecting market access and reducing future compliance risks in European markets.

Eco-tourism and natural heritage: The UNESCO inscription of the Cold Winter Deserts of Turan and the development of National Natural Heritage lists open opportunities for sustainable eco-tourism development, particularly in the Aral Sea region, Ustyurt Plateau, Western Tian Shan, and mountain biodiversity hotspots. Eco-tourism can provide alternative livelihoods for communities in environmentally vulnerable areas while incentivizing conservation.

## Conclusion

Uzbekistan's green economy transition stands out as one of the most comprehensive and multi-dimensional in Central Asia and the broader Turkic world. Over the six-year period 2019–2025, the country has moved from policy declaration to operational implementation across energy, industry, water, forestry, agriculture, urban development, and international climate engagement.

The 2025 milestones — the Law on Limiting Greenhouse Gas Emissions, the establishment of a legal framework for participation in international carbon markets, the updated NDC 3.0, the first Biennial Transparency Report, the submission of National Adaptation Plans, and participation in COP-30 — mark Uzbekistan's maturation as an internationally credible climate actor. The establishment of domestic carbon market infrastructure, green budget tagging, national green taxonomy, and green energy certificates signals the transition from ad hoc green projects to systemic green economic governance.

Flagship achievements such as 900 million trees planted under the "Yashil Makon" program, 2,000 MW of solar capacity installed, 10 billion cubic meters of water saved, 2.586 million hectares of Aral Sea Basin afforestation, and UNESCO World Heritage inscription of the Turan Deserts demonstrate that Uzbekistan's green ambitions are being translated into measurable outcomes on the ground.

International partnerships — with the World Bank, ADB, EBRD, AFD, GGGI, GIZ, the UN system, Japan, Hungary, Korea, and Germany — have provided both financial resources and knowledge transfer, accelerating the transition. The mobilization of more than $1.2 billion in international financing for green economy programs to date represents a significant achievement in attracting climate finance.

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CHAPTER VII

# Green Economy Transition in Hungary

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## Introduction

Hungarian meteorological observations show that temperature extremes, droughts, and water shortages now occur more often than before. These changes directly affect the ability of natural and economic systems to adapt. Agriculture is especially affected, as it depends strongly on weather conditions and water availability (HungaroMet, n.d.; Kovács, 2025).

Analyses dealing with the impacts of climate change also point out that extreme weather events play an increasingly important role. In the case of Hungary, such events are expected to remain a determining factor in environmental processes in the coming years (Kovács, 2025).

Hungary's energy policy and climate strategy are also changing. The National Energy and Climate Plan, together with other long-term strategic documents looking ahead to 2050, defines the main directions related to decarbonisation, including improving energy efficiency and expanding the use of renewable energy sources (NECP, 2024; GPC, 2024).

The transition to a green economy does not affect only the energy sector. Structural changes are also required in other parts of the economy, including transport, industry and agriculture.

Hungarian agriculture is particularly sensitive to the impacts of climate change. For this reason, adaptation measures and innovation-based solutions have become more important in recent years. Both the European Union's common agricultural policy and Hungarian policy instruments

support more sustainable forms of production, the wider use of precision technologies, and improvements in water and soil management practices (EC, n.d.; MFK, n.d.).

In this complex environment, Hungary's green transition is not important only from an environmental point of view. It also has economic and social relevance. The aim of this chapter is to give an overview of the main environmental challenges in Hungary, the related strategic policy frameworks, and sectoral developments. In addition, the chapter presents some good practices and innovative solutions that may help to improve the adaptability and competitiveness of the Hungarian economy.

## VII.1 Environmental and climate challenges facing Hungary

Hungarian climate analyses particularly emphasise that, based on long-term observation data, changes in the climate system have become increasingly apparent in recent decades. According to HungaroMet's climate assessments, clear trends include increased temperatures, more frequent extreme weather events, and temporal and spatial shifts in precipitation distribution (HungaroMet, n.d.). The assessments emphasise that these changes do not affect all regions of the country equally, but that eastern Hungary and the Great Plain are particularly vulnerable due to prolonged drought and water shortages.

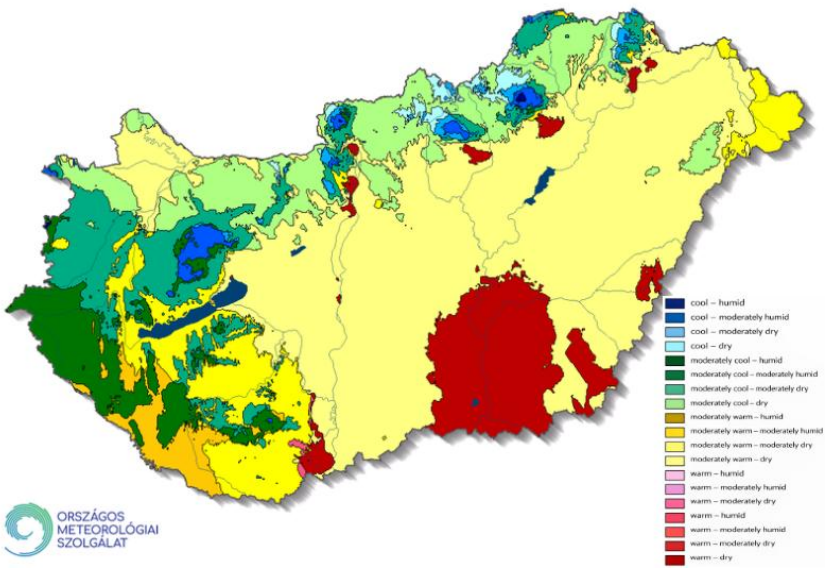
Hungarian climate analyses highlight that weather patterns observed in recent years differ clearly from earlier averages. Recent conditions do not fully follow what was previously considered normal. According to the Climate Policy Institute's climate forecast for 2025, extreme weather events appeared again in the 2024–2025 period. This happened even though the pace of warming was slightly lower than in the previous year (Kovács, 2025).

The analysis shows that meteorological extremes are becoming more frequent in Hungary's climate system. These include prolonged droughts, heatwaves, and sudden episodes of intense precipitation (Kovács, 2025).

The spatial imprint of long-term observations is also illustrated by the changes in Hungary's climatic zones when comparing the reference periods 1961–1990 and 1991–2020 (Maps VII.1–VII.2).

MAP VII.1: CLIMATIC REGIONS OF HUNGARY - A

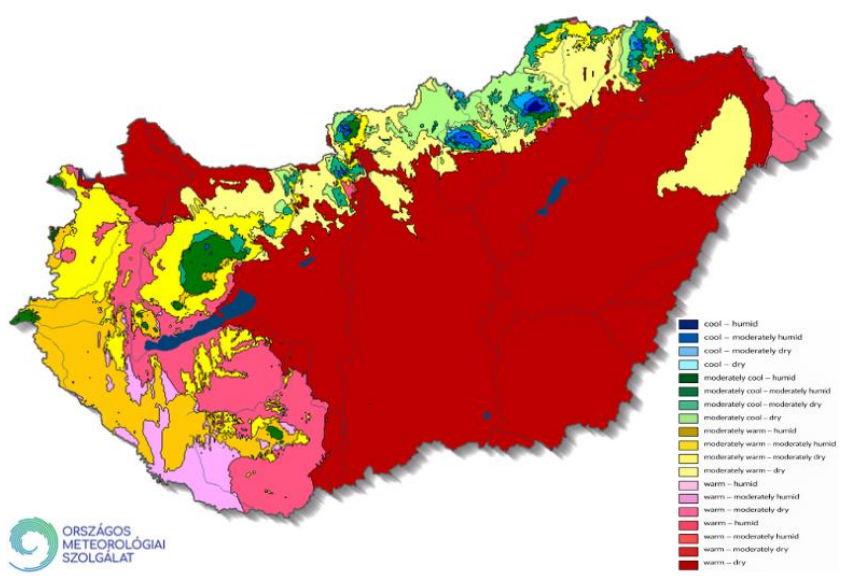
(BASED ON THE PÉCZELY CLASSIFICATION, 1961–1990 REFERENCE PERIOD)




Source: HungaroMet.

MAP VII.2: CLIMATIC REGIONS OF HUNGARY - B

(BASED ON THE PÉCZELY CLASSIFICATION, 1991–2020 REFERENCE PERIOD)




Source: HungaroMet.

Map VII.1 shows the spatial distribution of Hungary's climatic regions based on the Péczely classification for the 1961–1990 reference period. It reflects long-term average climate conditions from this earlier period. In this sense, it serves as a historical baseline for describing regional climate characteristics across the country.

The map distinguishes between humid, moderately dry, and dry climatic zones. In this way, it offers a reference point. It can be used to examine later climatic shifts and longer-term environmental changes.

Map VII.2 shows the updated spatial pattern of Hungary's climatic regions based on the same classification for the 1991–2020 reference period. Compared to the earlier reference period, clear changes are evident. The extent of drier climate types has increased, while more humid regions have become less widespread. These shifts point to longer-term changes in Hungary's regional climate structure. They also provide concrete evidence of growing climate-related pressures that are relevant for environmental and sectoral policy planning.

