OVERVIEW – A RESILIENT ZERO PATHWAY FOR TÜRKIYE

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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*

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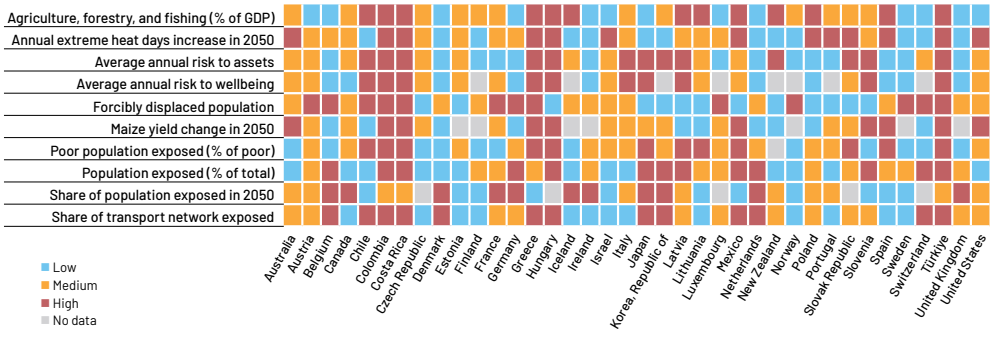
Although the increase in Türkiye's greenhouse gas (GHG) emissions has been slower than economic growth and its per capita emissions are lower than in the Organisation for Economic Co-operation (OECD) or EU countries, there is a strong case for a forceful mitigation agenda in Türkiye. The energy sector—which 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.

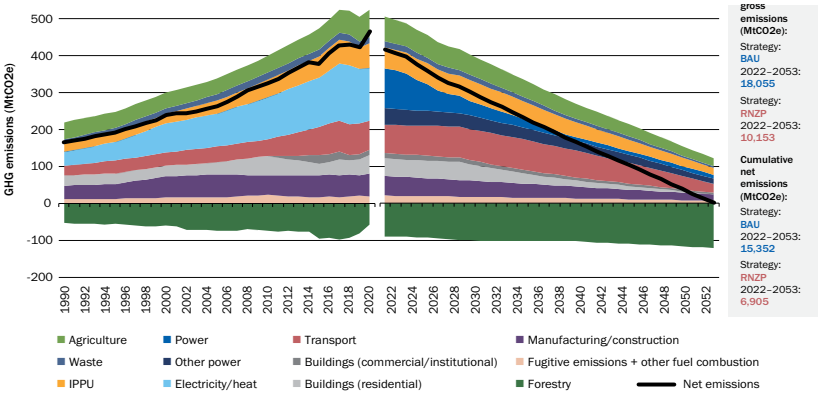
A resilient and net zero pathway can help Türkiye achieve its development and climate objectives but implies a significant departure from current trends and important policy changes.

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)

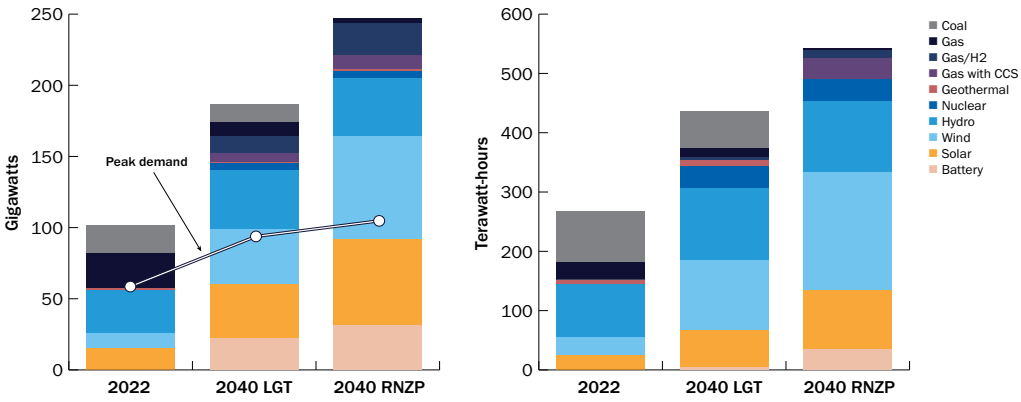


Notes: BAU = business as usual;
RNZP = resilient and net zero pathway.

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.

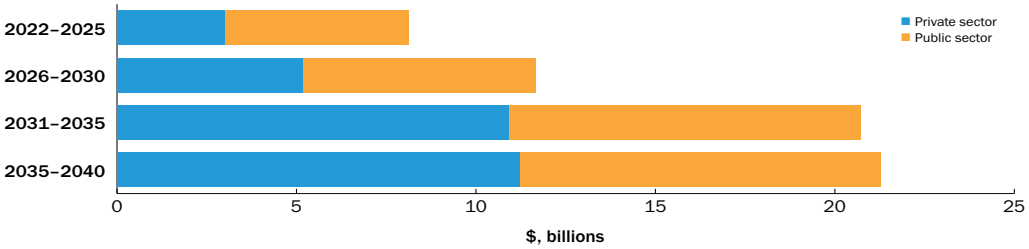
We can expect about half of these investments to come from the private sector. The ability to mobilize private capital depends on the macroeconomic context, sectoral regulations, financial sector deepening, and access to long-term capital. With these assumptions—equivalent to a broadly 50-50 public-private 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.

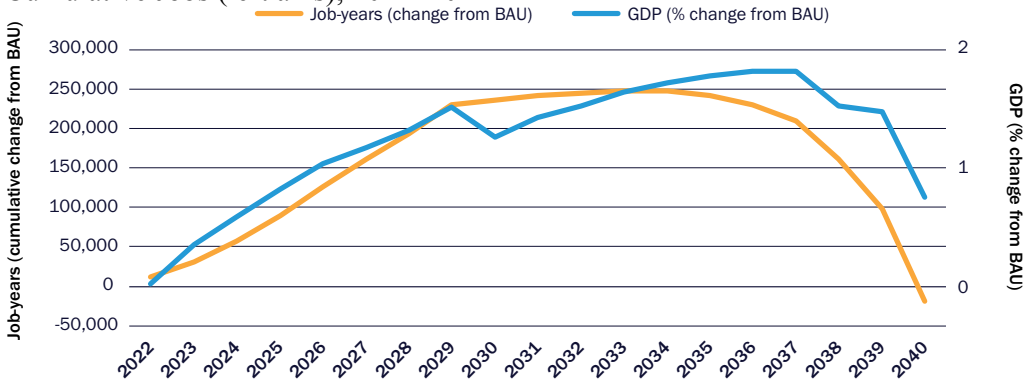
Figure S.5: Additional Annual Investment Needs for the RNZP



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.