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Special Climate Change Edition

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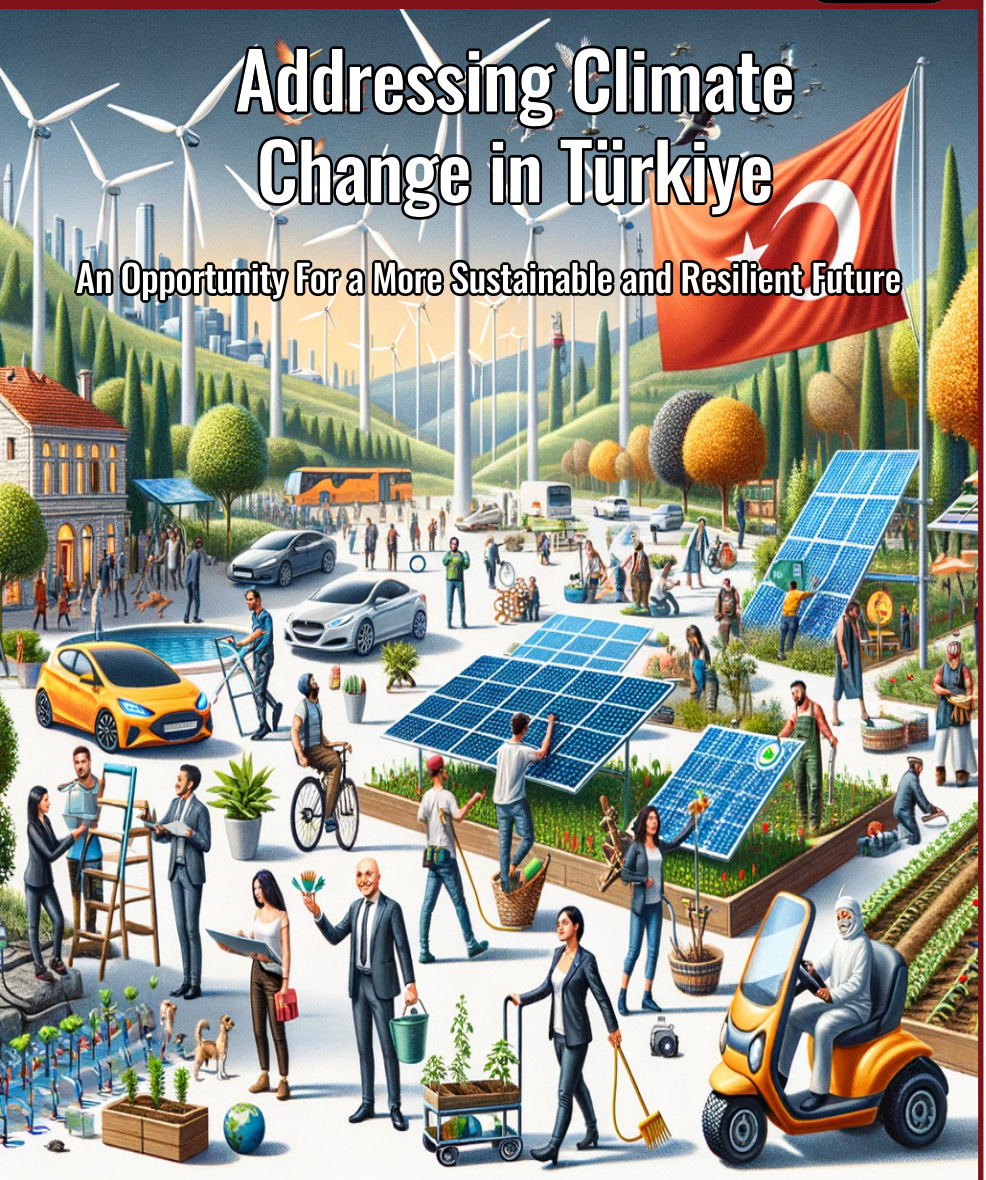
Addressing Climate Change in Türkiye

An Opportunity For a More Sustainable and Resilient Future



Overview – A Resilient Net-Zero Pathway for Türkiye

Reducing Emissions and Building Climate Resilience in Türkiye's Cities

Impact of Climate Change on Water Stress and Water Availability

Unblocking Private Sector Investment in Adaptation

The Energy Transition in Türkiye: A Zero-Emissions Power Grid

Sustainable and Resilient Transport

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Addressing Climate Change in Türkiye:

An Opportunity For a More Sustainable and Resilient Future

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The World Bank Issue of Transatlantic Policy Quarterly

Türkiye is particularly vulnerable to the impacts of climate change. The frequency, intensity and impacts of climate-induced extreme events have increased in Türkiye in recent years – including flooding in coastal cities and low-lying river deltas (flooding affects around 600,000 people annually, on average) wildfires and weather events, such as storms, snowfall, and hail. Going forward, this trend is set to continue, which would lead to more recurrent heatwaves, greater drought and flood hazard, and sea-level rise. This has real implications for the country's infrastructure and services, productivity, and the safety and health of its citizens. Climate risks compound existing seismic risks and add a level of complexity for response and recovery purposes, as was the case on 15 March 2023, when flooding from torrential rains hit the regions already affected by the devastating February 6th earthquakes. In addition, climate change poses significant risks to Türkiye's water security. Türkiye faces being water scarce by 2030, with over two-thirds of the country's 25 river basins at risk of severe water scarcity. Such impacts threaten agricultural productivity, rural incomes and employment, and food security. My colleagues at the World Bank estimate that a 10 percent reduction of water supply from climate change would cost Türkiye 6 percent of GDP or about US$50 billion due to reduced agricultural output.

But the story is not only about the need to adapt to climate change. Even though Türkiye is only responsible for slightly above 1 percent of global greenhouse gas emissions, the country is the world's 15th largest emitter. This exposes Türkiye to risks from the global low carbon transition. As countries take action to decarbonize their economies, demand will drop for emissions intensive goods. And this is not a hypothetical consideration: the expected impact of the European Union's Green Deal for the Turkish economy has contributed to the urgency of the country's climate change agenda (49 percent of Türkiye's good exports go to the EU). Most recently, Russia's invasion of Ukraine and attendant energy supply disruptions and price increases highlight risks for countries like Türkiye that rely on fossil fuel imports (Türkiye imports 99 percent of its gas and 93 percent of oil), underscoring the urgency of climate action in support of energy security and affordability.

In response to these challenges, Türkiye has made ambitious climate change commitments, joining the Paris Agreement in 2021 and committing to net zero emissions by 2053 as well as committing to implementing an emission trading system and installing 60GW of renewable energy by 2035. The country is establishing new institutional arrangements for climate change issues, including by forming the Ministry of Environment, Urbanization and Climate Change (MoEUCC), and for the first-time incorporating climate change and sustainability as core components of the

National Development Plan. These are steps in the right direction, though given the magnitude of the challenge the road ahead will be long.

The World Bank is supporting Türkiye to implement on this ambitious agenda. It is doing so by providing analysis and advice for the development of a robust policy framework that is critical for creating the necessary transition. It is also doing it by analyzing how, for example, the country can best expand the use of electric vehicles or design an emissions trading system. And more generally by working with the Government to support efforts aimed at incorporating climate change into the 12th National Development Plan.

Beyond technical assistance, we are also implementing projects focusing on adaptation to, for example, enhance forest fire management capacity to respond to the additional risks created by climate change. Indeed, as global warming increases, so does the frequency and intensity of weather conditions (hot, dry, and windy) conducive to wildfires and this is even more evident in countries which, like Türkiye, are part of the Mediterranean climate region making them particularly vulnerable to forest fires. These efforts will result in additional protection against wildfires to more than 6 million people and increase resilience in 7 million hectares of forest area. Also supporting climate change adaption, we have partnered with the Government of Türkiye to improve watershed collection, treatment and reuse, and to rehabilitate, construct and modernize irrigation systems. In this regard, we expect to contribute to the doubling of the volume of treated wastewater, and to provide almost 5000 users and more than 30 thousand hectares with new and/or improved irrigation systems.

And on the climate change mitigation front, we are aiming to increase the use of renewable energy through self-generation in public facilities and therefore will contribute to lower emissions and to public sector savings as it will reduce the need to buy energy. Indeed, we have a target to add more than 300 megawatts in public and municipal buildings therefore reducing the costs for the Government. And this is not all. We are already working on operations that will address flooding in the country, deal with the pollution in the Marmara Sea, introduce mechanism to finance firms interested in greening their productive infrastructure, and decarbonize transportation.

Going forward, Türkiye could reap significant benefits from climate action – both adaptation and mitigation – over the short and longer term, ranging from making the economy more resilient to climate impacts and global climate policy, as well as by unlocking opportunities from green products and technology upgrades, cleaner air and water, and cities where people can move, breathe and be productive. While significant investments are needed to build a low carbon, resilient economy, the World Bank estimates that tackling climate change will provide Türkiye with net economic benefits of $146 billion over 2022-2040.

The summer edition of *Transatlantic Policy Quarterly* aims to contribute to the policy debate of how to address climate change in Türkiye. The World Bank released the *Turkiye Country Climate and Development Report* in 2022, which reflects about how Türkiye's development goals can be achieved in the context of adapting to and mitigating against climate change. The articles included in this edition build on that report and investigate key issues that Türkiye will face as it undertakes the transition to a lower carbon and more resilient economy. They present: (i) an overview of key actions related to climate change and their impact on Türkiye's economy and people; (ii) reflect about how to adapt to a changing climate and building the resilience to its worst impacts, including how to prepare for a future with less water and how to improve the resilience of infrastructure to natural disasters; (iii) discuss key challenges associated to the decarbonization the Turkish economy; and (iv) argue how to meet these challenges in a way that supports sustainable growth and a just transition for people and communities.

I am sure you will enjoy this edition of Transatlantic Policy Quarterly which reflects the hard work and knowledge of my colleagues at the World Bank who have prepared the included articles. I also want to encourage you to continue engaging in the climate change agenda in Türkiye.

J. Humberto Lopez
Country Director for Türkiye
World Bank

TPQ's Note

Welcome to a special issue brought to you by the exceptional staff of the World Bank Türkiye! It is both a pleasure and an honor to showcase their insights in TPQ. In "Addressing Climate Change in Türkiye: An Opportunity For A More Sustainable and Resilient Future," we delve into the pivotal role of green finance in Türkiye's journey towards sustainability. This issue explores how the intersection of resilience and decarbonization is shaping Türkiye's future. As we navigate these crucial themes, we invite you to explore the strategies and innovations that promise a resilient, green Türkiye. We hope to have the World Bank's insighftful contributions on such important matters to continue in the future years as well.

We invite you to delve deeper into the various facets of this special edition of TPQ, titled 'Addressing Climate Change in Türkiye: An Opportunity For A More Sustainable and Resilient Future.'

On behalf of Transatlantic Policy Quarterly, I would like to extend our heartfelt appreciation to all the dedicated contributors who invested substantial time and effort into this endeavor. The TPQ team thoroughly enjoyed the process of curating this exceptional edition, and we are immensely grateful for the invaluable support provided by our new partner, the World Bank. Special recognition goes to our esteemed corporate sponsor, Tüpraş. We would also like to express our appreciation to our other sponsors, including Beko, Ford, Gordon-Blair, Kalekim, TEB, The Ritz-Carlton, Turcas, Uluslararası İlişkiler Dergisi, and Yapı Kredi for their unwavering support.

Aybars Arda Kılıçer
Editor-in-Chief
Transatlantic Policy Quarterly

TPQ Organized a Roundtable on "NATO's Open Door Policy"

As the Transatlantic Policy Quarterly, we believe that NATO's recent enlargement and open-door policy are critical developments in the international arena and should be understood by academics, bureaucrats, and the general public. At a time when security threats to its members are intensifying, we believe that NATO's open door policy needs to be better understood, and we believe that it is necessary to discuss what the possible consequences of this policy can offer for the future of the NATO alliance.

On 23 November 2023, in cooperation with NATO, TPQ organized a panel discussion on "NATO's Open Door Policy". During the panel, participants discussed the alliance's previous enlargement processes, highlighting the phases the alliance went through after the collapse of the Soviet Union, as well as the threats and opportunities facing the alliance's enlargement processes today. The event reviewed how the members of the alliance, particularly the U.S., the alliance's leading member, view the enlargement policy and the possible consequences of this policy.

Opening Remarks & Moderator
Pınar Akıntürk · Administrative Supervisor, Transatlantic Policy Quarterly (TPQ)

Speakers
Mr. Petre Roman - Former Prime Minister of Romania (1989-1992).
Amb. (F) Matthew J. Bryza - Former U.S. Ambassador to Azerbaijan.
Megan E. Gisclon - Managing Editor and Researcher at Istanbul Policy Center.

You can watch the Roundtable discussions (in English) by scanning the QR below.

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OVERVIEW – A RESILIENT ZERO PATHWAY FOR TÜRKIYE

DOI: 10.58867/VKSR3619

This article provides an overview of the key actions needed to lower emissions and improve resilience to climate impacts in Türkiye. It explores how climate action interacts with Türkiye's growth and development path and contributes to achieving the country's development objectives, helps seize opportunities offered by green technologies, protects the economy against longer-term risks such as large-scale disasters or carbon lock-in as the world transitions towards zero-carbon technologies, and supports a just and inclusive transition for all.

The World Bank*

Keywords: Adaptation, Climate Change, Emissions, Renewable Energy, Resilience.

TPQ

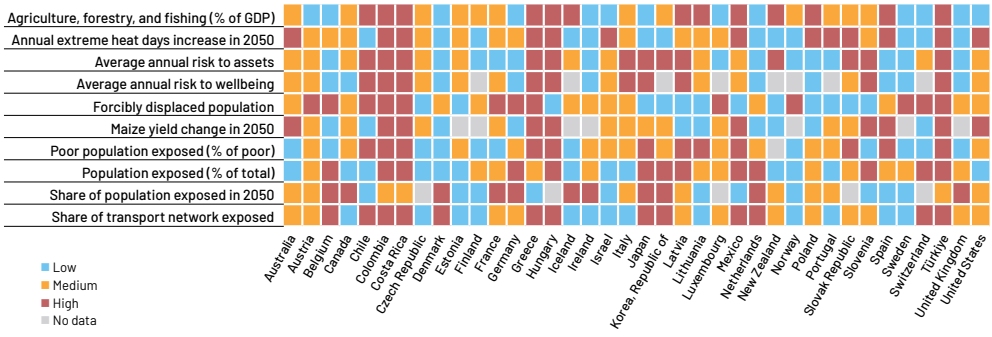
Fall 2023

* This article is based on the World Bank's Türkiye Country Climate and Development Report.

Although the increase in Türkiye's greenhouse gas (GHG) emissions has been slower than economic growth and its per capita emissions are lower than in the Organisation for Economic Co-operation (OECD) or EU countries, there is a strong case for a forceful mitigation agenda in Türkiye. The energy sector—which includes the power, transport, building, and industrial sectors—is the country's single largest contributor to GHG emissions, accounting for three-quarters of total emissions. Türkiye's power, transport, and agriculture sectors are less carbon-intensive than the EU average—partly due to the large penetration of renewable energy (RE) in Türkiye's power system and low motorization rates. However, coal dependency is high and set to increase further under current investment plans. And the building sector (residential and non-residential) is less energy-efficient than the EU average. Manufacturing is more carbon-intensive than the EU average, exposing Türkiye to risks if the EU introduces the Carbon Border Adjustment Mechanism (CBAM). Türkiye's forested landscapes act as carbon sinks, reducing the country's net carbon emissions.

Türkiye's geographic, climatic, and socioeconomic conditions make it highly vulnerable to the impacts of climate change and other environmental hazards, making adaptation and resilience high priorities. Türkiye has high vulnerability in 9 of 10 climate vulnerability dimensions, compared with a median of 2 of 10 in other OECD countries (figure S.2). Its transport system is more vulnerable than those of comparable countries, and the country is experiencing food security issues, increasing water stress, and unprecedented disaster events, such as the 2021 forest fire season. This vulnerability is due to a combination of climate factors, population exposure (for example, the share of the population exposed to floods and forest fires), and socioeconomic factors (such as the share of agriculture in the economy).

Figure S.2: Climate Risk and Vulnerability in Türkiye and Other OECD Countries



Notes: Countries are rated using a benchmark approach: those rated at high risk (red) are in the top third, medium risk (yellow) are in the middle third, and low risk (blue) are in the lowest third.

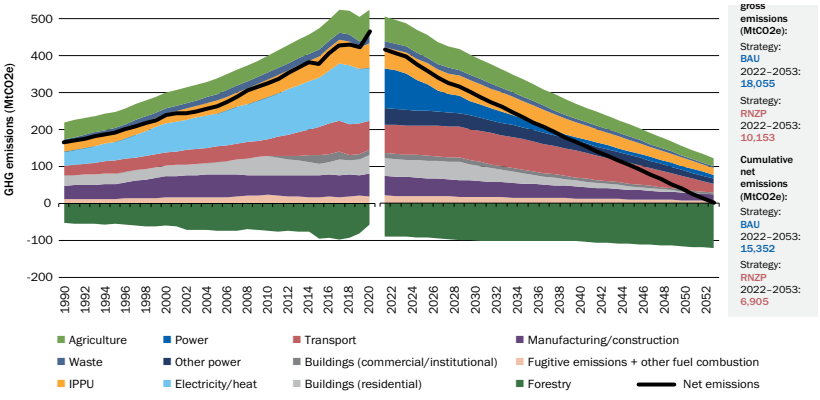
A resilient and net zero pathway can help Türkiye achieve its development and climate objectives but implies a significant departure from current trends and important policy changes.

There are multiple possible paths for aligning Türkiye's development and climate objectives. To explore feasibility, costs, and benefits, The World Bank developed an illustrative resilient and net zero pathway (RNZP) that combines adaptation and resilience actions with the 2053 net zero pledge. The RNZP is based on two main principles:

• **Boosting resilience and adaptation requires a whole-of-economy strategy and a supportive socioeconomic environment.** The RNZP prioritizes supporting adaptation in the private sector by ensuring access to information, technology, and finance. It includes actions to enhance the resilience of critical public assets and services, agriculture systems and land use plans, water resource management, and financial resilience (including insurance and adaptive social protection and the integration of climate and disaster risks in macroeconomic and fiscal policies).

• **Türkiye can achieve its 2053 net zero emissions target (figure S.3) but this will require major changes in many economic sectors.** The transformation includes deep decarbonization of the power sector; a combination of energy efficiency and electrification in buildings; modal shift, energy efficiency, and electrification in transport; a change in current practices to maximize carbon sequestration from forest landscapes; and emissions reduction efforts in the rest of the economy (including industries, agriculture, waste management, and water management).

Figure S.3: Historical Emissions (left) and RNZP Emissions (right)

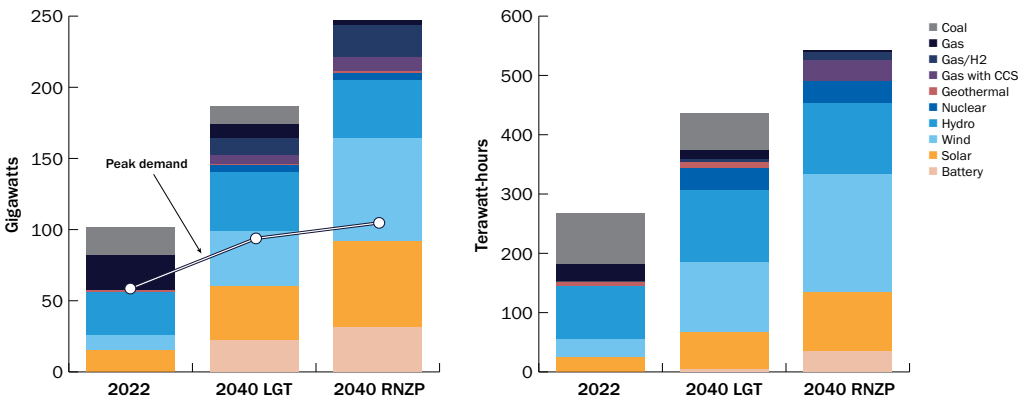


Notes: BAU = business as usual;
RNZP = resilient and net zero pathway.

The RNZP emphasizes several priority areas for boosting economy-wide resilience and adaptation. These include the need to facilitate adaptation by firms and people, for example by expanding public provision of climate and disaster risk information; adapting land use plans and protecting critical public assets and services, including strengthening resilience to severe and growing water-related risks; and mainstreaming adaptation, resilience, and disaster risk finance in macrofiscal policies, including by assessing the economic costs of climate change and disasters, and reflecting contingent liabilities in fiscal policies, budget allocation, and public investment.

In the RNZP, emissions from the power sector are significantly reduced by 2040, despite an increase in demand from electrification of end-use sectors (Figure S.4). Even without a carbon constraint, new coal power plants are neither needed nor the least-cost option to meet growing electricity demand. Instead, Türkiye can achieve energy security through an accelerated pace of least-cost investments in domestic solar and wind—building on its track record of tripling renewable energy capacity in the last decade—and investing in energy efficiency, battery and pumped storage, geothermal, and gas generation with carbon capture and storage (as well as completion of the nuclear plant under construction). This would enable the country to meet a doubling of energy demand by 2053 to fuel its growth ambitions, with the added benefit of lowering emissions and improving energy security by reducing reliance on imported coal, gas, and oil.

Figure S.4: Türkiye's Power System Capacity (left) and Electricity Generation Mix (right) in 2022 and 2040



Note: LGT = least-cost option including plants under construction and the government's RE target but with no emissions constraint; RNZP = resilient and net zero pathway.

By enabling Türkiye to achieve net zero emissions with significant residual emissions in hard-to-abate sectors, negative emissions from forest landscapes play a key role in the RNZP, but they also create risks. Forest carbon storage is vulnerable to economic and climatic factors, such as forest fires. A robust strategy toward net zero must therefore consider how to do more in emitting sectors if negative emissions from forests prove impossible—for example, due to increasingly frequent forest fires.

Achieving Türkiye's climate commitments would yield net economic gains, but require large public and private investments.

The RNZP illustrates the feasibility and overall benefits of aligning development with climate-related goals. As Türkiye imports 99 percent of its gas and 93 percent of its oil, energy efficiency and renewable energy could generate major benefits by reducing air pollution, energy imports and expenditure, and vulnerability to disruptions in global energy markets. When all costs and co-benefits are accounted for, the net economic impact of the RNZP is positive over 2022–30, and it increases when considering longer-term horizons: the RNZP leads to a net $15 billion gain over 2022–30 and a $146 billion gain over 2022–40, largely due to reduced fuel imports and health benefits from decreasing air pollution (Table S.1).

Large investments would be required, but remain manageable, when compared with the size of the Turkish economy. Compared with the baseline scenario that does not include climate objectives, Türkiye would need to invest an additional $68 billion over 2022–30 (in present value terms) in the RNZP; that is 1.0 percent of discounted cumulative GDP over the period. Over 2022–40, this number grows to $165 billion, or 1.2 percent of discounted cumulative GDP. These investments add 21 percent to the existing $319 billion needed over 2022–30 in key sectors: power ($52 billion), residential ($243 billion), and transport ($24 billion), and 34 percent to the $482 billion needed over 2022–40.

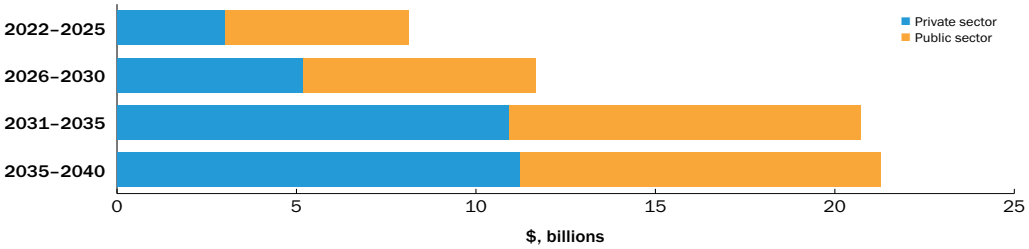
We can expect about half of these investments to come from the private sector. The ability to mobilize private capital depends on the macroeconomic context, sectoral regulations, financial sector deepening, and access to long-term capital. With these assumptions—equivalent to a broadly 50-50 public-private investment split on average—the analysis finds that additional annual (undiscounted) public investment needs for the RNZP could be around $5 billion until 2025, and $6 billion by 2030 (figure S.5). These estimates can be compared with the 2020 public investment budget, which covers all sectors and totals 2.6 percent of GDP, or around $18 billion per year.

Table S.1: Investment Needs and Economic Costs in the RNZP (Additional

	2022–30 ($, billions)	*2022–40 ($, billions)*
POWER		
Additional investment: new generation and storage capacity	+5	+33
Additional investment: transmission and distribution	+8	+14
Other economic costs: operational and fuel costs	-9	-23
Other economic costs: air pollution externality costs from coal	-9	-38
Other economic costs: decommissioning of coal plants and mines	< +1	+1.4
RESIDENTIAL		
Additional investment: energy efficiency, electrification, and resilience	+45	+100
Other economic costs: gas imports	-11	-46
Other economic costs: lives lost and injuries	-1	-3
TRANSPORT		
Additional investment: new resilient infrastructure	+8	+15
Other economic costs: fuel imports	-12	-36
Other economic costs: cost of disruptions	-3	-11
Other economic costs: air pollution, congestion, and road fatalities	-40	-171
FOREST LANDSCAPES		
Additional investment: restoration, reforestation, and fire management	+2	+3
Other economic costs: loss of harvest revenues	+1	+5
AGRICULTURE		
Other economic costs: on-farm emissions reductions	< +1	–
INDUSTRY AND MANUFACTURING		
Other economic costs: cement, iron, and steel	–	+11
TOTAL INVESTMENTS AND ECONOMIC COSTS		
Net economic costs	-15	-146
includes: additional investment	68	165

Notes: All amounts are discounted using a 6 percent discount rate. Decommissioning costs do not include the social expenditures to facilitate the transition of affected workers and communities. Numbers in red are net costs; numbers in green are net benefits.

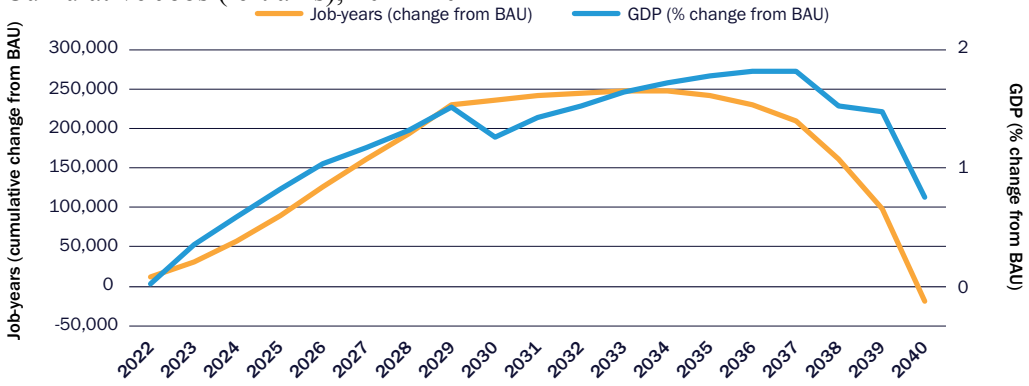
Figure S.5: Additional Annual Investment Needs for the RNZP



Integrating development and climate objectives would lead to higher growth and employment, but could create transition challenges for exposed sectors and their workers.