Beyond changes in average temperatures, seasonal dynamics are also shifting. Climate trends presented by HungaroMet indicate that warmer seasons are becoming longer. At the same time, winter periods are increasingly mild and bring less precipitation. These changes have both environmental and economic consequences. They include declining water resources and reduced soil moisture (HungaroMet, n.d.). This is particularly important for agriculture, where production conditions depend strongly on seasonal water availability and temperature patterns.

The more frequent occurrence of extremes also draws attention to the issue of adaptability. Alternating periods of low rainfall and sudden, intense precipitation can trigger unfavorable soil processes. These processes can reduce the water retention capacity of agricultural soils. Heat waves create additional pressure as well. They place strain on energy infrastructure, increase cooling demand, and indirectly add to the vulnerability of ecological systems.

Hungarian climatological and meteorological analyses emphasise that Hungary is likely to face serious challenges in the coming decades. According to these data, the expected impacts extend beyond the direct effects of extreme weather events and increasingly affect water management systems,

agricultural production structures and food security. The analyses highlight that adaptation to climate change is therefore not only an environmental issue, but also a strategic economic policy question, which requires policy and technological responses that are discussed in more detail in later chapters.

## VII.2 The strategic framework and institutional background of the national green transition

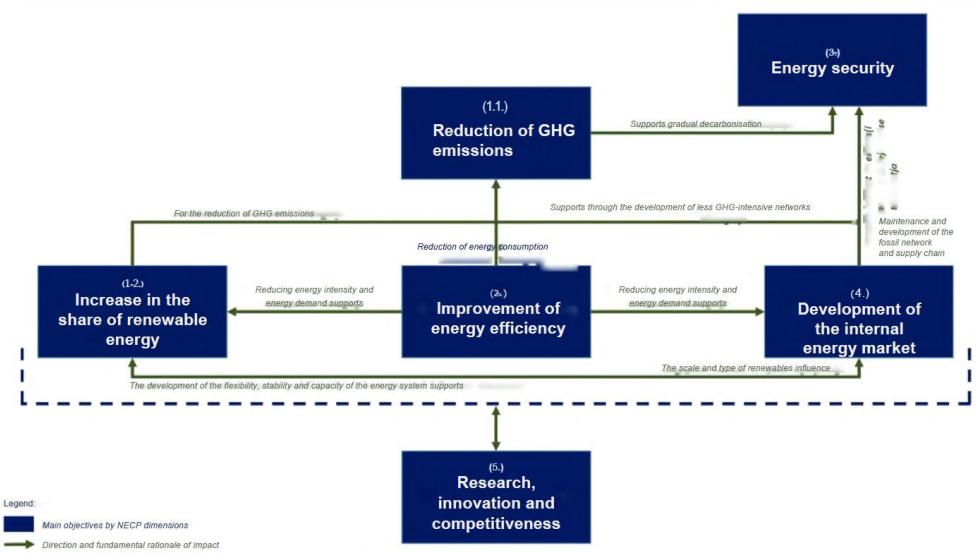
Hungarian policy analyses emphasise that the basis of the country's green transition is set out in strategic documents addressing the transformation of the energy system, climate change adaptation, and long-term sustainability goals within an integrated framework. Among these documents, the National Energy and Climate Plan (NECP) and Hungary's climate strategy extending to 2050 are considered the most important points of reference. Official parliamentary documents and professional analyses also emphasise that Hungary's climate and energy strategy is aligned with the European Union's long-term climate policy objectives (NECP, 2024; GPC, 2024).

The NECP sets out Hungary's energy and climate policy framework up to 2030. It defines the main policy directions for reducing greenhouse gas emissions, increasing the share of renewable energy sources, and improving energy efficiency. These objectives are presented as part of an integrated structure rather than as separate strands. Figure VII.1 illustrates how the objectives and policy dimensions of Hungary's National Energy and Climate Plan relate to one another. It combines greenhouse gas emission reduction, a higher share of renewable energy, stronger energy efficiency, development of the internal energy market, and energy security within a single framework. The figure also points to the role of research, innovation, and competitiveness across several policy areas in supporting climate and energy goals.

Figure VII.1 reflects a systemic approach. It indicates that progress in one area depends in part on progress in others, and that coordination across policy dimensions can strengthen results when measures are implemented consistently. The NECP's objectives seek to balance several considerations at the same time. These include sustainability, security of energy supply, and the need to preserve economic competitiveness. The plan also identifies priority areas for further development, including energy-efficient buildings,

expansion of the electricity grid, and targeted support for industrial sectors affected by the transition (NECP, 2024).

FIGURE VII.1: THE NECP OBJECTIVE AND MEASURE FRAMEWORK




Source: NECP (2024).

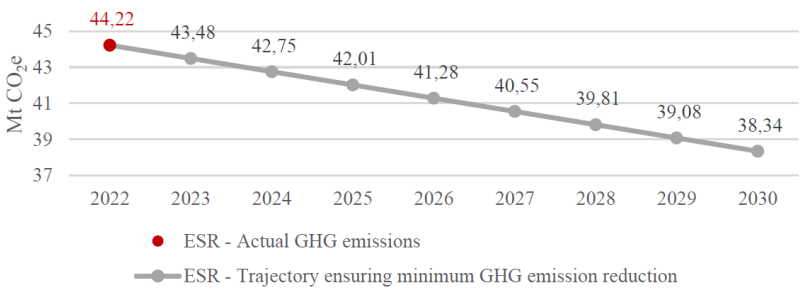
The long-term climate strategy guidelines for 2050 place strong emphasis on Hungary's move towards carbon neutrality. An analysis prepared by the Green Policy Center points out that Hungarian strategic planning follows European Union expectations in this respect. It describes a transition that requires broad modernisation across the economy. Particular attention is given to reducing emissions from energy production, transport, industrial activities and agriculture (GPC, 2024).

The emission reduction pathway that is considered necessary under this strategy is presented in Figure VII.2, which illustrates the projected trajectory of greenhouse gas emission limits in Hungary's Effort Sharing Regulation (ESR) sector up to 2030, expressed in million tonnes of $CO_2$ equivalent per year. It compares the actual emission level recorded in 2022 with the minimum reduction pathway required to meet national and European Union climate targets. The downward trend highlights the scale and pace of emission reductions necessary in non-ETS sectors, underlining the importance of coordinated policy measures across energy, transport, and

industrial activities to ensure compliance with the National Energy and Climate Plan.

Starting from the 2022 level of 44.22 Mt $CO_2$eq, the emissions ceiling falls year by year and reaches 38.34 Mt $CO_2$eq by 2030. That equals a cumulative cut of 5.88 Mt $CO_2$eq, or about 13.3%, over the period (Figure VII.2). The path is steady rather than abrupt, so Hungary needs annual reductions across the decade instead of deferring action to the final years. Delays in the earlier years would narrow the room for compliance and place heavier pressure on ESR sectors later in the decade.

FIGURE VII.2: GHG EMISSION LIMITS IN THE ESR SECTOR
(UP TO 2030)




Source: NECP (2024).

The importance of the long-term strategy lies in the fact that it sets out the directions for structural transformation that public policies, financing programs, and technological innovations should follow.

The institutional background involves several actors whose coordinated operation is necessary to achieve green transition goals. Government departments, ministries responsible for energy policy, research institutes, and analytical organizations all play a role in climate policy coordination. An analysis by the Green Policy Center points out that the Hungarian institutional system is complex, as EU and national resources, support mechanisms, and policy frameworks together determine implementation (GPC, 2024).

Overall, Hungary's strategic framework for green transition is based on clearly defined policy objectives that reflect both the specific characteristics of the Hungarian economy and EU expectations. The NECP and long-term climate

strategy documents provide the planning basis on which the sectoral transitions presented in the following chapters can be built.

## VII.3 Green transitional reforms by sector

The green transition requires simultaneous structural transformation in several economic sectors. In order to meet its climate policy goals, Hungary has defined interventions in the energy, transport, and industry sectors that are in line with European Union efforts and the National Energy and Climate Plan (NECP, 2024; GPC, 2024). The following reviews the main areas of reform in these three sectors based on available policy and analytical documents.

