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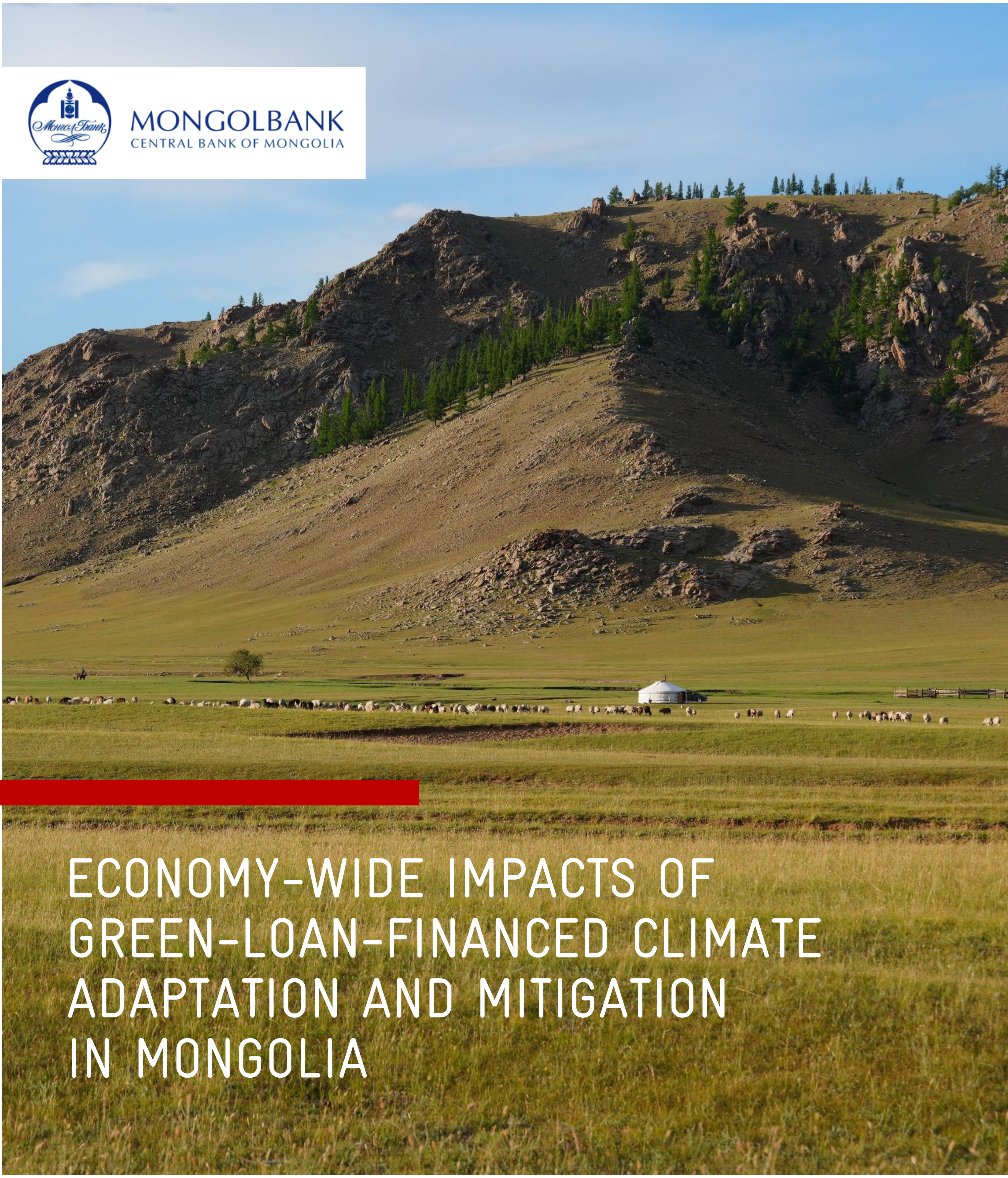

ECONOMY-WIDE IMPACTS OF GREEN-LOAN-FINANCED CLIMATE ADAPTATION AND MITIGATION IN MONGOLIA

On behalf of:

Federal Ministry
for the Environment, Climate Action,
Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

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Policy Dialogue and Knowledge Management on Climate Protection Strategies

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On behalf of
Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN)

Germany 2026

ECONOMY-WIDE IMPACTS OF GREEN-LOAN-FINANCED CLIMATE ADAPTATION AND MITIGATION IN MONGOLIA

Assessing Potential Macroeconomic Impacts of Climate Finance in Mongolia with the e3.mn Model

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CONTENTS

List of figures

List of tables

List of abbreviations

ADB	Asian Development Bank
AFOLU	Agriculture, forestry and other land use
BMUKN	Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (Germany)
Bn.	Billion
CBA	Cost-Benefit Analysis
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
DIAPOL-CE	Policy Dialogue and Knowledge Management on Climate Protection Strategies
E3	Economy, Energy, Emission
EWE	Extreme weather events
FEC	Final Energy Consumption
GDP	Gross Domestic Product
GCF	Green Climate Fund
Gg	Gigagram
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GWS	Institute of Economic Structures Research (Gesellschaft für wirtschaftliche Strukturforschung)
IEA	International Energy Agency
kt	Kiloton
MET / MECC	Ministry of Environment and Climate Change (Mongolia) – former Ministry of Environment and Tourism
MNT	Mongolian Tugrik (Currency)
Mn.	Million
Mt	Megaton
NCC	National Climate Committee (Mongolia)
NDC	Nationally Determined Contributions
n.d.	No date
n.e.c.	Not elsewhere classified
NGFS	Network for Greening the Financial System
O&M	Operation and maintenance
p.a.	Per annum
SL	Sustainable livestock
SSP	Shared socioeconomic pathway
t	Ton
TJ	Terajoule
Tn.	Trillion
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US Dollar
WP	Watering Points

Executive summary

Climate change, adaptation and climate mitigation are major challenges for Mongolia, requiring political measures in adaptation and mitigation and structural changes. Mongolia has developed a green taxonomy and aims to increase the share of green loans from around 4.1% by first quarter of 2025 and 5.3% at the end of 2025 to 10% by 2030 (Bank of Mongolia 2025 a, b). So far, green loans have been used primarily in the areas of agriculture, building efficiency, and renewable energy.

The e3.mn model can be used to run through appropriate measures in so-called "what-if analyses". Together with the Bank of Mongolia and GIZ, the authors explored which measures would be suitable for analysis and selected two adaptation measures and three mitigation measures, which were examined with the e3.mn model. Specific assumptions are made for each scenario, and the results are compared with a scenario that does not include these assumptions.

For the agricultural sector two adaptation options were evaluated to address the negative impacts of climate change on livestock and pasture: the expansion of effective grazing area and improvement of existing pastures by appropriate water, livestock and pasture management. Expanding pastureland requires new watering points, the creation of wells and ponds or implementing reserve areas. To counteract pastureland degradation, also the number of livestock must be reduced to sustainable levels. The macroeconomic results of both measures are positive: GDP is expected to accelerate and being up to 1.1% resp. 0.46% per year higher for "Additional watering points" and "Sustainable livestock and pasture management" compared to a situation without these measures. More jobs and income are associated with economic growth but also GHG emissions if no additional mitigation measures are taken.

In the energy sector, a liberalization of electricity and heat generation in the form of rising electricity prices until 2030 was analysed. In addition, based on our own earlier calculations, a carbon tax was gradually introduced from 2031 onwards to promote low-carbon technologies. The revenue was recycled to reduce rising costs for private households on the one hand and to promote investment in renewable energies on the other. The macroeconomic results are positive. GDP could be up to 0.5% higher per year, with corresponding increases in production and employment. Energy consumption could fall compared to the baseline and GHG emissions could be reduced. However, there would be significant price increases for electricity and heat due to market liberalization.

In the residential sector, improvements in energy efficiency promoted by green loans could also lead to positive macroeconomic effects. However, the programs examined are limited, so additional upscaling would be necessary. When it comes to financing, it must be considered that private homeowners and tenants will not be able to fully finance the efficiency measures on their own. On the one hand, the state should provide subsidies, and, on the other hand, international financial resources would be necessary for this.

Future model analysis could be extended to include further adaptation and mitigation measures. Also various model extensions are possible to better capture the interactions between the financial sector, climate risks and the real economy. An explicit modelling of the financial sector would need to be integrated into the existing e3.mn model. Future scenarios in the e3.mn model could also be based more closely on international model studies such as those conducted by the Network for Greening the Financial System (NGFS). This report provides first indications of the potential to work in this direction.

1. INTRODUCTION

Climate change adaptation and mitigation are key challenges for Mongolia. As a signatory to the Paris Agreement in 2016, Mongolia committed to reducing greenhouse gas emissions (GHG) and helping to limit global warming (UNFCCC 2022). At the same time, Mongolia is confronted with extreme weather events (EWEs) such as dzuds and droughts as well as gradual long-term changes of the climate. Climate scientists expect even more frequent, more severe and recurring EWEs for Mongolia as well as increasing temperatures above global average (USAID 2017). The recent Climate and Development Report from the World Bank (2024) highlights the following insights:

- Mongolia's development prospects are uniquely challenged by both the impacts of climate change and the global shift toward a low-carbon economy.
- The country's efforts toward decarbonization pose significant challenges given the structurally high-emission intensity of its economy.
- While challenging, climate action also presents Mongolia with opportunities to achieve important development benefits.
- The effects of climate risks and the shift away from coal will have diverse impacts across different regions, communities, and socioeconomic levels.
- The report assesses the critical interconnections between Mongolia's development ambitions and climate change action and identifies ways to transition to a more economically diversified, inclusive, and resilient development path.

The Network for Greening the Financial System (NGFS 2024) projects that climate change will have significant costs, with its updated long-term scenarios indicating that GDP losses by 2050 could be two to four times greater than previously estimated, reaching 5% in 2030 to 15% in 2050 under the 'Current Policies' scenario. These costs come from both physical risks (e.g., property damage from extreme weather, reduced agricultural yields) and transition risks (e.g., economic disruption from policy shifts). The specific cost depends on the climate scenario, with more ambitious policies leading to lower losses. The NGFS climate scenarios suggest at the same time that the cost of climate mitigation is a necessary investment that is less costly than inaction.

Mongolia is not considered separately in the NGFS scenarios, but as part of a region "Central Asia", making it difficult to transfer the results to Mongolia. It should be noted that the economic structures of individual countries vary greatly, so that although the direction of the effects can be transferred to Mongolia, it is difficult to conduct policy analysis on this basis. Following the results of the SSP5-8.5 scenario – incorporating the economic impacts of dzuds, floods, droughts and heatwaves – calculated with the e3.mn model, real GDP could be up to 4% per year lower compared to the "No climate change" (baseline) scenario.

Climate change impacts lead to economic costs and affects key industries such as agriculture directly. Policymakers need information on the potential impacts of climate change on the national economy, in order to develop adaptation strategies to reduce economic risks of climate change and thus initiate the transition to a climate resilient economy. E3 (economy-energy-emission) models in combination with scenario analysis support policymakers with these issues.

Under the Global Programme "Policy Dialogue and Knowledge Management on Climate Protection Strategies" (DIAPOL-CE) and a previous global programme implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN), such e3 models were developed for Georgia, Kazakhstan, and Mongolia jointly with local partners and combined with intensive capacity building. These models were then applied to better understand the economy-wide impacts of climate change and adaptation by evaluating the direct, indirect, and income-induced impacts.

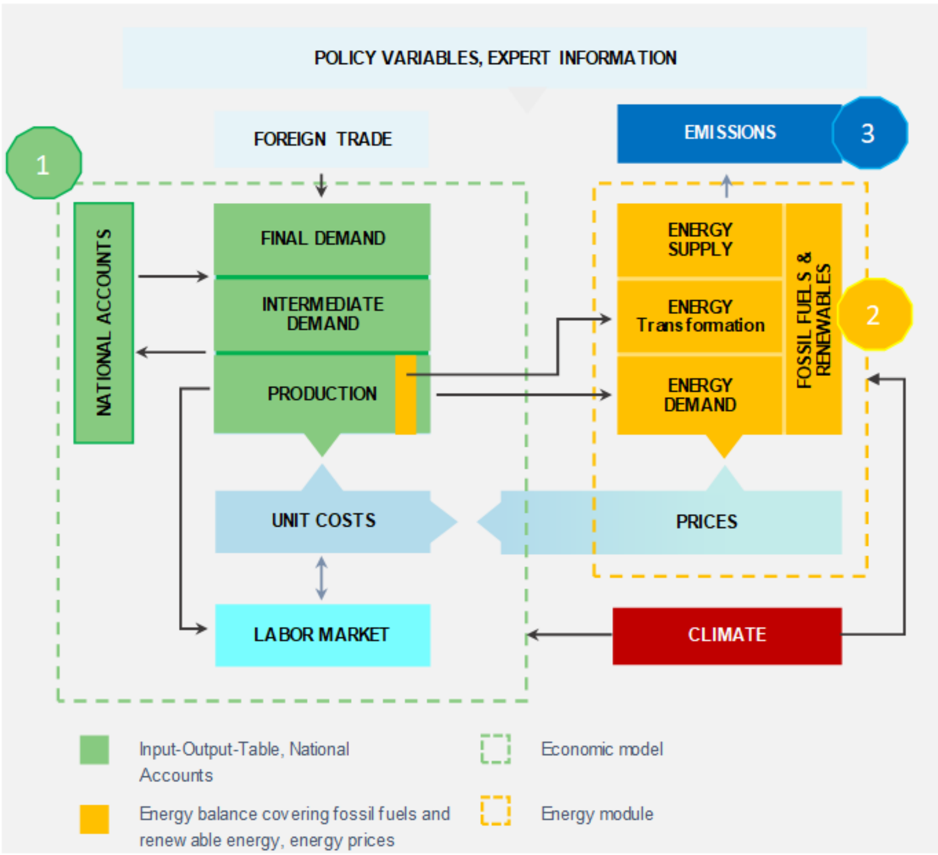
First, climate change and adaptation scenarios were designed comprising data on the most relevant climate hazards, their sector-specific impacts as well as appropriate adaptation options. Second, these scenarios were analysed with the E3 models. Results were then fed into stakeholder discussions and policy processes to support evidence-based policymaking and adaptation planning (GIZ 2025b).

