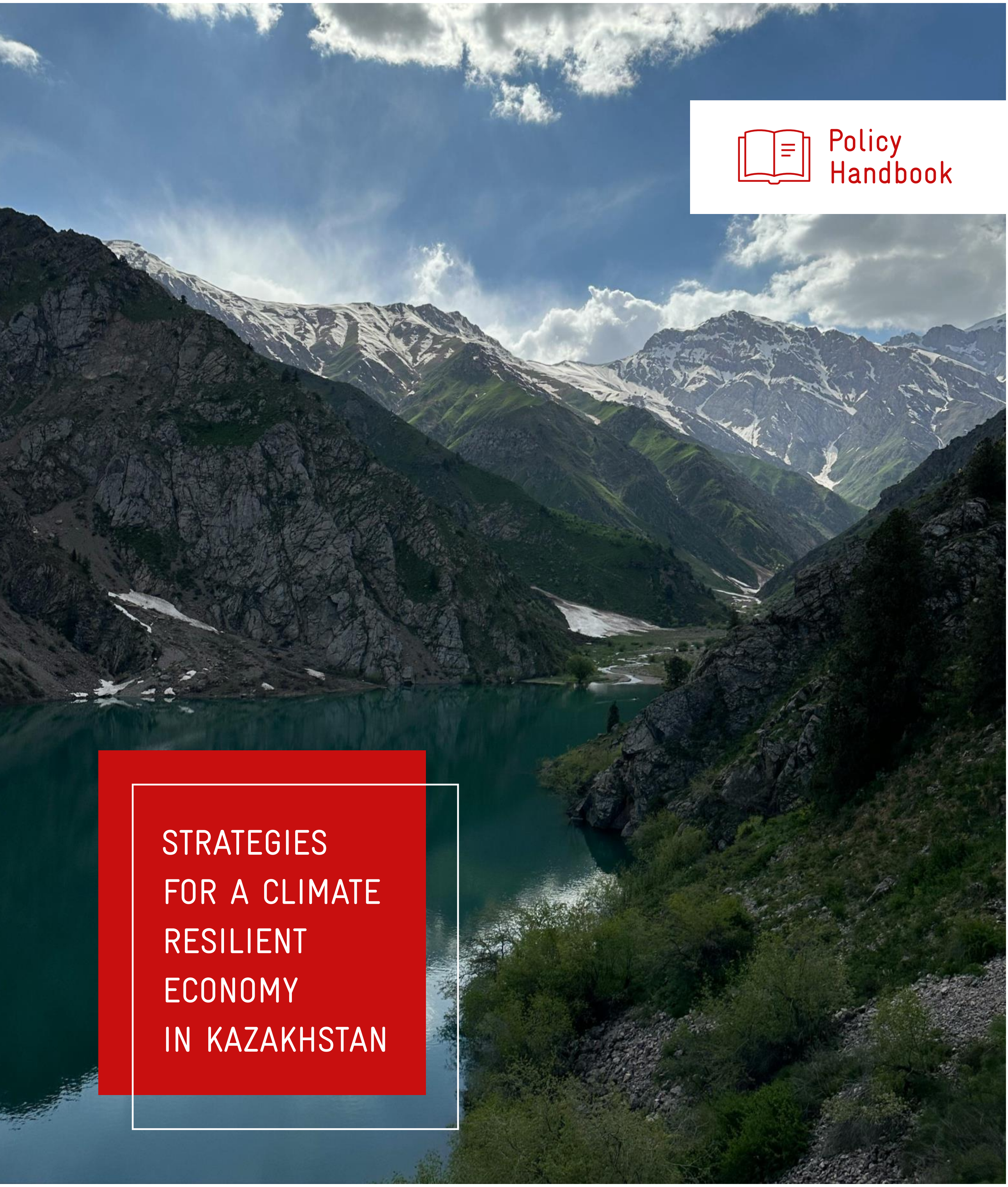

Policy Handbook

STRATEGIES FOR A CLIMATE RESILIENT ECONOMY IN KAZAKHSTAN

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On behalf of
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)

Germany 2025

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POLICY HANDBOOK

June 2025

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1. INTRODUCTION

This handbook has been prepared as part of the Global Programme on Policy Advice for Climate Resilient Economic Development (CRED), which is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and aims to fill a gap that exists in many countries: the lack of model-based assessments that can demonstrate how climate change affects economic growth, public finances and sector performance. By translating climate risks into concrete economic data, policy-makers can make more informed decisions and develop adaptation strategies that are grounded in evidence. This approach leads to more climate resilient policies and enables effective resource allocation.

In this context, the e3 (economy, energy, emissions) model – an analytical tool that incorporates economic, energy and environmental data – plays a key role. The model supports medium- and long-term scenario analysis and helps guide near-term decisions, such as budget allocations and the roll-out of initial public investment programmes in the context of strategic long-term visions. With the step-by-step guidance provided in this handbook, users learn how to identify, model and refine adaptation measures so that they yield a triple dividend – avoiding economic losses and realising economic and environmental benefits.

This handbook is aimed at policy-makers, adaptation specialists and others who contribute to climate and development planning in Kazakhstan. Public officials can use it to align resilience measures with national strategies and inform fiscal and regulatory decisions, ensuring that climate actions are backed by solid data. Adaptation practitioners – especially those working on National Adaptation Plans (NAPs), Nationally Determined Contributions (NDCs) or sector-level initiatives – can follow these guidelines to select policy scenarios, evaluate their potential outcomes and present model findings to decision-makers. By offering step-by-step instructions for scenario development, data analysis and interpretation of results, this handbook equips stakeholders to incorporate climate-focused actions into broader development programmes. It is a practical resource for designing and implementing adaptation strategies based on robust evidence and tailored to policy needs.

2. POLICY ENTRY POINTS FOR EVIDENCE-BASED ADAPTATION PLANNING

2.1. Role of climate adaptation in the country's development goals and strategic instruments

Climate adaptation is central to achieving sustainable economic development and addressing climate risks. Strategic instruments such as NAPs and NDCs outline key priorities in terms of climate adaptation measures. In Kazakhstan, climate adaptation is being embedded in sectoral strategies and broader development frameworks, emphasising the importance of resilience in economic planning. Kazakhstan is currently working on developing a NAP, underscoring its commitment to aligning national goals with international climate commitments, fostering policy coherence and increasing opportunities for accessing climate financing. Key stakeholders such as the Ministry of National Economy (MNE) and the Ministry of Ecology and Natural Resources (MENR) drive these efforts, ensuring the inclusion of sector-specific adaptation measures in the country's development goals.

2.2. Entry points for policy integration explored in the context of the CRED project

The CRED project identifies several key entry points for incorporating climate economic modelling results into the economic development policy cycle in Kazakhstan. [1] Policy entry points refer to the opportunities or stages in planning and decision-making processes where adaptation measures can be incorporated to most effectively influence policy outcomes. These points may include strategic frameworks, sectoral policies or fiscal planning mechanisms which provide a foundation for incorporating measures into broader goals.

In the context of Kazakhstan, one such entry point is the development of strategic plans and frameworks. By leveraging the results of climate economic modelling, sectoral adaptation strategies can be aligned with NAP and NDC priorities. For instance, the Ministry of Finance (MoF), the MENR, the Ministry of Agriculture (MoA) and the Ministry of Water Resources and Irrigation (MOWRI) can collaborate on identifying actionable measures for sectors such as agriculture and water management, which are highly vulnerable to climate impacts.

Another significant entry point lies in budget formulation and approval processes. Incorporating climate adaptation into national and sectoral budgetary frameworks allows for the justification of climate resilient allocations, such as investments in drought-resistant agricultural practices. During budget statements, the MoF can highlight climate resilient economic development as a critical priority.

Resource mobilisation and allocation also offer substantial potential for policy integration. It is crucial to ensure that sufficient funds are available to finance adaptation and that the funding aligns with policy objectives, even in the face of fiscal constraints. Climate budget tagging systems could be employed to monitor adaptation-related expenditures, and public procurement frameworks could incorporate climate resilience criteria to guide sustainable investments. These efforts are bolstered by sectoral dialogues involving key stakeholders, such as the MoF, the MNE, the MENR and the MOWRI. Collaborative efforts ensure that adaptation scenarios are accurately represented and that data gaps are addressed. Recent meetings with stakeholders, including the Electric Power and Energy Saving Development Institute

[1] International Institute for Sustainable Development (2021). Using Climate Economic Modelling for Sustainable Economic Development: A Practitioner's Guide. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2021-en-climate-economic-modelling-practitioners-guide.pdf.

(EEDI), and with national experts have highlighted the importance of increasing energy efficiency in housing and public buildings. Meetings with the MOWRI and national experts have emphasised the importance of policy measures that aim to prevent flooding by developing counter-regulatory reservoirs. Policy scenarios discussed with these stakeholders seek to incorporate climate adaptation into macroeconomic and sectoral planning processes, thereby promoting climate resilience within the broader context of national development objectives.

2.3. Key challenges

Despite significant progress, several challenges hinder the integration of climate adaptation into economic policy in Kazakhstan.

- **Data limitations** pose a major obstacle, as comprehensive and high-quality climate and economic data are often unavailable, particularly at the subnational level. This lack of data limits the ability to conduct detailed vulnerability and risk assessments, thereby impeding evidence-based decision-making. Institutional capacity gaps further exacerbate these challenges, with many institutions lacking the technical expertise required to interpret and apply climate economic modelling results. This issue is especially pronounced in rural areas, where resources for training and capacity building are scarce.

- **Fragmented coordination mechanisms** present another hurdle, as effective adaptation planning requires cross-sectoral and interministerial collaboration. Inadequate frameworks for coordination and unclear mandates often limit the effectiveness of such efforts.

- **Financial constraints** also impede progress. While international climate finance provides some support, domestic funding for adaptation remains inadequate, hindering the implementation of large-scale adaptation projects. In particular, private sector engagement is often low due to a lack of risk-sharing mechanisms, such as blended finance instruments, insufficient regulatory incentives and limited awareness of bankable adaptation opportunities.

- **Limited stakeholder engagement** reduces the effectiveness of adaptation initiatives. Non-government actors, including the private sector and civil society, are often not systematically involved in the design and implementation of adaptation measures, which weakens ownership and limits the mobilisation of additional resources and expertise.

Addressing these challenges requires a robust enabling environment that supports leadership, data sharing, capacity building and multi-stakeholder engagement. By overcoming these barriers, Kazakhstan can fully leverage the potential of climate economic modelling to inform and guide its adaptation planning and economic development efforts.

SUMMARY

Integrating climate adaptation into economic development is vital for building resilience and achieving sustainability. Strategic frameworks such as NAPs and NDCs enable alignment with global climate goals, while entry points such as planning, budgeting and resource mobilisation embed adaptation in vulnerable sectors. Key challenges, which include data gaps, institutional capacity, coordination, funding and stakeholder engagement, need to be addressed. By fostering collaboration, evidence-based decision-making and inclusive participation, countries can strengthen adaptation integration and ensure sustainable development.

3. PROCESS FOR USING THE E3 MODEL

This section provides an overview of the application of the e3 model for developing and refining adaptation policy scenarios. It draws on key insights from the Handbook on Macroeconomic Modelling for Climate Resilience[2] and offers guidance on how national stakeholders can use the model effectively in their specific contexts.

The model helps to quantify the economic effects of adaptation measures by offering a consistent framework to develop data-driven policy recommendations. It includes a structured seven-step process, from project setup to independent application, ensuring the thorough integration of adaptation considerations into macroeconomic policies.

Figure 1. Macroeconomic modelling in the adaptation policy cycle

Source: Taken from GIZ (2021); Climate-ADAPT (n.d.)[3]

The use of e3 templates for developing countries ensures the model's adaptability and transferability across various contexts. By incorporating economic, energy and emissions data, the e3 model serves as a robust tool for scenario analysis, guiding evidence-based adaptation planning and decision-making.[4] A more detailed description is provided in the following sections.

3.1. Model overview

The e3 model is designed to capture the interlinkages between economic activity, energy use and environmental impacts. While its core components include energy, emissions and macroeconomic interactions, the model is particularly well suited for adaptation analysis. It enables the quantitative evaluation of sector-specific adaptation measures by assessing their costs, macroeconomic implications and co-benefits, such as employment effects and avoided losses.

› Its input–output basis enables it to analyse different economic sectors and their interdependencies while accounting for domestic and foreign drivers of economic growth. By incorporating both demand and supply dynamics alongside pricing mechanisms, the model effectively evaluates macroeconomic trends and provides insights into sectoral interactions and policy outcomes. The model supports detailed assessments of policy scenarios, enabling the comparison of adaptation measures across

[2] GIZ (2023). Handbook on Macroeconomic Modelling for Climate Resilience: A manual for designing technical assistance on macroeconomic modelling supporting climate resilient development. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2023-en-handbook-macromodelling-resilience.pdf.

[3] GIZ (2021). Macroeconomic Models for Climate Resilience: An economic tool for adaptation and development planning. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf; European Environment Agency (n.d.). The Adaptation Support Tool – Getting started. Climate-ADAPT. Retrieved from https://climate-adapt.eea.europa.eu/en/knowledge/tools/adaptation-support-tool.

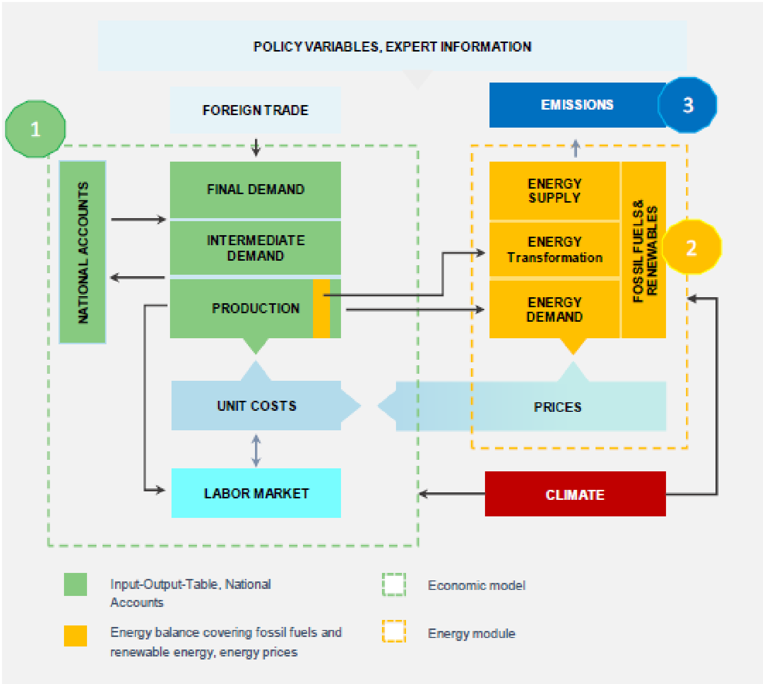
[4] GIZ (2023). Handbook on Macroeconomic Modelling for Climate Resilience: A manual for designing technical assistance on macroeconomic modelling supporting climate resilient development. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2023-en-handbook-macromodelling-resilience.pdf; GIZ (2021). Macroeconomic Models for Climate Resilience: An economic tool for adaptation and development planning. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf.

sectors based on their economic relevance and feasibility.