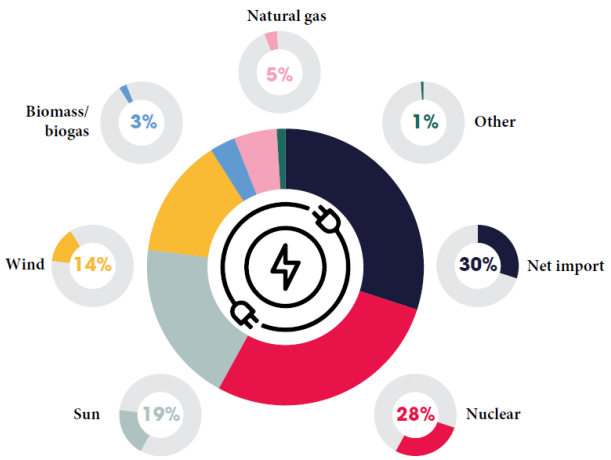
### VII.3.1 The transformation of energy production and energy consumption

The transformation of the Hungarian energy system plays a central role in the green transition. This issue is discussed in Energy Background (Egyensúly Intézet, 2023a), which looks at the main challenges currently facing the energy sector. It also outlines the directions in which further development is considered necessary. One key point of the document is that increasing the share of renewable energy sources is a central objective of this process. At the same time, it stresses that developing the electricity grid is necessary to achieve medium-term goals.

In addition, the study points out that greater system flexibility and strengthened energy efficiency measures are important parts of the sector's transition. These elements are closely linked to each other and together shape the expected changes in the energy system. The projected structural transformation of Hungary's electricity system is presented in Figure VII.3.

Figure VII.3 shows how Hungary's final electricity consumption is expected to be structured by 2030. It presents the relative shares of nuclear energy, renewable energy sources such as solar, wind and biomass or biogas, as well as fossil fuels and net electricity imports. The projection reflects the planned transformation of the Hungarian energy system. It is aligned with national climate objectives and with the medium-term targets related to decarbonisation.

FIGURE VII.3: PROJECTED FINAL ELECTRICITY CONSUMPTION IN HUNGARY
(2030)




Source: Egyensúly Institute (2023b).

By 2030, net electricity imports and nuclear energy are set to make up the largest shares of final electricity consumption, at 30% and 28%. Solar accounts for 19%, and wind for 14%. Natural gas, biomass and biogas, and other sources account for much smaller shares, at 5%, 3%, and 1% (Figure VII.3). The composition indicates that Hungary will still depend heavily on imported electricity, even as domestic low-carbon sources increase.

Alignment with European Union climate targets also has a strong influence on Hungarian energy policy. The industrial and energy transition guidelines of the Green Deal provide a common framework for EU Member States. Within this framework, emission reductions and technological modernisation are expected to be implemented in a coordinated way (EC, n.d.). As a result, the development of renewable energy sources, decarbonisation and the improvement of energy efficiency all appear as strategic priorities.

## VII.3.2 Greening transport and mobility

Emissions from the transport sector make up a large share of national greenhouse gas emissions. Because of this, change in this sector has become unavoidable. The Hungarian document linked to the Recovery and Resilience Facility (RRF) places particular emphasis on supporting alternative fuel vehicles. Within this, electric mobility appears as a priority area. This is

identified as one of the key areas of Hungary's greening efforts (EC Representation in Hungary, n.d.).

At the same time, the RRF does not treat transport in isolation. The greening of transport is approached in a broader way. Sustainable mobility objectives are connected to the energy transition and also linked to other policy areas. Connections to energy efficiency and digitalisation measures are also emphasised. These linkages and policy directions are summarised in Table VII.1. Four RRF components shape this approach. Sustainable green transport is the most direct route, centered on electric mobility, low-emission vehicles, and alternative propulsion technologies. The green energy transition supports transport electrification through a cleaner electricity supply. Energy efficiency measures lower energy demand across the economy, including in transport. Digitalisation and smart systems support smarter mobility solutions and more efficient transport management. The structure indicates a cross-sector model in which cleaner transport depends on parallel advances in energy, efficiency, and digital infrastructure.

TABLE VII.1: TRANSPORT-RELATED COMPONENTS OF HUNGARY'S RECOVERY AND RESILIENCE PLAN

| RRF component | Main Focus | Relevance to green transport and mobility |
|---|---|---|
| Sustainable green transport | Development of sustainable transport systems and alternative propulsion technologies | Supports the deployment of electric mobility, low-emission vehicles, and the decarbonisation of transport |
| Green energy transition | Expansion of renewable energy and energy system modernisation | Indirectly supports electrified transport through a cleaner electricity supply |
| Energy efficiency measures | Reduction of energy consumption across sectors | Contributes to lower energy demand in transport through efficiency improvements |
| Digitalisation and smart systems | Digital infrastructure and intelligent systems | Enables smart mobility solutions and more efficient transport management |

Source: EC Representation in Hungary (n.d.). RRF - Recovery and Resilience Facility.

The development of transport infrastructure, the spread of sustainable mobility tools, and the reduction of energy consumption in transport all contribute to long-term decarbonization goals. These development directions align with the EU policy framework, which, in addition to reducing emissions, also supports modernizing transport systems, developing urban mobility, and increasing energy efficiency.

## VII.3.3 Industrial and circular economy development

The development of the industrial sector and the circular economy plays a key role in the green transition. The industrial chapter of the European Commission's Green Deal highlights the areas where Member States need to take action: improving material efficiency, increasing recycling, strengthening resource efficiency, and reducing environmental impact (EC, n.d.). These directions are directly linked to the modernization processes of Hungarian industry.

The Green Policy Center's analysis points out that the financing of Hungary's industrial transition is being carried out through several EU funds, among which support programs aligned with climate goals play a decisive role (GPC, 2024). The main policy areas and development priorities of industrial and circular economy transformation are summarised in Table VII.2. These policy areas connect industrial decarbonisation with more disciplined use of materials, energy, and raw inputs. Higher recycling rates and lower landfill use move production away from linear models. Lower material intensity and more efficient resource use can cut costs while easing environmental pressure. A separate focus on reducing industrial emissions links factory-level changes directly to Hungary's climate commitments. EU and national climate-related funding provides the financial support needed for cleaner industrial technologies and more circular production methods.

TABLE VII.2: KEY INDUSTRIAL AND CIRCULAR ECONOMY DEVELOPMENT AREAS UNDER THE EU GREEN DEAL AND THEIR RELEVANCE FOR HUNGARY

| Policy area | Main objectives according to the EU Green Deal | Relevance for the Hungarian industrial transition |
|---|---|---|
| Material efficiency | Reducing material input and improving resource productivity | Supports the modernisation of industrial processes and reduces material intensity |
| Recycling and waste management | Increasing recycling rates and reducing landfill use | Facilitates the transition towards circular production models |
| Resource efficiency | Optimising the use of energy and raw materials | Enhances competitiveness and reduces environmental pressure |
| Emission reduction in industry | Lowering industrial greenhouse gas emissions | Aligns industrial activity with national and EU climate targets |
| Circular economy financing | Mobilisation of EU and national climate-related funds | Enables investment in sustainable industrial technologies |

Source: EC (n.d.); GPC (2024).

In the long term, the transition to a circular economy will help reduce material consumption, make industrial production more sustainable, and promote more efficient resource circulation.

Sectoral green transition reforms in the fields of energy, transport and industry are essential for achieving Hungary's climate objectives. At the same time, adaptation challenges appear most clearly in agriculture. In this sector, the effects of climate change directly affect production conditions. They also affect the availability of resources and the long-term economic viability of agricultural activity.

## VII.4 Sustainable agriculture and climate adaptation in Hungary

Hungarian agriculture is closely linked to weather conditions. Production results often depend on how the weather develops during the year. Farmers have to react to changing climate patterns. In recent years, extreme rainfall, droughts and heat waves have appeared more often (SzRFK, n.d.). These phenomena are now regularly present in agricultural practice.

As a result, agricultural policy measures have attracted greater attention. Simple technological solutions are also being used more often. The effectiveness of these measures varies from case to case, but they increasingly influence agricultural production.

### VII.4.1 Climate sensitivity of agriculture

Hungarian agriculture faces a widening set of climate risks (Table VII.3). Drought reduces soil moisture and water availability, which lowers yields and raises production risk. Heatwaves place crops and livestock under stress during sensitive growth stages and make yields less stable. Intense rainfall can erode soil and wash out nutrients, which weakens soil quality and farm productivity. Seasonal variability adds extra pressure by making growing conditions harder to predict and farm planning less reliable. The combined effect is greater exposure to lower output, less stable production, and higher planning uncertainty.

All these phenomena clearly show that Hungarian agriculture is one of the sectors most sensitive to climate change, where successful adaptation is a strategic economic interest.

TABLE VII.3: MAIN CLIMATE-RELATED RISKS AFFECTING HUNGARIAN AGRICULTURE

| Climate-related factor | Observed/expected impact | Agricultural relevance |
|---|---|---|
| Increasing drought frequency | Declining soil moisture and water availability | Reduced crop yields and higher production risks |
| Heatwaves | Heat stress during critical growth phases | Lower yield stability in arable crops and livestock |
| Intense precipitation events | Soil erosion and nutrient loss | Degradation of soil quality and productivity |
| Seasonal variability | Unpredictable growing conditions | Increased uncertainty in farm planning |

Source: SzRFK (n.d.).