Even without considering benefits from avoided climate change impacts, we expect the RNZP to increase GDP growth and employment, thanks to large investments, energy efficiency, technological upgrading, and reduced fuel costs (Figure S.6). Türkiye's GDP grows faster in the RNZP, in which sectoral roadmaps are combined with economy-wide interventions, including carbon pricing with appropriate recycling. However, this growth benefit would be lower if carbon price revenues are not recycled in a way that supports private sector investment and if additional investments in the RNZP crowd out other investments. Growth benefits are also markedly lower after 2035, as decarbonization of the power system gradually leads to higher electricity prices. The net impact on jobs is small, with 230,000 more jobs in 2030 in the RNZP, but with the growth slowdown after 2035 erasing these gains.

Figure S.6: Impact of the RNZP Transition on GDP (right axis) and Cumulative Jobs (left axis), 2022–40



Note: BAU = business as usual; GDP = gross domestic product.

While the additional investments needed are significant, their overall impacts on the fiscal and external balances are relatively small. The analysis shows that additional investments raise capital and related imports, but savings in oil and gas imports offset these in the current account balance. Public debt levels in the RNZP rise by 1 to 3 percentage points of GDP compared with a baseline scenario, as government revenues from a carbon price help offset borrowing for investment needs. This provides an indication of the fiscal space the government has should it choose to save less and instead take on a larger share of the total investment needed in capital and innovation to support the transition. Macroeconomic stability is essential to preserving this fiscal space and fostering private sector investments.

The impacts of decarbonization on consumption are positive. Policy makers need to pay careful attention to housing affordability, food security, electricity prices, mobility, and access to jobs and services. We expect the impact on inflation to be limited, with the effect on food and manufacturing prices under 1 percent in 2030 and below 2.5 percent in 2040. Additional carbon price revenues can be used to compensate low-income households for adverse impacts, such as a rise in energy prices. With 13 percent of the carbon tax revenues recycled as cash transfers, all household income classes would benefit.

Decoupling emissions from growth involves economic restructuring and changes in labor demand, which poses challenges to a just and inclusive transition. Although Türkiye's green transition likely will create new jobs in environmentally friendly production, it will also place other jobs at risk, particularly in sectors with fewer options for transitioning to more sustainable ways of production. And this transition will affect a country with already significant social challenges, including those linked to the recent rise in poverty (with over 10 million people now below the poverty line), the world's largest refugee population, and low female labor force participation (the lowest among OECD countries). Türkiye's lower share of green jobs and its higher share of jobs that require upskilling compared with its peers also make it a challenge to upgrade the skills of its workforce. Ensuring a just and inclusive transition will require careful management of economic and labor market adjustments, investments in human capital and education, strong and adaptive social protection systems, and targeted interventions for retraining and reskilling.

The advantages of pursuing the RNZP are greater if we account for global decarbonization trends and the benefits of retaining access to global markets and participating in global value chains. Climate action in other countries will affect Türkiye through changes in global demand, technologies in global value chains, and trade rules. The impacts of the EU's CBAM will be significant on a few emission-intensive industries that have high trade exposure to the EU market. Some of these industries will face lower output and employment, requiring action to facilitate structural adjustments both within and between sectors. But the aggregate macroeconomic impacts of an EU CBAM will be limited.

Türkiye's firms have a relatively high degree of sophistication, as reflected in their integration in global value chains and growing value-added from exports, and the country has large potential in green global value chains. The CBAM creates an opportunity for Türkiye to benefit in markets where competitors are more carbon-intensive, especially if the country makes increasing efforts on energy efficiency in industries and on the performance of the logistics system. Türkiye is already well integrated in electric mobility value chains and has significant opportunities to participate in the global solar and wind energy value chains.

Short-term priorities include "no regret" options that contribute to growth and climate objectives, but also difficult changes in a few key sectors.

Delaying some interventions could reduce short-term transition costs, allowing Türkiye to benefit from the decline in green technology costs and adjust its strategy as more information becomes available. For example, while electrifying residential heat and other energy use is needed to achieve net zero emissions, doing so immediately magnifies the challenge of decarbonizing the power system. In contrast, the cost of electrifying existing buildings is manageable, so delaying this action until 2030 would allow Türkiye to benefit from cheaper technologies (heat pumps, induction cooking) and less carbon-intensive electricity. Similarly, completely decarbonizing Türkiye's carbon-intensive industry will require new technologies, such as hydrogen-based steel making and carbon capture and storage, but widespread implementation of these technologies is more realistic after 2030.

Some changes are urgent, because current trends are creating lock-ins into carbon-intensive patterns that will increase costs and create financial risks, such as stranded assets. Particularly urgent is the need to realign current energy policies. This includes ending the costly support to domestic production and consumption of indigenous coal and stopping the construction of new coal power plants, which would be at high risk of becoming stranded assets before the end of their lifetimes. It would also require significant upscaling of renewable energy with a diversified power mix—including wind, solar, hydropower, geothermal, gas generation with carbon capture and storage, and nuclear—as well as investments in energy storage, particularly battery energy storage, which the country has yet to start investing in. This clean energy transition is necessary to achieve the government's net zero target, and it would contribute to reducing dependency on imported energy without compromising energy security. It would also reduce exposure to geopolitical risks and energy price volatility on global and regional markets.

Other changes are urgent in sectors with long-lifetime assets, technological inertia, or declining natural capital. This includes action to improve energy efficiency in new residential buildings, which would reduce energy costs and retrofitting needs, be synergetic with increasing resilience to earthquakes and high temperatures, and facilitate the decarbonization of the power system. Similar interventions to support energy efficiency in carbon- or energy-intensive sectors would improve external competitiveness and productivity and help Türkiye's economy prepare for future climate-related trade policies implemented by its main trade partners. For technologies to decarbonize heavy industries to be available and cost-competitive by 2030, investments in research and development and in pilot projects—including identifying sequestration opportunities—should start immediately. Supporting a modal shift toward rail, public transit, and soft modes (such as cycling and walking) requires early action on transport infrastructure and supportive, risk-informed urban planning with transit-oriented development. Finally, growing climate and disaster risks make adaptation and resilience interventions equally urgent, such as improved water management and agriculture practices to preserve water resources and productive soils.

Table S.3. Summary of Sample 2030 Sectoral Milestones
For the Illustrative RNZP

SECTOR	***2030 MILESTONES***
Power *27 percent of total gross emissions in 2020*	75 percent share of RE in power generation *(42 percent in 2020)* 37 percent share of variable RE in power generation *(12 percent in 2020)* 9 percent share of coal in power generation *(32 percent in 2020)* 10 GW battery storage capacity *(0 GW in 2020)*
Transport *15 percent of total gross emissions in 2020*	Share of rail in total freight transport: 8 percent *(4 percent in 2020)* Public transit (buses and rail) modal share for surface transport: 49 percent *(47 percent in 2020)* Electrification of cars and buses: 12 percent and 19 percent, respectively *(both 0 percent in 2020)* New investments screened for risks; critical assets identified and strengthened
Buildings *12 percent of total gross emissions in 2020*	New and retrofitted buildings to achieve Class A energy rating *(Class C in 2021)* From 2030, electrification of new and retrofitted residential buildings Combined seismic and energy retrofit of 2.5 million residential buildings 100 percent of urban plans updated to account for future climate risks
Forest landscapes *Carbon sequestration offsetting 11 percent of gross emissions in 2020*	Harvest rate 24.3 million m^3 *(26.0 million m^3 in 2020)* Zero deforestation after 2022 Average burnt area per wildfire reduced to below 2 hectares *(6.2 in 2020)* 102 MtCO2e/year emissions removals *(57 MtCO2e/year in 2020)*
Rest of economy *46 percent of gross emissions in 2020*	Agriculture: emissions reduced by 19 percent to 55 MtCO2e Fugitive emissions reduced by 18 percent to 17 MtCO2e Manufacturing/construction (except IPPU) reduced by 19 percent to 44 MtCO2e Solid waste reduced by 19 percent to 14 MtCO2e

Notes: GW = gigawatts; MtCO2e = million tonnes of carbon dioxide equivalent;
IPPU = industrial processes and product use.

Six Short-Term Priorities to Trigger the Transition

Some interventions that tackle underlying structural obstacles to Türkiye's growth and development can also help achieve the country's climate objectives. Those include measures to promote:

• **Macroeconomic stability:** Reducing macroeconomic volatility, stabilizing inflation, building external reserves, and maintaining a prudent level of public debt, all of which are essential to enable the required public and private investments.

• **Human capital and social protection:** Investing in people through health and education, ensuring higher labor force participation (especially for women), and building stronger and more comprehensive safety nets to reduce macroeconomic transition costs and minimize social costs.

• **Institutional strengthening:** Better integrated policy documents, improved economic decision- making and budgetary processes, and more efficient public spending through procurement and public investment management.

Making improvements in these three domains creates clear synergies: in addition to accelerating growth, they would make the economy better able to manage the transition toward climate resilience and net zero emissions. But these interventions also need to be complemented with a set of targeted sectoral approaches.

Priority 1. Realign energy policies to exit from coal and decarbonize the power sector: Make parallel efforts, through a new energy security compact, to commit a just and inclusive transition from coal, by (i) not building new coal plants; (ii) retiring most existing coal power plants and mines by 2040; (iii) supporting laid-off workers and affected communities; (iv) facilitating environmental remediation; (v) scaling up renewable energy; (vi) deploying grid integration measures, particularly battery and pumped storage, remunerating storage services, and expanding and digitalizing transmission networks; and (vii) ensuring well-designed power markets, with careful consideration of implications for reliability and electricity prices.

Priority 2. Maximize the economic benefits of the transition with a supportive macroeconomic and financial environment: Implement macro-stabilizing and structural interventions to raise economic productivity by (i) alleviating factor market rigidities; (ii) removing or repurposing fossil fuel and agricultural subsidies, and deploying de-risking instruments; (iii) enabling public investments and mobilizing private investments through a tax reform that combines subsidy reform with a carbon price in all sectors except agriculture and landfills; (iv) mainstreaming climate objectives in macro-fiscal and monetary policy; and (v) reforming the financial sector to extend tenor and taxonomy, developing green and blue bonds, and improving transparency and disclosure of climate-related risks in the financial system.

Priority 3. Make the economy more energy efficient: Establish a more ambitious National Energy Efficiency Action Plan to 2030 for transport, buildings, urban industry, and waste sectors, with (i) more stringent and well-enforced building standards and codes; (ii) strategies and investments to support modal shifts in transport and transit-oriented urban development; (iii) a national program for building renovations; (iv) national schemes to support energy efficiency in factories, including energy audits and efficiency reporting, and improved recycling programs for metals, e-waste, and other waste; and (v) a progressive and coordinated shift toward electrification in industries, as well as space and water heating, coupled with rooftop solar schemes to offset impacts on the grid.

Priority 4. Maximize negative emissions from forests and landscapes: Mainstream sustainable forest management to enhance carbon sinks and manage climate risks (especially wildfires), with investment in landscape restoration through reforestation, forest and grassland rehabilitation, cropland management, and wetland conservation.

Priority 5. Make growth more resilient and sustainable: Adopt an economy-wide approach that mainstreams (i) resilience and future climate change impacts in public and private sector decisions, by including climate risks in budgeting procedures; (ii) infrastructure and building construction standards; (iii) procurement and public investment management; (iv) urban and infrastructure planning; (v) water management plans and regulations, complemented by modernized irrigation and drainage and diversified freshwater resources; (vi) agriculture policies and support, including subsidy repurposing; and (vii) social protection systems.

Priority 6. Minimize social disruptions and ensure a just and inclusive transition: Build a strategy that (i) identifies at-risk sectors and workers; (ii) anticipates and prepares for retraining and reskilling needs; and (iii) strengthens social protection systems to make them more reactive, flexible, and better able to absorb expected and unexpected shocks.

REDUCING EMISSIONS AND BUILDING CLIMATE RESILIENCE IN TÜRKİYE'S CITIES

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Globally, cities play a key role in driving climate change while bearing the costly repercussions on basic services, infrastructure, housing, and the well-being of their citizens. Turkish cities are no exception to this trend, as they increasingly contribute to the country's growing GHG emissions. This article looks at effects of climate change on Turkish cities and the actions taken by the local and national government to increase climate resilience and reduce GHG emissions. It also aims to provide selected development and climate priorities for policy makers and urban residents in their efforts to follow low-carbon and resilient development pathways.

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Keywords: Adaptation, Decarbonization, Greenhouse Gas (GHG), Urban Resilience, Waste Management.

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Developing resilience to the consequences, both immediate and anticipated, of global warming while mitigating greenhouse gas (GHG) emissions is imperative for tackling the developmental limitations posed by a changing climate. Globally, cities play a key role in driving climate change while bearing the costly repercussions on basic services, infrastructure, housing, and the well-being of their citizens. Turkish cities are no exception to this trend, as they increasingly contribute to the country's growing GHG emissions.

Meanwhile, urbanization is also an important driver of economic growth and opportunity in Türkiye. Turkish cities have played a pivotal role in driving the nation's substantial economic growth and progress in recent decades, substantially promoting economic productivity. Since the rapid urbanization after 1980, the urban population now makes up 74.6 percent of the population, a substantial increase from the 25 percent recorded in 1950.[1] Yet, Turkish cities, like all urban centers worldwide, struggle with the challenges of a shifting climate. However, they also have a unique opportunity to strengthen urban resilience, enhance the quality of life, while continue serving as engines for economic growth.

This article looks at effects of climate change on Turkish cities and the actions taken by the local and national government to increase climate resilience and reduce GHG emissions. It also aims to provide selected development and climate priorities for policy makers and urban residents in their efforts to follow low-carbon and resilient development pathways.

Cities and Rising GHG Emissions

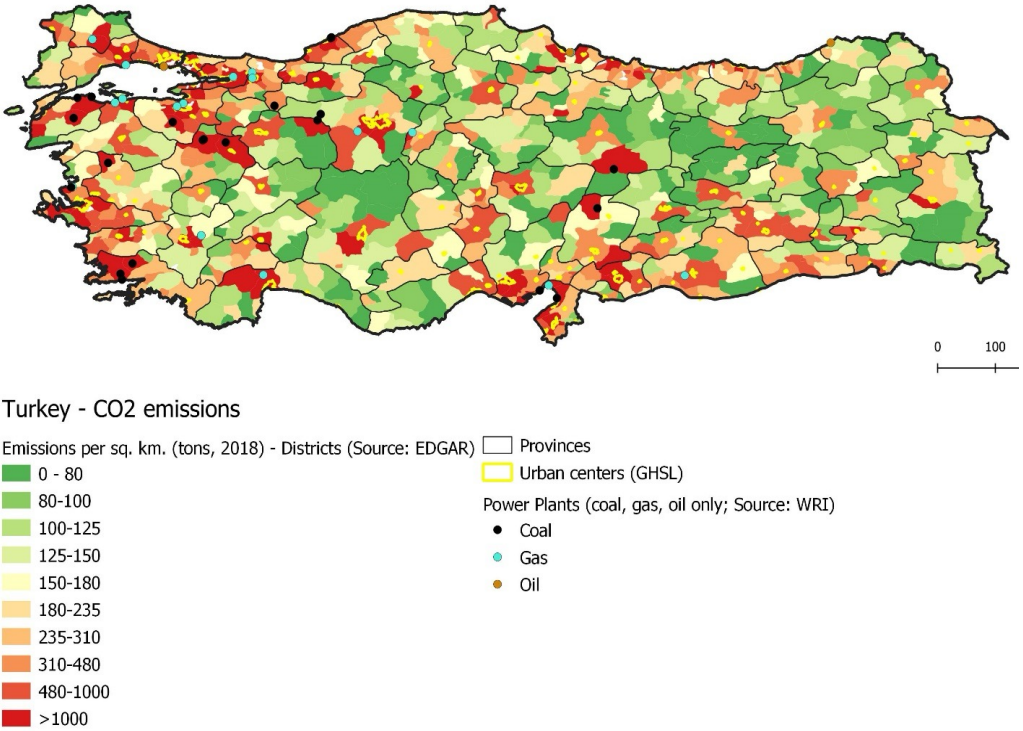
Türkiye's urban areas contribute a large and growing proportion of country's GHG emissions. In 2015, urban areas in Türkiye were responsible for 65 percent of the nation's CO2 emissions, including suburban and peri-urban regions, as well as densely populated and semi-dense settlement clusters. It's worth noting that this figure doesn't reflect emissions originating in rural areas due to the direct result of people and activities in urban centers, such as power plants in rural regions generating electricity consumed in cities, making the proportion of Türkiye's total emissions tied to urban areas most likely even higher.

GHG emissions in Turkish cities result from various sectors, spanning from the heart of urban centers to the peri-urban outskirts. In a broad context, urban areas contribute to GHG emissions through various means, including transportation, energy consumption for heating and cooling buildings, illumination for streets

1) https://databank.worldbank.org/source/country-climate-and-development-report-(ccdr)

and structures, industrial processes, waste management, and the carbon footprint embedded in urban infrastructure, among other origins. Notably, nearly half of Türkiye's total emissions stem from the energy sector,[2] with a significant 81 percent of these emissions in 2015 originating in urban areas.[3] Simultaneously, urban areas account for 69 percent of Türkiye's residential sector emissions, with a substantial portion originating from densely populated urban centers -population density exceeding 1,500 individuals per square kilometer.

Figure 1: CO2 Emissions per sq. km. in Türkiye, by District in 2018



Source: World Bank, using EDGAR Data[4]

2) This is the "energy-industry" figure from EU EDGAR data. Energy-industry includes *the combustion in the power and non-power generation industries, fugitive emissions, fuel production, refineries and transformation industries.*

3) Carter and Boukerche. 2020. *Catalyzing Private Sector Investment in Climate Smart Cities* (English). Invest4Climate Knowledge Series Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/179101596519553908/Catalyzing-Private-Sector-Investment-in-Climate-Smart-Cities

4) Monica Crippa, Diego Guizzardi, Marilena Muntean, Edwin Schaaf, Eleonora Lo Vullo, Efisio Solazzo, Fabio Monforti-Ferrario, Jos Olivier and Elisabetta Vignati, "EDGAR v6.0 Greenhouse Gas Emissions," European Commission, Joint Research Centre (JRC) [Dataset] (2021), PID. http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b

Cities and Climate Vulnerabilities

The concentration of people, infrastructure, and economic activity in Türkiye's urban areas highly exposes them to climate change's effects. Coastal cities in Türkiye, for instance, face the imminent threat of rising sea levels and coastal flooding due to the country's extensive coastline. 28 Turkish cities, in addition to 181 towns and villages, are located along its coastal areas, all situated at elevations of less than 10 meters above sea level, and host more than 22.2 million residents. Specifically, cities like Adana, Edirne, Izmir, and Samsun are identified as being at highest risk, primarily due to their geographical characteristics of low elevation and proximity to river deltas. A one-meter increase in sea level would submerge an area of 1,600 square kilometers, displacing more than 214,000 residents.[5] Furthermore, extreme rainfall events compound the risk of sea level rise, amplifying the threat of urban flooding in Türkiye's cities. In Adana alone, as of 2015, over 195,000 people were deemed vulnerable to flood risk.[6] Unfortunately, in addition to sea level rise and floods, Türkiye's urban centers are also exposed to heatwaves, wildfires (including smoke and air pollution resulting from fires occurring outside urban areas), and water scarcity.[7]

Yet, Türkiye's cities have a significant opportunity to make substantial emissions reductions and adapt effectively to a changing climate, enhance urban resilience, the well-being of city residents, and bolster local economies. Global estimates propose that cities have the potential to cut emissions by nearly 90 percent by 2050 through readily available, technically feasible measures, underscoring the pivotal role cities must assume in mitigating climate change.[8] This presents Turkish cities, along with other cities around the world, with a considerable responsibility. Cities must tackle this responsibility from all sides, addressing various fronts to reduce emissions. This includes transitioning to clean energy sources, implementing urban planning that promotes compact, transit-oriented development; investing in public transit and climate-friendly transportation options like walking, bicycling, and electric vehicles; providing incentives for energy efficiency in buildings and industries; and improving solid waste management practices.

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5) Sumeyra Duman Kurt and Xingong Li, "Potential Impacts of Sea Level Rise on the Coasts of Turkiye," *Journal of Environment and Earth Science*, Vol. 10 (2020): 40-47. DOI: 10.7176/JEES/10-5-04

6) Urban Centre Database UCDB R2019A – Aneta Florczyk, Christina Corbane, Marcello Schiavina, Martino Pesaresi, Luca Maffenini, Michele Melchiorri, Panagiotis Politis, Filip Sabo, Sergio Freire, Daniele Ehrlich, Thomas Kemper, Pierpaolo Tommasi, Donato Airaghi and Luigi Zanchetta, "GHS Urban Centre Database 2015, Multitemporal and Multidimensional Attributes," R2019A. European Commission, Joint Research Centre (JRC) [Dataset] (2019), PID. https://data.jrc.ec.europa.eu/dataset/53473144-b88c-44bc-b4a3-4583ed1f547e

7) https://thinkhazard.org/en/report/249-Turkiye/

8) Coalition for Urban Transitions 2019. Climate Emergency, Urban Opportunity. World Resources Institute (WRI) Ross Center for Sustainable Cities and C40 Cities Climate Leadership Group. London and Washington, DC. https://urbantransitions.global/urban-opportunity/

Simultaneously, cities must adapt to climate change through risk-sensitive land use planning; strengthening and building defenses against disasters, including nature-based solutions like green spaces, retention ponds, and wetlands, employing permeable and reflective materials; enforcing building regulations that minimize disaster-related damage, investing in early warning systems, emergency response mechanisms, and other appropriate measures.

Adaptation and Mitigation Measures in Türkiye

Türkiye can potentially derive advantages from climate-smart initiatives, whether in the immediate or distant future. These benefits confine both adaptation and mitigation efforts and the growth in worldwide demand for eco-friendly products, the advancement of green technologies, enhanced energy security owing to reduced energy imports, improved air and water quality, and the creation of more habitable and productive urban environments. To realize these benefits, local authorities must be equipped with the technical expertise and decision-making authority necessary for planning, coordinating, and executing various urban investments. Furthermore, they should have greater access to climate finance and establish a strong financial foundation enhancing their creditworthiness to attract, and manage the necessary funding for these investments effectively.

Some cities and municipalities have already introduced local climate change action plans, policies, and measures to strengthen resilience to climate change, while some sectoral policies and plans incorporate aspects or elements of climate change. Twenty-seven Turkish cities and municipalities have joined the Global Covenant of Mayors for Climate and Energy, the largest global alliance for city climate leadership with over 10,000 city and local government members. Of these, 16 have committed to a climate change mitigation target, but much remains to be done: 10 are still working on their emissions inventories and mitigation plans; none has an adaptation plan;18 and only one (Izmir) has a climate change action plan and Green Cities Action Plan.

These actions are also supported at the national government level. The Ministry of Environment, Urbanization, and Climate Change (MOEUCC), which coordinates activities to combat climate change in Türkiye established its Climate Change Presidency in 2021 in recognition of this challenge. On the other hand, IlBank, the municipal development bank as the primary vehicle to finance loans for municipalities for urban infrastructure, has been shifting its priorities to meet climate change mitigation and adaptation needs of municipalities in addition to basic infrastructure services by establishing a climate change unit.

Nonetheless, there remains a significant journey ahead. Swift and decisive measures are essential to redirect Türkiye's urbanized economy on to a low-carbon path, preventing the lock-in effects of carbon-intensive urban development for future generations. Projections indicate that Türkiye's urbanization rate will increase to 80 percent by 2030 and to 86 percent by 2050. Given the ongoing expansion of the economy and rising incomes within Türkiye's predominantly urban population, the development and management of urban areas will have a substantial influence on its emissions trajectory for the years to come. Urban form has a lock-in effect with long-term implications for climate mitigation and adaptation. Urban infrastructure only has a lifespan of several decades, but its consequent urban form can have persistent impacts for centuries. This is especially crucial when considering urban sprawl and expansion in Türkiye's major cities, most notably Istanbul.

Paths Towards Resilience and Decarbonization

Navigating the complicated relationship between climate challenges and the imperatives of urban development, various strategies and policies are needed that can steer Türkiye's cities toward a future marked by increased sustainability and readiness. Below are some areas with particular potential to both strengthen the resilience and decarbonization endeavors of Turkish cities. These recommendations focus on select areas of action and their interlinkages, setting the stage for a comprehensive exploration of transformative strategies for decarbonization and resilience building in cities:

• **Planning of flow-carbon cities:** Compact and coordinated urban growth, characterized by higher density, mixed-use development, and walkable, interconnected streets, is critical to reducing emissions particularly through transit-oriented planning (e.g. the Copenhagen approach[9]). This approach should encompass the widespread adoption of electric vehicles, the enhancement of accessible public transportation systems, the promotion of shared mobility solutions, and the encouragement of non-motorized transport options. Proactively managing a low-carbon transition in the transportation sector presents a significant developmental opportunity for Türkiye. This strategic approach is essential for a sustainable, low-carbon future, positioning Turkish cities to thrive while mitigating the effects of climate change. Compact growth can also reduce the energy required per capita for heating and cooling buildings. In some cities, denser urban growth can reduce future energy consumption from buildings as

9) If Turkiye's cities in 2050 resemble a sprawling, car-oriented city like Houston, USA (population density ~1,400 people per sq. km.) today, they will produce 593 million tons of CO2 from transport alone. If instead, they resemble a compact, transit-oriented city like Copenhagen, Denmark, which is similarly wealthy but has nearly five times the population density of Houston (~6,900 people per sq. km.), they will instead emit 79 million tons of CO2 from transport. https://ourworldindata.org/grapher/transport-emissions-city-density

much as improve the energy efficiency of buildings.[10] Adopting urban densities as Turkish cities accommodating the projected urban population expansion in Türkiye not only safeguards land and natural greenery but also substantially mitigates the embodied emissions linked to materials used in construction, notably steel and cement, which collectively contribute to 10-15 percent of global greenhouse gas emissions. The long-term implications of climate-smart urban form would have a profound effect on climate mitigation and adaptation, given that urban infrastructure can persist for centuries.