This approach, while ambitious in terms of data collection, modelling, coordination, and planning, is also time-intensive for all involved partners. Nevertheless, its highly participatory nature fosters collaboration between field experts and government ministries supporting evidence-based policymaking (GIZ 2023c, d).

For Mongolia, a corresponding model, e3.mn, has been developed since 2022 in close cooperation with national institutions such as the Bank of Mongolia, the Ministry of Economy and Development and the Ministry of Environment and Climate Change, and has been used for various simulations (GIZ 2023a, GIZ 2023b). The focus so far has been on simulations of the effects of climate change and adaptation (GIZ 2025a) but initial simulations of mitigation for carbon tax scenarios with different kinds of revenue recycling have also been calculated (GIZ 2024).

Figure 1 briefly shows the three model parts and their interrelations. Number 1 indicates the economic core of the E3 model, number 2 shows the energy module, which separates different energy carriers including renewables and number 3 indicates the emission module. The effects of climate change have an impact on the economy and energy use.

Figure 1. e3.mn model at a glance



Source: Own illustration based on GWS (2022)

Each of the three parts are based on a rich and up-to-date, country-specific dataset given as time series based on annual data from 2008 until 2022 for most important economic data and from 1990 to 2021 for energy and emission data. The economic part of the model is built from an input-output table and the system of national accounts (macroeconomic data) plus population and labour market data such as employment. Energy balances, which include energy supply, transformation and (final) energy demand, are at the centre of the energy part. Based on these data in physical units, combustion-related GHG emissions can be directly calculated using fixed emission factors.

The following report builds on the experience gained and focuses on the economic impacts of green-loan financing of specific adaptation and mitigation measures in Mongolia. It first discusses green loans in Mongolia. It then describes the overall economic effects of the individual measures separately for adaptation and mitigation. A brief summary and outlook conclude the report.

2. GREEN LOANS FOR CLIMATE ADAPTATION AND MITIGATION IN MONGOLIA

The idea behind the project is to quantify the potential economic effects of increased green loan issuance for adaptation and mitigation measures in Mongolia. The World Bank (2024, pp. 92–94) CCDR report lists 10 top recommendations for detailed policy actions. These range from reforming financing and prices in the agricultural sector, shifts in the mining sector from coal to other minerals, reforming the electricity and heating sector, improving disaster response capacity, to improving access to finance and measuring the progress of adaptation and mitigation policies.

This report provides exemplary quantification and modelling of important policy measures and outlines recommendations how to further develop analytical capacities in this regard. In the future, the necessary modelling steps could be carried out more easily and quickly. Once the data and information requirements for quantifying the impacts are clear, the relevant information can be collected directly in projects to enable more comprehensive specific modelling of possible policy measures in the long term.

To this end, the general design of the measures was first discussed and defined in collaboration with the Bank of Mongolia and GIZ. In particular, it was possible to build on experience with the granting of green loans in Mongolia. By the beginning of 2025, green loans of almost MNT 1.6 billion were outstanding, accounting for 4.1% of total loans (BoM 2025). At the beginning of 2020, when the green loan categorization started, only 2.5% of total loans were green. The focus was on energy efficiency (especially in buildings), renewables (mainly solar PV) and sustainable agriculture, land use, forestry and eco-tourism (almost completely agriculture).

The Green Taxonomy for Mongolia (Financial Stability Council 2019) clearly defines green loans. The "National Sustainable Finance Roadmap", which links the financial sector with the real economy, set out the goal of "increasing the green loan portfolio of all banking sector lending to 10 percent by 2030" (Financial Stability Council (2022).

Against this backdrop, the authors from GWS, Bank of Mongolia and GIZ examined which sectors are particularly suitable for modelling. The areas of energy efficiency, sustainable agriculture and renewable energy are those in which the majority of green loans are already being granted, so these areas were chosen. The extent to which modelling of the measures in the e3.mn model appears feasible was also examined.

At the same time, consideration was given to expanding the e3.mn model to explicitly include the financial sector. Although this appears to be possible in principle, it was decided to postpone this step in view of the limited time frame of the project. Instead, the focus was on finding quantifications that accurately describe the real economic relationships and the financing requirements for green loans. The model therefore ‘only’ simulates the expected real economic effects of the additional green loans, primarily in the form of changed investments and other effects. The approach therefore analyses green finance flows via modelling real economy effects, as the current version of the e3.mn model does not include the financial sector in the form of financial flows, so that direct modelling of financing flows is not possible.

In this regard, two measures were identified in agriculture for which corresponding quantifications are already available through cost-benefit analyses (CBAs), namely investment in watering points for climate-resilient livestock and investment in sustainable livestock and climate-resilient pasture management.

For mitigation, experience gained from two ongoing projects in the field of energy efficiency in buildings could be drawn upon, with project phases in Mongolia already completed and evaluated in each case, providing well-verified and suitable data. These projects support energy efficiency measures in panel apartments and ger houses in Ulaanbaatar.

No such detailed information was available for the renewable energy sector and, more generally, for the transition to low-carbon electricity and heat generation. The World Bank (2024) report recommends to "increase tariffs gradually to reach full cost recovery by 2030". The Mongolian government has already begun to raise electricity prices to a level that makes investment in a more efficient and green energy system more profitable. Based on internal considerations, it was assumed that electricity prices would have to rise by a further 30% by 2030 compared to a reference development implemented so far in the model without price increases above average in order to support the corresponding energy transition. After 2030, the carbon tax modelled in 2024 (GIZ 2024) will be introduced, which will further support the low-carbon transformation and at the same time cushion strong cost increases for poorer private households through revenue recycling.

Given the selection of measures, the modelling does not comprehensively reflect the target of achieving a 10% share of green loans in Mongolia by 2030 but covers measures that support this target. As it includes key areas on which green loans granted to date have focused, the results provide a good indication in this regard. The measures of energy efficiency in buildings in particular could be scaled up with the necessary financial resources, so that a target share of green loans could be achieved quite easily.

Essentially, green loans are represented in the e3.mn model mainly in the form of induced additional investments. Investments in adaptation and mitigation result in overall positive macroeconomic effects. In addition, part of the financing for building efficiency measures, for example, comes from abroad, which is generally positive for the Mongolian economy. Conversely, however, green investments may also crowd out other investments because financial resources are scarce. These are aspects that need to be taken into account when evaluating the results and could be considered more realistically in future simulations using a model version that explicitly includes the financial sector.

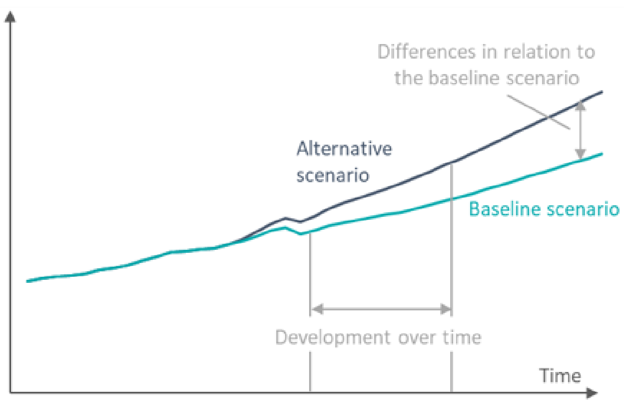
3. MACROECONOMIC ANALYSIS OF GREEN-LOAN-FINANCED ADAPTATION AND MITIGATION

3.1 Scenario comparison

The calculation of the macroeconomic effects is based on scenario analysis. For this purpose, a policy scenario is defined for each measure that differs from the reference development in a few specific aspects. The effects in the model context are then measured in terms of deviations in the model variables. To do this, it is important to define a suitable reference scenario.

The reference to which all scenario results documented in this report are compared is the SSP5-8.5 scenario which includes the effects of severe future climate change according to SSP5-8.5 (GIZ 2025a). Different alternative scenarios differ from this reference by only a few scenario specific assumptions such as price or investment differences. The impacts of a scenarios can be revealed by evaluating the relevant model variables (such as employment, GDP or production) against their values in the baseline scenario (Figure 2). All effects are then derived within a consistent model framework. The relative or absolute deviations from this baseline are considered the key results, describing the direct, indirect and induced effects of the respective measure in the model context. The respective measure is quantified as a scenario using corresponding specifications.

Figure 2. Scenario comparison



Source: Own representation by GWS

3.2 Green loan-financed adaptation options in agriculture

The Mongolian agricultural sector is of great relevance for the Mongolian economy. In total, it compounds 10% of Gross Domestic Product (GDP) and employs 28% of total employment in 2023 (Asian Development Bank (ADB) 2025). Agriculture is dominated by livestock and herding which account for 83% of total agriculture production (Government of Mongolia 2024). However, it suffers from the degradation of pastureland, water availability and biodiversity loss caused by overgrazing due to unsustainable herd sizes and the abandonment of traditional methods. Climate change and in particular climate hazards such as droughts and heatwaves exacerbates degradation and desertification resulting in reduced fodder and water availability and thus affecting livestock health, quality and mortality (Asian Development Bank (ADB) und Ministry of Environment and Green Development Mongolia (MEGD) 2014).

Herders generate most of their income from livestock but climate hazards such as dzuds kill tremendous numbers of livestock threatening their income security. Consequently, herders increase their livestock numbers even further to ensure a minimum of income (UNDP 2023). The number of livestock more than doubled between 1990 and 2024 but simultaneously livestock quality and carcass size declined (NSO 2025; Cai et al. 2025). Furthermore, 70% of pastureland is now degraded and pastureland capacity has been surpassing 2.6 times. This development is also attributable to the lack of a regulatory framework, enforcement capacities, and coordination measures (Asian Development Bank (ADB) 2021, 2020; UNDP 2023).

Adaptation options to address livestock vulnerability to climate change include the expansion of effective and sustainably managed grazing area and improvement of existing pastures by appropriate water and pasture management, as well as reducing the total livestock number to more sustainable levels. While expanding pastureland requires new watering points, the creation of wells or implementing reserve areas, for example (Asian Development Bank (ADB) und Ministry of Environment and Green Development Mongolia (MEGD) 2014), the reduction of livestock often involves capacity building and information about efficient livestock herding as well as coordination between herders (Asian Development Bank (ADB) 2021, 2020; IFAD 2025; UNDP 2023).

To counteract pastureland degradation and the increasing number of livestock, the implementation of pasture and rangelands user agreements (PUA) have been proven successful in piloting projects such as ENSURE (UNDP 2021b, 2021a). With these agreements, herders connect in groups and jointly agree in a reduction of livestock, to invest in watering points and higher quality of pastures and to coordinate grazing. Key to such agreements is capacity building that informs about sustainable herding such that although livestock is reduced, but herders' income is secured due to improved livestock quality. Within the ENSURE project, herders that signed PUA's did reduce their livestock number by 21% without loss in income and considerably reduced degradation of rangelands. This success also attracted around 15% herders that joined PUAs on a voluntary basis.

The Government of Mongolia recognized the importance of accelerating actions to improve pastureland and the need for financial support of herders. "Mongolian Government Resolution on Expansion of the New Cooperative Movement", #166, dated 2024" regulates the grant of "green" soft loans amounting to overall five trillion MNT to herders of cooperatives over a period of ten years (until 2033). To financially support herders, the loan interest rate is capped at 6% p.a. which means that the government finances approx. 12% of the loan interest rate.

Against this background, the following subsections analyse 1) the impact of an expansion of effective grazing area by implementing new watering points as well as 2) the improvement of grazing areas and reduction of livestock in two separate scenarios. It is expected that the herders have to finance the investments through "green" loans.

3.2.1 Investing in watering points for climate-resilient livestock

Scenario settings

The scenario settings of this scenario "expansion of the effective grazing area by implementing new livestock watering points" follow closely the "Investing in watering points for resilient livestock" scenario described in (GIZ 2025) aiming at reducing the adverse impacts of droughts and heatwaves. While the considered costs and benefits are based on the same cost-benefit analysis (CBA) conducted for the GCF funded UNEP/MET implemented project "Building Capacity to Advance National Adaptation Plan Process in Mongolia", see also National Climate Committee ((National Climate Committee (NCC) 2021), it differs regarding the funding of investments. In this scenario, investments by herder households are financed by "green" loans rather than fully paid for by the government. Moreover, the total number of additionally implemented watering points can be scaled up to reach 2,000 instead of 800.

From 2026 to 2033, 250 new watering points will be installed each year. Each watering point requires investments in wells Total investments add up to 3.7 Trillion (Tn.) Mongolian Tugrik (MNT), including operation and maintenance (O&M) costs until 2038. Afterwards O&M are paid from higher income. O&M costs amount to 11% of investments. The expected benefits from improved livestock quality including weight gain, milk production, wool quality etc. amount to 420 Billion (Bn.) MNT per annum (p.a.) once all watering points are established.

Loans must be paid back within five years, whereas loans used for O&M are expected to be repaid earlier (within one year). As investments take place until 2033, all loans will be fully paid back until 2038. Loan and interest payments are expected to constrain herder's consumption opportunities, while the government funds interest rate payments at the expense of public administration expenditures. Table 1 summarizes the costs, benefits and loan repayments set for the "Watering points" scenario.

Table 1: Assumptions on costs, benefits and loan repayments for "Watering points" scenario (WP)

Costs and benefits	2026	2028	2030	2032	2034	2036	2038	2040	2050
Additional green loans for investments and O&M, p.a. (Bn. MNT)	90.5	108.4	126.4	144.3	71.8	71.8	71.8	71.8	71.8
Interest payments by government, p.a. (Bn. MNT)	20.0	58.8	93.4	123.5	126.1	63.7	35.7	-	-
Interest payments by herder households, p.a. (Bn. MNT)	10.0	29.4	46.7	61.8	63.1	31.8	17.9	-	-
Herder green loan payback plus interest rate payments, p.a. (Bn. MNT)	43.2	148.6	282.2	376.3	608.3	471.6	315.7	-	-
Increased agricultural production, p.a. (Bn. MNT)	52.8	158.5	264.2	369.9	422.8	422.8	422.8	422.8	422.8

Source: CBA conducted for the GCF funded UNEP/MET implemented project "Building Capacity to Advance National Adaptation Plan Process in Mongolia", see also National Climate Committee (NCC) (2021). Own calculation. Note: Investments and increased agricultural production are price adjusted. Interest and loan repayments are in nominal terms. The first row contains investment costs which are are financed with green loans until 2038. Afterwards O&M costs are paid from higher income.