## VII.4.2 EU and Hungarian agricultural policy adaptation tools

The European Union's Common Agricultural Policy (CAP) emphasizes that Member States develop the Union's Common Agricultural Policy, which focuses on support and regulatory tools to address sustainability and climate adaptation. Within this framework, different types of interventions are available. These include promoting sustainable farming practices, using low-emission technologies, and applying digital solutions in agricultural production (Table VII.4). The purpose of these support measures is to help farmers respond to changing environmental conditions in their day-to-day activities.

TABLE VII.4: EU AND NATIONAL AGRICULTURAL ADAPTATION INSTRUMENTS SUPPORTING CLIMATE RESILIENCE

| Policy level | Main instruments | Adaptation focus |
|---|---|---|
| European Union (CAP) | Eco-schemes, agri-environmental measures, and digitalisation support | Climate adaptation, sustainable practices, and emission reduction |
| Hungary (national programmes) | Water and soil management support, climate-resilient farming schemes | Drought mitigation, resource efficiency, and farm resilience |

Source: EC (n.d.); MFK (n.d.)

At the Hungarian level, agricultural adaptation programs focus on improving water and soil management and encouraging resource-efficient production. The support schemes presented by the Hungarian Development Center (MFK), in line with EU adaptation objectives, help farms to address challenges such as water scarcity, surface water retention, and the introduction of climate-conscious farming methods (MFK, n.d.). One of the objectives of the support is to increase the resilience of farmers, especially in areas where the effects of climate change directly affect production security.

## VII.4.3 The role of water and soil management improvements

Water-conserving and soil-friendly farming methods are gaining importance in Hungarian agriculture. Recent analyses by SzRFK show that water shortages and the increasing frequency of droughts make these issues more visible. They also justify the development of irrigation infrastructure. In parallel, there is a growing need for farming solutions that are able to increase the water retention capacity of soils (Table VII.5).

These types of developments are not only relevant from a technical perspective. They have a direct effect on crop security as well. At the same time, they contribute to the stability of agricultural ecosystems. In this sense, improved water and soil management can be seen as an important element of long-term agricultural resilience.

TABLE VII.5: KEY WATER AND SOIL MANAGEMENT MEASURES SUPPORTING AGRICULTURAL ADAPTATION IN HUNGARY

| Measure type | Main objective | Climate adaptation benefit |
|---|---|---|
| Irrigation development | Improving water supply reliability | Reduced vulnerability to drought |
| Water retention solutions | Retaining surface and soil water | Increased resilience to precipitation variability |
| Soil conservation practices | Improving soil structure and organic matter | Enhanced water-holding capacity |
| Modern irrigation technologies | Efficient water use | Lower resource pressure under climate stress |

Source: SzRFK (n.d.); MFK (n.d.).

Hungarian support systems – as documented by the MFK – give priority to irrigation development, which responds to the uncertainties generated by climate change. Water retention, the development of drainage systems, and the application of modern irrigation technology solutions are all areas to

which policy makers are paying considerable attention (Figure VII.5). In the field of soil protection, both EU and Hungarian directives encourage sustainable farming practices that can mitigate the negative effects of extreme weather events.

While policy frameworks and support schemes set the strategic direction of agricultural climate adaptation in Hungary, the actual effectiveness of the green transition depends on what happens in practice. It largely depends on the solutions that are applied at the farm level and within everyday production processes. For this reason, adaptation cannot remain at the level of strategies and documents. It needs to appear in concrete technologies, management practices, and innovation-based approaches that respond directly to climate-related risks. At the same time, these solutions are expected to improve resource efficiency and strengthen economic resilience.

These considerations form the starting point for the review of selected good practices and agricultural innovations. The focus is on those examples that support the practical implementation of the green transition in Hungarian agriculture.

## VII.5 Good practices and agricultural innovations in the service of green transition

Technological and organizational solutions that directly help adapt to the effects of climate change while contributing to improved resource efficiency are of particular importance for the practical implementation of the green economic transition. In Hungary's case, agricultural innovations play a particularly important role, as agriculture is both affected by the negative impacts of climate change and capable of providing meaningful responses to them. This section presents three good practices that contribute to the green transition at different technological levels but follow the same adaptation logic.

### VII.5.1 Use of corn hybrids with low FAO numbers

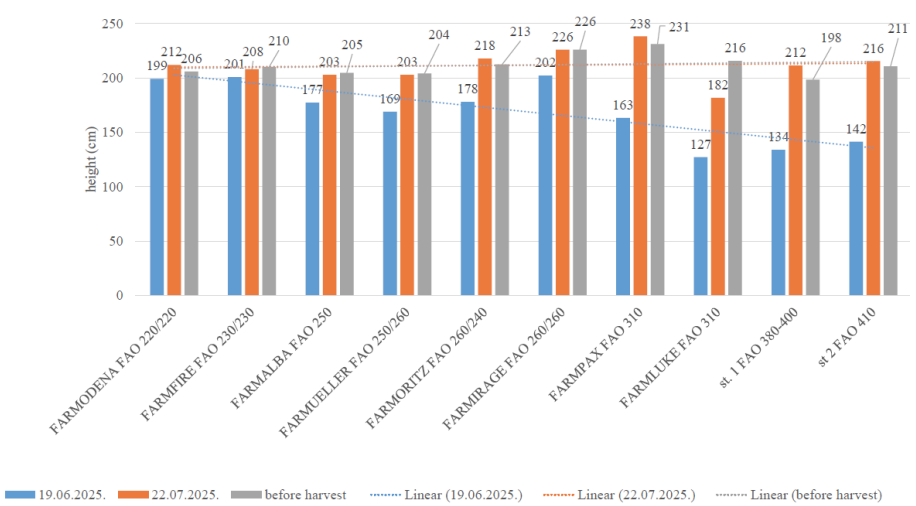
Corn production has traditionally played a key role in Hungary, but climate change is increasingly associated with higher production risks. Using hybrids with shorter growing seasons and low FAO numbers is an agronomic solution that helps adapt to changing climate conditions. One of the main advantages

of low FAO number hybrids is their shorter growing season, which means that plant development is less likely to coincide with summer heat waves and periods of drought.

In response to these challenges, Altoterra Ltd. started to focus on maize hybrids with low FAO numbers in 2025 (Farmsaat Polska, 2026). The aim was to identify cultivation approaches that better fit the changing climatic conditions. Related field observations and evaluations are carried out in cooperation with the University of Debrecen. These activities provide a practical basis for assessing how such hybrids perform under Hungarian growing conditions.

The field measurements support that logic (Figure VII.4). In the June observation, the lower FAO hybrids were already taller than many of the later-maturing entries, indicating faster early vegetative growth. By late July, most hybrids had reached 180-240 cm, and pre-harvest heights clustered around 200-230 cm. The main difference, then, appears to lie less in final plant height and more in earlier development, which gives low FAO hybrids a better chance to pass sensitive growth stages before late-summer heat and water stress intensify.

FIGURE VII.4: EARLY VEGETATIVE DEVELOPMENT OF MAIZE HYBRIDS WITH DIFFERENT FAO MATURITY CLASSES




Source: Farmsaat Polska (2025).

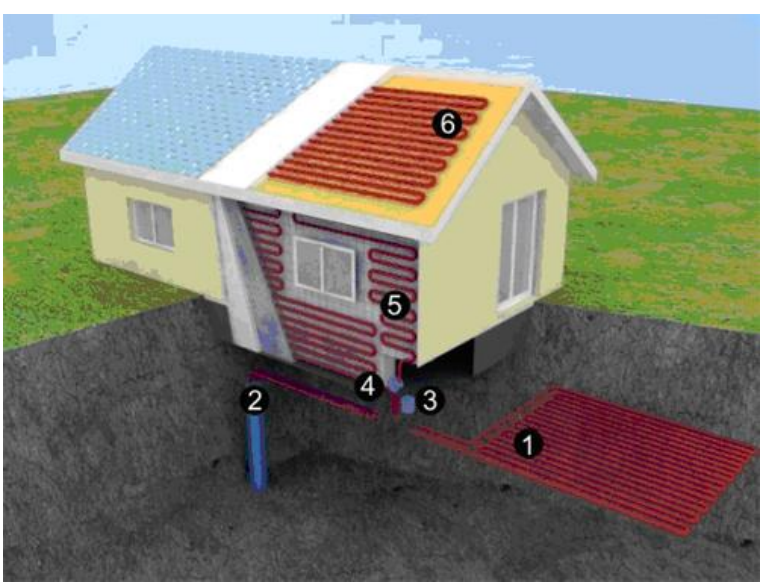
According to Hungarian professional experience and internal analyses, the use of such hybrids can contribute to mitigating production risks, especially

in regions where precipitation shortages and heat stress are becoming increasingly common. The inclusion of low FAO number hybrids in the crop rotation should not be seen as a stand-alone solution, but rather as part of a complex adaptation strategy that can be complemented by precision farming methods and improved water management.