• Utilizing nature-based solutions to fight against urban heat island (UHI) effect: The growing threat of extreme heat in urban landscapes, driven by the twin forces of climate change and the urban heat island (UHI) effect, has long-term economic and health consequences. Urban areas, being the epicenter of this heat crisis, are experiencing the dire effects of the UHI, a phenomenon born from the heat-absorbing tendencies of artificial surfaces, the absence of greenery, and the trap of heat within buildings, all exacerbated by the heat emanating from human activities, including industrial operations and vehicular traffic. Notably, extreme heat is unevenly felt within low-income neighborhoods where they endure the heavier burden, primarily due to limited urban greenery. To confront this escalating challenge, Turkish cities must take the necessary steps to protect their communities from the threats of extreme heat while bolstering the resilience of their most vulnerable residents. Although the Mediterranean coast and Southeastern Anatolia regions of Türkiye have historically grappled with hot and arid summers, forward-looking actions are imperative in the face of impending heat extremes. These strategies involve cooling urban areas by fostering greenery for shade and evaporative cooling, leveraging reflective materials, optimizing street layouts and building designs to maximize shade and airflow, and facilitating public awareness and education on the health risks associated with extreme heat. These coordinated efforts must be finely tuned to cater to the needs of vulnerable neighborhoods, specific demographic groups, and occupational sectors, such as construction and manufacturing, ultimately charting a course toward a cooler, safer, and more resilient urban future.

10) Güneralp et al., "Global Scenarios of Urban Density and Its Impacts on Building Energy Use through 2050," *Proceedings of the National Academy of Sciences*, Vol. 114, No. 34 (2017): 8945–50. https://doi.org/10.1073/pnas.1606035114

• **Low-carbon waste management and recycling programs:** Solid waste management is an important component in addressing climate change in Türkiye's cities.[11] For example, 10 percent of Istanbul's emissions are from the solid waste sector. [12] Waste generation in Türkiye is expected to increase from 36.4 million tons in 2020 to 58.2 million tons in 2050, which is below the projected global increase of 73 percent during the same period. Improving waste management, more significantly open dumping, can reduce GHG emissions and generate significant co-benefits including reduced soil and marine pollution; better local health and environmental outcomes; improved quality and access to a basic local government service; a more integrated informal sector; enhanced public environmental awareness; and stronger local economic development, city competitiveness, and livability conditions. Türkiye also has significant potential for circular economy practices that reduce emissions, as one of the largest polypropylene importers. Improving appropriate recycling capacities would reduce both emissions from waste and its dependence on imports.

The acute need to reduce emissions and enhance resilience in Turkish cities cannot be overstated. As urbanization continues to drive economic growth and opportunity in Türkiye, cities are poised to be the engines of progress. However, their rapid expansion is coupled with climate vulnerabilities, requiring swift action to safeguard their residents and future prosperity. The stakes are high, with rising sea levels, urban flooding, heatwaves, wildfires, and water scarcity threatening the well-being of urban residents.

The policy recommendations outlined in this article provide a number of ways for Turkish cities to navigate the complexities of climate change, fostering sustainability and readiness and offering a comprehensive approach to decarbonization. Turkish cities have the potential to make substantial emissions reductions and adapt effectively to a changing climate, enhancing the well-being of their residents and bolstering local economies. In sum, Türkiye's urbanized economy must avoid the lock-in effects of carbon-intensive development for future generations, aligning urban growth with climate goals and building a more sustainable, resilient future for all.

11) S. Kaza, L. Yao, P. Bhada-Tata and F. Van Woerden, "What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development Series," Washington DC: World Bank (2018). https://openknowledge.worldbank.org/handle/10986/30317

12) C40 Cities Knowledge Hub, https://www.c40knowledgehub.org/s/article/C40-cities-greenhouse-gas-emissions-interactive-dashboard?language=en_US

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IMPACT OF CLIMATE CHANGE ON WATER STRESS AND WATER AVAILABILITY

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Türkiye is already considered a water stressed country. Over two-thirds of the country's 25 river basins face severe water scarcity, including those hosting the largest cities and economic hubs. With increased risk of drought and uncertain rainfall from climate change coupled with current water management practices, water security is an increasingly important issue, including for agricultural production and the rural incomes that depend on it. This article examines how climate change will impact water availability and the measures that can be taken to improve water supply, management and access.

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Keywords: Climate Change, Drought, Floods,
Water Management, Water Scarcity.

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Türkiye, like other countries, is facing the harsh reality of climate change. In recent decades, floods, heatwaves, droughts, wildfires and landslides have affected the country with increasing frequency and intensity.

In 2021, Türkiye was particularly hit hard by climate changed induced extreme events:

• As a result of the drought in the second half of 2020 and early 2021, several reservoirs around major cities reached their lowest water storage levels in 15 years. For example, Istanbul's reservoir levels fell to less than 20 percent of their capacity, putting water supply services at high risk for the city's 16 million customers and other users, including industry.

• In June 2021, the outbreak of the Marmara Sea mucilage, believed to be the biggest in history, choked sea life, damaged the tourism and fishing industry, and threatened to impede the only shipping access to the Black Sea.

• In August 2021, the Black Sea region was hit by the worst floods in Türkiye's history. 97 people died and about 228 more were injured, more than 1,800 people were evacuated and at least 454 buildings sustained significant damage.

The Sixth Assessment Report of the United Nation Intergovernmental Panel on Climate Change highlights the Mediterranean Basin, where Türkiye is located, as one of the world's climate hotspots due to climate change. The report concludes that Türkiye will experience three accelerating trends at global warming of 2°C and above: (1) rising temperatures, (2) increase in droughts and aridity, and (3) rising sea water levels. Moreover, it predicts that 60 percent of the country's area could be subject to desertification if necessary measures are not taken.[1]

These are big challenges for Türkiye, and improved water management strategies and significant climate financing will be needed over the coming years.

How Water-Secure is Türkiye?

Türkiye is already considered a water-stressed country. On the global scale, countries classified as water-rich have 8,000–10,000 cubic meters of water available per person per year whereas countries with less than 1,700 cubic meters – such as Türkiye, with about 1,600 cubic meters – of consumable water per person per year are classified as "stressed".[2] Over two-thirds of the country's 25 river basins already face severe water scarcity, including those hosting the largest cities and

1) Climate Change 2021: The Physical Science Basis. Official website: https://www.ipcc.ch/report/ar6/wg1/

2) The Falkenmark Water Scarcity Index ranks countries according to the amount of water available per capita.

economic hubs such as Istanbul, Ankara, Izmir, and Antalya, as well as important agricultural areas, such as the Konya plains.[3] The current levels of water stress are likely to increase in the future, exacerbated by the effects of climate change, urbanization, and growth in economic activities such as tourism and agriculture. Turkish government experts believe that the available water could decline to as little as 1,200 cubic meters per capita annually by 2030.[4]

Despite increasing water scarcity, water use and withdrawals have steadily increased in recent decades. Between 2001 and 2020, total water withdrawal increased from 40.9 billion to 61.5 billion cubic meters per year. Agriculture remains the largest water consumer – 88 percent of water is used for irrigation, 10 percent by the municipal sector and 2 percent by the industry. In contrast, over the same period, most European countries were able to reduce their total annual water extraction rather than increase it, and even in southern Europe (where most irrigation undertaken by European countries occurs) agricultural water consumption was brought down by about 7 percent.

How Will Climate Change Impact Türkiye's Water Resources?

Climate change is primarily a water crisis. Its impacts will be mainly felt through the following channels: (i) water availability and stress; (ii) water quality and quantity; and (iii) intensification of extreme water-related events.

Climate change is expected to affect water availability and increase stress on surface and groundwater. According to a 2016 Climate Change assessment by the Ministry of Forestry and Water Affairs,[5] exploitable water resources could decrease from 112.1 billion m^3 to about 86 billion m^3 by the 2050s – in an optimistic scenario. However, in a worst-case scenario, water demand may exceed Türkiye's exploitable water level as early as the 2030s. Irrigated agriculture, which consumes most the country's overall exploitable water, would be the hardest hit.

The combined impacts of climate change and excessive groundwater pumping due to increasing water demand have already caused a significant decline in groundwater levels. For example, in the Konya basin, groundwater levels have dropped by more than two meters, threatening the long-term sustainability of agriculture and contributing to the occurrence of massive sinkholes.[6] While some sinkholes

3) Turkey Water Sector Engagement Note, 2020: 62.

4) Republic of Turkey, General Directorate of Water Management, Climate Change and Adaptation. Book, accessible online at https://www.tarimorman.gov.tr/SYGM/Belgeler/iklim%20de%C4%9Fi%C5%9Fikli%C4%9Finin%20su%20kaynaklar%C4%B1na%20etkisi/iklimkitap2020.pdf

5) Former Ministry of Agriculture and Forestry.

6) Sinkholes open up when underground caverns created by drought can no longer contain the weight of the soil layer above.

are relatively shallow, others can be as deep as 150 meters. Simulation of aquifer behavior until 2050 predict reductions in recharge of aquifers and groundwater availability, particularly in the coastal plains along the Mediterranean Sea where groundwater is the main source of irrigation water.[7]

Climate change is expected to exacerbate negative impacts of pollution on water quality. In many areas, increased water temperatures can cause eutrophication and greater outbreaks of harmful algal blooms. This in turn will impact the water quality of lakes and reservoirs as well as wetlands and ecosystems, with negative impacts on livelihoods of those depending on fishery and aquaculture.

A recent example is the climate change-induced warming of the Marmara Sea which – combined with widespread pollution from the discharge of untreated industrial and domestic wastewater and agricultural uses of fertilizers and pesticides – contributed to the Mucilage Crisis in June 2021.

Climate change is expected to increase the frequency and intensity and the costs of extreme water related events. Climate change has not been proven to directly cause individual extreme environmental events, but it has been shown to make these events more destructive, and likely happen more frequently than they normally would be.

In 2007-08, Türkiye experienced a severe drought that affected more than 435,000 farmers and resulted in economic losses of US$ 1.4–2.2 billion.[8] Likewise, devastating floods in 2006 and 2009, totaled almost 1 trillion US$ in damage. It is estimated that in the event of a 100-year flood, more than 3 percent of GDP (US$20 billion) and 3 million people (3 percent of the population) could be affected.[9]

7) Avci et al. 2021. Assessing the effect of climate change on groundwater use in Demre coastal aquifer (Antalya, Turkey), coupled use of climate scenarios and numerical flow modeling.

8) M. Bagherzadeh and M. Shigemitsu, "Building the resilience of Türkiye's agricultural sector to droughts. OECD Food, Agriculture and Fisheries," Papers 167, OECD Publishing (2021). Available at: https://ideas.repec.org/p/oec/agraaa/167-en.html

9) GFDRR, (2019).

The Impacts of Water Security and Climate Change for the Economy, Environment and Society

Water is a connector across sectors – such as agriculture, energy, and industry. It also plays an essential role in human capital accumulation and health. Water dependent sectors are also supporting economic recovery and contributing to job creation and employment. The 2015 World Water Development Report noted that three out of four jobs constituting the global workforce are dependent on water.[10]

Water and the Economy

Water is critical for food security and rural development. Since the 1980s, policies have supported lucrative cash crops, transforming Türkiye into the world's top ten agricultural producer. The sector is also a workhorse for the economy: as Türkiye's largest employer, it supplies jobs to nearly a fifth of the workforce and accounts for 6 percent of the country's economic activity. On the flip side, almost all export oriented and import substitution crops are heavily dependent on irrigation which accounts for almost 75 percent of the country's freshwater use — a figure that is not sustainable. Over the last decades, the switch to more water-intensive cash crops has dramatically depleted groundwater aquifers and dried out entire river systems. This has forced many farmers to drill illegal wells that tap already low groundwater. Agriculture's staggering water consumption is also due to the ages-old irrigation techniques of Türkiye's farmers: open channels and raised canals that deliver water to crops overland. It is estimated that these systems suffer water losses of 35 to 60 percent through evaporation, seepage, and leakage. The agriculture sector is expected to be most severely affected by climate change. As a result of droughts in the past years, farmers in Konya, Edirne and İzmir, already reported below-average harvest of wheat and other crops, forcing Türkiye to increase grain imports.

Water is essential for energy security. More than 25 percent (or 57.5 TWh) of the country's electricity demand is supplied from hydropower which also constitutes 60 percent of Türkiye's total installed renewable energy capacity.[11] There are more than 700 dam/reservoirs in Türkiye, with varying sizes. The water collected in these dams' is essentially used for three purposes: irrigation, domestic water supply and for electricity generation. Climate change effects, especially alterations in evaporation, river discharge, temporal precipitation patterns, frequency of extreme meteorological events, and glacial melt rate, could potentially induce appreciable change in Türkiye's hydroelectric production.[12]

10) 2016 World Water Development Report – Water and Jobs: https://www.unescap.org/sites/default/files/2016%20UN%20World%20Water%20Development%20Report-%20Water%20and%20Jobs.pdf

11) Source: https://www.hurriyetdailynews.com/hydropower-capacity-grows-despite-drought-lowering-output-167560

12) Hydropower Vulnerability and Climate Change: A Framework for Modeling the Future of Global Hydroelectric

Water is indispensable for industry and tourism. Tourism is one of the most dynamic and fastest developing sectors in Türkiye: in 2018, Türkiye attracted around 46 million foreign tourists, ranking it as the 6th most popular tourist destination in the world. Travel and Tourism contributed around 12 percent of Türkiye's total economy and supported 2.2 million jobs (or 7.7 percent of total employment).[13] However, tourism makes great seasonal demands on local resources, in particular, water supply and sewerage facilities, and the environment. During the tourist season from May to September, the resident population increases more than five-fold in coastal settlements located on the Aegean and Mediterranean coasts. In these areas, water is being supplied mostly from groundwater and in excessive amounts to satisfy the demand of the newly developed settlements, which has already led to lowering the water table and resulting in sea-water intrusion in most of the coastal aquifers. Likewise, sewage generated by congested population has caused pollution of bathing waters to exceed the standards relating to human health and environmental protection.[14]

Water and the Environment

Water and its related ecosystems, including lakes, wetlands, and coastal zones, provide a wide range of benefits, such as natural water storage, flood protection, and biodiversity conservation. Yet, Türkiye's water-related ecosystems are under increasing stress from factors such as, widespread water pollution due to the discharge of untreated or insufficiently treated industrial and municipal wastewater effluents, high levels of groundwater withdrawals, and agricultural activities.

The combination of drought and excessive abstraction of water has already led to the drying up to several lakes and wetlands. The Lake Tuz in the Konya basin was once the country's second largest lake, and it was visited by thousands of flamingos each summer in the past. Almost half of the famous salt lake has dried out and has begun the process of transforming into salt basins due to drought and continuous water withdrawal for irrigation. The same conditions affect Eregli Marshes and Bafa Lake.

Resources.

13) World Tourism Organization, (2019).

14) Harmancioglu and Altinbilek, (2019).

The discharge of untreated wastewater into freshwater bodies and the sea, and pollution from agricultural practices have caused widespread water quality and pollution concerns. While wastewater treatment capacity has steadily increased in the last decade, about 16 percent of domestic wastewater and 38 percent of industrial wastewater is still not treated before being discharged into water bodies.[15] A third of Türkiye's lakes and up to half of its rivers are considered either "contaminated" or "highly contaminated" by phosphorus and nitrogen.[16] Climate change induced warming of receiving water bodies exacerbates the impacts of excessive nutrient discharges (mainly nitrogen and phosphorous) from inadequate wastewater treatment – such as on the Marmara Sea, resulting in the Mucilage crisis in 2021.

Water and the Society

Water is at the core of human capital development. Türkiye has made steady progress in increasing access to safely managed water and sanitation services to its people. In 2021, 99 percent of the population were connected to a piped water network, and 78 percent of the population had access to safely managed sanitation services. This relatively high sanitation coverage has also contributed to declining mortality rates: the under-five mortality rate has significantly declined from 75 percent in 1990 to 9.5 percent in 2020.

Türkiye is currently hosting over 3.5 million refugees. While Türkiye's refugee response has been progressive and provides a model to other countries hosting refugees, the refugee and migrant influx has put significant pressure on existing municipal infrastructure, especially in the Southeastern part of the country. The population in the most affected municipalities has increased between 20 and 95 percent. In some of the impacted municipalities, the most vulnerable refugees are dwelling in informal urban and peri-urban settlements, some of which have inadequate access to water supply and sanitation services.

Türkiye's Climate Change Policies and Road to Decarbonization

In 2021, Türkiye ratified the Paris Climate Agreement and committed to net zero by 2053. The country is now preparing its long-term climate change strategy and action plan to enhance adaptation, accelerate mitigation of greenhouse gas emissions, and increase co-benefits for cities, sectors, and ecosystems. Accordingly, Türkiye will update its Nationally Determined Contribution (INDC) submitted in October 2015.

15) OECD, (2019).

16) Turkey Water Sector Engagement Note, 2020: 11.

There are also some encouraging signs at the domestic and regional levels. Türkiye's 11th Development Plan (2019-2023) acknowledges its commitment to undertake a "green transformation". In addition, Türkiye's Ministry of Environment, Urbanization, and Climate Change launched a Regional Climate Change Course of Action, in which it identified necessary actions to combat the adverse effects of climate change and underlined its awareness of the need for new strategies to preserve water sources, reduce water consumption, increase rain harvests, recycle water, and install drip-irrigation systems.

Opportunities Await

Despite the above, Türkiye still lacks a binding Water Law that can regulate state mechanisms, as well as civil society. Türkiye has strong water resource management capacity in general. However, its water resource management governance framework is fragmented, with multiple administrative and legislative shortcomings that limit efficiency in core functions.

Various institutions take part in different stages of flood and drought risk management processes such as planning, design and implementation of structural and non-structural measures on risk reduction, preparedness, response, and recovery. The Ministry of Agriculture and Forestry (MoAF) is currently preparing a new Floods Law which could be a good opportunity for elimination of unclarities and overlaps in terms of institutional responsibilities. With regard to drought management, the National Strategy and Action Plan for Drought Management for 2017-2023 was published in 2916. In addition to this Strategy, the MoAF - DG of Agrarian Reform recently announced the Strategy and Action Plan for Agricultural Drought for 2023 – 2027. However, there is a need for development of an integrated approach for drought management which considers all types of droughts (hydrological, meteorological and agricultural) and clear description of roles and responsibilities for all related institutions.

In 2003, Türkiye adopted an Integrated Water Resource Management Policy. The DG of Water Management is currently preparing River Basin Management Plans, Flood Management Plans, Drought Management Plans and Sectoral Water Allocation Plans in line with European Union Directives related to water as required per the Policy. However, further efforts are needed for disaster and climate resilience principles to be systematically integrated into all above mentioned policies, regulations, and investments for flood and drought risk management.

In conclusion, there is a need for further review and strengthening of the governance framework to improve efficiency and effectiveness, through completion of sector reforms, including enactment of the Draft Water Law pending Parliament approval since 2016. The new Law is expected to eliminate overlapping responsibilities of different government authorities to ensure effective co-ordination among different institutions and enable public participation in water management practices.

UNLOCKING PRIVATE SECTOR INVESTMENT IN ADAPTATION

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Despite steady growth of global climate finance over the last decade, a 590 percent annual increase in climate finance is needed by 2030 to meet climate finance needs. This is especially the case for Türkiye, which faces an annual adaptation cost estimated at $155-330 billion by 2030. Only 7.5 percent of climate finance in Türkiye is dedicated to adaptation, with the private sector lagging behind. This article presents several policy recommendations for mobilizing private sector adaptation financing in Türkiye's climate adaptation initiatives. It emphasizes four pillars: enhancing data accessibility, ensuring clear and consistent policy signals, establishing an enabling legal and policy framework, and economic incentives. These pillars offer Türkiye a promising pathway for increasing adaptation finance for a resilient and sustainable future.

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Keywords: Adaptation Finance, Climate Change, Private Sector Investment, Resilience Building, Türkiye's Climate Policy.

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Over the last decade, global climate finance increased steadily (with a cumulative average annual growth rate of 7 percent), almost doubling between 2011 and 2020,[1] reaching a cumulative $4.8 trillion. While the steady increase in climate finance is noteworthy, it is not sufficient to meet the climate finance needs to tackle climate change and its negative impacts.[2] The Paris Agreement strives to limit global temperature increase to 1.5°C in this century, while also increasing resilience to climate change. The Climate Policy Initiative (CPI) estimates that a minimum increase of 590 percent in annual climate finance is required to meet internationally agreed climate objectives by 2030.[3]

Finance for adaptation lags that of climate mitigation. Climate adaptation finance represents only 7.5 percent of the total climate finance flow of $653 billion in 2019-2020, compared to 89.7 percent of mitigation finance.[4] This contrast is distressing, especially considering that annual adaptation costs in developing economies will be in the range of $160 to $340 billion by 2030, as estimated by the United Nations Environment Programme.[5] The Global Commission for Adaptation highlights that often adaptation is cheaper than recovery or rebuilding. In their 2019 report, the Commission found that the overall rate of return on investments in improved resilience has benefit-cost ratios ranging from 2:1 to 10:1, and in some cases even higher.[6] Similarly, the World Bank's (WB) Lifelines Report found that every $1 invested in resilient infrastructure in low- and middle-income countries yields $4 in net benefits.[7]

The Crucial Role of the Private Sector in Adaptation and Resilience Finance

Adaptation finance has been and is predominantly channeled through the public sector. However, private sector participation is also essential in climate adaptation and resilience building. There are three important roles that the private sector can play to address adaptation: i) investing in their operations and assets' resilience as "adaptors" themselves, ii) providing goods and services that facilitate adaptation and becoming "solution providers", and iii) providing capital for adaptation and

1) Baysa Naran, Jake Connolly, Paul Rosane, Dharshan Wignarajah, Githungo Wakaba and Barbara Buchner, "Global Landscape of Climate Finance: A Decade of Data," Climate Policy Initative (2022): 9-12.

2) Naran et al. (2022): 9-12.

3) Barbara Buchner, Baysa Naran, Pedro de Aragão Fernandes, Rajashree Padmanabhi, Paul Rosane, Matthew Solomon, Sean Stout, Githungo Wakaba, Yaxin Zhu, Chavi Meattle, Sandra Guzmán and Costanza Strinati, "Global Landscape of Climate Finance 2021," Climate Policy Initative (2021): 2-4.

4) Naran et al. (2022): 31-36.

5) UNEP, "Adaptation Gap Report 2022," UNEP (2022): 19-20.

6) Global Commission on Adaptation, "Adapt Now: A Global Call for Leadership on Climate Resilience," Global Commission on Adaptation (2019): 12-14.

7) Stephane Hallegatte, Jun Rentschler, Julie Rozenberg, "Lifelines: The Resilient Infrastructure Opportunity", World Bank (2019): 1-4.

resilience-building projects as "financiers."[8] Each role helps the economy and the natural environment become more resilient.

It is widely recognized that the private sector faces barriers to investing in adaptation due to low perceived or actual returns on investment, immediate costs associated with distant exposure, and lack of available climate data.[9] The WB report, "Enabling Private Investment in Climate Adaptation and Resilience: Current Status, Barriers to Investment and Blueprint for Action" details the barriers and opportunities for private sector investment in adaptation.

As financiers, private actors offer financing along a spectrum of terms, ranging from highly concessional terms with more grant components, e.g. philanthropists or foundations to a combination of investment returns, e.g. blended finance to fully commercially driven with a focus on investment returns. Different investors and intermediaries have different investment strategies, risk appetite, return expectations, and investment horizons. Concessional capital is intended to fill a gap where the private sector (commercial capital) would not otherwise invest. Other sources of finance also offer potential opportunities to increase private sector participation in adaptation such as impact investors, venture capital (VC) funds, private equity (PE), and incubators with dedicated capital for small and medium-sized enterprises (SMEs) and start-up companies that can provide technologies and services necessary for adapting to a changing climate.[10] This article focuses on how the private sector can support Türkiye's adaptation and resilience-building projects as financiers.

The "Business Case" for Adaptation Finance in Türkiye

Climate change is already affecting the economy, society, and the ecosystems of Türkiye. The associated impacts are being manifested in rising temperatures (air and sea), sea level rise, coastal erosion, and changing rainfall and other weather patterns. The observed average annual mean temperature in Türkiye increased by more than 2°C during the last century, from 10.9°C in 1901 to 12.9°C in 2020.[11] Maximum and minimum temperatures have also increased significantly over the last 50 years. The number of summer days, warm days, warm nights and tropical nights have been increasing across Türkiye while frequency of frost days, cool days and cool nights are decreasing.[12] In winter, the number of frost and snowy days has also

8) Arame Tall, Sarah Lynagh, Candela Vecchi Blanco, Pepukaye Bardouille, Felipe Pino Montoya, Elham Shabahat, Vladimir Stenek, Fiona Stewart, Samantha Power, Cindy Paladines, Philippe Neves, Lori Kerr, "Enabling Private Investment in Climate Adaptation and Resilience: Current Status, Barriers to Investment and Blueprint for Action," World Bank (2021): 27-34.

9) Tall et al. (2021): 27-34.

10) Tall et al., (2021): 27-34.

11) World Bank Group, (2022), "Turkiye Adaptation and Resilience Assessment", CONFIDENTIAL.

12) Sensoy et al., 'Trends in Turkey climate indicated from 1960 to 2010' 6th International Atmospheric Science

significantly decreased over the last 30 years, while the lowest night air temperatures have increased.[13] These changes in extreme temperatures vary across the country and have repercussions on the frequency, duration and magnitude of heatwaves and other extremes such as drought and wildfire, with subsequent knock-on effects on health, labor productivity and ecosystems – in turn impacting economic activities, especially agriculture.[12]

For instance, Türkiye experienced severe droughts in 2007-08 and 2013-14, with the earlier drought affecting more than 435,000 farmers and resulting in losses of US$1.4–2.2 billion.[14] These led to agricultural losses, freshwater shortages, and drying and shrinking of lakes and wetlands. For instance, once Türkiye's second biggest lake, Lake Tuz (Tuz is Turkish for "salt") located on the Central Anatolia plateau, completely dried up in 2008 and 2016.[15]

Over the last 20 years, Türkiye introduced favorable investment legislation for public-private partnerships (PPPs). As a result, between 2003-2021, Türkiye implemented 193 PPP projects in a variety of sectors worth US$ 170 billion.[16] The country has set ambitious targets to upgrade its infrastructure. From transportation to energy, there are ample opportunities available in the pipeline for the private sector to get involved as financiers. For example, Türkiye is committed to transforming its rail transport infrastructure from conventional to high speed. In 2024 alone the investment amount is set to US$ 30 billion in rail projects.

