EUROPE AND CENTRAL ASIA

KAZAKHSTAN

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

November 2022

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Acknowledgements

The report was written by a core team comprising Daniel Besley (TTL), Sandeep Kohli (co-TTL), Sjamsu Rahardja, David Knight, Thomas Farole, and John Bryant Collier, with inputs from Abdulhamid Azad, Aimilios Chatzinikolaou, Alex Huurdeman, Andrea Liverani, Azamat Agaidarov, Cassandra Colbert, Christian Schoder, Chyi-Yun Huang, Daniyar Tanatarov, Ekaterina Benjamin, Elin Hallgrimsdottir, Fiona Collin, Fiona Gilbert, Gianfilippo Carboni, Harshit Agrawal, Heather Jane Ruberl, Henry Eshemokhai Aviomoh, Javier Aguilar, Kathleen Patroni, Kathrin A. Plangemann, Kazumasa Oba, Leela Raina, Maksudjon Safarov, Manuel Berlengiero, Mariana Iootty De Paiva Dias, Martin Melecky, Metin Nebiler, Mikhail Bunchuk, Noe Nicolas Reidt, Paola Agostini, Sakshi Varma, Salamat Kussainova, Samuel John Fargher, Szilvia Doczi, Suneira Rana, Talimjan Urazov, Tatiana Nenova, William Young, Yelena Yakovleva, and Zhimin Mao.

The team benefitted greatly from comments and suggestions from the peer reviewers Alex Huurdeman, Christophe de Gouvello, Claire Hollweg, Debabrata Chattopadhyay, Fernando Blanco, Irina Klytchnikova, Nancy Gracia, Stephane Hallegatte and the CCDR core team, Vivek Pathak, and Xiaodong Wang.

Support with administration and communications was provided by Grace O. Aguilar, Indira Chand, Linh Van Nguyen, Nadezhda Pronskaya, Olga Besedina, and Shynar Jetpissova.

Anne Himmelfarb provided editing support. IE Kabdulova supported the graphic design and layout.

The report was prepared under the guidance of Anna Bjerde, Steven Schonberger, Charles Cormier, Sameh Wahba, Tatiana Proskuryakova, Kseniya Lvovsky, Sudeshna Ghosh Banerjee, and Jean-Francois Marteau as well as Jane Ebinger and Antonio Nunez.

Abbreviations

AFR	Agency for Regulation and Development of the Financial Market
bbl	barrel
capex	capital expenditure
CBAM	Carbon Border Adjustment Mechanism
CCDR	Country Climate and Development Report
CCS	carbon capture and storage
CHP	combined heat and power
CO_2-e	carbon dioxide equivalent
CRER	climate-related and environmental risks
CSA	climate-smart agriculture
ECA	Europe and Central Asia
EJ	exajoule
ETS	emissions trading system
EU	European Union
EV	electric vehicle
GHG	greenhouse gas
GIS	geographic information system
GJ	gigajoule
GW	gigawatt
ha	hectare
HCI	human capital index
IEA	International Energy Association
KEGOC	Kazakhstan Electricity Grid Operating Company
KWh	kilowatt-hour
LCH	low-carbon hydrogen
LCOE	levelized cost of electricity
LPG	liquified petroleum gas
LULUCF	land use, land use change, and forestry
MDAs	ministries, departments, and agencies
MEGNR	Ministry of Ecology, Geology and Natural Resources
Mt	metric ton
NAP	National Allocation Plan
NDC	Nationally Determined Contribution
NFRK	National Fund of Republic of Kazakhstan
NZE	net-zero scenario
OECD	Organisation for Economic Co-operation and Development
opex	operating expenses
PJ	petajoule
RCP	Representative Concentration Pathway
R&D	research and development
RFS	reference scenario
SMEs	small and medium enterprises
SOEs	state-owned enterprises
STI	science, technology, and innovation
TWh	terawatt-hour
VAT	value added tax

Objectives and scope

This Country Climate and Development Report (CCDR) identifies ways that Kazakhstan can achieve its development objectives while fostering the transition to a more green, resilient, and inclusive development pathway. It sets out policy reforms and investments needed to build resilience to climate change impacts and reduce greenhouse gas (GHG) emissions in line with the country's ambitious climate change objectives. It is based on review of existing literature as well as a range of new analysis (box 1).

The CCDR is organized in five chapters:

- **Chapter 1: Climate change and development.** This chapter summarizes the overall development landscape and its interplay with climate, emissions, and vulnerabilities. It also identifies risks and opportunities for climate action in support of development priorities.
- **Chapter 2: Kazakhstan's climate commitments, policies, and capacities.** This chapter provides an analysis of Kazakhstan's climate-related commitments, plans, policies, and laws. It also assesses possible institutional reforms to support climate action, as well as the readiness of the private sector to invest in green technologies.
- **Chapter 3: Strategies for resilience and decarbonization.** This chapter identifies priority policy reforms and measures in key sectors needed to improve resilience to climate impacts and achieve the 2030 Nationally Determined Contribution (NDC) targets (under the Paris Agreement) and the 2060 net-zero targets.
- **Chapter 4: Macroeconomics, finance, and just transition.** This chapter analyzes the macroeconomic implications of potential climate impacts and of domestic decarbonization pathways. It also assesses their impact on public finances and their distributional effects on poverty and inclusion. It investigates approaches to addressing any adverse impacts on communities, with a focus on energy prices and the needed transition away from coal. Strategies for enhancing the finance sector's role in supporting climate goals are identified.
- **Chapter 5: Summary of recommendations.** This chapter recommends short- and long-term climate actions that create synergies with Kazakhstan's development objectives.

Box 1. New analysis undertaken for this CCDR

- Energy sector (power, buildings, industry, transport) least-cost optimization modeling on decarbonization pathways (section 3.1)
- Macroeconomic modeling of the energy transition to understand the impact on macroeconomic variables, poverty, and air pollution (section 4.1.2)
- Modeling of the economic damages from key climate impacts (section 4.1.1)
- Distributional impact analysis of the energy transition (section 4.2.3)
- Assessment of climate-smart development in agriculture, water, and rangelands, including carbon sequestration potential (section 3.2)
- Assessment of opportunities for Kazakhstan from mining minerals needed for a low-carbon future and exporting hydrogen (section 1.3)
- Modeling of the impact of the European Union (EU) Carbon Border Adjustment Mechanism (section 1.2)
- Assessment of the readiness of Kazakhstan's private sector for the green transition (section 2.5)
- Analysis of the institutional reforms needed for climate action (section 2.4)
- Role of the finance sector in supporting the climate transition, including needed reforms (section 4.2.4)
- Approaches to the just transition of the coal sector in Kazakhstan (section 4.2.3)

Chapter 1

Climate change and development

KEY POINTS:

- ***Kazakhstan could benefit from transitioning its economy and energy supply away from fossil fuels to reinvigorate economic growth and productivity, improve economic resilience, and shield against risks arising from the global low-carbon shift. In doing so, Kazakhstan will need to address the historic underinvestment in infrastructure, particularly in the power sector.***
- ***Kazakhstan's people and economy are vulnerable to physical climate changes—rainfall changes, droughts, and flooding in particular. Their impact will be spread unevenly across regions and have major consequences for Kazakhstan's agricultural and water sectors. Disruptions to transport or energy infrastructure—particularly from flooding—can disrupt international trade routes and global value chains and thus have widespread adverse economic impacts. Flooding alone is expected to reduce gross domestic product (GDP) by 1.3 percent by 2060 in the absence of adaptation.***
- ***There are growth opportunities, particularly if Kazakhstan acts to achieve climate goals, in clean energy, critical minerals, the agriculture sector, and other green growth sectors. Accelerating progress of economy-wide structural reforms will help to create an environment conducive to the emergence of new sectors.***
- ***Kazakhstan's response to climate change can also be a driver for much-needed reforms; development goals for economic growth, public sector reform, diversification, and improved health are strongly aligned with action needed to address climate risks and seize opportunities.***

1.1 Kazakhstan's economy is at the limits of a fossil fuel-dependent growth model

Kazakhstan achieved rapid economic development in recent decades, lifting the country to the threshold of high income. Kazakhstan's economy grew on average by 10 percent per year during 2000–2007 and by nearly 6 percent during 2010–14.[1] This growth helped to achieve a drastic reduction in poverty rates, from nearly 60 percent in 2002 to 4 percent by 2019 (figure 1), and fueled a large expansion of the middle class. Strong growth was underpinned by development of the country's massive hydrocarbon resources and a boom in oil prices, supported by initial economic reforms, foreign investment, and good agricultural harvests.

However, stagnant productivity and falling growth have revealed the limits of the fossil fuel–dependent model. Despite rapid expansion of the economy, diversification remains limited, with growth fueled by natural resource rents and domestic consumption. Private investment continues to be stifled, while state-owned and state-influenced enterprises dominate. Productivity growth collapsed following the global financial crisis in 2008–09 and has failed to recover since (figure 2). This situation has contributed to steadily declining GDP growth; the growth rate has fallen after each successive downturn, and even before the COVID-19 pandemic GDP growth was down to 3 percent per year. The pandemic led to a fall in economic output in 2020 and a sharp rise in poverty, while the major disruptions caused by the war in Ukraine and sanctions on the Russian Federation leave the outlook clouded in uncertainty.

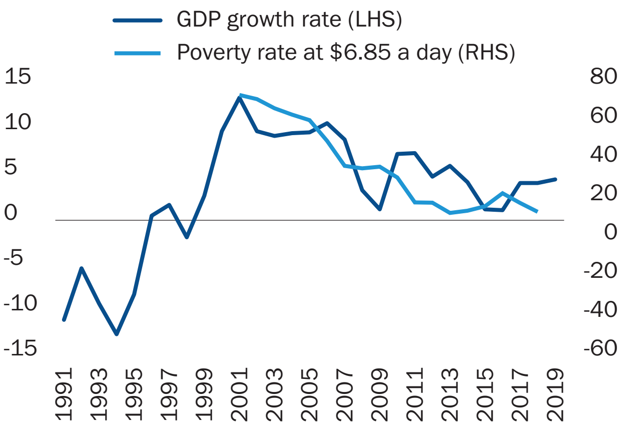
Moreover, the existing model has contributed to large interregional and urban-rural disparities. Stark differences in living standards remain across regions, and per capita consumption rates in parts of the southeast and north are substantially higher than in parts of the west (figure 3). Poverty rates in rural areas are, on average, twice as high as in urban areas. While large spatial disparities are not unexpected in a country as large and as sparsely populated as Kazakhstan, the heavy concentration of resource rents and limited development of diversified economic activities have contributed to entrenchment of regional inequalities.

Historical underinvestment eroded the security of power supply and the competitiveness of industry. As a result, large infrastructure investments are needed irrespective of climate action. Coal production is built on the

1 World Bank, World Development Indicators Database (GDP growth in constant prices, annual percentage).

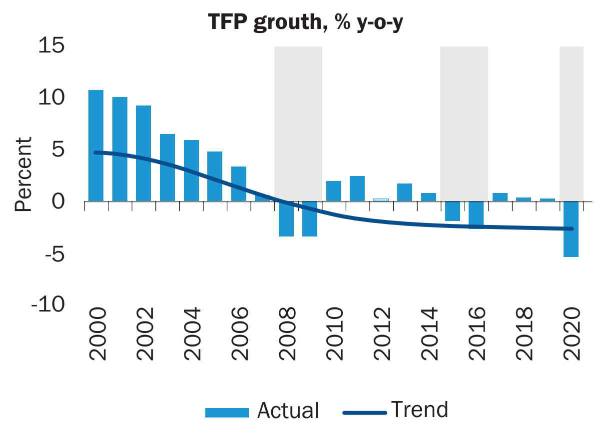
world's 10th-largest coal reserves, equivalent to 230 years of production at the current production rate, and coal currently supplies 50 percent of domestic energy (IEA 2022). Kazakhstan's coal is relatively easy to mine and cheap, but results in high levels of largely unregulated particulate matter and sulfur dioxide emissions. The domestic dependence on subsidized coal and gas has impeded investments in new generation technologies and allowed for inefficient allocation of gas and coal in power generation and industrial processes, in turn eroding the quality of service in the power sector and the competitiveness of industry over the past decade. Cross-subsidizing households through higher tariffs for industrial and municipal customers has led larger industrial customers to exit the system through self-generation. This makes it difficult for the shrunk customer base to sustain new investments in power generation that are needed as demand grows. It also strains municipal budgets and creditworthiness, affecting new investments not just in power, but also in the heating sector.

Figure 1. GDP growth and poverty rate, 1991–2018



Source: World Bank, World Development Indicators Database.

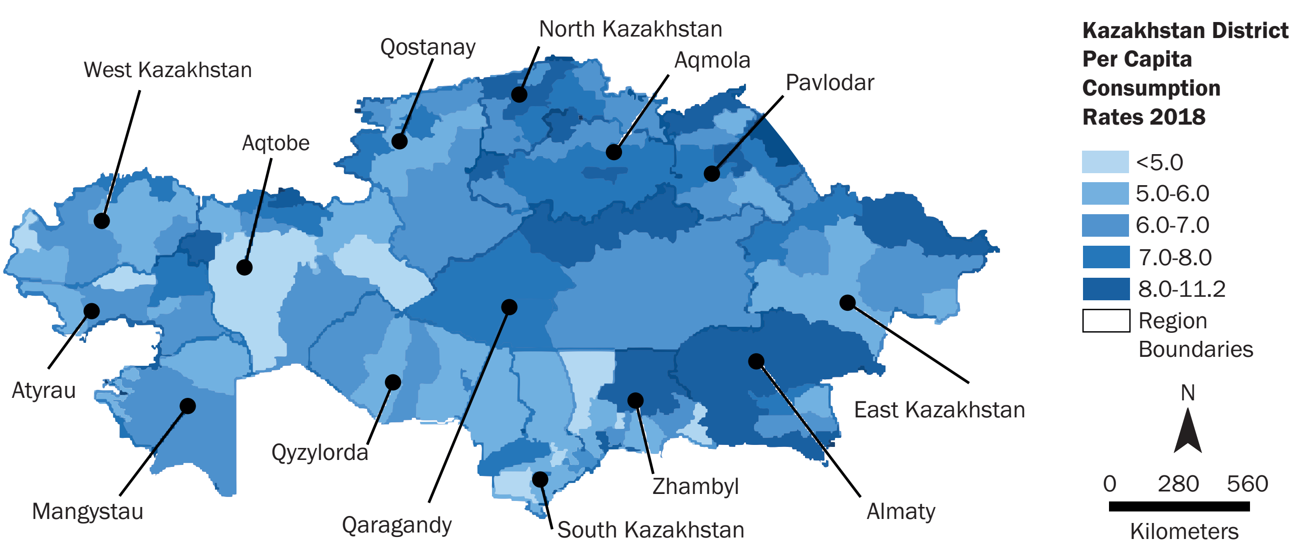
Figure 2. Trends in productivity growth, 2000–2020



Source: World Bank staff calculation based on data from National Bureau of Statistics.

Note: TFP = total factor productivity; y-o-y = year-on-year.

Figure 3. District-level per capita consumption rates for Kazakhstan, 2018



Source: World Bank modeling.

The Government of Kazakhstan has set ambitious goals that recognize the need to move beyond fossil fuels to a new growth model. Kazakhstan aspires to be one of the top-30 global economies by 2050, an ambition

that would require sustained growth at nearly 6 percent per year.[2] The government's National Development Plan 2025 sets out a medium-term plan for achieving these targets, with a focus on boosting private sector growth, increasing competition, improving productivity, developing human capital, promoting shared prosperity, and facilitating a green economic transition. The plan foresees technology- and knowledge-intensive sectors, including advanced manufacturing and services, will act as new growth engines driving diversification from natural resource reliance. In an economic and policy environment that has been shaped by the dominant rent-based economic model, achieving these aims will require a profound shift in institutional and policy frameworks to support balanced development of the nation's institutional, human, and non-resource physical capital.

1.2 Global climate action heightens the urgency for transformation

Changing consumer preferences and global climate actions will, over time, erode Kazakhstan's hydrocarbon exports, resulting in lower economic growth and competitiveness. While Kazakhstan currently is a competitive oil and gas producer, over the longer term, it faces more fundamental market shifts, as the continuing Russian invasion of Ukraine and changing consumer behavior increase uncertainty and the risk of price volatility in oil and gas markets. Global climate action is also likely to erode Kazakhstan's position. The International Energy Agency (IEA) anticipates that if countries act to meet announced targets and net-zero goals, global oil and gas demand will be reduced by half by 2050. Nonetheless, natural gas demand will increase in all IEA scenarios until 2025, followed by a gradual decline, which will be offset by an increase in low-carbon fuels such as hydrogen. Around 80 percent of Kazakhstan's oil production is exported, mainly to Europe and the US, so the country will benefit from the increased European demand for non-Russian- sourced gas arising from the Russian invasion of Ukraine. Kazakhstan's relatively low marginal production costs[3] will also help sustain competitiveness in the short to medium term, but it will need to improve its product offering (for example, offering low-carbon hydrogen). Its oil and gas sector also faces export risk due to its high reliance on pipelines that transit Russia, and addressing this issue will require exploring alternate routes and investing in pipeline infrastructure. For the country to sustain and enhance gas exports to Europe, it may need to revisit investments in new exploration and production for gas. Once the country develops its large renewables potential, new gas pipelines could be designed to allow for repurposing for hydrogen transport in the future. Importantly, Kazakhstan is more dependent on oil and gas revenues than many other producers: its fiscal breakeven oil price over the period 2018–20 was over US$70/bbl,[4] which is at the margin of global crude prices over the last five years. While prices now are elevated due to the Russian invasion of Ukraine, the trajectory is likely to be volatile, and long-term sustainability will depend on fiscal reforms. In terms of carbon intensity of the oil and gas value chain, Kazakhstan is in the middle league of major oil producers (in line with Russia but significantly more carbon intensive than Saudi Arabia), and it would face an eroding competitive position in the absence of decarbonization.

The emissions intensity of Kazakhstan's economy could erode the competitiveness of industries beyond oil and gas. Kazakhstan has an outsized GHG emissions footprint for a country of its economic size; it is the 20th-largest emitter worldwide in terms of emissions per capita.[5] Emissions rose sharply as the economy expanded, roughly doubling between 2001 and 2018, with electricity and heating accounting for the lion's share of emissions and renewables penetration still insignificant (figure 4 and figure 5). As a result, demand not only for oil and gas but also for other goods produced using Kazakhstan's fossil fuel–intensive energy are likely to face increasing barriers as global climate policies, such as the EU's Carbon Border Adjustment Mechanism (CBAM), are implemented. The CBAM, intended to limit carbon leakage and support the EU's GHG mitigation efforts, is set to level import duties based on the emissions intensity of iron and steel, cement, fertilizers, aluminum, and electricity starting in 2026, potentially expanding to products such as glass, chemicals, other metals, and petroleum products and to "embedded" electricity use emissions (i.e., emissions that stem from the production of goods). Modeling suggests that Kazakhstan could lose over US$250

2 To achieve this target, Kazakhstan would need to grow 2.3 percent faster per year than its peers. Assuming the average growth of peers over the last 10 years—3.6 percent a year—continues, this would mean sustaining growth of almost nearly 6 percent per year up to 2050. (Average growth of peers over the last 10 years is calculated using countries presently ranked 45th to 30th in the world in terms of gross national income in constant US dollar prices.)

3 While marginal production cost estimates vary across sources, Kazakhstan is generally assessed to be a lower-cost producer than the US, Russia, other European producers, and Latin American producers, but a significantly higher-cost producer than the lowest-cost producers in the Middle East (like Saudi Arabia and Iraq).

4 International Monetary Fund data.

5 Ranking is of greenhouse gas emissions, including land use, land use change, and forestry (LULUCF) in CO_2 equivalent terms per capita in 2018; data from World Bank, World Development Indicators Database.

million in export receipts to the EU per year due to the CBAM, with the iron and steel sector at most risk; the possible losses rise to US$1.5 billion if CBAM is expanded in the future. These losses could be mitigated if Kazakhstan acts to reduce the emissions intensity of its exports, particularly if it uses carbon pricing to do so, since carbon pricing could be recognized by the EU and deducted from the CBAM applied. See Background Note 1 on the impact of the EU CBAM for further details.

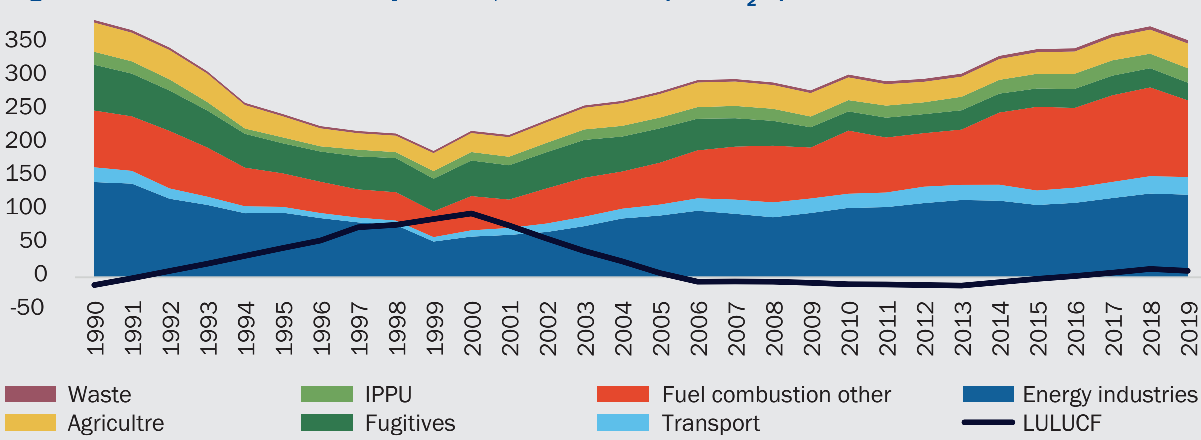
Box 2. A profile of Kazakhstan's emissions

Burning of fossil fuels, particularly for electricity and heating, is responsible for most of Kazakhstan's emissions. Electricity and heating account for 84 percent of overall emissions. Most of the 60 percent increase in emissions since 2001 has arisen from fuel combustion in energy industries, transport, and residential energy use. Emissions from energy industries more than doubled between 2000 and 2019, while emissions from the transport sector nearly tripled over the same period. Within the transport sector, road transport comprises by far the biggest portion of emissions (84 percent of transport sector CO_2 emissions in 2019), which are predominantly from cars (UNFCCC 2021). Residential energy use has grown by more than a factor of five since 2000 and now represents 27 percent of energy consumption and 12 percent of Kazakhstan's energy emissions.a

Kazakhstan's energy supply is highly carbon intensive, even relative to other countries in Europe and Central Asia (ECA). Kazakhstan has a relatively high reliance on coal and oil for domestic energy needs (figure 5). The role of natural gas has been growing, especially for electricity generation, and the share of low-emission sources in energy supply is extremely low. Kazakhstan performs somewhat better on energy intensity metrics: residential energy use per capita and energy intensity of GDP are both lower than the average for the region, but still higher than Organisation for Economic Co-operation and Development (OECD) European member countries and the world average.

Land sector emissions fluctuate and, in some years, serve as carbon sinks, demonstrating potential offsetting opportunities. Net land use, land use change, and forestry (LULUCF) emissions went from a high of 95 Mt CO_2-e (carbon dioxide equivalent) in 2000 to a low of -12 Mt CO_2-e in 2013 (figure 6). That change of 109 Mt CO_2-e over nine years—equivalent to nearly a third of 2019 emissions excluding LULUCF—makes the land sector the most volatile component of Kazakhstan's emissions. Emissions from croplands, at 125 Mt CO_2-e, were equivalent to more than half of nonland sector emissions in 2000. Between 2001 and 2014, forest and grassland sinks offset over 30 Mt CO_2-e per year. Since 2013, net LULUCF emissions have been increasing again, and the effects of climate change are putting potential future land sector emission offsets at risk.

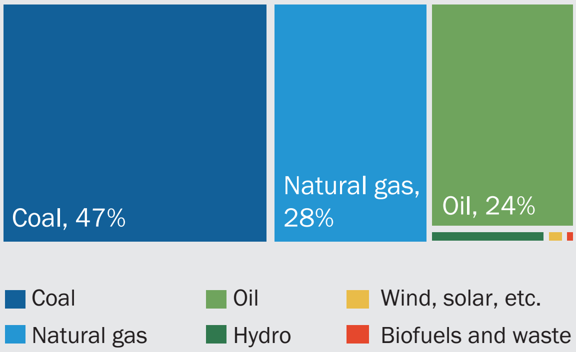
Figure 4. Historical emissions by source, 1990–2018 (Mt CO_2-e)



Source: UNFCCC 2021.

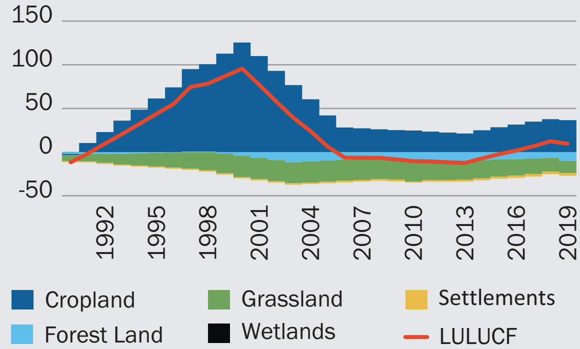
Note: LULUCF = land use, land use change, and forestry.

Figure 5. Total energy supply by source, 2019



Source: International Energy Agency, "Data and Statistics," https://www.iea.org/data-and-statistics.

Figure 6. LULUCF emissions, 1992–2018



Source: UNFCCC 2021.
Note: LULUCF = land use, land use change, and forestry.

The climate transition may exacerbate existing spatial and distributional divides. Already 15 percent of the population is energy poor,[6] and two-thirds of rural households use coal as their primary heating source; thus much of the population is highly vulnerable to price increases of energy and fossil fuels. Coal regions, such as Pavlodar and Karaganda, will face profound challenges in transforming to a very different socioeconomic future. The climate transition may also exacerbate labor market disparities. Evidence suggests that the green transition may be biased toward higher-skilled jobs,[7] and that lower-skilled workers and lower-income households may be more vulnerable to labor market impacts of the transition.

1.3 The climate transition opens opportunities for diversified development

With the right policy environment, reducing emissions can support improved economic resilience and sustainable growth. Decarbonization in Kazakhstan will not only support global climate change action but will increase Kazakhstan's resilience to energy price volatility and may help to spur a transition to new drivers of growth. While falling demand for fossil fuels and goods with high embedded carbon will weaken Kazakhstan's existing competitive position, domestic decarbonization can spur a modernization of industry and infrastructure and promote growth of sectors that experience rising global demand, resulting in a climate transition. To take advantage of these opportunities, however, the prerequisites for developing dynamic and competitive new markets would need to be strengthened, in particular competition and innovation policy, state-owned enterprise (SOE) reform, and improved finance and investment frameworks. While the emergence of successful new industries is difficult to predict and would be driven by the private sector, this CCDR presents three potentially important areas of opportunity for Kazakhstan: (i) clean energy, including green hydrogen, (ii) minerals critical for the low-carbon transition, and (iii) potential to enrich participation in green value chains based on existing production capabilities.

