Evaluating the climate finance required for Kazakhstan to meet its NDC and Green Economy targets

Task B.1 of project “Green Financial System for Kazakhstan”

Final report

8.1.2018

Contents

Executive summary

- **The total additional investment required to reach Kazakhstan's unconditional NDC target is estimated at around US$$_{2016}$ 140 billion from now until 2030, which is equivalent to around 4%[1] of GDP. The additional investments required to meet the full suite of GEC targets is expected to be US$$_{2016}$ 34–60 billion, which is equivalent to 1–2% of GDP.**
- **These estimates are slightly higher, but comparable, with estimates of green finance needs on a global scale.**
- **New mechanisms to raise funds from both domestic and international sources are needed, and companies may need significant new incentives to make green investments profitable.**
- **The Green Finance System should target investments from particular sectors which require the most funding. For example, the GEC estimates that up to 75% of the total green finance needed to meet this suite of targets will be used for implementing energy efficiency measures, developing renewable energy as well as establishing gas infrastructure.**

The purpose of Task B1 is to provide an estimate of the investment needed for Kazakhstan to achive its climate targets. Total investments in Kazakhstan were US$$_{2016}$ 30 billion in 2016 or 23% of GDP[2], with green investments representing a small fraction of this. While Kazakhstan seeks to continue economic growth through domestic and international investments in the country, the focus of these investments will increasingly need to shift towards green activities for Kazakhstan to achieve its climate and green economy targets and allow Kazakhstan to benefit from the growth in the global green investment market.

Relevant Targets

Kazakhstan has two major targets which fall under the green economy and climate change umbrella: Its Nationally Determined Contribution (NDC) under the Paris Agreement and its Green Economy Concept (GEC), which was adopted in 2013. These two targets can be compared only partially as they cover a different range of emissions (Figure 1) and were set independently of each other using different methodologies. For example, the GEC energy intensity target implies an increase in absolute energy-related emissions, whereas the NDC target specifies an overall absolute emission reduction. It is recommend that

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[1] This figure was obtained by the dividing the US$140 billion by the cumulative GDP of Kazkahstan over the period 2010–2030. GDP over this period was projected to grow by an average of 3.7% (in real terms) by the BUR-TIMES modelling.

[2] The gross domestic product (GDP) of Kazakhstan was US$2016 134 billion in 2016 and its GDP has grown at an average rate of 4.5% over the last 10 years [World Bank, 2017a; World Bank, 2017b].

Kazakhstan revisits its GEC targets to bring them in line with the ambition level defined in its NDC.

To achieve these goals, the Astana International Financial Centre (AIFC) has an important role to provide incentives and restructure the investment landscape to support green investments. The purpose of this report is to estimate the volume of climate finance.

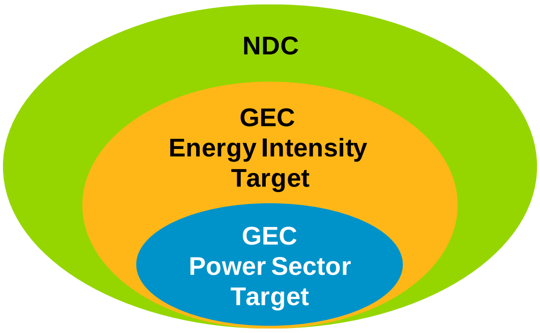

Figure 1 Overlap of NDC and GEC targets in terms of emissions coverage. The NDC covers economy-wide emissions, the GEC energy intensity target covers energy-related emissions and the power sector target covers emissions from the power sector only.

Kazakhstan's NDC unconditionally commits to reducing GHG emissions by 15% in 2030 compared to 1990 levels. In addition, the NDC conditionally commits to reducing GHG emissions by 25% in 2030 compared to 1990 levels. When compared to a *2030* baseline level,[3] these targets are equivalent to emission reductions of 132 $MtCO_2e$ and 169 $MtCO_2e$ as shown in Figure 2. This study focusses on the finance needs for Kazaksthan to meet the *unconditional* NDC target as the conditional target has been tied to a number of conditions, including financing and technology transfer.

[3] The word 'baseline' is used here in the sense of a reference emission projection, not in the sense of a historical emissions level.

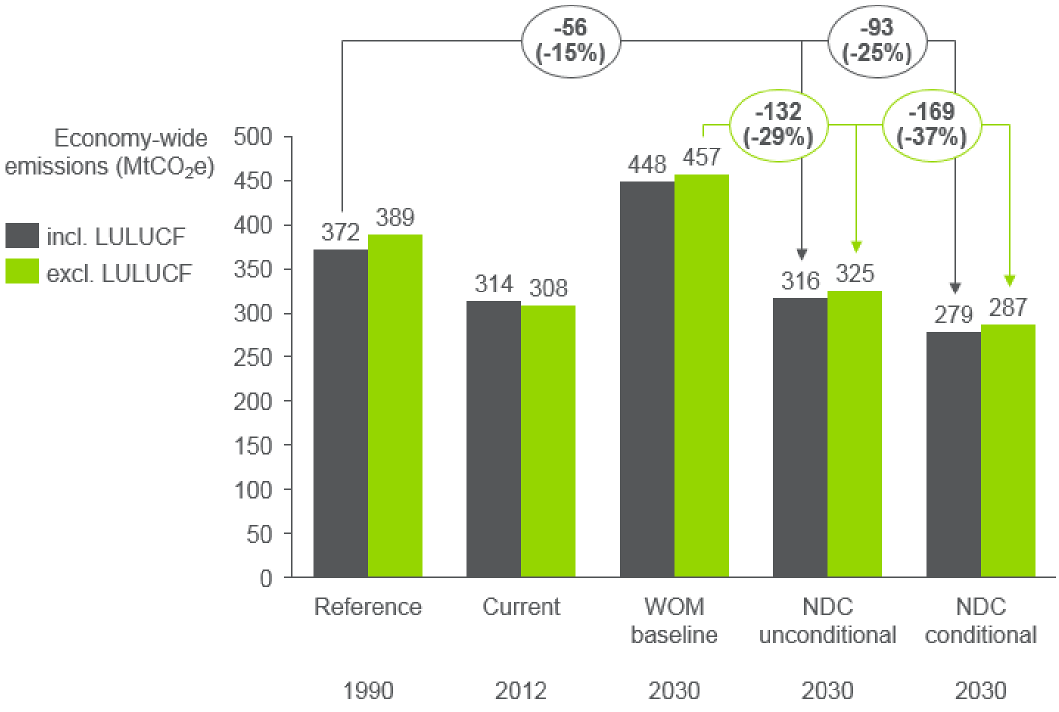

Figure 2 Estimated reduction in economy-wide emissions from NDC target, in comparison to the 2030 Without Measures (WOM) baseline of the Biennial Update Report excluding LULUCF. For reference, the reduction vs the 1990 reference including LULUCF is also shown.

Figure 3 shows the sectoral split of emission reductions in the scenario used here to quantify the NDC target. The power, industry and heat sectors collectively account for the majority of the emission reductions in this scenario.

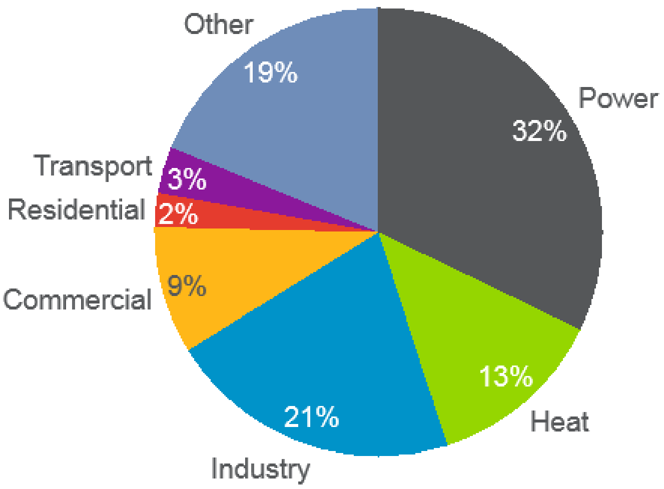

Figure 3 Share of emission reductions per sector in the scenario used here to quantify the NDC target

The GEC sets out targets related to the power sector, energy efficiency, the agriculture sector, water resources, air pollution, and waste recycling. Of these targets, some power sector and energy efficiency targets are directly related to GHG emissions mitigation.

The **GEC power sector targets** in 2030 assessed in this report aim for:

- 30% of electricity generation from alternative sources (nuclear and renewables)
- 25% of electricity generation from natural gas
- 15% reduction in CO_2 emissions from electricity generation compared to current levels

Assuming that the 'current' level of power sector emissions refers to 2012 levels, the GEC targets above completely overlap. The emission reduction implied by these targets compared to the 2030 baseline is 23 $MtCO_2e$ in 2030, as shown in **Error! Reference source not found.**.

The **GEC energy efficiency target** sets a goal to reduce the energy intensity of GDP by 30% in 2030 compared to 2008 levels. This study finds that the GEC energy efficiency target does not result in emission reductions in 2030 compared to the 2030 baseline emission level because the energy intensity of GDP in the baseline projection of Kazaksthan's recent Biennial Update Report [BUR, 2015] is lower than the energy intensity of GDP targeted by the GEC. For this reason, the emission reduction attributed to this GEC target is zero in **Error! Reference source not found.**.

Investment estimate summary

The total additional investment required to reach the **unconditional NDC** is estimated to be around US$2016 140 billion across all sectors from now[4] until 2030, while the additional investments required to meet the entire **suite of GEC targets** (including those not directly impacting GHG emissions) is expected to be US$2016 34–60 billion. These investments cover emissions reductions from targets in the power sector as well as the non-power sectors (heat and buildings, industry, transportation, AFOLU, waste). Note that the investment estimates of the NDC and GEC targets should not be summed together as there is overlap in the emission reduction components of the NDC and the GEC targets (see Figure 1).

The investment estimates differ considerably between the Green Economy Concept and the NDC. This is related to, but not fully explained by, the size of the emission reductions in 2030 targeted in the GEC compared to NDC: compared to the baseline level, the GEC targets result in an emission reduction of 23 $MtCO_2e$ in 2030, while the higher investment estimate is for achievement of the much larger unconditional NDC target of reducing emissions by 132 $MtCO_2e$. It is noted, however, that the GEC investments needed to meet the GEC target include non-GHG emissions related measures, whereas the NDC target relates only to investments in technologies that reduce GHG emissions.

The results for the different sources are summarised **Error! Reference source not found.** and Table 1. The upper part of the figure shows how investments are allocated per sector, while the lower part of the figure show how the NDC emission reduction target can be met according to the different studies analysed in this report.[5]

Table 1 Additional investment estimates for the NDC and GEC targets using the different approaches shown in Error! Reference source not found.

Target	Approach	Abatement estimate (MtCO2e in 2030)	Additional investment estimate (billion US$2016 in 2030)
Unconditional NDC	BUR-TIMES	132	140
GEC	GEC	23	60
GEC	GEC-WB power	23	34
GEC	GEC-TIMES power	23	37

[4] The definition of 'now' depends on the base year for the data sources which ranged from 2008–2011.

[5] The figures do not prescribe a non-power sector target, and no such target currently exists.