## VII.5.2 Active thermal insulation technologies in agricultural buildings

Improving energy efficiency in agricultural infrastructure is a less emphasized area of the green transition. Active thermal insulation reduces heat loss by circulating shallow ground thermal energy through pipe coils placed around the building envelope. In practice, the system uses the ground's stable temperature to moderate the walls' and roof's temperatures, helping limit heat transfer between the building and the outside environment.

IMAGE VII.1: CONCEPTUAL APPLICATION OF ACTIVE THERMAL INSULATION IN A BUILDING STRUCTURE




Source: Active thermal insulation (n.d.).
Note: 1 - horizontal ground absorber or ground collector, 2 - vertical ground probe, 3 -expansion tank, 4 - pump, 5 - wall pipe coil, 6 - ceiling or roof pipe coil.

The concept of active thermal insulation was originally developed by the Hungarian inventor Tamás Bárkányi (Image VII.1), whose work laid the basis for later scientific research and practical applications in building energy

systems. Figure VII.5 presents a conceptual model of the system. A horizontal ground absorber or a vertical ground probe is connected to the building through a pump and an expansion tank. The circulating fluid then passes through pipe coils embedded in the wall and in the ceiling or roof structure. In that configuration, the building envelope acts as an active thermal buffer. The system can reduce winter heat loss and also help limit overheating in warmer periods. For that reason, it may be relevant for agricultural buildings that require more stable indoor thermal conditions.

Several studies in international literature deal with the operation and long-term performance of active thermal insulation systems. Research conducted by the Białystok University of Technology presents the applicability and stability of active thermal insulation solutions based on long-term winter tests (BUT, n.d.). A study published in the MDPI journal provides an overview of the theoretical basis and operating mechanisms of active thermal insulation systems, emphasizing their energy efficiency significance (Król & Kupiec, 2023). Another article published in the journal Energy and Buildings discusses active and hybrid thermal insulation solutions in the broader context of building energy innovations (Kisilewicz, Fedorczak-Cisak & Barkanyi, 2019).

The agricultural application of these technologies, for example, in crop storage facilities, dryers, or livestock buildings, can contribute to optimizing energy use and reducing internal temperature fluctuations. Active thermal insulation can therefore be considered a good practice that serves both energy efficiency and climate adaptation.

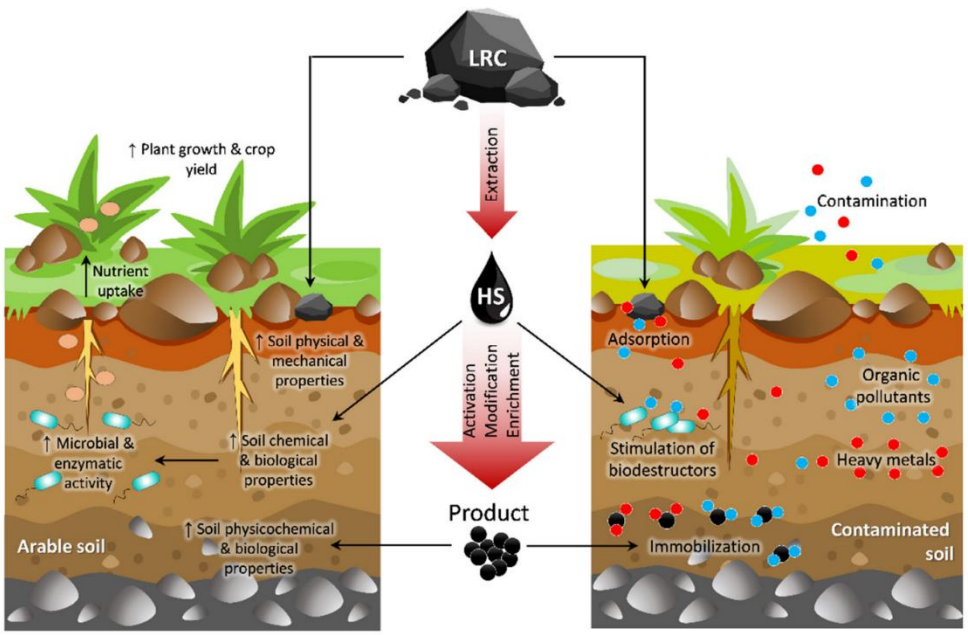
### VII.5.3 Humic acid and lignin-based soil improvement: the role of Agro-Carbon technology

Improving soil condition is a key factor in agricultural adaptation to climate change. The use of humic acid and lignin-based soil improvers aims to enhance soil structure, water retention capacity, and nutrient utilization.

Agro-Carbon technology is a Hungarian development based on lignin-based products containing humic acid. According to information published by the manufacturer, the technology aims to improve the soil's physical and chemical properties, particularly water retention and more efficient nutrient use (Agro-Carbon, n.d.). It is important to emphasize that the claims

regarding crop yield and resource savings are based on the manufacturer's communication and are presented as such.

IMAGE VII.2: SOIL AMENDMENT MECHANISMS OF HUMIC SUBSTANCES DERIVED FROM LOW-RANK COAL




Source: Akimbekov et al. (2021).

Image VII.2 sets out two main functions of humic substances derived from low-rank coal. First, it shows their use in arable soil, where they strengthen soil physical, mechanical, chemical, biological, and physicochemical conditions. The diagram also links them to higher microbial and enzymatic activity, stronger nutrient uptake, and better plant growth and crop yield. Second, it shows their use in contaminated soil, where they act through adsorption, stimulation of biodestructors, and immobilization. In that role, they help bind heavy metals and organic pollutants and reduce their movement in the soil. Although the image does not depict Agro-Carbon technology itself, it provides the conceptual basis for lignin-based approaches to soil conditioning and soil remediation.

Humic acid-based soil improvement is important for climate adaptation because improving soil water and nutrient management can directly increase the resilience of agricultural systems to extreme weather events. Agro-

Carbon technology can thus be classified among Hungarian agricultural innovations that aim to strengthen sustainable farming practices.

These good practices and innovations highlight that the practical implementation of the green transition is not just a technological and technical issue, but is also closely linked to the financial and institutional conditions available for the wider dissemination of such solutions, which justifies a detailed presentation of the financing framework supporting the green transition in the following chapter.

## VII.6 The financing framework for the green transition

The green economic transition requires significant financial resources, without which the strategic objectives cannot be put into practice. In Hungary's case, the financing framework is based on several pillars, which include both Hungarian budgetary instruments and European Union support mechanisms. The aim of the financing structure is to promote investments in line with climate policy objectives in the energy sector, transport, industry, and agriculture, in accordance with the guidelines set out in the National Energy and Climate Plan and the long-term climate strategy (NECP, 2024; GPC, 2024).

### VII.6.1 Hungarian financing instruments

Hungarian financing instruments mainly support investments linked to the green transition and to national policy objectives. According to an analysis by the Green Policy Center, budgetary resources and targeted support programmes play a role in promoting energy efficiency improvements, the use of renewable energy sources and different adaptation measures (Image VII.3). These instruments are often used together with European Union support. In this way, they help to make the co-financing of projects possible.

Hungarian funding is particularly significant in agriculture and rural areas, where the effects of climate change directly affect production conditions. Support for agricultural adaptation, such as incentives for water and soil management improvements, helps farmers mitigate the risks posed by extreme weather events (MFK, n.d.). Hungarian funds thus serve not only an investment function, but also a risk management function.

IMAGE VII.3: TYPICAL AREAS OF CLIMATE-RELATED FUNDING UTILISATION IN HUNGARY

Source: GPC (2024).

## VII.6.2 European Union funds and programs

European Union financing instruments play a role in Hungary's green transition. One of these instruments is the Recovery and Resilience Facility. It supports investments that are linked to economic recovery and to climate policy objectives at the same time. In the Hungarian recovery plan, the green transition receives increased attention. This mainly includes measures related to the modernisation of the energy system, the greening of transport and improvements in energy efficiency (EC Representation in Hungary, n.d.).

According to the Green Policy Center, a large share of European Union funds is used for climate-related purposes (GPC, 2024). This allows investments to be planned over a longer period of time. In many cases, EU funding is organised on a multi-year basis. They also involve clear conditions and performance indicators. As a result, the implementation of funded projects becomes more transparent.

### VII.6.3 Support for the Modernization Fund and the green transition

EU funds specifically designed to support emission reduction and the modernization of energy systems play a special role in financing the green transition. The Modernization Fund is an instrument that provides Member States with the opportunity to finance energy efficiency and decarbonization investments, particularly in the energy sector and industry. According to the Green Policy Center, this fund represents an additional source of funding for Hungary in relation to its climate policy objectives (GPC, 2024).

The effectiveness of financing instruments depends on several practical factors. One of these is how well support measures are linked to national strategies and to local needs. In the case of the green transition, coordination between sectors is especially important. It also matters how financial resources are used. If funding is directed only to isolated projects, the overall impact remains limited. For this reason, the combined use of Hungarian and European Union funding frameworks plays an important role in the green economic transition.