1.3.1 Clean energy opportunities

Kazakhstan has large renewable energy resources. The country's vast steppes have globally competitive wind resources, and though its solar potential is smaller, it is not land constrained (figure 7). Recent evidence suggests that renewables, appropriately developed through well-structured auctions, are already less expensive than a new coal plant. Auction prices for solar and wind plants indicate that these resources can be delivered at costs around 12

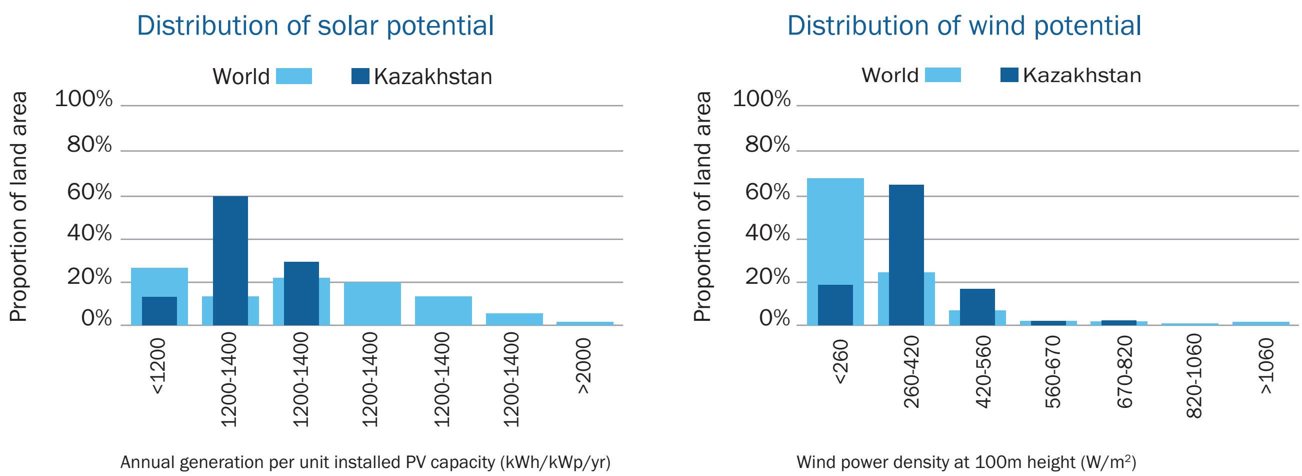
6 Energy-poor households are those that spend over 10 percent of their income on energy.

7 That is, there may greater demand for nonroutine cognitive skills, formal education, work experience, and on-the-job training. On higher-skilled jobs see Makovec and Garrote-Sanchez (2021); Consoli et al. (2016).

tenge/kWh (~2.9 cents/kWh) (USAID 2021). In the right enabling environment, clean renewable power could become Kazakhstan's dominant domestic energy source and a significant driver of exports. Decarbonizing the power supply would not only reduce the emissions intensity of Kazakhstan's large manufacturing exports (such as iron and steel) but also provide an opportunity to export clean energy directly—either through electricity or green hydrogen.

The significant energy efficiency programs involved in decarbonization will drive jobs in the sector. These include high-tech jobs in energy data gathering and digitization, as well energy audits and benchmarking analysis. For example, new regulations being considered by Parliament require large enterprises to have energy management professionals on staff for preparing and implementing energy conservation and decarbonization plans. Energy efficiency improvements in the existing building stock, as well as use of more advanced technologies such as heat pumps, geothermal heating where available, and distributed rooftop solar in future buildings, will produce both skilled and semiskilled construction jobs and will foster small and medium enterprises (SMEs) in energy audits and contracting. They will also create a whole new line of green lending and associated due diligence in the domestic banking sector.

Figure 7. Renewable energy potential in Kazakhstan



Source: IRENA, n.d. © IRENA.
Note: PV = photovoltaic.

Kazakhstan's industrial base presents opportunities for future green hydrogen production and export. The country has significant hydrogen production experience, producing 12 PJ of gray hydrogen per year (in 2020) for domestic industrial use. Global climate action would also help shift production to high-value, low-carbon intermediate products such as methanol and ammonia. KazMunaiGaz and other firms are also piloting carbon capture and storage (CCS) technologies, which will be used to produce blue hydrogen (hydrogen produced from natural gas using CCS). In later years, with the development of the country's vast wind potential,[8] green hydrogen can be produced, both for export and for domestic industrial use, replacing coal in industrial processes. Green hydrogen is also a potential source for energy storage; as technology cost curves improve, it could be used in advanced gas turbines and fuel cells to produce clean, load-following power. The economic opportunity from hydrogen production, including for export, is discussed in section 3.1.1.

1.3.2 Minerals for the low-carbon transition

Kazakhstan is also well placed to take advantage of the growing demand for critical minerals. The clean energy transition will require massive increase in the use of minerals and metals—for example, demand for minerals used in batteries (graphite, lithium, cobalt) is expected to grow fivefold compared to current production levels (IEA 2017; World Bank 2020). A large share of this demand will need to be supplied through new mining. Kazakhstan's mineral resource base is rich in both scale[9] and variety: it has the world's largest developed reserves of zinc,

8 Svevind is already working in Kazakhstan to develop the value chain of wind power–based green hydrogen.

9 Solid minerals and metals accounted for roughly 22 percent of export earnings in 2018 (OECD 2018).

tungsten, and baryte; is second globally for copper and fluorite; and has 10 percent of the world reserves of iron ore. Kazakhstan is also by far the largest uranium producer and exporter in the world, with 25 percent of the world's uranium reserves, making it one of the most likely areas outside of China to be able to supply highly valued rare earth elements.[10]

Table 1. Reserves and production of critical minerals and materials for low-carbon transition

Mineral (thousand Mt)	Kazakhstan reserves	World reserves	Kazakhstan 2021 production	World 2021 production
Chromium	220,000	570,000	7,000	41,000
Bauxite	160,000	32,000,000	5,200	390,000
Cadmium			1,500	24,000
Iron ore	900,000	85,000,000	64,000	2,600,000
Iron content			12,700	1,600,000
Manganese	5,000	1,500,000	160	20,000
Zinc	12,000	250,000	220	13,000
Aluminium refining	n/a	n/a	1,500	140,000

Source: USGS 2022.

Development of critical mineral value chains can catalyze broader knowledge-based opportunities for Kazakhstan's private sector. As global research on minerals proceeds, Kazakhstan's mineral resources could position it favorably for low-carbon technologies and for technology-transfer partnerships. These would support the development of human capital for SMEs providing goods and services to the mine developers and for potential start-ups that might focus on innovation and development of downstream applications. Development across integrated value chains—for example, in battery/storage—could open opportunities for diversified manufacturing and services activities. The country's success with monetization of domestic critical smart mineral resources will largely depend on early action and large private sector investments to adapt its currently underinvested mining industry to low-carbon requirements.

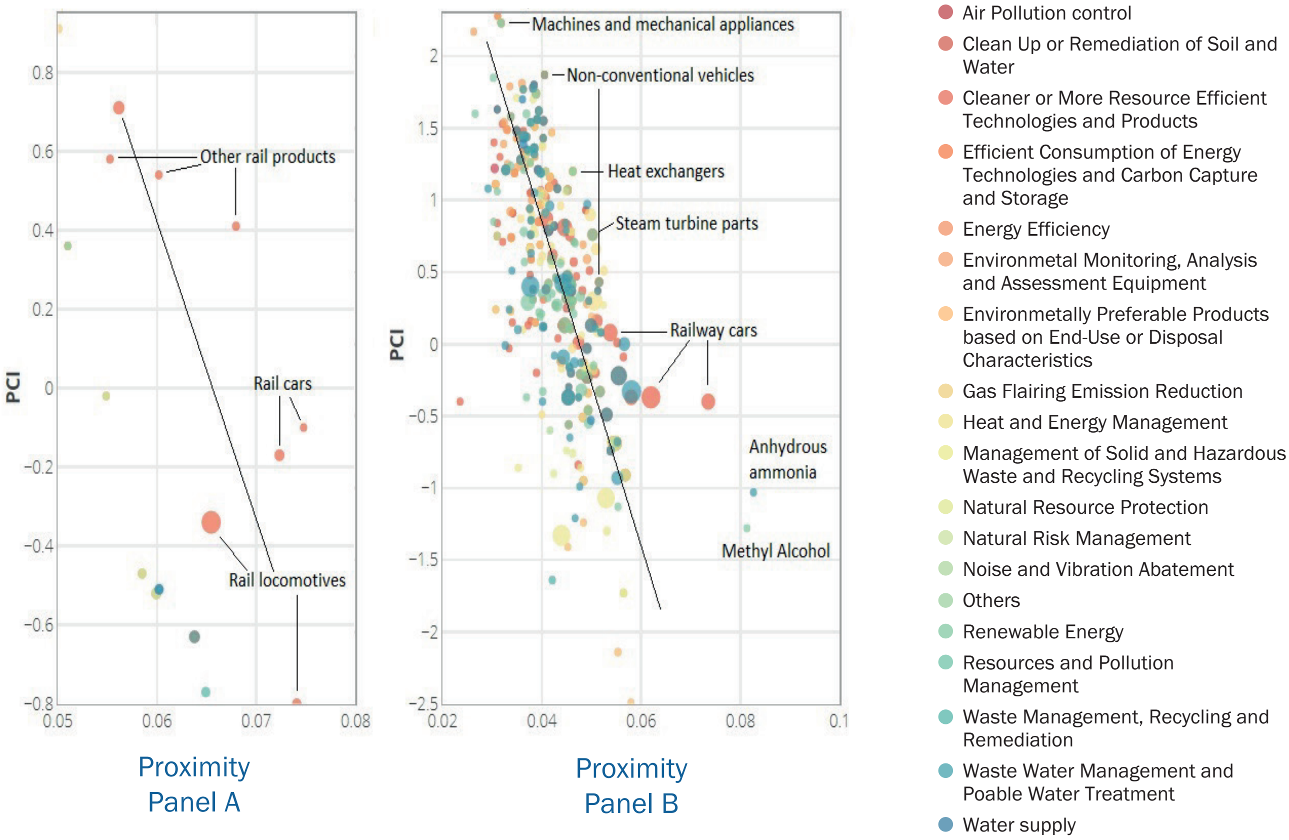
1.3.3 Green products and value chains

The climate transition offers opportunities to accelerate development of higher-value-added sectors and tap into emerging green global value chains. Many products and technologies necessary for the green transition are also technologically sophisticated and associated with greater knowledge spillovers; thus strengthening competitiveness in these areas would not only offer Kazakhstan an opportunity to diversify and expand exports but also accelerate technological upgrading (Mealy and Teytelboym 2020). At present, Kazakhstan ranks relatively low—between 120 and 150 out of 231 countries and territories—on metrics of the complexity and greenness of production.[11] However, while the green products that Kazakhstan exports competitively are limited (figure 8, panel A), with total exports of around US$100 million annually, existing production is proximate to (i.e., likely to entail similar production capabilities as) mechanical and electrical equipment and parts for use in sectors that are expected to see large global demand growth with the climate transition, including renewable energy, electric rail, electric vehicles, heating, and agriculture (figure 8, panel B). Kazakhstan has already started down the path of producing electric cars and buses, building on strengths and opportunities in parts of the electric vehicle (EV) value chain such as manganese (for batteries) and lead-acid electric accumulators, and on linkages to other existing areas of production.

10 Rare earths can be produced from uranium tailings.

11 See Green Transition Navigator, https://green-transition-navigator.org/.

Figure 8. Kazakhstan's green competitive strengths (panel A) and green opportunities (panel B)



Source: Green Transition Navigator, https://green-transition-navigator.org/.
Note: Product Complexity Index (PCI) is used as a proxy for technological sophistication. Proximity measures the product's similarity to Kazakhstan's productive capabilities and is correlated with the probability of developing future competitiveness in a product. Revealed Comparative Advantage (RCA) score indicates whether Kazakhstan exports a product competitively—an RCA > 1 means Kazakhstan exports more than the average. Green competitive strengths (panel A) are products where Kazakhstan's RCA > 1. Green opportunities (panel B) are products where RCA < 1. The size of the markers represents current RCA; the scale is adjusted between panel A and panel B.

To capitalize on growth opportunities, Kazakhstan will need to build market access and address other limitations on more complex production, like skills and state control of markets. Kazakhstan's exports of green products are generally directed to a handful of neighboring countries.[12] This makes exports vulnerable to cyclical demand for long-lived products and demand shocks in those countries, and limits opportunities to be involved in global value chains. In line with its national priority of actively developing economic and trade diplomacy, Kazakhstan will need to make inroads to markets where there is demand for the specific green products Kazakhstan does or could produce. Further examining the alignment of skills and knowledge needed to develop these opportunities is necessary. Broader macroeconomic reforms (690), will also help to attract investment and incentivize productivity and innovation to develop competitive industries. Measures to support the domestic market for electric vehicles may also support that industry. See Background Note 2 on Kazakhstan's opportunities in green products and value chains for further information.

1.4 Climate change raises risks for diversified, inclusive growth

Kazakhstan is facing higher average temperatures, rainfall volatility, and natural disaster risk as a result of climate change, with impacts falling hardest on vulnerable households. Average annual temperatures were 0.3 °C to 1.4 °C warmer over 1997–2010 than during 1971–2000 (Ministry of Environment and Water Resources 2013). Kazakhstan is expected to experience faster warming than the global average; projections predict further

12 Based on analysis of UN Comtrade data, https://comtrade.un.org/.

warming of between 1.6°C and 5.3°C by the 2090s (World Bank 2021). Higher temperatures and more frequent heat waves increase the risk of heat stress for Kazakhstan's population and will put pressure on the health system. Severe droughts are expected to occur more frequently, which may amplify existing environmental issues such as land degradation and desertification and associated issues such as dust storms (World Bank 2021). At the same time, the intensity of extreme rainfall events is expected to increase with rising temperatures (Westra et al. 2014), resulting in more intense and frequent flooding and mudflows. The number of weather-related emergencies increased from 39 in 2012 to 130 in 2021 (ADB & World Bank, 2021) and forecasts indicate that the frequency of mudflows could increase by a factor of 10. This will pose particular risks for the 26 percent of the population that live in mountainous and other areas prone to mudflows (World Bank 2021). Indeed, Kazakhstan's rural poor are most exposed to the increased disaster risks arising from climate change. Compared to better-off populations, they are also likely to have lower mobility and poorer access to critical services and early warning systems, and their assets are less well insured against extreme climate events (World Bank Group 2016, 2021). Moreover, they are less likely to invest in infrastructure to protect themselves from natural disasters, and they have limited resources to recover from damages of natural disasters.

Climate change will increasingly reduce availability of water resources. Medium-term projections indicate more water in the east and south from accelerated glacier melting, while strong aridification is expected in the west. By the century's end, significant declines in water availability are expected across the country, especially in the west and northeast. Increased withdrawals in upstream countries will also reduce water inflows to Kazakhstan, further increasing water stress in the eastern basins as well as conflict between users. These changes will impact critical water-dependent sectors, such as agriculture, water supply, industry, environment, and energy.

Water scarcity will be a particular challenge for Kazakhstan's agriculture sector, raising risks for vulnerable rural communities. Agriculture is dominated by rainfed wheat and livestock production, which will be vulnerable to rainfall changes and variability. A 5–15 percent increase in the aridity of the growing season and associated increase in drought occurrence are the most significant adverse impacts on agriculture arising from climate change. Reductions in spring wheat yield by 2030 could be 13–37 percent and by 2050 could be 20–50 percent (UNDP 2020). In the Central Asia region as a whole, crop losses of 50–70 percent could occur as a result of increased temperatures and inaccurate forecasting (UNECE 2019). While irrigation has generally been used to provide reliable water supply for crops that require higher temperatures, such as rice, cotton, and horticulture, high water losses[13] and competition for dwindling water supply will increase pressure on the sector, especially given plans to double the cultivated areas of these crops by 2030. Animal husbandry—the main source of employment and nutrition for the rural population—is likely to be significantly impacted by climate change, as pastures are expected to become much less productive, reducing their capacity to support current animal herds. Grass yields are expected to decline by 10–25 percent in lowland pastures and by 30–40 percent in mountain pastures. In addition to the adverse impacts of thinner pastures, longer periods of hot weather will further reduce the sheep population that can be supported on current pastures, as sheep must be moved to more northern or mountain pastures when the number of hot days exceeds a certain threshold.

Kazakhstan's critical infrastructure is vulnerable to more frequent and intense natural disasters resulting from climate change, with potentially large impacts on traded sectors and the overall economy. Road and rail networks are prone to high winds and snowfall, but more critically to flooding, which is exacerbated by poor sizing and poor maintenance of drainage structures. Analysis suggests that about 10 percent of Kazakhstan's transport infrastructure is exposed to natural hazards, particularly from flooding. Meanwhile, water levels in the Caspian Sea appear to be dropping, impacting maritime transport, inland coastal ports, and intermodal connectivity. Interruptions to transport links can disrupt connectivity between cities and regions, inhibit personal mobility, and affect global value chains and trade patterns. These disruptions, as well as impacts on other connectivity infrastructure like electricity and gas supply and telecommunications, cause significant economic losses. In 2019, for example, the additional cost to firms in Kazakhstan from lower utilization of transport infrastructure due to natural hazards was US$1.1 billion, or 0.51 percent of GDP; this cost can be expected to increase as natural disasters become more frequent (Hallegatte, Rentschler, and Rozenberg 2019).

13 Irrigation water withdrawal is twice as much as total crop requirements due to inefficiencies in systems; for example, 83 percent of canals are unlined.

Chapter 2

Kazakhstan's climate commitments, policies, and capacities

KEY POINTS:

- ***Kazakhstan has ambitious targets for climate change but lacks the policies and programs to achieve them. Its 2030 NDC, and particularly its net-zero by 2060 pledge, require strong action. While there are the beginnings of a mitigation policy framework, with an emissions trading system (ETS) and renewable auctions, the framework and its components need to be more ambitious, and additional policies are required to unlock barriers to scaling up, drive emissions reductions across sectors, and support communities through the transition.***
- ***Kazakhstan is currently developing a low-emissions strategy that helps to identify the technology pathways to achieve carbon neutrality and to make the case for climate action. However, a detailed policy implementation plan is needed to foster policy adoption.***
- ***Adaptation planning has just begun and must be accelerated. Kazakhstan must establish programs and practices to minimize the most adverse effects of climate change.***
- ***To enable effective and timely planning and implementation of policies, institutional and planning reforms are needed, particularly to support cross-government coordination.***
- ***The low priority given to green investment by the private sector reflects the absence of a conducive policy environment.***

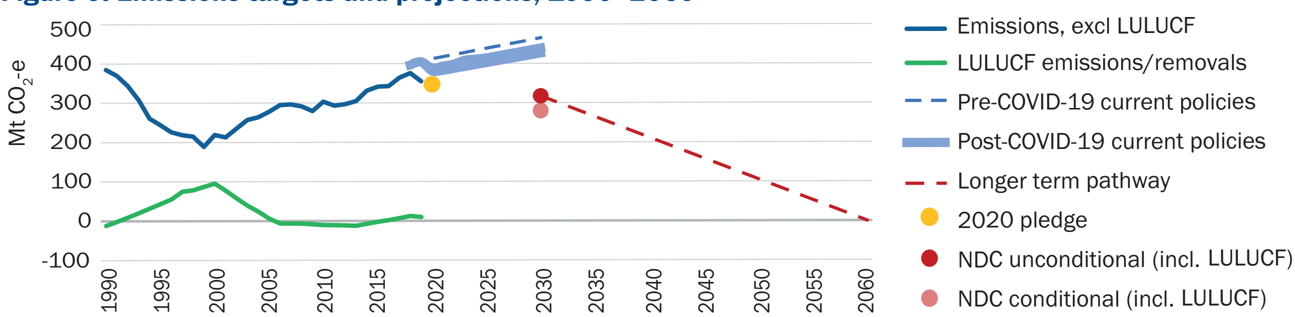
This chapter assesses Kazakhstan's commitments to reducing emissions and building resilience to climate change, as well as the policies and institutional capacities in place to achieve these goals. It also reviews the role the private sector plays in addressing climate change as well as public attitudes to climate change.

2.1 Kazakhstan has made meaningful climate change commitments

Kazakhstan has meaningful climate targets. In 2016, it signed the Paris Agreement to limit global warming to well below 2°C relative to 1990 levels, and it submitted its first Nationally Determined Contribution, pledging to reduce its emissions to 15–25 percent below 1990 levels by 2030. The 15 percent reduction is unconditional. Deeper cuts of 25 percent are subject to international support. Kazakhstan is currently updating its first NDC, which will include adaptation, though the 2030 emissions reduction target is not expected to change.

Kazakhstan's 2030 target requires action to achieve—and a reversal in the trend of increasing emissions. To reduce emissions by 15 percent relative to 1990 emissions, Kazakhstan's net emissions must not exceed 328 million tons of CO_2-e by 2030 (Republic of Kazakhstan 2021). This represents an 11 percent reduction from 2019 net emissions, which amounted to 364.5 million tons.[14] Taking account of expected growth over the next decade, the commitment to meeting the emissions target will require action (figure 9).

Figure 9. Emissions targets and projections, 1990–2060



Sources: UNFCCC 2021 (historical emissions); UNFCCC 2016 (2020 and 2030 targets); Satubaldina 2020 (2060 target); Climate Action Tracker 2020 (emissions projections).

Note: CO_2-e = carbon dioxide equivalent; LULUCF = land use, land use change, and forestry; NDC = Nationally Determined Contribution.

14 Data are not yet available for 2020.

In late 2020, Kazakhstan committed to achieving carbon neutrality by 2060. This goal will be challenging for a country where fossil fuels contribute more than 80 percent of national emissions. That said, technical solutions exist for deep decarbonization of the energy system; the challenges are more in the political sphere, given the large and entrenched fossil fuel interests in the country.

2.2 The beginning of a framework is in place, yet implementation gaps and challenges are high

Kazakhstan has established and updated a set of climate policy strategies and legislation over the past decade. Kazakhstan's focus on an environmentally friendly economy was formulated in 2013, with the adoption of the Concept on Transition to Green Economy until 2050. This followed the adoption of the long-term Strategy Kazakhstan 2050 and set out Kazakhstan's plan to transition away from an energy- and emissions-intensive economy to a greener path. It was accompanied by an Action Plan to guide implementation from 2013 to 2020.[15]

Kazakhstan's Environmental Code is the primary supporting legislation for environmental protection. It was introduced in 2007 and a new version adopted in 2021. It establishes a robust framework for environmental management, one that includes the "polluter pays" principle requiring businesses to take responsibility for past and future environmental damage. It outlines the architecture for Kazakhstan's ETS and requires that large new investments adopt "best available techniques" in emissions management. Other notable pieces of legislation that support Kazakhstan's climate goals include the Law on Renewable Energy (2009) and the Law on Energy Savings and Energy Efficiency (2012).

The Environmental Code contains Kazakhstan's NDC commitment and establishes an adequate national carbon budget, but meeting the Paris commitment will take strong political will. The carbon budget starts at 1.5 percent below 1990 levels in 2021 and falls by 1.5 percent per year to 2030. However, without meaningful action, Kazakhstan's NDC commitment will not be met. The Environment Code serves as a robust legislative framework but does not include the policies and measures needed to achieve the targets. Notably, the ETS emissions cap, which accounts for 43 percent of national emissions, has exceeded emissions levels, and—based on the quota allocation regulation recently released—looks unlikely to constrain emissions until 2025. This situation reflects the challenging political environment and influence of strong interest groups, notably the coal, oil, and gas sectors. Greater political commitment will be needed if Kazakhstan is to achieve its climate goals.

Kazakhstan aims to update its NDC and adopt a Low-Emissions Development Strategy in 2022. The draft updated NDC (Republic of Kazakhstan 2021) retains the 2030 emissions target and reinforces the role of the ETS, energy efficiency measures, and increased renewable energy in meeting Kazakhstan's 2030 and 2060 targets.[16] It also proposes additional mitigation measures—such as a new energy tax to cover transport fuels and small-scale coal use—and, for the first time, includes a component on adaptation to climate change. The Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan Until 2060 is currently being drafted. It lays out a vision (to achieve carbon neutrality by 2060), and it provides insight into the type, scale, and pace of the necessary transition. A detailed policy implementation plan will need to follow to be able to translate the vision into reality.

2.3 With the primary focus on mitigation, adaptation policies lag

2.3.1 Mitigation policy

Kazakhstan has established a solid starting framework for tackling climate change but will need to substantially strengthen its policy ambition if it is to meet its climate goals. Since making its first international emissions reduction commitment in 2012, Kazakhstan has introduced an emissions trading scheme, renewable energy

15 A new Action Plan for 2021–30 was adopted in 2020. It includes a range of measures supporting energy efficiency, forestry, infrastructure for and uptake of gas- and electric-powered vehicles, transition from coal to gas in the power supply of major cities (such as Almaty, Nur-Sultan, and Shymkent), improved waste management, preservation of natural capital (including transition to sustainable land use practices and organic agriculture), and raising of public awareness.

16 The draft NDC was developed in 2021 and is currently under review along with the draft NDC implementation roadmap.

auctions, energy efficiency legislation, a green projects taxonomy, and a range of measures to reduce transport emissions (box 3). Much of the initial focus has been on establishment of enabling legislation and sectoral targets, with a soft start on reducing emissions. Further measures with sufficient ambition are needed. However, the current arrangements provide a solid foundation for delivering the deeper emissions cuts needed in the next decade. Existing mitigation policies are reviewed in detail in Background Note 3.

Box 3. Overview of Kazakhstan's climate policies

An **emissions trading system** was adopted in 2011 and commenced in 2013. The ETS limits the emissions of around 225 large installations covering more than 40 percent of national emissions.

- Support for increased **renewable energy** capacity using feed-in tariffs began in 2013 and support for renewable energy auctions began in 2018.
- Expanded access to **natural gas** is encouraging fuel switching away from coal.
- A suite of **industrial and residential energy efficiency measures** is in place, including these:
  - Mandatory energy reporting, energy audits, and energy management plans for over 9,000 large installations
  - A thermal performance building code for new construction and upgrades
  - Energy efficiency labeling for appliances and equipment
- Measures are in place to promote cleaner **transport**, including modernizing the aging public transport fleet and establishing a local electric vehicle industry.
- **Best available techniques** for environmental performance are required in new industrial installations, and coal mine methane must be put to a productive use.
- Measures are in place to support green growth in **agriculture**, including promotion of conservation tillage practices, fertilizer subsidies to improve soil carbon, and support for breeding higher-quality livestock.
- Bans on logging and plans to expand forest cover have been established; and there are plans to establish new plantings and conservation areas to promote additional **carbon storage in forests.**

2.3.2 Adaptation policy

Future climate risks are well understood, and the government has taken action to bring adaptation to its climate strategy, though only recently. Kazakhstan does not have a policy document that specifically addresses adaptation and disaster risk reduction. However, Kazakhstan is increasingly recognizing the importance of reducing the country's vulnerability to climate change. The Strategy Kazakhstan 2050: A New Political Course of the Established State (dated December 14, 2012) provides a long-term vision for strategic development of the state; it acknowledges water shortages as a future challenge to agriculture and advocates for increased use of water-saving technologies. It also announces the aim of making Kazakhstan a global player in environmentally clean agricultural production. The Plan of the Nation—100 Concrete Steps (dated May 6, 2015) does not include any measures on adaptation to climate change but provides for a number of measures that had an impact on environmental regulation. The Strategic Plan for Development until 2025 (2018 Decree of the President No. 636) includes policy measures for achievement of the commitments under the Paris Agreement; definition of financing sources, including green finance and investments; promotion of investments in green technologies; increased efficiency in use and protection of water resources; and conservation of biodiversity.

This incorporation of climate adaptation into policy documents is supported by the inclusion of a legal framework for adaptation in the new 2021 Environmental Code. The framework aims to mainstream adaptation planning in public administration and make it a part of decision-making at all levels of government. This approach is critical because it ensures that climate risks are systematically identified and actions to build climate resilience are integrated into policies, programs, and asset management decisions. Adaptation priorities, but not specific measures, are identified in Kazakhstan's Seventh National Communication and Fourth Biennial Update Report to the United Nations Framework Convention on Climate Change (Ministry of Energy, UNDP in Kazakhstan, and GEF 2017). Much as with mitigation, certain plans and intentions are beginning to be integrated into strategic frameworks and laws, but the next step is to implement measures to achieve them.

Kazakhstan has made good progress with climate services that assess climate and disaster risks, and it could further expand public provision of this information to households, communities, and the private sector at both national and regional levels. In particular, it would be beneficial to provide public access to information on exposure and impacts at more granular level (e.g., local-scale hazard maps), set residual risk target levels, and identify and assess the socioeconomic vulnerability of the most vulnerable populations and communities—all areas that are lagging.

2.4 Cross-ministerial coordination with central authority is key to successful implementation of climate measures

Kazakhstan has taken steps to institutionalize climate policy development and coordination, but remaining gaps could undermine policy implementation. The Ministry of Ecology, Geology and Natural Resources (MEGNR) is defined by the 2021 Environmental Code as a lead agency responsible for the climate policy agenda. However, because climate change and efforts to address it are cross-sectoral in nature, almost all line ministries, departments, and agencies (MDAs) as well as subnational governments have a role in climate policy development, implementation, monitoring, and reporting. Existing provisions in the Environmental Code are vague and can be widely interpreted by MDAs, while the MEGNR lacks the mandate, resources, and capacity to set up and coordinate policies and budgets.