- The energy module provides a detailed examination of energy sector dynamics, encompassing demand, supply and transformation processes across fossil fuels and renewables, as shown in energy balances. This granularity enables precise assessments of fossil fuel combustion and its related CO2 emissions, which are further analysed in the emissions module.

- These emissions are represented in physical units, allowing the model to illustrate the impact of renewable energy deployment and energy efficiency improvements on CO2 savings. Notably, the emissions component of the e3 model does not include feedback effects on other model variables, ensuring a clearer distinction between direct and indirect impacts.

Figure 2. e3 model overview



Source: Taken from GIZ (2021); Institute of Economic Structures Research (GWS) (n.d.)[5]

The e3 model is particularly useful for scenario analysis, simulating the macroeconomic effects of various climate change scenarios and adaptation measures. This 'what if' approach addresses questions such as 'What are the macroeconomic impacts of specific climate hazards?' and 'How do sector-specific adaptation measures influence economic outcomes?' Scenarios are constructed using quantified assumptions assigned to model variables, which trigger chain reactions across the economy. The model outputs reveal not only direct effects but also indirect and induced consequences, offering a comprehensive perspective on macroeconomic outcomes.

- The analysis begins with climate change scenarios that define potential extreme weather events and their economic impacts and associated damage, such as destroyed assets, production losses, reduced labour productivity or infrastructure reconstruction costs. These scenarios draw on the

[5] GIZ (2021). Macroeconomic Models for Climate Resilience: An economic tool for adaptation and development planning. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf; GWS (n.d.). Energy and climate: Models. Retrieved from https://www.gws-os.com/en/energy-and-climate/models/detail/panta-rhei.

Shared Socio-economic Pathways (SSPs) developed by the Intergovernmental Panel on Climate Change (IPCC) to represent different climate futures and vulnerability levels.

- These scenarios are benchmarked against a reference case that assumes climate change impacts without any intervention or adaptation measures.
- Adaptation scenarios are then developed to incorporate measures that minimise or prevent these impacts.
- Comparing the results of climate change and adaptation scenarios highlights the economy-wide and sector-specific effects of preventive actions, including changes in gross domestic product (GDP), employment and emissions.

By linking adaptation measures to macroeconomic indicators, the e3 model enables policy-makers to evaluate costs, benefits and trade-offs, supporting evidence-based decision-making for sustainable adaptation planning.

3.2. e3.kz specifications

Each country's context will require the e3 model to be tailored to reflect its unique national characteristics. The model's structure should account for differences in economic composition, resource endowments and overarching policy priorities. For example, special attention might be given to the oil, gas and mining sectors in resource-rich economies such as Kazakhstan, whereas in countries reliant on agriculture, factors such as irrigation, crop yields and seasonal climate variability should be addressed. Where water shortages, droughts or flooding are pressing concerns, further adjustment of water-related parameters may be necessary. Additionally, each country has distinct policy objectives – such as NDCs or sectoral adaptation strategies – which must be integrated into the model.

Kazakhstan is a large country in Central Asia with a population of around 20 million and a population density of eight people per square kilometre. Consequently, when considering the macroeconomic impacts of climate change adaptation, the impacts of more densely populated areas must be considered to obtain meaningful results. Furthermore, Kazakhstan is a country rich in fossil fuels, such as coal, oil and natural gas, with coal a major source of heating. It is also extremely rich in other minerals and ores. Particular emphasis must be placed on uranium, as Kazakhstan is the world's largest uranium mining and exporting country, supplying around 12% to 15% of all uranium globally. The use and trade of natural resources is also reflected in the e3.kz model.

In the context of Kazakhstan, the e3.kz model is applied to simulate the economy-wide impacts of climate adaptation measures under three climate scenarios – SSP1-2.6, SSP2-4.5 and SSP5-8.5. The climate change scenarios and impacts from adaptation measures are compared to the reference scenario (REF), which is the benchmark for comparison. The REF developed for the e3.kz model considered the assumptions made in the LEDS models [6] with the latest available information on expectations for indicators such as energy sector production, exports and composition. However, the latest updates of the LEDS models are not taken into account as the REF was finished before the LEDS process was. The REF provides economic projections for all model variables until 2050 presuming that, apart from a few exogenous assumptions, the economic relationships observed in the past are valid for the future.

In the REF, the Kazakh economy is projected to expand until 2050, albeit at a more modest rate compared to its historical performance. For modelling purposes, economic growth is grouped into three projection periods: (i) 2020–2030 with average annual real growth of 3%, (ii) 2030–2040 with average annual real growth of −0.3% and (iii) 2040–2050 with average annual real growth of 2.1%. The subdued economic growth between 2030 and 2040 is indicative of the export assumptions embedded in the model. Export development is driven by exogenous assumptions, with accelerated growth between 2020 and 2030 of 3.2%, driven by high crude oil exports.

[6] The low-emission development strategy (LEDS) modelling tools for achieving carbon neutrality in Kazakhstan by 2060.

This outcome aligns with the expectations of the MNE. Projections for subsequent periods are contingent upon the LEDS. In contrast to the dynamic fluctuations observed in the export of crude oil, the export of agricultural goods is projected to exhibit a steady growth trajectory extending up to the year 2050. This underscores the necessity for adaptation in the agricultural sector. Conversely, imports are predicted to rise in tandem with economic activity, contingent upon the import dependency of specific economic sectors. Household consumption remains the primary driver of GDP, as observed in previous periods. The positive impact of employment opportunities and higher incomes on consumer expenditure decisions is also expected to be a key factor in this trend. Consumer spending by private households exhibits a consistent growth trajectory since the previous period, with an initial average annual growth rate of 3.5% from 2020 to 2030. This growth rate subsequently decelerates to 0.6% in the period from 2030 to 2040, before recovering to reach 2.3% from 2040 to 2050. The growth trajectory of gross fixed capital formation mirrors that of GDP growth. Consequently, investment will initially continue to grow at an average annual rate of 4.7% during the 2020–2030 period, decelerate between 2030 and 2040, resulting in zero annual growth, and rise by 1.3% a year in the 2040–2050 period. Government consumption expenditure is predicted to exhibit a growth rate of up to 3% a year, following GDP growth with a time lag. The major assumptions underpinning this analysis are outlined in Table 1 below.

Table 1: REF: Real GDP and components (expenditure approach), average annual 10-year growth rates in % (2000–2050)

	2000–2010	2010–2020	2020–2030	2030–2040	2040–2050
GDP	8.3%	3.9%	3.0%	−0.3%	2.1%
FINAL CONSUMPTION EXPENDITURE: PRIVATE HOUSEHOLDS AND NON-PROFIT INSTITUTIONS SERVING HOUSEHOLDS (NPISH)	8.9%	5.6%	3.5%	0.6%	2.3%
FINAL CONSUMPTION EXPENDITURE: GOVERNMENT	6.7%	7.0%	3.0%	0.04%	1.3%
GROSS FIXED CAPITAL FORMATION	14.0%	5.9%	4.7%	0.04%	1.3%
EXPORTS OF GOODS AND SERVICES	3.9%	−0.1%	3.2%	−2.2%	2.5%
IMPORTS OF GOODS AND SERVICES	2.8%	3.0%	4.6%	0.7%	1.6%

Source: GIZ (2025). Economy-Wide Impacts of Climate Change and Adaptation in Kazakhstan [Großmann, A., Hohmann, F.] GIZ, Berlin.

The analysis of sectoral production is contingent upon macroeconomic development, with consideration given to inter-industry relationships. For the projection period, no structural changes or economic diversification of the economy are assumed, except for developments in the energy sector, which follow LEDS growth assumptions.

3.3. Process for using the e3 model in Kazakhstan

In Kazakhstan, the e3.kz model was developed by the GWS in cooperation with the Economic Research Institute (ERI), which is a subordinate agency of the MNE. ERI is a think tank that provides economic analysis services to the Government of Kazakhstan. It is the primary owner of the model and is responsible for its maintenance, which involves updating the data. Another important player is ERI's parent institution, the MNE, which coordinates all major economic policy initiatives and is potentially one of the main users of the e3.kz model. The MENR is also likely to use the modelling results, as it coordinates all major climate change policies. It is responsible for the NAP, which is the document that can benefit the most from the e3.kz model results. Lastly, for adaptation policies involving large-scale government spending, the MoF is potentially an important user for budget planning purposes. Based on the stakeholder meetings conducted in June 2024 as part of the project, other line ministries are also interested in the modelling results for their respective sectors. For instance, EEDI[7] is interested in using the model for adaptation in energy efficiency, while the MOWRI is interested in the modelling results for adaptation policy involving the construction of multi-purpose water reservoirs.

SUMMARY

The e3 model analyses the economic impacts of climate adaptation by linking economic activity, energy use and emissions. It supports scenario analysis to evaluate climate hazards, adaptation measures and their effects on GDP, employment and emissions. The model's flexibility allows tailoring to national contexts by adjusting for economic structure, resources and policy goals.

For Kazakhstan, the model has been adapted to reflect key characteristics of the country's geography and economy, including low population density and the use and trade of natural resources. Across three climate change scenarios, impacts are modelled for different climate hazards of relevance to Kazakhstan, the most important being extreme precipitation, extreme temperature, extreme winds, heatwaves, droughts and wildfires.

[7] EEDI is a subordinate agency of Kazakhstan's Ministry of Industry and Construction (MOIC).

4. DEFINING AND FORMULATING ADAPTATION POLICY SCENARIOS

The formulation of adaptation policy scenarios is a crucial step in translating climate objectives into practical, data-informed measures. The identification of four viable scenarios involved close collaboration with the CRED National Adaptation Expert Group and key government stakeholders, including ERI, EEDI, the MNE, the MENR and the MOWRI. Their engagement ensures that the chosen scenarios draw on existing sectoral strategies, reflect the actual needs of local stakeholders and take into account data availability and technical constraints. This collective input also helps clarify how each measure can be incorporated into the macroeconomic model and informs discussions on required datasets and baseline information.

4.1. Selection criteria for qualitative adaptation policy scenarios

A clear and systematic framework for selecting adaptation policy scenarios is essential to ensure they are relevant, feasible and impactful.[8] Four key criteria guide this process:

(1) **Alignment with national priorities:** ensures that scenarios address the critical challenges identified in the NAP and are reconfirmed with key stakeholders. It guarantees that the proposed measures support broader national strategies and development goals.

(2) **Consideration of climate impacts:** evaluates the extent to which a scenario targets critical vulnerabilities, such as land degradation, water scarcity and other climate-related risks. Adaptation measures are tailored to mitigate these threats effectively while also considering co-benefits, such as improved public health or enhanced social equity.

(3) **Economic relevance and data availability:** assesses the potential for scenarios to deliver quantifiable economic benefits, such as increased productivity or cost savings while ensuring that the necessary data and technical expertise are accessible to support implementation.

(4) **Integration into modelling tools:** focuses on ensuring that scenarios are designed to work seamlessly with macroeconomic models. This compatibility enables the quantification of costs, benefits and long-term impacts, providing robust evidence to inform policy decisions.

In addition to these criteria, the framework is based on three principles – feasibility, impact and cost-effectiveness:

› **Feasibility:** examines the practical capacity for implementation, including regulatory, institutional and financial conditions

› **Impact:** captures how effectively the proposed measures address climate risks and their potential to deliver co-benefits

› **Cost-effectiveness:** evaluates whether the anticipated benefits of an adaptation measure outweigh its financial and administrative costs

Scenario selection must also reflect local priorities. For instance, in contexts where agriculture and water resource management are high-priority sectors, adaptation measures related to drought-resistant crops, irrigation infrastructure and watershed protection should receive special attention. By incorporating these considerations into a stakeholder-driven consultation process, decision-makers can ensure that selected scenarios balance ambition with achievability.

[8] European Environment Agency (2016). Assessing and selecting adaptation options. Climate-ADAPT. Retrieved from https://climate-adapt.eea.europa.eu/en/knowledge/tools/urban-ast/step-4-0.

This approach not only strengthens the relevance of the macroeconomic modelling and analyses but also fosters national ownership of the adaptation strategy, ensuring that the selected scenarios align with both local needs and long-term development objectives.

4.2. Formulating a sound adaptation policy scenario

Once promising measures are identified, the next step involves assembling each scenario into a coherent set of measures that aligns with defined policy objectives. At the heart of this process is the need to clearly articulate baseline conditions – including current levels of sectoral productivity, infrastructure and climate vulnerability – against which the effectiveness of new measures can be gauged. The baseline also incorporates existing policies and sectoral targets, ensuring that proposed actions do not duplicate efforts or conflict with ongoing initiatives.

Within each scenario, it is important to specify policy levels, which may include the scale of actions (regional or nationwide), the timeline for implementation (immediate, mid-term or long-term) and any budgetary or legislative adjustments required. When designing such policy levels, stakeholder feedback is invaluable; consultations with the National Adaptation Expert Group, sector ministries and local policy advice institutions help validate assumptions about costs, benefits and technical feasibility. In Kazakhstan, for practical suggestions and implementation of the adaptation policy scenarios, it is always useful to consult with institutions such as the MNE (and its ERI), the MENR and the line ministries responsible for the specific sector the adaptation policy scenario addresses. Furthermore, it is important to involve major international financial and donor organisations, such as the World Bank, the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), GIZ and the United Nations Development Programme (UNDP). Such consultations also clarify data availability – especially data relevant to cost–benefit analyses or macroeconomic modelling – and spotlight any gaps that must be addressed before finalising the scenarios.

This collective process ensures that adaptation policy scenarios are grounded in practical realities while remaining aligned with broader development goals. Once formulated and validated, the scenarios can be fed into the macroeconomic model to capture economy-wide effects, thereby informing revisions to national adaptation strategies and guiding more targeted, effective actions across key sectors.

4.3. Relationship between cost–benefit analyses and the e3 model

The cost–benefit analysis (CBA) and the e3.kz model serve complementary functions in assessing climate adaptation measures. While the CBA focuses on the direct financial and economic implications of individual measures – such as energy efficiency refurbishment, no-till seeding and the construction of water reservoirs – the e3.kz model assesses their broader macroeconomic effects, including indirect and induced impacts across sectors and time.

In Kazakhstan, the two approaches were used in combination where possible. The estimates of costs and benefits for conducting refurbishment of residential and public buildings and the construction of reservoirs served as valuable input for scenario building. Various research papers also provided some cost and benefit estimates for different types of adaptation measures. This research allowed assumptions to be made on unit costs, investment needs and expected benefits, such as increased yield from conservation agriculture practices.

In the e3.kz modelling process, these values were used to inform the structure of adaptation policy scenarios and to quantify model parameters, such as public investment levels or productivity gains. The e3.kz model then translated these into economy-wide impacts, allowing policy-makers to examine not only the sector-specific outcomes but also the resulting shifts in GDP, employment, energy use and emissions.