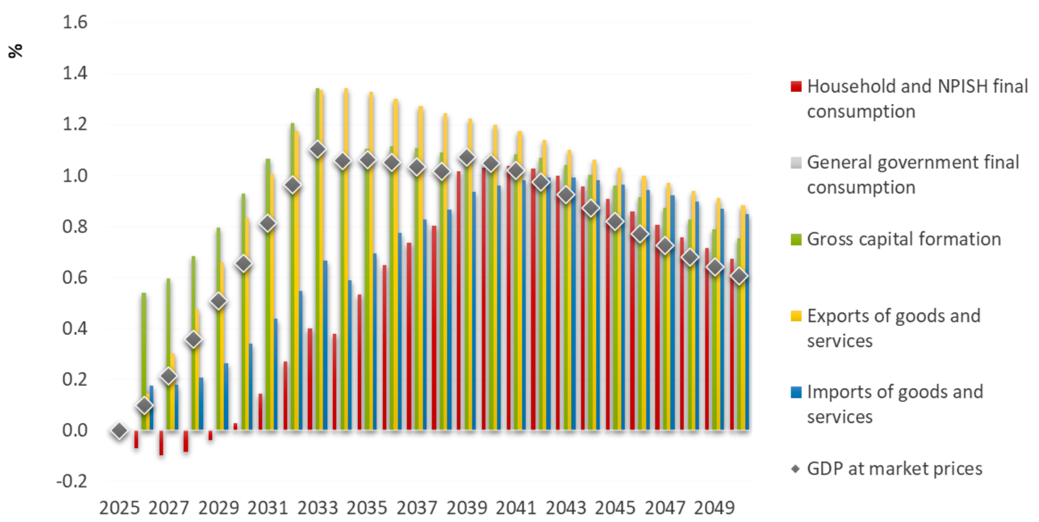
Scenario results

The installation of 2,000 additional watering points stimulates GDP which is up to 1.1% p.a. higher compared to a scenario with climate change but without this adaptation action (Figure 3). In particular, during the implementation period (until 2033), additional investment in herding infrastructure (up to 1.3% p.a.) supports economic growth. Agricultural exports contribute by up to 1.3% p.a. to economic growth, especially after the implementation phase, when the benefits of the additional watering points can be fully exploited.

More income and jobs, not only of herder households, accelerates household consumption by up to 1% per year. However, loan and interest rate repayments reduce consumption opportunities at the beginning of simulation period when the benefits cannot be fully utilized. After 2038, when all loans are paid back, the farmers benefit fully from the adaptation measure.

Due to Mongolia's heavy dependence on imports in particular in manufacturing, investment and private household consumption lead to imports, which rise by up to 1% annually and hamper overall economic growth.

Figure 3. Macroeconomic effects of the "WP" scenario, 2026–2050, deviations from a SSP5-8.5 scenario in percent

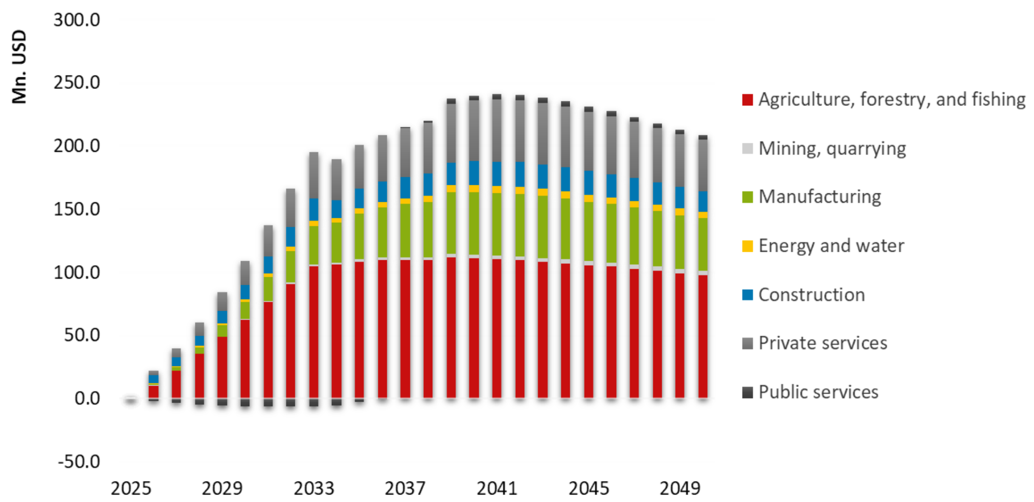


Source: Own illustration based on e3.mn results

As expected, agriculture benefits the most and can increase its output by up to 112 Mn. USD resp. 5.5% p.a. (Figure 4). The installation of watering point requires mainly manufactured products (e.g., machinery, vehicles) but also construction activities which increase production by up to 50 and 18 Mn. USD or 1.5% and 0.74% p.a., respectively. Due to the high import dependency, manufacturing accelerates only to a limited extent. Public services slightly decelerate due to lower government demand because of financial burden from paying back loan interest rates until 2038. The private service sector (incl. financial intermediation) benefits from direct, indirect and income-induced effects resulting to an increase in production of up to 49 Mn. USD or 0.5% per year. Overall, gross production increases by up to 241 Mn. USD resp. 0.7% per year.

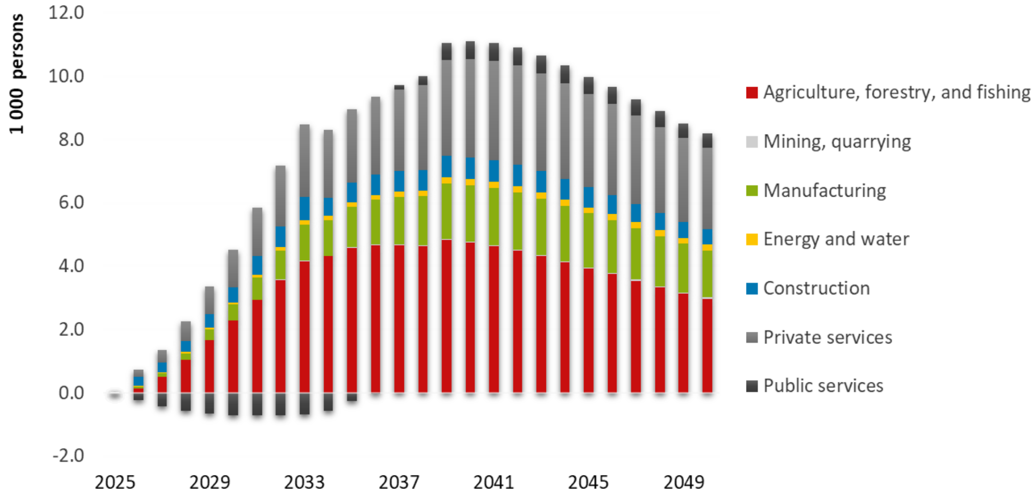
In general, employment by economic activity follows sectoral production considering sector-specific labour intensities. Overall, employment increases by up to 11,100 persons resp. 0.8% per year (Figure 5). Herders who benefit from adaptation are expected to be more productive, i.e., with the same number of herders (and fewer animals), they can increase production measured by the higher weight of the animals or higher milk production. However, employment in agriculture increases the most (up to 4,800 persons resp. 2.2% p.a.) due to indirect and income-induced effects causing greater demand for agricultural products. The economic sectors triggered from initial investment such as manufacturing and construction show limited additional jobs (up to 1,800 persons resp. 1.32% p.a. and 740 persons resp. 0.7% p.a.) due to lower labour intensity or moderate additional domestic production activity. The lower level of economic activity in public services is also reflected to a limited extent in a decline in the number of jobs compared to a situation with climate change and without adaptation (SSP5-8.5 scenario).

Figure 4. Effects of the "WP" scenario on gross production by economic sectors in constant prices, 2026–2050, deviations from the SSP5-8.5 scenario in Mn. USD



Source: Own illustration based on e3.mn results

Figure 5. Effects of the "WP" scenario on employment by economic activities, 2026–2050, deviations from the SSP5-8.5" scenario in 1 000 persons

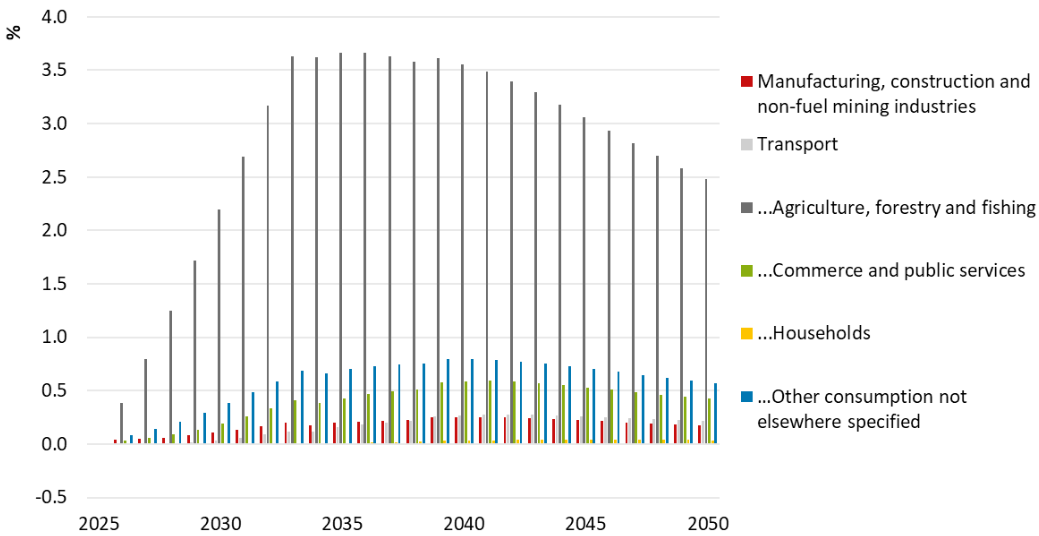


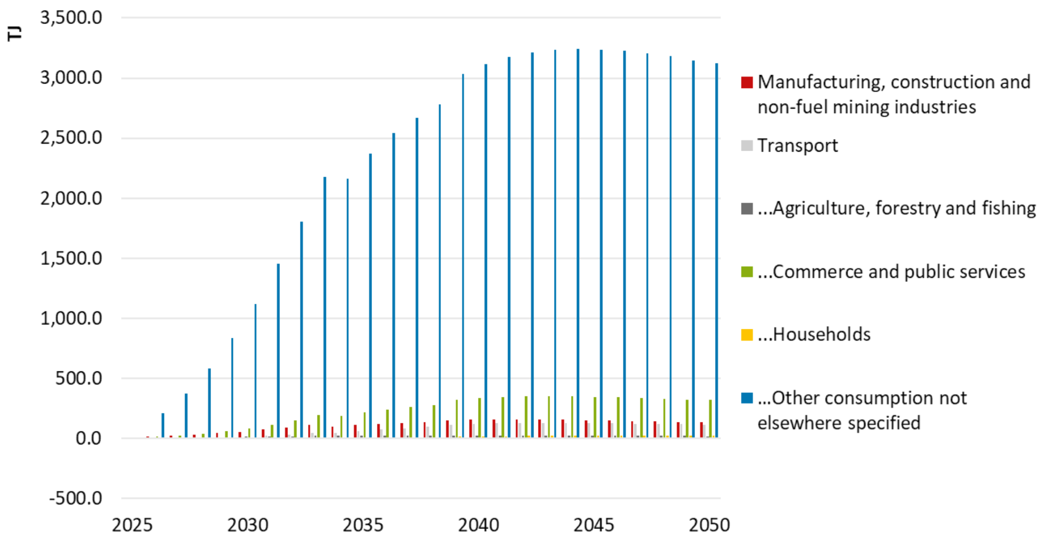
Source: Own illustration based on e3.mn results

Due to the similar employment structure of males and females across economic sectors, overall, both benefit to a similar extent (5,780 resp. 0.7% p.a. and 5,280 resp. 0.8% p.a.). At the level of economic activities differences can be detected: male employment prevails in construction and agriculture while females benefit more from job creation in private and public services.

Economic growth impacts energy demand (Figure 6) which increases by up to 3,750 Terajoule (TJ) resp. 0.5% p.a., with the largest increases in "Other consumption, not elsewhere classified (n.e.c.)" resulting in up to 3,200 TJ resp. 0.75% p.a.), followed by "Commerce and public services", "Manufacturing, construction etc." and transport. Agriculture contributes only to 23 TJ (resp. 3.7% p.a.) out of a total of 3,750 TJ per year.