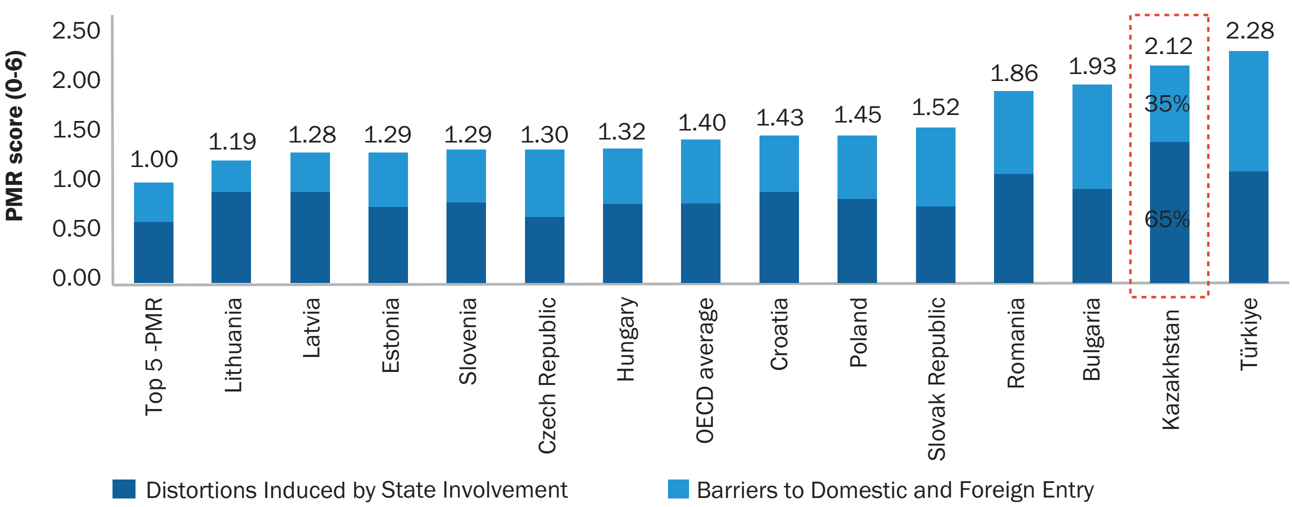
Despite some progress, central coordination to support climate policy implementation in Kazakhstan remains limited and lacks strong high-level political ownership, contributing to weak implementation of mandates and fragmentation of efforts. Different ministries have developed strategies related to climate change, but these have not necessarily been coordinated to ensure complementarity. For example, the Ministry of Energy is working toward a target of 15 percent renewables in power production by 2030 through reverse auctions, but there is not a clear view on what this contributes to the NDC and how it works with other policies to achieve the NDC, such as the ETS. While certain bodies have been established that could play a coordinating role, they have not done so for various reasons. All MDAs and subnational governments should be well integrated into climate change governance with properly assigned mandates, accountability, and resources, coordinated by a group that has high-level cross-ministerial representation, and, importantly, invested with the authority to govern the design and implementation of the government's response to climate change. The Agency for Strategic Planning and Reforms under the president, for example, has an important role in strategic planning for the state and could facilitate an integrated approach that mainstreams climate change planning across government. To further aid coordination, MDAs need to be given clear roles, responsibilities, and mandates that are understood by all. The Ministry of National Economy and Ministry of Finance are crucial members of any coordination approach; they could provide necessary policy and funding support across all sectors and help to integrate climate change into strategic and budget planning. The Ministry of National Economy's role in reviewing the 2060 net zero pathway is welcome, but a coordination mechanism with strong central authority will be an ongoing requirement for successful implementation of climate policy and programs.

2.5 The private sector is not yet positioned to support the green transition

Private sector action to reduce emissions and build resilience is critical to Kazakhstan's ability to meet climate targets. While the public sector can create incentives and set the rules of the game, the vast majority of decisions that need to be taken to engender a green transition will be made by private sector actors. The private sector will also be crucial in finding low-emissions alternatives through innovation and technological development and in supporting low-carbon structural change by new and existing firms taking advantage of opportunities in the low-carbon economy. The key question is how to ensure that the private sector is enabled to take these steps.

At present, private enterprise is constrained by dominant SOEs and high levels of regulation. The public sector and its SOEs dominate the economy, crowding out the private sector and affording only weak incentives for entrepreneurs and investors to drive innovative, productive new business forward. The private sector accounts for only one-quarter of jobs in the economy (World Bank Group 2018). Even compared to other fossil fuel–dependent economies like Saudi Arabia and the United Arab Emirates, Kazakhstan's share of jobs in SMEs is orders of magnitude lower (World Bank Group 2018). Large state presence in the economy is coupled with a product market regulatory framework that restricts competition (Figure 10).[17] Policy and regulations that create market distortions include the dominant role of SOEs in the energy and network sector, preferences in public and SOE procurement policies, and price controls and obligation to supply domestic market.[18]

Figure 10. Economy-wide product market regulation score and composition, 2018



Source: OECD, Indicators of Product Market Regulation.
Note: Index scale is from 0 to 6 (least to most restrictive). PMR = product market regulation.

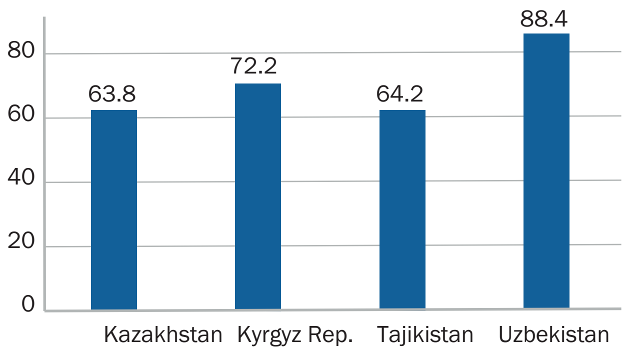
In addition, a lack of climate policy is undermining firms' incentive to take action. Climate policy, such as carbon pricing or emissions standards, helps to make green investments cost-effective. The lack of such policy undermines investment certainty, lowering the overall level of green investment. Indeed, the 2019 World Bank Enterprise Survey data indicate that while only a small proportion (10.3 percent) of private (manufacturing and services) firms in Kazakhstan were subject to climate policy, they had better green management practices and were more likely to invest in green technologies than those firms that did not operate under such conditions.[19]

17 The characterization of product market regulation is based on the OECD–World Bank indicators for product market regulations, which measure regulatory barriers to firm entry and competition in a broad range of sectors. See OECD, "Indicators of Product Market Regulation," https://www.oecd.org/economy/reform/indicators-of-product-market-regulation/. The characterization of frameworks for promotion of competition is from the Economist Intelligence Unit.

18 In 2021 Kazakhstan amended the Law on Public Procurement to improve competition and reduce the exceptions for single sourcing. The new amendments will be effective once implementing guidelines are issued.

19 World Bank Enterprise Surveys, http://www.enterprisesurveys.org (2019).

Figure 11. Percentage of private firms (in manufacturing and services) that have engaged in green investments in the past three years: Kazakhstan vs. regional peers, 2019



Source: World Bank staff elaboration based on World Bank Enterprise Surveys, 2019, http://www.enterprisesurveys.org.

As a result, it is little wonder that the private sector is not yet ready to lead the green transition. Private sector firms in Kazakhstan are less willing to engage in green managerial practices or invest in environmentally friendly solutions than those in other Central Asian countries. Only 18.5 percent of firms have targets for energy consumption or emission of CO_2 and other pollutants, a lower share than for regional peers, while the proportion of private manufacturing and services firms engaging in green investment is also lower in Kazakhstan than in Central Asian peers (figure 11).

Private sector readiness for the climate transition is discussed in further detail in Background Note 4.

2.6 Awareness of climate change is low, driving need for citizen engagement

Informing citizens about the green transition and ensuring popular support for it constitute an important agenda. Citizen participation in the transition needs to be well informed to support a successful transition. A recent survey found people who were more informed about climate change were more supportive of addressing it—even if doing so came at a cost.[20] Although 71 percent of people in Kazakhstan see climate change as a serious problem—a substantial majority but a lower proportion than in most other ECA countries—the country has one of the lowest rates of awareness of climate change, its impacts, and the government's measures to tackle the issue. This translates into less support for action to address climate change compared with other countries. Fewer than half of respondents agreed the country needs to start using alternative energy sources; this share is far smaller than in other ECA countries. Only about 40 percent believed that building a greener economy will lead to more or better jobs. Only 32 percent supported reducing public subsidies for fossil fuels if it raises energy costs. There is a lack of consensus around the impact climate change will have, the benefits of spending to address climate change, and the need to hold polluting industries to account.

Citizens' views can help tailor effective informational programs and policy messaging. Given high levels of concern about health and air pollution in Kazakhstan, climate policy's benefits in these areas could be emphasized to attract support for measures that reduce emissions. Few people see agriculture as contributing to climate change, so measures here could focus on the productivity and health benefits of climate action in the agriculture sector.

20 World Bank survey on public attitudes to climate change conducted in 2022. The remainder of this subsection draws on the survey data.

Chapter 3

Strategies for resilience and decarbonization

KEY POINTS:

- ***To address climate risks, adaptation considerations must be integrated into development planning and decision-making, while moving to more sustainable water and land management practices over time. This approach will be critical if planned increases in agricultural production are to be achieved along with climate targets.***
- ***New investment is required to build a resilient, reliable, and flexible power grid, as infrastructure ages and power demand grows. Competitively procured renewable energy is the least-cost option for building new generation.***
- ***Reduction of power sector emissions, a key priority for achieving NDC and net-zero targets, also requires a dramatic scaling up of renewable energy, combined with a planned phasing out of coal-fired generation.***
- ***The heating and transport sectors will take longer to decarbonize as assets turn over and technologies such as electric vehicles and heat pumps become cheaper. Nonetheless, measures are needed now to start the transition, improve energy efficiency, and establish an enabling policy environment.***
- ***Greater carbon sequestration from rangelands, particularly grasslands and forests, is possible. This increase will require improved management of pastureland (implementing monitoring systems, restoring pasture infrastructure, and adopting improved grazing practices) as well as large-scale afforestation. These steps could provide a carbon sink of 20–40 Mt CO_2-e by 2060 that could offset the more expensive abatement in hard-to-abate sectors and reduce the cost of achieving net zero.***

Achieving Kazakhstan's mitigation climate commitments and building resilience to the impacts of climate change will require substantial policy reforms and significant investments in key sectors. This chapter examines the priority strategies and investment needs across these sectors. In the process, it identifies actions needed in the near term as well as sectoral pathways for longer-term transformation.

3.1 Decarbonizing the energy system is key to achieving NDC and net-zero goals

Decarbonizing the energy system, which generates 80 percent of emissions, is key to achieving the 2030 NDC and the 2060 net-zero goals. This section examines a least-cost path for decarbonizing Kazakhstan's energy system (including power, buildings, transport, and industry energy use), informed by modeling undertaken for this report. It highlights the most critical policies and reforms needed to set a course toward the country's 2030 NDC targets and the national goal of net-zero GHG emissions by 2060.

To investigate feasibility, costs, and impacts of different pathways to achieve full decarbonization of the energy system, the CCDR used an integrated suite of sector, macroeconomic, and microeconomic models. Two main scenarios are investigated: **net-zero emission (NZE) scenario**, which achieves the energy sectors' contribution to NDC targets in 2030 and to zero emissions by 2060; and a **reference scenario (RFS)** representing no new climate policy.

Under the least-cost reference (RFS) scenario, which involves no new climate policy, emissions show a slightly declining path but miss the 2030 NDC emission target and the 2060 decarbonization objective. In this scenario, growth in energy demand is met largely through use of fossil fuels, which contribute to increasing GHG emissions; the overall decline in emissions is due to (i) electricity from solar photovoltaic becoming increasingly cost effective, (ii) significant shift from coal to gas in power and heating, (iii) energy efficiency improvements, and (iv) the steady switch from internal combustion to EVs. Nonetheless, under RFS, fossil fuels account for 70 percent of the final energy consumption in 2060; final energy consumption grows by 0.3 percent annually; and gas usage in 2060 is 170 percent of that in 2020.

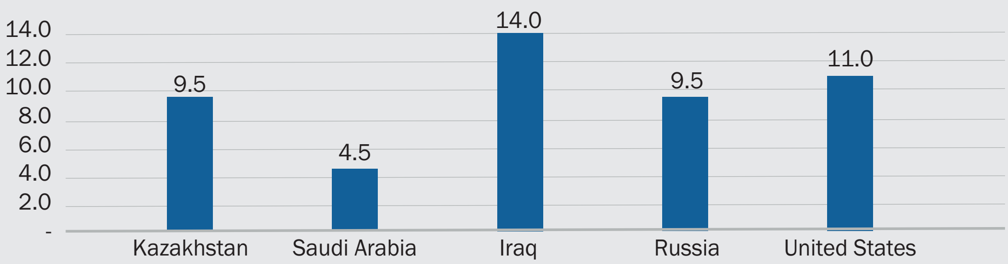
Box 4. The benefits of decarbonizing the oil and gas value chain

Maintaining competitiveness in oil and gas will be critical to support a smooth transition. Given the dominance of oil and gas in Kazakhstan's economy—it accounts for up to 60 percent of exports and more than a third of government revenue—it is critical that the country ensure a smooth transition to balance climate and development goals by maximizing the returns from the sector during the transition. This means taking steps to ensure the sector's relative competitiveness in global markets so that it can remain a viable producer and contributor to fiscal revenues even as global demand falls (potentially along with market prices). While marginal production costs for oil are relatively competitive,[a] Kazakhstan is more dependent on oil and gas revenues than many other producers; its fiscal breakeven oil price over the period 2018–20 was over US$70/bbl,[b] which is at the margin of global crude prices over the last five years. Long-term sustainability is likely to depend on fiscal reforms along with actions to strengthen investment and market competitiveness, including diversifying export routes to minimize overdependence on a single transit country, reducing regulatory barriers that raise costs of production and constrain investment (e.g., stringent local content requirements), and decarbonizing production and transport.

Further reducing emissions along the oil and gas value chain can reduce competitive risks and support climate targets. The carbon intensity of oil and gas production and distribution is likely to impact cost- competitiveness in export markets that adopt climate policies, including carbon border adjustment mechanisms. It will also increasingly impact investment choices of international oil companies under pressure to green their value chains. As with the cost of production, Kazakhstan compares favorably to some major oil producers in terms of the carbon intensity of its value chain; but it would need to decarbonize significantly to compete as a low-emissions supplier. Kazakhstan has made significant progress in recent years in reducing fugitive emissions (from 27 Mt CO_2-e in 2000 to 5 Mt CO_2-e in 2020), mainly by actions to reduce flaring and venting in the oil and gas sector, including adoption of more advanced technologies and a ban on flaring (IEA 2022). Further action could also be taken to improve the monitoring and measurement of fugitive emissions and to implement low-cost methods to eliminate them.

Figure 12. Carbon intensity: Kazakhstan vs. other major producers

Estimated upstream crude oil carbon intensity (2015) in g CO2eq/MJ crude oil delivered to refinery



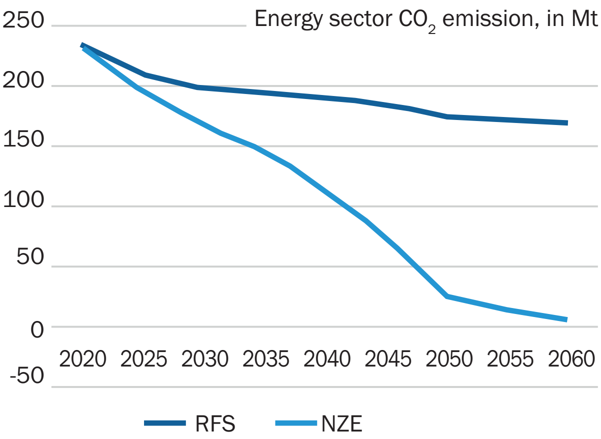
Source: Masnadi et al. 2018; US Department of Energy, Office of Scientific and Technical Information, https://www.osti.gov/.

a. Kazakhstan's marginal production costs are considered to be lower than those of major producers like the US and Russia, although substantially higher than the lowest-cost producers like Saudi Arabia and Iraq.

b. International Monetary Fund data.

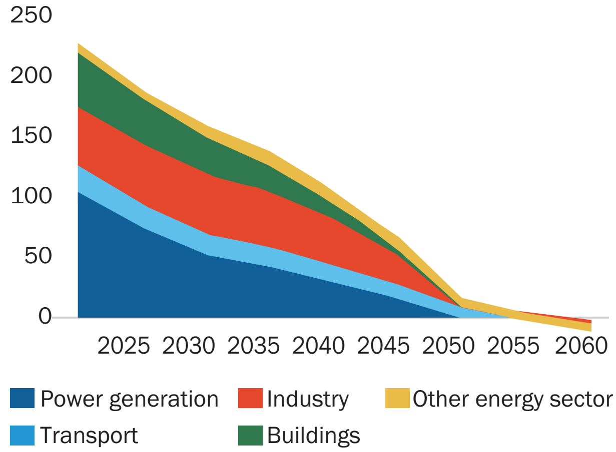
The net zero emissions by 2060 (NZE) scenario charts a least-cost path for the energy sectors to achieve their part of the 2030 NDC target and then full decarbonization by 2060. The power sector drives most of the emission reductions from the energy system needed to meet the NDC goal in 2030 and to approach decarbonization by 2050. The building sector decarbonizes in 2050 as energy efficiency increases followed by electrification and market penetration of heat pumps. Bioenergy with carbon capture and storage plays a significant role in industry, driving emissions to near zero by 2050. Next, road transport decarbonizes in 2055 as passengers fully shift to electric vehicles, following a consistent switch to EVs starting in 2030. Decarbonization of aviation and shipping occurs in 2060, so that net zero is achieved for the entire energy sector. Under the NZE trajectory, energy consumption reduces by 0.9 percent a year with increasing energy efficiency and significant electrification.

Figure 13. Energy system CO_2 emissions in the NZE and RFS scenarios



Source: World Bank modeling.
Note: NZE = net-zero scenario; RFS = reference scenario.

Figure 14. GHG emissions in NZE scenario, 2020–60

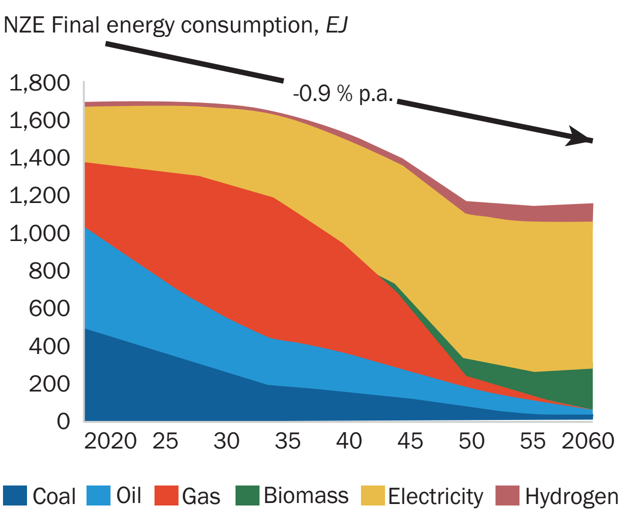


Source: World Bank modeling.
Note: GHG = greenhouse gas; NZE = net-zero scenario.

All scenarios are subject to uncertainties. Key among these are (i) pace of technology advancement and related technology cost curves for CCS, hydrogen production, fuel cells, battery technologies, and wind and solar; (ii) level of international collaboration, fuel, and electricity trade; and (iii) enabling policy environment for scale-up of renewables and for nuclear power adoption. It is also worth noting that there are a variety of NZE scenarios that can be constructed and the scenario used in this report is one illustrative path.

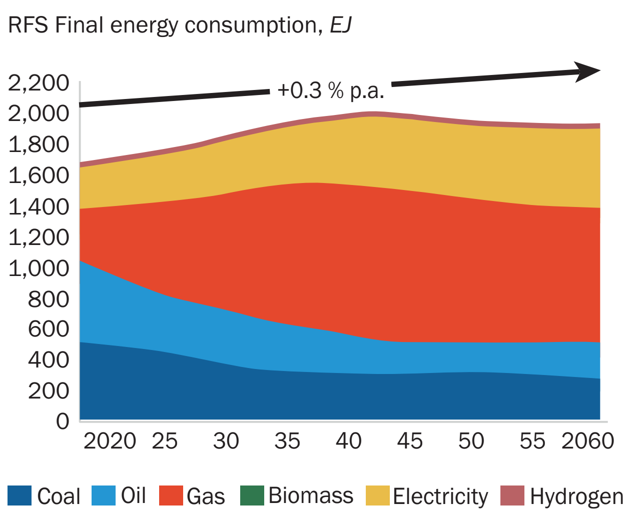
The following subsections focus on the NZE scenario, as modelled in this analysis, and describe the least-cost pathways for energy system decarbonization, including the clean transition of end-use sectors: power, buildings, transport, and industry. This discussion is followed by the analysis of investment needs and enabling environment.

Figure 15. Final energy consumption in the NZE scenario, 2020–60



Source: World Bank modeling.
Note:. NZE = net-zero scenario.

Figure 16. Final energy consumption in the RFS scenario, 2020–60



Source: World Bank modeling.
Note: RFS = reference scenario.

3.1.1 Energy system transformation for a net-zero Kazakhstan

The net-zero trajectory for Kazakhstan implies synchronous transformation of the energy sectors (power, buildings, industry, and transport) on the demand and supply sides (figure 14). On the demand side, end-user energy efficiency improvements, and switching to electricity, bioenergy, and hydrogen, complete the energy transition. Between 2022 and 2060 energy efficiency is responsible for reducing total energy consumption by 22 percent, with industry and transport representing the largest potential, followed by buildings. Technology shifts on the demand side result in fuel switching to electricity (61 percent of final consumption by 2060), bioenergy (21 percent), and hydrogen (7 percent) (figure 14). Cumulatively these measures result in an energy consumption decline of 0.9 percent a year below the reference scenario.

On the supply side, decarbonization means gradual decline in domestic oil and coal use and the transition to natural gas, along with renewables in the medium term for power. Oil use declines with the shift to EVs and alternative fuels. Existing coal generators ramp down and retire as they reach the end of their economic life. No new coal plants are developed. Natural gas is the transitional fuel making this shift possible. Domestic gas consumption increases to replace high-emission fossil fuels and peaks in 2030; a decline begins in 2035, when solar and wind generation continue to scale up, but gas continues to provide 22 percent of power in 2060, in combination with CCS. After 2030, renewables—namely solar, wind, and bioenergy—scale up significantly, while nuclear power does not become cost-effective under the NZE scenario.

Two key technologies emerge to aid decarbonization: low-carbon hydrogen and carbon capture and storage.

Kazakhstan is well positioned to take advantage of opportunities in hydrogen production. The country already has significant hydrogen production experience, producing 12 PJ of gray hydrogen per year (in 2020) for domestic industrial use. Going forward, Kazakhstan can leverage its legacy gas infrastructure and know-how, as well as wind power potential, to usher in the transition to a low-carbon hydrogen (LCH) economy.[21] This would not only facilitate decarbonization of hard-to-abate domestic industries but also foster a shift in the petrochemical industry to high-value, low-carbon intermediate products such as methanol and ammonia, which along with hydrogen offer significant potential for export.

Table 2. Low-carbon hydrogen penetration: Projected low-carbon hydrogen share in Kazakhstan's industry

Sector	End-use	2030	2035	2040	2045	2050
Ammonia	Fertilizer production	25%	38%	50%	63%	75%
Methanol	Petrochemical industry	20%	30%	40%	45%	50%
Iron & steel	Metallurgy	25%	38%	50%	63%	75%
Industrial heat	Heating	5%	8%	10%	13%	15%
Transport	Road freight	0.1%	0.1%	0.2%	0.2%	0.3%
Transport	Buses	0.4%	0.5%	0.7%	0.8%	1%

Source: World Bank estimates.

Modeling indicates LCH exports could be initiated by 2035 and become significant by mid-century. Green hydrogen from onshore wind and blue hydrogen are expected to quickly become competitive in Kazakhstan, replacing gray hydrogen and starting interregional exports by 2035. Exports are projected to grow steadily from 26 PJ to over 360 PJ between 2040 and 2055, when the hydrogen-ready pipelines come online and allow access to the main export market of China (reaching 347 PJ in 2055). By 2055, LCH export revenues are projected to reach US$3.5 billion per year. To put this in perspective, in 2018 natural gas exports from Kazakhstan were US$3.1 billion and accounted for around 5 percent of total exports.[22] Developing the LCH economy would require a cumulative

21 Such steps are already being taken by Svevind.

22 Data are from CEPII, 2022, http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp.

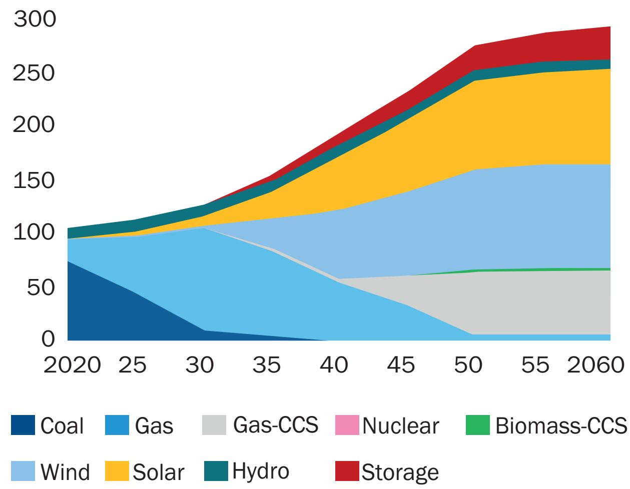
investment over the period of about US$60 billion and generate cumulative market value of about US$160 billion. Success will depend on the development of hydrogen transport infrastructure, access to the Chinese market, handling of financing issues, carbon pricing, CCS technology, and ability to overcome water availability issues.[23]

Under NZE, CCS becomes competitive in three key subsectors: blue hydrogen, power generation, and industry. In blue hydrogen production, CCS is cost-competitive from 2035. In power generation, gas largely replaces coal generation by 2030; then gas with CCS (and renewables) replaces natural gas by 2050. In industry CCS plays a role in iron and steel production and in nonmetallic minerals production. There are uncertainties around the cost and efficiency of CCS technology; in existing CCS facilities worldwide, the range of cost and achievable efficiencies is large. Thus further innovation in CCS technology is required to achieve decarbonization targets—specifically to increase overall carbon capture efficiency from 90 percent to 95 percent and reach cost levels of US$16/ton of CO_2 for transport and storage of CO_2 in Kazakhstan. CO_2 transportation and injection costs currently vary from US$10/ton to US$100/ton, subject to the length of transportation and the geophysical characteristics of aquifers. Further analysis should explore possible pathways for the development of Kazakhstan's CCS transport and storage infrastructure.

3.1.2 Power sector transition

There is an immediate need for power system modernization to ensure reliability and resilience of the sector. In 2020, 248 unscheduled outages occurred in the electricity networks of Kazakhstan Electricity Grid Operating Company (KEGOC)—a 17 percent increase over the number of outages in 2019 (KEGOC 2020). Similarly, in 2020, there were 1,104 thermal power plant boiler emergency shutdowns cumulatively lasting 61,811 hours, compared to 968 shutdowns lasting 51,223 hours in 2019. The total energy not supplied in 2020 was 1,369 MWh, versus only 132 MWh in 2019 (KEGOC 2020). This worsening performance is due to (i) increasing costs of maintaining aging infrastructure; (ii) need for substantial investments in generating capacity (~17–20 GW by 2035[24]); (iii) proliferation of energy-intensive industries (including cryptocurrency firms); (iv) changing load patterns that increase forecasting uncertainty; (v) an underdeveloped wholesale electricity market; and (vi) limited implementation of energy efficiency measures in buildings and the industrial sector.

Figure 17. Generation mix in NZE scenario, 2020–60 (TWh)



Source: WB modeling.
Note: CCS = carbon capture and storage; NZE = net-zero scenario.

Electrification is a key driver of Kazakhstan's decarbonization, driving energy demand growth. Under the NZE scenario, power generation reaches 260 TWh in 2060—an increase of 140 percent from the 106 TWh in 2020. The drivers of the demand increase include (i) transport electrification, (ii) electrification of buildings (shift to efficient heat pumps), (iii) accelerated movement to electrification of industrial processes, and (iv) emerging blue and green hydrogen production.