Where such national estimates were not available, literature-based proxies and open-source benchmarks were applied and validated through expert consultations. This ensured consistency and contextual relevance while maintaining transparency around assumptions. In some cases, benefit estimates were conservatively defined to avoid overstatement in the absence of robust data.

This combined approach allowed the model to reflect both the financial dimension of adaptation and its systemic economic implications, even when full standalone CBAs were not available for all measures.

4.4. Potential limitations and response strategies

The formulation of adaptation scenarios and their integration into the e3.kz model faced several data-related and institutional limitations in Kazakhstan. While a CBA was conducted for two adaptation policy scenarios (energy efficiency and flood protection), sufficient resources were not available to conduct CBAs for other scenarios.

To address this, the modelling team:

- Used literature-based benchmarks and open-source data for missing cost or benefit estimates
- Validated assumptions through expert consultations
- Applied conservative values or sensitivity ranges to reflect uncertainty

It should be noted that, in this process, the modelling team managed to obtain access to high-quality references providing cost and benefit figures. However, the major advantage of using the e3.kz model is that it is possible to demonstrate the results even with limited information, which means that assumptions can be made with rough estimates in order to understand the scale of the impact of an adaptation measure on the economy.

Another challenge was the lack of quantified adaptation targets, particularly in sectors such as flood protection and agriculture. Conducting consultations with the agencies responsible was also problematic. Therefore, the process of identifying the specific plans for adaptation required assumptions to be made based primarily on expert consultations.

Recommended mitigation strategies include:

- Developing sector-specific CBAs as part of national adaptation planning
- Clarifying quantitative adaptation targets for priority sectors
- Strengthening cross-agency data coordination and institutional capacity for ongoing model use

Despite these limitations, the combined use of national data, expert input and transparent assumptions allowed the model to generate meaningful insights and support scenario-based decision-making.

5. POLICY RECOMMENDATIONS AND RESULTS

5.1. Improving energy efficiency in buildings

Extreme weather events and heatwaves were identified as some of the major climate change threats for Kazakhstan.[9] These result in extremely low and high temperatures. Currently, the heating season in the country is roughly six months long, with heating needed from around 143 to 231 days.[10] Current heating needs and the risk of extreme weather events require different approaches to energy efficiency in buildings in Kazakhstan.

Accordingly, energy efficiency is one of the main priorities of Kazakhstan's energy policy agenda. This is also reflected in the country's legislation and the number of measures taken to create a basis for improvement. For example, in 2016, Kazakhstan created a digital State Energy Register, which records all energy efficiency statistics for public buildings in Kazakhstan. The public buildings included in the register are administrative, educational, cultural and health care buildings. In addition, amendments to the Law on Energy Savings and Energy Efficiency (adopted in 2012) established energy efficiency classes for buildings in 2015. The classification of public buildings in Kazakhstan shows that over 90% have an energy efficiency rating below C.[11]

The situation is similarly complex in the residential sector. Energy efficiency data are not available for all buildings in Kazakhstan; information on energy efficiency class is only available for new and renovated buildings. However, the Household Energy Consumption Survey can be reviewed as a source of proxy data to understand energy efficiency levels. The survey shows that more than half of buildings in Kazakhstan do not have sufficient insulation in any part of them. In addition, over 80% have no insulation on floors, foundations and roofs. This indicates that extreme cold and heat could become a particularly challenging issue in the country. It should also be noted that 28% of households use coal as the primary heating fuel,[12] which is associated with significant health problems related to indoor air pollution.

Improvements in energy efficiency can make a significant contribution to solving these problems by reducing household energy costs and health risks. In addition, one of the implicit benefits of such improvements will be higher levels of comfort in the home.

Scenario Description

The focus of the adaptation policy scenario is to improve the energy efficiency of public buildings and private residential buildings, requiring increased energy efficiency levels in both types of buildings.

Improving the energy efficiency of buildings helps to decrease heat stress and reduces heating and cooling energy costs, in compliance with Kazakhstan's Law on Energy Savings and Energy Efficiency. Furthermore, energy efficiency improvements provide win-win solutions for mitigation and adaptation in the context of rising energy demand and supply constraints due to climate change.

The Law on Energy Savings and Energy Efficiency established energy efficiency classes in 2015, and according to its provisions, new and renovated buildings must have an energy efficiency rating of Class C or better. However, with the exception of

[9] J. Soto-Navarro and G. Jorda (2021). Climate Hazards Analysis – Kazakhstan. Berlin: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

[10] International Energy Agency and EU4Energy (2020). Clean Household Energy Consumption in Kazakhstan: A Roadmap. Paris: International Energy Agency.

[11] EEDI (2023). Report on energy consumption monitoring results. Retrieved on 29 May 2024 from https://eedi.kz/site/gos-center/.

[12] Kazakhstan Bureau of National Statistics (2023). Fuel and energy consumption in households in the Republic of Kazakhstan. Retrieved on 29 May 2024 from https://stat.gov.kz/upload/iblock/22f/yajv6j4lbqdj1f9yyoyuw7tomqwnjfqq/Fuel_and_energy_consumption_in_households_in_the_Republic_of_Kazakhstan.pdf.

public buildings, data on newly constructed buildings and their energy efficiency are not publicly available.[13] As mentioned above, Kazakhstan has a State Energy Register that includes information on energy efficiency, but only for public buildings.

A qualitative adaptation policy scenario for energy efficiency in buildings can be defined according to type of building (i.e. private or public) and current energy efficiency class. More precisely, the qualitative adaptation policy scenario can be designed around improving the energy efficiency ratings of the different types of buildings to ensure compliance with the Law on Energy Savings and Energy Efficiency. This will lead to better adaptation to climate change hazards, such as extreme temperature changes.

Therefore, a focus on public buildings would make most sense. Of the 9,965 public buildings in Kazakhstan, 90.1% have an energy efficiency rating below Class C. Furthermore, the majority (76.2%) have the lowest energy efficiency class (G). The public buildings category can be further broken down into administrative buildings (2,456), educational buildings (6,874), health care buildings (282) and cultural buildings (353).

Alternatively, the qualitative adaptation policy scenario can be defined based on old privately owned buildings (residential and non-residential). The statistics for these buildings, including their total number, are not publicly available. However, the research team responsible for conducting the CBA for this qualitative adaptation policy scenario requested this information for large areas of Kazakhstan and made additional assumptions for the CBA.

The scope of the CBA was to analyse the impact of the energy efficiency refurbishment of public buildings and old privately owned buildings. This includes thermal modernisation of public and private buildings in Astana, Almaty and the northern and southern regions. The timeline under the scenario for modernisation is 2025–2027 for Astana, 2025–2037 for Almaty, 2025–2035 for the southern regions and the full 30-year period for the northern regions. The total investment cost of the adaptation policy scenario is estimated at around KZT 2.9 trillion.

Implementation and Assumptions

To quantify the costs and benefits of the considered energy efficiency improvements, assumptions are taken from the CBA conducted by AvantGarde (2025), which analysed the costs and benefits for public and residential buildings in more detail. These assumptions and the structuring of costs and benefits are the main source of scenario-specific data used for the implementation of the e3.kz model. The results of the CBA, summarised in Table 2, are implemented in the e3.kz model to analyse the economy-wide impact of these adaptation measures, going beyond the single-sector analysis.

Table 2. Summary of the CBA results for energy efficiency improvements in the building sector based on climate scenario SSP1-2.6

ADAPTATION MEASURES	CUMULATIVE INVESTMENT	CUMULATIVE ADAPTATION BENEFITS
ENERGY EFFICIENCY IMPROVEMENTS IN RESIDENTIAL BUILDINGS	- Capital investment for renovation (KZT 2.6 trillion); government contributes 50% of the investment)1 - Operating costs (KZT 70 billion) 1	- Lower heat consumption in winter (−7,069 ktoe) 1 - Lower electricity consumption in summer by 2050 (−0.5%)2, 3, 4 - Fossil fuel savings that provide export opportunities (KZT 1.4 trillion) 1 - Costs savings in health care (KZT 500 billion) 1 - Less repair and replacement of machinery due to upgrading (KZT 871 billion) 1
ENERGY EFFICIENCY IMPROVEMENTS	- Capital investment for renovation (KZT 280 billion);	- Lower heat consumption in winter (−984 ktoe) 1 - Lower electricity consumption in summer (−0.5%)2, 3, 4 - Fossil fuel savings that provide export opportunities (KZT 35 billion)

[13] International Energy Agency and EU4Energy (2020). *Clean Household Energy Consumption in Kazakhstan: A Roadmap*. Paris: International Energy Agency.

IN PUBLIC BUILDINGS	government bears the full cost of the investment)1 - Operating costs (KZT 11 billion) 1	- Costs savings in health care (KZT 30 billion) 1 - Less repair and replacement of machinery due to upgrading (KZT 210 billion) 1 - Lower labour productivity losses in public sector due to insulation (50%)

Source: 1. GIZ (2025). Economy-Wide Effects of Climate Change and Adaptation in Kazakhstan [Großmann, A., Hohmann, F.], 2. Zhaosong et al. (2014), 3. Own source, 4. Assuming that air conditioning accounts for one third of electricity consumption.

Further Assumptions

Additional assumptions are made in the economy-wide impact assessment to take into account the effects of different climate change scenarios. In particular, the costs and benefits of this adaptation option have been calculated under the assumptions of an SSP1-2.6 scenario, which is the least severe scenario in terms of greenhouse gas (GHG) emission concentration and temperature increase. To ensure that the assessment of economic impacts is robust for different climate change scenarios, the results will be adjusted based on the approach outlined in Table 3.

Under the SSPs that assume a temperature increase, heat savings are expected to be even higher than for SSP1-2.6. Heating degree days in the SSP2-4.5 and SSP5-8.5 scenarios decrease by up to 1.5% and 4.9% respectively, compared to the SSP1-2.6 scenario for the period 2040–2059. In contrast, electricity savings in cooling will be lower, as cooling degree days increase by up to 5.1% and 17.4% respectively for the period 2040–2059 (World Bank Climate Change Knowledge Portal). Fossil fuel savings can lead to export opportunities. Labour productivity is expected to follow the trend of cooling degree days, that is, smaller benefits with increasing temperatures. Health expenditure is expected to be lower than under SSP1-2.6, due to improved quality of life. Repair and replacement of machinery due to upgrading will remain at the same level, as it is linked to investment in energy efficiency improvements, which will be the same as assumed for the CBA in the SSP1-2.6 scenario.

Table 3. - Benefit adjustments under different climate scenarios

ADAPTATION BENEFIT	SSP1-2.6 (BASIS FOR CBA)	SSP2-4.5	SSP5-8.5
LOWER HEAT CONSUMPTION IN WINTER	100%	101.5%	105%
LOWER ELECTRICITY CONSUMPTION IN SUMMER	100%	95%	82.6%
FOSSIL FUEL SAVINGS THAT PROVIDE EXPORT OPPORTUNITIES	100%	100%	100%
COSTS SAVINGS IN HEALTH CARE	100%	110%	120%
LESS REPAIR AND REPLACEMENT OF MACHINERY DUE TO UPGRADING	100%	100%	100%
LABOUR PRODUCTIVITY IN PUBLIC SECTOR	100%	95%	82.6%

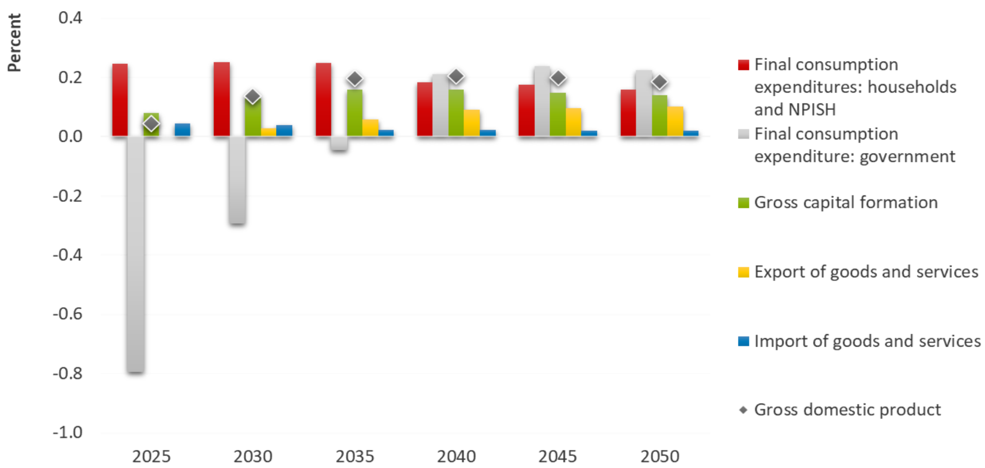
Source: GWS assumptions

Modelling Outcomes and Macroeconomic Results: GDP and Employment

Using the e3.kz model with the CBA, the economy-wide impact of the proposed energy efficiency improvements can be calculated. The macroeconomic effects of such measures in residential and public buildings are positive. The impact of large-scale implementation of energy efficiency improvements in Kazakhstan is reflected in a projected real GDP growth rate of 0.19 percentage points per year until 2050. This will have a substantial impact on the economy, a result that is robust across different climate change scenarios. Investment increases by up to 0.16% a year due to the renovation of public buildings and the overall increase in economic activity. Expenditure on insulation measures increases during the implementation of the measure. After successful implementation, households benefit from reduced expenditure on energy and on the repair and replacement of machinery due to the upgrading of the building. Overall, household consumption expenditure increases by 0.25%. If it is assumed that the government's financial support for the adaptation measure comes at the expense of other parts of the government budget, government consumption expenditure will fall by a maximum of 0.8% or KZT 60 billion. However, the government will also benefit from lower energy costs in public buildings, savings in health care costs and world market energy prices that are higher than domestic prices, which will offset the government's spending on financial support for climate protection over time.

There may be export opportunities for saved energy – mainly coal and gas – increasing total exports by up to 0.1% or KZT 16 billion. Imports will be slightly higher by 2050 compared to a scenario with climate change (SSP1-2.6) and without adaptation, due to economic growth and import dependency.