Figure 6. Effects of the "WP" scenario on FEC by sectors, 2026–2050, deviations from the SSP5-8.5 scenario in percent (top figure) and TJ (bottom figure)



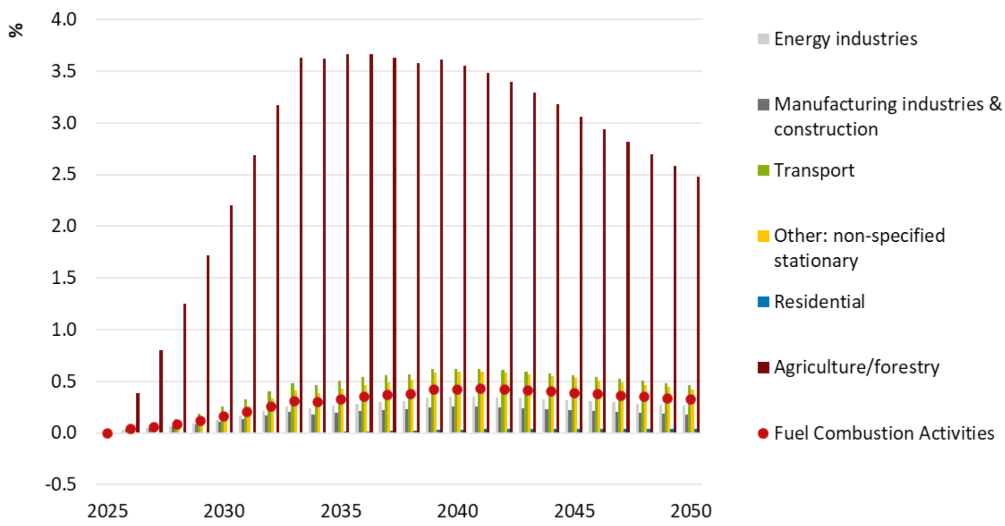


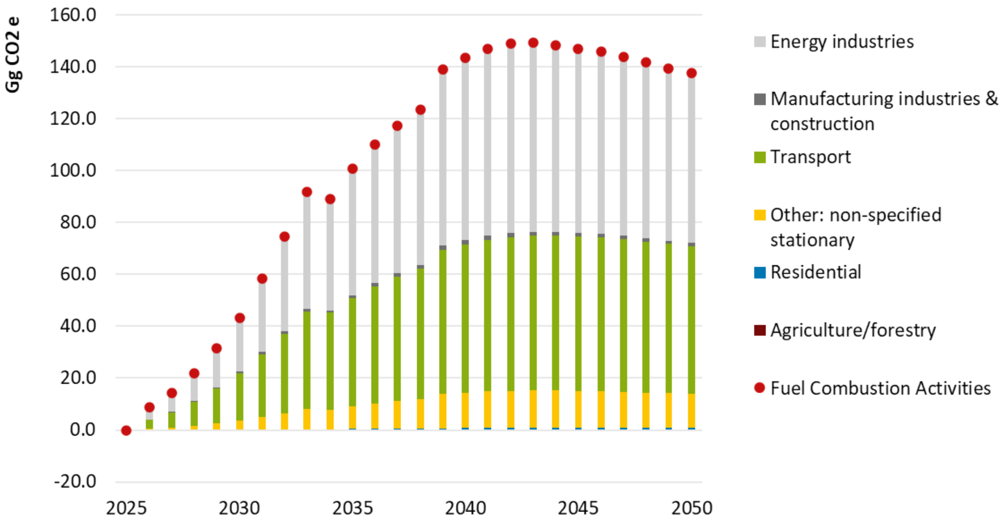
Source: Own illustration based on e3.mn results

Fuel combustion-related greenhouse gas (GHG) emissions follow energy demand of fossil fuels which are the main energy carriers used in Mongolia. Overall, GHG emissions increase by up to 149 Gigagram (Gg) Carbon Dioxide (CO_2) equivalents or 0.4% respectively (Figure 7).

Energy industries and transport are the main contributors to GHG emissions causing 73 Gg CO_2e (0.35% p.a.) and 60 Gg CO_2e (0.6%) per year. Due to comparatively low GHG emission in agriculture, the relative change caused by adaptation measures seems to be high (up to 3.7% p.a.) but in absolute terms is very low (0.23 Gg CO_2e).

Figure 7. Effects of the "WP" scenario on GHG emissions by sectors, 2026-2050, deviations from the SSP5-8.5 scenario in Gg $CO_{2}e$ (top figure) and percent (bottom figure)





Source: Own illustration based on e3.mn results

3.2.2 Investing in sustainable livestock and climate-resilient pasture management

Scenario settings

The settings for the scenario analysing the impact of an improvement of existing pastureland and a reduction of livestock numbers are based on an Asian Development Bank study (Asian Development Bank (ADB) 2021). The adaptation measure contributes to a more climate-resilient livestock farming during more severe and prolonged periods of droughts, heatwaves and dzuds. It evaluates sustainable livestock development in Mongolia through the establishment of around 450 pasture and rangelands user agreements (PUA's) for around 12,000 herders in four aimags covering 20 soums.

The investments comprise expenditures for construction activities (e.g. shelters, wells, fences, winter camps), transport equipment (e.g. trucks), other machinery (e.g. hayfield materials, scales, sorting facilities), plastics (e.g. eartags), computers, professional services (e.g. marketing materials and platforms, geophysical surveys, manuals or information documents) and for animal health. By signing the PUA, herders agree to gradually reduce their livestock numbers by around 20% over a 15 year period and to realize the necessary investment (Asian Development Bank (ADB) 2020, S. 32).

The investment required for the improvement of existing pastureland and a more sustainable number of livestock (Asian Development Bank (ADB) 2021) will be implemented between 2026 to 2031 and amount to a total of 266 Bn. MNT. O&M costs amount to 3.7% of investment and remain until the end of simulation period.

Investments by herder households are financed by "green" loans which have to be paid back within five years whereas loans used for O&M are expected to be repaid within one year. All loans will be fully paid back until 2038. Afterwards remaining O&M costs are paid from higher income. To financially support herders, the loan interest rate is capped at 6% p.a. which means that the government finances approx. 12% of the loan interest rate.

The measure is expected to be beneficial for herders. The higher quality of livestock will increase meat production and outweigh lower livestock numbers and slightly lower income from less fibre production from goats. According to the CBA (ADB 2021) it takes three years until herders can realize the benefits from higher meat production. In total, benefits increase by up to 60 Bn. MNT p.a according to the CBA. However, the gradual reduction of livestock results in lower additional benefits of 35 Bn. MNT from 2040 onwards. Overall, accepting the PUA's and implementing the required investments is beneficial for herders, although they need to reduce livestock numbers.

All costs and benefits as given from the CBA are scaled up by factor three assuming that approx. 36,000 herders sign a PUA agreement instead of 12,000. In order to build on the success of the piloting project ENSURE, it is of high importance to inform herders about the (longer-term) benefits in advance even though the number of their animals will be reduced.

Table 2 summarises the costs and benefits as well as loan repayments.

Table 2: Assumptions on costs, benefits and loan repayments for "Sustainable livestock" scenario (SL)

Costs and benefits	2026	2028	2030	2032	2034	2036	2038	2040	2050
Additional green loans for investments including O&M, p.a. (Bn. MNT)	20.5	68.1	50.3	9.9	9.9	9.9	9.9	9.9	9.9
Interest payments by government, p.a. (Bn. MNT)	5.3	38.4	53.1	30.8	10.1	4.6	5.0	-	-
Interest payments by herder households, p.a. (Bn. MNT)	2.6	19.2	26.6	15.4	5.0	2.3	2.5	-	-
Herder green loan payback plus interest rate payments	13.2	112.9	205.4	204.2	109.2	56.6	62.3	-	-
Increased agricultural production p.a. (Bn. MNT)	0.0	0.0	54.3	58.2	58.5	54.1	46.6	34.7	34.7

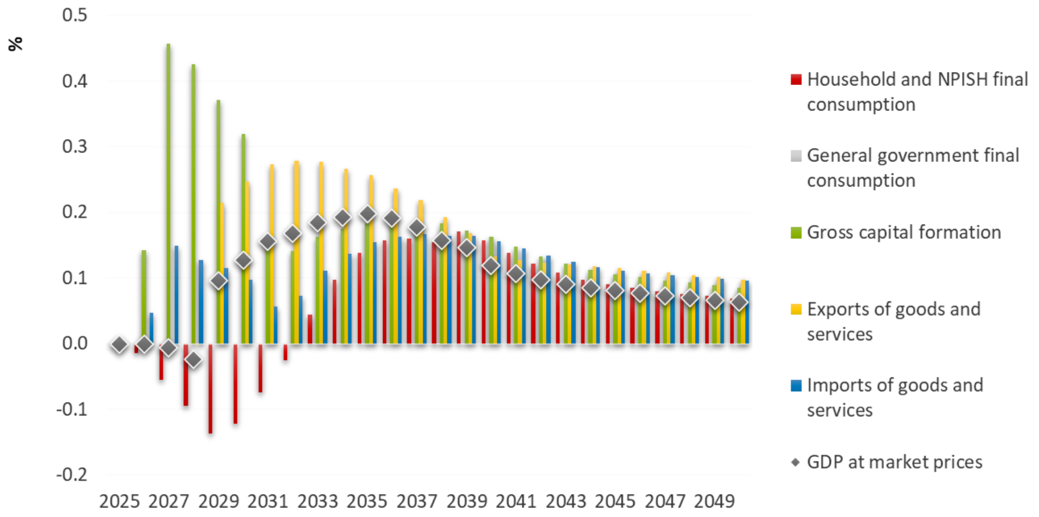
Source: Own calculation based on Asian Development Bank (ADB) (2021). Values are price adjusted. The first row contains investment costs which are are financed with green loans until 2038. Afterwards O&M costs are paid from higher income.

Scenario results

The economy-wide impacts of the "Sustainable livestock and pasture management" scenario are positive once the benefits of the measure are realized (Figure 8). During the implementation period, investment increase by up to 0.46% p.a. compared to a situation with climate change and without this adaptation action ("SSP5-8.5" scenario). Simultaneously imports increase by up to 0.15% p.a. due to the high import-dependency of manufactured products in particular which hampers economic growth. Additionally, a certain share of the loans is paid back which is expected to limit consumption opportunities of herder households.

However, after three years, herder households benefit from increased production resulting in additional export opportunities which accelerates GDP growth. The increased income enables higher consumption levels by up to 0.18% p.a. although loans must be fully paid back until 2038. However, at the beginning of the implementation period, the burden from loan payback outweighs the benefits leading to decelerated household consumption expenditures. Overall, real GDP increases by up to 0.2% and 100 Bn. MNT, respectively.

Figure 8. Macroeconomic effects of the "SL" scenario, 2026–2050, deviations from a SSP5-8.5 scenario in percent

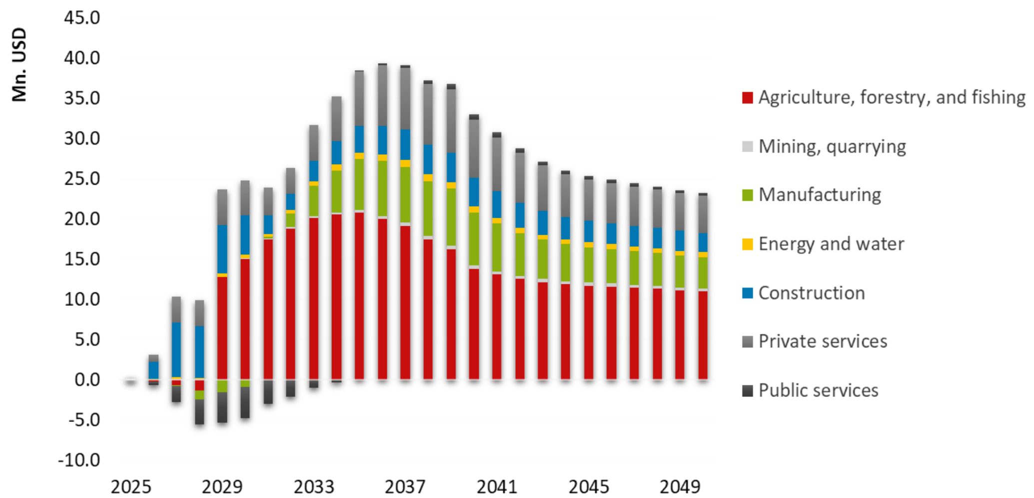


Source: Own illustration based on e3.mn results

Gross production by economic sectors is driven by the investment needs and the benefits for the herder households. Once the benefits can be realized, agriculture shows the greatest increase of gross production by up to 21 Mn. USD resp. 1.1% p.a. (Figure 9). Over time, additional output in agriculture is lower due to the gradual reduction of livestock numbers.

Manufacturing (up to 7 Mn. USD resp. 0.2% p.a.) and construction (up to 7 Mn. USD resp. 0.3% p.a.) increase their economic activity to a limited extent depending on the import-dependency of the respective economic sector and the initial investment stimulus. The negative impact of lower government expenditures for public administration is visible in decelerated gross production in public services until 2033. Afterwards, higher revenues due to economic growth allows for additional government expenditures although the payback period lasts until 2038.

Figure 9. Effects of the "SL" scenario on gross production by economic sectors in constant prices, 2026–2050, deviations from the SSP5-8.5 scenario in Mn. USD

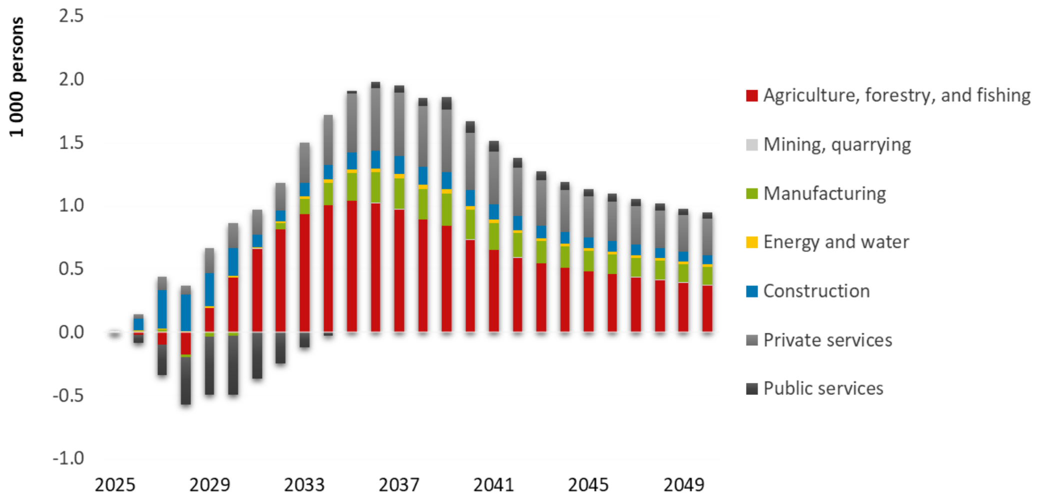


Source: Own illustration based on e3.mn results

Apart from the direct and indirect impacts of the adaptation measure, income-induced effects are beneficial for many sectors, amongst them the private services sector with an increase of production by up to 7.8 Mn USD resp. 0.1% p.a.).