Symopsium (2013), available at https://www.researchgate.net/publication/289520845_Trends_in_Turkey_Climate_Indices_from_1960_to_2010

13) Ministry of Environment and Urbanisation, "Climate Change Training Module Series 1: Scientific Basis of Climate Change and Impacts on Turkey. Ankara: Ministry of Environment and Urbanization." (2019). Available at: https://iklimiduy.org/module/iklimiduy_modul_1_en.pdf

14) Morvarid Bagherzadeh and Makiko Shigemitsu, "Building the Resilience of Turkey's Agricultural Sector to Droughts,", OECD Food, Agriculture and Fisheries Papers, (2021): 6-8.

15) NASA Earth Observatory, "Disappearing Lake Tuz," NASA Earth Observatory, 9 August 2021. https://earthobservatory.nasa.gov/images/149211/disappearing-lake-tuz

16) Presidency of the Republic of Türkiye, Investment Office, "Investing in Infrastructure and PPP Projects in Türkiye," July 2023. Available at: https://www.invest.gov.tr/en/library/publications/lists/investpublications/infrastructure-industry.pdf

While the business case for adaptation in Türkiye is clear, investment in adaptation falls short. Türkiye has accessed various sources of climate finance, with most of the climate finance flows being primarily focused on mitigation, especially in renewable energy.[17,18,19,20,21] Private sector investment in adaptation can grow substantially, if supported by the right enabling environment. However, adaptation is, or at least is perceived to be, a lot harder to profit from in comparison to mitigation projects. There are a range of important barriers to private sector investment in adaptation in Türkiye, but these can be addressed with the right policy environment and approaches to risk management.

Barriers to Private Sector Investment in Adaptation and How to Address Them

Economic and Financial Hurdles

The macroeconomic context in Türkiye remains the most critical challenge to private sector investment, inhibiting the capacity of firms to raise finance for adaptation and resilience-building projects. Macroeconomic hurdles include high inflation rates, high interest rates, and a volatile exchange rate.[22] Currency volatility has been a major deterrent for foreign investors to purchase lira-denominated securities. Furthermore, there remain constraints on doing business in the country, such as the time to resolve insolvency being 5 years, compared to the OECD average of 1.7 years.[23]

The financial system in Türkiye tends to operate around short or mid-term horizons. For tenures in local liras, timelines can be as short as 3 months and very rarely exceed 4 years. Beyond the macroeconomic conditions, structural barriers that hinder the availability of long-term finance include a small domestic saving pool, an underdeveloped institutional investor base, and debt finance being overly concentrated in the banking sector and mostly as loans. While private equity is growing in Türkiye, it is still limited, especially for smaller investments through venture capital and angel investors.[24] The main strategy from Turkish private equity actors consists of providing growth capital to established, cash-generative companies

17) AidAtlas (Undated), "All Donors to Turkey for Climate Adaptation during 2002–2020," Available at: https://aid-atlas.org/profile/all/turkey/climate-adaptation/2002-2020

18) Climate Funds Update (Undated). Data Dashboard. Available at: https://climatefundsupdate.org/data-dashboard/

19) World Bank, "Unlocking Green Finance in Turkey," (Washington, DC: Word Bank, 2022): 16. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099040002232227038/p174569076d6f30a20916807841092b30f3

20) Reuters, "Erdogan says Turkey signed $3.2 bln green climate fund deal," (2021). Available at: https://www.reuters.com/business/cop/erdogan-says-turkey-signed-32-bln-green-climate-fund-deal-2021-10-27/

21) Ministry of Foreign Trade, "Yilin Cumhurbaşkanliği Yillik Programi 2023 Presidency Annual Program," (2022). Available at: https://www.sbb.gov.tr/wp-content/uploads/2022/11/2023-Yili-Cumhurbaskanligi-Yillik-Programi.pdf

22) OECD, "Türkiye Economic Snapshot," OECD (2023): 1-3.

23) World Bank, undated, "Doing Business – Turkey," available at https://archive.doingbusiness.org/en/data/exploreeconomies/turkey#DB_ri

24) World Bank Group, "Selected Capital Markets Options to Promite Long-Term Finance for Türkiye," available at: https://documents1.worldbank.org/curated/en/099540306092222738/pdf/P174648015366902608 2f10c2fc617fcea0.pdf

with no specific sectoral focus and limited coverage of green investments. Change is needed to unlock private capital financing for adaptation and resilience-building projects in Türkiye. As macroeconomic conditions improve, in the longer term,[25] broader financial instruments will become more common.

Availability of Climate-Related Data

A key barrier in terms of data and information in Türkiye relates to the lack of adequate granular localized and sector-specific climate-risk data.[26] Adaptation is place and context specific – for example, sitting a project in a different location to avoid projected physical climate risks, or building a dam with a larger retention basin to account for higher precipitation variability. For the financial sector, this includes having the data and tools to stress test their overall balance sheets for specific climate scenarios. For instance, banks with an important loan book in municipal water utilities, could assess the materiality of a 'day zero' in Istanbul – the point at which municipal water supplies would have needed to be switched off.

The private sector in Türkiye experiences challenges in accessing climate risk data and information to guide investment decision-making. Türkiye has a robust climate observation network with 1,233 weather stations, 2,045 hydromet, and 956 online stations.[27] However, there is limited public access to this information, as not all the data is accessible without request. There is no specific regulation stipulating public access to climate change information and the country does not have a centralized climate change data platform equipped with adequate information and tools for public use. Therefore, when the private sector can access data, its reliability is questioned and there is a lack of knowledge on how to use and apply climate risk data and information to investment decision-making which limits the ability to identify, assess, and manage climate risks. As such, private actors commonly use international resources such as Bloomberg.

A Climate Portal[28] is being developed by the Directorate of Climate Change (DoCC) of the Ministry of Environment, Urbanization and Climate Change, which is expected to address this issue by providing a one-stop shop for climate and disaster risk information in Türkiye. It is recommended that the contents of the Climate Portal should be accessible to all key economic actors outside the government structure and include high-resolution hazard maps, and downscaled climate change scenarios

25) Long-term finance can be defined as "any financial instrument with maturity exceeding one year (such as bank loans, bonds, leasing and other forms of debt finance), and public and private equity instruments." (World Bank, Global Financial Development Report 2019 / 2020).

26) Long-Term Infrastructure Investors Association (LTIIA).

27) Ministry of Environment, Urbanization, and Climate Change (2018). Seventh National Communication of Turkey under the UNFCCC. Ankara: Ministry of Environment and Urbanization. Available at: https://unfccc.int/sites/default/files/resource/496715_Turkey-NC7-1-7th%20National%20Communication%20of%20Turkey.pdf

28) Program published in the Official Gazette on 25 October 2022. Access to the Climate Portal is through https://iklimportal.gov.tr/

that can be paired with socioeconomic data on risks, vulnerability, and impacts. The datasets provided on the Portal should be properly curated and regularly updated to ensure confidence by the private sector in their reliability. The Portal should also enable access to the information contained in existing but inaccessible data management infrastructure, and provide links to other types and sources of data and information required for public and private sector investment, such as those provided by Meteorological Services and the State Hydraulic Works, and external resources such as the WB's "ThinkHazard!" tool and the WB Climate Knowledge Portal.

Clear and Credible Policy Signals

The National Climate Change Adaptation Strategy and Action Plan (NASAP) provides for an overarching vision and strategic areas of intervention on adaptation in Türkiye. However, there are inconsistent policy signals related to the ambition of the Government of Türkiye (GoT) with respect to climate change, especially for adaptation. Policy settings are generally not well-known by the private sector, nor are they mainstreamed into the National Development Plan (NDP) or sectoral planning. The national development banks, the Sovereign Wealth Fund (Türkiye Varlık Fonu), and Turk Eximbank should be more closely involved in formulating the national strategy and investment pipeline for adaptation as current engagement from these actors is limited in policy development in adaptation. Including these actors will encourage closer alignment and coordination with sustainable finance initiatives regulated by key Turkish financial authorities such as Banking Regulation and Supervision Agency and Capital Market Board, and the wider Turkish insurance industry to create a harmonized approach to sustainable finance and climate adaptation investment. The NASAP alongside the National Climate Change Strategy are currently being updated by the DoCC. To create momentum for private sector investment in adaptation, it is important to engage the private sector as early as possible in the update of the policy framework.

Currently, the GoT is working towards mainstreaming strategies and plans of sectoral actors and local governments to better coordinate efforts and send a coherent message to the market. Here, the development of prioritized and costed sectoral and local action plans could lay the groundwork for producing a national adaptation investment plan and ensure that funding, both public and private, is directed towards those areas with the most adaptation impact.

Still, the lack of common understanding of what constitutes an adaptation and resilience project is another important constraint on private investment. Although there is limited clarity on how the green taxonomy will address adaptation and

resilience, this will be a critical step in developing a unifying language and definition as well as defining the remit for private sector participation in delivering the GoT's priorities on adaptation. DoCC is currently establishing a climate risk disclosure framework and green taxonomy. It is suggested that the taxonomy considers the significant advances made in recent years by multilateral development banks and other private investors such as Institutional Investors Group on Climate Change in introducing metrics and approaches for identifying, assessing and tracking climate resilient and adaptation investment, including from private investment. It should particularly take note of the European Union Taxonomy for Sustainable Activities technical screening criteria aligned to Climate Change Adaptation, to support interoperability with what is expected to be a key informant to the global taxonomy approach. A taxonomy will help direct financing to adaptation and resilience investments, making it easier for some investors to participate.

Predictable and clear policy signals are key for fostering the engagement of the private sector in climate finance. In Türkiye, it includes developing cross-sectoral strategies and a specific national adaptation taxonomy to help guide and unlock private capital to meet GoT adaptation needs.

An Overarching Legal and Regulatory Framework

Policy direction needs to be supported by a robust legal and regulatory framework. While the GoT has made some progress in this regard, there are still actions to be considered to improve the regulatory framework. For example, in July 2022, Türkiye amended its Environmental Impact Assessment (EIA) regulation making the assessment of the effects of climate change on investments mandatory prior to project approval. However, the 2017 Regulation on the Strategic Environmental Assessment (SEA) is yet to be updated. SEA is an important tool to integrate climate resilience and adaptation into national and sectoral development plans. Climate resilience and adaptation must be considered at an earlier stage of the infrastructure planning cycle at both national and sub-national levels. This includes moving the evaluation of infrastructure asset vulnerability to climate risks already at the project location phase. Infrastructure systems can be made more resilient by making prudent choices about where and what to build and which assets to upgrade, and by prioritizing green infrastructure where possible.

The incorporation of climate adaptation clauses within public procurement and PPP tenders, along with their inclusion in the evaluation processes would also provide an important entry point for ensuring private actors consider physical climate risks and adaptation measures in the design and management of infrastructure assets. Currently, companies only incorporate climate considerations on a voluntary basis

or because of requirements from IFIs that have an equity stake in the projects.[29] PPP contracts often use force majeure as the fallback option instead of considering climate resilience and adaptation considerations in project design, operation and maintenance (O&M) standards and KPIs of large capital investment projects. This apportions greater risks and costs to the GoT. Integration of climate considerations would serve as a pivotal entry point, ensuring that private entities factor in the assessment of physical climate risks and the implementation of adaptation strategies when conceptualizing and managing infrastructure assets.

Moreover, the development of a regulatory framework for mandatory climate-related risk disclosure, targeted primarily at large corporations, asset managers and asset owners, is an important step towards increasing the private sector's appetite for climate-related investments. This framework should encourage Turkish corporations and other stakeholders to assess and disclose climate-related risks and opportunities. Disclosure on climate risks and opportunities, aligned to the structure of the Task Force on Climate-related Financial Disclosure (TCFD)[30] recommendations, ensures that consistent information is available to understand how organizations are assessing risks and improving their resilience.

Economic and Financial Incentives

Despite growing climate awareness, private sector actors in Türkiye remain hesitant to invest in climate change adaptation, due to perceptions that the costs of investing in adaptation are too high or that the returns on investment are too low. This is particularly the case where there is a sizable upfront investment such as large infrastructure projects. The uncertainty over the timing and extent of climate disasters also means that pay-off from resilience investments are uncertain.

The incentives from government policy play a role in the attractiveness of adaptation investments. The only environmental tax in Türkiye is the ÇTV (Environment Cleaning Tax) on households, workplaces and other buildings based on the amount of water they use (Article 44, Law on Municipal Revenues). In addition, the Capital Market Board applies a registration fee discount of 50 percent for green bonds and green lease certificates to be issued under the BIST (Istanbul Stock Exchange).[31]

29) Norton Rose Fulbright, "Doing business in Turkey: Environmental, social and corporate governance (ESG)," (2023). Available at https://www.nortonrosefulbright.com/en/knowledge/publications/f049ea76/doing-business-in-turkey-environmental-social-and-corporate-governance-esg; Talu and Kocaman, "Turkey's Climate Change Policy, Legal and Institutional Framework," (2019). Available at https://www.iklimin.org/wp-content/uploads/2020/03/modul_04_en-1.pdf

30) TCFD is created by the Financial Stability Board (FSB), which is an international body that monitors and makes recommendations about the global financial system.

31) Borsa Istanbul, "Fee Schedule," (2022). Available at: https://www.borsaistanbul.com/files/borsa-istanbul-fee-schedule.pdf

A large number of perverse incentives, such as taxes or subsidies are also present which undermine the business case for investing in adaptation. For instance, water tariffs in Türkiye do not consider the lifecycle costs of more extreme weather and climate change on water utility assets and service provision over time.[32]

The GoT can mobilize a diverse toolkit of financial and non-financial incentives to motivate private sector engagement in adaptation efforts. Such incentives should encourage businesses to adapt their operations and business models. Simultaneously, it is crucial to conduct a holistic review of existing tax breaks, import/export duty reductions, public grants, and risk guarantee schemes across key priority adaptation sectors. By refining and expanding these incentives, Türkiye can create a more favorable investment environment, spurring proactive climate adaptation measures. Additionally, building the capacity of the VC and PE sectors to understand climate risks and opportunities is essential. Facilitating access to finance for start-ups and SMEs and developing a tailored adaptation taxonomy for VC and PE firms will enable more systematic assessment and support for climate adaptation innovations. By developing an ecosystem of start-ups and SMEs which can provide adaptation solutions and services will further drive Türkiye's resilience efforts, while promoting innovation and sustainability. This could, for example, be achieved by designing and delivering, in partnership with existing incubators or accelerators, a mentoring program targeted at selected enterprises.

The Future of Climate Financing in Türkiye

There are ample opportunities in Türkiye for the private sector to invest in adaptation either as adaptors, solution providers or financiers. As adaptors, the private sector is driven by business continuity and risk management, as financiers, the private sector can capitalize the investment need in the real economy, and as innovators the private sector is positioned to solve problems arising from climate change while generating revenue. To foster stronger private sector involvement in adaptation financing, the GoT can help foster enabling conditions by providing clearer policies, overarching regulations, and enhanced policy engagement on climate financing. Together, the public and the private sectors can ensure that Türkiye addresses its adaptation needs in the future to minimize the harm from a changing climate.

32) Organisation for Economic Co-operation and Development, "Agricultural Water Pricing: Turkey," (Paris: OECD Publishing, 2010). Available at: https://www.oecd.org/turkiye/45016347.pdf

THE ENERGY TRANSITION IN TÜRKIYE: A ZERO-EMISSIONS POWER GRID

DOI: 10.58867/TDCU6900

Decarbonizing Türkiye's power grid has many benefits over the short and long-term including reducing air pollution, energy imports and vulnerability to disruptions in global energy markets, while improving trade competitiveness. This article examines what is needed to transition the power grid including the pace of change, impact on economy and level of investment required.

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Keywords: Decarbonization, Energy Efficiency, Renewable Energy, Türkiye's Energy Sector, Zero-Carbon Transition.

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Decarbonizing energy will benefit Türkiye's economy for the long-term, but this requires major investments from diverse financing sources, supported by policy reforms to harness synergies and address trade-offs with other development goals. By meeting growing demand with resilient, zero-carbon energy sources, Türkiye can begin the transition away from fossil fuels and improve public health and trade competitiveness in the process.

Energy has fueled remarkable growth and development outcomes in Türkiye. The economy's energy-intensity and the carbon-intensity of electricity production to date come with significant costs and risks. Transformative opportunities remain to be tapped in renewables, energy efficiency and electrification, building on remarkable recent progress.

Approximately 70 percent of (gross) greenhouse gas emissions in Türkiye are energy-related, including from power, industry, transport and buildings. Within the energy sector, electric power generation is the largest individual source (27 percent of total gross emissions in 2020). As of 2021, Türkiye's total energy supply was met by natural gas (31 percent), oil (27 percent), and coal (25 percent), while energy supply from wind, solar and other renewable energy sources accounted for 16 percent. Energy and carbon intensity, at 145 ktoe/US$ 2015 and 440 g CO2e/kWh respectively, are above the European Union (EU) averages (88 ktoe/US$ 2015 and 229 g CO2e/kWh respectively), while Türkiye's electricity production is now less carbon-intensive than the EU average.

Türkiye has accomplished successful sector reforms over many years to develop and transform the energy sector, including on energy efficiency and renewables. As part of its broader response to inflation, Türkiye's acceleration of energy efficiency investments made it second among Organization for Economic Co-operation and Development (OECD) countries, in terms of improvement of energy intensity, in 2021.

Türkiye has also tripled renewable energy capacity in the last decade, to become the fifth largest renewable energy generator in Europe and the twelfth largest in the world. As of November 2023, installed capacity of all renewables (including hydropower) reached an historical high of 58.5 gigawatts (GW), or 55.2 percent percent of total installed capacity. The share of all renewable energy in total electricity generation increased from 32.4 percent in 2018 to 43.5 percent in 2022, exceeding the original target (set in 2019) of 38.8 percent by 2023.[1]

1) See, https://ytbsbilgi.teias.gov.tr/ytbsbilgi/frm_istatistikler.jsf, https://www.teias.gov.tr/turkiye-elektrik-uretim-iletim-istatistikleri

Türkiye's 2022 National Energy Plan targets a further tripling or more of solar and wind capacity over the next decade to achieve 82.5 GW of total solar and wind generation capacity by 2035, adding around 60 GW between now and then.
However, Türkiye has a substantial coal lock-in outlook, with a large pipeline of coal capacity (32 GW in 2020). This is mainly based on exploiting the local coal resources (estimated at 17.3 billion tons), composed mainly of lignite, which is of low calorific value.

Türkiye is heavily exposed to supply disruptions and price volatility in global and regional energy markets, and to the consequences of global crises like the Russian invasion of Ukraine. Over the past two decades, primary energy consumption has more than doubled. Most energy supply now depends on sources outside the country. Up to 75 percent of Türkiye's energy demand depends on imports, including 99 percent of gas and 93 percent of oil. Over the past decade, coal imports have tripled and are now greater than domestic production. In 2021, energy accounted for almost 20 percent of Türkiye's total imports, contributing to massive current account deficits (US$50.7 billion). This constitutes a macroeconomic and fiscal challenge, in addition to an energy security risk.

Energy infrastructure and supply chains are also vulnerable to risks from geophysical hazards, like the February 2023 earthquakes, as well as extreme weather events and temperatures, compounded by burgeoning impacts of climate change.

Energy, like other sectors, has also seen high consumer price inflation (around 137 percent for 2022), investments hit by currency depreciation and corporate and banking sector vulnerabilities, compounded by the effects of the crises. Türkiye has mature social assistance programs to support poorer households, who tend to spend a larger proportion of their income on necessities like energy, so are often more sensitive to price increases. However, state capital injections to natural gas, petroleum and electricity production state-owned enterprises (SOEs), to lower inflationary pressures, has also posed fiscal risks. In 2020, subsidies to coal-power generation amounted to $475 million including tax reductions for electricity production, in addition to direct spending for exploration.

Türkiye's primary objective for the energy sector, as presented in the 12th Development Plan, is to maximize self-sufficiency by using domestic and renewable energy resources, based on the 2053 net zero emission goal, along with uninterrupted, high-quality, sustainable and secure supply of energy at affordable costs. Further, the country aims to diversify energy supply sources and achieve a competitive structure through developing nuclear electric power, boosting energy

efficiency, integrating new technologies, and strengthening their strategic position in international energy trade.

Pathways to Decarbonize Power in Türkiye

There are many possible paths for an energy transition to net zero. To inform discussion, the World Bank performed an exploratory analysis to identify policy and investment priorities to deeply decarbonize Türkiye's power system. Two scenarios have been studied for the 2022 Country Climate and Development Report (CCDR), using the World Bank's Electricity Planning Model—a power system planning model that includes capacity expansion and unit dispatch—to understand the implications of different levels of emissions reduction on the capacity and generation mix, given assumptions about demand growth and available technologies.

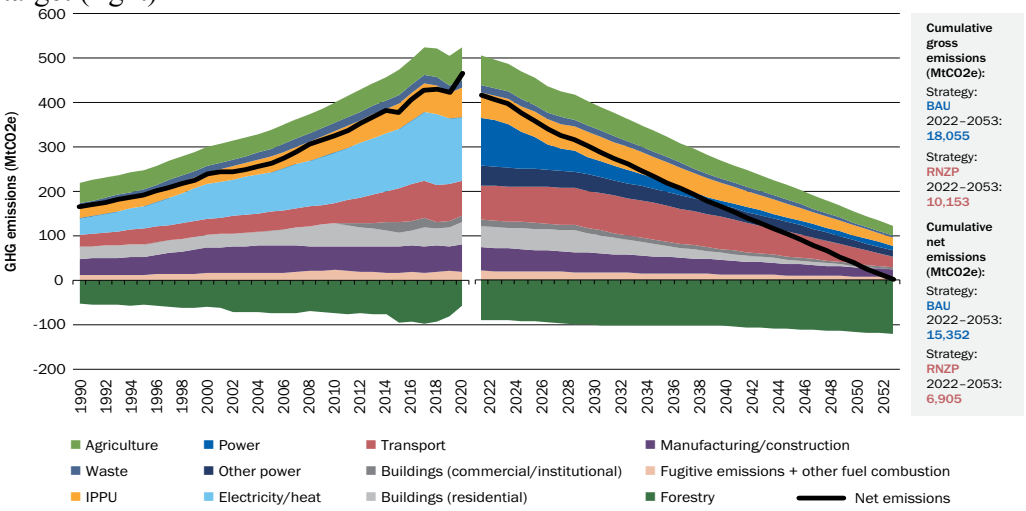
The first scenario is a least-cost expansion with recent government targets scenario (LGT). Used as a reference case, this scenario assumes Türkiye's renewable energy targets as of mid-2022,[2] the completion of the 4.8-gigawatt Akkuyu nuclear power station, and utility forecasts of demand growth.

A second scenario is the illustrative 'resilient net-zero pathway' (RNZP) toward the 2053 objective, shown in figure 1 below. This is just one possible path consistent with Türkiye's long-term target, and involves inevitable simplifications (e.g., adaptation to climate impacts was not modelled). More analysis and work is needed to settle on the best possible path, distribution of action across sectors, and preferred policies and investments.[3] However, analyzing this RNZP is useful for exploring challenges, policy options, costs, and benefits.

2) Before the 2022 NEP was published.

3) For example, in the 2022 NEP, 1.7 GW from domestic coal-fired plant is still expected to be included in the system by 2030, implying a need to accelerate a transformation of the power system post 2035.

Figure 1: Historical emissions (left) and RNZP emissions, consistent with the 2053 target (right)



Source: World Bank staff calculations, based on Government of Türkiye (2022)[4]
Notes: BAU = business as usual; RNZP = net zero pathway; IPPU emissions are assumed unchanged until 2030; emissions in sectors other than power, transport, residential buildings, and forestry are assumed to reduce between 68 and 69 percent by 2053.

The RNZP scenario assumes: deep decarbonization of the power sector by 2040; energy efficiency (from 2022) and electrification (from 2030) in residential buildings; modal shift and electrification in passenger and freight transport; changes in land use and practices to maximize negative emissions from forest landscapes; and emissions reduction efforts in the rest of the economy (industry, agriculture, waste management, and water management).

The RNZP assumes a 45 percent emissions reduction in the power sector in 2030 and a 90 percent reduction by 2040 relative to LGT, in line with achieving the economy-wide net zero target of 2053. In addition to the LGT assumptions, RNZP assumes that carbon capture with sequestration for gas and coal-fired power plants is available after 2035 and includes additional demand from electrifying residential buildings and transport.

Compared with the reference scenario, which does not include specific climate objectives, Türkiye would need to invest an additional $68 billion over 2022–30 (in present value terms) to be on the RNZP (that is 1 percent of discounted cumulative GDP over that period). Over 2022–40, this number grows to $165 billion, or 1.2 percent of discounted cumulative GDP over the period. Table 1 summarizes key costs and benefits over time comparing the LGT and RNZP scenarios.

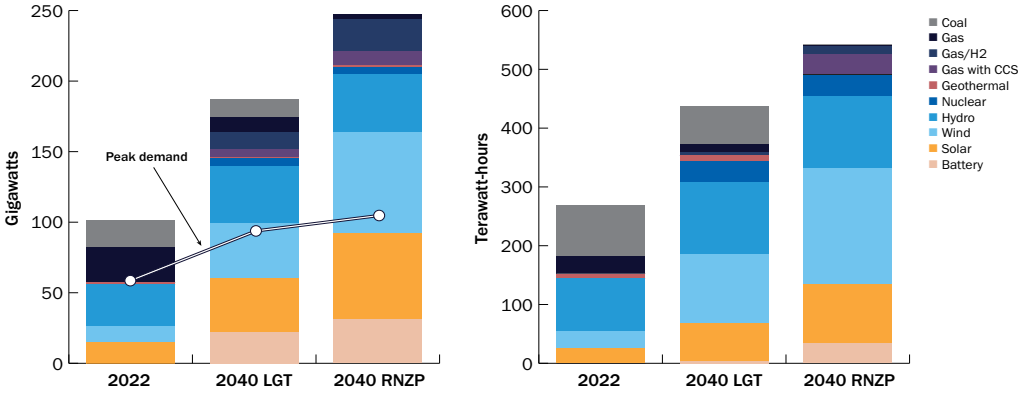
4) Ministry of Energy and Natural Resources (MENR), "Türkiye National Energy Plan," Republic of Türkiye (2022). https://enerji.gov.tr/Media/Dizin/EIGM/tr/Raporlar/TUEP/T%C3%BCrkiye_National_Energy_Plan.pdf

The RNZP scenario resulted in 60 percent of power generated by solar and wind, underscoring the importance of grid integration and storage (figure 2). New solar and wind investments are the cheapest way to meet new demand for energy and could meet most future power demand without compromising energy security, based on assumed availability of flexibility resources.[5] In this context, battery energy storage investments and policies to remunerate grid services are essential.[6]

Around 2030, Türkiye will need battery or pumped hydro storage to manage the increasing penetration of solar and wind and provide sufficient system flexibility. After 2030, some flexibility services could be provided by low-emission, flexible thermal generators which could run on natural gas or hydrogen, depending on the evolution of technology and the need for emissions reductions. In the RNZP, hydropower, geothermal, nuclear, and gas generation with carbon capture provide the stability of the power system. The RNZP sees 9.6 gigawatts of battery storage installed by 2030. The relative role of various technologies implemented after 2030, such as battery storage and carbon capture, will have to be reviewed over time, as the evolution and cost of these technologies remain uncertain.