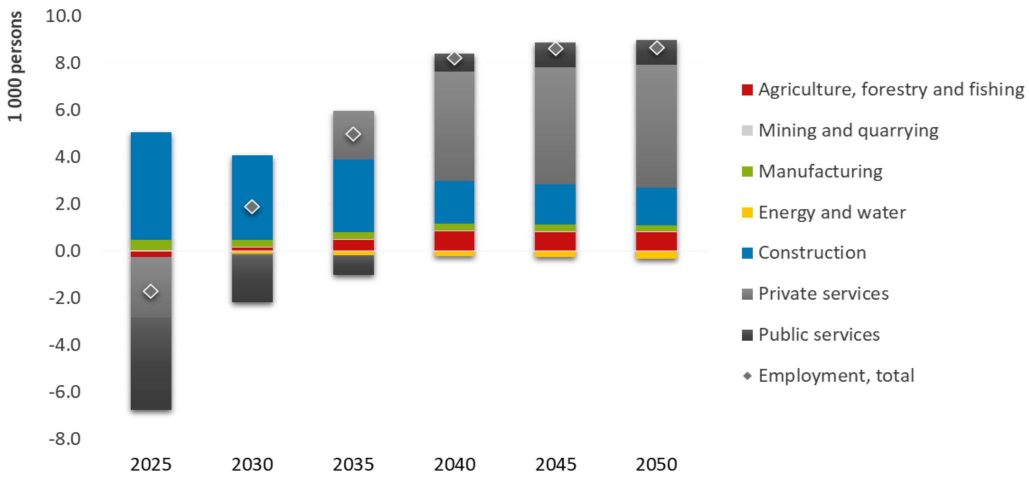
Figure 3. Macroeconomic effects of the SSP1-2.6_EE (energy efficiency) scenario, 2025–2050, deviations from a SSP1-2.6 scenario (percentage)



Source: GWS based on e3.kz scenario results

Following economic activity, employment growth accelerates, with up to 8,700 jobs created (Figure 4). The biggest increase is in construction, while employment in public administration (part of public services) and private services declines, especially at the beginning of the assessment period. At that time, financial support from the government is at the expense of public administration, which leads to lower expenditure and thus to a slowdown in activity and employment. Similarly, households shift spending from non-essential activities, such as accommodation and food services (part of private services), to renovation work. These effects are reversed by 2050. People working in hotels and restaurants benefit over time from the money freed up by energy savings, which it is assumed will be spent on non-essential items.

Figure 4. Effects of the SSP1-2.6_EE scenario on employment by economic sector, 2025–2050, deviations from the SSP1-2.6 scenario (1,000 people)



Source: GWS based on e3.kz results

Policy Recommendation

SUMMARY

The modelling results highlight expected long-term economic benefits, including increases in GDP, job creation, household consumption, capital formation and goods exports. The results clearly demonstrate that government spending on improving energy efficiency in public buildings is economically sound under any climate change scenario. The successful implementation of energy efficiency improvements in private residential buildings is more challenging. Coordination and the creation of incentives to encourage active participation in energy efficiency improvement programmes could be difficult for multi-family buildings. The programme should therefore be designed to include simple procedures for household participation and clearly demonstrate the benefits of energy efficiency improvements. This is particularly important to ensure that all households shoulder their share of the financial burden.

To reap the economic benefits of energy efficiency improvements in Kazakhstan, a clear, phased approach is recommended. The following steps can create an enabling environment for effective implementation:

1. *Planning government spending for energy efficiency improvements in the public sector*

In order to realise the projected benefits from energy efficiency improvements in the public sector, the government should create a workplan that will ensure the mobilisation of funds by 2030. This workplan should include standard modernisation packages for the buildings that will ensure compliance with the provisions of the law on energy efficiency.

Mobilisation of the funds needed will require coordination between major government stakeholders. The institutions driving this planning and coordination work should be the Ministry of Industry and Construction (Committee for Construction and Housing and Communal Services), the MNE and EEDI. The modelling results can be used as a useful tool to convince other stakeholders, especially the MoF, to fund energy efficiency improvement programmes.

2. *Planning a financing programme for energy efficiency improvements in private residential buildings*

While funding energy efficiency improvements in the public sector should be relatively straightforward, the government will need to plan for a special financing programme for the residential sector. The programme should be consistent with the funding proposal outlined in the next section. Furthermore, the following aspects should be taken into account when creating the programme:

- It should be determined whether it would be best to implement the programme nationally or whether a decentralised approach at the regional level could be more beneficial? Considering that Kazakhstan is a country with a vast territory and widely varying climatic conditions, a decentralised programme would probably provide more flexibility.
- Standard packages should be created for energy efficiency improvements in different types of residential buildings, and budgets should be established for the improvements.
- Local socio-economic conditions should be considered to create an affordable cost-sharing programme for households.

3. *Increasing household awareness of the benefits of energy efficiency improvements and the government programme*

Once the design has been finalised, the government will have to actively promote the financing programme for energy efficiency improvements in households. For successful implementation, local and regional governments must run large-scale awareness raising campaigns and advertisements for the programme. The promotion campaign must focus on demonstrating energy efficiency savings for different types of dwellings and the extent of the long-term financial benefits. This could include highlighting payback calculations for energy efficiency improvements with and without involvement in the programme.

4. *Parallel implementation of the programme in public and private buildings*

Since substantial economic benefits materialise when both public and private buildings are renovated, the government should consider running energy efficiency improvement projects in both sectors. This could be structured in two phases.

Phase 1. Pilot project (Years 1 and 2)

- Learn from existing energy efficiency modernisation pilots implemented across the country
- Launch pilots for different types of public and private buildings
- Launch pilot awareness raising and promotion campaigns for households to involve them in the co-financing programme
- Identify regions where implementation of the energy efficiency improvement programme is more and less successful
- Adjust co-financing components and other incentives in the less successful regions to improve programme performance

Phase 2. Scaling up and full implementation (Years 2 to 10)

- Use successful pilots in the public sector to amplify improvements across different types of public buildings
- Expand successful case studies of energy efficiency improvements within and across different regions of the country
- Expand the awareness raising and promotion campaigns, setting deadlines for applications and incentivising participation

5. *Data collection and analysis*

Successful implementation of such a large-scale programme in public and private buildings will require constant data collection to identify key performance indicators (KPIs). Data on each renovation project should be collected and stored both at the time of the renovation and after it is finished. It will be important to coordinate with local utility providers to track energy costs and calculate actual savings for households. This data collection, along with the adjustment of the programme over the long term, will help in awareness raising and promotion campaigns for the programme.

6. Monitoring and evaluation (M&E)

A comprehensive M&E framework should be established to assess the impact of the energy efficiency improvement programme. It should focus on:

- Energy savings: measuring actual savings in energy after the project has been implemented
- Budgeting: budgets for different refurbishment projects both for similar and different types of buildings must be measured, evaluated and compared to assess effectiveness, inform decisions on adjusting the co-financing component and incentivise efficiency in spending
- Socio-economic indicators: other additional effects of the programme should be assessed, including the impact on employment, households, public servants and health

Financing

The financing mechanism put in place to support energy efficiency and climate change adaptation investments in Kazakhstan's residential and public buildings sector will include two key components: 1) a grant component (e.g. 20% to 50% of investment costs), funded by the Government of Kazakhstan and international sources of climate finance, to reduce upfront costs and incentivise participation and 2) the Sustainable Energy Revolving Fund (SERF), which will provide concessional loans and access to financing for the remaining investment costs, ensuring affordability and scalability.

Grant component: to address affordability barriers, a grant mechanism would be introduced, covering 20% to 50% of total investment costs, depending on the type of action and target group. Grants would be prioritised for:

- Low-income households and vulnerable communities to support residential retrofits (insulation, efficient heating systems, smart meters and rooftop solar systems)
- Public buildings (schools, hospitals, government offices, etc.) for large-scale investments to reduce long-term operating costs
- Climate adaptation measures, such as resilient building materials, flood-proofing infrastructure and nature-based solutions (e.g. green roofs, greening of surroundings, permeable surfaces in urban areas and local stormwater management systems)

Concessional loan component: for investment costs not covered by grants, SERF will provide concessional loans to residential owner associations, public institutions and energy service companies (ESCOs) to finance energy efficiency measures. The Fund will be designed to provide accessible concessional financing for energy efficiency investments in Kazakhstan's residential and public building sectors. To ensure affordability and broad participation, SERF will work in combination with the grant component that covers 20% to 50% of investment costs, providing low-interest loans to finance the remaining amount.

Key features of SERF include low-interest financing at rates well below market levels (e.g. 2% to 5% interest), making energy efficiency investments financially viable for owner associations, public institutions and ESCOs. The fund will offer flexible loan terms of 10 to 15 years, which will allow energy cost savings to offset repayment obligations over time. To ensure the efficient disbursement of funds, SERF could work with local banks and financial institutions, such as the Development Bank of Kazakhstan, to enable on-lending to target beneficiaries.

Key Takeaways

Although energy efficiency is often seen as a climate change mitigation action, it can play an important role in adaptation as well. This is particularly relevant for a country such as Kazakhstan, where extreme temperatures are projected to become an increasingly important issue. Refurbishments of private residential and public buildings in order to improve their energy efficiency can improve living conditions in Kazakhstan under climate change conditions. Furthermore, it can create substantial benefits, through energy savings, for households and the public sector.

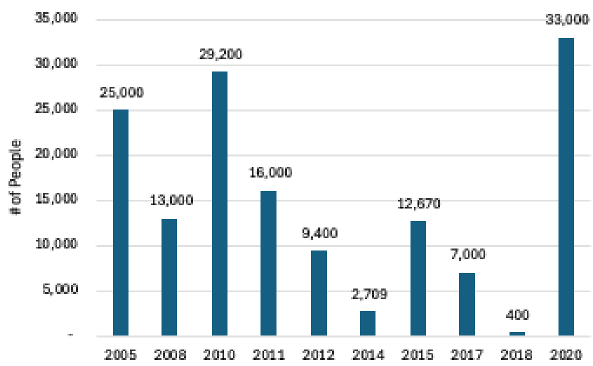
Large-scale implementation of energy efficiency improvements in Kazakhstan will have substantial economy-wide effects, as reflected in a projected real GDP growth rate of 0.19 percentage points per year until 2050. These results are robust under all major climate adaptation scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5). Energy efficiency improvements will also result in higher employment growth (0.08% a year) as well as substantially lower total final energy consumption (−0.78% a year) and CO_2 emissions (0.58% a year).

It should be noted that this climate adaptation policy entails substantial initial investment by the government. This will be important to finance energy efficiency improvements in the public sector and provide grant funding for households. However, the policy also creates benefits for the government and leads to increased household consumption and exports. Successful implementation of the policy is conditional on ensuring sound incentive mechanisms aimed at residential building owners (households) to encourage them to actively participate in the process and take advantage of concession loans to cover renovation costs not paid by the government.

5.2. Increasing flood protection through the construction of multi-purpose water reservoirs

Major flood events, which are increasing in frequency and magnitude, are a serious challenge for Kazakhstan.[14] They can lead to soil erosion, destruction of infrastructure and extremely severe economic losses in flood-prone urban areas. Flooding is the main natural hazard affecting the population of Kazakhstan.[15] In 2020, more than 33,000 people were affected by floods, the highest figure in the last 20 years (Figure 5). Moreover, the most recent figures from the spring of 2024 show that the number of flood victims has increased significantly, with as many as 117,000 people affected.[16]

Figure 5. Number of people affected by floods in Kazakhstan



Source: World Bank, Climate Change Knowledge Portal

Average annual losses from flooding are estimated to be around USD 419 million,[17] with the highest figures recorded in the regions of West Kazakhstan, Akmola, Kyzylorda and Turkistan, varying between USD 40 million and 61 million a year. These are also the regions that have the highest number of people affected annually, with figures ranging from 15,000 to 22,000 a year.

Some of the main causes of flooding, in addition to increased precipitation and glacier melt, are water management challenges in terms of water infrastructure. Some floods in the past (according to stakeholder consultations held in Almaty in June 2024) were caused by water releases from upstream reservoirs into transboundary rivers. Together with increased precipitation, these water management challenges may increase the impact of floods in the future.

[14] Global Water Partnership (2021). How water resources management can support climate-resilient development in Kazakhstan. Global Water Partnership.

[15] World Bank (n.d.). Climate Change Knowledge Portal: Kazakhstan, Historical Hazards. Retrieved on 1 September 2024 from https://climateknowledgeportal.worldbank.org/country/kazakhstan/vulnerability.

[16] Delegation of the European Union to the Republic of Kazakhstan (19 April 2024). European Union brings relief to the victims of floods in Kazakhstan. Retrieved on 1 September 2024 from https://www.eeas.europa.eu/delegations/kazakhstan/european-union-brings-relief-victims-floods-kazakhstan_en?s=222.

[17] Central Asia Regional Economic Cooperation (CAREC) (2022). Country Risk Profile – Kazakhstan. CAREC.

One of the solutions for adapting to these effects of climate change is the development of water management infrastructure. For example, the Koksaray Reservoir, which was built in 2011, collects excess winter runoff from upstream countries to prevent flooding. The water collected through such counter-regulatory reservoirs (CRR) is also used for irrigation in downstream areas.[18] This type of infrastructure can support adaptation to the impacts of climate change and have positive indirect impacts on other sectors of the economy, such as agriculture and water supply. This is well reflected in the recent literature, which recognises the role of reservoirs in flood control as a climate adaptation measure.[19] It should also be noted that this type of infrastructure is usually site-specific, so the indirect impacts, along with flood control, could vary from project to project.

Scenario Description

Stakeholder consultations with the Interstate Commission for Water Coordination of Central Asia (ICWCCA) have shown that there is a need for counter-regulatory reservoirs in Kazakhstan. During the consultations, it was mentioned that 15 to 30 new counter-regulatory reservoirs are needed in the country. In addition, the newly formed MOWRI has discussed the development of up to 20 new reservoirs in Kazakhstan.[20] The construction of such reservoirs will require substantial investment by the Government of Kazakhstan over many years, which could potentially have a nationwide economic impact. These climate change adaptation measures involving the construction of over a dozen counter-regulatory reservoirs and their benefits can be assessed using the e3.kz model to identify the macroeconomic impacts on the economy as a whole.

This adaptation policy scenario considers the development of a pipeline of projects for multi-purpose water reservoirs with flood control functions, determines the capital and operating costs and analyses the potential direct and indirect macroeconomic impacts on Kazakhstan's economy. Some of the reservoir projects will be multi-purpose and will provide irrigation and energy generation opportunities, depending on local conditions. Further analysis and stakeholder consultations have shown that a total of 42 new reservoirs need to be constructed. Most of these reservoirs will be constructed by 2035.

Implementation and Assumptions

To analyse the economy-wide impact of this adaptation measure beyond a single sectoral analysis, the results of the CBA – summarised in Table 4 – are implemented in the e3.kz model.

The CBA foresees the construction of 42 new reservoirs. In addition, investment in irrigation infrastructure is planned in order to increase the area under irrigation. The total additional investment amounts to KZT 311 billion. Over the lifetime of the reservoirs and irrigation systems, there will be additional operating and maintenance costs totalling KZT 46 billion.

Given the Islamic Development Bank's commitment at COP29 to support climate resilient water development projects in Kazakhstan with USD 1.15 billion, it is assumed that capital and operating expenditure will be fully covered by international donors and will not be a financial burden for Kazakhstan. The benefits of this adaptation measure include avoided damage to infrastructure during flooding and higher agricultural productivity due to additional irrigated land being available. Table 4 below summarises the results of the CBA conducted on the building of the water reservoirs.