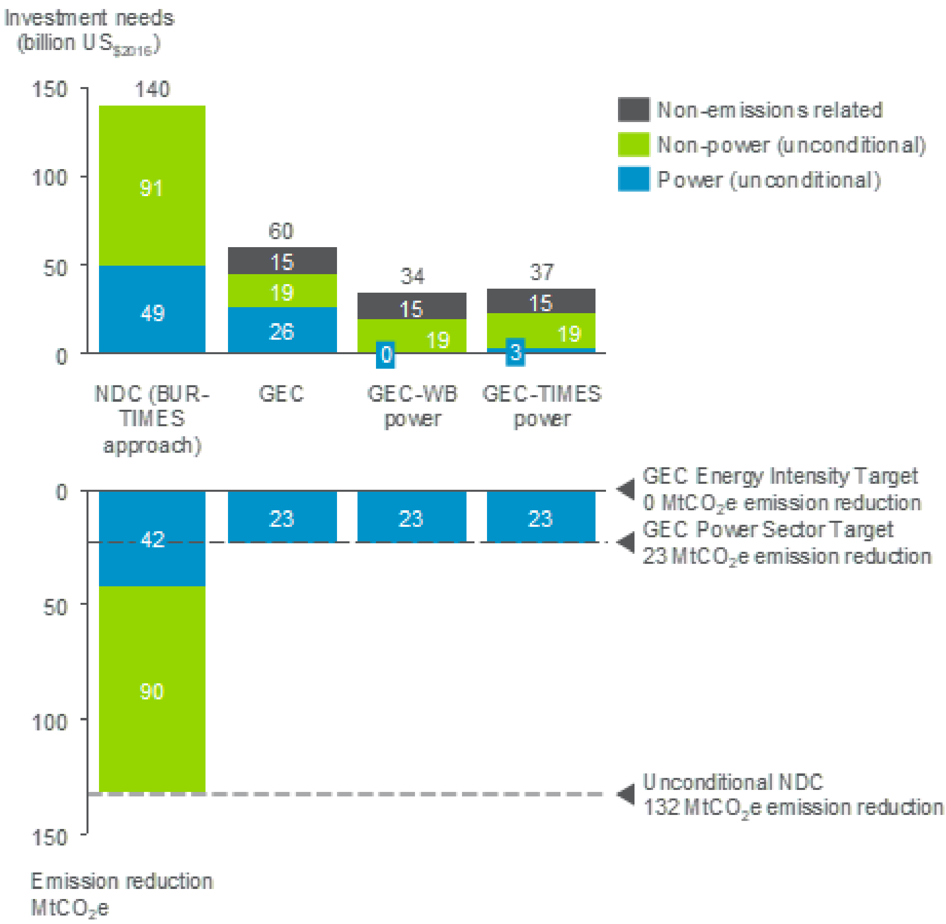

Figure 4 Summary of findings. Top: range of additional investment estimates from now until 2030. Own estimates of the NDC were based on results published in the BUR and TIMES modelling [BUR, 2015; EnEco Solutions, 2017]. Estimates of the GEC are also shown. These were based on [GEC, 2013] and own estimates combining [GEC,2013] and power sector estimates from World Bank [2017c] and [EnEco Solutions, 2017]. Bottom: Achieved emissions reductions per sector triggered by these investments and their relationship to the NDC unconditional and conditional targets and the emission reductions achieved under the GEC targets.

The average *annual* additional investments to achieve the unconditional NDC target are about US$$_{2016}$ 7 billion, which is equivalent to an average of 4% of GDP from now until 2030.[6] These estimates are slightly higher, but comparable with estimates of green finance needs on a global scale (see Section 3.5 for details). For example:

[6] We adopt the GDP growth rates that were used in the TIMES modelling; these GDP growth rates equate to an average compound growth rate of 3.7% between 2015 and 2030. To obtain the *annual* additional investment

- The World Economic Forum [2013] estimates approximately 1% of global GDP for both climate change mitigation and adaptation for a 2°C pathway.
- McCollum et al., [2013] found that approximately 1% of global GDP are needed in the energy sector *alone* for reaching a 2°C target.
- The New Climate Economy [2014] estimated that cumulative additional *infrastructure* investments approximately 0.3% of global GDP.
- The Stern review [2006] estimated that stabilising GHG emissions at between 500 to 550 ppm[7] CO_2e will cost between -2% to +5% of GDP.
- The IPCC [2014] found that 2°C scenarios entail losses in global consumption of 1–4%.

Options for improving green investment estimates

There is uncertainty in each of the estimates above due to inconsistencies between different sources available to quantify the demand for green investment in Kazakhstan. Although the NDC additional investment estimate was derived from a single source—the TIMES modelling that was used to develop Kazakhstan's Second Biennial Update Report (BUR)—uncertainties remain on the TIMES projections[8]. These relate, amongst others, to the difference in coverage of emissions between TIMES and BUR (see Annex), and the lack of consistency between TIMES and GEC numbers. This uncertainty is underscored by our review of other sources, including the NERA and BNEF [2011] marginal abatement cost curve (MACC) study for Kazakhstan. The investment costs from this source were estimated to be substantially lower than in the TIMES modelling. However, due to the lack of information on underlying assumptions and the age of this publication, this MACC study was not used further.

The range in the GEC targets is attributed to the use of different data sources with various, often undisclosed underlying assumptions. Few other estimates exist of the investments required for green finance outside the realm of emissions mitigation.

Future primary research on the potential and cost for mitigation options in Kazakhstan could reduce uncertainties in the level of investments required to achieve Kazakhstan's NDC and GEC targets. This can be done by establishing a transparent, detailed and up to date overview of all emission abatement options at measure level, and, depending on the scale of the research, a wider assessment of green economy opportunities. Ideally, future research efforts should engage a range of stakeholders including policymakers and representatives from industry and the authors of previous modelling efforts to highlight differences in approach, assumptions and results. We recommend including a comprehensive overview of the status, scope, and financing of existing policy measures

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cost, the *cumulative* investment costs were spread over a period of 20 years; this is equivalent to the number of years between the NDC target year (2030) and the base year of the TIMES modelling (2010).

[7] A CO_2e GHG cocnentration of around 500ppm is equivalent to a "more likely than not" or "about as likely as not" probability of limiting warming to 2°C. The applicability of "more likely than not" or "about as likely as not" depends on whether GHG emissions overshoot 530 ppm CO_2e [IPCC, 2014].

[8] Although the authors of this report did not perform this TIMES modelling, the results of this modelling were used as the main source for this estimate as they represented the best available (i.e. most up to date, detailed and holisticw) information at the time of writing.

to ensure appropriate attribution of additionality in funding requirements. Clarification by the Kazakh government of the precise definition of the emissions -related targets would also be helpful.

In addition, there is currently a dearth of studies estimating Kazakh-specific climate change adaptation costs. Future work should focus on addressing this data gap. Finally, efforts should be made to understand the barriers to investment that are not overcome by clear price signals, e.g. through a carbon price. These barriers hinder the adoption of cost-effective measures and result in an overall increase in abatement costs and therefore investment requirements for Kazakhstan to reach its climate targets.

Despite the uncertainties in the green finance demand estimate, even the lower bound of this estimate will require an order of magnitude increase in green investments compared to today's level. New mechanisms to raise funds from both domestic and international sources will be needed, complementary domestic policies incentivizing such investments are required.

Implications for the climate finance in Kazakhstan

This demand assessment has significant implications for the design and implementation of the Green Financial System in Kazakhstan. Green investments can be estimated to total between US$500–600 million in 2015.[9] In comparison, average annual additional investments to achieve the unconditional NDC target are about $US\$_{2016}$7 billion, which is equivalent to 4% of GDP per year. To achieve the GEC targets, annual average additional investments in the order $US\$_{2016}$2–4 billion are needed, which is equivalent to 1–2% of GDP per year. Clearly such an increase in investment and the corresponding increase in green finance requires profound changes in the way funds are funneled to green projects. New mechanisms to raise funds from both domestic and international sources are needed, and companies may need significant new incentives to make green investments profitable.

So far green finance from international sources with concessional character, for example finance provided by the Global Environment Facility (GEF), by the Climate Investment Funds (CIF) or by individual MDBs or bilateral aid, has covered a very significant portion of green investment. If local co-financing is considered, the average annual CIF and GEF funding alone covers more than a third of the current green investment. Moreover, the EIB has in recent years made a number of large loans, totalling approximately US$400 million, with either full or partial (at least 30%) climate change character. In the future, the share of funding to be mobilised from either domestic sources or more commercially-oriented international sources needs to increase, as overall green finance needs multiply.

The Green Finance System should be oriented to target investments from particular sectors which require the most funding. For example, the GEC estimates that up to 75% of the total green finance needed to meet this suite of targets will be in renewable, gas and

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[9] From 2013 to 2015 the Statistical Office reported an average of US$ 487 million in Investments in Environmental Protection across Kazakhstan's economy. The figure includes public and private as well as domestic and international investments in environmental protection. However, the measure is not comprehensive, as it does not cover green investments in renewable energy, energy efficiency and adaptation. According to the Green Economy Concept, the need for Green Investment in 2014 was USD 601 million, but it is not clear that all of this was actually provided. See Concept for Transition of the Republic of Kazakhstan to Green Economy, Astana 2013, page 11.

energy efficiency investments. Both sectors confront significant barriers. Due to devaluation of the exchange rate, many renewable energy projects that were once considered profitable have been put on hold. A Green Financial System that relies largely on providing financing at near-commercial terms can only succeed in this sector if sufficient incentives are put in place such as favourable renewable energy regulation.

Investments in energy efficiency, while often profitable, typically face financing challenges due to a variety of factors, including ex-ante uncertainty about the effectiveness of the energy-saving technologies, difficulties in measuring and allocating the energy savings to individual measures, high expectations for short payback periods, etc. Dedicated financial instruments, such as ESCo financing, that are tailored to the needs of energy efficiency investments, are therefore needed to achieve the targets.

1. Introduction

The purpose of Task B1 is to estimate the volume of climate finance required for Kazakhstan to reach its Nationally Determined Contributions (NDC) and Green Economy Concept (GEC) targets related to climate change mitigation and adaptation. This task forms part of Step 2 of the logical framework displayed in Figure 5 to develop a green financial system in Kazakhstan.

The climate finance demand is defined as the *additional* investment, i.e. capital costs, required from now until the year 2030 to achieve the targets compared to a baseline investment level. The climate finance demand comprises all green investments regardless of funding source, including domestic and international public and private-sector funders.

The first step to estimate the required climate finance for Kazakhstan is to clearly quantify the targeted emission reduction, because larger reductions typically require higher upfront investments. Because Kazakhstan has defined different, overlapping targets which aim to reduce greenhouse gas (GHG) emissions we begin by providing a comprehensive overview of the ambition level of Kazakhstan's emission mitigation targets in 2030 compared to a consistent baseline level.[10]

Section 2 of this report translates the NDC and GEC targets into GHG emission levels in 2030. These emissions projections are then compared against baseline emissions in 2030 to determine the **emission reductions** which can be expected in 2030 if the NDC and GEC targets are reached. Attainment of these emission reductions require funding via climate finance.