Employment by economic activity follows sectoral gross production. The greater the economic activity and labour intensity the more jobs are created. During the implementation period, workers in construction profit the most (up to 300 persons resp. 0.3% p.a.). As long as economic activity decelerates, for example, in public services, employment is also lower compared to a situation with climate change and without adaptation ("SSP5-8.5" scenario). In agriculture, most of the jobs (up to 1,000 persons resp. 0.45% p.a.) are created although the herder households benefitting from the measure are more productive (Figure 10). However, due to indirect and income-induced effects, also other farmers are experiencing greater demand and thus employment increases. Overall, employment increases by up to 2,000 or 0.14% per year.

Figure 10. Effects of the "SL" scenario on employment by economic activities, 2026–2050, deviations from the SSP5-8.5" scenario in 1 000 persons

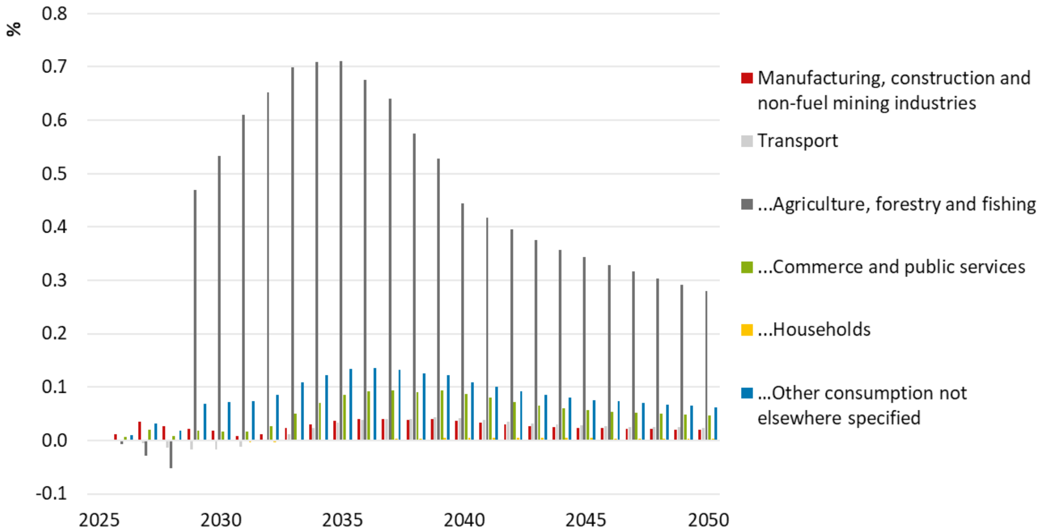


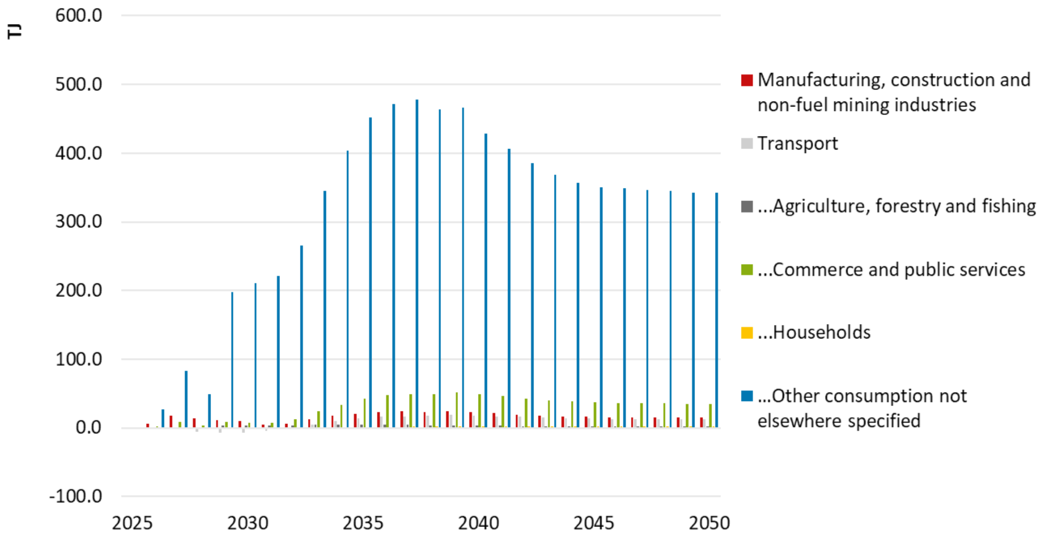
Source: Own illustration based on e3.mn results

Overall, males and females are largely affected equally: Female employment increases by up to 920 persons resp. 0.15% p.a., while male employment increases by up to 1,060 resp. 0.14% p.a.. The greatest differences can be observed in construction where males dominate and contrary in private services.

The accelerated production activity also leads to higher energy demand (Figure 11). Total final energy consumption increases by up to 574 TJ resp. 0.1% per year with the highest increase in "Other consumption, n.e.c." (up to 478 TJ resp. 0.14% p.a.), followed by "Commerce and public services" (up to 50 TJ resp. 0.1% p.a.), and "Manufacturing, construction etc" (up to 25 TJ resp. 0.04% p.a.),. Agriculture contributes only to 4.5 TJ (resp. 0.7% p.a.) out of a total of 574 TJ per year.

Figure 11. Effects of the "SL" scenario on final energy consumption by sectors, 2026–2050, deviations from the SSP5-8.5 scenario in percent (top figure) and TJ (bottom figure)





Source: Own illustration based on e3.mn results

The fuel-combustion related GHG emissions increase the most in energy industries (11 Gg CO_2e resp. 0.05% p.a.) and transport (8.7 Gg CO_2e resp. 0.1% p.a.). Both sectors mainly use fossil fuels. Overall, GHG emissions increase by up to 22 Gg CO_2e resp. 0.07% per year.

Although not covered by the model, it can be expected that GHG emissions of the agriculture, forestry and other land use (AFOLU) sector decelerate due to the reduction in livestock numbers.

3.3 Green-loan financed mitigation in the energy and residential sectors

Mongolia submitted its Nationally Determined Contribution (NDC) update (NDC 3.0) in September 2025, committing to a GHG reduction compared to the Business As Usual (BAU) scenario of 23.0% by 2030 and 30.3% by 2035, and up to 52.8% by 2035 conditional on international support and with forest sequestration (UNFCCC 2025). The energy sector is expected to make the largest contribution. On the production side, increased use of renewable energies (hydro, wind, and solar plants, and heat pumps) and improved energy production efficiency are planned. On the consumption side, energy savings by improved energy efficiency are planned in the transport, construction (buildings), and industry sector. Various sources indicate that the energy sector in Mongolia should be reformed in order to finance the necessary conversion and expansion and to reduce GHG emissions (World Bank 2024). For example, the Asian Development Bank is supporting efforts to reform the energy sector in Mongolia in 2025.

As described in GIZ (2024), energy production in Mongolia faces major challenges: "The generation of electricity and heat in Mongolia is currently facing structural problems with a centralized and outdated system. The production costs are currently higher than the state-fixed prices for private companies and households. From a technical point of view, a high share of combined electricity and heat production makes the system unflexible and causes unnecessary and expensive losses. At the same time, the system of state-owned plants is outdated, meaning that reforms are needed to be able to supply a growing population and economy with enough electricity and heat in the future. Market liberalization will be necessary to attract finance and to induce investment. In addition, there is the necessity to replace the domestically available coal with renewable energies in the future in order to reduce GHG emissions and to significantly increase energy efficiency overall. Furthermore, energy generation from coal causes high air pollution, which leads to health problems. According to studies by the International Energy Agency (IEA 2024) and the International Renewable Energy Agency (IRENA 2024), renewable energies are already the cheapest (new) sources of electricity generation in many parts of the world. In the next few years, the costs of photovoltaics in particular are likely to fall further with a massive expansion, especially in China, so that this energy source will soon be the cheapest worldwide."

To this end, the following section considers a scenario in which, an electricity price reform in conjunction with a carbon tax according to GIZ (2024) and higher green loans create the conditions for increased investment in the energy sector.

On the consumption side, the analysis focuses on the building sector (construction). Two measures to increase the energy efficiency of buildings are considered: firstly, the renovation of panel apartments, which leads to a significant reduction in energy consumption, and secondly, an improvement in energy efficiency in Ger houses, both of which are subsidized with green loans. The quantification is based on the RePaRe and GERES projects and information from the Mongolian Green Finance Corporation. Essentially, the aim is to improve the insulation of buildings through efficiency measures, thereby reducing energy consumption. As the necessary investments are high, the measures are supported by green loans and additional funding in the form of grants.

The GIZ-RePaRe project foresees the implementation of the thermo-technical retrofitting of the panel building blocks. In the current phase, the project is planning to retrofit 200 panel building blocks (out of 1,077 blocks) in between 2022-2027. The current financial scheme is 25 percent of the investment cost should by paid by a resident of the apartment and 75 percent shared by GIZ project.

The Geres project supports the implementation of the retrofitting individual houses in "Ger districts" in the capital city. The project "Switch-off Air Pollution in Mongolia's Cities (SOAP) › GRANTS PROGRAMME | SWITCH-Asia-" (2018-2022) implemented by Geres Mongolia NGO (Who we are - Geres), supported by the European Union, aims at offering affordable building retrofit solutions to households living in Ger districts of Ulaanbaatar in Mongolia by focusing on insulation, heating and cooking efficiency (Geres 2023).

The project involves insulating houses, educating homeowners, training construction brigades, and developing a sustainable insulation market. Under the project support, 1,546 households implemented energy efficient solutions, 73 construction brigades were trained, and 3,556 CO_2 emissions were avoided. The second phase of the project launched in 2022 and will continue until 2026. The average size of the individual house is 60 m2 and there are 124,000 houses built in the capital city, according to a study conducted by the Municipality office. The project is providing access to green loans, specifically offered by Xac Bank (commercial bank), to help households afford the necessary renovations. A survey from 2023 concludes that the financial capacity of households living in Ger houses is often poor and that they will need specific support for efficiency measures (ERI 2023).

The following section briefly describes how the three mitigation measures were implemented in the e3.mn model. The relevant assumptions are explained. The macroeconomic results and the effects on energy consumption and GHG emissions are then presented. The measures in the residential sector will also contribute to adaptation in the long term, because well-insulated buildings will also support adaptation to climate change in summer, that will become hotter in the future due to climate change.

3.3.1 Electricity sector: liberalization and energy transition

Scenario settings

New developments that have already been implemented and are included in the baseline scenario are of interest for this measure: The electricity tariffs have been increased in Mongolia since November 15, 2024. According to the Energy Regulatory Commission the average electricity tariff is raised from MNT 216 per kWh to MNT 280. A three-tier tariff based on consumption is also introduced. Previously, there were two tariffs for electricity, daytime and nighttime, a new evening “Peak Hour Tariff” is being introduced. The nighttime electricity discount for households in Ger districts is continuing to apply. The average household tariff was previously MNT 140, but under the revised tariff, consumption up to the first 150 kWh in a month will be charged at MNT 175, consumption between 150-300 kWh at MNT 256, while consumption exceeding 300 kWh will be MNT 280.

In the first quarter of 2025, green loans totalling MNT 95 Bn. were granted in Mongolia in the field of renewable energy for electricity generation. In our scenario, we assume that these green loans will triple to MNT 285 Bn. by 2030, leading to additional investments in renewable energies of USD 50 Mn. in that year.

We also refer to a carbon tax scenario that we calculated in 2024 to model the green transition. This scenario introduces a carbon tax that increases linearly, reaching USD 12/t CO2 in 2030. Fifty percent of the revenue will be recycled to private households. The other half will be allocated to industry: 25% each to additional investments in wind power and PV systems and 50% to additional heat pumps to increase the efficiency of energy production. As in the 2024 model analysis, a price elasticity of -0.2 is assumed. This means that if energy prices rise by 30%, energy demand is assumed to fall by 6%. As liberalisation and carbon tax will both burden electricity consumers, the liberalization of the electricity market and the introduction of the carbon tax take place one after the other. The carbon tax will only be introduced in 2031 in order to spread the burden on electricity consumers over time.

To reflect additional electricity price increases that are necessary to make investments in new plants and more efficient grids worthwhile, electricity prices are increased by an additional 30% by 2030 compared to the baseline scenario, to mirror price liberalization.