Investments on energy efficiency can bring significant benefits at least cost. A sensitivity on the RNZP scenario has indicated that reducing the assumed electricity demand growth in half could reduce the investment needed to achieve deep decarbonization by 20 percent avoiding US$ 1.3 billion on investment each year.

Figure 2: Türkiye's power system capacity and electricity generation mix, 2022 and 2040



Source: World Bank staff estimates Notes: Gas/H2 = hydrogen gas; CCS = carbon capture and storage.

5) Under the RNZP, gas demand will gradually decline, but will pick up again after the mid-2030s. This will provide system flexibility to accommodate a high share of variable renewable energy with a very low-capacity factor, but it could be replaced by green hydrogen with cost reduction. Therefore, RNZP reduces dependency on gas imports compared with business as usual.

6) Türkiye's distribution sector is fully privatized, and while it has been successful in reducing losses and ensuring RE integration, on the back of the need for greater RE supply, continued investments in distribution are key.

Table 1: Investment needs and economic costs in the RNZP (additional compared to baseline)

	2022–30 ($, billions)	*2022–40 ($, billions)*
POWER		
Additional investment: new generation and storage capacity	+5	+33
Additional investment: transmission and distribution	+8	+14
Other economic costs: operational and fuel costs	-9	-23
Other economic costs: air pollution externality costs from coal	-9	-38
Other economic costs: decommissioning of coal plants and mines	< +1	+1.4
Note: negative costs in this table represents an economic benefit. Not all costs and benefits associated with the energy transition are shown.		

Note: Negative costs in this table represents an economic benefit. Not all costs and benefits associated with the energy transition are shown. All amounts are discounted using a 6 percent discount rate.

The buildings sub-sector is expected to support decarbonization through its vast potential for electrification and energy efficiency. The role of EE will be especially important for electrification of buildings considering that buildings are currently 10 percent of Türkiye's emissions and building energy demand is growing driven by more construction, larger building and growing demand for air conditioning. Most of the energy consumed in residential, commercial, and public buildings is for heating and cooling, which represents up to 70 percent of residential energy consumption.[7] Without further energy efficiency and heating improvements, energy demand from buildings will likely more than double by mid-century due to expected population and economic growth. Without prioritizing energy efficiency, electrification alone would bear more than double the cost of decarbonization of the building sector. In the short-term, stringent energy efficiency standards in buildings codes is crucial for avoiding costly retrofits later.

7) Sabanci University IICEC, "Turkey Energy Outlook 2020," (Istanbul: TEO Book, 2020): 350.

Table 2: Emissions, investment needs, electricity demand growth, and gas import savings in the RNZP scenario for residential buildings

Targets: 50 kWh /m²/year in 2053; 0 percent fossil fuels by 2053; 100 percent seismically resistant buildings by 2040

Cumulative emissions 2022–53	788 MtCO2e
Total investments 2022–53 (discounted, 6 percent)	$126 billion
Electricity demand growth from 2021 to 2030	19 percent
Gas import savings 2022–53 (discounted, 6 percent)	$87 billion

Notes: Investments are additional to a business-as-usual scenario. MtCO2e = million tonnes of carbon dioxide equivalent.

Electrification of transport creates an opportunity to decrease emissions since transport accounts for 17 percent of Türkiye's emissions greatly in the form of road transport. If charging is left uncoordinated by 2040 the demand from e-mobility will require system investments in the order of 23GW mainly in the form of wind and battery storage at a cost of US$ 20 billion excluding the cost of charging infrastructure. Vehicle owner's charging behaviors should be coordinated. Coordinated charging reduces investment needs by US$ 3 billion by 2040 with greater savings in the next decade.

While scaling up clean energy to meet growing demand, preparing to transition from coal-fired power is also essential to achieve the government's net zero target, and makes economic sense without compromising energy security. Deep decarbonization in the power sector implies Türkiye has to retire most of its coal power plants by 2040, build no new coal plants, and replace the energy with cleaner, affordable, and reliable alternatives. Analysis suggests that 6 gigawatts of coal-fired generation can be retired because of age or economics as soon as renewable energy, or zero carbon alternatives can be operationalized to replace the retired energy. An additional 13 gigawatts of coal plants must be retired by 2040 to achieve deep decarbonization in the power sector.[8]

8) See World Bank Group, Türkiye Country Climate and Development Report, CCDR Series. © (Washington, DC: World Bank, 2022). http://hdl.handle.net/10986/37521 License: CC BY 3.0 IGO, for further estimates of costs associated with a transition from coal.

The Decade Ahead

The RNZP illustrates the feasibility and overall benefits of aligning energy development with climate-related goals. Türkiye can achieve energy security through an accelerated pace of least-cost investments in domestic solar and wind—building on its recent track record and in line with its new targets—and investing in energy efficiency, battery and pumped storage, geothermal, and gas generation with carbon capture and storage (as well as completion of the nuclear plant under construction). This would enable the country to meet a doubling of energy demand by 2053 to fuel its growth ambitions, with the added benefit of lowering emissions and improving energy security by reducing reliance on imported coal, gas, and oil. Even without a carbon constraint, new coal power plants are neither needed nor the least-cost option to meet growing electricity demand. Renewables, which are cost competitive with coal, offer a better longer-term solution (when coupled with balancing technologies) for domestic energy supply and achieving energy security goals.

There is an urgent need to realign current energy policies because current trends are locking-in carbon-intensive patterns that will increase costs and create financial risks, such as stranded assets. Significant upscaling of renewable energy with a diversified power mix—including wind, solar, hydropower, geothermal, gas generation with carbon capture and storage, and nuclear—are needed as well as investments in energy storage, particularly battery energy storage, which the country has yet to start investing in. It is also important to end the costly support to domestic production and consumption of indigenous coal and stop the construction of new coal power plants, which would be at high risk of becoming stranded assets before the end of their lifetimes.

Among six short-term priorities recommended by the CCDR, the number one priority is to realign energy policies to decarbonize the power sector. This involves parallel efforts to: (a) scale up renewable energy; (b) deploy grid integration measures, particularly battery and pumped storage, remunerating storage services, and expanding and digitalizing transmission networks; and (c) ensure well-designed power markets, with careful consideration of implications for reliability and electricity prices. Moreover, revised standards and grid codes should consider increased climate risks (e.g wildfires, heat and flooding).

A related priority is to make the economy more energy efficient. This involves establishing a more ambitious National Energy Efficiency Action Plan to 2030 for transport, buildings, urban industry, and waste sectors, with (a) more stringent and well-enforced building standards and codes; (b) strategies and investments to support modal shifts in transport and transit-oriented urban development; (c) a

national program for building renovations; (d) national schemes to support energy efficiency in factories, including energy audits and efficiency reporting, and improved recycling programs for metals, e-waste, and other waste; and (e) a progressive and coordinated shift toward electrification in industries, as well as space and water heating, coupled with rooftop solar schemes to offset impacts on the grid.

Finally, Türkiye can minimize social disruptions through a new energy security compact to ensure a just and inclusive energy transition. Such a strategy could (a) identify at-risk sectors and workers; (b) anticipate and prepare for retraining and reskilling needs; and (c) strengthen social protection systems to make them more reactive, flexible, and better able to absorb expected and unexpected shocks. This foundation can position Türkiye to: (d) not build new coal plants; (e) retire most existing coal power plants and mines by 2040 and compensating for lost future revenues; (f) support laid-off workers and affected communities; and (g) facilitate environmental remediation. Repurposing retired coal power plants and closed coal mines can not only lead to economic and energy transition, but also mitigate the social impacts and disruption of these closures.[9]

Table 3 presents sample milestones from the RNZP which the government can use as medium-term targets for its next NDC, as a basis for sectoral ministry and agency proposals and investment plans, or to allocate budgets, track progress, and report to Parliament and the population. As Türkiye's tracks its progress towards current and new targets backed by strategic sectoral plans, the next challenge will lie in implementation.

Table 3: Summary of sample 2030 energy milestones for the illustrative RNZP

SECTOR	*2030 MILESTONES*
Power	• 75 percent share of RE in power generation *(42 percent in 2020)* • 37 percent share of variable RE in power generation *(12 percent in 2020)* • 9 percent share of coal in power generation *(32 percent in 2020)* • 10 GW battery storage capacity *(0 GW in 2020)*
Transport	• Electrification of cars and buses: 12 percent and 19 percent, respectively *(both 0 percent in 2020)*
Buildings	• New and retrofitted buildings to achieve Class A energy rating *(Class C in 2021)* • From 2030, electrification of new and retrofitted residential buildings • Combined seismic and energy retrofit of 2.5 million residential buildings

9) See World Bank, "Scaling-up to phase down: Financing Energy Transitions in the Power Sector," https://www.worldbank.org/en/topic/energy/publication/scaling-up-to-phase-down for framework to further assess barriers to in scaling-up clean energy investments to allow a phase-down of fossil fuels in the power sector.

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SUSTAINABLE AND RESILIENT TRANSPORT

DOI: 10.58867/ZGWH1121

The transport sector is one of the fastest growing sources of emissions in Türkiye. This set to continue as motorization rates and population grow. At the same time, extreme weather events from a warming climate can impair transport infrastructure, disrupting logistics and supply chains with real economic impacts. This article investigates approaches to decarbonizing transport in Türkiye and improving the resilience of transport infrastructure.

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Keywords: Decarbonization, Electric Mobility, Green Growth, Net Zero Emissions, Transport Sector.

TPQ

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As one of the 195 states that have ratified the Paris Agreement, Türkiye has set itself a target of achieving net zero carbon emissions by 2053. Achieving this goal is not only crucial for global climate-related objectives but can simultaneously offer co-benefits for the country by tackling underlying structural obstacles for growth and development from economic, social, and environmental perspectives.

Introduction and Context: Decarbonizing Transport Will be Key for Enabling Green Growth

Türkiye is working from a strong baseline and a demonstrated commitment to achieving its goals. While the energy sector, which includes transportation, accounts for three-quarters of the country's greenhouse gas emissions, the full sector overall is less carbon-intensive compared to the EU average.[1] This is primarily due to an existing large penetration of renewable energy in the power system and low motorization rates. However, the transport sector is undergoing two momentous transitions that will shape its impact on green growth. These include (i) accommodating personal mobility for a country of 84 million people predicted to reach 107 million by 2060; and (ii) modernizing the logistics sector of an intensely trading nation with global aspirations. Accommodating these transitions while significantly reducing carbon emissions, ideally on an eventual long-term trajectory to carbon neutrality, is within Türkiye's reach given the right combination of investments and sectoral policy that focus on (1) electrification and decarbonization of transport, (2) a modal shift, and (3) energy efficiency. The policies proposed in this article will help explain how to strengthen this baseline further to achieve the goal of achieving net-zero carbon emissions by 2053.

Economically, the net fiscal impact of following a resilient and net zero pathway as defined by the World Bank Group (WBG) in the Country Climate and Development Report (CCDR) for Türkiye[2] is positive and, in fact, increases when considering longer-term horizons. Adopting a resilient and net zero pathway plan, such as the plan outlined by the WBG in the CCDR, leads to a net US$ 15 billion gain over 2022–30 and a US$ 146 billion gain over 2022–40, largely due to reduced fuel imports and health benefits from decreasing air pollution.[3] Furthermore, working towards this zero-emissions goal facilitates growth of industry, jobs and export opportunities offered by green technologies and sectors and protects the economy against longer-term risks such as carbon lock-in and corresponding lack of economic competitiveness as the world transitions towards reduced greenhouse gas

1) Türkiye's CCDR, (2022): 7.
2) Türkiye's CCDR, (2022).
3) Türkiye's CCDR, (2022): 9.

emissions. From a social perspective, achieving these goals can facilitate growth and employment within newly evolving sectors which poses great opportunity, if jobs in exposed sectors are adequately protected.

The path towards a net zero-carbon economy will increase GDP growth and employment, thanks to large investments and energy efficiency. This shift is likely to result in increased consumer consumption due to technological upgrading and reduced fuel costs.[4] Furthermore, by adopting a new structure of operation, Türkiye can intentionally and proactively support a just and inclusive transition.

Finally, there are also environmental benefits associated with transitioning to a decarbonized transportation future. Proactive mitigation and adaptation within industries allow for concerns of high vulnerability to the impacts of climate change to be addressed. Türkiye's road, rail, airport, and port infrastructure are highly exposed to the impacts of climate change, which namely include more frequent and more severe flooding, wildfire, and heatwave events. World Bank modeling shows that Türkiye's road network is significantly less resilient to disruption than that of Germany and Serbia and is about on par with that of Mexico. At the sub-national level, the road networks of the Adana, Izmir, and Black Sea regions are less resilient than those in the Ankara and Istanbul areas. Nationally, the rail network is much less resilient than the road network. The co-benefits associated with achieving a net-zero future not only justify the importance of such an environmentally important transition but also highlight the wider set of benefits associated with such a transition.

Next, we present the three main intervention pillars for decarbonized transport identified in Türkiye's CCDR, along with discussions on the key issues associated with each topic, key policy intervention areas and potential implementation strategies. It is important to note that this article does not provide a comprehensive list of recommended policies for green transport in Türkiye, but rather highlights the need for progress on multiple axes to achieve decarbonization and climate resilience. It also aims to suggest a well-rounded approach that includes a broad spectrum of policy options, including placing greater focus on electrification, public transport, multimodality, and freight efficiency gains.

PILLAR 1: Decarbonization, Supported by Electrification

Key Issue: While significant progress has been made on electrification within the Turkish context, electric mobility and electric vehicles (EVs) alone will not be enough to reach net zero in Türkiye by the target year. An electrified approach must be combined with significant investments in public transport and other, low-carbon

4) Türkiye's CCDR, (2022): 11.

modes that will help keep the motorization rate low while still offering citizens better overall mobility.

Key Policies:

· Electrifying 12 percent of cars and 19 percent of buses (both of these measures were at 0 percent in 2020) (CCDR – p. 68);

· Investment in research and development and pilot projects to make technologies to decarbonize heavy industries available and cost-competitive by 2030;

· Government actions and support to ensure institutional readiness for the adoption of zero-carbon fuel aircraft and vessels in domestic transportation;

· Implementing public policies, infrastructure interventions, and behavioral dynamics to achieve long-term transport decarbonization pathways;

· Prioritizing measures to decarbonize and increase the efficiency of trucking operations, as the trucking sector is likely to remain the dominant mode of freight transport;

· Taking steps towards enhancing readiness for the decarbonization of aviation and maritime transport, such as public-private collaboration and research;

On the passenger side, decarbonization will primarily be about managing the transition of car ownership and use.

Implementation Strategy: Deep decarbonization of transport of the kind anticipated under the resilient and net zero pathway (RNZP) scenario outlined by the World Bank, the most recent CCDR (2022) is not significantly more expensive over the 2022–60 timeframe compared with the business as usual scenario in terms of infrastructure investments and is associated with sizable savings in the outyears through reduced oil consumption and the economic value of avoided carbon emissions. The RNZP scenario results in estimated savings of US$ 114 billion in avoided fossil fuel consumption, without counting the benefits from energy security and reduced exposure to global oil price volatility, and US$ 639 billion in avoided road transport externalities, all in present value terms cumulative through 2060.[5]
Public policy support would be critical for EV production and adoption. A mandate to increase the percentage of zero and low-emission vehicles, for example, would foster greater EV market penetration by creating incentives for charging infrastructure development and investments in EV and battery manufacturing. However, considering the need to balance EV transition with a focus on decarbonization, the key is to promote conversion to EVs on one hand, and to promote investments in decarbonized public transport on the other. The goal therefore is to green the existing vehicle fleet by converting it to EVs as much as possible, while at the same time resisting an increase in the motorization rate. The latter is accomplished by offering

5) Türkiye's CCDR, (2022): 44.

sustainable mobility options not centered on private vehicle ownership (e.g., mass transit, micro-mobility, active mobility, intercity passenger rail, etc.)

PILLAR 2: Multimodality and Public Transport

Key Issue: In 2019 exactly 50 percent of Turkey's 82.4 MtCO2e from transportation came from passenger transport, while the other half from freight transport (CCDR Transport – p. 11). Surveys of Türkiye-based shippers show that a primary reason for the low adoption of rail freight is a generalized lack of last-mile rail connectivity to/from organized industrial zones, major manufacturing facilities, maritime ports, logistics centers, and other cargo-related logistics clusters.[6] At present, only 16 out of 210 ports in Türkiye have railway connections at the "last mile" (for a total length of 85 km). Nevertheless, even this small length accounts for 7.5 percent of the overall freight carried on the national rail network of over 13,000 km. A railway connection to Istanbul's Ambarlı container port complex, which handled 3.2 million TEUs in 2022 (26 percent of national port throughput), is yet to be completed. Similarly, rail connections to the new Çandarlı (Izmir) and Gemlik (Bursa) ports are still pending.

Key Policies: Financial investment focused on infrastructure, paired with railway service delivery improvements can create a set of benefits including increasing rail freight modal share, reducing logistics costs, highway congestion and road infrastructure wear and tear, while also freeing up capital for firms to invest in productivity-inducing projects. This kind of approach would support the government in its national development plan objective of more than doubling the modal share of rail freight to achieve a 10 percent market share by 2023 (CCDR – p. 46). Furthermore, Türkiye's commodity mix—intense in bulk and breakbulk goods like iron ore, steel products, and cement, as well as bulky products like passenger cars—and the relatively long distances per freight trip are compatible with greater use of bulk and intermodal rail (containers and trailers on rail). To achieve this, supportive, risk-informed urban planning with transit-oriented development to support a modal shift toward rail, public transit, and soft modes such as cycling and walking. Promoting compact and coordinated urban growth, mixed-use urban development, transit-oriented development, and walkable and well-connected streets can help to reduce transport-related emissions in Turkey's cities. Furthermore, increasing the share of rail in total freight transport to 8 percent (which was at 4 percent in 2020) and achieving a public transit modal share of 49 percent for surface transport (compared to 47 percent in 2020) are good benchmark goals to help facilitate the multimodal shift.[7]

6) Türkiye's CCDR, (2022): 47.

7) Türkiye's CCDR, (2022): 68.

Implementation Strategies: Surveys of Tu¨rkiye-based shippers show that a primary reason for the low adoption of rail freight is a generalized lack of last-mile rail connectivity to/from organized industrial zones, major manufacturing facilities, maritime ports, logistics centers, and other cargo-related logistics clusters. Managing the transition to higher rates of car ownership proactively is a major development opportunity for Turkey. This will include considering facilitation of electric vehicle adoption with greater provision of public transport (bus services, Bus Rapid Transit services, and urban, suburban and inter-city rail services), shared mobility (such as carpooling services), and active mobility (such as micro-mobility and non-motorized transport) will determine much of Turkey's decarbonization pathway over the next 40 years.[8] Furthermore, Targeted infrastructure investment, complemented by improvements in service delivery on the part of railway undertakings—including private providers under Turkey's reformed railway market consistent with the EU acquis—can bring about sizable gains in rail freight modal share, which would in turn reduce logistics costs, reduce highway congestion and road infrastructure wear and tear, and free-up capital that firms can invest in productivity-inducing projects.[9]

PILLAR 3: Efficiency Gains in Freight and Logistics Key Issue: Türkiye's logistics sector is underperforming relative to potential. Logistics infrastructure and service delivery performance, which improved noticeably because of massive infrastructure investments in the 2000s, deteriorated through most of the 2010s, as evidenced by Türkiye's downgrading in the World Bank's Logistics Performance Index (LPI) from 27th place in 2012 to 47th place in 2018. Türkiye's most recent LPI rank—for 2022—improved to 38th in the world, thus showing gains in performance since 2018 and stemming the deteriorating trend, but this result is still below Türkiye's 2012 placement, suggesting untapped potential. Further, logistics in Türkiye are still highly dependent on trucking with little incidence of multimodality, even for long-distance movements. Rail freight captures only about 4 percent of all ton-km transported, significantly less than in relevant high- and middle-income comparator countries. Even if rail freight gained significant modal share in the coming years—an unlikely development without a concerted policy and private sector engagement effort, as evidenced by international experience—this would still leave the trucking sector as the likely dominant mode of freight transport in Türkiye for years to come.

8) Türkiye's CCDR, "Transport," (2022): 12.
9) Türkiye's CCDR, "Transport," (2022): 12.

Key Policies:

· Improving energy efficiency in the transport sector, particularly in carbon- or energy-intensive sectors, to improve external competitiveness and productivity.

· Implementing efficiency-enhancing measures in logistics, such as cargo consolidation, equipment sharing and standardization, digitalization of corridors, and seamless inter-modal truck-rail transitions.

· Logistics modernization towards a more even modal distribution, higher efficiency, and widespread adoption of zero-carbon traction. This will require an "all-of-the-above" approach, of which electrification is only a part.

Implementation Strategies: Even if rail freight gained significant modal share in the coming years, trucking would likely remain the dominant mode of freight transport, as it is in most upper-middle income and high-income countries. Therefore, measures to decarbonize and increase the efficiency of trucking operations deserve policy priority. At current levels of battery technology, electrifying trucking—particularly heavy-duty trucks used for long-haul shipments—is challenging, while other promising technologies, such as hydrogen, are still under development. Complementary measures, such as wider cargo consolidation, equipment sharing and standardization, digitalizing corridors through technologies like intelligent highways and smart railway signaling systems, and more seamless intermodal truck-rail transitions for containerized freight, will therefore be needed to increase the efficiency of trucking and logistics.[10]

While battery technology is likely to evolve to accommodate long-haul trucking operations, no zero-carbon alternatives for long-haul trucking are as yet commercially available, whether in the form of battery technology, alternative (zero-carbon) fuels, or infrastructure solutions such as electrified highways (some of these approaches are being tested). Therefore, complementary measures will be needed, particularly in the short and medium term, to increase the efficiency of trucking and logistics. Electric trucks alone—even in instances where this is already possible, such as in the case of small commercial vehicles—are unlikely to deliver the modernization that Turkey's logistics sector requires. Examples of efficiency-enhancing measures that can both reduce logistics costs and help decarbonize logistics include wider incidence of cargo consolidation, equipment sharing and standardization, digitalization of corridors through technologies like intelligent highways (ITS) and smart railway signaling systems (digital rail traffic management), and more seamless inter-modal truck-rail transitions for containerized freight.[11]

10) Türkiye's CCDR, (2022): 46.

11) Türkiye's CCDR, "Transport," (2022): 13.

What the World Bank Group is Doing to Support These Efforts

Priority 1: Logistics and the Middle Corridor (MC)

Türkiye's position at the western terminus of the MC between China and Europe is of significant strategic importance to Türkiye's trade and growth prospects. For Türkiye, developing the MC is consistent with its aspiration to (1) boost trade and economic integration with the South Caucasus and Central Asia, as well as East Asia, and (2) promote rail freight adoption and reduce logistics costs. The International Rail Logistics and Network Resilience Project (IRREP), under preparation and co-financed by the World Bank, is a first step in turning this aspiration into reality but other links will be needed. Notably, establishing a freight rail link across the Bosporus at Istanbul's Third Bridge is a crucial missing link for continuous railway connections from end to end along the MC at higher freight volumes. The World Bank can convene the donor community to make the case for and finance this link. Logistical centers are also suffering from underinvestment in Türkiye. A study on this subject could be a first step towards improving overall logistical performance in the country.

Priority 2: Urban transportation and mobility for continued growth

Essential to the decarbonization of Türkiye's economy, cities need to invest in mobility solutions that will allow them to remain the country's engines of growth and competitiveness. eMobility, public transit, transit-oriented development, use of all available modes of transport including ferries, micro mobility, and improved intermodal connectivity of urban transit all offer interesting possibilities for Türkiye to maintain and enhance mobility in its urban areas.

The World Bank suggests that Türkiye consider establishing a national eMobility platform to enable municipalities to procure eBuses under concession or leasing agreements from private providers. This method of pooling demand to help overcome the high capital cost of entry into the eBus market has been implemented with success in India where it is known as the Grand Challenge, and economic savings of more than 30 percent have been demonstrated for eBuses. Such a platform would require cooperation among municipalities and the Government of Türkiye to build capacity for procuring and managing such contracts and linking demand with eBus manufacturers who could supply the needed vehicles. From this perspective, manufacture of EVs in Türkiye is also an attractive possibility for private sector driven growth in a green industry with export potential.

Priority 3: Ports and decarbonization of maritime transport

Türkiye is a maritime shipping power of regional significance, and its trade footprint is amplified by its position as a transshipment hub and the western terminus of the

MC. Further development of the ports sector to improve governance, last-mile and hinterland connectivity, efficiency, and readiness for low- and zero-carbon bunker fuels (LZCBF) will be necessary to maintain the sector's ability to serve Türkiye's growing exports and meet the low-carbon regulations emerging from its main trading partners in the EU. At the same time, the World Bank is helping Türkiye explore its potential to produce or distribute LZCBF as a source of growth and jobs that also support international efforts to decarbonize global shipping. The intention would be to use shipping as a possible anchor customer for green methanol, hydrogen, and/or ammonia to be produced in Türkiye from renewable sources.

Priority 4: Network resilience

A national-level assessment of the vulnerability of Türkiye's transport infrastructure and services is needed but has never been conducted. This would be a good time to fill this gap, and the WBG is bringing resources to aid in doing so. A high-level assessment conducted for the Türkiye CCDR showed that there are significant risks to the road and rail networks, and that at least two of Türkiye's main airports and seaports are exposed to flooding risks. A detailed, national study modeling impacts across the whole Turkish transport network will permit the government to understand specific systems or locations that are vulnerable to climate-related threats (e.g., flooding, precipitation, landslides, and wildfires) and other natural hazards (e.g., earthquakes). This in turn makes it possible to begin identifying asset management and investment priorities in both hard infrastructure and softer systems to help manage disaster risk in the network and around the country as a way of increasing resilience in mobility and logistics. A resilient transport system is itself a critical element of overall societal resilience because it is essential to moving disaster-affected people out of danger zones and moving needed relief or reconstruction supplies to the danger zones. Türkiye should begin to study its options in this domain.

THE CONTRIBUTION OF TÜRKIYE'S FORECAST FOR ACHIEVING CARBON NEUTRALITY IN 2053

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Türkiye's forestry sector can play a vital role in helping to achieve the country's net zero target through absorbing greenhouse gases. By acting as a carbon sink, it relieves the need to undertake the most expensive abatement in hard-to-abate sectors, significantly reducing the cost of achieving carbon neutrality. This article outlines current trends in the forestry sector and what is needed for forestry to play its important role in reaching climate targets while improving land-use management.

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Keywords: Afforestation, Carbon Neutrality, Deforestation, Environmental Kuznets Curve (EKC), Reforestation.