The volume of climate finance needed for reaching each of the targets is then analysed in Section 3. Three different approaches were used to estimate climate finance requirements to make use of all available data to narrow down the uncertainty in our estimate:

- An estimate for the funding required to 2030 to achieve the GEC targets from the "Concept for transition of the Republic of Kazakhstan to Green Economy" publication.
- An estimate based on modelling results using the TIMES model [EnEco Solutions, 2017]; this modelling formed the basis for Kazakhstan's second biennial update report [BUR, 2015].
- Assessing a World Bank [2017c] estimate of investment costs needed in a "Green Case" power scenario which was intended to be in line with the GEC power sector targets.

We discuss the status of adaptation planning in Kazakhstan seprately in Section 3.3. Although a few reports on adaptation needs in Kazakhstan exist, few have attempted to

[10] The word 'baseline' is used here in the sense of a reference emission projection, not in the sense of a historical emissions level.

quantify the overall cost impact and required investments for adaptation actions; we provide an overview of the available literature in this section.

Section 3.4 then gives an overview of the current status of implementation of projects in Kazakhstan funded by the of Global Environment Facility (GEF) and Climate Investment Funds (CIF), Section 3.5 presents global estimates of green finance in comparison to our findings, and Section 3.6 looks at the demand for green investment in the Central Asian region.

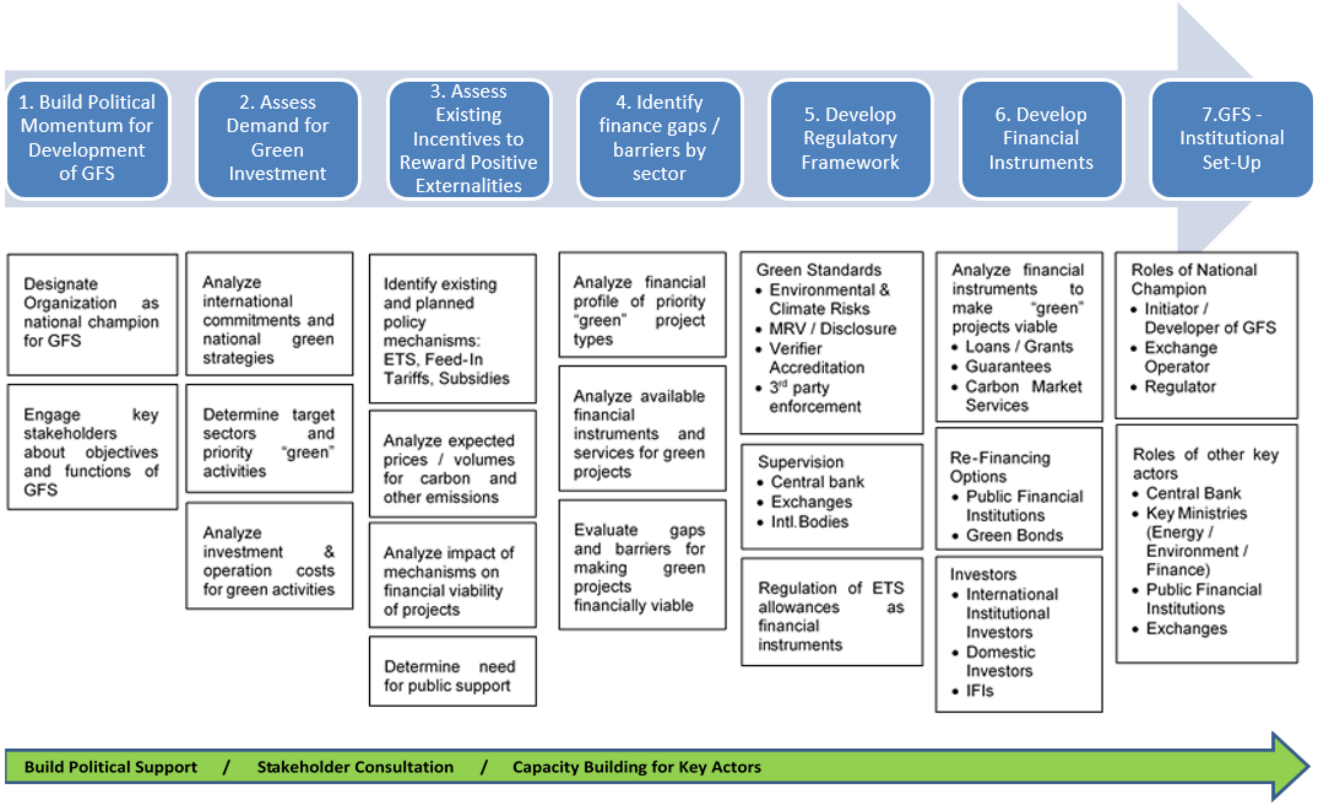

Figure 5 Steps in developing a green financial system for Kazakhstan

2. Quantification of targets

2.1 Summary of emission reductions

The NDC and GEC set out targets which, if achieved, impact GHG emissions levels. The emission reductions implied by these targets are evaluated against a common baseline level of emissions in 2030.

We find that the NDC target requires much more substantial emission reductions compared to the 2030 baseline than the GEC targets: the NDC implies emission reductions of 132 or 169 $MtCO_2e$ for the unconditional and conditional targets, respectively, while the GEC power sector targets result in a 23 $MtCO_2e$ emission reduction with no additional reduction expected from achievement of the GEC energy efficiency target.

It is also noted that as power sector emissions are a sub-set of energy-related emissions, the energy intensity target also applies to emissions from the power sector. Considering this overlap and the considerably different ambition levels of the power sector targets, which require an emission reduction, compared to the energy intensity target which does not, we recommend that the targets be reconsidered so that they are consistent.

This study therefore assumes that the NDC target is the leading emission reduction target which has a 100% overlap with the GEC targets quantified. Similarly, we assume that the power sector targets—30% of generation from zero-carbon sources and 25% from natural gas completely—overlap with the target to reduce emissions from electricity generation.

A comparison of the results above shows that if it is assumed that the GEC power sector target is reached yielding emission reductions below baseline in 2030 of 23 $MtCO_2e$, the emissions reductions required from all other sectors to fulfil the NDC commitment would be around 109–146 MtCO2e.

Details of this analysis are presented below: the definition of a suitable baseline is discussed in Section 2.1, Section 2.2 summarises the NDC and GEC targets and their various baseline definitions and Section 2.3 analyses the emissions mitigation of the NDC and GEC targets.

Using these target emissions reductions as our guide, we estimate the climate finance required to reach these targets in Section 3.

2.1 Baseline definition

When trying to understand what effort is needed to achieve a reduction in emissions we need to define a reference, or baseline, level for the target year, e.g. 2030. The question we are trying to answer when defining this baseline is: *In the absence of the target, what would have happened in 2030?* Emissions may have increased from current levels in 2030 or they may have decreased, depending on trends and actions already underway in the economy. These trends will be triggered partially by investments already being made as part of 'business-as-usual' in the country. The impact of an emission reduction target, and its requirement for financing, is always calculated relative to such a baseline scenario.

To compare different targets on an equal footing, we need to define a common baseline for 2030. The difference between this baseline emissions level and the target emission level is the volume of GHG emissions that needs to be abated through measures that may require climate finance. As Kazakhstan has sector specific and economy-wide targets, baselines for these sectors as well as an economy-wide baseline are needed.

There are two key sources of such baseline emission projections:[11]

- The 2nd Biennial Update Report (BUR) scenarios, which covers economy-wide emissions with the following sectoral resolution: energy, transport, industry/industrial processes, agriculture, waste and forestry/LULUCF at a highly aggregated level.
- The TIMES scenarios [EnEco Solutions, 2017], which were used as input to the BUR scenarios and have the following sectoral resolution: power, heat, oil and gas, coal mining, industry, commercial, residential, transport, waste and agriculture. Detailed TIMES modelling results were provided for use in this current analysis including information about investment needs (this information was not published in the BUR).

Due to the different sectoral coverage of the BUR and TIMES scenarios, the following baselines are used in this assessment:

- The BUR baseline is used for **economy-wide emissions** and **energy-related emissions** in 2030.
- **Power sector emissions in 2030** are derived from the TIMES modelling.

It is important to note the distinction between *energy-related* emissions and *power sector* emissions. According to the Intergovernmental Panel on Climate Change (IPCC), energy-related emissions originate from fuel combustion activities (e.g. electricity generation and fuel use in industry), fugitive emissions from fuels (e.g. methane emissions from coal

[11] Note that we have modified the TIMES scenarios as provided by EnEco Solutions [2017] to ensure consistency between these two sources: The total volume of emissions modelled in the TIMES scenario is a subset of the emissions covered in the BUR. This is due to the incomplete emissions coverage of the TIMES model and inconsistencies between the national energy balances and national inventories. We have addressed this discrepancy between the BUR and TIMES scenarios by adding an additional emissions category to capture these missing emissions.

mining) and emissions related to the transportation and storage of CO_2. **Power sector emissions are therefore a subset of energy-related emissions.**

Both the BUR and TIMES model the following three scenarios:

- without measures (WOM),
- with measures (WM), and
- with additional measures (WAM).

EnEco Solutions [2017] regards the WM scenario to be the baseline scenario. However, we have chosen to use the WOM scenario for our baseline in this analysis for the following reasons:

For 2030, the TIMES WM scenario assumes a clean energy share that is more ambitious than the GEC target. As a result, power sector emissions from the WM scenario in 2030 are *lower* than the emissions implied by the GEC target. This outcome shows that the WM scenario includes measures which are considered additional in GEC, thereby rendering this scenario invalid for the purposes of setting a baseline.

The selection of a baseline was further complicated by the lack of information on the policies and measures adopted in each of these scenarios. In addition, there is little clarity on the financing status of already adopted and planned policies. Because of the latter limitation, this analysis evaluates the total climate finance need in the WAM scenario compared to the WOM scenario, including Kazakh government funding and private investors and irrespective of potential partial implementation of policies in either scenario.

These issues mean that the WOM scenario is the most suitable baseline choice. The baseline emission levels are summarised in Table 2 below.

Table 2 Baseline level from BUR-TIMES

Baseline	Emissions in 2030 ($MtCO_2e$)
Total emissions excl. LULUCF	457
Energy-related emissions	345
Power sector emissions	100

We note that the GEC also has a BAU scenario, which could be considered to be a baseline. This scenario projects power sector emissions of 86 $MtCO_2e$ in 2030. As an economy-wide baseline is not provided in the GEC, for the purpose of this analysis, the WOM power-sector emissions from the TIMES modelling is the most suitable baseline as this is consistent with the BUR economy-wide baseline.

2.2 NDC and GEC targets

As discussed earlier, the NDC and GEC set a number of targets, some of which have quantifiable impacts on climate change mitigation and associated climate finance needs. The targets of the GEC are mostly sector specific whereas the NDC target is cross-sector or economy wide, as shown schematically in Figure 6. This means that the GEC targets overlap fully with the NDC targets in terms of their *definition*.