Coal is replaced by natural gas and renewables without need for new coal capacity. Existing capacity for coal combined heat and power (CHP) declines consistently over the next two decades as CHP plants reach the end of their useful economic life. Coal is fully phased out by 2040, and no new coal plants enter the power system. Assuming a 35-year economic life, there are no "early retirements" and no stranded assets for coal generation owners. Modeling results indicate that coal generation fitted with carbon capture and storage is not a cost-effective way to achieve net zero. Approaches to coal transition and support for affected workers are discussed in section 4.2.3.

23 Achieving the volumes of LCH projected requires annual water consumption ranging from 8 million m3 to 90 million m3 in 2030 and 2055 respectively, or 0.03 percent and 0.4 percent of the total freshwater withdrawal consumed by the country in 2017 (FAO 2020).

24 KEGOC, Forecast Energy Balance by 2035.

Power system decarbonization involves large-scale deployment of wind and solar capacity and development of power system flexibility. Utility-scale solar and onshore wind become competitive as the levelized cost of electricity (LCOE) for solar and wind falls below the LCOE for coal and gas with increasing abatement costs. Solar and wind capacity increases from around 2 GW currently to 19 GW of utility-scale solar and 10 GW of onshore wind by 2035; by 2060, capacity reaches over 69 GW for solar and 34 GW for onshore wind. By 2035 variable solar and wind generation already reaches the critical level of 35 percent (increasing to 72 percent by 2060). This trajectory will require significant additional power system flexibility, to be provided by combining efficient gas-based generation with CCS, storage, green hydrogen production, transmission, and demand-side flexibility of coordinated and smart EV charging. With this arrangement, storage requirements increase to 28 GW by 2035 and to 76 GW by 2060. New hydro, nuclear, and offshore wind do not become cost-effective in the net-zero scenario. Additional analysis is needed to adjust the pace of solar and wind deployment if the solar and wind capital expenditure (capex) increases reported in 2021 and 2022 persist over the next couple of years.

Natural gas plays an important role by providing low-carbon power and heat while renewables scale up; it also provides the power system with flexibility and needed load-following capability on days and hours of low solar and wind generation. Existing natural gas CHPs retire at the end of their useful economic life by 2030 and are replaced by new gas CHP from 2030 and new combined cycle gas turbine plants from 2025 onward. New gas power plants are equipped with CCS from 2035 onwards.

Box 5. The role of nuclear power in decarbonizing the power grid

Kazakhstan has one of the world's largest uranium reserves and is a major exporter of uranium, while domestic use of uranium to date has been limited (it is used in three operating nuclear research reactors in Kurchatov and Almaty). Building on its significant uranium resources, the government has been considering bringing new nuclear capacity online in the coming decade. To illustrate the impact of the nuclear power plants being considered, the CCDR team developed alternative RFS and NZE scenarios, with an addition of 2.4 GW (two reactors) of nuclear generation in 2035.

Nuclear power can support decarbonization and contribute to energy security but will increase system costs. New nuclear power generation would replace lower-cost wind and gas resources, resulting in a US$1 billion increase in system costs in the NZE scenario; this represents less than a 1 percent increase over the next four decades. This results in an increase in LCOE of 0.3–0.5 cents/kWh—an increase of over 10 percent. The system cost increase in the RFS scenario is higher than in the NZE: it amounts to US$ 3 billion with a 0.4–0.6 cents/kWh increase in LCOE. The considered nuclear could play a significant role in the power system generating 12 percent of annual electricity by 2035 and 7 percent by 2060 in the NZE. It would also contribute to system stability. The share of solar and wind would be 6 percent smaller than in the original NZE scenario, 66 percent in 2060. With the addition of nuclear only 0.5 GW of wind would come online in 2035 instead of 9 GW of wind in the least-cost original NZE pathway. In both alternative scenarios, nuclear replaces more flexible and cost-efficient gas and wind resources, providing needed additional power system flexibility. This increases the storage requirement to 39 GW (28 GW in the original NZE) by 2035.

3.1.3 Buildings, industry, and transport sector transitions

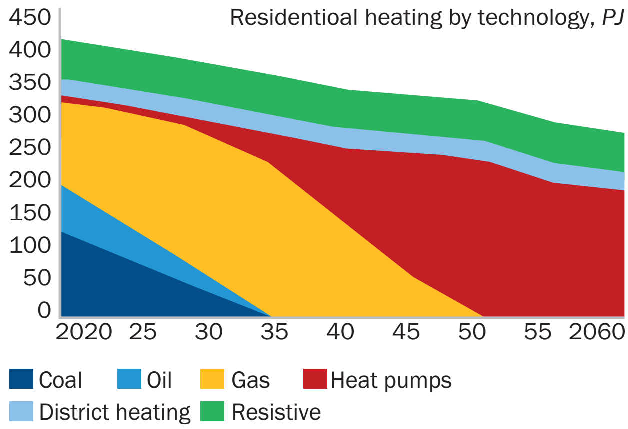
Kazakhstan's aging heating systems and inefficient building stock have large potential to improve outcomes with well-directed investments. Buildings accounted for 20 percent of energy-related greenhouse gas emissions in 2020. Besides being necessary for decarbonization, energy-efficient buildings and sustainable heating and cooling systems provide better health outcomes, greater comfort, and lower energy costs. Most of the energy consumed in residential, commercial, and public buildings is for heating and cooling. Heating of residential and commercial buildings is largely delivered by state-owned CHP systems through centralized heating networks in big cities, 80 percent of which run on coal. Most of these facilities were built between 1960 and 1980 and need upgrading. The average boiler efficiency is only 40 percent, heat losses in the network average 36 percent, and there are 200 technical failures every year per 100 km of heating network. In smaller townships, where district heating is not available, individual heating systems supply heat. On the residential side, 55 percent of households are individually heated; of these, 55 percent use coal, 35 percent gas, and 10 percent other sources such as biomass. The dominance of coal and other solid fuel contributes significantly to local air pollution. Kazakhstan's building stock is also relatively inefficient, requiring greater levels of energy to heat or cool. Kazakhstan's residential buildings consume 270 kWh/m2—more than double the figure for Europe (100–120 kWh/m2) and much higher than even neighboring Russia (210 kWh/m2). There is huge potential to reduce emissions from the building stock through both supply- and demand-side measures.

Buildings will decarbonize through electrification of heating, while gas can play a transitional role. Over time, electrification of heating should be introduced as the norm in new buildings; in existing buildings, technologies that use fossil fuels, such as coal-fired boilers, should be replaced by electric technologies such as heat pumps. There is potential for gas to play a transitional role, particularly if there is concern over air quality and a desire to move away more quickly from coal-fired heating. The role of gas is uncertain, however, given the need to move to electric heating and therefore the shortened time to recoup investment costs. District heating with gas CHP with CCS continues to play a major role in heating commercial buildings.

Improving building energy efficiency brings substantial cost savings and should begin now. Energy efficiency in the building stock is achieved by upgrading efficiency standards for new buildings and retrofitting existing buildings. To reach net zero, stricter energy efficiency standards in building codes for new construction should be enacted early, to avoid more expensive retrofitting later. Modeling suggests that 2 percent of existing buildings should be retrofitted each year starting from 2023. Combined, these energy efficiency measures could save over 100 PJ of energy per year, allowing more time for adding clean generation, reducing power bills for households, and lowering the investment required for heating through proper sizing of boilers and heat pumps.

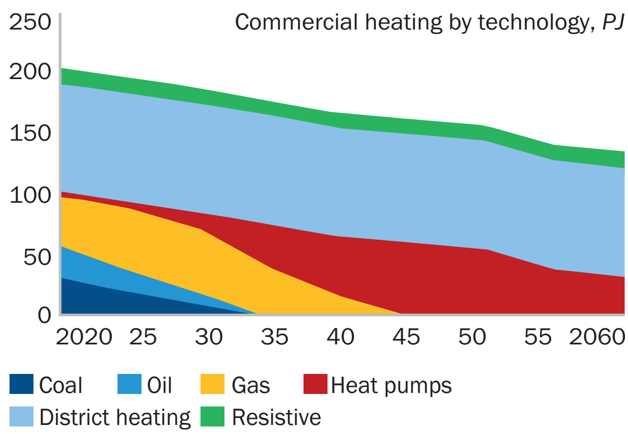
To achieve significant decarbonization of the industrial sector, technology and process innovations will

Figure 18. Change in composition of residential heating by technology, 2020–60



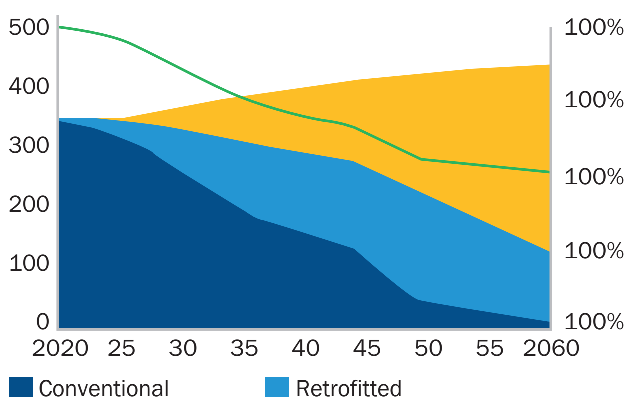
Source: World Bank modeling.

Figure 19. Change in composition of commercial heating by technology, 2020–60



Source: World Bank modeling.

Figure 20. Change in energy efficiency, 2020–70



Source: World Bank modeling.

be needed in energy-intensive industries. Manufacturing and construction are responsible for 13 percent of direct emissions plus a considerable portion of emissions from electricity generation.[25] Emissions are dominated by heavy manufacturing, such as iron and steel, aluminum, cement, chemicals, and mineral and metal processing. In many heavy industries, technologies for decarbonization are nascent. To help drive down costs, it will be important to support development of these technologies, including through piloting, as well as programs for energy efficiency that can reduce energy demand and improve output efficiency. For energy efficiency, first understanding energy use is key. This can be done by adopting already available technologies and software for digitized energy audits and for monitoring and analysis of industrial processes' energy use. The resulting data will inform management information systems, line operators, and policy makers. For achieving industrial decarbonization targets, development and testing of new technologies in pilots will be needed. For this, government support to de-risk such investments and make returns viable for private investors is recommended. For example, modeling indicates a role for CCS in decarbonization of nonmetallic sectors, such as cement (figure 22), with perhaps a lesser role to aid blast furnace decarbonization in the steel industry. Thus, early piloting of CCS with government support could help in preparing industry for decarbonization.

Transport emissions are dominated by road transport and have grown steadily over the past two decades, contributing to worsening air quality. Transport emissions account for 7 percent of national GHG emissions, with 84 percent of transport emissions coming from road transportation, up from 65 percent in 2000. Steadily increasing motorization rates over the last two decades, along with use of older vehicles with poor emissions standards and low-quality fuels, have contributed not only to rising emissions but also to deteriorating air quality in urban areas. The populations of Almaty and Nur-Sultan are exposed to concentrations of air pollution that far exceed the guideline level set by the World Health Organization. A number of factors contribute to the high reliance on carbon-intensive transport, including subsidized fossil fuels, the country's large size and sparse population, the availability of cheap and customs-exempt second-hand cars from nearby countries, and the increase in private vehicle use with rapidly increasing incomes.

Electric cars are expected to be cost-competitive with combustion engine vehicles within the decade and—aided by government policy to level the playing field with combustion engines—could dominate the car market from the 2030s. Motorization is expected to continue to rise into the 2040s due to increasing population and incomes, making electrification an important strategy for decarbonization. In Kazakhstan's private vehicle fleet, the lower cost of liquified petroleum gas (LPG) (a function of lower tax rates and price controls) is increasing the rates of conversion from diesel- and petrol-fueled vehicles to LPG-fueled vehicles. Modeling suggests this trend will reverse, with gas-fueled cars phased out by 2030. The shift to electric vehicles will take time: vehicle fleet turnover takes decades, while the dominance of second-hand vehicle imports from customs-free neighbors means Kazakhstan is likely to lag several years behind those countries in adopting electric vehicles. Most additional cars between 2020 and 2025 are expected to be liquid fuel vehicles. Battery electric cars become cost effective between 2025 and 2030, and completely dominate the sector by the 2040s. This occurs even under the business as usual scenario, though the transition is somewhat slower.

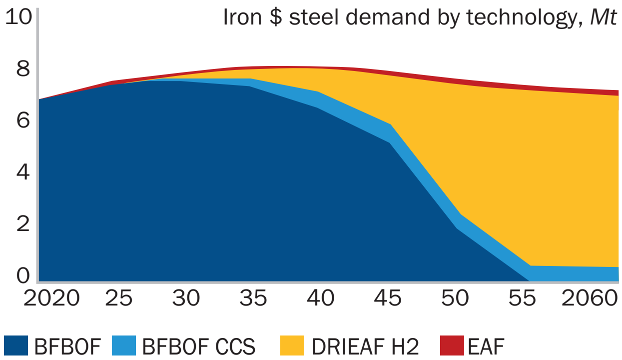
Battery electric and hydrogen are the leading mitigation technologies for heavy vehicles, but both are nascent and need to develop further before application at scale. Modeling suggests that given current expectations for technology costs, heavy vehicles (buses and trucks) are likely to go electric under a net-zero scenario (figure 26). This shift doesn't occur until closer to 2050 under business as usual due to higher relative costs, indicating the importance of policies to encourage the shift in time for 2060. Alternative fuel technologies for heavy vehicles are in the early stages of development. The role of hydrogen is unclear. World Bank modeling suggests hydrogen could fuel 1–2 percent of road freight by 2060, while other studies indicate that the share could be as high as 15 percent by 2060, based on conservative assumptions.

3.1.4 Financing needed to decarbonize the energy system

Large investments are needed to replace aging infrastructure irrespective of decarbonization; decarboniza-tion requires additional and different investment. Under the RFS scenario, total system costs—capex and operating expenses (opex)—are US$920 billion (5 percent of GDP) for the period 2025 to 2060, while costs under the NZE

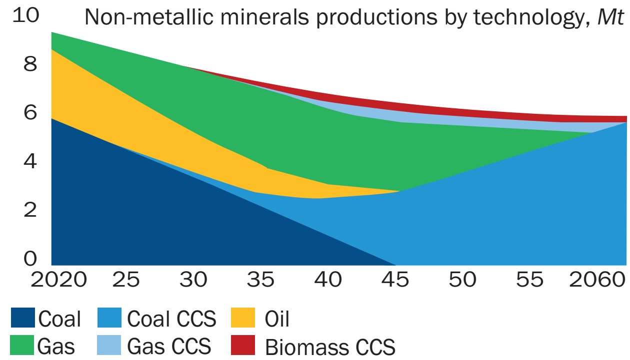
25 Industry (not including transport) was responsible for 61 percent of electricity consumption in 2019. IEA (International Energy Association), "World Energy Balances," https://www.iea.org/data-and-statistics/data-product/world-energy-balances.

Figure 21. Decarbonization of iron and steel, 2020–60



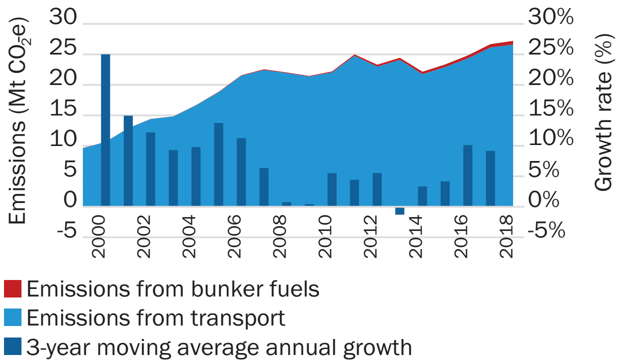
Source: World Bank modeling.
Note: BFBOF: blast furnace–basic oxygen furnace; CCS = carbon capture and storage; DRI = direct reduced iron; EAF= electric arc furnace.

Figure 22. Decarbonization of nonmetallic minerals, 2020–60



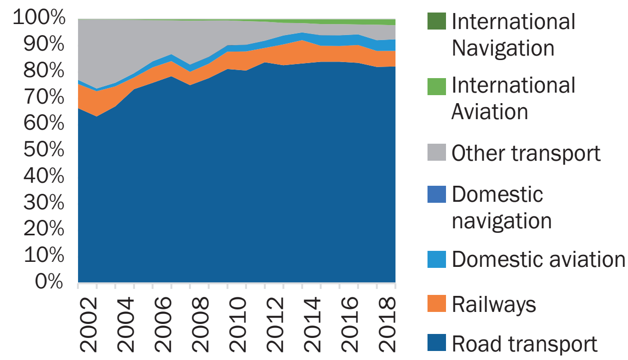
Source: World Bank modeling.
Note: CCS = carbon capture and storage.

Figure 23. Increase in transport emissions, 2000–19



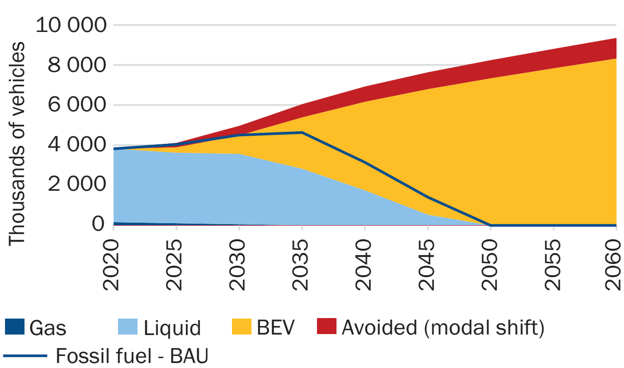
Source: UNFCCC 2021.

Figure 24. Composition of transport and bunker emissions, 2000–19



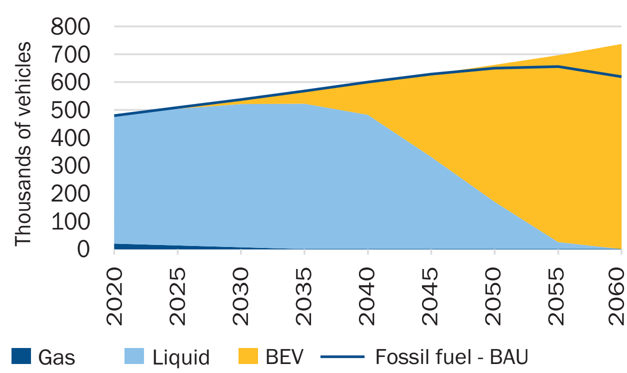
Source: World Bank calculations based on UNFCCC 2021.

Figure 25: Change in composition of cars under net-zero scenario by fuel type, 2020–60



Source: World Bank modeling.
Note: BAU = business as usual; BEV = battery electric vehicle.

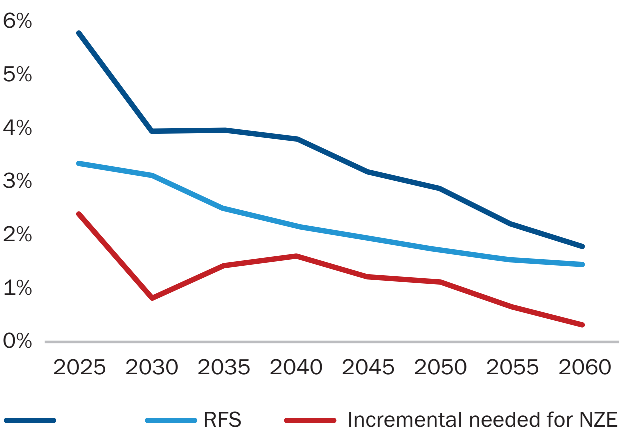
Figure 26. Change in composition of heavy vehicles under net-zero scenario by fuel type, 2020–60



Source: World Bank modeling.
Note: BAU = business as usual; BEV = battery electric vehicle.

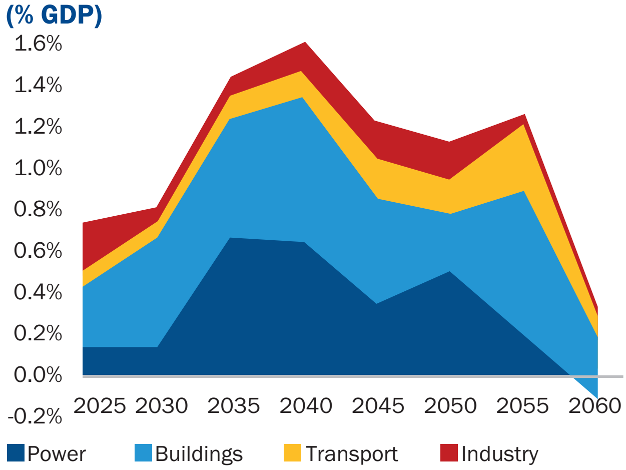
scenario are US$1,150 billion (6 percent of GDP). Thus, NZE costs are higher than the RFS costs by US$230 billion, or roughly 25 percent. The capital investment component of these costs in NZE is US$660 billion (2.9 percent of GDP) over the period to 2060. A large portion of these costs (US$440 billion) would need to be incurred to keep the system operational, as indicated in RFS; hence additional capital costs of decarbonization are estimated at US$220 billion over the period to 2060, equivalent to 0.9 percent of GDP. Two sectors are responsible for most of the difference in capital expenditure between the NZE and RFS scenarios: power and buildings (figure 28). Power sector investment (which captures generation and not transmission and distribution investment) is higher largely due to higher electricity demand (due to electrification of end-uses). For buildings, the building retrofits and the switch to low-carbon heating (heat pumps) in NZE requires more investment than continuing to use gas as heating fuel in the RFS; but implementing energy efficiency measures reduces the needed capacity of the heating units and thereby the need for capital expenditure on heating systems. It also reduces energy use and thereby fuel costs (opex).

Figure 27. Capital investments needed for full energy system decarbonization, 2025–60 (% GDP)



Source: World Bank modeling.
Note: NZE = net-zero scenario; RFS = reference scenario.

Figure 28. Differences in capital investment required for NZE and RFS scenarios, 2025–60 (% GDP)



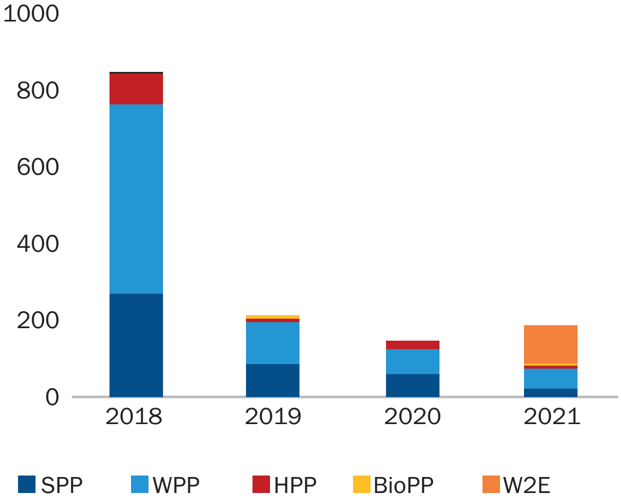
Source: World Bank modeling.
Note: NZE = net-zero scenario; RFS = reference scenario.

The large decline in power sector investment in recent years needs to be reversed. To 2060, the power sector under NZE is estimated to require US$109 billion of investments, or average annual investment of US$3.1 billion. This appears manageable when compared with power sector investments between 2009 and 2014, when Kazakhstan spent on average US$2.4 billion per year. Most of these investments were in the public sector and based on investment plans approved under a state-managed investment commitment scheme, with payments included in tariffs. This spending continued until 2016, when this system was abolished in favor of a capacity and energy tariff scheme. It resulted in almost no new investments coming into the power sector between 2016 and 2019. Since 2019, the government has invited private investments for renewables, has awarded contracts for CHP plants, and is working on auctions for gas-fired generation alongside utility-scale battery storage. It has also financed life extension of coal plants and the rehabilitation of hydropower units. While renewable auctions have been successful in delivering capacity and low prices, their scale has been limited and has declined in recent years (figure 29). Significant work will be needed to scale up renewable investments. Assuming an 80/20 private/public split in generation investments, US2.2 billion of private investment will be needed annually (on average) to 2060.

The actual volumes of annual capex and opex vary significantly over the period until 2030. As power demand increases and fossil fuel–based generation units retire, the composition of total expenditure (capex plus opex) is determined by the new generation mix. As the proportion of renewable generation increases, fuel costs fall.[26] However, as variable wind and solar increase later, gas-fired generation is used to absorb more renewables, contributing to an increase in fuel and operating expenses peaking in 2030 and then tapering down till 2050.

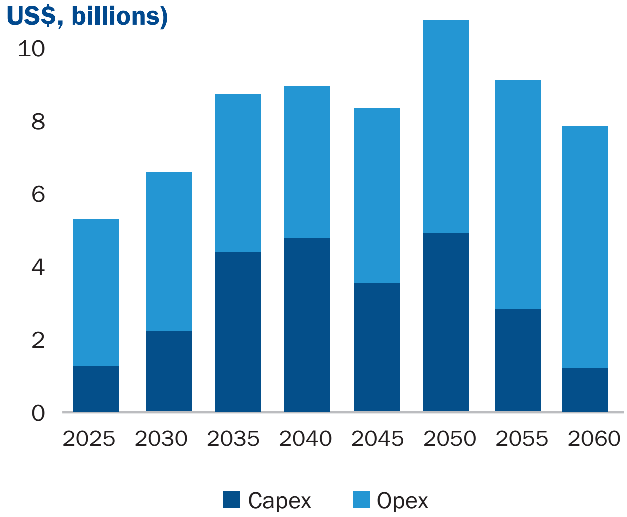
26 Modeled investment costs do not include transmission and distribution costs.

Figure 29. Renewable energy source capacity awards through auctions, 2018–21 (MW)



Source: World Bank staff calculation based on Ministry of Energy data.

Figure 30. Capital expenditure and operating costs for the power sector in NZE (real 2021 US$, billions)



Source: World Bank modeling.
Note: capex = capital expenditure; NZE = net-zero scenario; opex = operating expense.

Operating expenses also increase when wind-based plants with operating expenses larger than solar begin to dominate the generation mix. Another factor contributing to increasing operating expenses is the addition of CCS costs for gas generators after 2040. It is important to keep in mind the differences in the power purchase agreement (PPA) terms needed for promoting these different generation technologies. While different business models can be successful, it may be difficult to attract the necessary investments unless the risks are appropriately parsed between government and private stakeholders.

Building in appropriate storage that supports variable wind and solar and fosters a resilient and flexible system presents its own investment challenge. Under NZE, by 2035 the total capital investment needed for storage is estimated at US$4.8 billion. Most of this can be provided by the private sector if the regulatory and market framework provides appropriate compensation for batteries for balancing, availability, and ancillary services. Effective electricity markets can enable revenues from power trade, alongside other possible use-cases behind the meter. The smart charging of the EV vehicle fleet can also contribute to power system security and balancing but requires a time-of-use (TOU) tariff structure, with behavioral incentives for consumers and charges for point operators and distribution system operators alike. Further analysis is needed to specify the most cost-effective combination for incorporating resources for power system flexibility.

Investments in energy efficiency reduce the costs of decarbonization by reducing the need for power and heating infrastructure. The energy efficiency improvements achieve total system cost savings (capex and opex) of over US$70 billion in the period to 2060.

The costs of decarbonizing the energy system could be further reduced through offsetting (rather than emissions reduction) in the hard-to-abate sectors, as well as through enhanced regional power trade and improved power system flexibility.

- **Offsetting for the most expensive emissions reductions.** Emissions can be offset either through enhanced domestic carbon sequestration or through the purchase of international offsets. Offsetting frees Kazakhstan from undertaking the most expensive abatement, and therefore contributes substantially to reducing the cost of meeting the net-zero target. Assuming Kazakhstan could achieve an additional 30 Mt of carbon sequestration per year by 2060[27] and apply this as an offset for the energy sector, it would save US$80 billion over the period 2020–60 in total system costs (capex and opex).