Table 3: Assumptions for "Liberalization and energy transition" scenario (EL_DEL)

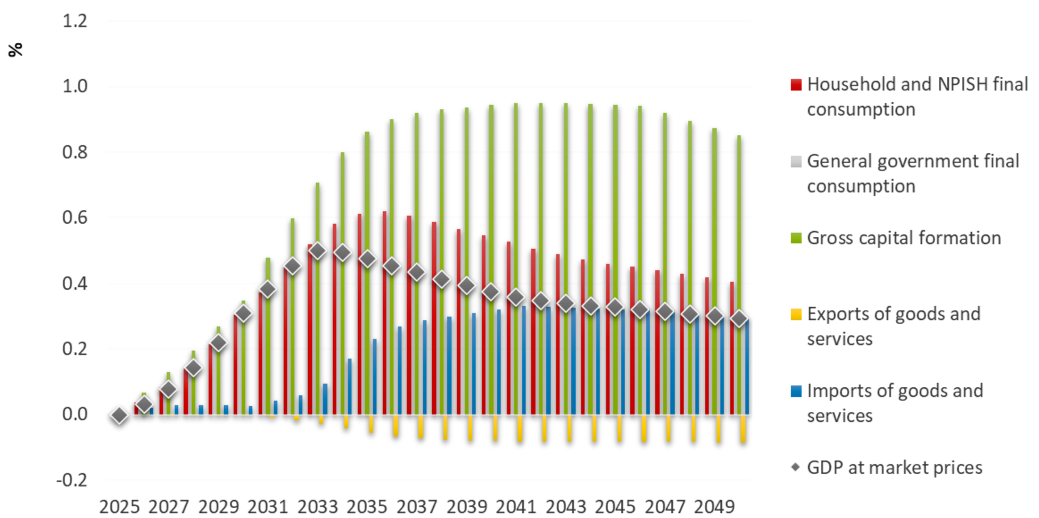
Assumptions	2026	2028	2030	2032	2034	2036	2038	2040	2050
Electricity price increase in % against ref	6.0	18.1	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Additional green loans for renewable energy in bn MNT	39	117	190	190	190	190	190	190	190
Investment in renewable energy (wind, PV) in mn USD against ref	10.0	30.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Carbon tax in USD/t	0	0	0	4.2	8.7	13.2	17.6	22.1	35.5

Source: Calculation based on own assumptions and GIZ (2024)

Scenario results

The overall economic results are strongly driven by the assumption that electricity price liberalization and green loans will lead to additional investment in the energy sector. As a result, annual investment is up to almost 1.0% higher than in the baseline scenario. However, private household consumption may also increase by up to 0.7% annually. Higher economic output also leads to an increase in imports, partly because many capital goods come from abroad. Higher domestic prices, on the other hand, reduce price competitiveness vis-à-vis other countries, leading to slightly lower exports. Compared to the baseline, GDP is 0.5% higher at its peak (Figure 12). It is important to note, that assumptions in Table 3 and the results are reported as deviations in absolute or percentage terms against the reference scenario SSP5-8.5 without the assumptions of electricity market liberalization and introduction of a carbon tax plus revenue recycling

Figure 12. Macroeconomic effects of the "Liberalization and energy transition" scenario, 2026–2050, deviations from the SSP5-8.5 scenario in percent

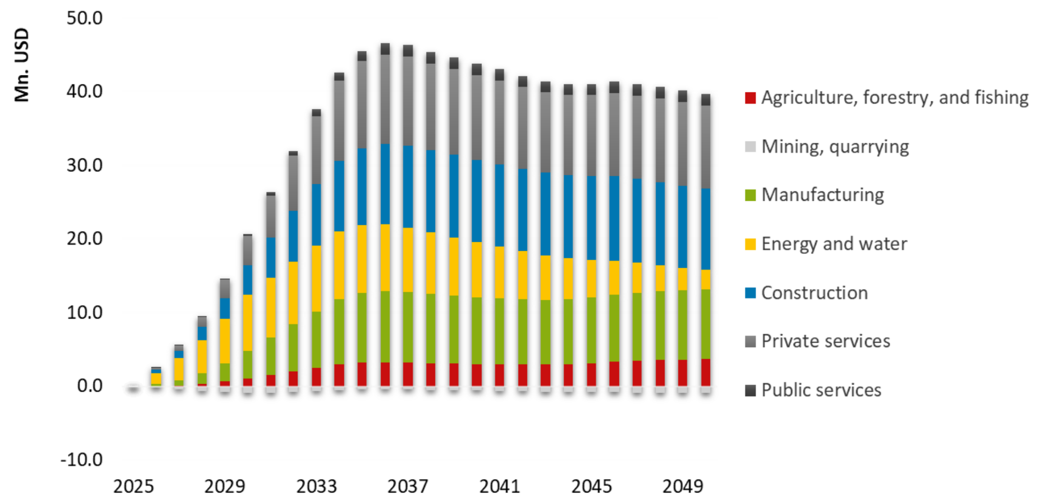


Source: Own illustration based on e3.mn results

At the sectoral level, Figure 13 shows that, with the exception of mining and quarrying, output is increasing significantly, with particularly strong effects in manufacturing, construction, and private services. In the energy sector, the increase is significant until 2035 with 9.2 Mn. USD, but then declines, partly because the scenario does not assume any further changes to the baseline after that point.

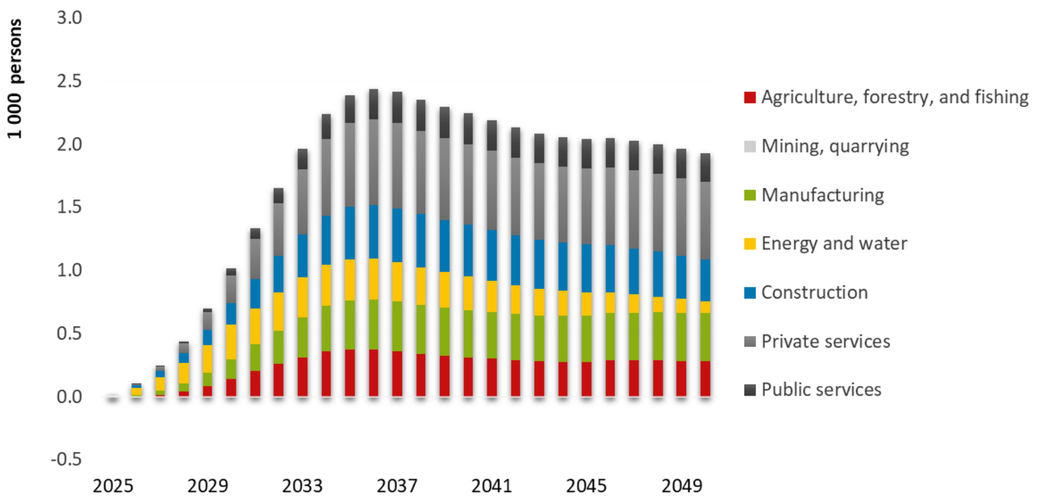
The production effects are also reflected in a similar sectoral distribution in employment (Figure 14). Clearly positive employment effects are evident in 2030 in agriculture, manufacturing, the energy sector, construction, and private services. However, the effect in public services is also noticeable. There are minimal negative employment effects in mining because less fossil energy needs to be extracted.

Figure 13. Effects of the Liberalization and energy transition" scenario on gross production by economic sectors in constant prices, 2026–2050, deviations from the SSP5-8.5 scenario in Mn. USD



Source: Own illustration based on e3.mn results

Figure 14. Effects of the "Liberalization and energy transition" scenario on employment by economic activities, 2026–2050, deviations from the SSP5-8.5" scenario in 1 000 persons

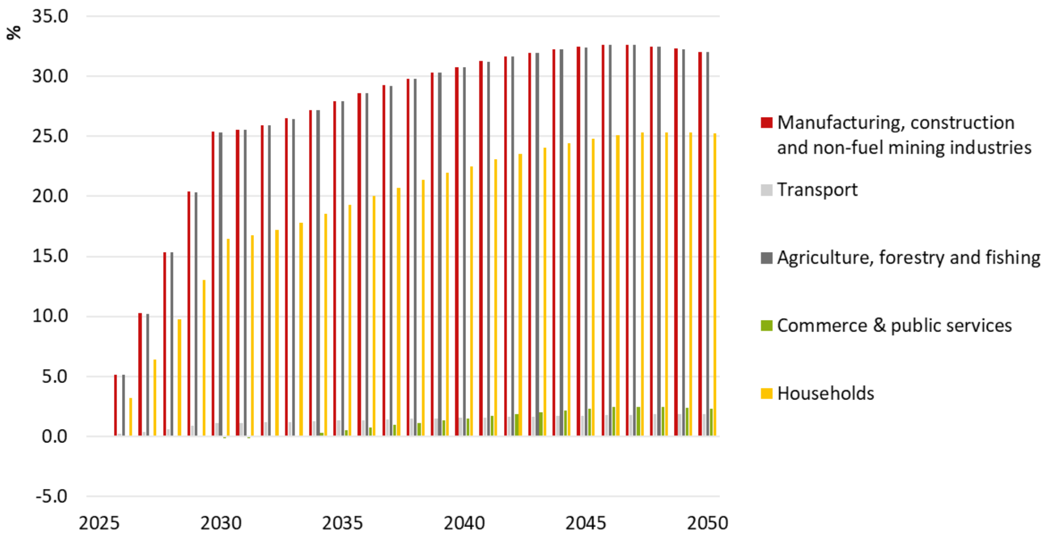


Source: Own illustration based on e3.mn results

Since men and women are employed to varying degrees in the individual sectors, assuming unchanged gender ratios in the individual sectors results in differing absolute effects. While the effects in agriculture and manufacturing are similarly high, more men are employed in the energy and construction sectors. In the service sector, the proportion of women is above average, but the overall effect is low, especially in public services. Overall, this means that employment among men increases significantly more than among women.

Energy prices increase in all sectors. The increase in energy prices is particularly high in the manufacturing and agriculture sectors with 25% in 2030 and even beyond 40% from 2040 onwards. The increase up to 2030 stems from liberalization, whereas the increase after 2031 is due to the carbon tax. The price increase for private households is somewhat lower. For transport and commerce, the increase is limited to less than 2% and less than 3%, respectively, because oil is predominantly used, which is not becoming more expensive (Figure 15).

Figure 15. Effects of the "Liberalization and energy transition" scenario on energy prices by sectors, 2026–2050, deviations from the SSP5-8.5 scenario in percent



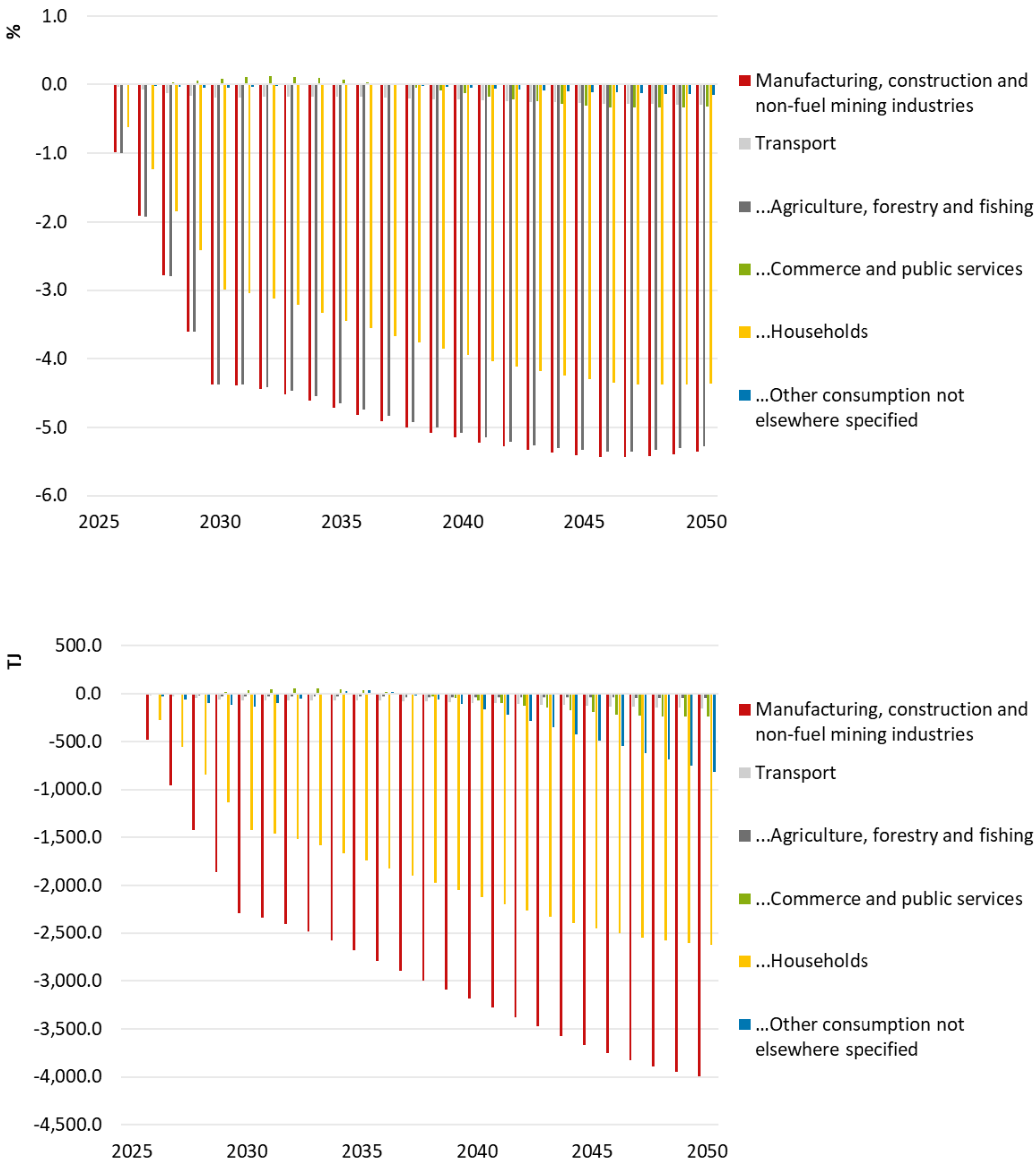
Source: Own illustration based on e3.mn results

Higher electricity prices are likely to reduce inefficient electricity use across economic sectors and households, thereby strengthening incentives for energy savings.

In the manufacturing sector, firms producing higher-quality goods may adjust product prices in response to rising energy costs, meaning their energy consumption may not decline significantly. In contrast, firms producing lower-quality goods may be less able to adjust prices and therefore reduce energy consumption more sharply.

Since electricity (and heat) are used to varying degrees in different sectors, there are also significant differences. Energy consumption is falling significantly in manufacturing, agriculture, and private households. With energy prices rising by around 25% to 30%, the declines are in the order of -5% given the assumed energy price elasticity of -0.2. In contrast, the transport and trade sectors, among others, are hardly affected. Overall, final energy consumption is around 1% lower than the baseline (Figure 16).