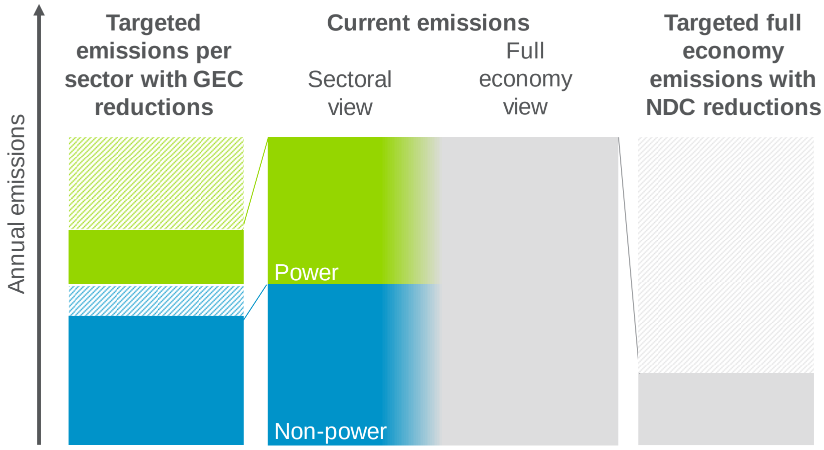

Figure 6 Illustration of the overlapping nature of the NDC and Green Economy Concept targets

To assess whether and how much they overlap in terms of *amount of emission reduction*, we have quantified the implied emission level of the targets in Section 2.3. A comparable quantification of the emission reduction is necessary because of the varying definitions and baselines of the targets: some of the targets under investigation here are expressed in relative, rather than absolute, reduction amounts and some are expressed against a reference or a baseline, whereas other specify an end state. Note that the baseline level of these targets is usually not the same baseline as described in Section 2.1.

For an emission target to be quantifiable it must specify: the targeted percentage reduction, the target year, the reference year, the reference emissions level (including sectoral scope definition). **Table 3** gives an overview of the targets and the associated information available for the purpose of quantifying the impact on emissions. For most targets, the reference emissions level was not specified in the original GEC documentation; some targets also lacked a reference year.

Section 2.3 analyses the impact on emissions for those targets which are directly related to emissions mitigation: the NDC, GEC energy efficiency and power sector targets. Data gaps were filled with best available data. While the GEC water resources, agriculture, air pollution and waste recycling may have emission reduction co-benefits, we do not quantify their emission reduction impact as reducing GHG emissions is not the focus of these targets. In addition, the emissions impacts of these targets are not quantifiable due to data limitations.

Table 3 Complete set of targets related to climate mitigation and/or adaptation under the Kazakh NDC and Green Economy Concept (GEC, 2013; NDC, 2015)

Sector	Target description	2030 Target	Refe-rence year	Refe-rence level	Emission reduction target quantifiable?
NDC: Economy-wide	unconditional (conditional) reduction in GHG emissions	-15% (-25%)	1990	372 $MtCO_2e$	Yes
GEC: Energy efficiency	Reduction of energy intensity of GDP from levels of 2008	30%	2008	Not provided	Yes, with assumptions made on GDP projection for target year.
GEC: Power	Share of alternative sources in electricity production	30%	N/A	Not provided	Yes, but assumptions need to be made on the reference level and the base year.
	Share of gas power plants in electricity production	25%	N/A	Not provided	
	Gasification of regions	Akmola and Karaganda regions (2020), northern and eastern regions (2030)	N/A	Not provided	No. It is assumed that this target is linked to the target for the share of gas power plants in electricity production
	Reduction of current CO_2 emissions in electricity production	-15%	Not provid ed	Not provided	Yes, but assumptions need to be made on the reference level and the base year.
GEC: Water resources	Eliminate water gap on national level	Provide all population with access to water (2020), provide agriculture with water (2030)	N/A	N/A	Not relevant to mitigation, relevant to adaptation finance.

Sector	Target description	2030 Target	Refe-rence year	Refe-rence level	Emission reduction target quantifiable?
	Elimination of water gap on basin level	Elimination of water gap in each basin by 2030	N/A	N/A	Not relevant to mitigation, relevant to adaptation finance.
Agriculture	Labour efficiency in agriculture	3 fold increase (2020)	N/A	N/A	Not relevant to climate finance
	Wheat yields (ton/ha)	2.0	N/A	N/A	Not relevant to mitigation, relevant to adaptation finance.
	Water spent on irrigation (ton/ha)	330	N/A	N/A	Not relevant to mitigation, relevant to adaptation finance.
Air pollution	SOx, NOx emissions into environment	European levels of emissions	N/A	N/A	Not relevant to climate finance
Waste recycling	Municipal solid waste coverage	100%	N/A	N/A	Impact on emissions not quantifiable without additional information.
	Sanitary utilization of waste	95%	N/A	N/A	Not relevant to climate finance
	Share of recycled waste	40%	N/A	N/A	Impact on emissions not quantified

2.3 Quantification of the 2030 GHG emissions mitigation requirement

2.3.1 Nationally Determined Contribution (NDC)

Kazakhstan submitted its INDC to the UNFCCC on 29 September 2015. The country ratified the Paris Agreement on 27 October 2016, and its INDC became its NDC.

Kazakhstan's NDC targets an unconditional 15% reduction in economy-wide GHG emissions by 2030 compared to the 1990 base year. The conditional target aims to achieve a 25% reduction by 2030 compared to the 1990 base year.

The corresponding absolute emission levels of the unconditional and conditional targets were evaluated assuming that emission reductions will come from the energy, industry, agriculture and waste sectors, i.e. not from land use, land-use change and forestry (LULUCF).

The emission level including land use, land-use change and forestry (LULUCF) of the 1990 base year is 372 $MtCO_2e$ (UNFCCC, 2017). From this figure, the unconditional target of a 15% reduction by 2030 equates to an emission level of 316 $MtCO_2e$ in 2030 including LULUCF, while the conditional target is equivalent to an emission level of 279 $MtCO_2e$. The NDC does not explicitly identify which LULUCF accounting method will be used. In our quantification, we subtract the LULUCF emissions level projected in the BUR of -9 $MtCO_2e$ in 2030 [BUR, 2015]. The unconditional and conditional target emission levels in 2030 are therefore 325 $MtCO_2e$ and 287 $MtCO_2e$, respectively, *excluding* LULUCF.

When compared to the WOM baseline for 2030, the emission reduction implied by the NDC is 132 $MtCO_2e$ and 169 $MtCO_2e$ for the unconditional and conditional targets, respectively. This is equivalent to a -29% or -37% reduction in emissions in 2030, as shown in Figure 7. It is noted that the emission reduction achieved in 2030 compared to a baseline level is, by nature, dependent on the baseline assumptions adopted. While there is more certainty in the ambition level of the target compared to 1990 historical emissions, this study requires an estimate of emission reductions against a 2030 baseline to determine future climate finance needs.

This study focusses on the finance needs for Kazaksthan to meet the *unconditional* NDC target as the conditional target has been tied to a number of conditions, including financing and technology transfer.

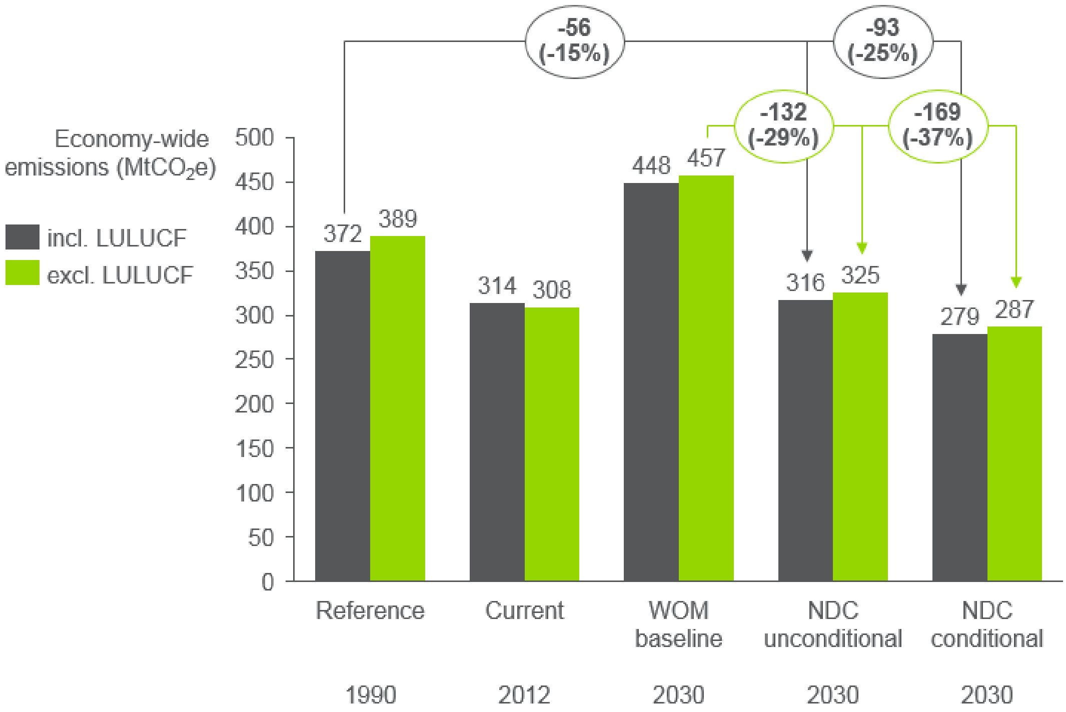

Figure 7 Estimated reduction in economy-wide emissions from NDC target, in comparison to the 2030 WOM baseline excluding LULUCF. For reference, the reduction vs the 1990 reference including LULUCF is also shown.

2.3.2 Green Economy Concept

<u>Power sector targets: share of gas and alternative generation sources</u>

The GEC power mix target stipulates the following shares of power generation in 2030:

- 30% alternative sources (nuclear and renewables)
- 25% natural gas

In the quantification of the implied emission level, it is assumed that the remaining 45% of generation in 2030 is from coal-fired generation.

The GEC target for shares of gas and alternative generation is modelled in the GEC "Green" (cheap gas scenario). The power sector emissions resulting from the targeted generation mix according to the GEC [2013] is 77 $MtCO_2e$.

As explained above, the baseline was selected to be the without measures (WOM) scenario of the TIMES modelling [2017], which projects power sector emissions to total 100 $MtCO_2e$ in 2030. The difference between the GEC target emission level and the baseline equates to an emission reduction of 23 $MtCO_2e$.

GEC power sector target: reduction of current CO_2 emissions from the power sector

This GEC power target aims at a 15% reduction in power sector emissions in 2030 compared to current levels. There is some uncertainty surrounding this target as the GEC does not explicitly state the year which is considered to be 'current'. This study adopts EnEco Solutions' [2017] interpretation that 'current' means 2012 power sector emissions. According to GEC (2013), these totalled 91 $MtCO_2e$. A 15% reduction equates to an emission level of 77 $MtCO_2e$, or a 23 $MtCO_2e$ reduction in emissions in 2030 compared to the WOM baseline (or a 9 $MtCO_2e$ emission reduction compared to the GEC BAU level). This target is thus consistent with the power sector target that specifies the share of generation from gas and alternative sources, as shown in Figure 8 below.