27 This is the midway point of the 20–40 Mt estimate of carbon sequestration potential discussed in section 3.2.2.

- **Regional power trade.** Enhancing regional trade, such as with members of the Eurasian Economic Union (Russia, Belarus, Armenia, and Kyrgyz Republic), could reduce the cost of supplying power and improve grid stability—particularly when greater renewable penetration increases variability in generation output. Some countries well endowed with gas resources, for example, can facilitate peaking and intermediate power more cheaply, while others can provide cheaper seasonal hydro resources that would allow for lowering the use of coal and fossil-based generation. Kazakhstan could benefit from competitive advantage in the region with its cost-effective onshore wind.
- **Power system flexibility.** Further optimization of resources for power system flexibility—including the optimal balance of transmission infrastructure (not included in modeled investment figures), storage, hydrogen, and flexibility from power generation (including hydro, solar, wind, and flexible gas)—is expected to reduce the high curtailment seen in NZE, reaching over 10 percent of solar and 4 percent of annual wind generation from 2050 onward, further reducing system costs in NZE.

The costs of the energy transition are increased if action is delayed or if coal generation is maintained. Delaying action until 2030 to reduce emissions in the energy sectors would add US$55 billion, or 4.8 percent, to the total system costs of achieving full decarbonization by 2060. Costs increase as more emission-intensive infrastructure is put in place and businesses have less time to develop low-carbon solutions and drive down technology and implementation costs. If coal-based power generation is maintained at current levels and fitted with CCS, total system costs grow by US$45 billion to 2060 (table 3).

Table 3. Additional total system costs (capex and opex) of decarbonizing the energy system under different scenarios, 2023–60

	2023–60 Cumulative, real 2021 US$, billions (% GDP)	**Net impact on additional total system costs**
RFS total system costs	920 (5.0%)	
NZE total system costs	1,150 (6.0%)	
Additional total system costs for full decarbonization	230 (1.0%)	
Additional savings from using sequestration as an offset	80	150
Additional costs if action is delayed to 2030	55	288
Additional costs if coal is used (with CCS)	45	278
Additional costs if action is delayed and coal (with CCS) is used	100	333

Source: World Bank modeling.
Note: Additional total system costs refers to the difference between NZE and RFS scenarios. capex = capital expenditure; CCS= caron capture and storage; NZE = net-zero scenario; opex = operating expenses; RFS = reference scenario.

3.1.5 Enabling energy sector decarbonization

The NZE scenario envisages a full-fledged transformation of the energy sector from a fossil fuel–dependent system to a clean energy system. Although NZE targets are ambitious, they are achievable should a conducive enabling environment be put in place. This section sets out priority actions to enable decarbonization of the energy system.

Power, buildings, and industry

The government must update the existing long-term strategy and supporting action plans to reflect the national ambition to achieve NDC targets and net-zero emissions. A dedicated long-term energy sector decarbonization program should be developed with explicit interim targets to facilitate an orderly transition. The long-term program needs to be embedded with short- and medium-term targets and policy actions. The government should put in place an institutional mechanism to conduct regular progress reviews under the program and introduce corrective actions to ensure achievement of intermediate and long-term emissions targets.

Large-scale deployment of renewables, especially solar and wind, will be the main driver of the energy transition. Under the NZE scenario, their share increases from below 4 percent in 2021 to 35 percent by 2035 and 72 percent by 2060. The government must announce long-term renewable targets to give a decisive signal for investors. A competitive and transparent procurement approach, such as through auctions, may yield desired outcomes for the affordability and sustainability of renewable energy. They would also complement the existing emissions trading system (Box 6). In parallel, investments should be made in grid enforcement, power system flexibility, grid digitalization, storage, and better forecasting to enable grid integration of renewable energy sources at scale. Adequate risk allocation among stakeholders and a clear regulatory framework will assist in attracting investment.

Medium-term availability of domestic or imported natural gas is important for successful decarbonization. Significant disparity between the purchase price of gas for domestic use and gas for export must be addressed to ensure availability of natural gas. Solving the gas conundrum involves not just efficient procurement of gas, but a very concerted effort to use it prudently and effectively to integrate renewables, build efficient load-following gas generators, modernize industry, and develop CCS. Further analysis is required to estimate the optimal balance of natural gas supply fundamentals: natural gas production, exports, and imports during the decades of decarbonization until 2060.

Box 6. Interaction between the ETS and renewable auctions

Existing legacy-based central planning approaches in the power sector are not amenable to merit-order power dispatch or to market-based investment and consumption decisions. Such approaches also do not facilitate the incorporation of carbon pricing from the ETS in the operation of the power sector. To bring in market forces, renewable energy auctions are recommended because they spur competition for renewable investments. At the same time, ETS coverage should be maintained across the power sector, since this will offer two benefits as carbon prices become more significant: (i) it will facilitate a more orderly phaseout of higher-emission generators and favor additional or continued operation of lower-emission generators, and (ii) it will help rationalize dispatch decisions by incorporating carbon costs in day-to-day operations of power and CHP facilities.

Decarbonization requires rethinking the current price-setting mechanism and subsidy structure. Kazakhstan transfers significant resources to subsidize fossil fuels, driving inefficient resource allocation in the country (box 7). The government should work to redirect energy subsidies to protecting households (see section 4.2.3) while allowing more cost-reflective prices to attract investment and efficient resource allocation. Establishing an independent regulator or consolidating all price-setting functions under a single authority would facilitate the transition to cost recovery–based tariff setting. A well-designed communication campaign should accompany tariff reforms.

Removing fossil fuel subsidies is particularly important for achieving transformation in the heating sector, where new investments are badly needed. Tariff reforms are needed to allow investors to recover costs while programs to protect vulnerable populations from price impacts are being developed. Unless these competing priorities are well balanced, reliable heating services will become increasingly unsustainable. Furthermore, to improve the reliability of heating services, the government must develop good-quality heating sector master plans for each locality, with decentralization of decision-making to akimats, and at the same time continue to set reliability and quality standards at a central level. Assurance of appropriate budget and guarantee support from the center can also be predicated on good governance and transparency requirements. In addition, considering that geothermal resources in Kazakhstan remain mostly untapped, geothermal can where available supplement fossil-based heating, reduce GHG emissions, and improve air quality. Developing this green heating option builds upon expertise the country already possesses in the oil and gas sector. Greater use of geothermal heat pumps will also help build expertise around heat pump technology in general, which is crucial for decarbonizing heating.

Box 7. Implications of fossil fuel subsidies in Kazakhstan

According to the International Energy Agency, Kazakhstan ranks among the top-25 countries for size of fossil fuel subsidies; its subsidies came to US$4.3 billion in 2020, or around 2.8 percent of GDP. Kazakhstan's energy subsidies are estimated at around US$228 per capita, which is high even among peer fossil fuel–producing countries (figure 31). Regulated retail tariffs are not fully cost-reflective and do not account for the cost of modernization. Electricity tariffs are set for households at around 3.2 cents/kWh and for business at 5.5 cents/kWh—much lower than its full cost. Similarly, domestic gas prices are set at around US$50–60/1,000 m3 across consumer categories, which is about a third of the Henry Hub natural gas price (a proxy for export prices) of around US$163/m3 (US$4.91/MMBtu on January 31, 2022).

The current system of artificially low tariffs and high subsidies undermines investment and has several undesirable results: (i) a large portion of sector assets left obsolete and in need of modernization or replacement; (ii) lack of proper pricing signal for renewable energy scale-up—in fact, renewable energy capacity addition declined from 850 MW in 2018 to around 200 MW in 2021; (iii) lack of incentives to save energy, causing sudden supply-demand gaps and fast-changing load patterns (also associated with the rapid increase of cryptocurrency firms attracted by artificially low electricity prices), as well as slow implementation of sustainable heating and energy efficiency programs in end-user sectors; and (iv) lack of incentives to invest in gas sector development to support the country's energy transition away from coal.

A comprehensive, consistent, long-term strategy is needed to improve demand-side energy use, especially in energy-intensive sectors such as buildings and industry. A national energy efficiency program spanning at least a decade should be considered to develop the right enabling environment. The program would aim in part to improve the gathering and use of energy efficiency data to promote good policy development and demand-side management. An apex body could be established responsible for implementing energy efficiency policy and for monitoring outcomes. This body could develop increasingly stringent energy efficiency standards, report on and monitor energy use, and undertake digitization and dissemination of aggregated data to policy makers and the public. The government could further accelerate energy efficiency initiatives through incentive programs that encourage commercial, industrial, and residential users to achieve energy efficiency measures, through wide-scale replication of an energy-labeling system, and through adoption of energy efficiency standards, such as for appliances. In Brazil, an aggressive demand-management and energy efficiency campaign reduced total electricity consumption by 10 percent, substantially reducing the need for subsidies.

Transport

In the transport sector Kazakhstan will need to take a steady and comprehensive approach to reduce road transport emissions, while maintaining mobility and trade connectivity.[28] Three main initiatives are proposed as a means to reduce energy consumption and emissions from the transport sector: (i) enabling the shift to e-mobility; (ii) promoting the modal shift from personal vehicles to low-emission alternatives in the urban setting; and (iii) undertaking further electrification of rail. These initiatives align with the Avoid-Shift-Improve (ASI) approach.[29] These changes also have important co-benefits, including improved health and well-being of citizens through better urban air quality, improved opportunities for active mobility, lower overall transport costs and travel times, and improved accessibility and equity.

28 Given the low contribution to transport sector emissions from domestic aviation and domestic shipping, these subsectors are not addressed in detail in this report. However, in aviation, emissions may be reduced by shifting short-haul passenger and freight trips from air to rail, retiring older aircraft, retrofitting existing fleets with energy-efficient features, and increasing the use of sustainable aviation fuel.

29 The Avoid-Shift-Improve approach entails three pillars that work in tandem to achieve net-zero emissions from transport by 2060. The first goal is to improve the efficiency of transport systems to avoid or reduce the need for motorized transport through shorter and fewer trips. The second is to shift away from emissions-intensive modes of transport, and the third is to improve vehicle and fuel efficiency of remaining modes.

To aid uptake of electric vehicles, barriers to their deployment need to be addressed. A key issue is convenient and affordable publicly accessible chargers. Government can support EV charging infrastructure through direct investment or through incentivization. Urban settings will be the early priority for charging infrastructure, as cities are likely to be the focus of the transition early on, particularly given the expected growth in vehicle numbers; but regional chargers will also be important to enable interregional mobility. To ensure deployment, the government could finance the early rollout of EV charging stations, gradually reducing its intervention as the number of vehicles becomes sufficient for the private sector to invest. Efforts could include publicly accessible chargers but also incentives for installation of personal recharging facilities in private homes and apartments. An upper bound for the cost of government provision of EV charging infrastructure for the first 10 years (servicing about 2 million vehicles) is estimated at US$1 billion.[30] Providing infrastructure for the first five years of EV uptake amounts to US$210 million. These costs could be offset with associated revenue and potential for privatization over time. Electrifying the government vehicle fleet and purchase incentives should be considered until EVs are mainstreamed. The dominance of second-hand vehicle imports from customs-free neighbors yet to see substantial uptake of EVs means liquid fuel vehicles from these countries will have a continued cost advantage compared with electric vehicles available from other regions, such as China and Western Europe. Fiscal incentives, including lower customs duties applied to imported second-hand electric vehicles, can support and even hasten the initial uptake of electric vehicles and underpin a scale-up in EV manufacturing and battery industries. Purchase subsidies averaging US$1,000 for the first 500,000 vehicles (US$500 million) could help to kick-start the sector. Incentives should focus on making EVs competitive and then gradually phasing out purchase subsidies as availability expands. Battery production is a possible path for commercial development in Kazakhstan; batteries for new vehicles and replacement batteries for older vehicles could be produced.

Better aligning vehicle and fuel taxes and subsidies to reflect efficiency and pollution levels could further guide the shift to cleaner vehicles and public transport use. Kazakhstan has two vehicle-related taxes, one based on engine size and paid at the time of purchase, and the other a tax on registration. Both could be adjusted to incentivize more efficient and less-polluting vehicles by basing them on emissions or fuel efficiency. Reforming fossil fuel subsidies will incentivize less driving and more efficient vehicles while reducing traffic congestion and road accidents. Adopting Euro-V or Euro-VI fuel standards, along with fuel efficiency labeling and emissions standards for fossil-fuel vehicles, could help reduce emissions in the near term.

Shifting trips from private vehicles to public and active transport would improve congestion, a growing issue in Kazakhstan's cities, and would deliver cost, health, and emissions benefits both for passenger and freight transport. Although the shift to e-mobility will reduce cars' emissions of GHGs and local particulates in coming decades, it will not address congestion—a problem that increases transport costs, parking issues, and emissions from remaining liquid fuel freight vehicles. TomTom data for April 2019 showed peak hour traffic speeds in the Almaty region to be 50 percent slower than free-flow speeds, with traffic in the city frequently at a standstill.[31] World Bank modeling found that modal shift under the net-zero scenario could avoid the need for 225,000 cars by 2025, and over 1 million by 2060. One way to avoid the need for so many car trips while improving cities' livability and affordability is through changes to urban planning, investment in digital connectivity, and public transport. If people can live closer to essential services like shops, education, and work, or can work remotely, there is less need to travel distances. Changes to urban planning approaches have an effect only as new developments are built and building stock is renewed or renovated. They can have the biggest and quickest effect on rapidly developing peri-urban areas, which can also house more vulnerable populations. Continuously improving accessibility and consumer experience would also attract more people to public transport. For example, further progress is needed on dedicated bus lanes; Kazakhstan's goal is to have regular bus routes available for 96 percent of settlements with more than 100 residents. The government could play a more active role in improving the emissions intensity of passenger and urban transport by expanding the urban public transport networks, adopting green public procurement, supporting local production of vehicles, and offering incentives for cleaner vehicles. The shift to low-emissions urban public transport was modeled through expansion of the electric bus network. Metro rail development was not modeled. The estimated additional cost of moving to electric buses is US$13.8 billion to 2060 with an annual cost ranging from US$200 million to US$600 million.

30 Cost is estimated for Type 1 and Type 2 chargers for every 20 EVs and Type 3 chargers for every 50 km of national road network. Assuming 2 million EVs over the first 10 years, this equates to 50,000 Type 1, 50,000 Type 2, and 500 Type 3 chargers. The estimation allows for replacement every five years.

31 The TomTom Traffic Index ranks urban congestion at the local and global levels. TomTom, https://www.tomtom.com/en_gb/traffic-index/.

Box 8. Summary of recommendations for energy system decarbonization

Power, buildings and industry sector recommendations

Short term (0–5 years) to establish an enabling environment for decarbonization while scaling up renewables:

- Update existing net-zero strategies and action plans to reflect the ambition to achieve net-zero emissions by 2060. Put in place an institutional mechanism to monitor progress and interim targets and identify policy actions to facilitate an orderly energy transition.
- Develop a plan for ramping down and retiring the coal-generation fleet following the just transition approach. Start retiring older plants. Conduct and regularly update system planning exercises that involve progressive decarbonization of the power sector.
- Gradually realign fossil fuel subsidies so that prices are more cost-reflective, using the fiscal savings to support poorer households (see chapter 4). Develop and implement a well-designed communication and outreach campaign.
- Accelerate scale-up of renewables, especially solar and wind, through transparent competitive processes such as auctions; develop public-private partnership structures and internationally financeable power purchase agreements and associated contracts that allow for appropriate parsing of risks between public and private participants.
- Invest in grid enforcement, power system flexibility, digitalization, storage, and better forecasting to enable grid integration of renewable energy sources at scale.
- Explore the potential for using geothermal for sustainable heating.
- Aim to bolster the monitoring, measurement and reporting of fugitive emissions as an important step to better management of fugitive emissions.
- Prepare and implement a comprehensive, consistent, long-term energy efficiency strategy and associated implementation programs, including incentive schemes for energy conservation, acceleration of an energy efficiency labeling program, and establishment of a dedicated body consolidating energy efficiency policy research and monitoring functions. Incorporate more stringent energy efficiency targets into industry standards, upgrade energy efficiency standards in building codes, and aim to retrofit at least 2 percent of existing buildings annually from 2023 onward.

Longer term for deep decarbonization:

- Improve power system flexibility by 2035 with the (i) development of revenue streams for storage (battery, pumped hydro, hydrogen) and flexible power plants through ancillary services market, wholesale electricity trade, and removal of regulatory barriers; (ii) targeted incentives for transmission and distribution system flexibility, including removal of barriers to connecting solar, wind, and new technologies to the power system; and (iii) demand-side management practices through rebates, prices, and tariffs, with emphasis on industrial and commercial demand shifting and coordinated smart charging of EVs.
- Design and implement an investment program to commercialize new technologies in areas such as (i) blended finance for deep renovation of buildings, (ii) reduction of heat losses in pipelines outside the jurisdiction of district heating companies, (iii) drilling of exploratory geothermal wells, (iv) rebates to encourage distributed technologies, including heat pumps and rooftop solar, and (v) construction of zero-emission buildings.
- Assess the potential of emerging technologies and consider technology demonstrations/pilots for carbon capture and storage in industry and the power sector, clean hydrogen production, and battery storage.
- Develop a program to create a domestic supply chain around the renewable energy industry.

Transport sector recommendations

Short term (0–5 years)

- Develop and implement early-stage EV recharging infrastructure and prepare a longer-term strategy for the infrastructure needed to facilitate the rapid uptake of low-cost electric vehicles expected from 2025.
- Consider fiscal incentives, such as removal of customs duties on second-hand electric vehicles, adjustment of vehicle taxes to be more aligned with emissions, and purchase subsidies for EVs.
- Undertake public procurement of low-emissions vehicles for public purposes and offer incentives for cleaner vehicles to decrease emissions from the public transport and government fleets.
- Adopt higher-quality fuel standards, fuel efficiency standards, and fuel efficiency labeling for vehicles.
- Develop a planning scheme for new peri-urban developments that incorporates compactness and mixed-use developments, local access to services and public transport, and high-quality, dedicated, physically protected, connected networks for active transport.
- Expand public transport networks, including more dedicated bus lanes to improve speed and efficiency of trips. Continue to plan the introduction of more low-emissions buses and expansion of the Almaty metro, when feasible.
- Develop a plan for continued electrification and logistical improvements to the rail network that can help reduce emissions from the freight and logistics sector and maximize the efficient use of local construction capabilities.

Longer term

- Rationalize and electrify the rail network.
- Develop infrastructure to support uptake of low-emissions heavy vehicles; depending on which technology becomes more commercial, this could be hydrogen refueling or electric charging.
- Expand urban planning reform to integrate transport-oriented development principles.

Decarbonizing transport is discussed further in Background Note 5.

Shifting freight from road to rail offers opportunity to decarbonize freight transportation, along with electrification and rationalization of existing diesel-powered rail routes. A 2020 study for the European Environment Agency comparing GHG efficiency rates of passenger and freight modes found that road freight had up to six times the carbon emission per tonne-km of rail freight, while air freight had up to 43 times the carbon emissions of rail freight (Fraunhofer ISI 202). The implication is that modal shift of freight to rail offers significant opportunity to decarbonize the transport sector.[32] About 26 percent of the rail network is already electric.[33] Kazakh Temir Zholy (KTZ, Kazakhstan's state-owned rail company) is proposing to electrify a further 1,012 km of rail network through construction of the Dostyk-Minty and the Almaty bypass, critical to international transit of freight through Kazakhstan, at an estimated cost of US$1.35 billion over the next five years.[34] Electrification could be further encouraged over the coming decades with rationalization and electrification of the remainder of the network and purchase of more electric locomotives. The government could reduce emissions from non-electric rail and encourage a shift from road to rail freight through various measures: adjustments in train schedules and pricing to meet the needs of shippers; synchronization of train movements between countries to reduce transit time and delays; use of audits and performance monitoring to reduce fuel consumption and emissions; and improved IT systems to improve fleet management, locomotive operations, train control and track access. Investment is needed

32 This study was based on "well-to-wheel" emissions, i.e., emissions from the production and distribution of fuels are accounted for. The values are not strictly representative of Kazakhstan, given the different GHG intensity of energy production and geography.

33 The total rail network is 16,040 km, with 4,216 km electric as of 2019 (CAREC 2021).

34 The cost excludes electric locomotives and lighter wagons.

in electric rail infrastructure and equipment logistics services and efficient operations to make modal shift to rail an attractive alternative.[35]

Any cost increases to fuels or transport may impact low-income households, so the rollout and communication of changes to transport should be carefully planned and coordinated to ensure they are understood in the context of the more significant upsides. The proposed measures to address transport emissions will have both immediate and longer-term benefits for citizens; but some benefits, like lower whole-of-life vehicle running costs and health improvements, may not be immediately obvious to the population, so these will need to be promoted. In isolation, cost increases can have detrimental impacts on low-income residents, particularly those in rural areas who have fewer transport options and further to travel. They can also cause social disturbance, as witnessed in the 2022 unrest sparked by increasing LPG prices. The rollout should therefore focus first on measures to expand and improve affordable public transport. Measures that reduce costs for low-income households, such as targeted subsidies, public transport fare differentiation, or customs duty waivers, should be delivered together with subsidy and tax reform to balance any cost impacts, and where possible cost changes should be implemented gradually to enable behavioral and other changes to keep pace.

3.2 Development in water, agriculture, and rangelands should be climate-smart

3.2.1 Addressing adaptation

Water, agriculture, and rangelands in Kazakhstan are highly vulnerable to climate change and require a cross-sectoral approach that considers regional differences. Land and ecosystem degradation are already having negative impacts in Kazakhstan that will be compounded by climate change. Observed temperature and precipitation shifts are resulting in desertification and degradation of croplands and pastures, with an estimated 66 percent of land already subject to some form of degradation. Additionally, with both annual and seasonal changes in rainfall patterns, areas suitable for currently cultivated crops and livestock are shifting northward as summers grow longer and hotter and winters grow shorter and warmer. A key determinant of resilience to droughts—the level of moisture stored in soils as a result of rainfall and temperature patterns—is declining across the northern and western regions of the country. In southern Kazakhstan, where irrigation is prevalent and land plots are much smaller, the higher temperatures and rainfall changes are expected to lead to a 10–14 percent increase in demand for water for irrigation by 2050. This is a significant increase for the already water-stressed region, which will experience higher water needs to meet the growing population and rising food demand in the future. Given the interrelationship of water, agriculture, and rangelands, there is a need to pursue a cross-sectoral approach to help build climate resilience.

A key part of the climate change adaptation agenda is to cope with the impacts on water resources. Significant variations across the country in water supply, water demand, infrastructure status, and future climate change impacts give rise to economically and socially significant water management challenges. The capacity to adapt and meet these challenges is weakest in the lagging and most-water stressed regions of the country. While clear directions have been set for water resource management policy, further strengthening of governance and regional cooperation—on policy, institutions, and regulations—is required. Climate adaptation priorities need to be clearly integrated into water resource policy and planning. The recent idea to establish a National Water Council, especially to help manage transboundary water allocations and agreement, is encouraging and requires support. Building the scientific and technical foundations for water management in government institutes and universities will be important. There is also a need to better enforce regulations to monitor and impose abstraction and disposal measures that optimize utilization of water resources (e.g., increase efficiency of use, protect the environment, and increase the water allocation for restoration of environment, such as in the North Aral Sea) while ensuring proper management of all basins. This effort may entail reducing abstraction from threatened basins and review of the spatial match between the economic sectors, or mobilizing water to intensive-demand centers from outer regions with greater availability of water resources.

35 Examples of improvements to logistical services and operations include double-stacking, synchronizing train movements between countries, simplifying and digitizing cargo documentation, and introducing flexible tariffs.

Box 9. Cost-effective climate-smart agriculture investments in Kazakhstan

Cost-benefit analyses of investments in specific CSA technologies in Kazakhstan indicate the value of adaptation and mitigation benefits derived from them. Specific findings include the following:

- Adopting conservation agriculture at 7.2 million ha (40 percent of total cereal, seed oil, and leguminous crop area) requires investments of US$263 million, resulting in potential GHG reduction of 2.3 million t CO_2-e/year and annual benefits of approximately US$250 million.
- Adopting efficient field machinery (69,000 tractors and 25,000 harvesters) requires investments of US$1 billion, resulting in potential GHG reduction of 260,000 t CO_2-e/year and annual benefits of approximately US$63 million.
- Adoption of precision agriculture (around 45,000 units of systems of parallel driving on 9 million ha) involves US$80 million in investments and can result in potential GHG reduction of 122,000 t CO_2-e/year and annual benefits of approximately US$10 million.
- Adopting improved greenhouses (around 150 ha and up to 300 ha including new greenhouses) involves investments of US$4 million, resulting in potential GHG reduction of 45,000 t CO_2-e/year and annual benefits of approximately US$1 million (Santos 2019).

A study in Ukraine (Carbon Trust and UkrAgroConsult 2022) shows that CSA solutions not only deliver GHG reductions and promote climate resilience but also make business sense; see table 4.

Table 4. Benefits of CSA practices in Ukraine

CSA solution	Average GHG reduction per ha (kg CO_2-e)	Average yield improvement in year 1	Average change in revenue per year (US$)	Net margin
Crop protection chemicals	1.8	10%	99	63%
No-till	308.9	8%	79	63%
Agri-tech/data and planning	68.7	12%	117	65%
Seeds (drought, disease, yield)	1.8	10%	99	61%

Source: Carbon Trust and UkrAgroConsult 2022.
Note: CSA = climate-smart agriculture; GHG = greenhouse gas.

The efficiency of water use can and should be improved. There is significant scope to increase water efficiency for irrigated crops by reducing transport and evaporation losses and by introducing water-saving technologies, such as drip and in-soil irrigation, sprinkling, local impulse irrigation, and irrigation along furrows. Existing agriculture and water subsidies and public investment in those sectors need to be oriented to promote adoption of innovative and water-efficient technologies at scale. Attention will also need to be paid to diversifying crop production to higher-value crops with lower water use. Targeted expansion of irrigation systems seems to be necessary to preserve productivity, particularly in the southern regions, but expansion must carefully consider the current and projected water resources availability as well as the cost-effectiveness of efforts. Water-saving technologies should also be introduced in industry, which consumes 20 percent of water and where only 20 percent of enterprises employ water-recycling technologies.

In addition, to mitigate uncertainties and shifts in availability of water resources, both within a given year and interannually, it is necessary to increase and optimize multipurpose water storage. Combining storage with small- and medium-scale hydropower will also provide renewable energy while supporting a more complex, multipurpose strategy for water saving and development. Investment is required for modernizing existing infrastructure and filling key infrastructure gaps for water storage (for water supply, hydropower, and flood mitigation). Storage (of all sizes) is a key tool to manage future water resource uncertainties (both spatial and temporal). Reservoir operations should also be reviewed to better balance water supply, flood mitigation, and hydropower generation considering future climate uncertainties. In parallel, opportunities for nature-based solutions for storage should be explored.

Climate-smart agriculture (CSA) practices can improve productivity while building resilience to climate change and reducing emissions. CSA practices include the introduction of water-saving technologies, cultivation of water-efficient crops, restoration of water infrastructure, and leakage control. Additionally, the use of moisture-saving technologies (conservation agriculture, no-till farming) can contribute to soil conservation. While CSA has a strong potential to add sustainable food security and financial value to the economy, proactive government assistance is required to harvest the full benefits. Many public good CSA interventions have benefits—including decreased deforestation, increased soil carbon sequestration, and reduced water consumption—that do not accrue financially to private sector companies, including farmers, and that cannot be captured in financial models. Concrete revenue streams or upfront resources to help incentivize and internalize these positive externalities are required. This could be done by linking existing subsidy programs to the adoption of selected CSA practices by farmers. Targeted blended concessional finance programs are needed to support technical assistance in emerging markets to offset perceived and actual risks, reduce the high cost of adoption, and incorporate public good co-benefits of CSA investments (IFC 2021).

Sustainable land management is key to supporting the resilience of rangelands. To adapt rangelands to the consequences of ongoing climate change, it is necessary to introduce sustainable land management practices, including the transition to an adaptive landscape system for animal husbandry and fodder production. This step would be strengthened by realigning subsidies to make them conditional on the adoption of adaptation practices. In the long term, updating the 2017 Law on Pastures and adopting the Forestry Development Program (until 2050) would help to resolve the consequences of the reorganization of the republican forest management body and better coordinate land management across agencies.

Nature-based adaptation against potential disasters is also important for addressing the effects of climate change. Kazakhstan has already invested significantly in infrastructure in the southern mountains, particularly around Almaty, to protect against floods and mudslides. These investments should be augmented with nature-based solutions such as reforestation of upstream slopes and watersheds. Additionally, flood-prone areas should undertake natural floodplain management, which includes floodplain or wetland restoration, planting of green infrastructure (e.g., hedgerows, woodlands, natural grasslands), and blue elements such as pools, ponds, buffer basins, or water courses. Current plans for increased saxaul plantations in degraded arid landscapes could also help lesson desertification and dust storms.