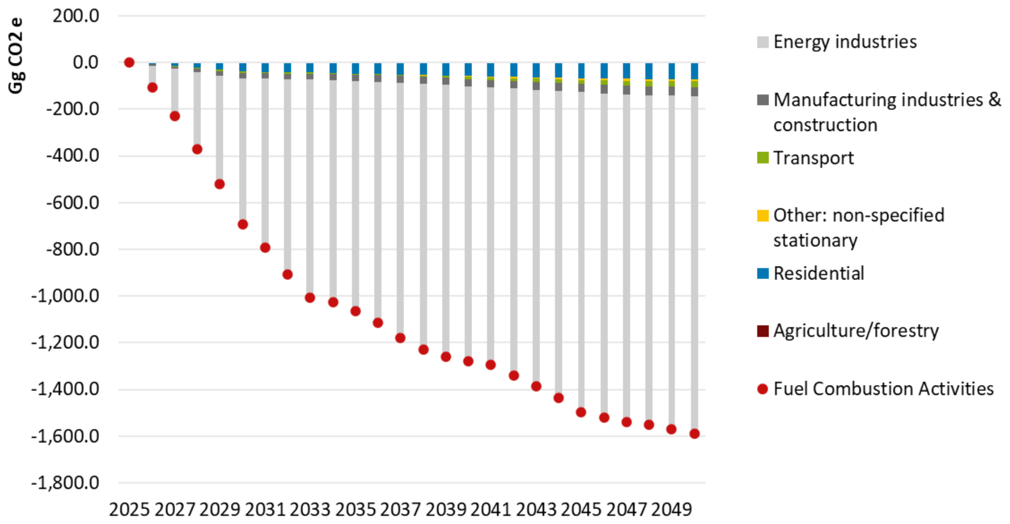
Figure 16. Effects of the "Liberalization and energy transition" scenario on FEC by sectors, 2026–2050, deviations from the SSP5-8.5 scenario in percent (top figure) and TJ (bottom figure)

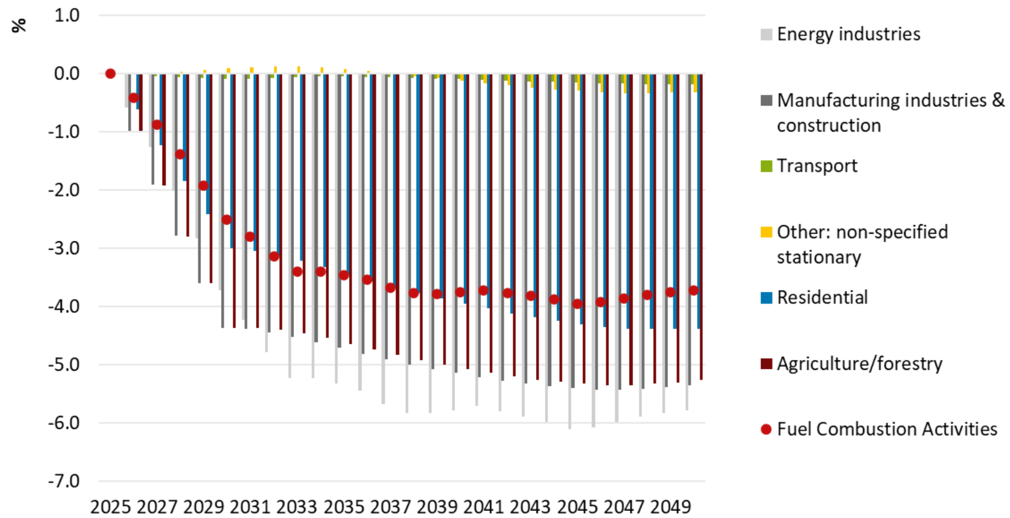


Source: Own illustration based on e3.mn results

Lower energy consumption is also associated with lower GHG emissions. Because energy consumption for electricity generation, which is primarily based on coal, is declining more sharply than final energy demand, the decline in GHG emissions is significantly greater than the effect on final energy demand. Overall, GHG emissions will be around 1.1 Megaton (Mt) lower than the baseline in 2030, and by 2050 the difference could grow to 1.6 Mt. This corresponds to about 4% of Mongolia's total GHG emissions in the baseline. The percentage decrease in emissions is therefore significantly greater than the decrease in energy consumption because coal-intensive power generation is being reduced in particular and is being partially replaced by renewable energies. Most of the savings will be in the energy industry due to the increase in renewables and savings in electricity and heat demand, but there will also be visible effects in the residential sector and manufacturing (Figure 17). A look at the development over time shows that liberalization has a greater impact until 2030, while the carbon tax staring in 2031 has less of an effect and the percentage difference increases only slightly after 2033.

Figure 17. Effects of the "Liberalization and energy transition" scenario on GHG emissions by sectors, 2026-2050, deviations from the SSP5-8.5 scenario in Gg $CO_{2}e$ (top figure) and percent (bottom figure)





Source: Own illustration based on e3.mn results

3.3.2 Energy efficiency in buildings, panel apartments

Scenario settings

The scenario is based on experiences and key figures from the above-mentioned RePaRe project of GIZ in Mongolia. In the current project phase, 200 apartment buildings are to be renovated between 2022 and 2027 with an investment of 25 Mn. euros. According to first experiences from this RePaRe phase, the following cost for retrofitting have been assumed: 245,000,000 MNT for 5-storey (8.5 mio per HH), 396,000,000MNT for 9-storey (11 mio. per HH) and 594,000,000MNT for 12-storey (12.4 mio. per HH). Exact values would need to be calculated based on actual square meter of the different apartment types (1 room, 2 room etc.). For the energy savings potential initial measurements during a relatively warm winter indicate the following: 5-Storey: 114,000kWh saving per block per year, 9-storey: 171,000kWh saving per block per year. 12-storey: 236,461kWh saving per year. Average values based on this were then used to determine the scenario.

The scenario assumes that corresponding investments of USD 30 Mn. will be made between 2026 and 2030. For financing purposes, it is assumed that 50% will be provided by households via green loans with particularly favorable financing terms of interest rates of 8% for 4 years. This assumption is based on information provided by GIZ RePaRe project and illustrated by own assumption discussed with the project local advisor. The idea behind this is that they will also benefit economically from the insulation of the buildings and see their energy costs fall.

This means that private households are bearing 50% of the total investment costs. A further 30% of the financing will be provided by the government in the form of subsidies, and 20% of the financing will come from international financial sources.

In addition to payments for green loans, which are recorded as expenditure on real estate services in the model, households must also pay interest to the financial sector, which is recorded as financial services, amounting to 2.6 bn MNT in 2030. Due to declining energy consumption, they will have to spend less on energy, which will amount to 0.7% after all buildings have been retrofitted.

Table 4: Assumptions for "Energy efficiency in buildings, panel apartments" scenario (EFFA)

Assumptions in bn MT against baseline	2026	2028	2030	2032	2034	2036	2038	2040	2050
Additional investment in insulation/construction	21.0	21.0	21.0	0	0	0	0	0	0
Support for private households from government and international finance	10.5	10.5	10.5	0	0	0	0	0	0
Higher spending of pr. households for real estate services via green loans	10.5	10.5	10.5	0	0	0	0	0	0
Higher spending of pr. households for financial services	0.6	1.8	2.6	1.2	0	0	0	0	0
Lower spending of pr. households for energy	0.0	0.3	0.5	0.7	0.7	0.7	0.7	0.7	0.7

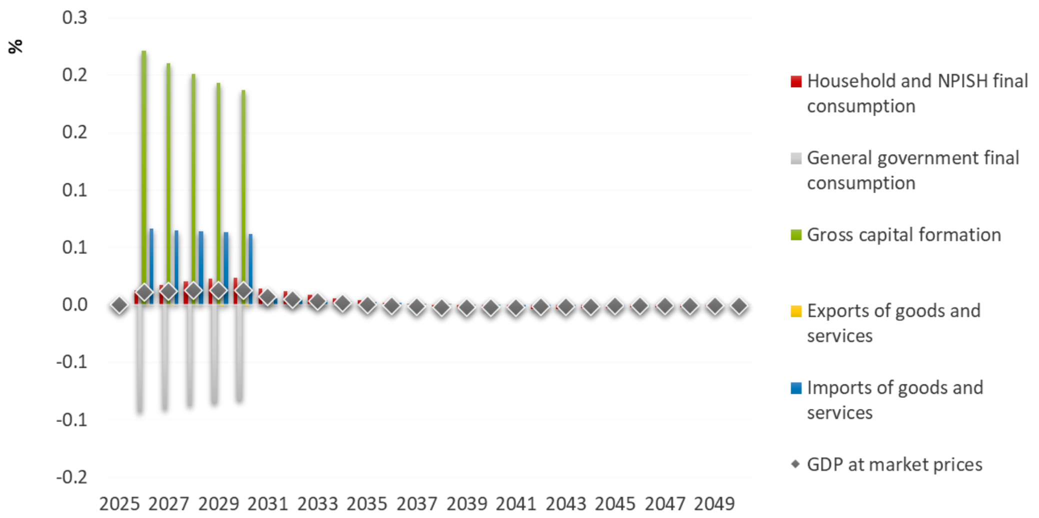
Own calculation based on RePaRe project and own assumptions

Scenario results

Energy efficiency measures in panel apartments amounting to about 6 mn. USD or 21 bn MNT will initially lead to additional investment in the building envelope in particular. In macroeconomic terms, this is the decisive stimulus that will also lead to a slightly higher GDP and higher imports for capital goods.

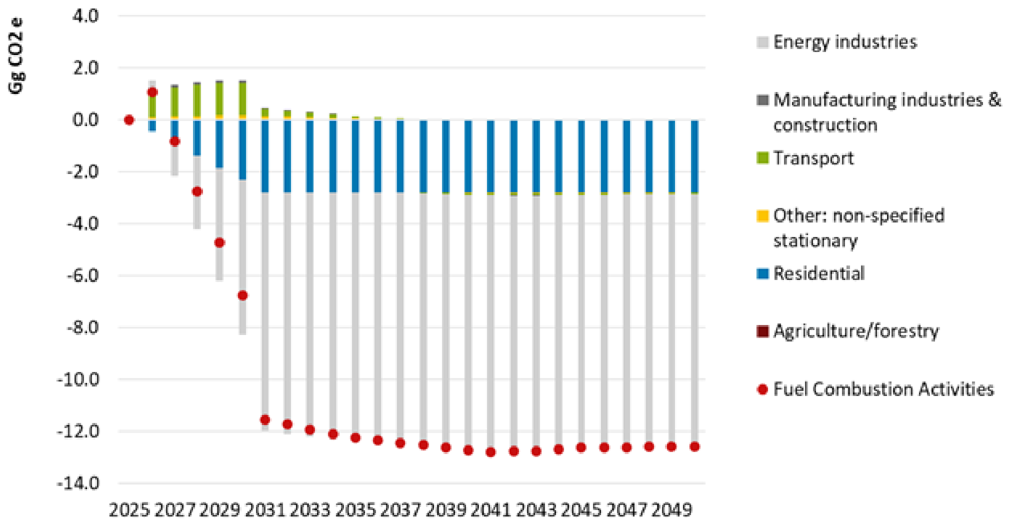
Public consumption is reduced by the subsidies for building renovation. Other components of GDP are hardly affected. The reason for this is that it mainly leads to shifts in the expenditure structure of private households, and the long-term energy savings remain limited at 0.7 bn. MNT.

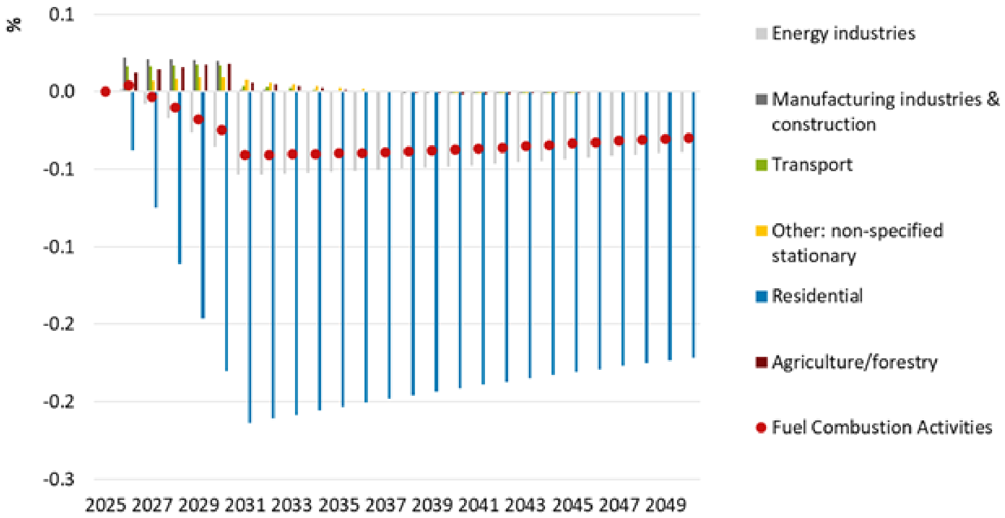
Figure 18. Macroeconomic effects of the "Energy efficiency in panel apartments" scenario, 2026–2050, deviations from a SSP5-8.5 scenario in percent



Source: Own illustration based on e3.mn results

Figure 19. Effects of the "Energy efficiency in panel apartments" scenario on GHG emissions by sectors, 2026-2050, deviations from the SSP5-8.5 scenario in Gg CO_2e (top figure) and percent (bottom figure)





Source: Own illustration based on e3.mn results

Accordingly, the effects on energy consumption and GHG emissions remain limited. GHG emissions, particularly in the residential sector and the energy industry, are reduced by 12 kt compared to the baseline, which corresponds to around 0.1% of total GHG emissions.

In summary, it can be said that energy efficiency measures are already having positive economic effects in a small proportion of the panel apartments, and energy consumption and emissions are declining. As the program only covers a small proportion of panel apartments in Mongolia, the effect remains limited. However, the simulation shows the fundamental potential if corresponding measures are extended to the entire stock of panel buildings. Then much bigger effects could be possible. Of course, financing must be provided for this.

3.3.3 Energy efficiency in buildings, ger houses

Scenario settings

The scenario is based on experiences and key figures from the above-mentioned Geres project in Mongolia. In the current project phase from 2022 to 2026, the aim is to reach 5900 households directly and 1000 households receive green loans (Geres 2023). Again, all assumptions are relative to the reference scenario. According to first experiences, 1546 households got insulation and 3556 t of CO_2 were avoided in the first project phase until 2022. In the next phase until 2026 1000 households have been scheduled to receive a green loan.

In addition to payments for green loans, which are recorded as expenditure on real estate services in the model, households must also pay interest to the financial sector, which is recorded as financial services, amounting to 1.7 bn MNT in 2030. Due to declining energy consumption, they will have to spend less on energy, which will amount to 0.9% after all buildings have been retrofitted.