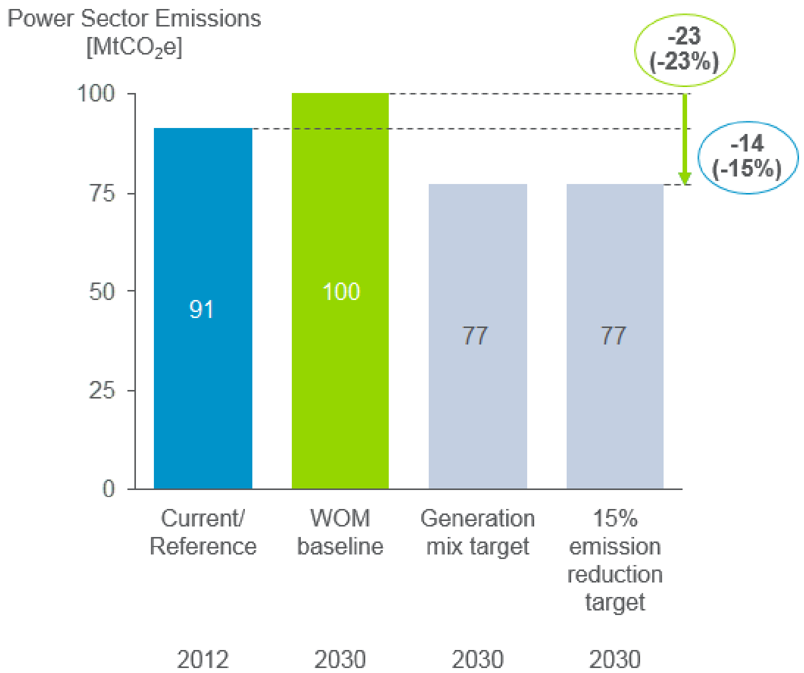

Figure 8 Power sector emissions in the reference year, WOM baseline, and as a result of the GEC power sector targets in 2030

As described in Section 2.1, the GEC [2013] considers BAU emissions in the power sector in 2030 to be 86 $MtCO_2e$. Compared to this baseline, the emission reduction from the two power sector targets would be 9 $MtCO_2e$.

GEC reduction of energy intensity

The GEC targets a 30% reduction in the energy intensity of GDP compared to the 2008 level. We interpret the term "energy intensity of GDP" to mean the total primary energy supply (TPES) divided by GDP. Based on the description of the measures included under this target,[12] we assume that the emission reductions are 100% additional to the power sector targets.

To translate the 2030 energy intensity target into an emission level, three values are required:

- The **energy intensity in 2030**, which is 70% of the energy intensity in 2008
- The **GDP level in 2030**
- The **emissions intensity of TPES**

Their relationship with the GHG emissions level is summarised through the formula:

$$Em = EnInt \times GDP \times EmIt$$

where

Em = energy related emissions in tCO_2e per year

EnInt = energy intensity of GDP in GJ per unit of GDP ($US_{\$2016}$)

GDP = gross domestic product

EmInt = emissions intensity in tCO_2e per GJ ($US_{\$2016}$)

The TPES in 2008 was derived from the IEA (2016) and Kazakhstan’s GDP in 2008 was obtained from the World Bank (2017b), resulting in a 2008 energy intensity value of 0.020 TJ/thousand $US\$_{2016}$. Based on this, the **2030 energy intensity level** is calculated to be 0.014 TJ/thousand $US\$_{2016}$.

The **2030 GDP level** was calculated using GDP growth rates which equate to a compound annual growth rate of 3.7% [EnEco Solutions, 2017]; these were the rates used to prepare the BUR-TIMES projections. It is noted that the BUR published a 3% growth rate in its report, but this was the growth rate used for industrial process projections only [EnEco Solutions, 2017]. The GDP growth rate results in a GDP level in 2030 which is around 2.3 times the GDP in 2009, or 1.9 times the GDP in 2012. We note that these appear to be lower than the assumptions made in the GEC publication which mentions using a GDP projection for 2030 which are ‘almost three times’ higher than current, assumed to be 2012.

The following possibilities are available for the third input, the **emissions intensity of TPES**:

1. A constant emission intensity based on 2008 energy-related emissions from the 2017 National Inventory Submission and TPES from IEA (2016).
2. Energy-related emissions in 2030 BUR WOM scenario combined with the TPES from the TIMES WOM scenario in 2030.

[12] The measures listed in GEC [2013] are: Installation of house metering equipment and thermostats, insulation in buildings, targeted programs focused on training and implementation of energy efficiency production technologies in industry, fuel efficiency increases in transport and repaid and upgrade of heat transmission grids, modernization of CHPs and boilers, reduction of primary resource consumption through decreasing power and heat consumption

The energy-related emissions resulting from the energy efficiency target was calculated for both the possibilities above and the results are summarised in Table 4 below. They are then compared to the baseline energy-related emissions which are derived from the WOM scenario of the BUR [2015]. The positive 'emission reduction' values in Table 4 and Figure 10 indicate that the implied emission level is *higher* than the baseline, meaning that the target does *not* result in emission reductions compared to WOM. This outcome is primarily attributable to the 2030 WOM baseline energy intensity being 44% lower than the 2008 reference value, i.e. a much larger reduction than the 30% stipulated by the GEC target. These energy intensity levels are displayed in Figure 9.

Table 4 Evaluation of GEC energy intensity target. All values pertain to 2030

Scenario	GDP (billion US$_{\$2016}$)	TPES/GDP (TJ/thousand US$_{\$2016}$)	Emissions/ TPES (tCO_2/GJ)	Energy-related emissions ($MtCO_2e$)	Emission reduction vs WOM ($MtCO_2e$)
WOM	355	0.011	0.087	345	N/A
1	355	0.014	0.080	387	42
2	355	0.014	0.087	423	78

As the energy-related emissions in 2030 under the GEC target are greater than the baseline energy-related emissions, we do not quantify the climate finance demand for this target.

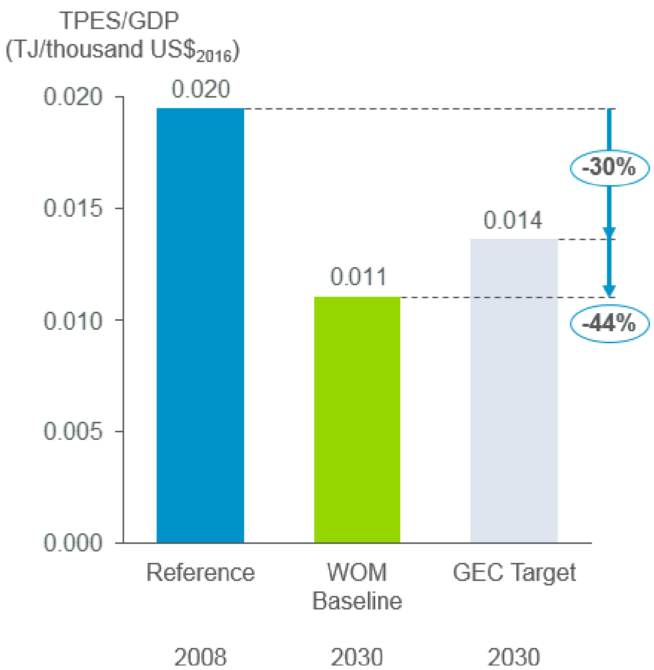

Figure 9 GEC energy intensity target compared to WOM baseline in 2030 and 2008 reference level.

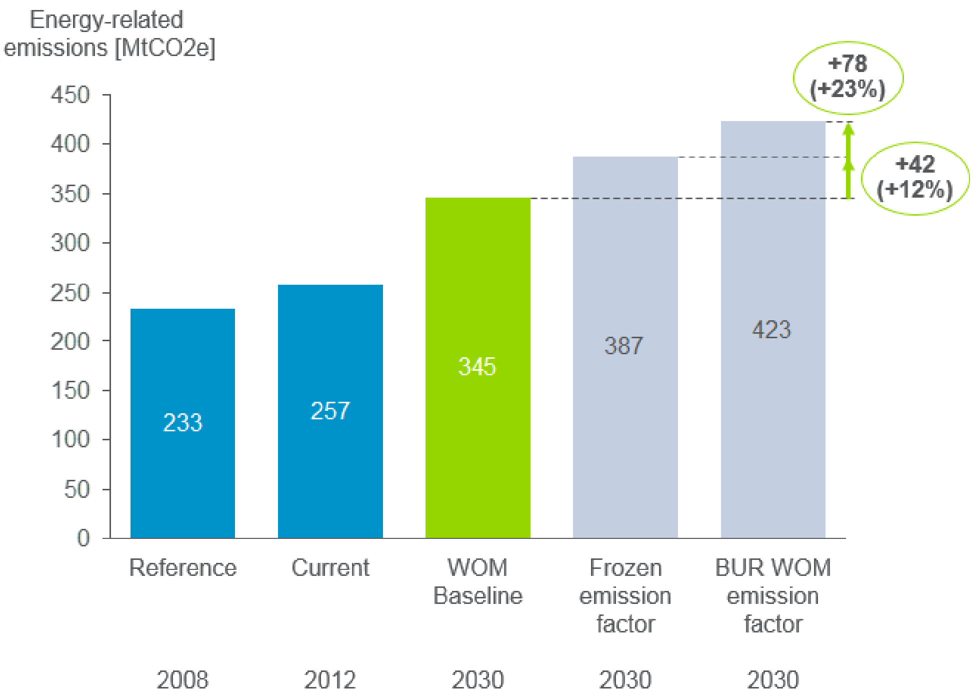

Figure 10 Energy-related emissions in the reference year, current year and WOM baseline, compared to the emissions projected from the GEC energy efficiency targets in 2030

3. Demand for climate finance

This section quantifies the demand for climate finance based on the volumes of emission reductions required to meet the NDC and GEC targets as evaluated in Section 2. The climate finance requirements to meet the NDC are estimated using BUR-TIMES in Section 3.1. The climate finance demand required to meet the GEC target is evaluated in Section 3.2. Section 3.3 summarises the available literature on adaptation planning and cost estimates for Kazakhstan. Section 3.4 then gives an overview of the status of GEF and CIF implementation in Kazakhstan. Section 3.5 presents global estimates of green finance in comparison to our findings, and Section 3.6 looks at the demand for green investment in the Central Asian region.

3.1 Quantification of NDC climate finance

We have estimated the investment needs to meet the NDC in 2030 using the BUR-TIMES modelling.

Considering the scenarios evaluated in the BUR, the emission reduction of the WAM scenario compared to the WOM baseline (134 $MtCO_2e$) is sufficient to reach the unconditional NDC emission reduction target of 132 $MtCO_2e$. In comparison, the emissions reduction achieved in the WAM scenario compared to the WOM baseline in the TIMES model in 2030 is 100 $MtCO_2e$, meaning that 34 $MtCO_2e$ of the reduction communicated in the BUR was not covered by the TIMES model. This discrepancy is attributable to the post-modelling adjustments[11] that were made to the TIMES modelling results to align them with the emissions levels of the National Inventory Report [EnEco Solutions, 2017].

Figure 11 shows the sectoral split of emission reductions in the WAM scenario. The power, industry and heat sectors collectively account for the majority of the emission reductions in this scenario.