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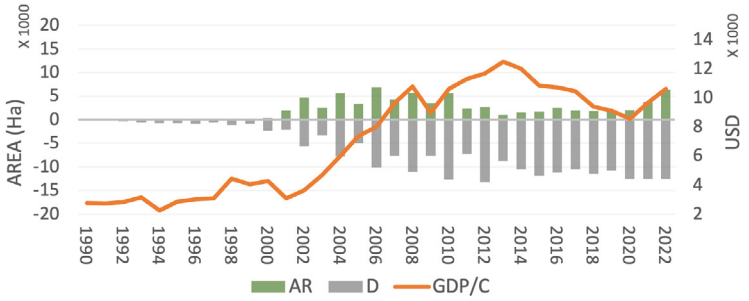
The way land is planned and used in a country plays a vital role in its economic activities. This is because land use can have significant impacts on critical areas such as transport, urbanization, agriculture, and energy, among others.[1] Proper and efficient land use can support a country's sustainable development while reducing climate vulnerabilities and disasters. In contrast, inappropriate land use can cause significant issues in a warming planet, such as erosion, sedimentation, land degradation, and desertification, all of which can worsen with rising temperatures and drought risk.[2] Türkiye experienced an Environmental Kuznets curve (EKC)[3] in terms of land use transition in the last couple of decades. The balance between land use conversion to forestland (afforestation/reforestation) versus conversion of forestland to other land uses (deforestation) clearly shifted towards the latter in the early years of economic growth during this period (Figure 1).

Figure 1: The relationship between Gross Domestic Product per Capita (GDP/C) with the afforestation/reforestation (AR) and deforestation (D) rates indicates a typical EKC of a developing country for the last couple of decades in Türkiye.



1) Jianbao Li, Xianjin Huang, Xiaowei Chuai, and Hong Yang, "The Impact of Land Urbanization on Carbon Dioxide Emissions in the Yangtze River Delta, China: A Multiscale Perspective," *Cities*, Vol. 116 (2021): 103275. doi: 10.1016/J.CITIES.2021.103275; Asif Raihan, "The Dynamic Nexus between Economic Growth, Renewable Energy Use, Urbanization, Industrialization, Tourism, Agricultural Productivity, Forest Area, and Carbon Dioxide Emissions in the Philippines," *Energy Nexus*, Vol. 9 (2023): 100180. doi: 10.1016/J.NEXUS.2023.100180

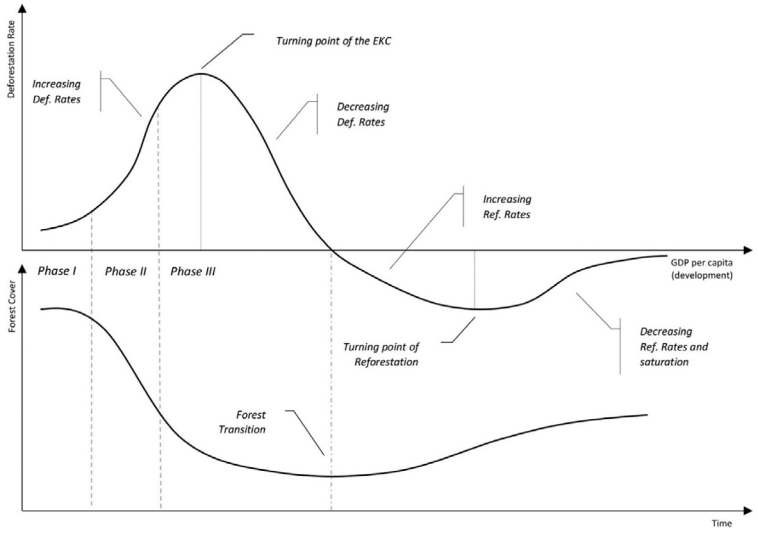
2) Donia Jendoubi, Md Sarwar Hossain, Markus Giger, Jelena Tomicevic-Dubljevic, Mohamed Ouessar, Hanspeter Liniger, and Chinwe Ifejika Speranza, "Local Livelihoods and Land Users' Perceptions of Land Degradation in Northwest Tunisia," *Environmental Development*, Vol. 33 (2020): 100507. doi: 10.1016/J.ENVDEV.2020.100507; Gebeyehu Taye, Tesfaye Teklesilassie, Daniel Teka, and Henok Kassa, "Assessment of Soil Erosion Hazard and Its Relation to Land Use Land Cover Changes: Case Study from Alage Watershed, Central Rift Valley of Ethiopia," *Heliyon*, Vol. 9, No. 8 (2023):e18648. doi: 10.1016/J.HELIYON.2023.E18648

3) Nkwetta Ajong Aquilas, Alfred Kechia Mukong, Jude Ndzifon Kimengsi, and Forbe Hodu Ngangnchi. "Economic Activities and Deforestation in the Congo Basin: An Environmental Kuznets Curve Framework Analysis," *Environmental Challenges*, Vol. 8 (2022): 100553. doi: 10.1016/J.ENVC.2022.100553; Patrícia Hipólito Leal and António Cardoso Marques, "The Evolution of the Environmental Kuznets Curve Hypothesis Assessment: A Literature Review under a Critical Analysis Perspective," *Heliyon*, Vol. 8 No. 11 (2022): :e11521. doi: 10.1016/J.HELIYON.2022.E11521

Türkiye observed a significant increase in its GDP/C from 2001 to 2008 and then a second leap following the 2009 global crisis up to 2013. During this period of economic growth, Türkiye moved from a steady neutral AR vs D state into a net D state. By the end of 2010's, the economic growth drove some typical side effects such as urbanization, urban sprawl, and land degradation, leading to a reduction of the carbon sink capacity of the country's land sector.[4]

In a typical EKC, the deforestation rates—a characteristic of environmental degradation— also increase during the initial phases of development. As GDP/C continues to grow, the growth becomes more environmentally friendly with rising wellbeing and public awareness. Therefore, increases in GDP/C levels subsequently become associated with net reforestation rates leading to a replenishment of forest cover (Figure 2). In the Türkiye case we do not observe a typical steady increasing GDP/C curve. The strong development until 2013 moves to an opposite direction until 2020 while the AR vs D balance continues to stay on the D side. However, an increasing trend seems to start in 2021 for both GDP/C and AR rates. From this point forward, Türkiye's economy can continue to grow with a strong environmental coupling. We assume that the improved environmental awareness and the ratification of the Paris Agreement in 2021 under the United Nations Framework Convention on Climate Change will be the driver of this upcoming sustainable development period.

Figure 2: Changes in deforestation an forest cover in time on a typical Kuznets Curve.[5]



4) NIR Turkiye. 2023. NIR Türkiye. https://unfccc.int/documents/627786

5) Nicola Caravaggio, "Economic Growth and the Forest Development Path: A Theoretical Re-Assessment of the Environmental Kuznets Curve for Deforestation," *Forest Policy and Economics*, Vol. 118 (2020) :102259. doi: 10.1016/J.FORPOL.2020.102259

Currently, one of the critical issues related to land use globally is its potential to offset greenhouse gas emissions as a means for mitigating climate change and helping countries meet their carbon neutrality targets under the Paris Agreement.[6] Many countries have started to evaluate this aspect, and Türkiye is no exception. In this regard, this article aims to assess the potential of Türkiye's land use sector for offsetting the country's residual greenhouse gas (GHG) emissions. By doing so, we identify the strengths and weaknesses of Türkiye's current land use practices and suggest ways to enhance them. Ultimately, this will help Türkiye achieve its climate goals and contribute to global carbon neutrality efforts.

In order to fully tap into the potential benefits of forests as carbon sinks and nature-based solutions for climate adaptation, it is crucial to prioritize the improvement of ecosystem productivity and forest cover. According to the latest data from the General Directorate of Forestry (GDF), as of 2022, forestlands reached an impressive 13,707,843 hectares equivalent to 17.5 percent of the country. However, it is worth noting that there are still vast areas of low stocked forests, covering 9,537,157 hectares.[7] By reforesting or restoring these areas, the productivity and ecological value of Türkiye's forests can be significantly increased.

According to Türkiye's latest National GHG Inventory Report,[8] the Land Use, Land Use Change and Forestry (LULUCF) sector removals account for 47.2 Mt CO_{2e}, which offsets 8.4 percent of the total 564.4 MtCO2e GHG emissions in 2021. This represents a significant decrease from the previous NIRs, with total net removals reported at 56.9 Mt CO_{2e} in 2020[9] and 84.0 CO_{2e} in 2019.[10] The Forest Management (FL-FL) and Harvested Wood Products (HWP) categories are responsible for almost all of the LULUCF sector removals in Türkiye. Other categories such as Croplands, Grasslands, Settlements, and Wetlands contribute less than 1 percent of the sector total. Therefore, in order for Türkiye to achieve net zero emissions it is essential to prioritize forest and wood products management and provide additional support for other land uses that can act as carbon sinks.

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6) Jingyi Liu, Qianqian Yan, and Menghan Zhang, "Ecosystem Carbon Storage Considering Combined Environmental and Land-Use Changes in the Future and Pathways to Carbon Neutrality in Developed Regions," *Science of The Total Environment*, Vol. 903 (2023): 166204. doi: 10.1016/J.SCITOTENV.2023.166204; Antti Majava, Tere Vadén, Tero Toivanen, Paavo Järvensivu, Ville Lähde, and Jussi T. Eronen, "Sectoral Low-Carbon Roadmaps and the Role of Forest Biomass in Finland's Carbon Neutrality 2035 Target," *Energy Strategy Reviews*, Vol. 41 (2022): 100836. doi: 10.1016/J.ESR.2022.100836; S. L. Swamy, H. Darro, A. Mishra, Rattan Lal, Amit Kumar, and Tarun Kumar Thakur, "Carbon Stock Dynamics in a Disturbed Tropical Forest Ecosystem of Central India: Strategies for Achieving Carbon Neutrality," *Ecological Indicators*, Vol. 154 (2023): 110775. doi: 10.1016/J.ECOLIND.2023.110775

7) GDF, "Türkiye Forest Product Annual Market Review – 2023," UNECE (2023). Available at https://unece.org/sites/default/files/2023-09/Market%20Report%20Turkiye.pdf

8) NIR Turkiye. 2023. NIR Türkiye. https://unfccc.int/documents/627786

9) NIR Turkiye. 2022. NIR Türkiye. https://unfccc.int/documents/461926

10) NIR Turkiye. 2021. NIR Türkiye. https://unfccc.int/documents/271544

The World Bank conducted an analysis to establish a projection that compares two scenarios: a High Forest Scenario (HFS) and a Business as Usual (BAU) scenario. Our HFS is a stylized scenario that showcases the full potential of the land sector by setting ambitious but achievable targets to reach carbon neutrality by 2053. This is made possible by leveraging the wide area of degraded forests available in the country. It is worth noting that the HFS scenario presented here does not involve any additional land allocation to forestland. It is a conversion of understocked forest areas (crown closure less than 10 percent) to productive forests (forest restoration).

To estimate the GHG benefits and costs of specific LULUCF activities, such as forest restoration, afforestation/reforestation, and grassland restoration, we first conducted an activity-based assessment. Our assessment revealed that A/R with fast-growing species is the most cost-effective land-based mitigation activity. However, this option is much more constrained by the availability of ecologically suitable lands with high site productivity. On the other hand, grassland restoration will not enable a large carbon sink as compared to forestry options, but it was included in the HFS due to its important co-benefits for nature and people in rural areas.

Based on our assessment, we propose that a total investment of approximately USD 9 billion can bring about the expansion of 3 million hectares of forest restoration, the establishment of 500,000 hectares of new plantations with fast-growing species, and the restoration of 1 million hectares of grasslands by 2053, the climate neutrality target year of Türkiye. To achieve this, we propose 93,750 hectares of productive forest restoration, 15,625 hectares of fast-growing plantations, and 31,250 hectares of grassland restoration per year, starting in 2023 until 2053. The table below provides a summary of the proposed activity-based mitigation options and their cumulative GHG impacts and costs. The costs have been estimated based on performance tables from the most recent GDF Activity Reports.[11]

11) GDF (2023).

Table 1: Activity-based mitigation options, estimated removal rates and costs

Activity-based mitigation options	Area targeted Ha	Total investment USD	Cumulative GHG removals by 2053 tCO2eq	Unit cost USD/tCO 2e
Forest Restoration	3,000,000	7,603,410,000	71,437,500	106.43
Afforestation/Plantations	500,000	962,940,000	64,743,800	14.87
Grassland Restoration	1,000,000	702,475,000	586,700	1197.40
Total	4,500,000	9,268,825,000	136,768,000	-

The investment amount of USD 9 billion is undeniably large, but its potential benefits in terms of ecosystem services, economic development, employment generation, and climate and disaster mitigation make it a smart investment. With the current annual budget of the GDF being around USD 1 billion, an increase of 10-20 percent in its annual budget would allow achieving these targets. Importantly, having this level of carbon sink will offset the most expensive abatement from across the economy. In other words, the most difficult and expensive emissions reductions will not need to be undertaken, saving the country many billions of dollars.

To capture the full land-based mitigation potential of the key category (FL-FL) of the LULUCF sector for the BAU and HFS scenarios up to 2053, we took into account the impacts of the above three activities along with a complementary set of sectoral Policies and Measures. Our assumptions are interconnected and have a cascading effect on the total forest carbon sink, reflecting the aggregate benefits brought by an overall improvement in land and forest management across the country's forests. For instance, we considered that Policies and Measures designed to promote reduced harvest, minimize illegal logging, and avoid large forest fires will result in an increase in increment rates across the entire area of forest lands, which significantly enhances the total carbon sink capacity.

In the HFS scenario, we applied a harvest rate that corresponds to an annual decrease of 0.321 percent, from 22.1 million m3/yr in 2020 to 19.8 million m^3/yr in 2053. Conversely, in the BAU scenario, the harvest rate followed the trend of the 1990-2019 period, with an increase from 22.02 million m^3/yr in 2030, 26.38 million m^3/yr of harvest in 2040, to 32.04 million m^3/yr of harvest in 2053. Considering that the increment rates of the forests in Türkiye have leveled off and even started

to decrease in recent years[12] the BAU scenario suggesting overharvesting seems plausible. However, the main reason for the increased harvest rate is the demand from the domestic forest industry and high timber prices. As of November 2021, the weighted average timber price was USD 149.32. Therefore, a one million m^3 decrease in annual harvest would result in a loss of around 149 million USD/yr to the GDF as an opportunity cost, which may also affect the wood industry to some extent. Therefore, consultations with business and civil society will be crucial to assess trade-offs for different stakeholders.

The category of HWP is the second largest contributor to the LULUCF sector in Türkiye's GHG inventory. Our analysis assumes that the current trend in the HWP pool will persist, with sawn wood and wood panels becoming increasingly dominant over pulpwood in both the BAU and HFS scenarios. We also project a slightly faster decline in the use of fuelwood and illegal logging in the HFS compared to the BAU scenario.

In the HFS scenario, we assume that forest cover will remain stable with net zero deforestation until 2053, while in the BAU scenario forest cover is projected to decrease slightly due to factors such as urban sprawl and other drivers. It is worth noting that we did not consider the indirect positive effects of the proposed mitigation activities and policies and measures, such as decreased emissions due to reduced runoff of organic carbon or co-benefits such as increased standing volume, biodiversity benefits, erosion/sedimentation, and protection against floods, torrents, and landslides. However, when positive policies and measures are combined with additional mitigation activities, the increase in ecosystem services and total economic value could be substantial.[13]

The LULUCF sector has the potential to significantly contribute towards achieving net zero emissions by 2053 in Türkiye. However, the effectiveness of reducing GHG emissions from other sectors while fully implementing the HFS scenario is crucial for achieving this goal. For example, if the HFS is fully implemented while GHG emissions from other sectors are maintained at current levels, the LULUCF sector's contribution to carbon neutrality (offsetting emissions from other sectors) would still be about 25 percent, which is in line with the Paris Agreement (Table 2).

12) NIR Turkiye. 2023. NIR Türkiye. https://unfccc.int/documents/627786

13) A. Weatherall et al., "Defining Climate-Smart Forestry," in: R. Tognetti, Smith, M., Panzacchi, P. (eds) *Climate-Smart Forestry in Mountain Regions. Managing Forest Ecosystems*, Vol 40 (Springer, Cham, 2020). https://doi.org/10.1007/978-3-030-80767-2_2

Table 2: Scenarios of baseline GHG emission reductions combined with LULUCF removal scenarios to assess Türkiye's forests' contribution to climate neutrality by 2053. The baseline year is 2019.[14]

	LULUCF removals	Full HFS	80 percent HFS	50 percent HFS
Baseline GHG emissions (2019)	**MtCO2e**	**-121.3**	**-112.5**	**-99.3**
No reduction	**506.1**	23.95 percent	22.23 percent	19.62 percent
50 percent reduction	**253.1**	47.90 percent	44.46 percent	39.24 percent
80 percent reduction	**101.2**	119.74 percent	111.14 percent	98.10 percent

In fact, even with a 50 percent reduction in baseline GHG emissions from other sectors and full HFS implementation there will still be a large carbon debit (132.2 $MtCO_2$ eq) which would have to be provided from carbon markets. On the other hand, if 80 percent of emission reductions in other sectors are achieved along with 50 percent of the HFS implementation, Türkiye could become almost carbon neutral with a slight debit of 3.1 $MtCO_2$ eq. If the HFS is further implemented, Türkiye could even become a net sink with potential for carbon trading of its surplus under Article 6 of the Paris Agreement. Therefore, while reducing emissions in key emitting sectors should be the first priority for achieving carbon neutrality, an increasing carbon sink can contribute to alleviating the burden by offsetting residual emissions in hard-to-abate sectors.

Discussion and Further Considerations

In Türkiye, while the forest area[15] is increasing according to official data, the carbon sink capacity of its forests is decreasing according to the latest NIRs, which points to a reduction in the quality of the country's forests. Therefore, there is a considerable area of land that can be restocked through afforestation or forest restoration. On the other hand, agriculture areas are decreasing due to urban sprawl around cities and migration of rural communities to urban centers.[16] Restoration of degraded rangelands together with conservation agriculture may not only increase carbon stocks but also support rural development, food security, and numerous economic benefits.[17]

14) NIR Turkiye. 2021. NIR Türkiye. https://unfccc.int/documents/271544

15) The forest area increase reported by the GDF each year in its Activity Reports represents the area covering both stocked and unstocked lands allocated for forest land use. The term "stocked" refers to a forest crown closure of over 10 percent and "unstocked" below 10 percent. Some of these lands can be afforested or restored in time provided they can still support a woody vegetation, which is nto the case for a large portion of these lands.

16) Erda Çeler, Yusuf Serengil and Ufuk Özkan, "A Comparative Assessment of Forest/Green Cover and the Awareness of Forestry District Managers," *Environmental Monitoring and Assessment*, Vol. 195, No. 520 (2023): 520.

17) N. Stoeckl, T. Chaiechi, M. Farr, D. Jarvis, J. G. Álvarez-Romero, M. J. Kennard, V. Hermoso, and R.

Our analysis assumes that Türkiye initiated a HFS by 2023. Any delay in applying the HFS may raise the cost or lower the level of carbon sink. It is important to note that the HFS presented in our analysis is not an exact estimate; it is rather meant to indicate the potential contribution of the LULUCF sector to Türkiye's carbon neutrality in the next three decades. The forest land category is the largest and only carbon sink mechanism in the country. Therefore, it is crucial to fully mobilize its potential. This comes with co-benefits such as reducing the urban heat island effect, flood and landslide control, erosion reduction, groundwater recharge, and biodiversity conservation, among others.[18]

It is worth noting that there is potential for additional land-based GHG removals in Türkiye. According to the Ministry of Agriculture and Forestry there are approximately 2 million hectares of abandoned farmlands in rural areas due to urban migration. If the government of Türkiye develops a policy to convert these lands into productive orchards or fast-growing plantations, there can be additional carbon benefits.

The wetlands and settlement LULUCF categories have not been directly discussed in this article as GHG estimates for these categories are not well established in Türkiye's NIR. However, conversion from forests to these categories are assessed under deforestation. In the coming decades, we can expect a lower rate of reservoir construction compared to the last few decades, since the hydroelectric potential of the country has been almost fully mobilized.[19] On the other hand, settlements can further expand (urban sprawl). This may cause carbon stocks to decrease around cities but can be slowed with smart land use solutions. Urban development can even increase carbon stocks, especially around semiarid cities if there is water for irrigation available.

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Conclusions

Türkiye's GHG removals in the LULUCF sector currently offset around 8.4 percent of its total GHG emissions according to the latest NIR.[20] To increase CO_{2e} removals from the LULUCF sector to enable net zero emissions by 2053 Türkiye must focus on the following policies and measures:

· Achieve net zero deforestation by 2025;

· The increment rate of standing forests should be enhanced to further increase the growing stock of the country's forests. This can be achieved through reduced harvesting and improved forest management approaches, keeping the harvest rate around 20 million m3/yr during the 2023-2053 period,

· 3 million hectares of degraded forests should be rehabilitated in the period 2023-2053,

· 500,000 hectares of land suitable for A/R should be allocated for fast growing species plantations during the period of 2023-2053,

· Additional actions including grassland rehabilitation, climate smart agriculture practices and decreased illegal logging should be pursued.

These land-based activities and complementary Policies and Measures can enable LULUCF removals to reach well over 100 million tCO_{2eq}/yr by 2053, the year in which Türkiye is plans to reach carbon neutrality.

There is a significant potential for the land sector to increase its GHG removals and further offset residual emissions from the other sectors of the economy that are harder and more expensive to abate on the road to Türkiye's carbon neutrality.

20) NIR Turkiye. 2023. NIR Türkiye. https://unfccc.int/documents/627786

THE POTENTIAL IMPACT OF THE EU CBAM ON TÜRKİYE'S ECONOMY

DOI: 10.58867/WWNS3896

With a large heavy industrial sector and strong trade links with the EU, Türkiye is particularly exposed to the European Union's implementation of the Carbon Border Adjustment Mechanism. Using a global trade and environment model, this article outlines the potential impacts of the CBAM on Türkiye's economy and the specific effects on CBAM sectors. It also assesses how, by taking action to reduce emissions, the impact of CBAM can be reduced and exports maintained or grow.

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Keywords: Competitiveness, Emissions Intensity,
EU Carbon Border Adjustment Mechanism (CBAM), Exports, Türkiye.

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The European Union (EU) is introducing a Carbon Border Adjustment Mechanism (CBAM) to prevent carbon leakage under the EU emissions trading system (ETS) and support the mitigation ambitions of the EU and of other countries.[1] The CBAM will require certain importers to purchase and surrender CBAM certificates to cover emissions embodied in imported goods. This will increase the cost of these imported goods, with the additional cost reflecting the emissions-intensity of each product, sending a price signal to importers to reduce emissions and to EU consumers to preference low-emissions alternatives. It also provides a level playing field for domestic producers in these sectors, as going forward both they – and their import competitors – will be subject to a carbon price.

The obligation on importers will be reduced for products already subject to carbon pricing in their country of origin. This provides an opportunity for countries to implement domestic carbon pricing, effectively reclaiming government revenues that would otherwise be payable to the EU.

The CBAM will be closely related to the EU Emissions Trading System (EU ETS) in its scope and operation. The CBAM price will mirror the weekly EU ETS permit price, The CBAM obligation will also be adjusted to take into account any free allocation of EU ETS permits that EU industry receives in the relevant sector.

The embodied emissions of covered products will generally be determined based on each importer's emissions measurement, reporting and verification (MRV). Where importers do not have sufficient data to demonstrate the emissions associated with their products, a default value will be applied. In this case, the default will be based on the worst-performing EU installations. This means that producers that can demonstrate relatively low emissions intensity of production will face lower CBAM costs, while those without reliable MRV will pay the potentially higher EU-based default rate.

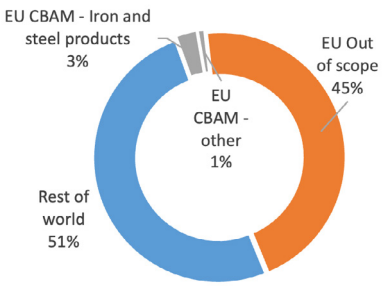
The CBAM will come into full force in 2026, with a transitional phase from 1 October 2023 to 31 December 2025. During the transitional phase importers will report the embedded emissions in covered products. The CBAM will initially cover Scope 1 (direct) emissions from certain products in the Iron and Steel, Cement, Fertilizers, Electricity, Hydrogen and Aluminum sectors, plus scope 2 emissions for Cement and Fertilizers. The EU intends to expand coverage of the CBAM to other emissions-intensive, trade exposed (EITE) products under the EU ETS such as glass, chemicals, petroleum and other fossil fuels.

1) Carbon Border Adjustment Mechanism (europa.eu).

The impact of the CBAM on each country will ultimately depend on many factors, including the proportion of their production covered by the CBAM, the elasticity of demand for covered products, the level of cost pass-through to consumers, each country's emissions intensity of production and emission reduction opportunities relative to that of competitors, opportunities to divert exports to other countries, and the ability for exporting countries to robustly measure and report emissions. This paper explores the potential impact of the CBAM on Türkiye's economy.

Around 4 percent of Türkiye's total goods exports by value would be subject to the CBAM in its early stages (Figure 1). The industry sector of most concern is Iron and Steel. Exports to the EU of covered products in this industry represent 3 percent of Türkiye's total goods exports (Figure 1). Nearly 40 percent of Türkiye's Iron and Steel exports go to the EU (Figure 2). The emissions intensity of Türkiye's ferrous metals sector is estimated at 226 tCO_{2e}/Million USD (Figure 3).[2] When compared with other major exporters, this is higher than that for the EU (124 tCO_{2e}/Million USD) and Republic of Korea (149 tCO_{2e}/Million USD), though lower than China (422 tCO_{2e}/Million USD) and Russia (492 tCO_{2e}/Million USD).[3] About 70 percent of Türkiye's steel production uses scrap metal in electric arc furnaces, keeping emissions intensity below many competitor countries.

Figure 1: Share of Türkiye's Goods Exports by Value (2018-2020 Average)



2) Emissions intensities in this paper (unless otherwise stated) are based on GTAP data.

3) Figures are derived from GTAP data. Due to the high level of sector aggregation, comparisons between countries mask differences in the outputs of sectors between countries. For example, glass and cement are both included in 'mineral products'. If one country's production is concentrated in more energy-intensive cement, their emissions intensity (expressed per Million USD of output) may seem higher than a country whose focus is on glass, and these countries may not be competitors. This metric does however provide a useful guide to the cost of a carbon price relative to production value. GTAP data does not include all emissions (for example CO_2 emissions from industrial processes).