Table 5: Assumptions for "Energy efficiency in buildings, ger houses" scenario (EFFB)

Assumptions in bn. MNT against baseline	2026	2028	2030	2032	2034	2036	2038	2040	2050
Additional investment in insulation/construction	18.0	18,0	18.0	0	0	0	0	0	0
Support for private households from government and international finance	13,5	13.5	13.5	0	0	0	0	0	0

Assumptions in bn. MNT against baseline	2026	2028	2030	2032	2034	2036	2038	2040	2050
Higher spending of pr. households for real estate services via green loans	0.5	1.0	1.7	1.7	1.7	0	0	0	0
Higher spending of pr. households for financial services	0.3	0.8	1.1	0.5	0	0	0	0	0
Lower spending of pr. households for energy	0.0	0.3	0.5	0.7	0.9	0.9	0.9	0.9	0.9

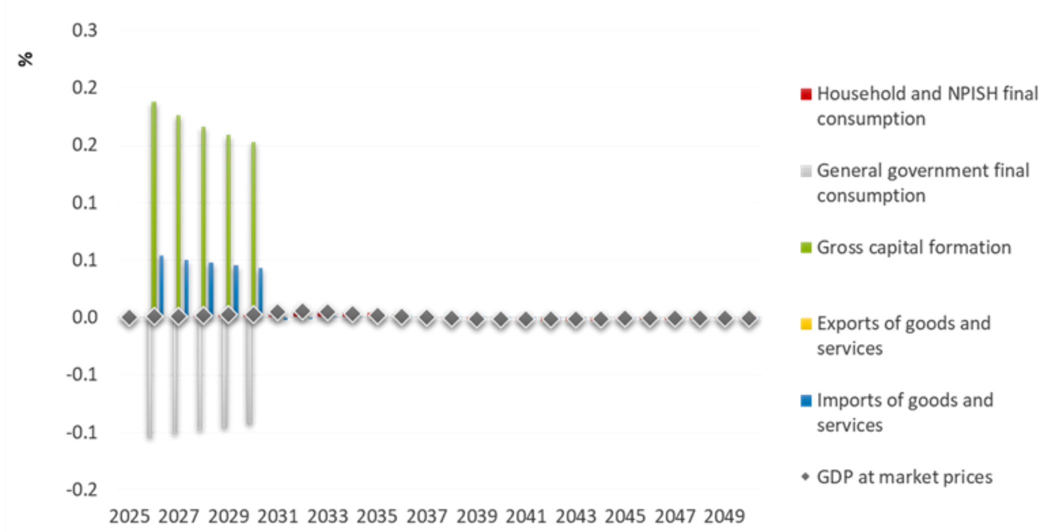
Source: Own calculation based on Geres project and own assumptions

The scenario assumes that corresponding investments of USD 50 Mn. will be made between 2026 and 2030. For financing purposes, it is assumed that 25% will be provided by households via green loans with particularly favourable financing terms of interest rates of 8% for 4 years. The assumption is based on information of Mongolia Green Finance Corporation (ToC 2018) that USD 50 million funding is approved and illustrated by own assumption discussed with the project local advisor. A further 40% of the financing will be provided by the government in the form of subsidies, and 35% of the financing will come from international financial sources. Due to the lower average income of residents of ger houses compared to residents of panel apartments, higher subsidies are required.

Scenario results

Annual energy efficiency measures in Ger houses of 5 mn. USD or 18 bn MNT over 5 years will initially lead to additional investment in the building envelope in particular. In macroeconomic terms, this is the reason that will also lead to a slightly higher GDP and higher imports for capital goods. Public consumption is reduced by the support for private households for building renovation. Other components of GDP are hardly affected. The reason for this is that it mainly leads to shifts in the expenditure structure of private households and not in the total, and the long-term energy savings remain limited at 0.9 bn. MNT.

Figure 20. Macroeconomic effects of the "Energy efficiency in Ger houses" scenario, 2026–2050, deviations from a SSP5-8.5 scenario in percent

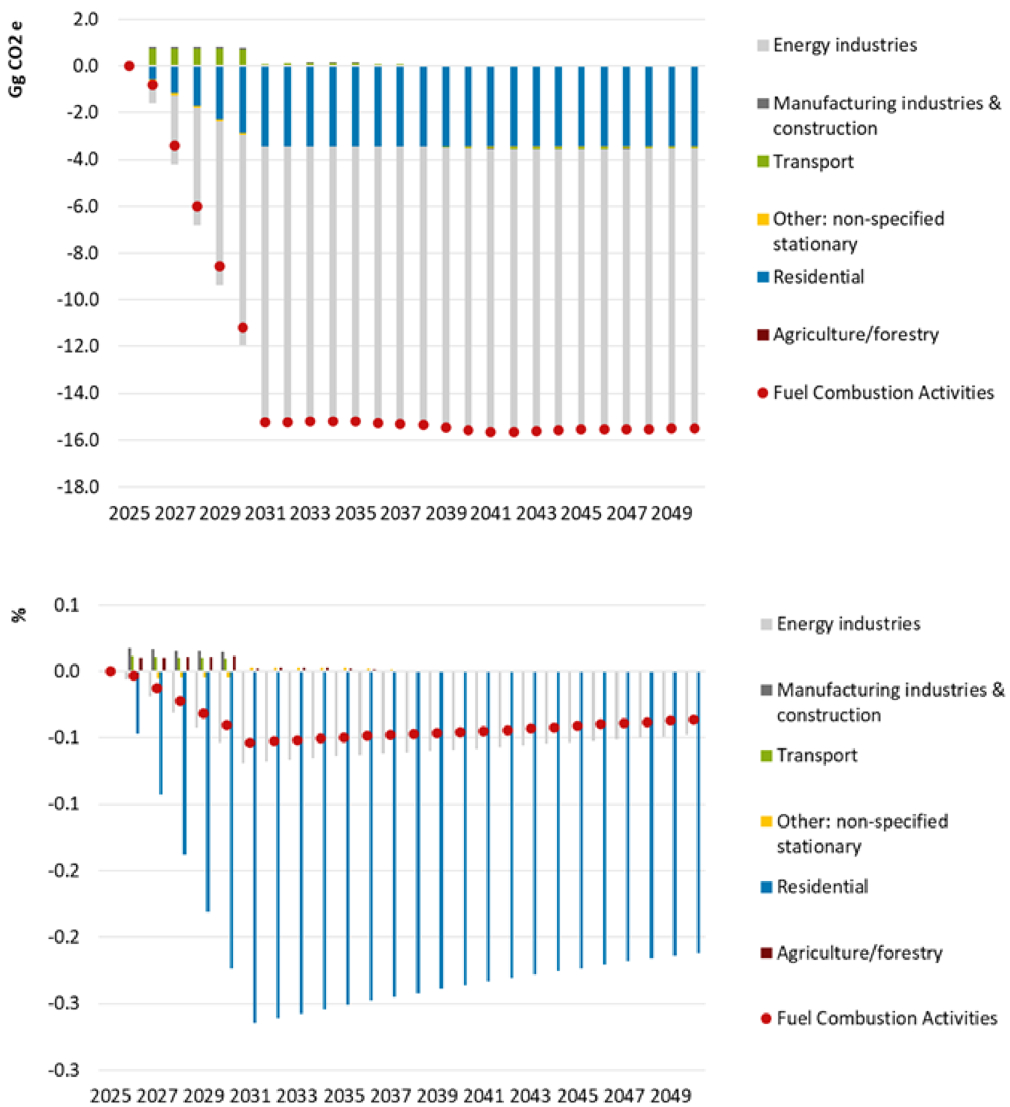


Source: Own illustration based on e3.mn results

Accordingly, the effects on energy consumption and GHG emissions remain limited, as in the example for panel apartments. GHG emissions, particularly in the residential sector and energy industry, are reduced by almost 16 kt compared to the baseline, which corresponds to around 0.1% of total GHG emissions.

In summary, it can be said that energy efficiency measures are already having positive economic effects in a small proportion of the Ger houses, and energy consumption and emissions are declining. As the program only covers a small proportion of Ger houses in Mongolia, the effect remains limited. However, the simulation shows the fundamental potential if corresponding measures are extended to all Ger houses. Then much bigger effects could be possible. Of course, financing must be provided for this.

Figure 21. Effects of the "Energy efficiency in Ger houses" scenario on GHG emissions by sectors, 2026-2050, deviations from the SSP5-8.5 scenario in Gg $CO_{2}e$ (top figure) and percent (bottom figure)



Source: Own illustration based on e3.mn results

4. CONCLUSIONS AND OUTLOOK

Mongolia is affected by climate change and has committed to reducing its GHG emissions from a baseline in the future. Adaptation and mitigation measures are being discussed to this end. Green loans are one way of incentivizing such measures. Mongolia has developed a green taxonomy and has also set itself the goal of increasing the share of green loans from a good 4% today to 10% in 2030.

In earlier projects, the so-called e3.mn model was developed for Mongolia, which can be used to map the economy-wide effects of climate change, adaptation measures and mitigation measures. However, although the model does not yet cover the financial sector, this report highlights the potential of the model to quantify potential impacts from green loans when combined with targeted policy reforms that trigger investments. The report discusses key measures in the areas of energy efficiency in buildings, renewable energies and sustainable agriculture, which currently account for the large part of green loans in Mongolia. It shows how these measures can be incentivised through green loans and presents the detailed direct and induced effects on specific sectors, GDP and employment (disaggregated for gender). Two adaptation measures for which CBAs are available were considered. In the area of mitigation, a scenario was developed that envisages increased liberalization and energy transition in the energy sector. In addition, efficiency measures in panel apartments and ger houses were quantified based on experiences from two specific projects.

The results show that the selected adaptation and mitigation measures could have a positive impact on GDP and related indicators such as production and employment in Mongolia. However, the adaptation measures could also lead to additional energy consumption and GHG emissions due to higher GDP. In contrast, the mitigation measures would reduce the consumption of fossil fuels and energy-related GHG emissions.

The additional green loans issued as part of the green measures modelled in section 3 will total almost 3.2 tn MNT by 2030. This amount is twice as high as the outstanding green loans in the first quarter of 2025. It should be noted that the measures in the building sector are highly scalable, meaning that significantly more green loans could be issued if insulations are expanded. Furthermore, it is important to note that additional green measures from the NDC—such as those promoting electric vehicles or more energy efficiency in industry—as well as further adaptation measures have not yet been considered in the calculations. Achieving the 10% target by 2030 appears feasible.

From the economic evaluation at project level using cost-benefit-analyses and with the e3.mn model for macroeconomic perspective, it is recommended to further increase the green loan share to 10% by 2030 according to the National Sustainable Finance Roadmap. Green loans are relevant to incentivise and steer sustainable investments and finally achieve national sustainable development and climate goals. Mongolia has committed to reduce its GHG emissions by 23% by 2030, 30.3% by 2035 and up to 52.8% by 2050 against a baseline, which can be achieved by using “green” energy and improving energy efficiency (UNFCCC 2025). Several of the measures examined above could be scaled up further, which would also increase the green loans granted for them. This applies in any case to energy efficiency measures in the building sector, which could be extended to other buildings. In addition, according to the NDC, there are other areas where GHG emissions should be reduced, such as the transport sector or power generation, where more renewable energies could be promoted. There are also further possible measures of climate change adaptation. Many of the investments required for these climate mitigation and adaptation measures could be promoted through green loans in the future, meaning that a share of 10% of total loans could be achieved by more ambitious mitigation and adaptation policies by 2030. The e3.mn model could serve as an important tool to identify policy reforms that have the highest potential in this regard.

Mongolia is also hit hard by the impacts of climate change in particular in key sectors such as agriculture. Adaptation measures which improve herder's climate resilience as well as secure their income and protecting nature simultaneously are key. Investing in watering points for livestock as well as sustainable pasture and livestock management are exemplary measures that are expected to have positive impacts for the herders and pastures as well as beneficial economy-wide effects. Pasture and rangelands user agreements (PUA) support the key policy objective of the government to reach the shift from "Quantity to Quality" of the Government. At the same time, adjusting livestock numbers to the carrying capacity of the land improves sustainable pasture management.

The model analysis could be extended to include further policy measures, such as those listed in the recommendations of the World Bank (2024) or planned by national policymakers. The advantage of the e3.mn model is that the effects of the measures can be simulated in the form of what-if analyses to quantify obvious direct effects and detect indirect and induced effects. Therefore, it is always advantageous if, as in the analysis above, quantifications from cost-benefit analyses or from specific projects are available that can be scaled up to the national level.

In order to achieve the target of 10% green loans in Mongolia by 2030, national policymakers must define the areas in which green loans should increase significantly compared to today. From a climate mitigation and adaptation perspective, this selection process takes place via the NDC and NAP processes. It is useful to select measures that are also beneficial to the economy as a whole. The analysis with e3.mn can support in this regard by calculating the socio-economic effects of individual measures and their combination.

Based on the model results, various model extensions are possible. To better understand the dynamics of green lending in Mongolia, the financial sector should be explicitly modelled in the e3.mn model This would allow for better assessment of possible crowding-out effects and examination of the impacts of different sources of financing, such as the banking sector and foreign countries. It could also support climate stress-testing of the financial sector based on existing climate risk assessment to identify sectors where business activities and credits are most exposed. A further aspect is to simulate potential effects from further improving green loan or credit availability through further activities in the banking sector that effect investment in the real economy.

The e3.mn model could also be further applied to evaluate distributional effects of policy measures. It would be interesting to calculate impacts on different income groups to quantify the effects of various measures and impacts such as carbon tax, changes in electricity prices or investments in building efficiency on different income groups and to analyse policies that directly address these different impacts. This would require data on consumer spending on various goods, including housing, energy, and transportation, and income groups, as found in a social accounting matrix, among other sources. A distinction between urban and rural consumers could also be very interesting in this regard, as their consumption patterns are likely to differ significantly.

Finally, scenarios could also be based more closely on international model studies such as those conducted by the NGFS. To this end, various scenarios considered at the international level could be implemented at the national level in the e3.mn model and exchange with international green finance networks strengthened.

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