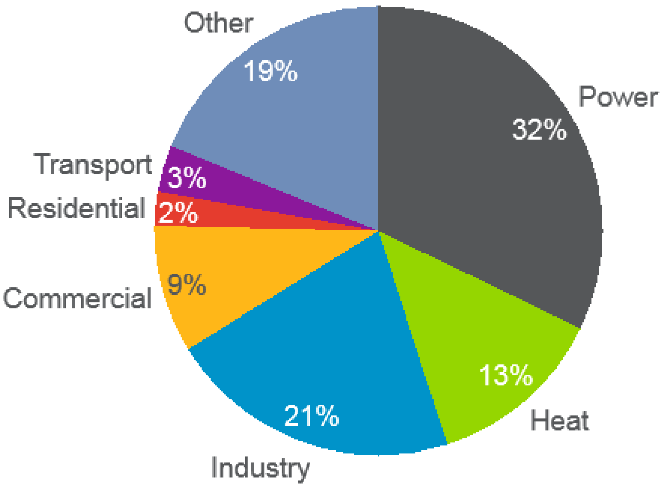

Figure 11 Share of emission reductions per sector in the WAM scenario

EnEco Solutions [2017] provides estimates of annual investment needs per sector for the scope of emissions covered under the TIMES model. For the sectors that *are not* covered by the model, it is assumed that the investment needs are equivalent to the average investment cost per tonne of CO_2 mitigated of the sectors that *are* covered in the TIMES modelling. Using this assumption, we estimate the additional annual investment to achieve the WAM scenario compared to the WOM scenario in the BUR, as shown in Table 5 below. Investment costs are zero in 2010 because this is the base year of the TIMES modelling.

Table 5 Additional investment estimate from TIMES model

	2010	2015	2020	2025	2030
Additional investments (all sectors) (billion US$$_{2016}$)	0	0.7	3	12	21
Additional investments (power sector) (billion US$$_{2016}$)	0	0.1	0.8	5	7

Based on these annual costs, the cumulative additional investments required over 2010–2030 to achieve the WAM scenario is US$$_{2016}$ 142 billion for all sectors; of this amount, US$$_{2016}$ 50 billion is required for the power sector. Scaling the investment costs according to the ratio between the WAM emission reduction and the emission reductions targeted by the NDC, the total investment costs to meet the NDC are estimated at **US$$_{2016}$ 140 billion** for the unconditional NDC and at least **US$$_{2016}$ 179 billion** for the conditional NDC. The split of these investment needs between power and non-power sectors is shown in Table 6 below.

Table 6 Additional investment costs to achieve the NDC targets based on BUR-TIMES

	NDC investment needs	
	Unconditional (billion US$$_{2016}$)	**Conditional** (lower bound) (billion US$$_{2016}$)
Power sector	49	63
Non-power sectors	91	116
Total investments	140	179

The average additional investment cost per tonne of CO_2 abated is displayed in Table 7. The table shows that additional investment costs increase over time in real terms due to lower cost abatement options being implemented first. The costs required in the power sector are comparatively higher than those in the non-power sectors.

Table 7 Additional investment costs per tonne of CO_2 abated in the power and non-power sectors

	2015	2020	2025	2030
Additional investment costs power sector (US$$_{2016}$/t$CO_2$e)	18	71	151	172
Additional investment costs non-power sectors (US$$_{2016}$/t$CO_2$e)	29	44	109	143

It is noted that there is a larger uncertainty on the investments needed to achieve the conditional NDC compared to the unconditional NDC. This is because investment costs do not follow a linear trajectory; rather investment costs generally increase with each the emission reductions targeted because least cost abatement measures are implemented first as shown in Table 7. This does not pose a problem for the achievement of the unconditional NDC as the emission reduction targeted is similar to that achieved in the WAM scenario. In contrast, the conditional NDC requires an additional 35 $MtCO_2e$ emission reduction compared to the WAM scenario. For this reason, we consider that the $US\$_{2016}$ 179 billion figure is a lower bound to the actual investment cost range for this target.

Further details on the approach taken in this analysis is presented in the Annex.

We note that NERA and BNEF [2011] produced a marginal abatement cost curve (MACC) study for Kazakhstan which potentially could be used to develop an estimate of investment costs needed to meet the NDC targets. However, due to the lack of information on underlying assumptions and the age of this publication, this MACC study was not used here.

3.2 Green Economy Concept

GEC [2013] estimates that total *additional*[13] cumulative investment costs of $US\$_{2016}$ 131 billion ($US\$_{2010}$ 119 billion) are required from now to 2050 to reach the whole suite of targets (displayed in **Table 3**) in the Green Economy Concept. Of this figure, 75% of investments are directly related to emission reductions: $US\$_{2016}$ 57 billion ($US\$_{2010}$ 52 billion) in renewables and gas investments and $US\$_{2016}$ 41 billion ($US\$_{2010}$ 37 billion) in energy efficiency measures. GEC [2013] also lists the total *annual additional* investment needs for all targets covered in the GEC per period (including those targets not related to GHG emission reductions) as shown in Table 8 below.

Table 8 Evaluation of investment needs to meet all GEC targets

Year	Annual additional total investment cost (billion $US\$_{2016}$)
2014	0.7
2016-2017	1.1
2018-2019	3.4
2020-2024	6.1
2025-2029	3.3
2030-2039	3.3

Using these annual investment costs up until 2030 and the 75% share of investments related to emission reductions from above, we estimate that the climate finance need to reach the GEC emission-related targets is **$US\$_{2016}$ 45 billion over 2014–2030** ($US\$_{2010}$ 41 billion). Of the total volume of climate finance, an estimated $US\$_{2016}$ 26 billion

[13] This interpretation is based on the understanding of EnEco Solution [2017].

is related to power sector investments, while US$$_{2016}$ 19 billion of investments is needed in the other sectors.

Due to inconsistencies within the GEC, there is some uncertainty in the accuracy of this estimate of climate finance; other estimates of additional investments required for the GEC power generation mix target attainment yields substantially different results from the above, as explained in sections 3.2.1 and 3.2.2.

It must be noted that we have estimated the emissions reduction below baseline of these targets to be around 23 MtCO_2e in Section 2.3.2, but that this reduction is entirely due to the power sector targets as the energy intensity target appears to be less ambitious than the Kazakh BAU as published in the BUR [2016]. Although this target is not sufficient to fulfil the overall NDC commitment, it provides a useful **lower bound** for climate finance required for Kazakhstan.

As described above, the GEC also stipulates investment costs for other targets relating to water resources, agriculture, air pollution, and waste recycling, totalling **US$$_{2016}$ 15 billion between now and 2030.**

3.2.1 Quantification of GEC power sector target using TIMES modelling

To evaluate the investment costs of the power mix targeted by the GEC, the additional investments needed in this scenario were compared to the BAU scenario in the GEC. According to GEC [2013], the installed capacity of renewable energy and nuclear is the same under all scenarios. Under the GEC Green "cheap gas" scenario, which is aligned with the GEC power mix target, the only additional capacity compared to BAU is 3 GW of additional gas capacity.

Assuming that these capacity additions are spread evenly over the period from 2012–2030, and using the power generation cost information from EnEco Solutions [2017], we estimate that the additional climate finance requirement to achieve the GEC power mix target is **US$$_{2016}$ 3.2 billion,** which is needed for the additional 3 GW of gas capacity. This figure is much lower than our US$$_{2016}$ 26 billion estimate, suggesting that the additional capacity numbers stated in GEC are incomplete. It is also possible that the BAU scenario described in the GEC was inappropriately set, supported by the fact that TIMES assumes a much smaller share of renewables in their baseline WOM [EnEco Solutions, 2017]. We also note that Exhibit 15 of the GEC shows that CapEx would be lower in the "cheap gas" scenario, compared to BAU (due to reductions in RES costs).

3.2.2 Quantification of GEC power sector target using World Bank [2017c]

The World Bank [2017c] performed a study to estimate the capital investments needed in a "Green Case" power scenario which was intended to be in line with the GEC power sector targets.

However, various inconsistencies in this report raise doubts on the degree to which this scenario is aligned with the GEC targets.

Figure 5.25 of this study interpreted the GEC target to generate 30% of electricity from alternative sources in 2030 to mean a 21% and 9% share of generation from renewables and nuclear, respectively. In contrast, Figure 5.23 of the study, which is also related to the

Green Case scenario, reports generation values of 18%, instead of 30%, from alternative sources. The figure also shows a 23% share from natural gas in 2030, which is lower than the 25% targeted by GEC. The reason for these discrepancies is unclear. Also, the emission reductions achieved in the modelled scenario was 12% below 2012 levels in 2030, which is slightly lower than the 15% target of the GEC.

Due to these inconsistencies of the modelled scenario with the GEC power sector targets, we consider the investment estimates presented in World Bank [2017c] to be lower bound estimates of the investments needed to meet the GEC target.

In comparison to the base case which is also modelled in the World Bank [2017c] study, the green case power sector scenario does not require any additional investments, but rather results in US$625 million in cost savings over the period from 2015 to 2030.[14] For reference, the total investment costs in 2015 to 2030 in the green case is US$41.5 billion.

The investment cost savings are the net result of reduced installed capacity of gas power plants, which is partially offset by a higher deployment of nuclear technology in the green case compared to the base case. No additional investment costs are estimated for renewable generation technologies, due to the assumption that the installed capacity of variable renewable energy is the same in the two scenarios.[15] The reduced gas generation can be attributed to the energy efficiency measures implemented in the green case, which means that electricity demand in 2030 is 18 TWh lower under this case compared to the base case.[16]

3.2.3 Summary of additional investments needed for the Green Economy Concept

In summary, the following estimates were made of additional investments required to meet the Green Economy Concept:

- Non-power sector related investments directly affecting GHG emissions: $\$US_{2016}$ 19 billion
- Power-sector related investments $\$US_{2016}$ 0 – 26 billion
- Investments not directly affecting GHG emissions: $\$US_{2016}$ 15 billion

Combining these different figures, we use a final estimate of additional investment requirements for the achievement of the complete suite of GEC targets of **$US\$_{2016}$ 34–60 billion.**

[14] Refer to Table 5.8 of World Bank [2017c] for further details.

[15] See Table 5.3 in World Bank [2017c].

[16] Obtained from a comparison of Figures 5.13 and 5.23 in World Bank [2017c].

3.3 Demand for Green Investment related to Adaptation

3.3.1 Key Adaptation Issues

Kazakhstan has not yet developed a National Adaptation Plan. However, the country is in the process of doing so with the support of the UNDP, a process that started in July of 2016. According to the Third National Communication the agricultural and the water sector as the most vulnerable.[17] Managing water stress, i.e. the limited availability of water for irrigation, industrial uses and as drinking water, is a key strategic priority in the Green Economy Concept and has been referred to as a national security issue.[18] Kazakhstan's water efficiency is very low both in agriculture and in industrial. Some regions in Kazakhstan already face significant water shortages, and much of Kazakhstan's arable land is subject to draught. Over the next two decades the water shortage is expected to increase dramatically. According to the UNDP, a combination of rising temperatures, declining average rainfall, and regional deglaciation threaten to cause:[19]

- Increased drought risk in rainfed farmlands
- Increased salinization risk in irrigated farmlands
- Increased erosion risks in both farmlands and rangelands
- Declining rangeland water resources, leading to overstocking and erosion around remaining water resources
- Decreased habitat for native fauna

Adaptation is only mentioned in passing in the Green Economy Concept. However the activities referred to under the principles of "Sustainable Water Use" and "Achieving Sustainable and High-Productivity Agriculture" overlap closely with the adaptation priorities. According to the Green Economy Concept, it is the government's goal to ensure a sustainable access to water for residents and agriculture and close the water gap by 2050. Future challenges to the water balance result from climate change and is aggravated by management issues of transboundary rivers, where Kazakhstan is dependent on the actions of upstream countries, such as China, Russia, Uzbekistan and the Kyrgyz Republic. The climate-change-related accelerated melting of glaciers temporarily improves the water balance before 2050, but this will negatively affect long-term water supply.