3.2.2 Reducing emissions and carbon sequestration

Landscape-based carbon sequestration needs more study but has significant potential to provide an important net carbon sink that can offset the more expensive abatement from hard-to-abate sectors and reduce the cost of achieving net zero. Based on the existing information, the potential for sequestration in rangelands, pasturelands, and forests in 2060 ranges from 20 million t CO_2-e/year, a conservative estimate, to 40 million t CO_2-e/year, an ambitious estimate; the cost would be US$62–124 million per year from 2022 to 2060.[36] In order to reach even the conservative estimate, work must start now on focused research into sequestration potential, and promising techniques must be piloted. Significant scaling up of successful pilots should start in the early 2030s and expand through the 2050s; otherwise this sequestration potential will not be met.

In order to increase the potential for carbon sequestration in rangeland and pastureland, it is necessary to implement monitoring systems, restore pasture infrastructure, and promote environmentally balanced pasture use, all of which require significant investment. Increased soil carbon sequestration should be achieved through the adoption of improved grazing management practices, which allow more reactive management of grazing pressure (in time and space) and contribute to improving and diversifying pasture vegetation cover. Immediate measures include the creation of a single center for improving methods for collecting and analyzing data on GHG emissions and removals, and the introduction of an improved grazing management system to increase carbon sequestration.

36 These estimates are based on the rough extrapolation of the data available from Jasyl Damu for the Low Emissions Development Strategy .

To reduce GHG emissions, the livestock sector and rangelands management should shift from an expansion-based to an efficiency-based approach. The latter involves improving feed balancing and feed digestibility (reduced enteric methane); improving manure management (reduced methane and nitrous oxide emissions); and improving grazing practices and restoring degraded soils (carbon sequestration). In addition, energy-efficient equipment, renewable energy generation (reduced fossil fuel use), improved storage, and reduced food and feed losses (reduced waste-related losses) would complement the climate change mitigation strategy in livestock development. Such a shift would reduce area expansion and prevent GHG emission, as well as increase and foster carbon sequestration.

Increasing forest cover through afforestation and reduced deforestation will increase carbon sequestration, improve biodiversity, and help build climate resilience by preventing land degradation, mudslides, and flooding. Government afforestation efforts include the recently announced target of planting 2 billion trees by 2025 over an area of 1.5 million ha, including the dried Aral seabed. While this program should bring many ancillary benefits, neither a roadmap nor an implementation plan for the green program has been shared. The most significant threats are the projected increase in forest fires and the expanding range of pests and shifts in ecological zonation in the coming decades due to higher temperatures and dryer conditions in the summer months. Ensuring a coordinated approach across the country as well as a longer-term vision for maintenance, fire prevention, and further planting will be key to success.

3.2.3 Creating an enabling environment

A supportive enabling environment will require actions across policy and investments, capacity building, and information and knowledge. To achieve climate goals, climate change will need to be integrated into existing legislation and sectoral strategies, and existing plans will need to be implemented. For example, the benefits of conservation agriculture in setting the stage for resilient agriculture in Kazakhstan are clear (they include continuous minimum mechanical soil disturbance, permanent organic soil cover, and diversification of crop species); but the state program (2021–30) contains no specific targets. Inclusion of climate change considerations in the 2003 Land Code would help ensure a holistic approach to land degradation, soil erosion, habitat fragmentation, and ecosystems stressors. Updating the 2003 Forest Code to eliminate barriers to commercial forest cultivation would help expand sequestration potential for forests. Strategic environmental assessment should also be considered to help integrate environment and climate change issues into development planning.

Climate adaptation and sector planning can be strengthened by investing in information systems and by sharing and using data and information for consultative planning. In the water sector, for example, modeling and forecasts for better protection and disaster prevention and the monitoring network of the water bodies should be expanded. In addition, it will be important to develop capacity to address transboundary water management through better water infrastructure, climate-smart agriculture, and modern processing, handling, and storage of agricultural products. Adaptation investments in climate-resilient water management, agriculture, and improved early warning systems at the cost of 0.3 percent of GDP will reduce significantly higher average annual losses from natural disasters (see section 4.3.2)

Improving research and data collection will fill key information gaps and inform policy responses. The water sector could benefit from improved water accounting for surface water and groundwater, assessment of water balances for individual territories, and improved methods for hydrological forecasts and analysis. Research into the carbon sequestration potential of rangelands, pasturelands, and forests is nascent and must be bolstered given the important role these land types will play in offsetting emissions elsewhere and enabling achievement of the net-zero target. Further agricultural research into subnational impact prediction and response (e.g., drought-tolerant wheat varieties and shifts to other cereals) is needed. In this regard it will be important to improve the overall hydrometeorological system, including agrometeorological support for crop production and monitoring of rangelands. A service for meteorological support of animal husbandry might also be created to improve the pasture monitoring system, which could be located on the premises of agricultural/livestock research institutes. Use of GIS (geographic information system) and remote sensing would allow better management and response to hazards such as floods and fires. It would also strengthen development of the Agricultural Drought Risk Index and maps, which have been piloted successfully in Kazakhstan (Kim et al.), and strengthen the national geoportal to assist land use planning.[37]

37 National geoportals have been developed in other countries under INSPIRE Directive 2007/2/EC (UNECE 2019).

Box 10. Summary of recommendations for climate-smart development in water, agriculture, and rangelands

Short term (0–5 years) to improve coordination and planning for addressing climate impacts while introducing climate-smart practices:

- Integrate climate change considerations into existing land and water management plans and legislation, including the 2003 Land Code and 2017 Law on Pastures.
- Strengthen transboundary cooperation and data sharing with upstream and downstream riparians on Kazakhstan's international rivers.
- Improve the assessment of how climate change may impact the spatial and temporal mismatch between water resource availability and demand; strengthen the understanding and management of trade-offs among key water-using sectors.
- Strengthen adaptation and sector planning through investments in hydromet, water information systems, and data sharing and use for decision-making.
- To reduce water losses and improve water productivity, invest in renewal and modernization of the aging water supply and irrigation assets.
- Make investments to increase the share of water-saving technologies in industry and agriculture (including, for example drip and in-soil irrigation, sprinkling, and local impulse irrigation); diversify crop choices to include higher-value, lower-water-use crops.
- Rehabilitate and optimize multipurpose water storage to manage availability of water resources within a given year and interannually.
- Kick-start adoption of climate-smart agricultural practices by introducing targeted incentive schemes (such as linking existing subsidies with adoption of certain resource-efficient farming practices) and a capacity-building program for farmers. Government-supported pilot programs for new technologies should also be considered.
- Expand research and data collection, including through cooperation with universities and research institutes, to fill information gaps (e.g., relating to water accounting for surface water and groundwater); introduce GIS-based data collection for disaster monitoring.
- To understand sequestration potential and develop programs for afforestation and pasture management, undertake comprehensive planning and research into dramatically scaling up carbon sequestration in rangelands and forests.

Longer term to mainstream sustainable land and water management practices and to build the necessary infrastructure:

- Move to 100 percent sustainable agricultural practices; this will involve moving from a expansion-based to an efficiency-based approach.
- Pursue formal updated transboundary water-sharing agreements and strengthen joint regional institutions for water operations, planning, and climate adaptation.
- Improve allocation and utilization of water resources among key sectors based on improved information base and planning.
- Where feasible, invest in water recycling and resource recovery from wastewater to further enhance water use efficiency.
- Increase and optimize multipurpose water storage capacity, including nature-based storage solutions, to manage future water resource uncertainties and mitigate flood and drought risks.
- Implement national programs to increase carbon sequestration in landscapes through improved rangeland and pasturing techniques, increased forest cover, and, potentially, commercial forestry.

3.3 Meeting mitigation targets efficiently requires a coherent mitigation policy suite

The pathway to achieving Kazakhstan's mitigation targets will involve action in all sectors, with policies that are cohesive and complement each other. Policy coherence is especially important when using an emissions trading system that caps emissions in covered sectors.[38] In the presence of a well-functioning ETS, other measures that cover the same emissions will change the mix, but not the volume of abatement. As these measures don't change the volume, they serve to change the cost—and can increase the cost to the economy of meeting climate goals if they are not well-targeted. Three approaches to additional climate policy can be considered and are directly relevant to the "system of carbon regulation" currently under review by the government:[39]

1. **Complementary infrastructure and planning approaches.** City design, transport infrastructure, and land use plans shape the options available to individuals and communities, the function of networks and the way individuals interact within them, and the externalities they may inflict on each other. This chapter has identified some important priorities in this context, including investing in public transport infrastructure, making changes to land use planning to support carbon sequestration, and improving the operation of the power system to support additional investment.

2. **Addressing market failures.** Additional mitigation policies should aim to reduce the cost of emissions reductions by addressing market failures that can prevent participants from reacting efficiently to price signals. Common failures include the following:

   - The principal/agent problem occurs where principals and agents have different priorities—for example, if a landlord is responsible for appliances and tenants pay the energy bills, there is suboptimal investment in energy efficiency. Appliance standards and building codes are examples of measures that can help address this issue.

   - The network effect increases the value of a product or service as more people use it. This effect may lead to private investment in low-carbon technologies below socially optimal levels. Technologies that rely on networks—such as electric vehicles, which rely on charging infrastructure—can be difficult to develop because of the high up-front costs in expanding the network. In this case, there is an argument for government support for public charging infrastructure to incentivize a shift toward electric vehicles.

   - Informational barriers may prevent individuals and firms from pursuing low-carbon investments due to a lack of information. For example, people often lack clear information regarding energy efficiency in their homes and resist making energy efficiency improvements given their up-front costs. Energy efficiency labeling is one option to address this issue.

   - Barriers to finance. Plagued by incomplete financial and risk markets, innovative or large-infrastructure projects often struggle to secure the necessary funding, even when they are competitive. In addition, the capital required to transition to low-carbon futures often faces large uncertainties, political risks, illiquid assets, and a lack of returns in the short term. Aside from the standard credit constraints, investors lack the knowledge and information necessary to assess the quality of innovative, low-carbon projects.

Supporting communities through the transition. The transition will require replacing high-emitting activities with new ones that are low-emitting or based on zero-emissions energy. This could involve adverse impacts in some emissions-intensive industries (such as coal mining), warranting support from government to assist affected workers and communities. This issue is discussed further in section 4.2.3).

38 Recommendations for the emissions trading system are discussed in section 4.1.1

39 The approaches are from High-Level Commission on Carbon Prices (2017).

Chapter 4

Macroeconomics, finance, and just transition

KEY POINTS:

- ***The green transition makes it even more urgent for Kazakhstan to accelerate its path toward becoming a post–fossil fuel, high-income country. Without action, Kazakhstan could be significantly worse off if the world decarbonizes and it does not keep pace.***
- ***Modeling projections suggest that the large amount of investment needed to support the energy transition would spur higher economic growth over the medium term and bring positive co-benefits from emission reduction. However, the projections also suggest that undertaking the transition under lower demand and prices could diminish the positive effect on growth and increase the fiscal pressure.***
- ***Providing the right price signals to support low-carbon investment and activity is also a prerequisite for success. Reforms in energy pricing and tariff setting are needed to attract the required private capital to the power and heating sectors. Similarly, reforms to the emissions trading system—especially reducing the cap—are needed.***
- ***The potential impact of pricing reform on households needs to be managed, as does any concentrated adverse employment effect, such in the coal mining towns. The government should consider options for targeted compensation to poor families for price impacts, should support affected workers through the transition, and should develop regional economies.***
- ***Broadening the revenue base, including gradually raising excise tax on fossil fuels, will provide additional revenue to support climate adaptation and mitigation, compensate low-income households, and increase the quality of assets needed to diversify away from fossil fuels. Given the pressure on spending and the lower oil revenue, the fiscal rule needs strengthening to ensure net government debt is consistent with long-term fiscal sustainability.***
- ***To attract investments, significant improvements in the operating environment for both domestic and international businesses are needed. Frameworks for competition must be strengthened, the role for SOEs narrowed down, and innovation and financial systems strengthened.***

As a nation highly dependent on fossil fuel, Kazakhstan is both vulnerable to climate change and exposed to the global efforts to mitigate it. The challenge for Kazakhstan is to manage a transition away from carbon-intensive assets to support longer-term growth, while mitigating the costs of that transition and of the physical impacts of climate change.

Decarbonization comes with risks that must be managed. Some sectors and demographics, if not prepared, stand to be adversely impacted. But decarbonization can also act as a catalyst to accelerate development for years to come. How the green transition transpires in the coming decades for Kazakhstan critically hinges on the steps that the country takes to fully enable a positive economic transformation. This chapter sketches out some such possible scenarios and their macroeconomic impact, and highlights the key policies to support a productive and inclusive transition.

4.1 The macroeconomic implications of climate change and decarbonization are significant

4.1.1 Climate change's predicted impact on Kazakhstan's economy

The effects of climate change are already expected to have a harmful impact on Kazakhstan, and without bold, global action, the impacts will be even more severe. The physical impacts of climate change are expected to adversely impact Kazakhstan. Under a scenario with a high degree of climate change (RCP [Representative Concentration Pathway] 8.5), a modeling exercise suggests that output will be 1.6 percent lower in 2050 and 4.3

percent lower in 2100 compared to the baseline (table 5).[40] Flooding due to climate change poses the greatest risk to Kazakhstan's economy. Under a high climate change scenario, flooding is expected to reduce GDP by 0.9 percent by 2050 and by 3.3 percent by 2100. Both the uncertainty and scale of flooding impacts could be reduced through adaptation spending. Reduced agricultural production by 2050 due to climate change is also expected and is estimated to reduce annual GDP by 0.5–1.0 percent. Productivity losses due to heat waves are estimated to be smaller, due to the moderate climate. Nevertheless, the simulations consider limited only transmission channels and do not capture the nonmonetary costs, such as biodiversity loss and social issues from human displacement. These projections therefore present a first approximation of the potential economic damage from climate change (table 5).

Table 5. Projected damages and economic impact from climate shocks

	RCP 2.6		RCP 4.5		RCP 8.5	
	2050	2100	2050	2100	2050	2100
Real GDP per capita (constant 2020)[a]	-1.0	-1.3	-1.2	-1.7	-1.6	-4.3
Real household consumption per capita (constant 2020)[a]	-1.0	-1.3	-1.2	-1.7	-1.6	-4.3
Damages (% of GDP)						
Agriculture	*-0.5*	*-0.6*	*-0.7*	*-0.7*	*-0.7*	*-1.0*
Heat	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.1*
Flooding	*-0.5*	*-0.7*	*-1.0*	*-0.9*	*-0.9*	*-3.3*
Total damages	-1.0	-1.3	-1.2	-1.7	-1.6	-4.3

Source: World Bank modeling.

Note: RCP = Representative Concentration Pathway.

a. Deviations from baseline are expressed as percentage of baseline level for real GDP per capita. For all other variables, deviations from baseline are expressed as percentage points of GDP in the corresponding scenario less the percentage of GDP in the baseline scenario.

Climate shocks are expected to worsen labor market outcomes for people in Kazakhstan. These estimated macroeconomic impacts are expected to feed through to worsening labor market outcomes across the economy.[41] Real wages are expected to decrease by 2.1 percent by 2060 and by 3.7 percent by 2090 (Figure 31) in a combined climate shock scenario (agriculture, flooding, heat shocks) in the RCP 8.5 scenario. As a result, poverty would be 3 percent higher by 2060, corresponding to 87,000 additional poor in 2060, rising to 123,000 additional poor by 2090.

4.1.2 Decarbonization's ability to insure against risks from the global climate transition

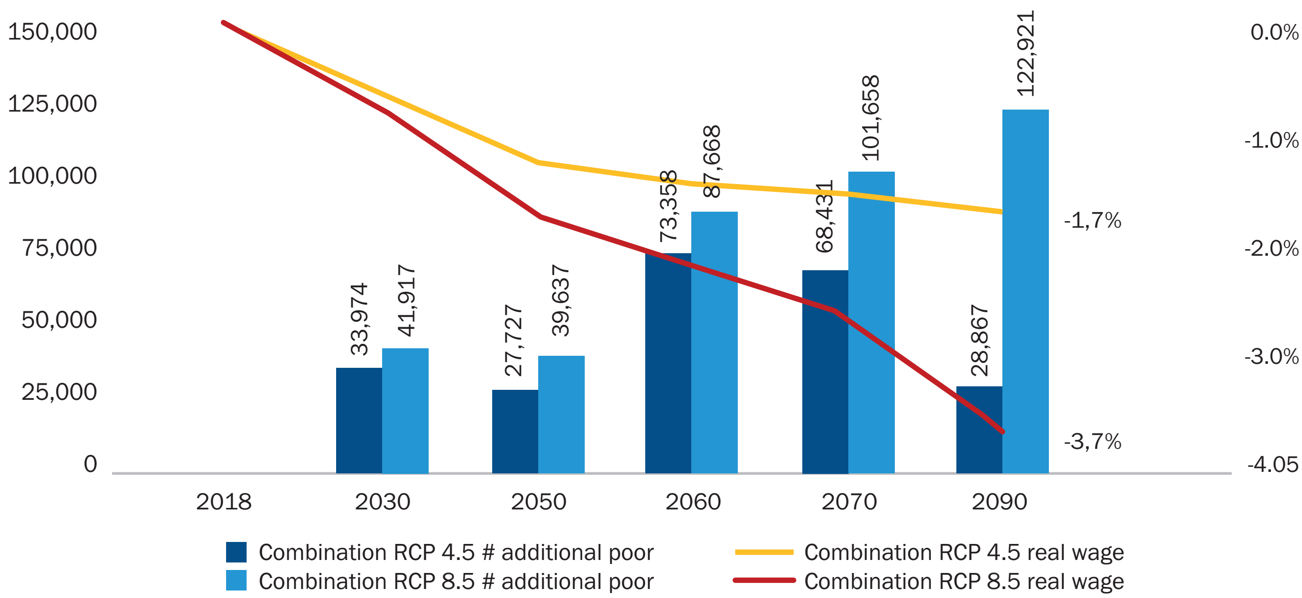
In a world where global decarbonization proceeds rapidly, Kazakhstan could see a significant slump in growth if it does not act. Kazakhstan's oil production is continuing to increase and is projected to rise by 14 percent by 2030.[42] But as global decarbonization gathers pace, the transition increasingly exposes Kazakhstan's oil and gas sector, and its economy more broadly, to downside risks. The IEA anticipates that if countries act to meet announced targets and net-zero goals, global oil demand will not ever return to pre-COVID-19 levels (IEA 2021).

40 While long-term GHG emissions in the RCP 8.5 are considered pessimistic, the CMIP5 (Coupled Model Intercomparison Project 5) climate change scenarios with RCP 8.5 provide useful (and not implausible) high-warming scenarios, which would be consistent with continued GHG emissions and high climate change sensitivity or positive feedback from the carbon cycle.
Note that the modeling exercise for the economic impact of climate change uses a longer timeline (until year 2100) than the modeling exercise to evaluate the economic impact of the energy transition (until 2060, when Kazakhstan pledges to achieve net-zero emission).

41 The macroeconomic modeling conducted assumes that the labor market adjustment takes place via the real wage adjustment, so there are negligible employment effects

42 Government announcement, December 2021 (Bulatkulova 2021).

Figure 31. Estimated impacts of climate shocks on poverty and real wages, 2018–90



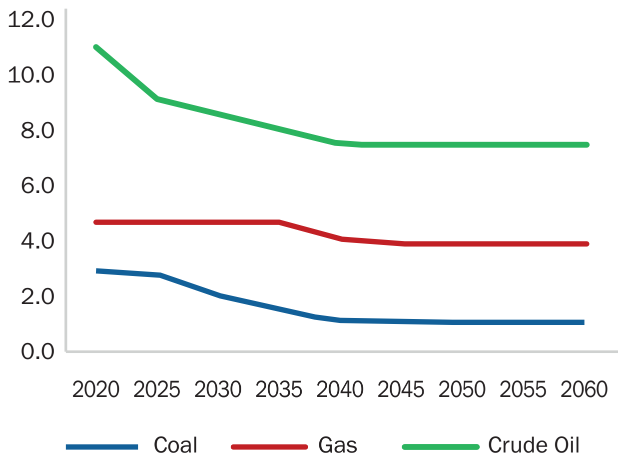
Source: World Bank staff calculation.
Note: RCP = Representative Concentration Pathway.

Moreover, investment in Kazakhstan's oil sector is likely to undergo further strain as international oil companies face growing pressure from shareholders to commit to a clean energy transition.[43] Modeling suggests that under a moderately high global decarbonization scenario (Figure 32), if Kazakhstan remains carbon intensive (**global decarbonization** scenario), real GDP per capita in Kazakhstan could be 2.0–2.5 percent lower than the baseline (Figure 33). Given already limited growth in the baseline, this would mean a sustained weaker economic performance over several decades. Lower oil prices are expected to lower government's revenue and hence significantly affect its investment. The lower oil price will not automatically help shift resources to the non-oil sector, and private investment is expected to decline by 3.2 percent compared to the baseline.

Taking action to decarbonize requires a large scale-up in investment and marginal costs of decarbonization. Modeling (energy transition scenario) has shown that, to successfully decarbonize the economy by 2060, Kazakhstan will need to invest in new capital, particularly in the energy sector (Table 6). Considering first the costs of decarbonization (changing the energy mix to a less carbon-intensive one), this would equate to a relatively modest reduction in real GDP per capita relative to the baseline of 0.5 percent by 2040. There would also be a reduction in real wages during the transition, of 0.8 percent in 2040. However, alongside these costs, large increases in investment—private and public—are needed. Programming this required investment into the macroeconomic model translates to private investment in 2040 being up to 5 percent higher than the baseline, and government investment being up to 10 percent higher. This government spending could raise the fiscal deficit by about 0.4 percent of GDP. Despite an increase in real interest rates due to a crowding-out effect, this increase in investment stimulates increased output per capita in the medium term (Figure 33). Taking all these factors together, the net effect of domestic decarbonization would be an increase in output per capita relative to the baseline of 1.3 percent in 2040 and beyond. Under a high global decarbonization scenario, which would adversely affect Kazakhstan's export and budget revenue, the net effect of the energy transition on real GDP would be smaller and would increase the fiscal deficit as a percentage of GDP by about 2.4 percentage points from the baseline in 2040. However, the results show clearly that domestic decarbonization would act as a significant insurance against the shocks of rapid global decarbonization, with real GDP two percentage points higher in 2040 and 2.7 percentage points higher in 2060 in the scenario where Kazakhstan acts (**energy transition + global decarbonization** scenario relative to **global decarbonization** scenario). See Background Note 6 on the modeling framework for a description of the models used and key assumptions.

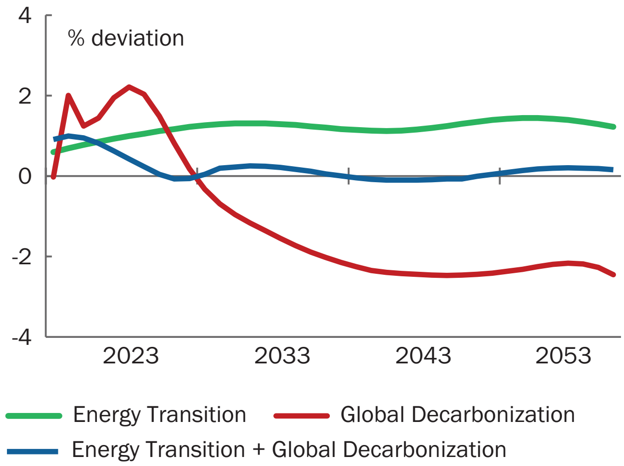
43 On pressure for international oil companies to take part in a clean energy transition, see Krauss (2021).

Figure 32. Projected fossil fuel prices under high global decarbonization scenario, 2020–60 (real 2020 US$/GJ)



Source: World Bank commodity price forecast.

Figure 33. Projected impact of energy transition and global decarbonization on Kazakhstan's average real GDP per capita (percentage relative to baseline)



Source: World Bank staff projections.

The economic benefits of the energy transition are further bolstered by the improvement in air quality. Reducing fossil fuel use, particularly coal for heating and oil for transport, can significantly reduce air pollution as well as the negative health and productivity impacts of poor air quality. Decarbonizing the energy system would reduce air pollution by 86 percent from today's levels. This in turn would result in US$1 billion of GDP savings from fewer working days lost and US$2.5 billion in reduced health expenses, leading to a 0.5 percent improvement in GDP in 2060 compared to business as usual.

Table 6. Indicators of economic costs and benefits of NZE (additional to baseline)

	2023-2030 Cumulative, 2021 real US$, billions	**2023-2040** Cumulative, 2021 real US$, billions
ADDITIONAL INVESTMENT COSTS		
Power sector (generation and storage)	3	36
Residential (energy efficiency and electrification)	11	43
Industry (mitigation of energy use emissions)	3	8
Transport (passenger and freight)	2	8
TOTAL ADDITIONAL INVESTMENT COSTS	19	95
NET IMPACT ON GDP		
Additional real GDP	17	52
Of which additional real private consumption	3	13
CO-BENEFITS		
Air quality improvement – reduced health costs and lost working days	1	1

But major structural reforms will be needed to catalyze such a scale-up in investment and to sustain higher productivity growth. Such large private sector investment will be a challenge to achieve and will require significant policy effort. A package of carbon pricing and regulation combined with pro-competition, investment, and innovation reforms will be essential to unlock the levels of investment required to finance the green transition in Kazakhstan. But more importantly, deep structural reforms and improvements in the quality of assets (human capital, market, and public institutions) are still needed to sustain higher productivity growth. Without such reforms, Kazakhstan risks repeating the old growth model of accumulating investments but with limited productivity gains critical for long-term growth.

The government will need to properly manage the macro-fiscal adjustments. Supporting the green transition will put strain on the government budget; and the need for additional public investment, alongside potentially declining oil revenue, will put pressure on the budget deficit. The government should anchor the non-oil primary balance to a long-term fiscal rule to ensure fiscal sustainability. The government will need to act early to broaden the revenue base and reduce the deficit in the non-oil primary balance. Prioritizing and improving efficiency in public spending through better budgeting, planning, and monitoring should also be considered. The government could also consider tapping more resources from the National Fund of Republic of Kazakhstan (NFRK) during early stages of the energy transition and utilizing sovereign loans with lower interest rates.

4.2 Strategies for high growth, diversification, and shared prosperity should focus on the whole economy

Achieving high growth as part of sustained economic diversification goes beyond sectors and depends on economy-wide reform. As discussed, there are a plethora of areas that may support economic growth in a green transition. Yet in a complex and dynamic global market, it is difficult to identify successful growth opportunities ahead of time. Reforms that remove constraints and allow business to choose its own path, given the right incentives and social protection, are key. Direct interventions, e.g., closing coal power generators or taxing carbon pollution, will cause behavioral responses from consumers and producers. But broader reforms in the public sector, the competition environment, and the financial sector will help redirect resources from fossil fuels toward greener industries.

Moving away from dominant, long-established fossil fuel sectors is not easy, but it is key to reaching high income levels. Previous World Bank work has shown that attempts at diversification in resource-dependent economies often fail because of the difficulty in addressing underlying policy and institutional factors and reorienting capital that is all built around a resource economy. Broad economic diversification in Kazakhstan will require shifts in policy settings that put competitiveness, innovation, and economic dynamism at the forefront and remove implicit preference from resource rent–driven sectors. The transition will open new opportunities for Kazakhstan to diversify beyond fossil fuels. But the process also creates friction from changes in energy prices and loss of jobs in some GHG-intensive sectors, even while new sectors develop. Fiscal policy (such as adjusting the tax structure to internalize GHG emissions from fossil fuels) must also identify sustainable ways to support green growth (such as feebates to support the expansion of less GHG-intensive sectors) while ensuring sufficient support for those impacted by shifts in the economy.[44]

4.2.1 Getting prices right: Kazakhstan's emissions trading system

Getting prices right is an essential part of any efficient, market-led decarbonization program. In Kazakhstan, as in many countries, this process is twofold. First, it is necessary to redirect energy subsidies (see section 3.1.5) in such a way that they do not provide an undue market advantage to fossil fuels, but still perform their important

44 A feebate ("fee" plus "rebate") is a self-financing approach to shifting consumer behavior. For example, feebate used to promote low-emission cars could impose a one-time fee on car sales based on CO_2 price, the difference between the vehicle's CO_2 emission/km and the average of CO_2 emission/km of the latest vehicle fleet, and the average life-time use of the vehicle.

function of protecting the vulnerable. Second, it is necessary to correct the market price of carbon emissions for the externality of the social cost that it carries by imposing a regulatory price wedge, such as with an emissions trading scheme or carbon tax.