[18] Organisation for Economic Co-operation and Development (OECD) (2018). Strengthening Shardara Multi-Purpose Water Infrastructure in Kazakhstan. Paris: OECD.

[19] J. Sun, W. Chen, B. Hu, Y. J. Xu, G. Zhang, Y. Wu, B. Hu and Z. Song (2023). 'Roles of reservoirs in regulating basin flood and droughts risks under climate change: Historical assessment and future projection'. Journal of Hydrology: Regional Studies, Vol. 48, pp. 1–19.

[20] The Times of Central Asia (30 January 2024). 'Kazakhstan Improves Its Water Infrastructure'. Retrieved on 1 September 2024 from https://timesca.com/kazakhstan-improves-its-water-infrastructure/.

Table 4. Summary of the CBA results for counter-regulatory reservoirs (CRR) with applications in agriculture based on climate scenario SSP2-4.5

ADAPTATION MEASURE	CUMULATIVE INVESTMENT	CUMULATIVE ADAPTATION BENEFITS
CONSTRUCTION OF MULTI-PURPOSE WATER RESERVOIRS WITH APPLICATIONS IN AGRICULTURE	- Investment costs for building reservoirs and installing irrigation infrastructure (KZT 311 billion) - Operating costs for reservoirs built (KZT 46 billion)	- Reduced damage from flooding (-50%) - Increased agricultural productivity due to better irrigation and more irrigated land (KZT 946 billion)

Source: Calculations by CBA consultants

Table 5. Benefit adjustments under different climate scenarios

ADAPTATION BENEFIT	SSP1-2.6	SSP2-4.5 (BASIS FOR CBA)	SSP5-8.5
REDUCTION IN DAMAGE FROM FLOODING	KZT 1,710 billion	KZT 1,368 billion	KZT 1,778 billion
HIGHER AGRICULTURAL OUTPUT DUE TO BETTER IRRIGATION AND NEW IRRIGATED LAND UNDER CULTIVATION	100%	100%	100%

Source: Calculations by CBA consultants

Further Assumptions

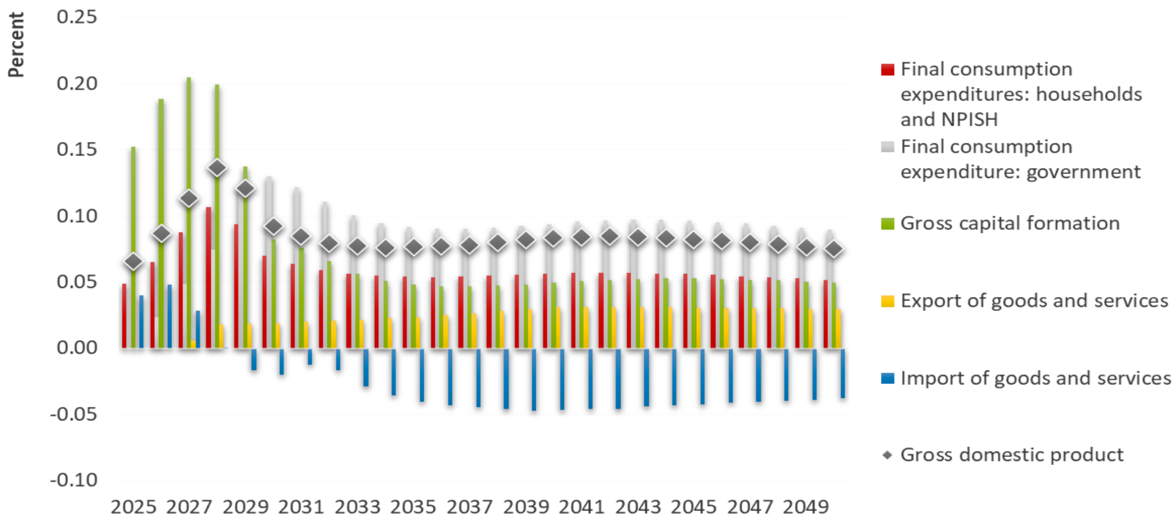
The costs and benefits of this adaptation option have been calculated under the assumptions of an SSP2-4.5 climate scenario, which is the medium severity scenario in terms of GHG emission concentration and temperature increase. Therefore, the assumptions on benefits for the same investments (costs) need to be adjusted for SSP1-2.6 and SSP5-8.5. The CBA tool allows adjustment of the probability of flooding under different SSP scenarios. The probability is taken as the average (2024–2050) provided by EarthYield Advisories. The resulting benefits, that is, avoided damage from floods, are shown in Table 5.

Increased agricultural output due to better irrigation and new irrigated land is a climate-independent benefit and is therefore the same as SSP2-4.5 for all climate scenarios.

Modelling Outcomes and Macroeconomic Results: GDP and Employment

The macroeconomic impacts of the adaptation measure referred to in the above scenario description and assumptions are overwhelmingly positive. The impacts were calculated for the three climate change scenarios, but it is the macroeconomic impact for SSP2-4.5 that is presented here. In this climate change scenario, implementing the adaptation measure accelerates GDP growth, which is up to 0.14% a year higher compared to a situation with climate change (SSP2-4.5) and without adaptation (Figure 6). Investment is up to 0.2% higher due to countervailing effects, since investing in water reservoir infrastructure will decrease periodic government investment in rehabilitation of damage. While investment in water reservoirs and irrigation infrastructure is beneficial, avoided flood damage to infrastructure reduces involuntary investment to rebuild infrastructure such as roads, buildings and bridges. It should be noted that this decrease in involuntary spending creates new opportunities for the government to invest in sectors that enhance economic growth.

Figure 6. Macroeconomic effects of the SSP2-4.5_CRR scenario, 2025–2050, deviations from a SSP2-4.5 scenario (percentage)



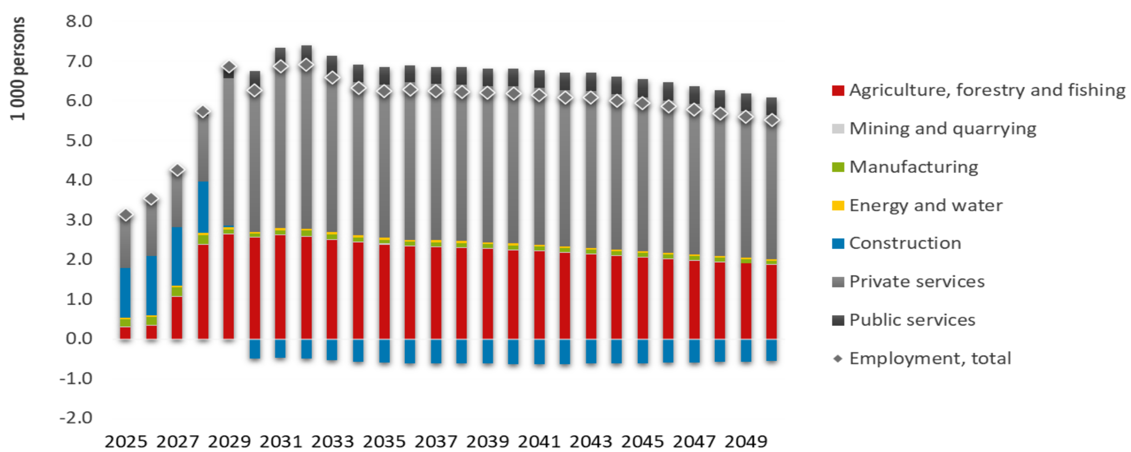
Source: GWS based on e3.kz scenario results

The positive impacts on agriculture, which will benefit from additional irrigated land and improved irrigation, will increase export opportunities for agricultural products, reduce dependence on imports of livestock and other agricultural products and thus support food security.

Government final consumption expenditure is up to 0.13% a year higher than in a situation without adaptation and climate change. Household final consumption expenditure increases by up to 0.1% due to higher incomes and employment.

The employment impacts are driven by economic activity in the different sectors and their labour intensity. Overall, employment increases by 0.1%, with up to 6,900 jobs created (Figure 7). During the period when the reservoirs are being constructed, the demand for construction workers accelerates. After that, the impact of avoided reconstruction activities and the benefits in agriculture (up to 2,639 jobs per year) can be observed. Private services also benefit due to increased spending on food services (part of private services).

Figure 7. Effects of the SSP2-4.5_CRR scenario on employment by economic sector, 2025–2050, deviations from the SSP2-4.5 scenario (1,000 people)



Source: GWS based on e3.kz results

Policy Recommendation

SUMMARY

The modelling results highlight expected long-term economic benefits, including increases in GDP, job creation, household consumption, capital formation and goods exports. The results clearly show that the construction of multi-purpose water reservoirs is beneficial to the economy. Although this proactive adaptation measure involves high initial investment costs, benefits include a permanent reduction in flood damage repair costs. Both the government and the population benefit in the sense that they can avoid involuntary and defensive spending and use the money for other purposes. Although maintenance costs will have to be paid, the provision of additional services from water reservoirs can potentially cover these increased costs. Furthermore, other uses of the reservoirs could lead to additional benefits, including the provision of irrigation water for agriculture.

To reap the economic benefits of constructing multi-purpose water reservoirs in Kazakhstan, a clear, phased approach is recommended. The following steps can create an enabling environment for effective implementation:

1. *Project pipeline planning*

Although some work has already been done, it will be essential to develop a clear pipeline of projects. As a first step, this will require a detailed identification of flood risks and the development of an approach for prioritising specific reservoirs. This prioritisation could be based on several criteria, including flood risks, budget constraints and the complexity of the project as well as land rights and legal and regulatory issues that may arise in connection with such projects. Ensuring the effective development of the pipeline and the efficient implementation of the projects could also encourage stakeholders to prepare for the use of the additional benefits that reservoirs can provide, such as irrigation water.

2. *Project financing and resolution of project implementation challenges*

Once the pipeline is completed, the government should work to secure project financing. Although there is a commitment from the Islamic Development Bank to support such projects, other sources of funding may be required. In addition to fundraising, government agencies should start preparing the necessary documentation for project implementation. Actions to be taken at this stage include:

- Proactively engage potential fund providers, including international financial institutions and local agencies (such as the MoF) to ensure funding for the projects
- Prepare the projects' financial plans
- Identify and prepare the environmental regulatory documentation required for project implementation
- Identify potential constraints associated with land rights and resolve them
- Identify regulatory constraints for the provision of additional services by the multi-purpose water reservoirs
- Include additional services, such as bulk irrigation water provision, in the projects' financial plans

3. *Project implementation*

Efficient project implementation entails two major components: (i) reservoir construction and (ii) stakeholder awareness raising. This second component is vital to avoid misunderstandings with the local population and ensure that additional services provided by reservoirs are utilised.

Component 1 – Reservoir construction

- In the construction process, take into consideration the potential for the provision of additional services by water reservoirs and the development of additional infrastructure, such as pumps for irrigation water supply or micro-hydropower plants

- Ensure that environmental impacts and impacts on the local population are minimised during the construction process

Component 2 – Stakeholder awareness raising and support

- Inform local farmers and potential investors about the construction of the reservoirs and the additional services they can provide
- Raise the awareness of the local population about water reservoirs and their role in flood prevention
- Raise awareness about local losses from floods and the opportunities that reservoirs create
- Provide support to smallholder farmers to utilise additional services provided by water reservoirs

4. M&E

A comprehensive M&E framework should be established to assess the efficiency of project implementation, the impact of the water reservoirs on flood prevention and additional benefits provided by the projects. It should focus on:

- Project implementation: collecting data and measuring the projects' KPIs to assess project efficiency
- Flood prevention: measuring the direct and indirect benefits of the construction of water reservoirs, by creating a flood loss monitoring system and identifying the impacts of the water reservoirs
- Direct benefits of water reservoirs: collecting data and assessing the direct benefits of the reservoirs constructed – the provision of additional irrigation water and/or hydropower

Financing

The financial component – EUR 520 million – covers the construction of 42 counter-regulatory reservoirs, with the integration of hydropower and nature-based solutions, where feasible, the modernisation of irrigation systems and the introduction of smart water technologies. It should be noted that in some applications, multi-purpose water reservoirs combined with nature-based solutions could help to minimise the adverse impact of floods on local ecosystems.

Upstream – multi-purpose water infrastructure (MPWI)

For large-scale infrastructure investments, such as counter-regulatory reservoirs and flood control systems, financing must be structured to accommodate high upfront capital costs and long payback periods. The financial instruments most suitable for MPWI are shown below.

INSTRUMENT	DESCRIPTION
SOVEREIGN LOANS (AND GREEN BONDS)	Funding from multilateral development banks and international climate funds (grants) to support government budget allocations for infrastructure projects. Concessional loans providing low-interest financing from multilateral development banks (ADB, World Bank) are aimed at reducing financial risk for large-scale public investments. They could also be structured as policy-based loans to implement policy measures in the water sector.
PUBLIC–PRIVATE PARTNERSHIPS	Private sector co-financing opportunities may exist, particularly for integrated energy projects incorporated into water infrastructure, such as hydropower generation.

Downstream – climate resilient agriculture and water efficiency

To support smallholder farmers and agribusinesses in adopting water-efficient irrigation systems, a blended financing mechanism will be employed, ensuring the affordability and sustainability of the proposed initiatives. The financial structure will include grants, concessional loans and performance-based financing to de-risk farmer investments and promote long-term adoption. The financial mechanism will be implemented through local banks and agricultural support funds, ensuring accessibility for smallholder farmers. International climate finance will play a role in the initial phase by de-risking concessional loans and mitigating default risks, enabling financial institutions to provide affordable credit for sustainable investments in irrigation technologies.

INSTRUMENT	DESCRIPTION
SEED GRANTS (10%)	Initial funding for technical training, capacity building and knowledge transfer to enable farmers to adopt water-efficient irrigation systems
RESULTS-BASED GRANTS (10–30%)	Financial incentives provided upon successful implementation and maintenance of water-saving irrigation systems
CONCESSIONAL LOANS (60–80%)	Low-interest credit provided through local financial institutions to support farmers in purchasing and installing climate-smart irrigation technologies

Exit strategy and sustainability

To ensure long-term sustainability, the financial support mechanism will transition toward a self-sustaining model by:

- Phasing out grants and shifting toward market-based credit solutions while maintaining limited performance-based incentives for new adopters
- Strengthening revolving funds, where loan repayments are reinvested into further irrigation system upgrades and maintenance
- Leveraging revenue from improved agricultural productivity, enabling farmers to finance ongoing water management investments independently

Key Takeaways

The construction of multi-purpose water reservoirs with the primary aim of preventing flood losses while also providing other water supply-related services is essential for climate adaptation in Kazakhstan, taking into account that flood risks and average annual losses due to floods are significant in Kazakhstan, especially on transboundary rivers where the country does not have control over infrastructure in neighbouring upstream countries. In addition to reducing annual flood losses, multi-purpose reservoirs also have the potential to provide additional services, such as irrigation water and/or micro-hydropower generation.