Water-saving measures in agriculture, which accounts for two-thirds of water consumption in Kazakhstan, and infrastructure improvement measures in the water sector have received due attention in Kazakhstan. However, they are more likely to take place under the impetus of increasing employment, enhancing food and energy security and improving public health rather than with a view to adapt to climate change.[20]

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[17] https://unfccc.int/files/national_reports/annex_i_natcom_/application/pdf/kaz_nc3,4,5,6_eng.pdf, page 7.

[18] Concept for transition of the Republic of Kazakhstan to Green Economy. Astana 2013, p. 12-18.

[19] http://www.adaptation-undp.org/projects/spa-community-based-adaptation-kazakhstan

[20] III-VI National Communication of the Republic of Kazakhstan to the UN Framework Convention on Climate Change. Astana 2013, p.23.

3.3.2 Legal Basis for Climate Change Adaptation Measures

There are no national or local policy and legal documents on climate adaptation in Kazakhstan. In 2017 the Ministry of Energy initiated the drafting of the law on climate change adaptation and on June 30, 2017 the document was submitted to the Ministry of Justice. It is expected that the draft concept will be adopted by September of this year by the inter-ministerial commission.

The draft concept outlines the planned development of legislation on climate change adaptation, climate change mitigation, the regulation of ozone-depleting substances, and waste management. Regarding climate change adaptation the draft addresses the following needs for the development of legal and policy frameworks: glossary of terms; competencies of public authorities; policy and process of planning of adaptation measures; process and criteria for identification and determination of climate adaptation measures; monitoring and assessment; reporting on climate change adaptation; finance for climate risk assessment and implementation of measures on climate change adaptation.

The key public authority in Kazakhstan for the development and implementation of national policies and measures on climate change is the Department of Climate Change within the Ministry of Energy. It consists of two sub-departments: The sub-department of Low-Carbon Development and the Sub-department of Adaptation and Climate Risks. In fact, there is no clear-cut distribution of competencies on climate change and climate change adaptation in the Department of Climate Change. Other important national ministries for climate adaptation are the Ministry of Agriculture (which is responsible for water resources, agriculture, forests, national parks, and land management), the Ministry of Internal Affairs (which is responsible for disaster prevention and response), the Ministry of National Economy, the Ministry of Investments and Development, the Ministry of Healthcare, and the Ministry of Finance.

3.3.3 Green investments in climate change adaptation

No national or local cost estimates for climate change adaptation have been conducted in Kazakhstan. The draft concept of the law on climate change adaptation indicates that no additional funding from the national budget is needed for the implementation of the proposed legislative amendments. The currently agreed approach to planning and financing climate adaptation measures is to identify climate change adaptation measures among those measures that are currently financed and implemented under different programmes, in particular those for the agriculture and the water sector.

The Green Economy Concept has identified water saving measures in agriculture, industry and municipalities and estimated the cost to be US$8.5 billion until 2030, of which US$3.3 billion would need to be funded by public investment. Additional supply-enhancing measures in irrigation infrastructure, reservoir management and groundwater extraction would be needed to fully close the water gap, however no cost estimates are available at his time. Much of such needed investment can be considered as adaptation investment, where adaptation is understood not as a limited environmental issue but rather as a cross-cutting economic theme comprising various important economic activities relating to businesses, infrastructure, agriculture, water, energy.

The key measures within the agricultural sector that are contained in the Green Economy Concept are:

- Adoption of water-saving irrigation techniques (such as drip irrigation)
- Move to more water-efficient crops, for example by reducing the areas for rice and cotton
- Metering of water consumption and water tariffs that reflect costs as well as water scarcity

These would be supplemented by water saving measures in industry and municipal water networks. In addition to initiatives that take place under the general headings of agriculture and water infrastructure there have been a few initiatives specifically designed as climate change adaptation measures. The projects displayed in Table 9 are the exception, as they have relied on international funding.

Table 9 Financing of adaptation projects in Kazakhstan

Source of funding	**Project Description**	**Approved in**	**Amount Million US$**	**Co-Financing Million US$**
Asian Development Bank	Irrigation Rehabilitation Project[21]	planned	250	
EBRD	South Kazakhstan Water Supply Project[22]	2016	180	21.4
Islamic Development Bank	Rehabilitation of Irrigation and Drainage Project[23]	2016	249.57	
World Bank	Second Irrigation and Drainage Project[24]	2013	102.9	240.1
European Investment Bank	Climate change adaptation projects in the agri-food sector. Implemented via KazAgro National Management Holding	2013	158.9[25]	N.A.
GEF / UNDP	Community-Based Adaptation Programme, Kazakhstan: Small-scale demonstration projects (10 projects)	2009	0.4	0.5
GEF / UNDP	Supporting Sustainable Land Management in Steppe and Semi-arid Zones through Integrated Territorial Planning and Agro-environmental Incentives	2015	1.9	9.5
GEF / UNDP	Rangeland Ecosystem Management-under CACILM Partnership Framework, Phase 1	2008	0.95	2.9
GEF / World Bank	Forest Protection and Reforestation	2005	5.0	58.8

[21] https://www.adb.org/projects/50387-001/main#project-pds

[22] http://www.ebrd.com/work-with-us/projects/psd/south-kazakhstan-water-supply-project.html

[23] http://www.isdb.org/irj/servlet/prt/portal/prtroot/tenderuser.TenderEndUser?Title=GENERAL%20PROCUREMENT%20NOTICE%20_%20GPN

[24] http://projects.worldbank.org/P086592/second-irrigation-drainage-improvement-project?lang=en

[25] OECD. Environmental Lending in EU Eastern Partnership Countries. 2016, p.47/48.

3.4 Stocktake of the CIF and GEF implementation in Kazakhstan

3.4.1 Green Finance for Kazakhstan from Climate Investment Funds (CIF)

The Climate Investment Funds (CIF) include four key programmes as shown in Table 10 that help developing countries pilot low-emissions and climate resilient development. Total CIF pledges of $8.3 billion are expected to attract an additional $58 billion of co-financing for a portfolio of over 300 projects in 72 countries.[26]

Table 10 Financing Windows under the Climate Investment Funds

Name of Fund	**Countries**	**CIF Funding available Billion US$**	**Average Co-Financing Ratio**	**Targeted Sectors**
Clean Technology Fund (CTF)	Middle-Income Countries	5.6	10:1	Renewable Energy, Energy Efficiency, Sustainable Transport
Pilot Program for Climate Resilience (PPCR)	Developing Countries	1.2	2:1	Climate Resilience, Climate Change Adaptation
Scaling Up Renewable Energy in Low Income Countries Program (SREP)	Low-Income Countries	0.78	7:1	Renewable Energy
Forest Investment Program (FIP)	Developing Countries	0.78	1.5:1	Forestry

As an upper middle-income country Kazakhstan has so far received funding only from the Clean Technology Fund. The country is not eligible for SREP funding, which is targeted at low-income countries. Kazakhstan has also not received any funding under the PPCR or FIP programmes. The country is quite different from those countries that have received funding. Those are typically poorer countries located in Africa, Latin America or South-East Asia. The only Central Asian countries to receive PPCR funding are the Kyrgyz Republic and Tajikistan, both considerably less developed than Kazakhstan. No Central Asian countries have received funding under the FIP. Going forward, the Clean

[26] https://www.climateinvestmentfunds.org/

Technology Fund remains the most promising financing window of the Climate Investment Funds.

3.4.2 Current Funding from the Clean Technology Fund

In 2009, the Government of Kazakhstan prepared its investment plan for the CTF. The plan was updated in April 2013, and it requests USD 200 million in funding from the Clean Technology Fund.[27] The support is expected to mobilize an additional US$ 1 billion of co-financing in the areas of renewable energy, district heating and energy efficiency. The plan covers two thematic areas: renewable energy development (US$ 116 million) and municipal energy efficiency and district heating modernization (US$ 84 million). Up to now six projects have been approved in Kazakhstan with CTF funding amounting to US$ 108.8 million as shown in Table 11.[28]

Table 11 CTF funding for green investments in Kazakhstan

Source of funding	**Implementing MDB**	**Project Description**	**Status**	**CTF Funding million US$**	**Co-Financing million US$**
Clean Technology Fund	EBRD	Energy efficiency in district heating	Approved in October 2014	34.0	160.0
	EBRD	Renewable and energy efficiency projects by KAZREFF[29]	Approved in October 2015	29.5	95.0
	EBRD	Waste-to-energy projects	Approved in December 2012	22.4	80.6
	EBRD	Yereymentau wind power plant	Approved in November 2014	20.7	0
	EBRD	Energy efficiency in rail transport	Approved in November 2013	1.0	28.4
	IFC	Advisory services for investments in renewables	Approved in June 2014	1.2	2.7
Total				108.8	366.7

[27] https://www.climateinvestmentfunds.org/sites/default/files/meeting-documents/ctf_tfc.11_5_update_of_ctf_investment_plan_for_kazakhstan.pdf

[28] See the website of the Climate Investment Funds at https://www-cif.climateinvestmentfunds.org/projects?field_related_country_target_id=53&field_mdb_tid=All&field_sector_tid=All&field_pp_sector_tid=All&field_related_fund_target_id=All&title=

[29] EBRD's Kazakhstan Renewable Energy Financing Facility.

From December 2012 to October 2015, an average of US$ 36 million in CTF funding per year was approved, with a co-financing of US$ 122 million per year.

3.4.3 Green Finance for Kazakhstan from the Global Environment Facility (GEF)

Kazakhstan is not a donor country to the GEF but receives GEF funding for projects. Altogether, Kazakhstan has received funding for 33 national projects,[30] with a total of US$ 104 million in GEF funding and US$ 577 million in co-financing. Most of the funding was in the areas of Climate Change, Land Degradation, Biodiversity and Persistent Organic Pollutants. Kazakhstan has been supported by the GEF since 1996 and from 2007-2016 received an average of US$ 8 million per year in GEF funding, which was used to mobilize approximately US$ 50 million in additional co-financing for green investments.[31] Some of the key projects are listed in Table 12 below.

Table 12 Selected GEF funded projects for green investments in Kazakhstan

Implementing Agency	**Project Description**	**Approved in**	**GEF Funding, million US$**	**Co-Financing million US$**
UNDP	City of Almaty Sustainable Transport	2010	4.9	76.5
UNDP	Nationally Appropriate Mitigation Actions for Low-carbon Urban Development in Kazakhstan	2013	5.9	65.3
UNDP	De-Risking Renewable Energy Investments	2016	4.5	32.5
UNDP	Sixth Operational Phase of the GEF Small Grants Programme in Kazakhstan	2016	2.6	4.7
EBRD	Reducing GHG Emissions through a Resource Efficiency Transformation Programme (ResET) for Industries in Kazakhstan	2011	7.1	45.0

[30] This includes funding for one project under the Special Climate Change Fund (SCCF). See https://www.thegef.org/country/kazakhstan

[31] Own calculations based on data from https://www.thegef.org/country/kazakhstan

3.5 Comparison of different finance estimates

The total additional investment required to reach the NDC is estimated to be $US\$_{2016}$ 140 billion across all sectors from now until 2030, while the additional investments required to meet the entire suite of GEC targets (including those not directly impacting GHG emissions) is expected to be $US\$_{2016}$ 34–60 billion.