Kazakhstan intends to use carbon pricing as an important component of its decarbonization policy. Kazakhstan has already shown itself ready to redress the market distortions associated with energy pricing by establishing an ETS. The ETS covers 43 percent of national emissions, and the government plans to expand the use of carbon pricing to play a central role in achieving its 2030 emissions target. This section outlines key considerations for carbon pricing in Kazakhstan.

The ETS is yet to make a meaningful contribution to reducing emissions. Kazakhstan's ETS is well established, with a strong legislative framework. Businesses are experienced in its operation. Yet in the decade since its commencement, the ETS has had little impact on emissions because the allocation of quotas (representing the emissions cap) has been consistently too generous; it has generally been sufficient to cover business-as-usual operations and has imposed little to no constraint on emissions. Hence national emissions have continued to rise. The lack of a binding constraint is reflected in the carbon price, which has remained negligible (at little more than US$1).[45]

The ETS cap needs to be tightened in line with climate targets if Kazakhstan is to meet its Paris commitment. The emissions cap actually increased in 2021 and the caps for 2022-25, recently established, will see the cap reduce by 1.5% per year. This is unlikely to have much impact on emissions over this time. Stronger reductions (5-7%) will be needed in 2026-2030 if covered entities – many of the largest emitters in Kazakhstan – are to play their role meeting the NDC. Given the availability of cost effective mitigation options in covered sectors, and consistent with the draft NDC Roadmap, the ETS cap should be set to achieve about 50 percent of national emissions reduction.[46]

Kazakhstan could lower mitigation costs by expanding the ETS. Kazakhstan should consider expanding the ETS to transport, methane, and the remaining industrial process emissions. Broadening the base for carbon pricing in this way helps reduce costs for all participants by accessing new low-cost abatement opportunities.

Emissions from transport are experiencing rapid growth, so making them subject to a carbon price is important to meeting Kazakhstan's 2030 target. Transport emissions could be priced using a carbon tax (as proposed in the draft NDC roadmap) or via an expansion of the ETS. Both could be applied upstream in the fuel supply chain the way an excise tax is. To minimize distortions, the carbon price applied to transport fuels should match the ETS price; this would maximize access to low-cost abatement and ensure emissions are reduced at lowest cost to the economy. A carbon tax would have the advantage of building on the existing excise framework, but the carbon price component of the excise rate would need to be adjusted periodically to match the ETS carbon price. Expanding the ETS would automatically equalize the carbon price among ETS installations and transport fuels. Under this approach, fuel suppliers would surrender quota to cover the downstream emissions associated with burning fuel. An equivalent carbon tax could be expected to raise more revenue, at least in the short to medium term, as only a small portion of ETS allowances will likely be auctioned before 2030.

Kazakhstan has moved to a fairer system of quota allocation based on industry average benchmarks, but the system could be improved by using a single benchmark for energy. In 2021, Kazakhstan replaced free allowance allocation based on historical emissions with an allocation system based on industry average benchmarks.[47] With a single benchmark for each product (regardless of fuel type, location, or technology), benchmarks reward the lowest emitters per unit of output.[48] Benchmarks for power and heat are split based on whether the power is generated using coal or another fuel,[49] but the incentives for cleaner power production could be strengthened by giving all power suppliers the same benchmark.

45 Average 2020 quota price from International Carbon Action Partnership, 2021.

46 While it covers only 43 percent of national emissions, the sectors it covers are those with widely recognized cost-effective abatement opportunities (such as renewables in the power sector).

47 Under a benchmark approach, installations get the same quota allocation per unit of production.

48 The government has published 52 benchmarks, representing the industry average emissions intensity of covered products.

49 The benchmark for coal-fired electricity is 0.986 tonnes CO_2 per MWh, while the benchmark for electricity produced using other fuels is 0.621 tonnes CO2 per MWh. The benchmark for heat is 0.484 t CO_2 per Gcal for coal and 0.310 t CO_2 per Gcal for other fuels.

Offsets can encourage abatement in sectors whose inclusion in the ETS is not practical or cost-effective, but their use should be limited to manage integrity risks. Kazakhstan's ETS currently allows unlimited use of domestic offsets against ETS compliance obligations.[50] There may be merit in introducing quantitative limits to manage the risks associated with the nature of offsets, including risks related to measurement of land-based emissions and sequestration, risks of reversal from wildfires or other natural events, and the risk that projects generating offsets are part of routine operations and would have happened anyway. The coverage of offsets must not overlap with ETS coverage. In this respect, offsets should not be issued for renewable energy or energy efficiency projects to avoid the problem of double counting. These projects reduce power sector emissions, which are covered by the ETS. This means the abatement is counted twice—the power station's ETS liability falls at the same time the offsets are created. This has the effect of increasing (or relaxing) the overall emissions cap.

Only a modest carbon price is needed for the ETS to drive its share of the 2030 target even with expanded coverage. Achieving just over half of the abatement target using the ETS would require a carbon price of US$20 by 2030. Assuming consistently tightening emission caps, the price rises from about US$2.50 in 2023 to US$20 in 2030. Expanding the ETS to cover transport fuels allows the ETS to drive a further 2 Mt of emissions reductions in 2030 at the US$20 price level.

Auctioning quotas can support a more efficient ETS while raising revenue. Auctioning promotes price discovery by revealing the value of carbon allowances early in the compliance period. This can help to stimulate behavioral change and support investment decisions. Auctioning also reduces rent seeking among businesses aiming to maximize their allowance allocation and supports allocative efficiency by directing allowances to their most valuable use.[51] Kazakhstan's draft NDC roadmap recommends gradually introducing auctioning on a small proportion of quotas, up to 10 percent in phase 3 (2026–30). This is a modest auctioning schedule that would support some revenue mobilization, but only if the ETS becomes binding and presents a meaningful carbon price, as discussed above. Auctioning of 3 percent of quotas in 2023, rising to 10 percent in 2030, raises US$0.34 billion (real 2021 US dollars) in revenue in 2030, or US$1.23 billion over 2023–30. Expanding coverage of the ETS to transport increases revenue gains to US$0.36 billion in 2030, or US$1.30 billion over the period. Covering transport using a carbon tax rather than the ETS and assuming the full tax is collected (i.e., no exemptions or tax decreases for certain users) increases the revenue that can be raised from the transport sector to US$0.64 billion in 2030, or US$2.61 billion over the period 2023–30.

4.2.2 Role of a decarbonization fund

It is important to direct scarce public resources to where they can be of most use. Kazakhstan is considering establishing a national decarbonization fund, initially funded through proceeds from ETS auctions. The size of such a fund, regardless of its funding sources, can only ever be a very small proportion of the total investments needed to decarbonize the Kazakhstan economy. World Bank modeling suggests, for example, that ETS revenues may reach US$1.23 billion over the period 2023–30, while energy sector capital investment needs for decarbonization are US$84 billion over the same period.[52] Thus if the fund's aim is climate mitigation, it must be able to unlock emissions reductions that are not cost-effectively addressed by other policies. Section 3.4 outlines the basis for government intervention and provides ideas for the role of a such a fund—investing in public infrastructure, supporting a just transition, and addressing market failures that inhibit cost-effective mitigation action. One way to address an important market failure would be to encourage technological development through support for innovation and research and development (R&D). This could help reduce the cost of technologies needed for the transition. Public investment is justified because private firms and innovators underinvest in R&D for or deployment of low-carbon technologies, since they are not accounting for social benefits from knowledge or innovation spillovers. A firm investing in innovation will create benefits for other firms while incurring all the costs. This disincentivizes private sector innovation and results in investment below socially optimal levels (Jaffee, Newell, and Stavins). To address this underinvestment, governments can provide funding for R&D and subsidies for the development and deployment of low-carbon technologies. Support to innovation is discussed further in section 4.2.5.

50 Article 298(1) of the Ecological Code 2021.

51 A simple model, such as a single-round, sealed-bid auction, can help to maximize participation, while paying bidders a uniform (market clearing) price provides the best incentive for them to reveal their true price.

52 The ETS revenue estimate assumes existing coverage and growth of auctioning from 3 percent in 2023 to 10 percent in 2030.

Funding low-cost emissions-reduction projects in ETS sectors would not provide additional abatement or reduce the economic cost of the transition. Rather, the national decarbonization fund should aim either to unlock emissions reductions that other policies cannot achieve cost-effectively or to help communities through the transition.

Box 11. Summary of recommendations on carbon pricing

Short term (0–5 years)

- Revise the National Allocation Plan to make ETS caps consistent with NDC targets and timelines.
- Include methane at all covered installations under the ETS, as well as nitrous oxide emissions from nitric acid plants and PFCs from aluminum production.
- Replace the coal and "other fuels" benchmarks with single, fuel-neutral benchmarks for electricity and heat to encourage cleaner power production.
- Introduce at least 10 percent auctioning of emission allowances by 2030, with a growing share thereafter, using a single-round, sealed-bid, uniform price auction.
- Expand carbon pricing to include all transport fuels, including gasoline, diesel, CNG (compressed natural gas), aviation fuel, and LPG.
- Introduce quantitative limits on the use of offsets for compliance under the ETS to limit risks around their integrity, and do not issue offsets for reductions in emissions covered under the ETS.

4.2.3 Just transition: Preventing the costs of transition from falling on the vulnerable

Inclusive and progressive policies are key to ensure the climate transition is sustainable. Like any significant economic shift, climate policy action will be disruptive. Even if the overall economy benefits, there are likely to be winners and losers, particularly during the transition period. Failure to appropriately mitigate the risks to potential losers and support people and communities during the transition could raise serious risks for social inclusion and undermine the social and political sustainability of the transition. In this context, two issues need to be addressed for a just transition in Kazakhstan: (i) mitigating the risks of energy poverty; and (ii) addressing spatially concentrated losses in economic activity and jobs.

Energy poverty: Compensatory policy to mitigate the impact of energy price increases

Energy poverty is high in Kazakhstan, and large numbers of households are vulnerable to rising prices.[53] Lower-income households in Kazakhstan spend a significant share of their household budget on energy and are thus highly sensitive to price changes.[54] Despite low energy prices, 15 percent of the population is energy poor. Energy poverty varies significantly across the country: 21 percent of households in rural areas experience energy poverty, compared to 12 percent of households in urban areas, and energy poverty ranges from less than 3 percent in the Aktobe, Atyrau, and Mangystau regions and Nur-Sultan city to 30 percent in regions like Akmola and North Kazakhstan. In this context, energy price increases are likely to be regressive and risk negatively impacting large tracts of the population unless the revenues collected are used progressively to support vulnerable households.

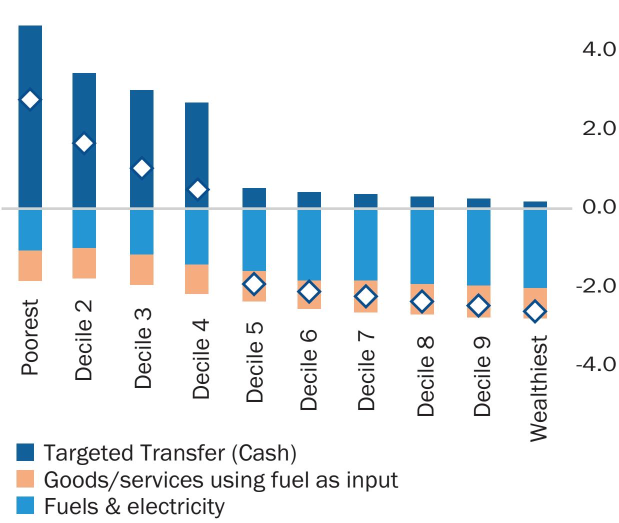
53 A household in considered to be in energy poverty if energy spending constitutes more than 10 percent of its total per capita consumption.

54 Households in the bottom income decile spent around 27 percent of their budget on energy, while the richest 10 percent of households spent around 19 percent of their budget on energy. Energy consumption includes expenditure on electricity, gas, LPG, coal, wood, central heating, and hot water. The consumption aggregate does not include imputed rent in Kazakhstan, since these data are not available for Kazakhstan. Moreover, energy consumption was more inelastic for low-income families, with a price elasticity of electricity demand at -0.62 compared to -0.78 for high-income households.

Poorer households need to be supported to cope with price increases in a manner that keeps incentives intact. Price changes aim to trigger changes in behavior that reduce carbon-intensive activity, but such changes may happen only gradually over time, and in some cases there will be limited scope for substitution away from energy-intensive goods in the near term. Therefore, compensatory policy is needed to alleviate financial impacts in a targeted way, while leaving incentives intact.

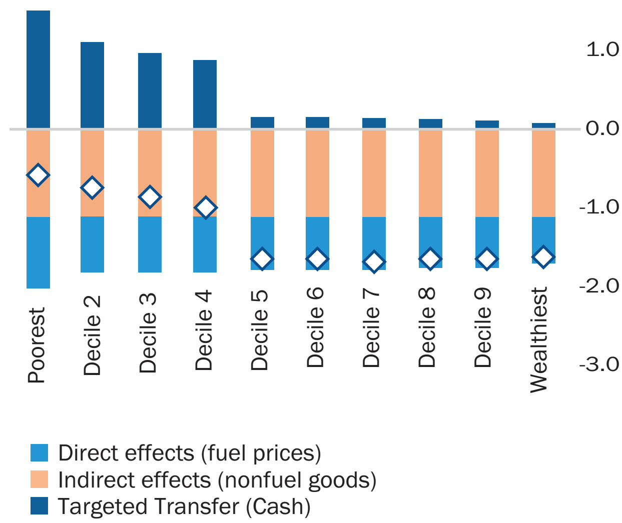
Phasing out fossil fuel subsidies can generate substantial savings to the budget to offset the adverse impacts of price changes on the poor. Gradually phasing out fossil fuel subsidies until 2030 implies significant increases in prices compared to the baseline.[55] Gasoline prices would increase by 82 percent, coal by 68 percent, and diesel by 27 percent, for instance. These adjustments could potentially raise US$3.3 billion in 2030 and close to US$15.4 billion over the period 2023–30. These resources would then be available to offset the impact of fuel price increases on households and support needed public investments. To cushion the impact on poorer households and create fiscal space, the poorest 40 percent of households could be supported through cash transfer using 40 percent of the revenue raised from such subsidy reform (Figure 34) and 100 percent from ETS reform (Figure 35). However, an effective targeting system is required to deliver cash transfers to vulnerable groups.

Figure 34. Potential impact of fuel subsidy withdrawal with partial redistribution to the bottom 40 percent: Relative mean consumption effect (% consumption)



Source: World Bank staff calculation using World Bank/IMF Carbon Pricing Assessment Tool (CPAT).
Note: Analysis is based on 100 percent energy subsidy withdrawal, 40 percent recycling of revenue, and 20 percent leakage in transfers.

Figure 35. Potential impact of US$20 carbon price with full redistribution to the bottom 40 percent: Relative mean consumption effect (% consumption)



Source: World Bank staff calculation using World Bank/IMF Carbon Pricing Assessment Tool (CPAT).
Note: Analysis is based on a US$20 carbon price by 2030, 10 percent auctioning by 2030, an equivalent carbon tax on transport, 100 percent recycling of revenue, and 20 percent leakage in transfers.

Reforming fossil fuel subsidies should involve recycling the savings in two ways: direct financial support to households and broader development spending (box 13). Policy makers need to explore strategies for addressing distributional concerns from higher fuel/energy prices. Targeted direct income support has the advantage of relying on existing systems and limited fiscal costs, while supporting those most in need. Targeted cash transfers have several benefits compared to existing energy subsidies. First, cash transfers can encourage households to use energy more efficiently as the economy moves to low-carbon energy resources. Second, targeted income transfers can target multiple vulnerabilities within households by adding benefits to the existing social assistance transfers (for employment loss, disability, elderly, poor, female-headed households, etc.). However, to secure support for the policies in a challenging environment, countries have also used more universal transfers or increased spending

55 The aggregate level of subsidy per fuel is taken from the 2021 Fossil Fuel Subsidy Database of the International Energy Agency (https://www.iea.org/data-and-statistics/data-product/fossil-fuel-subsidies-database) and disaggregated further using the price-gap method from the World Bank/IMF Carbon Pricing Assessment Tool (CPAT). The scenario models a gradual phaseout of fuel subsidies (excluding electricity) until 2030.

on broader development objectives, such as education and health services and public infrastructure. Spending on issues that are of public concern—and clearly linking such spending to the subsidy/pricing reform—can help ensure public support for the reform. The government can also explore lowering payroll tax to help compensate the impact of higher fuel prices on workers.

When phasing out subsidies, a well-designed public communication strategy can help garner support and trust from the wider population and should be part of the policy package. An effective communication strategy should engender a constructive public debate on the importance of redirecting energy and fuel subsidies for other development purposes, making clear the benefits of doing so. It would also be helpful to publish critical data—the amount of the subsidies, the beneficiaries, and household-level information, as well as how revenues will be spent—so the public stays informed and so researchers can conduct independent assessments.

Box 12. Options for reducing the impact of energy subsidy consolidation and carbon pricing on households

There are many different examples of compensation schemes for carbon pricing and energy subsidy withdrawal that have been effective around the world, and the best approach depends on country-specific factors.

Countries like Sweden, for example, have combined strong carbon pricing with reductions in other taxes such as employee income tax. This is an effective and popular policy, but for countries with a higher level of labor informality, it would leave informal workers and those not in work still worse off.

Existing social protection systems can be used to identify low-income and other vulnerable households and provide payments to them to alleviate higher energy costs. Kazakhstan has established systems such as targeted social assistance (TSA), which direct aid to low-income households through means-tested social assistance programs, but they are relatively underused and under-resourced. Such programs could be a platform to provide lower-income households with assistance to deal with price rises.

Countries such as Iran have used more universal forms of compensation when implementing subsidy reform (Vagliasindi 2013). In this case, the majority of the population was given access to bank depository accounts that contained compensation payments. While this is a much more costly approach, it helped ensure broad support for the subsidy reform, and payments were progressive in that the flat amount paid to households represented a larger proportion of household income for lower-income households.

While flat energy tariffs are simple and transparent, many countries combat energy poverty with a "lifeline" tariff. This consists of a low-priced initial block of metered energy, usually electricity, up to an amount in line with minimal basic needs. Analysis suggests this amount should be around 30–50 kWh a month (World Bank 2015). Lifeline tariffs can be subsidized in three ways: first, and most transparently, by direct fiscal transfer; second, by implicit cross-subsidization, in which the main rate is set at a higher level to offset the subsidy; and finally, by a hybrid approach in which a second, higher-priced energy block is added such that, as a household's consumption is higher, the subsidy is recouped. In the hybrid case there is no cross-subsidization, and the fiscal subsidy of the lifeline tariff applies only to those consumers who have low energy usage.

An alternative approach to compensation aims to limit the price increase on households in the first place. An example of this approach is the allocation of free allowances based on emissions-intensity benchmarks and occurring under an ETS. In this way the Kazakhstan ETS already reduces cost pass-through, as only the costs above the emissions-intensity benchmark are passed on. By limiting the price increase, however, this approach dampens the demand-side response.

Figure 36. Pillars of the just transition for the coal sector

The World Bank's three -by-three assessment methodology dashboard supporting energy transitions in coal regions. Each cell defines an overall objective and cntains many discrete activities.

	Pillar 1 Institutional Governance	Pillar 2 People and Communities	Pillar 3 Environmental Reclamation and Re-purposing Land & Assets
Phase 1: Pre-Closurc Planning 10-18 months	Strengthen policies. Institutions, Inclusive processes, and build vision / strategies for fiscal, macro-economic & socio-economic transformations with communities	Early-stage dialogue and community engagement to ensure local voice and Influence In planning: Appraisal of social sustainability outcomes; Pre-layoff social protection assessments & planning, labor profiles, user-needs	Assessing land & assets, preparing for reclamation and re-purposing, resourcing EMV remediation costs
Phase 2: Closure 2+ years	Coordinating closure / decommissioning activities between enterprise and agencies	Social assistance to workers & communities, re-skilling, Active Labor Market Policies; Community engagement in prep, management, repurposlng of closed facilities	Implementation of appropriate technical standards, transfer of assets, mitigation of methane
Phase 3: Regional Transition 10» years	Special Purpose intlty coordinating transition project Implementation, managing funding sources	Longer term re-sklllIng, education. Active Labor Market policies, preparing workers for Future lobs; Locally-led, participatory planning for adaptive management, COD/Smart Villages Investments	ENV remediation of select land & assets by private / public sector, re-permltting and repurposing for private investors to sustain regional transformation

Source: World Bank
Note: ENV = environmental.

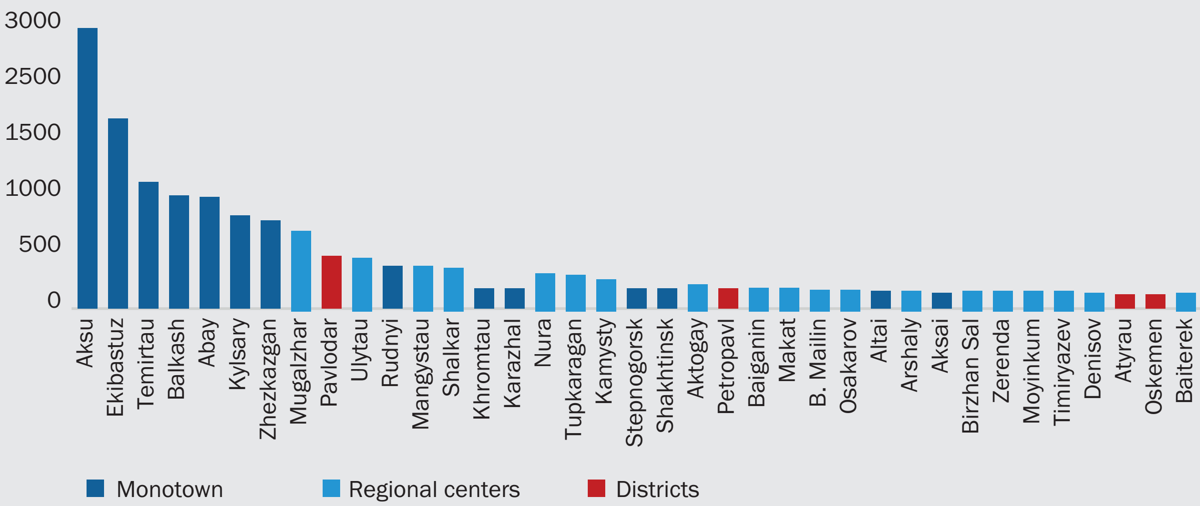
Kazakhstan has an established social protection system, but it is not used fully to support households affected by climate challenges. Kazakhstan has a TSA program and a targeted housing assistance program, both of which might be used to support households during a green transition. The government mainly provides the population with ad hoc support (in-kind and cash transfers) through a special fund (government reserve) based on compensation for harm caused to the environment, individuals and legal entities in accordance with the Law on Civil Protection. Existing regular social protection programs (e.g., survivors' benefits, burial allowance, unemployment benefit) can also provide citizens with some support. Still, the scope of these programs is limited and does not include additional mechanisms to address the needs of severely climate-affected populations, especially the poor.

Further reforms in the social protection system are needed to guarantee income security for vulnerable households during transition and climate shock events. The TSA constitutes only 3 percent of total social assistance spending. Coverage should be increased to minimize exclusion errors in tandem with efforts to improve the accuracy of targeting. Changing the approach to calculating the poverty line, which is set at a very low level at present, is also critical to determine the coverage of TSA. In 2020 only 5.3 percent of people were classed as poor, and the threshold for TSA is set at 70 percent of that already-low level. Furthermore, improving the design of the social protection programs and social registers could help mitigate the impacts of climate-related shocks and support early warning and data collection. For example, the social family card could include the mechanisms for systematic data collection, allowing updating and assessment of households' vulnerability to climate shocks in selected geographical areas of Kazakhstan that are less prone to natural hazards or climate-related risks. Similar approaches are in use elsewhere. In the Dominican Republic, the Vulnerability to Climate Hazards Index (IVACC) uses data from the country's national social registry and evaluates the likelihood of a household being vulnerable to hurricanes, storms, and floods. In Chile, the electronic Basic Emergency Sheet collects and merges existing social registry data with post-shock needs assessments.

Box 13. The challenge of coal monotowns

The transition will pose particularly acute challenges for Kazakhstan's coal monotowns—i.e., towns that are almost completely reliant on a single industry—such as Aksu, Balkhash, Ekibastuz, and Temirtau. In Kazakhstan, these can be identified in part by their extremely high per capita emissions levels (Figure 37). Most monotowns are also located in geographically isolated areas with low economic diversity and limited infrastructure. As the single industrial activity shrinks in monotowns, many workers will struggle to find employment in their local communities. These conditions can push local people into deep poverty and create social tensions. Measures to facilitate labor mobility from monotowns to economically active urban areas can be implemented by the government during the low-carbon transition.

Figure 37. Emissions per capita by type of settlement



Source: World Bank staff estimates using Bureau of Statistics data.

Coal industry decline presents challenges for regions, towns, and workers dependent on coal-related livelihoods. Coal is mostly produced in the Pavlodar and Karaganda basins in the north and east of Kazakhstan. While around 18 private coal mines still operate, 96 percent of coal production is from 5 of these mines, which employ around 40,000 people. Although mining sector jobs make up a relatively small share of employment, salaries in these jobs are the highest on average in Kazakhstan, and wages tend to be the only source of income in mining households. Not only coal workers but the wider communities and regions in which they are based will face profound challenges in transforming to a very different socioeconomic future (see box 14 for the impact on coal monotowns). These impacts could start to be felt by 2025, so planning to support affected households and communities should begin now. Where coal is phased out, job losses and the shuttering of industry will set in motion a transformation in which lifestyles, cultural identity, social systems, and economic outlook will change. Authorities at different levels should address the needs of directly and indirectly impacted workers and their families. In doing so, it is important to be sensitive to the impacts on gender and youth, to strengthen education and skills, and to ensure an inclusive process in which local regions shape future options. While the costs will always be context specific, any transition program entails different phases of action: pre-closure, closure, and regional transition. In addition, actions can be grouped into three thematic pillars: institutional governance, people and communities, and environmental remediation and repurposing of land and assets (figure 42).[56]

A just coal transition will require significant private and public investments covering decades. The cost of managing a just coal transition in Kazakhstan is estimated to be US$2.5–3.0 billion to 2050 and includes expenditure for social preplanning, environmental preplanning, mine closure and reclamation, social support, creation of a conducive business environment, monitoring and repurposing of land, and infrastructure projects.[57] Public investments are expected to focus on liquidating state mines and decommissioning coal-fired power plants, providing social protection to workers and communities, and creating the conditions to enable private investments in economic transformation. The regional transition phase focusing on long-term development and revitalization requires crowding in of public and private sector investments around repurposing of lands and physical assets, re-skilling/education, new infrastructure, and new economic activities.

Box 14. Summary of recommendations on preparing a just transition

Short term (0–5 years)

- Review existing social protection programs with a view to expanding access beyond the current very small share of the very poorest households; and adopt mechanisms, such as active labor market programs, that support graduation from these programs.
- Design a compensation package for poorer households to offset any energy and other cost increases. In doing so re-target a portion of energy subsidies to direct financial assistance to households, such as through cash transfers or tax reductions.
- To build public support for reform, develop a strong communication plan explaining how revenues from subsidy reform and carbon pricing will be spent.
- Start preparing for a just transition by taking immediate action on process planning and community preparedness for coal mine closure, applying a framework like the one outlined above.

4.2.4 Improving thefinance and investment environment

A vibrant financial sector will be key to mobilizing the private capital needed to support the green transition. Significant annual average investments are needed to achieve net zero by 2060, but the government is also faced with other expenditure commitments complementary to the green transition, such as human capital and social protection spending. A developed and robust domestic financial system plays a particularly important role

56 For more information, refer to World Bank (2018).

57 The expenditure for the energy transition replacing coal-to-power and coal-to-heating is excluded from this number.

in maximizing the impact of climate mitigation policies.[58] Creating a more vibrant financial sector in Kazakhstan will require improving the prudential regulatory framework, increasing the transparency of public support in the financial sector, and focusing on indirect approaches rather than interest subsidies and directed credit.