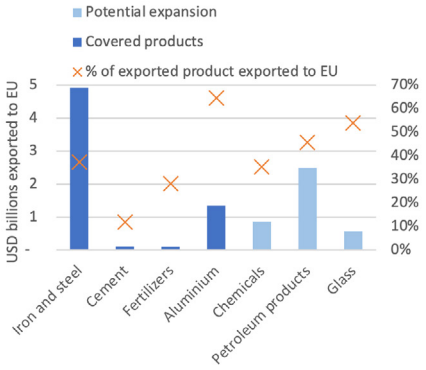
Aluminum production, which accounts for most of the remaining 1 percent of Türkiye's exports to be covered under the current proposal, is also highly exposed. 64 percent of exports of covered Aluminum products go to the EU. These exports are worth nearly US$1.4 billion a year. The emissions intensity of Türkiye's production of non-ferrous metals (including aluminum), at 85 tCO_{2e}/Million USD, fares slightly better when compared with other major exporters: the EU 42 tCO_{2e}/Million USD, China at 93 tCO_{2e}/Million USD.

If, or when, the CBAM scope is expanded, Türkiye faces risks in other emissions-intensive sectors exposed to the EU. This includes petroleum products, in which nearly 50 percent of Türkiye's US$2.5 billion annual exports go to the EU, and glass, in which 54 percent of exports also go to the EU.

Turkish Textiles

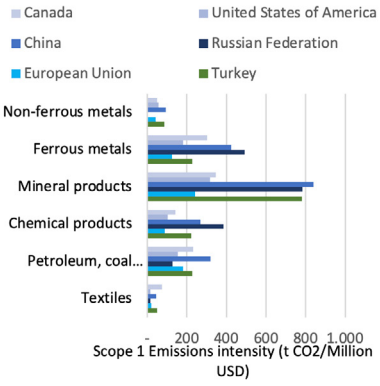
Although Textile production may not be covered by the EU CBAM in the near-term, the sector is subject to increasing attention for its climate impact. Given the sector makes up nearly 6% of Türkiye's exports by value, the sector's competitiveness is important to Türkiye's economy, The emissions intensity of Türkiye's production, at 48.5 tCO_2e/Million USD, is higher than that of other major exporters, including China (44.6 tCO_2e/Million USD) and the EU (19.1 tCO_2e/Million USD).

Figure 2. Value of exports to EU and EU share of global exports, annual average 2018-2020



Source: UNCOMTRADE (from WITS)

Figure 3. Emissions intensity (scope 1) for Turkey and select competitors



Source: Derived from GTAP data

Findings from Modelling the Economic Impact of EU CBAM

In order to quantify the potential impact of the CBAM on Türkiye's economy and that of other countries in Europe and Central Asia (ECA) the World Bank has undertaken macroeconomic modelling. The modelling explores the impact on the economy overall, as well as on individual sectors. It also investigates what might happen under different CBAM coverage and if the US adopted a similar mechanism. The scenarios modelled and discussed in this paper are outlined in Table 1.

Table 1: Modelled Scenarios

Short name	Description
Baseline	All countries reduce emissions in line with NDCs. No CBAM is introduced.
Current proposal[4]	CBAM introduced in EU & EFTA, obligation to buy permits from 2026, covering scope 1 emissions for certain products in Iron and steel, Aluminum, cement, fertilizers and electricity in line with the current proposal. Countries' domestic carbon prices credited towards CBAM charges. Free allocation is accounted for in the CBAM price applied.
Expanded CBAM	As under 'Current proposal', with coverage extended to all chemicals, all non-ferrous metals, petroleum and coal production (embedded emissions during processing, not on the carbon content of fuels), extraction of asphalt bitumen and iron ore, and glass. Scope 1 and 2 emissions are included.
U.S.	As under 'Expanded CBAM', but with the U.S. also imposing a CBAM on the same emissions scope, from 2026. No free allocation is included for the U.S. CBAM.
All ETS, U.S.	CBAM applied to Scope 1 and 2 emissions for all products in all ETS sectors by both the EU & EUFTA and the U.S..

The CBAM is Forecast to have Major Impacts for Some Sectors

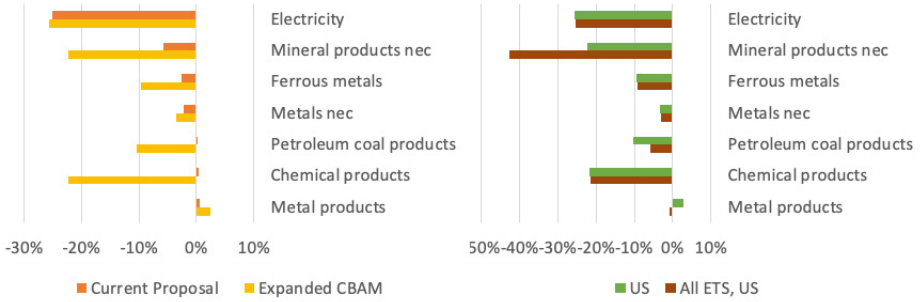
The biggest impact from the CBAM is lower exports to the EU of products covered by the CBAM (Figure 4, Table 1). This is the result of the European countries substituting imports with domestic production, switching to imports from other countries where the emissions intensity of production might be lower, or reducing consumption entirely. Exports of mineral products, such as cement, to the EU would be around 5.8 percent lower under the 'Current Proposal' compared with the 'Baseline' scenario where there is no CBAM. Under this scenario, scope 1 emissions from most cement products are covered but other mineral products, such as glass, and scope 2 (electricity use) emissions are not. The reduction in mineral product exports to the EU could be as much as 42.8 percent with coverage of the sector broadened beyond cement and scope 2 emissions included ('Expanded CBAM', 'U.S.', 'All ETS, U.S.'). Reflecting the Iron and Steel (Ferrous metals) sector's exposure, exports to the EU could be 2.6 percent lower under 'Current Proposal', but around 10 percent lower if scope 2 emissions are included ('Expanded CBAM', 'U.S.', 'All ETS, U.S.'). In scenarios where Petroleum products and scope 2 emissions are covered, exports of petroleum and coal to the EU could be more than 10 percent lower ('Expanded CBAM'). The impact on the Chemicals sector is expected to be substantial if it is captured broadly by the CBAM and scope 2 emissions are included – exports to the EU are more than 20 percent lower than under the baseline (Expanded CBAM', 'U.S.', 'All ETS, U.S.').[5] In contrast, some higher value-added sectors could achieve higher exports to the EU through improved competitiveness

4) Although the final CBAM agreement includes Hydrogen, this modelling exercise, conducted before the starting scope was finalized, does not include Hydrogen in [any] scenarios. Including Hydrogen would be unlikely to have a meaningful impact on the modelling results out to 2030, given current Hydrogen production is small and the future production and use is uncertain. However, Türkiye's Hydrogen Roadmap demonstrates the country's plans to ramp-up hydrogen production, so hydrogen's inclusion could have implications in the longer-term.

5) Under 'Current proposal', only fertilizers are covered. 'Expanded CBAM' includes all chemical products.

compared with EU producers, who face higher costs when some of their inputs are subject to the CBAM. For example, sectors like Metal products, Motor Vehicles and Parts, Machinery and Equipment, Food, and Agriculture could see marginally higher exports under the 'Current Proposal', and a 1-3 percent bump under scenarios with broader CBAM coverage.

Figure 4. Modelled real exports to the EU in 2030, select sectors, deviation from 'Baseline'



When considering the value of exports, the chemical products sector faces potential forgone exports to the EU of around $2.5 billion in 2030 (Table 1, 'Expanded CBAM', 'U.S.', 'All ETS, U.S.').[6] Combined lost exports to the EU from sectors most likely to be subject to the CBAM could be between $430 million ('Current Proposal') and $4 billion ('All ETS, U.S.') in 2030 alone.

The modelling suggests some portion of exports of some products can be diverted from the EU to other countries. For example, of forgone exports of ferrous metals to the EU of over $350 million in 2030 under 'Expanded CBAM' over a quarter (nearly $90 million) are diverted to non-EU countries. Some diversion is also possible for 'petroleum and coal products', 'metals nec', and 'mineral products'. Around 3 percent of forgone exports of CBAM goods overall can be diverted in this scenario. For the higher value-added sectors there is potential for higher exports also to non-EU countries, again reflecting improved competitiveness compared with EU producers.

6) All modelled $ values in this note are constant 2014 US$.

Table 2: Modelled real exports in 2030, select sectors, deviation from 'Baseline'

Scenario:	Current proposal					Expanded CBAM				
Export destination:	EU		Non-EU	Global		EU		Non-EU	Global	
	%	$ millions	$ millions	%	$ millions	%	$ millions	$ millions	%	$ millions
Electricity	-25.2%	-54.3	-0.1	-10.3%	-54.4	-25.7%	-55.4	-0.1	-10.5%	-55.5
Mineral products nec	-5.8%	-430.0	298.0	-1.7%	-132.0	-22.3%	-3,751.4	3,255.3	-6.5%	-496.0
Ferrous metals	-2.6%	-95.8	6.7	-0.4%	-89.1	-9.6%	-353.7	89.5	-1.3%	-264.2
Metals nec	-2.3%	-180.1	1.6	-1.4%	-178.6	-3.6%	-278.1	22.3	-2.0%	-255.9
Petroleum coal products	0.1%	0.5	1.3	0.1%	1.8	-10.4%	-68.2	8.7	-1.9%	-59.5
Chemical products	0.3%	32.6	0.9	0.1%	33.6	-22.3%	-2,551.9	-17.1	-9.0%	-2,569.0
CBAM goods, narrow	-1.7%	-430.0	9.5	-0.6%	-420.5	-14.8%	-3,751.4	110.8	-5.2%	-3,640.6
Metal products	0.6%	23.7	6.8	0.3%	30.5	2.4%	95.6	47.9	1.4%	143.4
Motor vehicles and parts	0.2%	47.4	3.5	0.1%	51.0	1.0%	302.3	40.4	0.9%	342.7
Other manufacturing	0.2%	108.6	35.1	0.1%	143.7	1.5%	824.4	343.8	1.2%	1,168.2
Agriculture	0.1%	4.1	-1.7	0.0%	2.4	0.9%	50.8	28.9	0.5%	79.7
Food	0.1%	9.1	4.6	0.1%	13.7	1.3%	80.9	86.5	0.8%	167.4
Machinery and equipment nec	0.4%	20.9	8.2	0.2%	29.1	1.8%	102.6	63.4	1.1%	166.0

Scenario:	U.S.					All ETS, U.S.				
Export destination:	EU		Non-EU	Global		EU		Non-EU	Global	
	%	$ millions	$ millions	%	$ millions	%	$ millions	$ millions	%	$ millions
Electricity	-25.6%	-55.2	-10.2	-12.4%	-65.4	-25.4%	-54.9	-10.2	-12.3%	-65.0
Mineral products nec	-22.2%	-3,676.7	3,015.2	-8.7%	-661.5	-42.8%	-4,078.1	2,744.6	-17.5%	-1,333.5
Ferrous metals	-9.4%	-345.8	-264.7	-3.0%	-610.5	-9.3%	-341.6	-243.4	-2.9%	-585.0
Metals nec	-3.3%	-259.9	19.2	-1.9%	-240.6	-3.2%	-247.0	28.5	-1.7%	-218.5
Petroleum coal products	-10.2%	-67.1	0.6	-2.1%	-66.5	-6.0%	-39.3	68.9	1.0%	29.6
Chemical products	-21.9%	-2,506.8	-189.7	-9.4%	-2,696.5	-21.4%	-2,453.1	-163.4	-9.1%	-2,616.5
CBAM goods, narrow	-14.5%	-3,676.7	-597.9	-6.2%	-4,274.6	-16.0%	-4,078.1	-740.5	-6.9%	-4,818.6
Metal products	2.8%	111.5	60.8	1.7%	172.3	-0.8%	-33.9	53.1	0.2%	19.3
Motor vehicles and parts	1.3%	375.9	56.2	1.1%	432.1	1.6%	459.2	67.5	1.3%	526.7
Other manufacturing	1.8%	985.9	394.6	1.4%	1,380.5	2.1%	1,181.6	481.7	1.7%	1,663.2
Agriculture	1.0%	61.3	31.8	0.6%	93.0	1.3%	77.4	37.4	0.7%	114.8
Food	1.5%	98.2	94.9	0.9%	193.1	1.9%	119.6	119.9	1.2%	239.5
Machinery and equipment nec	2.3%	125.1	81.0	1.4%	206.2	2.7%	149.2	94.4	1.7%	243.6

Reflecting the impact on sectoral exports, some sectors face lower output (Figure 5) and employment (Figure 6, Table 2). The extent to which changes in exports impact the sector's output depends largely on the portion of the sector's outputs that are exported. The sector most affected is non-ferrous metals ('Metals nec' eg. Aluminum), which sees the value of output in 2030 0.6 percent lower under 'Current proposal' than under the 'Baseline'. This represents lost output of nearly $170 million in 2030. For other covered sectors the expected change in output under the 'Current proposal is between -0.1 percent (Ferrous metals, Other Mining) to 0.4 percent (Mineral products nec). However, with broader CBAM coverage ('Expanded

CBAM, U.S., 'All ETS, U.S.') the value of output in chemical and mineral sectors could decline up to 3.6 percent. The overall decline in output for sectors most likely to be covered by the CBAM is between 1.4 and 1.8 percent for 'Expanded CBAM' and other scenarios with broader CBAM coverage. Changes in employment by sector follow similar patterns to output. For example, under 'Expanded CBAM', the 2.7 percent decline in output for chemicals translates to a 2.9 percent decline in employment, the 1.3 percent decline in mineral products output results in 1.4 percent lower employment.

Figure 5. Modelled Real output in 2030, select sectors, deviation from 'Baseline'

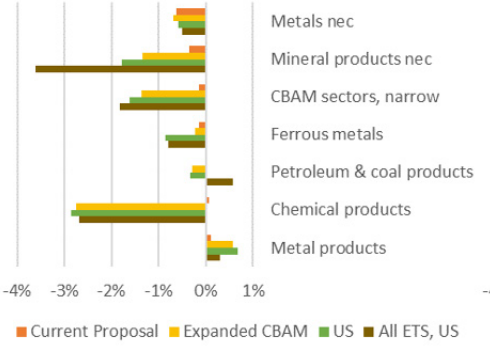


Figure 6. Modelled employment in 2030, select sectors, deviation from 'Baseline'

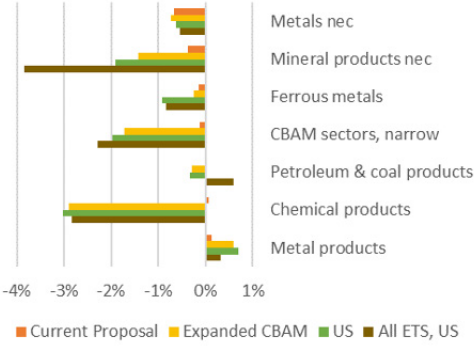


Table 3: Indicative employment in 2030, select sectors, deviation from 'Baseline'

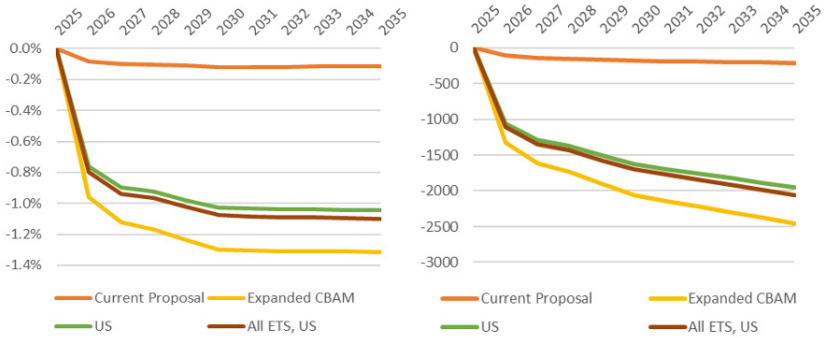
Scenario:	Current proposal		Expanded CBAM		U.S.		All ETS, U.S.	
	Workers	%	Workers	%	Workers	%	Workers	%
Metals nec	-300	-0.7%	-400	-0.7%	-300	-0.6%	-300	-0.5%
Mineral products nec	-700	-0.4%	-2,700	-1.4%	-3,600	-1.9%	-7,300	-3.8%
Ferrous metals	-200	-0.1%	-300	-0.2%	-1,000	-0.9%	-900	-0.8%
CBAM goods, narrow	*-1,200*	*-0.1%*	*-15,800*	*-1.7%*	*-18,000*	*-2.0%*	*-20,900*	*-2.3%*
Petroleum & coal products	0	0.0%	-<100	-0.3%	-<100	-0.3%	<100	0.6%
Chemical products	300	0.1%	-11,800	-2.9%	-12,300	-3.0%	-11,500	-2.8%
Metal products	200	0.1%	1,100	0.6%	1,300	0.7%	600	0.3%
Other manufacturing	1,200	0.1%	9,200	0.7%	10,900	0.8%	13,100	0.9%
Agriculture	<100	0.0%	3,500	0.2%	4,100	0.2%	5,000	0.3%
Food	<100	0.0%	600	0.1%	700	0.1%	900	0.2%
Motor vehicles and parts	300	0.1%	1,700	0.7%	2,100	0.9%	2,600	1.1%
Machinery and equipment nec	200	0.2%	1,300	0.8%	1,500	1.0%	1,800	1.2%

Note: The estimated number of workers impacted is very approximate. The model calculates employment in 2014$USmillions and % changes. The number of workers estimate is based on annual employment costs per worker of 2014$US5,140 for Agriculture and 2014$US8,330 for other sectors, then rounded to the nearest 100. This does not account for other potential variables such as number of hours worked and productivity.

But the economy-wide effects are small.

Total exports to EU countries see small deviations from the baseline, reflecting that lower exports in covered sectors are offset by higher exports for value-added sectors (Figure 8). In 2030, these exports are forecast to be 0.1 percent lower under the current proposal, 1.3 percent lower under an 'Expanded CBAM' and around 1 percent lower if the U.S. also adopts a CBAM ('U.S.', 'All ETS, U.S.'). This represents up to around $2 billion in forgone exports in 2030.

Figure 7. Modelled Real exports to EU, deviation from 'Baseline', % (LHS), US$millions (RHS)



As noted, Türkiye is able to divert some of these exports to other countries, so the impact on total global exports is smaller. Under the 'Current proposal', total exports are less than 0.03 percent lower in 2030 compared with the baseline, or $93 million. Under more ambitious scenarios the impact is larger, but still very small – 0.3 percent lower than the baseline under an expanded CBAM, if the U.S. adopts a similar scheme, or with ambitious expansion and U.S. adoption. Under all scenarios Türkiye 's exports are expected to see strong growth, with real exports in 2035 more than 70 percent higher than in 2020 under every scenario.

The modelling shows a very minor, though negative, macro-economic impact on Türkiye from the CBAM (Figure 10). The model forecasts Real GDP in 2030 marginally lower than under the 'Baseline' if the CBAM is implemented as currently proposed (-0.0017 percent, $24 million). This remains the case even with an expanded CBAM (-0.0100 percent, $142 million), the U.S. adopting a similar mechanism (-0.0136 percent, $194 million), or even an ambitious expansion of the CBAM and U.S. adoption (-0.0203 percent, $290 million).Under this most ambitious scenario the proportional impact continues to worsen over time. The impact on household consumption is more pronounced but still small: up to around 0.1 percent impact under the most ambitious coverage scenario (Figure 11).

Figure 10. Modelled Real GDP, deviation from 'Baseline'

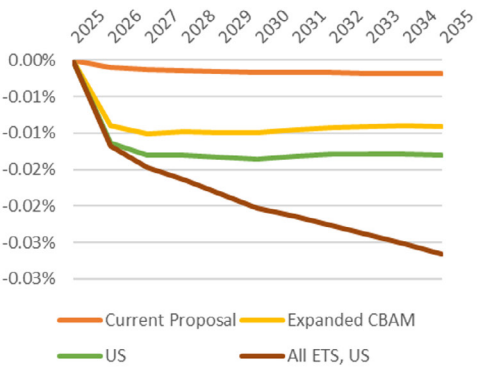
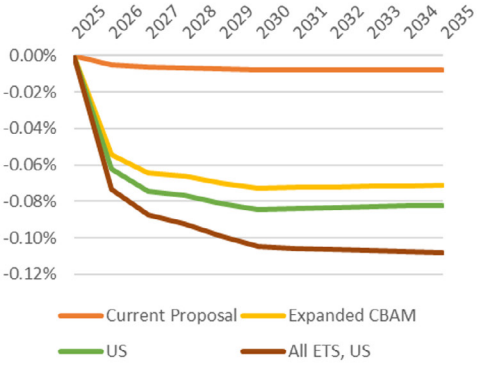


Figure 11. Modelled Real household consumption, deviation from 'Baseline'



If Türkiye Takes Action to Reduce Emissions

As part of this assessment, the impact of Türkiye taking action to reduce emissions was modelled. A carbon price was modelled as a proxy for climate mitigation policy with the benefit that the carbon price would be deducted from the CBAM applied. The scenarios modelled are outlined in Table 4.

Table 4: Scenarios modelled of action to reduce emissions.

Short name	Description
Türkiye acts[1]	Türkiye takes action consistent with forecast EU ETS price. Carbon price revenue is recycled to households
Türkiye acts, high inv[2]	Türkiye takes action consistent with forecast EU ETS price. Carbon price revenue is recycled to investment
Others act, Türkiye doesn't	Other countries in ECA take action to reduce emissions, but Türkiye does not
No action	Türkiye (and other countries) take no action

[1,2] Carbon price starts in 2026 and gradually rises to match EU ETS price in 2030. Follows EU price afterward. Carbon price is applied to power, heat, industry, and transport (i.e. not only CBAM sectors).

Taking action to reduce emissions lowers the impact of CBAM on exports to the EU. By lowering their emissions, some sectors, such as chemicals and aluminum, can actually grow their exports to the EU beyond what they would be without a CBAM. By taking action, Türkiye can become more competitive in EU markets. In all cases, exports to the EU suffer the most if Türkiye takes no action to reduce emissions and other countries in the region do take action, as market share is lost to competitors.

Figure x. Exports to the EU - Chemicals

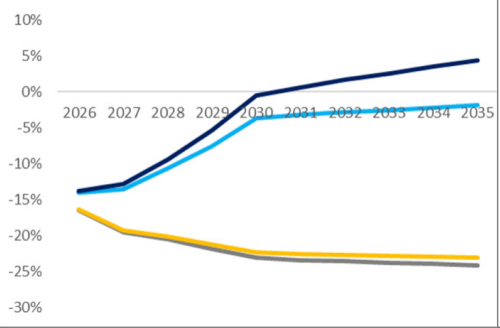


Figure x. Exports to the EU – Ferrous metals

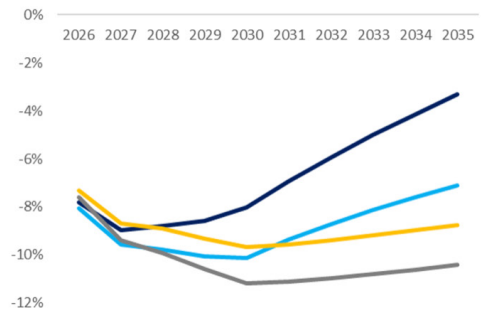
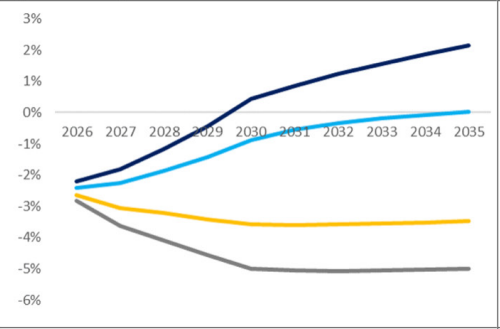
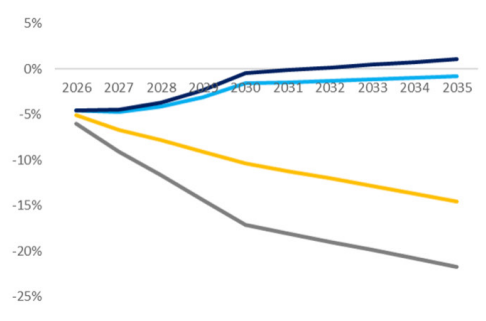


Figure x. Exports to the EU – Metals



Exports to the EU – Petroleum products



Legend:

In many ways, the EU CBAM is an opportunity for Turkish industry. Türkiye is in a good starting position – it has made a good start in decarbonizing its power sector, and it has geographical proximity and strong trade relations with the EU. Türkiye could capitalize on these advantages and, by decarbonizing industry, become more competitive in a low-carbon world.

THE IMPORTANT ROLE OF GREEN FINANCE IN THE TRANSITION

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Transitioning to a low carbon and resilient economy involves large investments across sectors sustained over decades. Access to finance will be a crucial component to facilitate these investments. This article investigates what reforms are needed in Türkiye's financial sector to advance financing of climate-related investments while improving management of climate-risks in finance sector portfolios.

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Keywords: Climate Change, Financial Stability, Green Finance, Investments, Türkiye.

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Türkiye's financial sector plays a crucial role in delivering on the green agenda and mobilizing capital for climate action, and yet climate change poses risks to financial stability and the soundness of institutions. As the COVID-19 crisis has shown, major disaster events have direct impacts on the financial sector. They heighten levels of uncertainty regarding the medium- to long-term macro-economic outlook and growth, increase public and private sector financing needs, cause structural changes to the economy, and influence the distribution of wealth and income. Climate and environmental crises[1] can have a similar impact and threaten the stability of financial institutions and systems. Due to its specific geopolitical position. Türkiye is also exposed to climate and environment migration more than other countries. With increasing knowledge and awareness of these risks, more frequent occurrence of extreme weather events and awareness of transition-related risks, Türkiye's financial sector must be able and ready to respond to a climatic crisis.

Large investments are needed to address climate change. Based on the World Bank's Country Climate and Development Report (CCDR), Türkiye needs to prioritize climate mitigation, adaptation, and resilience to ensure sustainable growth and needs to invest $165 bn over 2022–40 in addition to the $482 bn baseline in the power, residential, and transport sectors.[2] Half of these investments are expected to come from the private sector. Increasing appetite by international investors for green investments[3] are an opportunity for Türkiye to crowd in private capital for achieving climate targets.

While public spending is expected to play a key role in the transition, meeting the investment needs required for resilience and reaching net zero requires more private investments toward resilient and zero-carbon options. The financial sector needs to mobilize capital for the green transition; yet green finance[4] in Türkiye comprises mostly short-dated bank lending for renewable energy while long-term finance is needed to address investment needs. Banks have been the main issuers of green Eurobonds,[5] but Türkiye overall is lagging behind

1) Both physical (sudden, like a cyclone, and slow-onset, like changing weather patterns), and transitional (related to the global transition to low-carbon and sustainable economies that triggers changes in regulations and investor and consumer behavior).