The construction of 42 multi-purpose reservoirs in Kazakhstan will have a significant impact on the economy as a whole, as reflected in a projected real GDP growth rate of 0.08 percentage points per year until 2050. These results are robust under all the main climate adaptation scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5). It should be noted, however, that additional GDP growth peaks at 0.14 percentage points between 2027 and 2029. The construction of the reservoirs will also lead to higher employment (increase of 0.06% a year). The employment effects will be visible in the construction sector during the project implementation period and in the agricultural sector afterwards. Employment will also be generated in the private sector, as reduced flood losses will free up additional resources for business development.

It is important to note that the environmental implications of constructing water reservoirs must be carefully assessed. This includes understanding potential impacts on local ecosystems, biodiversity and water quality and taking into account cumulative and transboundary effects. In this context, nature-based solutions, such as the restoration of wetlands, reforestation or natural floodplain management, should be considered alongside grey infrastructure options. These approaches can provide effective and cost-efficient flood protection while also preserving ecosystem services and enhancing climate resilience.

This climate adaptation policy will require substantial project funding, which could be obtained from international financial institutions and climate adaptation funds. In addition, to maximise the impact of the additional services provided by the reservoirs, the government could consider implementing irrigation support programmes that offer grants and concessional loans, especially for smallholder farmers. The efficient use of these services could potentially cover reservoir operating costs.

5.3. Increasing the use of conservation agriculture practices

Over the past 10 years, agriculture, forestry and fishing have represented around 4.6% of GDP in Kazakhstan.21 Seasonal crops accounted for about 57% of total agricultural output in 2023 (KZT 7,625 billion in current prices), while livestock accounted for about 40%. Most seasonal crops are highly vulnerable to climate change and require adaptation measures to ensure sustainable production and food security for the country.

It is evident that conservation agriculture (CA) is a pivotal strategy for adapting to the challenges posed by climate change. CA includes practices that improve soil health, such as no-till farming which enhances soil water infiltration. The use of agricultural residues reduces the need for chemical fertilisers, which can deplete the minerals in the soil. Minimum-till and no-till farming, which primarily apply to the largest part of Kazakhstan's agricultural sector (i.e. seasonal crops), is one of the main CA tools. An understanding of the predominant types of seasonal crops produced in Kazakhstan is imperative. Table 6 below provides a summary of the statistical data.

Kazakhstan is one of the leading countries in Central Asia in the adoption of CA.[22] However, much remains to be done to ensure that the country's agricultural sector adapts to climate change hazards, particularly those related to soil health and the sustainability of yields.

Kazakhstan began to adopt CA in the early 2000s through the coordinated work of the Kazakh Government and the donor community.[23] At that time, the adoption of CA practices was the most advanced in northern Kazakhstan, and the slowest in southern Kazakhstan (FAO 2013). The latest information available on the uptake of CA practices is from 2016 and suggests that no-till practices are being used on 2.5 million ha out of around 23 million ha of temporary crops. It should be noted that no detailed, up-to-date data are available on the extent of CA adoption in Kazakhstan's agricultural sector. However, the country already has experience in adopting policies to support CA, including subsidies for herbicides, which are essential for weed control.

Table 6. Share of different types of seasonal crops in total agricultural output and in seasonal crop output

TYPE OF SEASONAL CROPS	SHARE IN SEASONAL CROP OUTPUT	SHARE IN TOTAL AGRICULTURAL OUTPUT
CEREALS (EXCEPT RICE), LEGUMES AND OIL SEEDS	41.3%	23.6%
RICE	1.6%	0.9%
VEGETABLES, MELONS, ROOT CROPS AND TUBERS	38.8%	22.1%
FIBRE CROPS	1.7%	1.0%
OTHER	16.6%	9.5%

Source: Kazakhstan Bureau of National Statistics

[21] Kazakhstan Bureau of National Statistics

[22] FAO (2013). Conservation Agriculture in Central Asia: Status, Policy, Institutional Support, and Strategic Framework for its Promotion. Ankara: FAO Sub-Regional Office for Central Asia.

[23] World Bank (2024). Republic of Kazakhstan: Climate Adaptation Options and Opportunities in the Agriculture Sector. Washington, DC: World Bank.

Scenario Description

The adaptation policy scenario involves an increase in the use of CA practices in the context of seasonal crop production in Kazakhstan. As the background section indicates, despite its status as a leading nation in Central Asia in terms of adopting CA practices, Kazakhstan has significant potential for increasing the share of temporary crops that are resilient to climate change hazards. For the purposes of this qualitative adaptation policy scenario, CA is defined as the adoption of minimum-till and no-till practices, along with the corresponding use of fertilisers and herbicides.

The adoption of CA practices in Kazakhstan faces several challenges related to the availability of machinery to carry out minimum-till or no-till sowing, the lack of knowledge on implementing CA practices among local farmers and the scarcity of biomass residues for good soil cover. To address these challenges, the government could consider several actions:

(a) Subsidise machinery for minimum-till and no-till seeding, especially for small and medium-sized farmers
(b) Carry out regional awareness raising campaigns on the benefits of CA practices and ways to implement them
(c) Continue herbicide subsidy programmes and make them more locally focused
(d) Gradually replace subsidy programmes with soft loan schemes to incentivise CA

According to the World Bank (2024), the following targets can be defined in relation to the use of 'water-conserving' technologies or CA technologies:

- Northern Kazakhstan could expand its CA area by 25% to 50% within five years
- The eastern and western areas of Kazakhstan could reach a CA area of 50% after five to seven years
- The south-eastern and southern areas of Kazakhstan could reach a CA area of 25% to 30% within five years

Implementation and Assumptions

It is estimated that, following a period of five to seven years, CA technologies are likely to have been adopted on an additional 9.6 million ha. The estimated costs and benefits of CA technologies, as shown in Table 7, are specified for a hypothetical farm with 10,000 ha of land. The implementation of CA technologies on these additional hectares is then entered into the e3.kz model to quantify the economy-wide impacts. It is presumed that the adaptation measure is financed by the agricultural sector, which passes the costs on to consumers via higher prices for agricultural products.

Table 7. Assumptions for CA based on climate scenario SSP5-8.5

Costs (in USD per 10,000 ha)	Benefits (in USD per 10,000 ha)
- Investment in new machinery for CA practices (USD 1.2 million); replacement investment after approximately 10 years - Information campaigns for farmers on CA (USD 0.05 million) - Costs for additional crop residues spread on the soil (USD 0.1 million) - Purchase of herbicides, including glyphosate (USD 0.3 million)	- Increased agricultural yields (USD 0.15 million a year) - Elimination of fallow and additional crops (USD 0.7 million a year) - Reduction in number of workers operating soil tillage and related equipment; fuel savings (USD 0.3 million a year) - Sale of machinery for deep tillage (USD 0.6 million)

Source: World Bank 2024

Table 8. Benefit adjustments under different climate scenarios

Adaptation benefit	SSP1-2.6	SSP2-4.5	SSP5-8.5 (basis for CBA)
Increased agricultural yields	116%	105%	100%

Source: GWS assumptions for the e3.kz model

Further Assumptions

The costs and benefits of this adaptation option were calculated under the assumptions of an SSP5-8.5 scenario, which is the most severe scenario in terms of GHG emission concentration and temperature increase. Consequently, the assumptions regarding the benefits, assuming equivalent investments (costs), must be adapted for the SSP1-2.6 and SSP2-4.5 scenarios. The benefits are adjusted by reflecting the frequency of droughts under the three SSP scenarios. Accordingly, droughts are projected to occur with reduced frequency in SSP2-4.5 (5% decrease) and SSP1-2.6 (16% decrease) compared to SSP5-8.5, resulting in increased benefits (see Table 8).

As there is little or no evidence, the following assumptions were made regarding benefit adjustments.

The following section sets out the outcomes of this adaptation measure under SSP5-8.5, as this was the fundamental assumption employed in the CBA. Subsequently, the robustness of the results is also checked for SSP1-2.6 and SSP2-4.5.

Modelling Outcomes and Macroeconomic Results: GDP and Employment

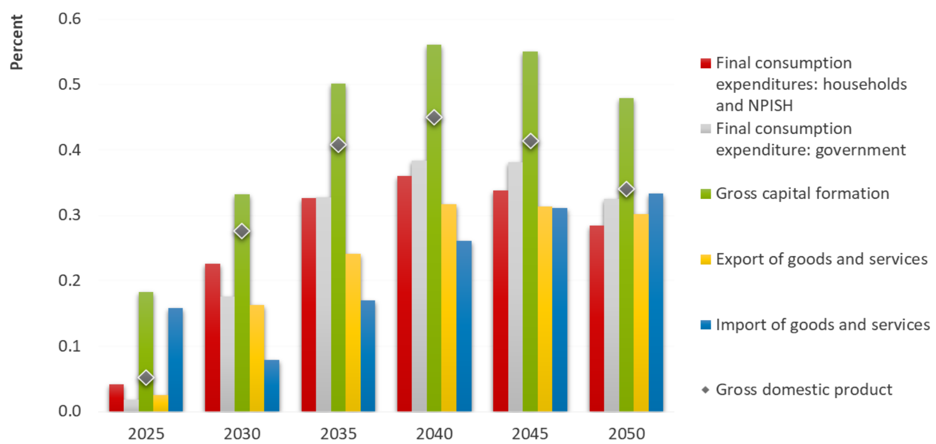
The macroeconomic modelling results demonstrate the favourable influence of the enhancement of CA on Kazakhstan's economy. GDP growth accelerates by up to 0.45% a year compared to a situation with climate change (SSP5-8.5) but without adaptation (see Figure 8). Initially, the positive effects of investment in machinery predominate; however, after the implementation period, the full benefits can be observed in agriculture, through increased productivity due to better adaptation and greater resilience to potential climate change impacts.

It is hypothesised that additional investment in CA practices will be financed by the agricultural sector (i.e. farmers). Nevertheless, the financial burden can be mitigated because the measure itself provides cost reduction opportunities, for example, through reduced expenditure on fuel and labour and the sale of redundant agricultural machinery.

It is anticipated that the enhanced agricultural yields will result in an increase in exports (up to 0.3% a year) and a reduction in imports. Conversely, investment in minimum-till and no-till machinery, which is imported, is expected to have an increasing impact on imports. The overall import dependency of different economic sectors is a determining factor in the volume of imports, with increasing economic activity resulting in an increase in imports of up to 0.3%.

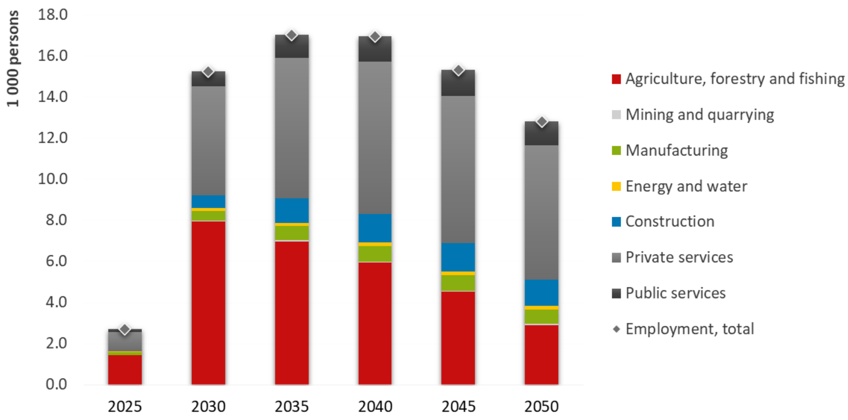
The positive impacts of economic growth on the income and expenditures of private households have been well documented and result in increased consumption (up to 0.36% a year). Overall, increased productivity in agriculture also influences government revenue. This in turn increases government expenditure and investment by companies, which further boosts economic activity.

Figure 8. Macroeconomic effects of the SSP5-8.5_CA scenario, 2025–2050, deviations from the SSP5-8.5 scenario (percentage)



Source: GWS based on e3.kz scenario results

Figure 9. Employment effects of the SSP5-8.5_CA scenario, 2025–2050, deviations from the SSP5-8.5 scenario (1,000 people)



Source: GWS based on e3.kz results

The creation of employment opportunities is observed during the implementation period, albeit to a limited extent, with a subsequent increase in the number of jobs following full exploitation of the benefits. The overall employment effect is estimated to be an increase of up to 0.2%, representing an additional 18,000 jobs (see Figure 9). Agriculture is the sector that benefits most, with 8,000 jobs created, followed by private services, with 7,400 jobs.

Policy Recommendation

SUMMARY

The modelling results highlight expected long-term economic benefits, including increases in GDP, job creation, household consumption, capital formation, and exports and imports. The results clearly demonstrate that, economically, it is highly beneficial to incentivise farmers to use CA, in particular, minimum-till and no-till practices. It should be noted that the modelling results assume that the agricultural sector pays for CA implementation, including the purchase of machinery. However, this implicitly assumes that farmers are aware of the benefits of CA practices, which is not the case based on existing research.

Therefore, it is recommended that the government incentivise CA practices through active support policies. If government funding is involved in the process, this will increase public spending and reduce private consumption. Switching to CA practices also generates a significant number of new jobs in the long term, both in the agricultural sector and private services.

To reap the economic benefits of CA improvements in Kazakhstan, a clear, phased approach is recommended. The following steps can create an enabling environment for the effective implementation of this adaptation measure:

1. *Preparation of a support programme for CA practices*

To incentivise farmers to implement CA practices, such as no-till and minimum-till, it is important to design a sound support programme. Such a programme should help farmers make the necessary investments to switch to CA practices. As Kazakhstan already leads in Central Asia in terms of the adoption of CA practices, such a programme will accelerate the cultivation of crops that are more resilient to climate change hazards.

The support programme can be designed with a variety of components, including subsidies and soft lending. Importantly, it should focus on demonstrating the benefits of CA, raising awareness and incentivising farmers to adapt. Its aim should be to accelerate CA adoption across the country. However, its preparation will require active coordination between the government and international financial institutions, including the MoA, the MNE, the MoF and partners such as the World Bank and ADB.

In the preparation stage, several important points should be addressed:

- The duration of the support programme and the phase-out plan.
- The government level at which the programme is implemented. It must be determined whether the programme for supporting CA practices should be implemented in a decentralised manner or as a national initiative.
- As there are multiple definitions of CA, the government should have clear rules for defining CA practices and conditions for the provision of financial support.
- Conditions for financial support could take into account the types of crops, the local situation and the government's agricultural priorities. However, creating a whole raft of conditions could overcomplicate the financial support programme and reduce its effectiveness.

2. *Financing the support programme*

Once the programme has been clearly defined, it is essential to ensure that it is funded on a sustainable and long-term basis. Active cooperation between the above-mentioned stakeholders is crucial. The results of the e3.kz model could be an important tool for convincing different decision-makers that such a support programme is worthwhile. It is also important to ensure that the funding phase includes a clear phase-out strategy within a 10-year period when the targets for arable land using CA practices are reached.

3. *Increasing farmer awareness of CA*

Raising awareness about CA among farmers in Kazakhstan requires a multi-faceted approach to ensure the successful implementation of the funding programme. Many farmers in Kazakhstan, particularly in rural and semi-arid regions, may be unaware of these practices or lack access to the knowledge and resources needed to implement them effectively.