The authorities have been making progress in developing green capital. The Astana International Finance Center (AIFC) set up the Green Financial Center in 2018 to facilitate fundraising through green instruments. It sets out the rules that issuers should meet to issue green bonds listed in the Astana International Exchange (AIX), which include third-party verification. Similarly, the Kazakh Stock Exchange (KASE) is actively promoting the issuance of green bonds. However, the green bond issuance in Kazakhstan has been dominated by public sector entities, including SOEs, and international financial institutions. Further opportunities could be explored by facilitating the issuance of these instruments by local banks, to reinforce their loss-absorbing capacity.

Strengthening prudential regulations will help Kazakhstan sustain inflows of private capital for green financing. Many green projects lack scale, expect returns only over the longer term, and have high or uncertain perceived risk, all of which decrease investor appetite. Addressing these issues will require focused action. The new Environmental Code and the introduction of a green taxonomy are important for Kazakhstan as it begins identifying green economic activities. But Kazakhstan still needs to create a framework by which financial institutions can credibly earmark their financial assets as truly sustainable. Meaningful climate policy will help drive real green projects seeking financing.

It is also important that green finance does not contribute to risks in the financial sector. Banking supervisors have a key role in ensuring that banks pay close attention to climate-related and environmental risks (CRER). First, "green bubbles" can arise if the banking sector chases green-labeled projects without sufficient focus on borrower creditworthiness or project sustainability. Second, if green labeling leads bank lending to become detached from the market, "directed" lending may result in some target areas becoming overfunded and others underfunded. Kazakhstan's Agency for Regulation and Development of the Financial Market (AFR) can ensure that CRER are sufficiently considered in bank decision-making, introduce CRER reporting requirements, develop enhanced CRER methodologies to guide the supervisor's activities, and subsequently develop new procedures and methodologies to ensure thorough assessment of CRER risks. The authorities, in line with the practice of other countries, could define a strategic roadmap for sound management of CRER.[59]

Box 15. Summary of recommendations on the finance and investment environment

Short term (0–5 years)

- Scale down the use of interest subsidies and directed credit in favor of improved prudential management of green finance.
- Introduce new CRER disclosure and reporting requirements and CRER risk assessment methodologies for the financial supervisor (AFR) and consider developing a strategic roadmap to guide the sound management of CRER.
- Enhance the green taxonomy for green projects in lending and capital markets.
- Develop new green financial instruments, especially monetary and banking policy instruments.

Longer term

- Develop disaster risk insurance products with the aim of making them more widely available and affordable.

58 This view is based on panel data from 49 countries covering the period 2000–17.

59 For example, see National Bank of Georgia (2019); National Bank of Ukraine (2021).

Expansion of disaster risk insurance products could help address financing needs and reduce risks to firms and businesses. Effective financial management of disaster risks calls for a mix of approaches. High-frequency and low-severity events (such as seasonal flooding) can be cost-effectively managed through adaptation measures that lower risk, while low-frequency and high-severity events (such as earthquakes) are usually more effectively managed through risk transfer such as insurance (Linnerooth-Bayer and Hochrainer-Stigler 2014). More developed insurance markets can thereby help countries manage the impact of natural disasters.[60] In many OECD countries, governments and the private insurance sector collaborate to make disaster risk insurance more widely available and affordable (Ang, Röttgers, and Burli 2017).

4.3 Fiscal policy should be aligned with efforts to address climate change

The budget is a key enabler of the climate transition, yet climate change also brings significant fiscal challenges. Transition to a low-carbon world is just as disruptive to an erstwhile fossil fuel–dependent country's budget as it is to its economy. Disruption, however, need not be negative and can shift the budget to a more sustainable long-term trajectory. About 30 percent of the budget revenue (6 percent of GDP averaged over 2017–21) depends on fossil fuels, and acting early to shift this revenue to other bases will help to reduce revenue risk as Kazakhstan, and the world, reduce dependence on fossil fuels. There will be numerous additional demands for government expenditure arising from the low-carbon transition. Modeling suggests that the energy transition would have only a modest impact on the fiscal deficit under a high-oil-price scenario, but would have a high impact under accelerated global decarbonization when the oil price is low. Climate change is also expected to bring additional fiscal costs as the incidence of disasters increases. To enable the budget to be a sustainable and effective stalwart for the transition, reforms could support expanding the revenue base plus enhancing integration of climate-related factors into fiscal management and public finance systems such as procurement.

4.3.1 Building a solid fiscal base to support climate action

The transition to a low-carbon economy and strengthening of climate resilience will increase demands for government spending. This report estimates that the additional investments for full energy system decarbonization in Kazakhstan by 2060 will average 0.9 percent of GDP per year (Figure 38). Based on existing industry make-up and type of investments, the government could make about a third of these investments. This means additional government spending of about 0.3 percent of GDP per year. In addition, the future cost of the physical impacts of climate change, much of which would be met by government, could under a high climate change scenario rise to 4.3 percent of GDP by 2100 if adaptation action is not taken.

Global decarbonization is not only likely to place demands on expenditure but over time may also undermine key sources of fiscal revenue. Kazakhstan's fiscal oil revenues amount to about 6 percent of GDP per year and consist of two major streams. First are the revenues to the NFRK from corporate income tax of oil companies, oil royalties, and production-sharing arrangements. Second is the direct revenue to the state budget from oil export duty (between 2010 and 2021). These oil revenues are pivotal in narrowing the non-oil deficit of the state budget (Figure 39). Because of the linkages between oil and non-oil activities, the transition may also have a negative impact on non-oil tax revenues. An estimate based on historical data suggests that a 10 percent decline in oil prices could reduce the non-oil tax revenue by 1.0 to 1.8 percent.[61]

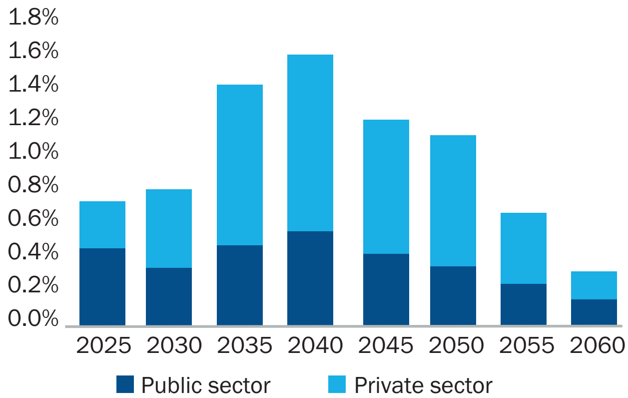
Early action to broaden the revenue base and continue improvement in tax administration could help build fiscal buffers and improve budget resilience. The tax revenue base at present is concentrated in corporate income tax and value added tax (VAT), mostly collected from a small group of large firms in a limited set of sectors (OECD 2020). The share of excise duty is only 2.5 percent of total tax revenue. It is also notably lower than the equivalent figures in other countries (0.5 percent of GDP for Kazakhstan and 4 percent for average upper-middle-income countries). There is scope to increase excise rates on certain fuels by extending recent increases to coal and gas, which represent a substantial share of inputs for energy. Another option to broaden the tax base is to limit exemptions on VAT, corporate

60 Melekcy and Raddatz (2015) found that countries with lower levels of insurance penetration faced larger declines in economic output and more considerable increases in fiscal deficits in response to disasters than countries with higher levels of insurance penetration.

61 The estimate uses data from 2000 to 2020 and applies an ordinary least squares method. The dependent variable is non-oil tax revenue; right-hand-side variables are oil price and lagged non-oil tax expressed in natural logarithm. A time trend is included to control for the size of the economy. Non-oil tax revenue is total tax revenue minus customs duty from oil export.

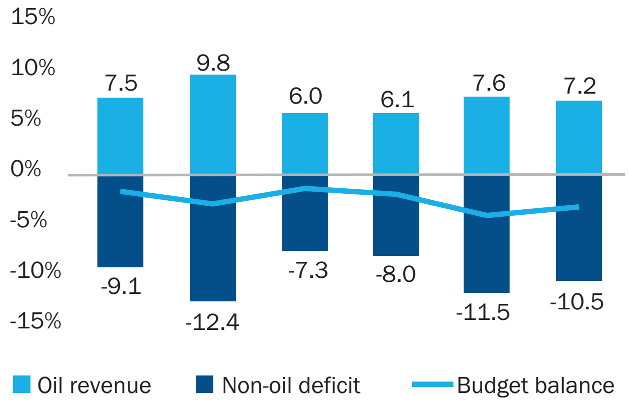
income tax, and personal income tax. Investment incentives for downstream fossil fuel industries through duty exemptions and tax preferences could be rationalized. Applying excise on all fuels to complement the broadening of the ETS could both strengthen incentives to reduce consumption and raise fiscal revenue. As an illustration, Figure 40 shows that a gradual increase in excise rates on all fuels to 25 percent of the level specified under the EU directive will gradually increase tax revenue up to 4 percent of GDP by 2030. The projections also suggest that recycling 40 percent of the excise revenue as cash transfers for the bottom 40 percent of income distribution (Figure 41) could more than offset the negative impact of a higher fuel price on their consumption.

Figure 38. Additional capital expenditures to achieve net-zero emissions by 2060 (% GDP)



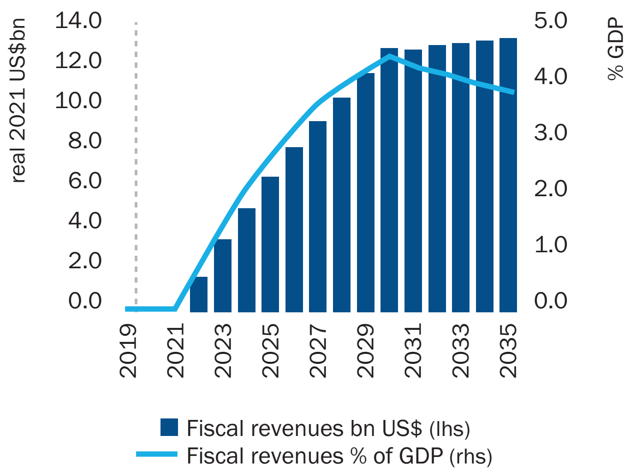
Source: World Bank estimates.

Figure 39. Oil revenue in balancing the fiscal position, 2016–21 (% GDP)



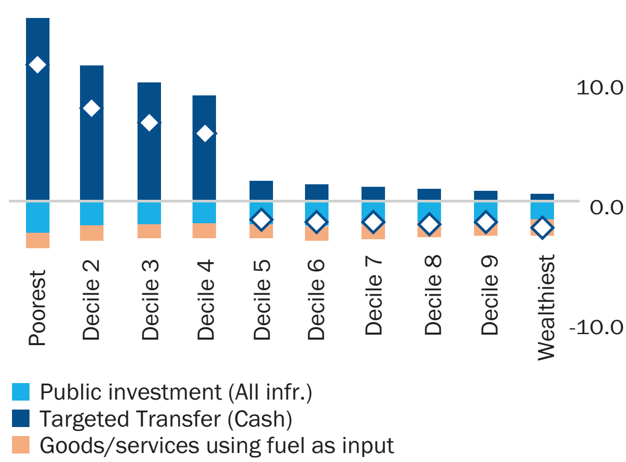
Source: World Bank estimates based on Ministry of Finance data.
Note: Oil revenue consists of transfers from National Fund of Republic of Kazakhstan (NFRK) and oil export duties.

Figure 40. Projected additional fiscal revenue from excise on all fossil fuels relative to baseline



Source: World Bank staff calculation using World Bank/IMF Carbon Pricing Assessment Tool (CPAT).

Figure 41. Projected impact of broadening and increasing excise on fossil fuels: Relative mean consumption effect (% consumption in 2030)



Source: World Bank staff calculation using World Bank/IMF Carbon Pricing Assessment Tool (CPAT).

4.3.2 Strengthening fiscal risk management against natural disasters

Natural disasters can expose a risk to the government budget. Drought and floods, both exacerbated by climate change, account for about two-thirds of losses from natural disasters. Climate-related contingent liabilities are highly uncertain, and annual averages belie what could be far greater losses in a particular year when major disasters hit (Melekcy and Raddatz 2015). The government primarily relies on the national budget and international assistance to cover disaster losses. The government should ensure that it has the ability to analyze and model the potential cost implications of different shocks over time to ensure adequate fiscal space is provided for.

Strategic investments in adaptation and resilience could significantly reduce the cost of natural disasters to the economy of Kazakhstan and the flow-on fiscal impacts. The annual costs of adapting to climate-related hazards is estimated to be approximately US$610 million, or 0.4 percent of GDP (Table 7). This amount is smaller than the estimated cost of natural disasters, which is 1.9 percent of GDP every year,[62] and also smaller than the projected 4.3 percent of GDP by 2100 under a high climate change scenario.

Table 7. Climate adaptation priorities for Kazakhstan

	Priority score (out of 5)	US$, millions	% GDP
Making new infrastructure resilient	4	221.8	0.1
Making water resources management more resilient	3	166.3	0.1
Improving dryland agriculture crop production	2	110.9	0.1
Strengthening early warning systems	2	110.9	0.1

Source: UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific), "Kazakhstan Risk and Resilience Profile" (accessed May 2022), https://rrp.unescap.org/country-profile/KAZ.

4.3.3 Strengthening the fiscal framework and public financial management

Kazakhstan could consider revisiting the fiscal framework to support the transition while maintaining long-term fiscal sustainability. Kazakhstan's existing fiscal rule focuses on limiting the transfers of the NFRK to the budget based on projected oil price and capping government spending growth. There are also multiple fiscal targets (government debt limit, government debt service limit, minimum level of NFRK) (IMF 2022). But having too many targets can complicate the implementation of fiscal rules and restrict government borrowing. Moreover, regulating withdrawal from the NFRK should not be the main focus of fiscal policy because it could create inconsistency in managing asset liability. For instance, restricting transfers could push the government to borrow at higher cost than the return from NFRK savings. Investing more of the NFRK savings in human capital, climate adaptation, and green infrastructure could be more optimal for present and future generations.[63] The government could work to ensure that net government assets (stock of financial assets minus stock of debt and guarantee) are consistent with long-term fiscal sustainability,[64] which implies anchoring the non-oil primary balance to a long-term fiscal anchor.[65]

Box 16. Summary of recommendations on fiscal policy to support climate change action

- Improve the primary balance by broadening the revenue base and rationalize various tax exemptions. Consider broadening and adjusting the excise rates for fossil fuels with recycling some of the revenue to compensate the regressive impact of excise on the poor.
- Ensure adequate contingency funds are available to respond to emergencies from natural disasters. The amount of contingency funding should be based on thorough risk assessment.
- Strengthen the fiscal framework to ensure that spending to support green transition is in line with the long-term fiscal sustainability.

62 UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific), "Kazakhstan Risk and Resilience Profile," (accessed May 2022), https://rrp.unescap.org/country-profile/KAZ.

63 Van der Ploeg and Venables (2011) argue that transferring most of the consumption of windfall revenue to future generations may not be optimal for developing countries with scarce financial, human, and physical capital.

64 To achieve this objective, the net government assets plus the present value of the future path of oil revenue ("resource wealth") should at any given time be equal to the path of non-oil primary balance (non-oil revenue minus spending but excluding interest payment). See Basdevant, Hooley, and Imamoglu (2021) for variations of the fiscal adjustments for resource-rich countries.

65 The Public Finance Review for Kazakhstan (World Bank 2017) recommends anchoring the non-oil primary balance to a long-term anchor, such as the permanent income hypothesis.

Chapter 5

Summary of recommendations

This Country Climate and Development Report identifies ways that Kazakhstan can achieve its development objectives while transitioning to a greener, more resilient, and inclusive development pathway. It sets out policy reforms and investments needed to build resilience to climate change impacts and reduce greenhouse gas emissions in line with the country's climate change goals. These are organized into four areas: (i) decarbonizing the energy system, (ii) pursuing climate-smart development in water, agriculture, and rangelands, (iii) creating an enabling environment, and (iv) ensuring a just transition. To provide an indication of priority and sequencing, the recommended actions are divided into urgent actions needed in the next two years and those to be undertaken over the medium-term (to 2030).

5.1 Urgent climate actions

The CCDR proposes a selection of urgent actions needed in the next two years. These are actions that are important for reaching the 2030 NDC target and that must start now in order to deliver the required emissions reductions. Some actions are starting points, with longer-term actions to follow the initial planning and steps they establish. Longer-term implementation does not mean delayed action: planning, piloting, institutional strengthening, and initial steps toward longer-term outcomes may need to start now for realization of future results.

Decarbonizing the energy system	**Roadmap for achieving 2030 climate targets.** Outline a coherent policy suite to achieve targets, with clear timelines for their implementation consistent with achieving net-zero emission by 2060. Put in place an institutional mechanism to monitor progress and interim targets.
Decarbonizing the energy system	**Renewable energy.** Substantially scale up renewable auctions under a "plug-and-play" scheme where the government is responsible for siting and land acquisition, support to internationally financeable power purchase agreements, and power evacuation, while the private sector is invited to invest in and operate generation assets through well-structured, transparent auctions.
Decarbonizing the energy system	**Emissions trading system reforms.** To ensure large installations contribute their fair share toward the 2030 climate target, consistently reduce the ETS cap over time to arrive at the 2030 cap as set out in the National Allocation Plan; establish a plan for introducing auctioning, with auctioning to begin by 2025.
Decarbonizing the energy system	**Ramping down coal use.** Begin engagement with affected businesses and communities on developing a plan for ramping down coal use in power and heating sectors, in line with climate targets. Coal plants can be retired after their economic life; planning for their exit, including upstream impact on the coal mining sector, should be undertaken.
Decarbonizing the energy system	**Energy efficiency.** Implement more stringent energy efficiency standards for new buildings. Start preparing a comprehensive energy efficiency strategy and associated implementation programs, including establishment of a dedicated body that consolidates energy efficiency policy research and monitoring functions, incentive schemes for energy conservation, energy labeling program, more stringent energy efficiency standards for industry, and targets for building retrofits (such as 2 percent of existing buildings annually).
Agriculture, water, and rangelands	**Transforming the agriculture sector.** Kick-start adoption of climate-smart agricultural practices by introducing targeted incentive schemes (such as linking existing subsidies with adoption of certain resource-efficient farming practices) and a capacity-building program for farmers. Government-supported pilot programs for new technologies should also be considered.
Enabling environment	**Institutional reform.** To strengthen implementation and prevent fragmented efforts, establish an ongoing mechanism to coordinate the government's response to climate change (both mitigation and adaptation) backed by a strong central authority.

5.2 Medium term actions

The CCDR outlines further actions to be taken over the medium term (to 2030) to realize development and climate visions. The timing of these stages is informed by the need for prior foundational work, the cost and level of development of relevant technologies, and the risk of locking in higher emissions if action is delayed.

5.2.1 Decarbonizing the energy system

Decarbonizing the energy system (power, heat, transport, industry), which generates over 80 percent of emissions, is key to achieving the 2030 NDC and the 2060 net-zero goals. The power sector is the priority due to the aging generation fleet and availability of cost-effective renewable energy alternatives. At the same time, actions are needed across the sectors to kickstart decarbonization—including electrification of transport, industrial process changes, and energy efficiency. Moreover, modernization of the energy system is key to maintaining reliability and the downstream competitiveness of human resources and industry.

Energy pricing	**Gradual removal of fossil fuel subsidies** through establishing and implementing cost-reflective tariff methodologies. Put in place a robust social mitigation plan to protect the poor from price adjustments (see chapter 4). Develop and implement a well-designed communication and outreach campaign. Consider establishing an independent regulator or consolidating price-setting functions under a single authority.
Power sector	**Resilient, modern power infrastructure.** Improve power system flexibility by 2035 by (i) developing revenue streams for storage (battery, pumped hydro, hydrogen) and flexible power plants through ancillary services market, wholesale electricity trade, and removal of regulatory barriers; (ii) offering targeted incentives for transmission and distribution system flexibility, including removal of barriers to connecting solar, wind, and new technologies to the power system; and (iii) implementing demand-side management practices through rebates, prices, and tariffs, with emphasis on industrial and commercial demand shifting and coordinated smart charging of EVs.
Heating sector	**Sustainable heating.** Design and implement an investment program to commercialize new technologies and business models in areas such as (i) blended finance for deep renovation of buildings, (ii) reduction of heat losses in pipelines outside the jurisdiction of district heating companies, (iii) drilling of exploratory geothermal wells, (iv) rebates to encourage distributed technologies, including heat pumps and rooftop solar, and (v) construction of zero-emission buildings. To support reduction in fugitive emissions, aim to progressively improve the monitoring, measurement and reporting of fugitive emissions including from oil and gas sector.
Energy efficiency	**Energy efficiency programs.** Implement more stringent energy efficiency standards in industry and appliances and continue retrofitting at least 2 percent of existing buildings annually from 2023 onward. Institute target of carbon neutrality for all new buildings built after 2030. Build in appropriate budget support mechanisms to allow akimats and government agencies to access private capital for renovations and upkeep of buildings and energy infrastructure.
Transport	**Electric vehicle uptake.** Develop early-stage EV recharging infrastructure; prepare a longer-term strategy for charging infrastructure; consider fiscal incentives (removing customs duties on second-hand EVs, adjusting vehicle taxes and purchase subsidies). In the longer term, consider support needed to develop infrastructure for low-emissions heavy vehicles.
Transport	**Urban planning and public transport.** Develop a planning scheme for new peri-urban developments that incorporates compactness and mixed-use developments, local access to services and public transport, and high-quality, dedicated, physically protected, connected networks for active transport. Once complete, expand urban planning reform to integrate transport-oriented development principles. Institute public procurement of and incentives for low-emissions vehicles to decrease emissions from the public transport and government fleets; expand public transport networks, in part through more dedicated bus lanes to improve speed and efficiency of trips; continue to plan expansion of the Almaty metro.
Transport	**Improved consumer outcomes.** Adopt higher-quality fuel standards, fuel efficiency standards, and fuel efficiency labeling for vehicles.
Transport	**Transformation of rail.** Develop a plan for continued electrification and logistical improvements to the rail network. Based on that plan, rationalize and electrify the rail network.
Power, transport, industry	**Development of new technologies through pilots.** Assess the potential of emerging technologies and consider technology demonstrations/pilots for CCS in industry and the power sector, clean hydrogen production, and battery storage.

5.2.2 Water, agriculture, and rangelands

Greater carbon sequestration from rangelands—particularly grasslands and forests—is possible and would provide a potential net carbon sink in the order of 20–40 Mt CO_2-e, which could offset emissions from hard-to-abate sectors and reduce the cost of achieving net zero by 2060. These gains would require improved pastureland management and large-scale afforestation and would also deliver important cobenefits for biodiversity and reduced land degradation. Similarly, action to reduce agricultural emissions and improve water efficiency would improve agricultural productivity and build greater resilience to physical climate risks. The CCDR outlines steps to prepare these vital sectors to adapt as climate impacts worsen. The first steps, to improve coordination and planning for addressing climate impacts while scaling up climate-smart practices, need to be taken within the next five years. These actions lay the foundations for longer-term action to mainstream sustainable land and water management practices and to build the necessary new infrastructure.

Water	**Improved planning.** Integrate climate change considerations into existing land and water management plans and legislation; improve the assessment of how climate change may impact the spatial and temporal mismatch between water resources availability and demand; strengthen the understanding and management of trade-offs among key water-using sectors to improve allocation and utilization of water resources.
Water	**Transboundary cooperation.** Strengthen cooperation and data sharing with countries sharing international rivers. In the longer term, pursue formal water-sharing agreements and strengthen joint regional institutions.
Water	**Investment in infrastructure.** Renew and modernize aging water supply and irrigation assets; increase the share of water-saving technologies in industry and agriculture; rehabilitate and optimize multipurpose water storage to manage water resource availability within a given year and interannually. In the longer term and where feasible, invest in water recycling and resource recovery from wastewater to further enhance water use efficiency; increase and optimize multipurpose water storage capacity.
Agriculture	**New approaches.** Support diversification of crop choices to higher-value, lower-water-use crops. Kick-start adoption of climate-smart agricultural practices by introducing targeted incentive schemes (such as linking existing subsidies with adoption of certain resource-efficient farming practices) and a capacity-building program for farmers. Government-supported pilot programs for new technologies should also be considered. Over time, move to 100 percent sustainable agricultural practices, including moving from an expansion-based to an efficiency-based approach.
Water	**Filling information gaps.** Expand research and data collection, including through cooperation with universities and research institutes to fill information gaps (e.g., relating to water accounting for surface water and groundwater); introduce GIS-based data collection for disaster monitoring. Strengthen adaptation and sector planning through investments in hydromet, water information systems, and data sharing and use for decision-making.
Rangelands	**Carbon sinks.** To understand sequestration potential and develop programs for afforestation and pasture management, undertake comprehensive planning and research into dramatically scaling up carbon sequestration. In the longer term, implement national programs to increase carbon sequestration in landscapes.

5.2.3 Just Transition

Some communities will need support through the transition, particularly poorer households, who will need to deal with any increases in energy prices, and populations living where adverse employment effects are concentrated, such as coal mining towns. This support involves a mix of shorter-term relief and longer-term planning for the economic development of regions.

Social assistance	**Better targeting.** Review the existing targeted social assistance program with a view to expanding access beyond the current very small share of the very poorest households; and adopt mechanisms, such as active labor market programs, that support graduation from TSA.
Social assistance	**Compensation package.** Design a compensation package for poorer households to offset any energy and other cost increases. In doing so, re-target a portion of energy subsidies to direct financial assistance to households such as through cash transfers or tax reductions.
Communi-cations	**Public support.** To build public support for reform, develop a strong communication plan around how revenues from subsidy reform and carbon pricing will be spent.
Community support	**Support for coal communities.** Start preparing to support communities through the transition by taking immediate action on process planning and community preparedness for mine closure, applying a framework like the one outlined in this report.

5.2.4 Enabling environment

Various important enabling reforms are needed to support mitigation and adaptation policy. These include reforms to remove market distortions and stimulate private investment.

Power, transport, industry	**ETS reforms.** Expand carbon pricing to all transport fuels, methane, and industrial process emissions. Replace the coal and "other fuels" benchmarks with single, fuel-neutral benchmarks for electricity and heat to encourage cleaner power production. Introduce quantitative limits on the use of offsets for compliance under the ETS to limit risks around their integrity, and do not issue offsets for reductions in emissions covered by the ETS.
Structural reforms	**Cross-cutting reforms.** Undertake deep structural reforms needed to sustain productivity growth during green transition. Consider improving the functioning of markets and market institutions by rationalizing the involvement of SOEs in economic activities and cementing competitive neutral policies, reducing distortion in the credit market, and allowing movement of capital and labor for more productive use. Increase access to good-quality education for all citizens by focusing on learning outcomes and improving the capacity of local governments to respond to their education sector priorities.
Information	**Bringing people along.** Use citizens' views to tailor effective informational programs and policies. For example, emphasize benefits for health, air quality, and productivity.
Market reform	**Data and transparency.** Introduce systematic accounting for the size of cross-subsidies for energy by government entities. The results can then inform reform of energy pricing and implicit fossil fuel subsidies to deliver more cost-reflective pricing, attract private capital, and elicit an appropriate demand-side response.
Financial sector	**Green finance.** Improve disclosure and reporting, including green taxonomies for green projects in lending and capital markets. Strengthen financial sector regulators' remit in overseeing climate-related and environmental risks. Kazakhstan's agency for financial sector development and regulation (AFR) should ensure that climate and environmental risks are sufficiently considered in bank decision-making—including through rules and guidance along with monitoring and review—to ensure "brown" finance costs fully reflect physical and transitional climate risks.
Fiscal policy	**Fiscal sustainability.** Consider improving the revenue base to support the green transition, in part by broadening and adjusting the excise rates for fossil fuels, with consideration for the need to compensate the poor. Based on thorough risk assessment, ensure adequate contingency funds are available to respond to emergencies from natural disaster. Strengthen the fiscal framework to ensure that spending to support green transition is in line with long-term fiscal sustainability.
Financial sector	**Improved access to insurance.** Implement measures to support the development of disaster risk insurance products that are more widely available and affordable.

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