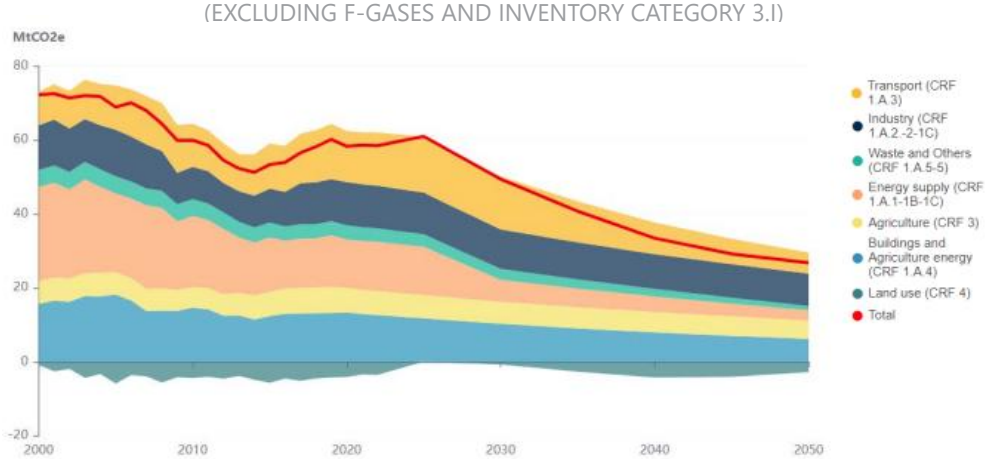
## VII.7 Shortcomings and opportunities in Hungary's green transition

Based on the environmental challenges, strategic frameworks, sectoral reforms, and financing instruments presented in the previous sections of this chapter, it is clear that Hungary's green transition is well advanced in several areas, but it also faces a number of structural and implementation challenges. These shortcomings and opportunities do not occur in isolation, but influence the effectiveness of the transition as interrelated system elements.

Figure VII.5 illustrates the projected development of Hungary's greenhouse gas emissions by main sectors up to 2050 under the current policy trajectory. The trend highlights the uneven pace of emission reductions across sectors and indicates that, without additional and better-coordinated policy interventions, the current trajectory is insufficient to fully achieve long-term climate targets. The sectoral breakdown makes the constraint clear. Much of the decline comes from lower emissions in energy supply and buildings, while waste also trends downward and land use remains a modest net sink. Transport and industry fall more slowly and still account for a large share of

emissions well into the mid-century. Agricultural emissions also persist with only a limited decline. Total emissions keep falling after 2030, but the curve becomes flatter, and a sizeable volume remains by 2050. Under the present policy path, Hungary reduces emissions, yet the remaining sectoral burden suggests that deeper cuts will require stronger action in transport, industry, and agriculture.

FIGURE VII.5: PROJECTED EVOLUTION OF HUNGARY'S GREENHOUSE GAS EMISSIONS UNDER THE CURRENT POLICY TRAJECTORY
(EXCLUDING F-GASES AND INVENTORY CATEGORY 3.I)




Source: GPC (2024).

There are clear regional differences. Climate change does not affect all regions equally (Table VII.6). Droughts and water shortages are more common in certain parts of the country. In other areas, this is less visible. Because of this, adaptation does not follow the same pattern everywhere. In some areas, irrigation development and water conservation solutions have already become more prominent. In other areas, however, their introduction is progressing more slowly. These differences are also visible in the level of agricultural production security and in the ability of farmers to adapt, as shown by analyses of climate impacts and agricultural adaptation (HungaroMet, n.d.; SzRFK, n.d.).

At the policy level, the National Energy and Climate Plan and the long-term climate strategy define a set of objectives. At the same time, implementation is not straightforward. The green transition affects multiple sectors simultaneously, making coordination more difficult. In practice, the effectiveness of policy measures depends on cooperation between

institutions and on how different interventions work together (NECP, 2024; GPC, 2024). The coordination of parallel programmes and financing instruments, therefore, remains an open issue.

In the financing area, Hungarian and European Union funds together offer significant opportunities. At the same time, access to these funds and their effective use are not without difficulties. Administrative limits and capacity constraints often slow down implementation. According to an analysis by the Green Policy Center, the mere availability of climate-related funding is not sufficient on its own (GPC, 2024). Effective use also depends on project preparation, institutional capacity, and long-term planning. This is especially relevant in the case of complex, multi-sector investments.

TABLE VII.6: KEY SHORTCOMINGS AND OPPORTUNITIES IN HUNGARY'S GREEN TRANSITION

| Area | Key shortcomings | Related opportunities |
|---|---|---|
| Sectoral emission reduction | Uneven pace of greenhouse gas emission reductions across sectors under the current policy trajectory, with slower progress in certain non-ETS sectors | Targeted sector-specific policy interventions and stronger coordination between mitigation measures could accelerate emission reductions |
| Regional adaptation capacity | Significant regional differences in exposure to climate impacts, particularly droughts and water shortages, resulting in unequal adaptation capacities | Place-based adaptation strategies and targeted support for vulnerable regions can improve resilience and reduce regional disparities |
| Institutional coordination | A complex institutional framework and parallel policy instruments increase coordination challenges across sectors and governance levels | Improved inter-institutional cooperation and integrated policy design can enhance the effectiveness of green transition measures |
| Financing and implementation capacity | Administrative and project preparation constraints may limit the effective absorption and utilisation of Hungarian and EU climate-related funds | Capacity building, streamlined administrative procedures, and long-term project planning can improve fund absorption and implementation efficiency |
| Agricultural adaptation | Slow and uneven adoption of sustainable farming practices and climate-adaptive technologies despite available support schemes | Wider dissemination of good practices, advisory services, and knowledge transfer can strengthen farm-level resilience and productivity |
| Integration of policies and tools | Fragmented implementation of strategic objectives, financing instruments, and technological solutions | Integrated application of existing strategies, funding mechanisms, and innovations can generate systemic and mutually reinforcing impacts |

Source: HungaroMet (n.d.); SzRFK (n.d.); GPC (2024); NECP (2024).

In agriculture, both problems and opportunities can be observed (Table VII.6). Support frameworks for sustainable farming practices, precision technologies, and improvements in water and soil management are already available. However, their practical application does not progress at the same pace everywhere. Some good practices are already visible. These include the use of low FAO number hybrids, active thermal insulation solutions and different soil improvement technologies. They show that there are workable responses to climate-related challenges. At the same time, wider adoption still depends on additional incentives and better knowledge transfer.

Overall, an important opportunity in Hungary's green transition lies in the joint use of existing strategic objectives, financing instruments, and technological solutions. These elements are already available, but they are not always applied in an integrated manner. The identification of shortcomings should therefore not be interpreted as a sign of systemic weakness. Rather, it reflects the complexity of the transition process itself.

## Closing remarks

The chapter examined Hungary's green economy transition through four linked lenses: climate pressure, policy architecture, sectoral change, and farm-level adaptation. The evidence points to a transition that has moved beyond planning alone. Hungary already has a defined policy base, sectoral reform paths, and a growing set of applied responses in agriculture and energy use. Yet progress remains uneven, and the gap between policy design and implementation continues to limit results.

Meteorological records and recent climate assessments point to a harsher operating environment. Higher temperatures, longer dry periods, water scarcity, and more frequent extremes already affect production conditions, resource use, and local resilience. Agriculture stands at the center of that pressure because yields, farm planning, and water security remain closely tied to weather variability. Climate adaptation is no longer a narrow environmental matter. It is also part of economic security, rural stability, and long-term competitiveness.

Hungary's strategic base rests on the National Energy and Climate Plan and the longer-horizon climate pathway to 2050. Both provide a clear direction on emissions, energy use, and adaptation. Yet policy intent alone will not

deliver the transition. Results depend on coordinated public action, steady financing, and stronger administrative execution. Hungarian and EU funding can support that shift, but funding volumes alone will not close the gap where project preparation, institutional capacity, or coordination remain weak.

The sectoral picture also shows an uneven pattern. Energy, transport, and industry already sit within a defined decarbonisation agenda, but progress does not move at the same speed across all areas. Emissions decline more slowly in transport, parts of industry, and agriculture, leaving a heavier burden on later years. Regional disparities add another constraint. Areas facing more severe drought and water stress do not start from the same position, so a uniform adaptation model would leave vulnerable regions behind.

The agricultural cases included in the chapter offer the clearest practical lesson. Earlier maturing maize hybrids, active thermal insulation in farm buildings, and humic acid or lignin-based soil conditioning show that workable responses already exist. Their value lies less in novelty than in applicability under real Hungarian conditions. Wider uptake will depend on advisory support, farm-level capacity, and closer alignment between policy support and day-to-day production decisions.

Hungary's green transition has real momentum, but momentum alone will not be enough. The next stage requires tighter coordination across institutions, more even uptake across regions and sectors, and stronger links between strategy, finance, and applied solutions. Where that alignment strengthens, the transition can deliver lower emissions, stronger resilience, and a more competitive economic base.