One of the most effective ways to raise awareness is through targeted education and extension services. Government agencies and agricultural universities in Kazakhstan can collaborate to design training programmes and workshops tailored to the needs of local farmers. They should be practical, hands-on and delivered in local languages. The funding programme, along with the educational materials, must be actively advertised. It will also be vital to create digital materials for these training activities to ensure maximum uptake.

Digital platforms can play a significant role in disseminating information. Mobile apps, SMS alerts and social media platforms, such as WhatsApp and Telegram, can deliver timely tips, videos and success stories and could be used for advertising the educational programme and the financial support for switching to CA practices.

4. *Implementation of the support programme for CA practices*

Since substantial economic benefits materialise when CA practices are used on a large scale in the agricultural sector in Kazakhstan, the support programme could be implemented in two phases.

Phase 1. Pilot project (Years 1 and 2)

- Learn from existing farmers using CA practices to develop awareness raising and training materials
- Launch pilot awareness raising and promotion campaigns for farmers with farms of different sizes, in different regions and specialising in different crops
- Launch pilots for different types of farmers and crops

- Identify regions where implementation of CA practices is more and less successful and adapt the rest of the programme taking into account the successful case studies
- Adjust co-financing components and other incentives in the less successful regions to improve programme performance

Phase 2. Scaling up and full implementation (Years 2 to 10)

- Leverage successful pilots to start full-scale implementation of the financial support programme for CA practices
- Expand the awareness raising and promotion campaigns, setting deadlines for applications and incentivising participation
- Expand financing programmes in the pilots with less uptake and adjust grant and soft lending components
- Apply the phase-out strategy to ensure that the implementation of CA practices is sustainable

5. *M&E*

A well-structured M&E plan is essential to ensure the effectiveness, transparency and accountability of a financial support programme for CA in Kazakhstan. The primary aim of the M&E framework is to track progress in implementing the programme, assess the impact of financial assistance on the rate of adoption of CA practices and inform future policy and funding decisions. It should focus on:

- Implementation of the support programme: monitoring activities will focus on real-time tracking of fund disbursement, farmer participation and the adoption of specific CA practices
- Budgeting: measuring and evaluating the budget allocations for different farmers benefiting from financial support for CA and monitoring grant funding and soft lending components
- Socio-economic indicators: assessing other additional effects of the programme, including employment and impact on households and farmers, especially smallholders

Financing

A comprehensive financing plan for a financial support programme promoting CA in Kazakhstan should strategically blend grants and soft lending mechanisms to ensure both accessibility and sustainability. The goal is to provide initial financial relief and capacity building support to smallholder and medium-scale farmers while encouraging long-term investment and ownership of CA practices. The financing plan should align with national agricultural development goals and be supported by public–private partnerships and international donor collaboration.

1. Grant component

The grant component will focus on reducing the initial barriers to adopting CA, especially among resource-constrained farmers. Grants will be provided for:

- Capacity building and training: covering the costs of training programmes, workshops, field demonstrations and technical advisory services
- Initial equipment and inputs: providing partial or full grants for machinery (e.g. no-till seeders), cover crop seeds and soil testing kits for smallholder farmers
- Pilot initiatives: funding smallholder pilot farms in different agro-ecological zones to demonstrate CA benefits and gather local data

According to the grant eligibility criteria, smallholdings, female-led farms and farms in degraded or vulnerable ecosystems will be prioritised. Grants will be disbursed through a competitive, transparent application process managed by regional agricultural departments in collaboration with local extension services.

2. Soft lending component

To support medium- to long-term investment in CA, the programme will offer soft loans with favourable terms, including:

- Low interest rates (e.g. 1% to 3% annually), significantly below market rates
- Flexible repayment periods, ranging from five to ten years depending on loan size and farm type

- Grace periods of up to two years to allow for yield stabilisation and adaptation to new practices

Soft loans will be available for the purchase of conservation equipment, the development of infrastructure for crop diversification and on-farm improvements, such as water retention systems and organic composting facilities. The loans will be administered by state-backed agricultural banks in partnership with international financial institutions, with risk-sharing instruments in place to mitigate default risks.

3. Blended financing and co-funding strategy

The financing plan will leverage blended finance by combining public funding (national and regional budgets), contributions from international donors – for example, the Global Environment Facility (GEF), the International Fund for Agricultural Development (IFAD) and the Food and Agriculture Organization of the United Nations (FAO) – and private sector investment. Cost-sharing arrangements can be introduced where farmers contribute a percentage (e.g. 10% to 30%) of project costs, enhancing buy-in and ownership. Matching grants may also be used to encourage private sector engagement in input supply chains and service provision.

Key Takeaways

Adopting CA practices is especially relevant for a country like Kazakhstan, where increasing weather variability, soil degradation and water scarcity are expected to pose growing challenges to agricultural productivity. The adoption of practices such as minimal soil disturbance, crop rotation and permanent soil cover can help improve soil health, retain moisture and reduce vulnerability to droughts and extreme weather. These measures can strengthen the resilience of Kazakhstan's farming systems to climate impacts while also supporting food security and rural livelihoods. Moreover, CA can lead to long-term economic benefits by lowering input costs and enhancing the sustainability of agricultural production.

The large-scale adoption of CA practices in Kazakhstan will have substantial economy-wide effects, as reflected in a projected real GDP growth rate of between 0.34 and 0.45 percentage points per year until 2050 under different climate change scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5). Across different climate change scenarios, GDP growth and the increased efficiency of the agricultural sector also boost employment (0.12%–0.17% a year) and substantially lower total final energy consumption (reduction of 0.08%–0.1%) and CO_2 emissions (reduction of 0.09%–0.12%).

It should be noted that this climate adaptation assessment was conducted without considering government funding and assuming that all adaptation costs will be paid by the agricultural sector. However, to increase the pace of adoption of CA practices and incentivise all types of farmers, government financing could be essential. This is why a combination of grant funding and soft lending could be a sound financial support measure for increasing the expansion of CA practices in Kazakhstan's agricultural sector.

5.4. Rehabilitating degraded pastures through sustainable pasture management

Over the past 10 years, agriculture, forestry and fishing have represented around 4.6% of Kazakhstan's GDP. Livestock accounts for about 33% of the country's total agricultural output (KZT 7,625 billion). Dairy cattle farming accounts for around 13% of agricultural output and about 3% of the total output of the livestock sector. Moreover, in 2024, livestock numbers are estimated to increase by 6% to about 33 million head. A summary of the livestock sector is presented in Table 9.

Table 9. Share of livestock categories in total agricultural output and livestock numbers

LIVESTOCK CATEGORY	SHARE IN TOTAL AGRICULTURAL OUTPUT	NUMBER OF HEAD
CATTLE	23%	7,842,572
HORSES AND OTHER UNGULATES	5%	4,217,371
CAMELS	0%	281,576
SHEEP AND GOATS	4%	20,175,130
PIGS	1%	467,901

Source: Kazakhstan Bureau of National Statistics

Although Kazakhstan is rich in pastureland and resources, high growth rates in the livestock sector are creating considerable pressure on pastures. According to FAOSTAT data, cultivated pastures in Kazakhstan account for about 4 million ha, and naturally growing pastures for about 72 million ha. The area of degraded pastures increased from 26.6 million ha to 27.1 million ha between 2001 and 2020.[24] The United Nations Framework Convention on Climate Change (UNFCCC) Representative Concentration Pathway (RCP) 4.5 climate change scenario indicates a 9.8% decrease in the livestock carrying capacity of pastures by 2030.[25] This makes the adaptation of pasture management to climate hazards essential for Kazakhstan's agricultural sector. Therefore, it will be important to develop a coherent policy for pasture conservation and adaptation to climate change hazards.

Scenario Description

Improving pasture management and rehabilitating degraded pastures can be achieved through several measures, such as (i) integrated pasture management, (ii) cover cropping and rotational grazing, (iii) improved livestock breeds and health and (iv) rehabilitation and maintenance of infrastructure (roads, bridges, water points).[26] These activities could lead to increased pasture and livestock production, with average productivity growth in the range of 5% to 15%, and improved resilience to the impacts of climate change (Polo, Santos and Syzdykov 2022).

Although pasture management issues and opportunities for improvement are relatively clear, implementing measures to improve grazing practices and overall pasture management can be challenging. Most of these activities can be grouped around the provision of financial incentives either to livestock farmers or to entities responsible for pasture health.

› Financial incentives to livestock farmers: they can be provided through subsidies to encourage rotational grazing and the creation of common pasture management systems. As an alternative to subsidies, an incentive mechanism could be established in the form of a differentiated tax on grazing in different pastures to encourage farmers to move their livestock to those with more abundant resources.

› Subsidies to entities responsible for pasture health: subsidies can be provided to farmers or government agencies responsible for pasture management, for example, for the planting of perennial grass varieties to improve degraded pastures. A recent World Bank study estimates the cost of rehabilitating pastures to be around USD 141,200 per 10,000 ha.

[24] The World Bank (2024). Republic of Kazakhstan: Climate Adaptation Options and Opportunities in the Agriculture Sector. Washington, DC: World Bank.

[25] UNDP (2020). Summary analytical report on the assessment of economic losses in the agricultural sectors. Nur-Sultan: UNDP project Development of the Eighth National Communication of the Republic of Kazakhstan under the UNFCCC and preparation of two (fourth and fifth) biennial reports.

[26] M. Polo, N. Santos and Y. Syzdykov (2022). Adoption of climate technologies in the agrifood system: Investment opportunities in Kazakhstan. Rome: FAO.

These types of instruments can be used to improve pasture management, and their impact can be assessed using the e3.kz model, which shows the wider impact of the policy on Kazakhstan's economy. In this scenario, three million out of 27 million ha of degraded land are expected to be improved over the next five to ten years, mainly in south-eastern, southern, western and desert areas where livestock density is the highest.

Implementation and Assumptions

The estimated costs and benefits of sustainable pasture management technologies are shown in Table 10 for a 10,000 ha farm. It is presumed that farmers have the necessary tillage and seeding machinery, so that no capital investment is required. Considering the additional hectares on which sustainable pasture management technologies are applied, the resulting costs and benefits are implemented into the e3.kz model to quantify the economy-wide impacts. It is presumed that the private sector can finance the necessary costs as the benefits for farmers are even higher.

Table 10. Assumptions for sustainable pasture management based on climate scenario SSP5-8.5

Costs (in USD per 10,000 ha)	Benefits (in USD per 10,000 ha)
Fuel required for tilling and seeding (USD 52,000)	Total value of hay harvested from new pastures over five years (USD 5.4 million)
Seeds (USD 20,000)	
Fertiliser (USD 20,000)	
Labour costs (USD 49,200)	
Financially supported by the government	

Source: World Bank (2024)

Further Assumptions

The costs and benefits of this adaptation option are calculated under the assumptions of the SSP5-8.5 scenario. The assumptions regarding the benefits, assuming the same investment (costs), are adjusted for the SSP1-2.6 and SSP2-4.5, applying the same assumptions as for CA (Table 11). This is done to ensure the robustness of the results across different climate change scenarios. As there is little or no evidence, the following assumptions were made regarding benefit adjustments.

Modelling Outcomes and Macroeconomic Results: GDP and Employment

Based on the modelling results, with sustainable pasture management, real GDP is expected to increase by up to 0.3% or KZT 195 billion a year (Figure 10). Agricultural exports such as dairy and other livestock products will accelerate, and agricultural imports will decelerate. The benefits will increase over time and are expected to be fully realised as soon as the measure is fully implemented.

With the expansion of economic activity, employment, income, investment (up to 0.26% a year) and household expenditure (up to 0.23% a year) will be higher than in a situation without adaptation and climate change (SSP5-8.5).

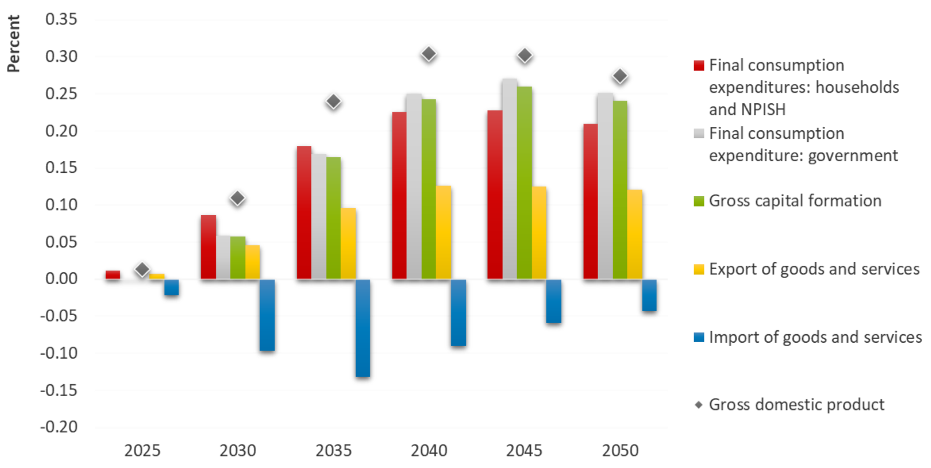
According to the CBA, the demand for labour in agriculture increases during and also after the implementation period. Up to 8,000 more people are employed in the agricultural sector compared to a situation without the measure and climate change. Depending on sectoral economic activity and labour intensity, additional jobs are also created in private services and, to a limited extent, in public services and construction. In total, up to 15,000 more people (+0.16%) are employed (Figure 11).

Table 11. Benefit adjustments under different climate scenarios

Adaptation benefit	SSP1-2.6	SSP2-4.5	SSP5-8.5 (basis for CBA)
Increased agricultural yields	116%	105%	100%

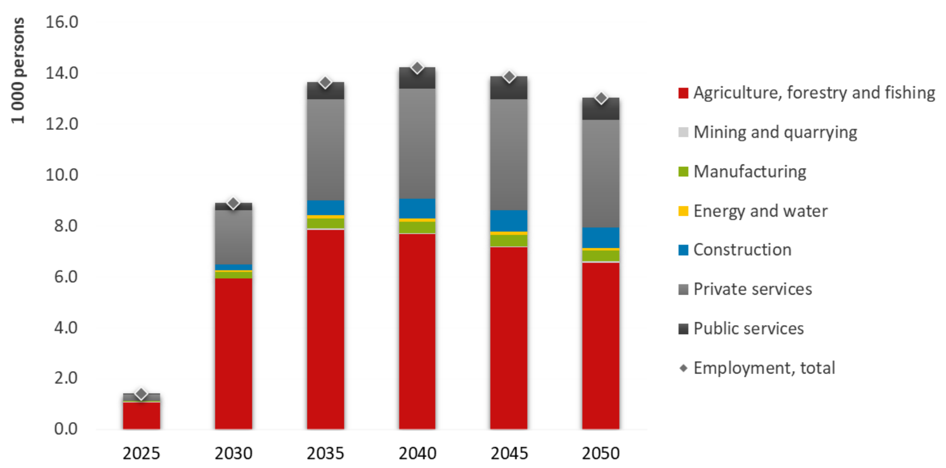
Source: GWS assumptions for the e3.kz model

Figure 10. Macroeconomic effects of the SSP5-8.5_SPM scenario, 2025–2050, deviations from the SSP5-8.5 scenario (percentage)



Source: GWS based on e3.kz scenario results

Figure 11. Employment effects of the SSP5-8.5_SPM scenario, 2025–2050, deviations from the SSP5-8.5 scenario (1,000 people)



Source: GWS based on e3.kz results

Most of the additional jobs are for male workers (0.18% or 8,500). Jobs for female workers increase by up to 0.14% or 6,500. For both genders, most jobs are created in agriculture, followed by private services.