2) Türkiye Country Climate and Development Report (CCDR), 2022, World Bank.

3) In 2020, investors demanding green and sustainable investments represented over a third — more than USD 35 trillion — of total assets under professional management (Global Sustainable Investment Alliance, 2021).

4) Green finance includes all lending and investment contributing to climate mitigation, climate adaptation, resilience, and other environmental objectives. Climate finance refers to local, national, or international financing that is drawn from public, private, and alternative sources to support mitigation and adaptation actions that will address climate change.

5) Green bonds are bond instruments where the proceeds, or an equivalent amount, will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible green projects. In Türkiye, the criteria stipulated in

peer emerging markets in terms of green issuance.[6] Barriers to the growth of green capital market instruments are primarily macro-financial, however challenges also remain regarding knowledge and institutional capability, limited demand for green instruments by domestic institutional investors, and the need to accelerate efforts towards a holistic regulatory and policy framework. Neither the public sector nor banks will be able to meet the investment needs for the green transition alone and private capital will need to be mobilized through a range of instruments.

At the same time, climate change poses risks to financial stability and institutions. Physical and transition risks can affect credit, market, underwriting, operational, and liquidity risks, posing risks to the profitability and solvency of financial institutions. Banks, which hold more than 90 percent of total financial system assets, are exposed to both physical and transition risks. Physical risks—including droughts, forest fires, floods, and landslides—affect economic performance and the value of assets, potentially leading to a rise in nonperforming loans (NPLs). Transition risks need to be monitored, especially if the transition to a low-carbon economy is rapid and banks have large exposure to carbon-intensive and transition-sensitive sectors, potentially leading to NPLs in these sectoral portfolios. Risks can differ significantly across banks, depending on their respective exposures.

A holistic approach is needed for greening Türkiye's financial sector. Considering the nature of investments needs, a range of financing options need to be available, including green loans (especially long-term) and green capital market instruments. Capital market instruments include both equity and debt instruments. While diverse financing instruments are needed, they need to go hand-in-hand with creating an enabling environment for green finance to flourish in Türkiye while preparing for increasing financing needs as the frequency and severity of natural disasters increases. This proposal aims to take a holistic view towards these interrelated development needs, acknowledging that a holistic and long-term approach will be needed.

Domestic financing for green projects in Türkiye relies primarily on the banking sector, and it faces several barriers for green financing. The banking sector in Türkiye, which is a major part of its financial sector that has played a crucial role in the development of renewable energy generation in the country and the issuance of green bonds and mortgages, is well developed, and has taken steps towards embracing sustainable finance. However, it is facing barriers in these efforts, which

the CMB's Guidelines on Green Debt Instruments must be met for the green label to be assigned.

6) In 2021, total green bond issuance amounted to US$ 1.2bn in Türkiye, (US: $90bn; China: $72.2bn; Germany: $67.1bn; India: $8bn; Brazil: $2.4bn; Mexico: $0.5bn; South Africa: $0.1bn) according to the Climate Bonds Initiative. https://www.climatebonds.net/market/data/

include, among others, challenges regarding the policy environment, and limited information and institutional capacity at the sectoral level, as well as a low level of readiness to support strong green growth. Learning from Türkiye's significant success in mobilizing international climate finance in the past, and the well-developed systems for deploying it into mitigation projects, existing barriers can be removed through targeted interventions of the public sector to provide certainty over the course of action, as well as robust and reliable support for managing the risks the private sector is facing when investing in climate action. The improvement of the policy and regulatory framework to address the barriers to financing enhanced climate change and sustainability, supported by institutional capacity to develop and implement them, are fundamental prerequisites for scaling-up green investments in Türkiye. In addition, providing the banking sector with best practice guidance based on international advances in sustainability finance, including risks related to the global and domestic environmental policy, can help drive finance towards greener projects. The authorities, especially financial sector regulators including the Central Bank of The Republic Türkiye (CBRT), the Banking Regulation and Supervision Agency (BRSA), and the Capital Markets Board (CMB) could step up their recent efforts to guide financial sector players on environmental sustainability.[7]

In the aftermath of the COVID-19 and Kahramanmaraş earthquake crises, Türkiye has the potential to grow greener and benefit from embracing green growth. There is rising interest in green growth and climate action in Türkiye. Energy efficiency, nature conservation, clean energy options, and a stronger focus on the improvement of sustainability in the transport sector can be win-win areas for stimulus investments in Türkiye, if designed well. Restoring degraded forestlands and landscapes could create many jobs over the short term, while also generating net benefits from watershed protection, better crop yields, and forest products, especially regarding potential positive impacts on CO2 emissions of using forest products as structural wood compared to cement. Another area in which to create jobs and support economic recovery concerns investment in the large-scale retrofitting of buildings to make them more energy efficient, more sustainable and healthier, as well as better adapted to higher temperatures in the future. Investments in coastal resilience, climate-smart agriculture, and resilience of infrastructure to flood, drought, and precipitation changes, as well as improvements in water treatment and sanitation, waste management, and air quality, are opportunities for building the foundation of green growth, while addressing country-specific priority areas.

7) Türkiye's New Economic Reform Package (2021), the Sustainability Finance Framework of MoTF (2021), the CMB's draft Green Bond and Sukuk Guideline (2021), and the BRSA's Sustainable Banking Strategic Plan (2021). aim to diversify finance for investments that are environmentally sensitive. Especially CMB and BRSA have stepped up efforts to guide financial sector players, build capacity, and develop data and analytics, and innovative products on sustainable and green finance drawing on international best practices. The CMB's guideline is aligned with EU and ICMA standards on green bonds and sukuks.

Projects tackling post-earthquake economic recovery can help strengthen overall system resilience, and it is important that economic stimulus interventions lay the foundation for green and sustainable growth in the medium- to long-term.[8]

As a next step, Türkiye would benefit from putting in place a strategic framework for green finance. The 11th National Development Plan foresees action in several strategic areas, including developments of environmental impact assessment, strategic environmental permit, license, monitoring and audit mechanisms and capacities and strengthening of the legislation on these issues, as well as expansion of the environmental labeling system, and many initiatives to address air quality, biodiversity, and nature conservation areas on land and sea. Importantly, it also recognizes the need for improvements in the harmonization of public institutions and organizations with each other and local administrations in their powers and duties, to eliminate conflicts and to strengthen coordination and cooperation with other stakeholders in implementation. Recent announcements indicate ambitious plans at the regulatory level to boost climate action in mitigation and adaptation and address several environmental priorities. BRSA's Sustainable Banking Strategic Plan[9] was the first step by the regulator towards encouraging green banking, and efforts are underway together with the Banking Association to develop a Green and Sustainable Banking Guideline that will aim to guide banking sector players on green and sustainable finance, aligned with international best practice.[10] Other efforts by BRSA focus on preparing a Green Asset Ratio Communique and Climate Risk Management Guidelines. On the capital markets side, the team supported the Capital Markets Board (CMB) on the "Guidelines on Green Debt Instruments, Sustainable Debt Instruments, Green Lease Certificates and Sustainable Lease Certificates", published in 2022.[11] Through the Green Debt Guidelines, the CMB is encouraging the issuance of green capital market instruments. The CMB has also stepped up its efforts to build internal capacity and develop data and analytics on sustainable and green finance. Türkiye ratified the Paris Agreement in October 2021 and renamed the Ministry of Environment, Urbanization and Climate Change affirming its commitment to climate action and long-term greener growth. This will drive increased demand for green finance and a stronger role for the private sector in the future. To support the achievements of these plans and ensure the removal

8) S.Hammer, S. Hallegate and F. Banaji, World Bank, "How countries' climate ambitions can support a sustainable recovery from COVID-19," Development and a Changing Climate, May 2020.

9) https://www.bddk.org.tr/KurumHakkinda/EkGetir/19?ekId=115

10) BRSA aims to take actions based on the European Green Deal and Network for Greening the Financial System (NGFS). It joined NGFS in 2021.

11) "Green and Sustainable Guidelines" refers to the CMB's Guidelines on Green Debt Instruments, Sustainable Debt Instruments, Green Lease Certificates and Sustainable Lease Certificates" published by the CMB Board decision i-SPK 128.18 dated 24/02/2022 and numbered 10/296. https://cmb.gov.tr/data/628165661b41c617eced0ff4/c271c36f7bbd4a9429b0d503626c43d1.pdf

of persistent barriers to green investments, the key "building blocks" and areas where efforts are required include: i) enabling policies and regulatory framework, ii) institutional support and ownership, iii) data and analytics, iv) capacity building, and v) technical innovation and innovative financing approaches. Progress in these areas would support the development of a coherent strategic framework that brings various ongoing efforts together to provide a roadmap that aligns financial sector policies, regulations and incentives with the vision for pursuing green and resilient growth (See Box-1).

Box-1: Unlocking Green Finance in Türkiye:

There is increasing momentum to build a green finance ecosystem in the financial sector and government but still a holistic approach is needed. Important steps include:

- Creating an overall strategy or roadmap on green, blue, or sustainable finance would align financial sector policies, regulations, and incentives with environmental and climate goals.
- A roadmap covering both the risks and opportunities of climate change can help prioritize actions and coordinate the activities of different stakeholders, including financial and environmental policymakers, regulators, and financial institutions. It would also provide clear signals to potential investors and help create an enabling environment for increased green investment.
- Disclosure requirements and a green, blue, or sustainability-based taxonomy can foster transparency and boost public and private investment to finance the transition.
- National development banks and the Credit Guarantee Fund can be highly effective in mobilizing private finance for the green transition, including through financial innovation and de-risking instruments.
- More generally, de-risking investments by maintaining a stable macro-financial environment, and targeted guarantees and temporary cost-reducing incentives to bond issuances can play a role.
- Insurance/Pension Funds should be encouraged to make green investments.
- Risk solutions can help improve protection: Specific instruments include catastrophe bonds and/or expansion of homeowner, private and municipal asset insurance, catastrophe insurance risk pools, contingent financing, and weather-related parametric insurance.
- If blended climate finance is mobilized, municipalities could play an essential role in low-carbon, climate-resilient urban development.

Source: Türkiye Country Climate and Development Report (World Bank, 2022);
Konya Climate Council (February 2021).

A JUST TRANSITION FOR PEOPLE AND COMMUNITIES

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The transition to a low carbon and resilient economy will create challenges and opportunities for industries and communities. Managing these so that people do not get left behind and opportunities are widely available is important for ensuring a Just Transition for all.

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Keywords: Climate Change, Economic Impact,
Green Transition, Türkiye, Vulnerability.

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With warming temperatures, rising sea levels, and erratic rainfall patterns, being more frequently confronted with extreme climate events is the new, common reality across Türkiye.[1] Heavy flooding, storms, protracted droughts, and intense heatwaves have aggravated food insecurity, water stress and land degradation, and led to unprecedented disaster events. In 2021, the country experienced its worst-ever wildfire season. 139,500 hectares of forest burned across 54 provinces, destroying vital carbon sinks, displacing numerous local communities, and injuring and killing many.[2] The following year, it witnessed a record-breaking 1,030 extreme events, in the form of intense rainstorms and flooding.[3] This rising trend of hazardous events is worsening with continued global average temperature increase. A historically water-rich country, Türkiye is expected to be water-scarce by 2030, due to decreasing precipitation (including snowfall in the mountains), retreating glaciers, and the shrinking or salinization of major lakes and wetlands, posing a serious threat to the country's freshwater supply and agriculture sector.[4] Projected sea level rise furthermore puts at risk coastal cities, including Istanbul, threatening major economic centers, critical infrastructure such as roads, bridges and power lines, as well as densely populated residential areas.

Although Türkiye's greenhouse gas emissions have been rising sharply over the past decade, this increase has been slower than economic growth, and its per capita emissions are lower than for members of the Organization for Economic Co-operation and Development (OECD) and the European Union.[5] Yet compared to these countries, the combination of such physical climatic risks, regional and population exposure and sensitivity to hazards, and socioeconomic factors make Türkiye much more vulnerable to climate change.[6] The recent steps the Government has taken to mitigate and adapt to climate change, such as ratifying the Paris Agreement, committing a net-zero emissions target by 2053, and adopting a Green Deal Action Plan, among others, are promising. But to be successful in implementing adaptation and mitigation policies and actions, people and communities must be at the heart of the country's 'green transition' towards a climate-resilient and low-carbon economy.

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1) World Bank, *Türkiye Adaptation and Resilience Assessment: A Whole of Economy Approach to Climate and Disaster Risks* (Washington, D.C.: World Bank, 2023). https://documents1.worldbank.org/curated/en/099042723135539629/pdf/P174569094145902509 07f0334d02fd1be1.pdf

2) OGM (2021) Forestry Statistics 2021. Ankara. General Directorate of Forestry; https://documents1.worldbank.org/curated/en/099042723135539629/pdf/P174569094145902509 07f0334d02fd1be1.pdf ; World Bank, Türkiye Country Climate and Development Report. CCDR Series (Washington, D.C.: World Bank, 2022). https://openknowledge.worldbank.org/entities/publication/01826a0c-059f-5a0c-91b7-2a6b8ec5de2f

3) Turkish State Meteorological Service, The State of Türkiye's Climate in 2022. Ministry of Environment, Urbanization, and Climate Change (2023). http://www.emcc.mgm.gov.tr/files/State_of_the_Climate_in_Turkey_in_2022.pdf

4) Barak, T., Yanarocak and H. E. C., "Confronting Climate Change, Turkey needs "Green" Leadership now more than ever," Middle East Institute (2022). https://www.mei.edu/publications/confronting-climate-change-turkey-needs-green-leadership-now-more-ever; World Bank (2022).

5) World Bank (2022).

6) World Bank (2022).

Vulnerability to Climate Change is Unevenly Distributed

Annual losses from floods combined with non-climatic events such as earthquakes are already estimated at 1.5 billion dollars.[7] While this figure is stark, it does not reflect how unevenly distributed the impacts of such biophysical hazards are across the country and its population. Indeed, vulnerability to climate risks is a function of how exposed and sensitive regions and people are to hazards, and the resources and capacity they have to cope with and recover from shocks to their livelihoods. As in other countries, it is the poorest areas and communities of Türkiye that will continue to bear the brunt of the adverse effects of climate change. Those most vulnerable include communities in rural parts of the country, primarily located in the eastern and southeastern provinces, which are already falling behind the rest of the country in terms of social welfare and economic prosperity.[8] Their predominantly agricultural livelihoods are highly dependent on natural resources and a healthy ecosystem. Data from the 2019 Survey on Income and Living Conditions show that on average, 10 percent of the income of the country's households below the international poverty line of $5.5 a day is from agriculture, with the rest often coming from precarious, informal or seasonal jobs that lead to long spells of unemployment.[9] Such households consequently have fewer resources to draw on during times of need, as well as fewer options to diversify their sources of income towards sectors that are less sensitive to climate shocks and thus lack requisite resilience.[10] The data also show that over half of poor households live in dwellings with a leaking roof, damp walls, floors or foundations, or rotting window frames or floor.[11] Making matters worse, they tend to live in more marginal and hazardous areas, such as those exposed to high levels of seismic or climatic risks; 13.7 percent of people living in poverty are exposed to flooding, Türkiye's second most frequent cause of disasters, after earthquakes.[12]

Climate change does not only widen regional disparities, but also exacerbates pre-existing and intersecting social inequalities, such as those based on gender and age. Currently, Türkiye ranks 129th out of 146 countries on the World Economic Forum's Global Gender Gap Index (based on measures for economic participation and opportunity, educational attainment, health and survival, and political empowerment).[13] Female workforce participation is only at 33 percent, the lowest in

7) World Bank (2023), Just Transition in Türkiye: Challenges & Opportunities - Country Team Discussion.

8) UNDP, https://www.adaptation-undp.org/explore/europe-and-central-asia/t%C3%BCrkiye

9) World Bank (2023), *Türkiye Adaptation and Resilience Assessment: A Whole of Economy Approach to Climate and Disaster Risks* (Washington, D.C.: World Bank, 2023).

10) World Bank (2023).

11) World Bank (2023).

12 World Bank (2023); Rentschler, J., Salhab, M. and Jafino, B.A, "Flood Exposure and Poverty in 188 Countries," *Nat Commun*, Vol. 13 (2022): 3527. https://doi.org/10.1038/s41467-022-30727-4

13) World Economic Forum, *Global Gender Gap Report 2023: Insight Report* (Geneva: World Economic Forum, 2023). https://www3.weforum.org/docs/WEF_GGGR_2023.pdf

the OECD.[14] Traditional gender roles often mean that women, who are predominantly responsible for sourcing water and ensuring household food security and wellbeing, are experiencing heavier care burdens as a result of immediate and longer-term climatic changes.[15] They are often also disproportionately impacted by shocks due to long standing and unequal gender norms and values dictating ownership or control of resources, access to markets and essential services like education, health and social protection, and engagement in decision-making, among other critical factors that help build adaptive capacity and resilience.[16] This means that when disasters strike, women and girls are less likely to survive and more likely to be injured than their male counterparts.[17] In the aftermath, they are less able to access relief and assistance, further threatening their livelihoods, wellbeing and recovery, and contributing to a vicious cycle of vulnerability to future shocks. Effects of climate change on livelihoods, resource availability and competition, migration patterns, social cohesion, and human security, among others, are also shown to aggravate gender-based violence.[18]

Youth, who in general have fewer resources, coping mechanisms, social networks, and safety nets to draw on, are likewise more vulnerable than other groups to the impacts of climate change. Because the impacts of current high levels of global GHG emissions will be felt by generations to come, they moreover suffer from increasing uncertainty and anxiety regarding future quality of life, wellbeing, health, security, education, and employment prospects. Over half of Türkiye's population is under the age of 32, yet the country has a youth unemployment rate of nearly 26 percent, with approximately 30 percent of young people between 15 and 29 not currently in employment, education, or training.[19]

Türkiye's green transition is thus not only urgent for achieving its net-zero emissions target; it is also essential for ensuring that the country's good progress on poverty

14) World Bank Group, *Country Partnership Framework for the Republic of Turkey for the Period FY18-FY21* (Washington, D.C.: World Bank, 2017). https://documents1.worldbank.org/curated/en/585411504231252220/pdf/Turkey-CPF-08072017.pdf

15) IPCC (2022) *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)] (Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA), doi:10.1017/9781009325844

16) IPCC (2022); Fruttero et al. (2023) *Gendered Impacts of Climate Change: Evidence from Weather Shocks* (Washington, DC: World Bank). http://hdl.handle.net/10986/39813

17) Bradshaw, S. & Fordham, M. (2015) Double Disaster: Disaster through a Gender Lens. In *Hazards, Risks, and Disasters in Society*. https://doi.org/10.1016/B978-0-12-396451-9.00014-7

18) Desai, B. H. & Mandal, M. (2021) "Role of Climate Change in Exacerbating Sexual and Gender-Based Violence against Women: A New Challenge for International Law," *Environmental Policy and Law*, Vol. 51. DOI: 10.3233/EPL-210055; Erman et al. (2021) *Gender Dimensions of Disaster Risk and Resilience*. World Bank, Washington, DC. https://elibrary.worldbank.org/doi/abs/10.1596/35202

19) European Training Foundation (2021) Focus on Turkey. https://www.etf.europa.eu/en/news-and-events/news/focus-turkey#:~:text=Turkey%20has%20a%20relatively%20young,education%20or%20training%20(NEETS)

reduction and socioeconomic development is not reversed because of climate change. The ongoing recovery from the devastating effects of February 2023 earthquakes, the COVID-19 pandemic, and recent climate extremes, presents an opportunity for building a more resilient, prosperous, and fairer future for the Turkish population.

A 'Just' Green Transition

Lowering emissions towards net zero and building resilience to climate change demand transforming key systems in Türkiye's economy, including those relating to energy, industry, transport, urban, agriculture, food, and water. Doing so will create large opportunities and long-lasting benefits for the country. According to the World Bank, such a pathway leads to a net $15 billion gain over 2022-30 and a $146 billion gain over 2022-40.[20] These are largely due to reduced fuel imports (Türkiye currently imports 99 percent of its gas and 93 percent of its oil), increased investment in renewable energy, and health benefits from reduced air pollution. Analysis by the United Nations and International Labour Organization finds that a swift and comprehensive implementation of low-carbon policies in Türkiye will lead to over 300,000 extra jobs by 2030, spread across the economy.[21] Emerging green sectors open opportunities for social entrepreneurship, and the decentralized nature of green infrastructure (e.g. renewable energy) is well-suited for the establishment of cooperatives. Investments in climate adaptation and the rehabilitation of local ecosystems likewise create earning opportunities for households and populations at the frontlines of climate change impacts and environmental degradation.

But like climate change itself, these transformations may cause uneven risks across households, workers, and regions, especially in the short- and medium-terms. Jobs will be created in some economic sectors but lost in others – notably in the traditional (fossil fuel) electricity industry.[22] Some regions and populations may be less able to benefit from the opportunities of the green transition than others. For instance, research from the World Bank finds a high concentration of 'brown' jobs in industries that have elevated rates of GHG emissions, and which tend to be held by prime-aged, male workers, not only in the economically leading, western regions of the country, but also in less prosperous (Hatay, Mardin, Malatya) and transition (Gaziantep, Zonguldak, Manisa, Aydin, Konya, and Kayseri) provinces in the east.[23] Yet, emerging 'green' jobs have so far been concentrated in the western regions only, and are moreover expected to require higher-skilled workers. Given that the

20) World Bank (2022) Türkiye Country Climate and Development Report. CCDR Series. Washington, D.C.: World Bank.

21) International Labour Organization & United Nations Development Programme, "Social and Employment Impacts of Climate Change and Green Economy Policies in Türkiye," (2022). https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms_849761.pdf

22) International Labour Organization & United Nations Development Programme (2022); World Bank (2022).

23) Garrote-Sanchez, D. & Makovec, M. (2022) *Jobs, Skills, and the Green Transition: Challenges and Opportunities for Türkiye*.

largest proportion of unemployed women and youth are in the eastern provinces, these vulnerable groups will require targeted support to overcome the double barrier they face in accessing such new economic opportunities.

It is therefore imperative that Türkiye's green transition is also a 'just' transition. By 'just', we mean that the transition should help build inclusive societies, by expanding access to not only jobs, but also markets, services, and political, social, and cultural spaces for all those affected – especially vulnerable and marginalized groups who are currently excluded from such opportunities. It should strengthen trust, cohesion, and willingness to cooperate within and across communities, and between communities and the government. And it should strengthen the whole population's resilience to external shocks, climate-related and other, ensuring that people are safe, protected and can thrive over time, rather than fall into poverty trying to cope.[24]

The process of preparing for and implementing the transition, and achieving these just outcomes, also needs to be legitimate.[25] The extent to which communities accept who has authority over the green transition, what goals they pursue, and how policies and programs get implemented, depend on a transparent, accountable, and inclusive consultation and decision-making process, which welcomes meaningful participation from and dialogue with allsegments of society. Well-intentioned efforts to embark on low-carbon pathways risk being met with resistance (and even lead to social unrest and violence) if consultation and involvement from the most affected groups and prioritization of their needs are deemed insufficient.

How can Türkiye Ensure a Just Green Transition for People and Communities?

First, the country should expand opportunities for all affected and vulnerable groups, especially already marginalized populations, with economic strategies for target sectors and regions. This includes diversifying local economies and expanding the economic base in carbon-intensive regions (such as in Bursa and Kocaeli, where jobs are concentrated in sectors such as steel, cement, chemicals and automotives that are in positions to gain from decarbonization.)[26] Doing so would create decent and sustainable work for people in the local area. Intervening in the labor market and building human capital is crucial, to ensure that workers have the skills needed to thrive during and after the transition; this means investing in reskilling, upskilling, and longer-term investment in education, particularly to take advantage of the demographic dividend brought about by Türkiye's large youth population.

24) Barron, P., Cord, L., Cuesta, J., Espinoza, S., Larson, G., Woolcock, M., *Social Sustainability in Development: Meeting the Challenges of the 21st Century* (Washington D.C.: World Bank, 2023).

25) Barron, P. et al., (2023).

26) Garrote-Sanchez, D. & Makovec, M. (2022).

Support should also extend far beyond jobs. For example, the State should establish community benefit-sharing measures in areas where green investment is high, such as in the western provinces, and repurpose funding from industry closure to support the just transition. Additional revenues from the removal of fossil fuel subsidies or a carbon tax, moreover, can be used to compensate for or protect low-income regions and households from any adverse transition impacts;[27] adverse impacts might include reduced investment in basic social services (e.g. education and health), community upheaval and increased social tensions, among others.

Second, Türkiye should adopt policies to protect and mitigate the costs of the transition for people and communities. Social protection coverage, including in the forms of social safety nets, unemployment insurance, and health insurance, needs to be expanded so that all those who are adversely affected by the green transition are protected. Social protection measures can also be put in place to compensate for increased costs (e.g. of energy, heating, transport, housing) to consumers or businesses. In addition, care must be taken to ensure basic services and infrastructure are maintained in soon-to-be former, 'brown' mono-industry areas (such as in the coal regions of Zonguldak and Manisa). These communities' access to schools, health services, water, and digital connectivity should not be interrupted, nor should plans for future investments in the region. For those who prefer to seek better opportunities elsewhere, policies to facilitate migration are critical— including to help build the resilience of migrants, host communities, and the communities they leave behind to climate and other shocks. Proactive efforts are also needed to mitigate wider social risks in communities affected by job losses, migration, or other transition impacts, such as gender-based violence, challenges related to mental health, and substance abuse.

Finally, Türkiye should establish the right processes to support change, empower citizens, and build trust in a shared vision for the post-transition future. Indeed, the global vision for a post-transition future is a positive one, with lower air pollution, fewer climate change impacts, higher paying jobs, better urban planning, transport and public infrastructure and services. The success of Türkiye's green transition depends on processes to establish local and national dialogues on climate change and action, as well as social dialogues in target carbon-intensive sectors and regions to ensure that affected workers and communities are informed, have a voice, and play a meaningful role in decision-making. Existing community platforms may be used for mitigation and adaptation planning and supporting locally led climate action. Online platforms can further ensure widespread civic engagement and stakeholder consultation and input into green transition policies and programs.

27) World Bank (2022).

It is crucial that these efforts are led by Government, with the support of other key actors, including the regional and local stakeholders, private sector, civil society, and community leaders. Türkiye's transition will have uneven impacts on people and places and may aggravate challenges in accessing economic opportunities, particularly for the most vulnerable. Transitioning towards a greener and more inclusive future is therefore challenging, but there is no doubt that Türkiye has much to benefit from its ambitious climate agenda.

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NOTES

This joint issue is a collaboration between TPQ and the World Bank. The World Bank released the Türkiye Country Climate and Development Report in 2022, which examines how Türkiye's development goals can be achieved in the context of adapting to and mitigating against climate change.

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