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CHAPTER VIII

# Building a Green and Climate Resilient Economy in the TRNC

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## Introduction

Small island economies such as the Turkish Republic of Northern Cyprus (TRNC) face disproportionate environmental and climate vulnerabilities, including water scarcity, energy insecurity, and the degradation of natural ecosystems. These challenges, intensified by climate change, necessitate a structured transition toward a green economy—one that promotes sustainable development, resource efficiency, and climate resilience.

According to the United Nations Environment Programme, green economic transformation improves long-term well-being while reducing ecological risks. This report outlines a strategic framework for the TRNC's transition, highlights sector-specific policy actions, and provides an implementation roadmap aligned with global sustainability principles.

TRNC stands at a strategic moment where economic modernization, energy security, and environmental sustainability intersect. With its unique geographic location, climatic advantages, young population, and expanding service-based economy, the TRNC is well-positioned to initiate a comprehensive Green Economy Transition aligned with global sustainability goals and the strategic vision of the Organization of Turkic States (OTS).

TRNC is highly dependent on imported fossil fuels for electricity production, with over 90% of power generated from heavy fuel oil. This dependency exposes the economy to price volatility and supply insecurity. At the same time, water scarcity—exacerbated by declining precipitation and the over-extraction of groundwater—poses an existential constraint on agriculture and public water supply.

Additional constraints include inadequate recycling and waste management systems, land degradation and coastal erosion, biodiversity loss in ecologically sensitive areas, and structural governance limitations in environmental monitoring.

Despite these challenges, the TRNC possesses substantial renewable energy potential—particularly in solar power—with annual irradiation levels among the highest in the Eastern Mediterranean.

The TRNC sits at the center of the Eastern Mediterranean—a strategic corridor between Türkiye, Europe, the Middle East, and the Turkic world. The TRNC economy is dominated by services, education, tourism, and agriculture, each of which offers significant potential for sustainability transformation.

Drawing on the best international practices, six strategic pillars are identified:

- Clean and secure energy systems
- Water security and climate-resilient agriculture
- Sustainable mobility and urban planning
- Circular economy and waste reduction
- Biodiversity conservation and climate adaptation
- Green finance, governance, and institutional reform

## VIII.1 Green economy policy and strategic priorities in the TRNC

In the TRNC, green economy policy must respond to a tight set of linked pressures, including heavy reliance on imported energy, chronic water stress, car-centered urban growth, and limited access to formal international climate finance. The policy agenda must be practical rather than abstract. It needs to cut fuel exposure by accelerating the shift to solar power and strengthening the grid, protect scarce water through reuse, smarter irrigation, and firmer aquifer management, ease transport pressures, and build investment pipelines through local banks, private capital, Türkiye-linked support, and externally funded programs. Each area affects the others. Lower-cost clean electricity can support water and transport reform, while better financing can determine whether these measures move beyond small pilot efforts. For the TRNC, a credible green economy transition depends less on broad ambition and more on policy design that fits its political and institutional realities.

## VIII.1.1 Clean energy transition: Policy actions for the TRNC

TRNC has a legally binding 40% renewable electricity target by 2030. Setting a statutory target creates policy certainty for investors, utilities, and international partners. It aligns the TRNC with regional climate commitments. This target should be embedded in an updated Renewable Energy Law, accompanied by annual progress reporting.

Deploying large-scale photovoltaic (PV) fields on state-owned land is a cost-effective intervention. Benefits include reduced dependence on foreign fuel and predictable, long-term generation costs. Considerations include environmental assessment processes and land-use planning.

Fiscal incentives for rooftop solar, including feed-in tariffs and net metering, can decentralize electricity generation and widen participation by households and businesses. Feed-in tariffs can support early market uptake, while net metering can make small-scale systems more attractive to consumers. Capacity caps, time-of-use pricing, and smart meter rollout can help contain fiscal pressure and manage grid stress as uptake rises.

Grid upgrades need to move in parallel with this expansion. Smart grid systems, more flexible substations, and infrastructure capable of accommodating storage are needed to absorb higher volumes of distributed renewable power. Blended finance and public-private partnership models can help close funding gaps where domestic resources remain limited.

A gradual move away from heavy fuel oil would cut both environmental damage and import costs. Hybrid renewable and storage systems can support system stability during the transition and reduce fuel demand. Dual-fuel generators can also provide a temporary bridge when reliability risks remain.

These policy actions reduce energy insecurity and position the TRNC as a regional clean-energy demonstrator. Success requires proper sequencing: set the target, modernize the grid, deploy utility-scale solar, expand rooftop PV, and retire oil-fired units.

## VIII.1.2 Water scarcity

Water scarcity is one of the most persistent structural challenges facing the TRNC. The island's semi-arid Mediterranean climate, rapid urbanization, and agricultural dependence place increasing pressure on finite freshwater resources. Climate change intensifies these vulnerabilities, leading to reduced rainfall, higher evapotranspiration, and increased competition among domestic, agricultural, and environmental water demands. Within this context, water security and climate-resilient agricultural transformation are central to ensuring long-term socio-economic stability.

This section discusses three strategic pillars relevant to the TRNC: (1) expanding treated wastewater reuse, (2) promoting precision agriculture and climate-resilient practices, and (3) enhancing groundwater governance through digital monitoring and regulatory reform.

The Mediterranean region has increasingly adopted treated wastewater reuse as a sustainable solution for agricultural irrigation, reducing pressure on groundwater and surface water resources. For the TRNC, where agriculture accounts for a significant share of total freshwater consumption, scaling up the reuse of treated effluent can significantly improve water security.

Existing wastewater treatment plants—particularly in urban centers such as Lefkoşa, Girne, Gazimağusa, and Güzelyurt—represent underutilized assets. Integrating effluent pipelines with agricultural zones, especially citrus-dominant areas in Morphou/Güzelyurt, can relieve pressure on stressed aquifers, such as the Güzelyurt aquifer, which has been historically affected by over-extraction and seawater intrusion.

Climate-resilient agriculture entails optimizing resource use while sustaining yields under climatic stress. TRNC's smallholder-dominated agricultural structure is well-positioned to benefit from technological innovations that reduce water and input inefficiencies.

Precision agriculture integrates digital tools, such as soil moisture sensors, automated drip irrigation, remote sensing, and evapotranspiration-based scheduling, are necessary to improve irrigation efficiency. Smart irrigation systems can reduce water use by 20–40%, improving crop health and lowering energy costs.

In the TRNC, precision agriculture can be introduced through targeted subsidies or credit schemes for sensor-based irrigation equipment, farmer training programmes delivered jointly by the Ministry of Agriculture, local universities, and international partners, and the integration of digital tools into existing greenhouse and open-field production systems.

Crop diversification is a central adaptation strategy. Drought-resistant varieties—such as improved cereals, legumes, and climate-adapted horticultural cultivars—can stabilize yields under water stress. For perennial crops like olives, carob, and drought-tolerant citrus strains, improved rootstocks can enhance resilience to salinity and reduce irrigation volumes.

Groundwater remains the backbone of agricultural water supply in many regions of the TRNC. However, historical over-extraction, limited regulation, and insufficient monitoring have compromised aquifer health.

Unregulated or poorly monitored groundwater extraction accelerates water-table decline, increases saline intrusion into coastal aquifers, and raises the risk of long-term, irreversible aquifer degradation. Stronger groundwater governance, therefore, requires extraction permits to reflect hydrological conditions, firm enforcement of abstraction caps, and penalties for unauthorized well operation.

### VIII.1.3 Mobility policies

Research on small island states emphasizes that sustainable mobility policies must simultaneously reduce fossil fuel dependence, improve access and affordability, and address space constraints in dense coastal cities.

"Avoid, Shift, Improve" frameworks are widely recommended in sustainable mobility planning. They focus on reducing unnecessary travel through compact urban form and mixed land use, moving travel away from private cars toward public transport and active modes such as walking and cycling, and upgrading vehicle and fuel technology, with electrification as a central part of that transition. European and Mediterranean cities that pursued integrated sustainable urban mobility plans (SUMPs)—for example, Limassol in the Republic of Cyprus—show that reallocation of street space to pedestrians and cyclists, combined with public transport upgrades and coastal regeneration, can significantly enhance walkability and urban liveability. These lessons are

directly relevant to the TRNC, where coastal corridors and historic cores are under similar pressure from car-oriented development.

### VIII.1.4 Green finance in the TRNC context

Due to political non-recognition, the TRNC cannot directly access many global green-finance institutions. Instead, green financing appears through local banks, private investors, Türkiye-linked support, and EU/UN programs targeting the TRNC. These provide grants, technical assistance, and project-based investment opportunities.

Since the TRNC is not internationally recognized (except by Türkiye), it cannot directly access many classic green-finance channels (e.g., most World Bank sovereign loans, many EU green bond windows, etc.). Instead, "green finance" typically comes through:

- Local banking and project finance – commercial banks and investors backing solar, efficiency, and eco-tourism projects
- Türkiye-linked or Turkey-based funding and expertise – Turkish institutions and companies bringing investment and technical know-how.
- EU and UN funds that are *de facto* channelled to the TRNC (without recognizing it), for example, through UNDP Cyprus and the EU Aid Programme for the Turkish Cypriot Community.