Policy Recommendation

SUMMARY

The modelling results highlight expected long-term economic benefits, including increases in GDP, job creation, household consumption and goods exports. The results clearly show that even assuming full private sector funding of pasture restoration, there are significant economic benefits. However, it may be necessary to introduce incentive mechanisms for pasture restoration and sustainable pasture management. They could be in the form of financial incentives for livestock farmers, such as soft loans, and subsidies to agencies responsible for pasture restoration, especially on government land. For sustainable pasture management, it will be important to carry out activities to raise awareness among livestock farmers in parallel with restoration activities.

To reap the economic benefits of sustainable pasture management in Kazakhstan, a clear, phased approach is recommended. The following steps can create an enabling environment for effective implementation:

1. *Preparation of a support programme for sustainable pasture management practices*

To promote the adoption of sustainable pasture management practices in Kazakhstan, it is essential to design a comprehensive support programme tailored to the needs of livestock producers and pastoral communities. Such a programme should facilitate investment in improved grazing systems, rotational grazing, water infrastructure and pasture restoration techniques. It should consist of multiple components, including targeted subsidies, soft loans and technical assistance. It must also focus on demonstrating the long-term benefits of sustainable pasture practices, raising awareness among herders and providing incentives for widespread adoption. The ultimate goal is to scale up sustainable pasture management across the country. Designing and implementing such a programme will require close collaboration between the Government of Kazakhstan and international financial institutions, including the MoA, the MENR, the MoF and key partners such as the World Bank and ADB. In the preparation stage, several important points should be addressed:

- The duration of the support programme and the phase-out plan.
- Government level at which the programme is implemented. It must be determined whether the pasture restoration programme should be implemented in a decentralised manner or as a national initiative. When addressing the restoration component of the programme, consideration should be given to the question of whether support should be provided just for government-owned degraded pastures or for private land as well.
- As there are multiple definitions of sustainable pasture management, the government should consider prioritising certain restoration and grazing practices.

2. *Financing the support programme*

Once the sustainable pasture management programme is clearly defined, it is essential to ensure that funding is both sustainable and long-term to ensure lasting impacts. Strong collaboration among key stakeholders – including government bodies and international financial institutions – is critical throughout the process.

The use of analytical tools such as the e3.kz model can play a key role in demonstrating the value and effectiveness of the support programme to policy-makers and financial decision-makers. Additionally, it is important that the financing strategy include a clearly defined phase-out plan over a 10-year period, aligned with measurable targets for improved pasture health and sustainable grazing practices. This will help ensure that the programme leads to self-sustaining outcomes and long-term land stewardship.

3. *Increasing farmer awareness of sustainable pasture management*

Raising awareness about sustainable pasture management among livestock producers in Kazakhstan requires a comprehensive and targeted approach to ensure the success of any associated financing programme. One of the most effective strategies for building awareness is through well-designed education and extension services. Government institutions and agricultural universities can work together to develop training programmes and workshops that are practical, field-oriented and tailored to local needs. These should be delivered in local languages and grounded in real-world examples relevant to Kazakhstan's rangelands. To support uptake, the financing programme and accompanying training materials must be widely promoted across different regions. The success of such training programmes could largely depend on making them available to larger audiences, which means that it would be important to provide training materials online using digital tools.

Digital tools can also play a critical role in outreach. Mobile apps, SMS notifications and platforms such as WhatsApp or Telegram can be used to share grazing tips, short training videos and success stories. These channels can effectively advertise both the educational components and the financial support available for adopting sustainable pasture practices, ensuring broader engagement and participation.

4. *Implementation of the support programme for sustainable pasture management practices*

Given that the economic and environmental benefits of sustainable pasture management become more significant when adopted at scale, the support programme in Kazakhstan could be implemented in two strategic phases.

Phase 1. Pilot stage (Years 1 and 2)

- Engage with livestock farmers already applying sustainable grazing practices to develop targeted awareness raising materials and practical training sessions
- Launch pilot outreach and education campaigns tailored to different types of livestock producers across various regions and ecological zones
- Implement pilot projects among diverse pastoral systems to understand the unique challenges and opportunities in each
- Identify regions demonstrating strong programme uptake and effectiveness and use these as case studies to inform broader programme design
- Adjust co-financing mechanisms and incentives in regions with lower engagement to enhance the programme's performance and local relevance

Phase 2. Scaling up and full implementation (Years 2 to 10)

- Leverage successful pilot experiences to initiate full-scale implementation of the financial support programme for sustainable pasture management
- Expand awareness campaigns with clear application timelines and attractive incentives to encourage widespread adoption
- Scale up financial mechanisms – grants and soft loans – and technical assistance, particularly in areas that showed limited uptake during the pilot phase, ensuring adjustments are made to improve accessibility and impact
- Introduce and follow a structured phase-out strategy to ensure that sustainable pasture management becomes self-sustaining beyond the initial support period

5. *M&E*

A well-designed M&E framework is crucial to ensure the effectiveness, transparency and accountability of any financial support programme promoting sustainable pasture management in Kazakhstan. The primary goal of the M&E system is to track progress in implementing the programme, evaluate the impact of financial assistance on the adoption of sustainable grazing practices and inform future policy and investment decisions.

The M&E plan should focus on the following key areas:

- Programme implementation: monitor real-time data on the disbursement of funds, the participation of livestock producers and the uptake of sustainable pasture management techniques, such as rotational grazing, reseeding and water infrastructure development.

- Budget tracking: evaluate how financial resources are allocated and spent across different types of beneficiaries. This includes tracking the performance and reach of both grant and soft loan components to ensure the equitable and efficient use of funds.
- Socio-economic impacts: assess broader outcomes of the programme, including job creation, improvements in household livelihoods and specific benefits for smallholder and vulnerable pastoralist communities.

Financing

A robust and well-targeted financing plan is essential to support the transition to sustainable pasture management in Kazakhstan and reduce the area of degraded pastures. The proposed financial support programme will include two main pillars: 1) financial incentives for livestock farmers to adopt sustainable grazing practices and 2) subsidies to institutions or entities responsible for the restoration and long-term health of pastures, particularly for the planting of perennial grass varieties.

1. Financial incentives for livestock farmers

To encourage sustainable grazing practices, such as rotational grazing, stocking rate adjustments, seasonal rest periods and infrastructure improvements (e.g. fencing, water points), the programme will offer targeted financial incentives, including:

- Direct payments or results-based incentives: payments to farmers who implement certified sustainable pasture management practices. Verification would be based on measurable criteria, such as vegetation cover, livestock densities and grazing schedules.
- Cost-sharing mechanisms: financial support covering 50% to 70% of the cost of installing infrastructure needed for sustainable grazing (e.g. mobile fencing, water systems).

In this support programme, priority should be given to small- and medium-scale livestock operations in areas facing moderate to severe pasture degradation.

2. Subsidies for pasture restoration entities

In parallel, the programme will provide subsidies to land management authorities or private owners of large areas of pastureland. These subsidies will focus on:

- Perennial grass planting: covering up to 80% of the cost of seeding perennial, drought-resistant grass species to restore productivity and prevent erosion on degraded pastureland
- Pasture improvement works: funding for soil conditioning, erosion control measures and small-scale infrastructure to support regrowth and vegetation cover
- M&E systems: support to build capacity to monitor pasture health using satellite data, field surveys and community engagement

These subsidies will be conditional upon the submission of approved pasture management plans and subject to periodic review to ensure accountability and effectiveness.

3. Blended financing and strategic partnerships

The financial plan will utilise blended financing, combining:

- National budget allocations: funds from Kazakhstan's MoA and MENR
- International donor contributions: grants and technical support from entities such as the GEF, the World Bank, FAO and UNDP

Key Takeaways

Sustainable pasture management is particularly critical for Kazakhstan, where increasing climate variability, land degradation and water scarcity are placing growing pressure on livestock-based systems. The adoption of practices such as rotational grazing, controlled stocking rates and pasture rehabilitation can help restore soil health, enhance vegetation cover and improve water retention in rangelands. These measures play a key role in boosting the resilience of Kazakhstan's pasture ecosystems to droughts and extreme weather while also supporting the livelihoods of rural herder communities and contributing to national food security. In the long term, sustainable pasture management can also deliver significant economic benefits by improving forage productivity, reducing land degradation and ensuring the viability of livestock systems for future generations.

Large-scale adoption of sustainable pasture management in Kazakhstan will have substantial economy-wide effects, as reflected in a projected real GDP growth rate of between 0.27 and 0.31 percentage points per year until 2050 under different climate change scenarios (SSP1-2.6, SSP2-4.5 and SSP5-8.5). Across different climate change scenarios, GDP growth and the increased efficiency of the agricultural sector also influence employment, leading to an increase of 0.13% a year.

It is important to acknowledge that implementing sustainable pasture management practices will require significant initial investment, primarily from the government. These funds will be crucial for financing essential improvements in rangeland management, such as the restoration of degraded pastures, water resource development and the adoption of best grazing practices. Although this will involve upfront costs, it will also generate long-term benefits for the government, including improved environmental outcomes, increased livestock productivity and enhanced rural livelihoods. The success of this initiative depends on creating effective incentive structures for livestock producers to actively engage in sustainable practices, including access to concessional loans or grants to help offset initial costs. By leveraging such financial tools, the burden on the government can be minimised while ensuring widespread adoption of sustainable pasture management techniques.

6. PRACTICAL APPLICATION OF RESULTS FOR POLICY-MAKING

The policy recommendations for energy efficiency, flood protection and the agricultural and livestock sectors need to be effectively integrated into Kazakhstan's broader policy framework. This section outlines the mechanisms through which research findings and quantitative results can guide actionable policies and improve implementation.

Expanding institutional involvement is crucial to ensuring the successful integration of climate adaptation policies across sectors. Effective policy action requires strong inter-agency coordination, structured financial planning and multi-stakeholder engagement. Additionally, utilising robust economic and energy–environmental models, such as the e3.kz model, can help policy-makers assess trade-offs, predict long-term socio-economic and environmental impacts and refine adaptation strategies based on evidence-based projections. The following additional key points outline how Kazakhstan can institutionalise its climate adaptation strategies to enhance resilience and long-term sustainability.

Table 12: Prioritisation framework for policy integration

POLICY MEASURE	EXPECTED IMPACT	TIMEFRAME	LEAD INSTITUTIONS	CLIMATE RELEVANCE	ECONOMIC RELEVANCE
IMPROVING ENERGY EFFICIENCY IN BUILDINGS IN KAZAKHSTAN	Improves energy efficiency in residential and public buildings, adapting them to extreme temperatures and weather events	Long-term (5–10 years)	MOIC, EEDI	High	High
INCREASING FLOOD PROTECTION THROUGH THE DEVELOPMENT OF MULTI-PURPOSE WATER RESERVOIRS	Ensures the protection of infrastructure and settlements from floods while providing additional services, such as irrigation water for agriculture and energy	Medium-term (3–5 years)	MOWRI	High	High
SUPPORTING CA PRACTICES	Ensures the climate resilience of temporary crops while decreasing costs and increasing yields	Medium-term (5-7 years)	MoA	High	High
SUPPORTING SUSTAINABLE PASTURE MANAGEMENT	Improves the condition of 27 million ha of degraded pastureland	Long-term (5–10 years)	MoA	High	High

Source: Own illustration

Role of the MoF and the MNE in climate-smart budgeting

- The MoF should implement a climate budget tagging system to track and optimise spending for climate adaptation and resilience projects across all sectors
- Budget allocations should prioritise climate-smart investments, ensuring funding is directed toward initiatives that yield both environmental and economic benefits
- The MNE should coordinate with sectoral ministries to align fiscal planning with long-term adaptation and mitigation strategies

Strengthening governance and monitoring systems

- Determine priority areas for climate adaptation by finalising the NAP process and its implementation roadmap
- Establish a centralised M&E framework to track the effectiveness of policy implementation across sectors
- Ensure transparency by publishing progress reports on climate adaptation spending and outcomes
- Develop adaptive governance mechanisms that allow policy-makers to respond to emerging climate challenges with evidence-based adjustments

Successfully integrating climate adaptation policies across energy efficiency, flood protection, agriculture and pasture management requires a coordinated institutional approach. By leveraging structured financial planning, inter-agency collaboration and evidence-based modelling tools such as the e3.kz model, policy-makers can develop more targeted and effective adaptation strategies.

Ensuring that budget allocations prioritise climate-smart investments, establishing robust governance and monitoring frameworks and maintaining transparent reporting mechanisms will be crucial for long-term resilience. With strong institutional engagement and dedicated financing mechanisms in place, Kazakhstan can effectively mitigate climate risks while promoting sustainable economic growth and environmental protection.

7. CONCLUSION

Developing well-structured adaptation scenarios is essential for integrating climate resilience into Kazakhstan's economic and development planning. This handbook outlines a step-by-step approach to scenario formulation, selection and integration, enabling policy-makers, adaptation specialists and macroeconomic modellers to design evidence-based climate adaptation strategies. By leveraging the e3 model, stakeholders can assess the economic impacts of climate change, quantify the benefits of adaptation measures and refine policy decisions using a data-driven approach.

The handbook provides practical guidance on identifying key policy entry points, aligning adaptation measures with national priorities and incorporating economic modelling into decision-making. Through structured scenario development, policy-makers can evaluate trade-offs, prioritise measures and justify resource allocation for energy efficiency in buildings, flood protection, CA practices and sustainable pasture management. The emphasis on institutional coordination, stakeholder engagement and financial feasibility ensures that adaptation measures are not only technically sound but also implementable within Kazakhstan's governance framework.

However, challenges such as data limitations, institutional capacity gaps and financing constraints must be addressed to enhance the credibility and effectiveness of scenario-based planning. Strengthening climate-smart budgeting, improving inter-agency collaboration and establishing a robust monitoring framework will be crucial to ensuring that adaptation scenarios translate into actionable policies.

By embedding scenario development into broader development planning and refining strategies based on evolving climate risks and economic conditions, Kazakhstan can enhance its adaptive capacity and drive sustainable economic growth. This handbook serves as a resource for stakeholders seeking to implement data-driven, forward-looking adaptation measures that align with national development goals and international climate commitments.