So, the architecture is more "patchwork" than a recognized state with its own sovereign green bonds or an official green budgeting framework.

## VIII.2 Electric vehicle transition: tax incentives and charging infrastructure

For the TRNC, the shift to electric vehicles rests on two linked policy needs. One is to make ownership more affordable through tax relief and targeted support. The other is to build a charging network that matches local grid capacity and urban travel patterns. Given the economy's reliance on imported fuel and the concentration of traffic in main corridors, both need to advance together so uptake can grow without adding strain to the power system.

### VIII.2.1 Tax exemptions and fiscal incentives

Global evidence shows that electric vehicle (EV) uptake strongly correlates with robust fiscal incentives, including tax exemptions on purchase and ownership, reduced company-car taxation, and targeted grants. Many European countries exempt battery electric vehicles from registration taxes altogether or apply strong $CO_2$-differentiated taxation (e.g., Greece, Finland, France).

For TRNC, key measures could include:

- Full or partial exemption from registration and circulation taxes for zero-emission vehicles for an initial period (e.g., 5–10 years).
- Reduced VAT/import duties on EVs, batteries, and charging equipment, aligned with practices in emerging EV markets documented by the IEA Global EV Outlook.
- Targeted subsidies or low-interest credit for taxis, minibusses, and delivery fleets to switch to EVs, prioritizing high-mileage vehicles with the highest air-quality benefits.

Such policies are particularly salient in small island systems that rely on imported fossil fuels and where local air pollution impacts are concentrated in dense urban corridors.

### VIII.2.2 Charging infrastructure in urban and energy planning

EV roll-out must be linked to both grid planning and urban design. Recent studies stress the importance of integrating EV charging with photovoltaic (PV) generation, smart metering and demand management to avoid overloading small island grids. For TRNC, this suggests:

- A national EV charging masterplan, mapping fast-charging hubs along inter-city corridors (Nicosia–Famagusta, Nicosia–Kyrenia, Morphou axis) and slower chargers in residential and mixed-use urban areas.
- Regulatory requirements for new buildings and large renovations to pre-equip a share of parking spaces with conduits and capacity for future charging, following best practices in European building codes.

- Integration with distributed solar PV, especially on public buildings, park-and-ride facilities and municipal car parks, to create low-carbon "solar-charging hubs".

Governance-wise, many countries exempt charging infrastructure operators from complex electricity trading licenses to accelerate deployment—an approach the TRNC could emulate in its regulatory framework.

### VIII.2.3 Main area of application: Energy

Solar power dominates green finance in the TRNC. The region's high solar potential supports rooftop PV systems, private PV farms, and hybrid PV-battery studies. Local banks sometimes promote solar-linked loans, while EU-UNDP initiatives help municipalities adopt energy management systems and efficiency measures.

The TRNC has excellent solar potential. A series of academic and technical studies describes solar and hybrid PV-battery systems as a key solution for the TRNC's chronic electricity problems (Maltini & Minder, 2015).

Green financing here tends to appear as:

- Project finance for PV plants and rooftop solar – often backed by private investors, sometimes in cooperation with universities and companies.
- Household and commercial PV – supported by local incentives and, in some cases, concessional loan schemes from banks or promotional campaigns by real-estate/investment firms that market "solar-ready" homes and resorts.
- Technical and feasibility studies funded via international programmes (EU, UNDP) that de-risk future private investment in renewables and storage (Maltini & Minder, 2015).

The EU, through UNDP Cyprus, has launched dedicated EU-funded initiatives for sustainable energy practices in TRNC municipalities (Lefkoşa, Girne, Güzelyurt, Lefke, Gönyeli, Dikmen, Değirmenlik, etc.). These programmes introduce energy management systems for municipalities, support efficiency upgrades in public buildings and public services, and combine grant funding

with technical assistance as a soft form of green finance, since the funding is tied to sustainability-related outcomes.

There are also bi-communal and buffer-zone projects (e.g., planned EU-funded solar installations in the buffer zone) that benefit both communities and are presented as "green" investments to the Turkish Cypriot side as well.

## VIII.3: Governance, participation and implementation in the TRNC context

Implementing the agenda in the TRNC requires not only technical plans but also institutional coordination and public participation. Studies on sustainable urban mobility in European cities and small islands highlight that success depends on:

- Cross-sectoral coordination between transport, environment, energy, housing, and tourism authorities.
- Stable funding mechanisms, possibly including green bonds, climate funds, and international cooperation tailored to island mobility transitions.
- Participatory planning with citizens, transport operators, universities, and business associations to ensure social acceptance and behavioral change.

In the TRNC case, universities, municipalities, and the Evkaf/waqf sector (as major landholders and building owners) can play a pivotal role by hosting charging hubs, park-and-ride facilities, and active mobility corridors on their properties, linking historic waqf assets with contemporary sustainability goals.

In practical terms, this means pairing tax exemptions with charging infrastructure to speed up electric vehicle adoption, upgrading public transport fleets while strengthening inter-city connectivity, and redesigning urban space to accommodate bike lanes, pedestrian routes, and low-emission zones.

A parallel priority is to strengthen circular economy and waste management systems by establishing a centralized recycling and material recovery facility, gradually phasing out single-use plastics with EU Directive 2019/904 as a useful reference point, and supporting SMEs in repair, reuse, composting, and recycling through targeted green financing.

Another priority is biodiversity conservation and climate adaptation, which calls for stronger protection of ecologically sensitive areas such as the Karpaz Peninsula, the use of coastal setback zones to limit erosion risk, and investment in early fire-detection systems and reforestation programs.

Governance reform and green finance also need to advance together through the creation of an independent Climate and Green Economy Authority, the adoption of green public procurement standards, the introduction of economy-wide carbon accounting and emissions inventories, and the development of frameworks that can support access to international climate funding.

Universities in the TRNC also play a practical role in shaping future green investment by producing research on solar feasibility, PV-battery microgrids, cost efficiency, and sustainable banking. Their role carries added weight because formal green finance infrastructure remains limited. Academic conferences held in Famagusta brought together researchers and practitioners to examine ESG issues, sustainable banking, and financing tools, while technical case studies on renewable energy systems provide the kind of financial and operational analysis that potential investors need (see Ozatac, Taspinar & Rustamov, 2024). In that sense, university-led research helps build the analytical foundation for future green projects and supports the development of investable project pipelines, even where the policy framework is still developing.

## VIII.4: Expected economic, social, and environmental benefits

A successful green transition would generate measurable economic, social, and environmental benefits, including reduced dependence on imported fossil fuels, lower long-term energy costs, increased investment in green sectors, improved air quality, public health, and energy affordability, as well as restoration of ecosystems, reduced emissions, improved water conservation, and resilience against climate shocks. Empirical studies indicate that green investments yield higher employment per unit of capital than fossil fuel investments.

The green economy transition can be sequenced across three phases between 2025 and 2035. In the first phase, covering 2025 to 2027, the focus should be on building the legal and regulatory base for renewable energy and the circular

economy, while also launching major solar installations, expanding recycling programs, and starting a national water efficiency strategy to respond to growing water scarcity and protect ecosystems and economic activity under climate pressure.

In the second phase, from 2028 to 2031, the focus should shift to scaling up renewable electricity generation to at least 30% through added solar and other clean energy capacity, grid upgrades, and stricter rules that support public and private investment. During the same period, public transport systems should be modernized, electric vehicle use should expand through charging infrastructure and fiscal support, and coastal and biodiversity protection should advance through coastal defenses, habitat restoration, and biodiversity monitoring.

In the third phase, from 2032 to 2035, the aim should be to reach 40 to 50% renewable electricity generation, reduce dependence on fossil fuels, strengthen energy security, and put circular economy systems in place to reduce waste and expand reuse and recycling across major sectors. Together, these steps would support lower greenhouse gas emissions in line with regional benchmarks and international climate commitments, while supporting sustainable economic growth.

## Concluding remarks

TRNC's transition to a green economy is both necessary and achievable. The chapter shows that progress depends on practical policy design, stronger institutional coordination, and financing arrangements that fit the TRNC's political and economic constraints. With a phased approach over 2025 to 2035, the TRNC can reduce its exposure to imported fossil fuels, strengthen energy security, improve water resilience, and support more sustainable patterns of mobility, production, and resource use.

Scaling solar and storage systems, preparing municipal green investment plans, expanding green banking tools such as green mortgages and sustainability-linked lending, and deepening cooperation through Türkiye and wider Turkic regional channels should be treated as connected parts of the same transition effort. Taken together, these steps can help move green investment from isolated initiatives to a more consistent and workable model,

with stronger local implementation capacity, better project preparation, and wider economic, social, and environmental gains.

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Jointly prepared by Turkic Economic Policy Research Centers Network (ERCNET)

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