The average *annual* additional investments to achieve the unconditional NDC target are about $US\$_{2016}$ 7 billion, which is equivalent to an average of 4% of GDP from now until 2030.[32] To achieve the GEC targets, annual average additional investments in the order US$2–4 billion are needed, which is equivalent to 1–2% of GDP in 2016. Further details on how this was evaluated from the TIMES modelling are presented in the Annex.

These estimates are slightly higher, but comparable with estimates of green finance needs on a global scale. For example:

- The World Economic Forum [2013] estimated that the average annual additional investments under a 2°C compatible pathway over the period from 2010–2030 is $US\$_{2016}$ 0.8 trillion or approximately 1% of global GDP.[33] These investments include measures for both climate change mitigation and adaptation.
- McCollum et al., [2013] evaluated a central estimate for additional investments of $US\$_{2016}$ 0.9 trillion per year ($US\$_{2010}$ 0.9 trillion)—also approximately 1% of global GDP[28] in 2016—are needed over 2010 and 2050 in the energy sector alone to transition to an economy that is compatible with a 2°C climate change target. The lower and uppper bound of this investment estimate was $US\$_{2016}$ 0.3 – 1.7 trillion per year, or 0.3–2% of global GDP.
- The New Climate Economy [2014] estimated that cumulative additional infrastructure investments of $US\$_{2016}$ 4.5 trillion over 2015–2030 are needed in the low-carbon transition, or approximately 0.3% of global GDP. [28]
- The Stern review [2006] estimated that stabilising GHG emissions at between 500 to 550 ppm[34] CO_2e will cost around 1% of GDP. The review's literature analysis found that cost estimates ranged from -2% to +5% of GDP.
- The IPCC [2014] found that scenarios that limit the atmospheric concentration of GHGs to a level that is likely to restrict warming to 2°C entail losses in global consumption of 1–4%.

[32] We adopt the GDP growth rates that were used in the TIMES modelling; these GDP growth rates equate to an average compound growth rate of 3.7% between 2015 and 2030. To obtain the *annual* additional investment cost, the *cumulative* investment costs were spread over a period of 20 years; this is equivalent to the number of years between the NDC target year (2030) and the base year of the TIMES modelling (2010).

[33] To convert absolute investment costs into costs as a percentage of GDP, a real GDP growth rate of 4.2% is assumed over the period to 2030 [IEA, 2017]. This growth rate was applied to World GDP from the World Bank [2017b].

[34] A CO_2e GHG cocnentration of around 500ppm is equivalent to a "more likely than not" or "about as likely as not" probability of limiting warming to 2°C. The applicability of "more likely than not" or "about as likely as not" depends on whether GHG emissions overshoot 530 ppm CO_2e [IPCC, 2014].

The volumes of finance needed to meet Kazakhstan's targets are much larger than the financing received from the CIF and GEF, and the associated co-financing of these projects. A total of US$109 million was received from CIF with US$367 million in co-financing, and US$104 million was provided from GEF with $US577 million in co-financing.

While the CIF and GEF funds are not the only source of green finance in Kazakhstan, the order of magnitude difference between current CIF and GEF investments and the finance requirements estimated in this study suggests that the development of a green financial system and the introduction of complementary domestic policy incentives in Kazakhstan will be key to triggering the investments needed to transition to a low-carbon economy.

3.6 Demand for Green Investment in Central Asian region

AIFC's strategy calls for developing into a regional hub for green finance, with an intention to cover the Central Asian region, including the Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. Table 13 shows summary statistics for the four countries, plus Kazakhstan.

Table 13 Summary Statistics for Central Asian countries

Indicator	**Kazakh-stan**	**Turkme-nistan**	**Uzbe-kistan**	**Kyrgyz Republic**	**Tajikistan**
Population (million, in 2016)	17.92	5.66	32.12	6.14	8.7
GDP (USD billion, 2016)	133.66	36.18	67.22	6.55	6.95
Energy-related CO2 (Mt, 2014, IEA)	223.69	67	97.9	8.36	4.66
Electricity Consumption (TWh, 2014, IEA)	96.82	14.64	50.61	11.33	12.38
Total Primary Energy Supply (Mtoe, 2014, IEA)	76.67	26.75	43.68	3.8	2.8
GDP / capita (USD, 2016)	7459	6392	2093	1067	799
UN Classification	Upper Middle Income	Upper Middle Income	Lower Middle Income	Lower Middle Income	Low Income

In Table 14, the statistics for each of the four countries are expressed as a ratio compared with Kazakhstan. Clearly Turkmenistan is the country most similar to Kazakhstan. The economy, population, primary energy supply and CO2 emissions are all about 30% of Kazakhstan's values. A plausible figure for the demand of green investment is therefore 30% of Kazakhstan's value. For Uzbekistan the economy, energy and CO2 figures are all approx. 50%. However, since Uzbekistan has a much lower GDP per capita, a plausible estimate for the demand for green investment is therefore chosen as

30% of Kazakhstan's figure. Tajikistan and the Kyrgyz Republic are both small and have a low GDP per capita. Together they are estimated to have a demand for green investment equaling 5% of Kazakhstan's figure. In total, Central Asia without Kazakhstan is expected to have a demand for green investment of about 65% of Kazakhstan's figure. For Tajikistan and the Kyrgyz Republic, adaptation is expected to play a larger role than for Kazakhstan. They are also expected to largely rely on concessionary financing from international sources.

It is noted that these comparisons assume that all Central Asian countries would have emission reduction targets comparable to those of Kazakhstan and engage in a similar transition programme to a green economy.

Table 14 Key statistical indicators in other Central Asian countries compared to Kazakhstan

Indicator	**Kazakhstan**	**Turkmenistan as % of Kazakhstan**	**Uzbekistan as % of Kazakhstan**	**Kyrgyz Rep. as % of Kazakhstan**	**Tajikistan as % of Kazakhstan**
Population (million, in 2016)	17.92	32 %	179%	34 %	49 %
GDP (USD billion, 2016)	133.66	27 %	50%	5 %	5 %
Energy-related CO2 (Mt, 2014, IEA)	223.69	30 %	44%	4 %	2 %
Electricity Consumption (TWh, 2014, IEA)	96.82	15 %	52%	12 %	13 %
Total Primary Energy Supply (Mtoe, 2014, IEA)	76.67	35 %	57%	5 %	4 %
GDP / capita (USD, 2016)	7459	86%	28%	14%	11%
UN Classification	Upper Middle Income	Upper Middle Income	Lower Middle Income	Lower Middle Income	Low Income
Green Investment	100%	30%	30%	2,5%	2,5%

4. References

We have used following data sources available to estimate the demand for green investment in Kazakhstan:

[BUR, 2015] The Second Biennial Report of the Republic of Kazakhstan, published in 2015

[EnEco Solutions, 2017] Personal communication of outcomes of TIMES modelling used for the BUR, 2015 scenarios.

[GreenStream, 2016] Technology roadmap: for a low-carbon future of the Kazakhstan cement industry

[GEC, 2013] Concept for transition of the Republic of Kazakhstan to Green Economy, published in 2013

[IEA, 2017] Framework assumptions. https://www.iea.org/etp/etpmodel/assumptions/

[IEA, 2016] Energy Balances

[IEA, 2014] CO2 emissions from fuel combustion

[IPCC, 2014] Climate Change 2014 Mitigation of Climate Change; Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

[McCollum et al., 2013] "Energy Investments Under Climate Policy: a Comparison of Global Models", Climate Change Economics, 4(4), (2013)

[NDC, 2015] The Kazakh Nationally Determined Contribution, submitted to the UNFCCC in 2015 (used for emission reduction estimate only)

[NERA and BNEF, 2011] The Demand for Greenhouse Gas Emission Reduction Investments: An Investor's Marginal Abatement Cost Curve for Kazakhstan

[New Climate Economy, 2014] Better Growth, Better Climate: The New Climate Economy Report

[Stern, 2007]. The economics of climate change: the Stern review. Cambridge University Press

[UNFCCC, 2017] National Inventory Submissions 2017

[World Bank, 2017a] GDP growth (annual %)

[World Bank, 2017b] GDP (constant 2010 US$)

[World Bank, 2017c] Stuck in transition : reform experiences and challenges ahead in the Kazakhstan power sector

[World Bank, 2017d] GDP (current US$)

[World Bank, 2017e] GDP deflator

[World Economic Forum, 2013] The Green Investment Report: the ways and means to unlock private finance for green growth

Annex: Calculations of investment costs using BUR-TIMES

Post-modelling adjustments to TIMES modelling

We have modified the TIMES scenarios as provided by EnEco Solutions [2017] to ensure consistency with the BUR, which covers 100% of Kazakhstan's emissions. The total volume of emissions modelled in the TIMES scenario is a subset of the emissions covered in the BUR. This is due to the incomplete emissions coverage of the TIMES model and inconsistencies between the national energy balances and national inventories. We have addressed this discrepancy between the BUR and TIMES scenarios by adding an additional emissions category to capture these missing emissions as shown in the Table 15 below. From these figures, the emission reductions implied in the WAM scenario compared to the WOM scenario were evaluated.

Table 15 Emissions excluding LULUCF covered by TIMES modelling compared to the BUR in the WOM and WAM scenarios. The emissions reductions in the WAM scenario compared to the WOM scenario are also displayed. Note that the emissions not modelled is the difference between the emissions reported in the BUR and the emissions covered in the TIMES model.

	Emissions in WOM scenario ($ktCO_2e$) excluding LULUCF			Emissions in WAM scenario ($ktCO_2e$) excluding LULUCF			Emissions reductions of WAM scenario vs WOM ($ktCO_2e$)		
	TIMES	BUR	Emissions not modelled	TIMES	BUR	Emissions not modelled	TIMES	BUR	Emissions not modelled
2010	249,169	308,842	59,673	239,985	308,842	68,857	9,184	0	-9,184
2015	278,693	345,075	66,382	260,653	315,388	54,736	18,040	29,687	11,647
2020	304,338	381,308	76,970	256,109	321,934	65,825	48,228	59,374	11,146
2025	331,239	418,943	87,704	255,236	322,158	66,922	76,003	96,785	20,782
2030	359,835	456,578	96,743	259,782	322,382	62,600	100,052	134,196	34,144

Next, the *additional* investment costs required in the WAM scenario was calculated by taking the difference between the *total* investment costs in the WOM scenario and the WAM scenario which were estimated using the TIMES modelling. As these additional investment costs only account for the emissions covered in the TIMES modelling, and do not account for the remainder of emissions in the economy not modelled in TIMES, the following approach was taken to estimate the investment costs of the remaining emissions:

1. It is assumed that the average additional investment cost per tCO_2e abated is constant for sectors included and excluded from the TIMES modelling. This figure

was calculated by dividing the additional investment cost in one year by the emissions abated.

2. The product of this average additional investment cost per tCO_2e and the emission reductions achieved in the sectors not modelled yields the additional investment cost of the remaining emissions.

The figures evaluated are listed in Table 16 below.

Table 16 Post modelling adjustments to evaluate total additional investments in the WAM scenario vs WOM scenario

	2010	2015	2020	2025	2030
Additional investment costs from TIMES modelling per year (US$ $_{2016}$ million)	127	452	2,443	9,556	15,561
Additional investment cost per year (US$ $_{2016}$/tCO_2)	14	25	51	126	156
Investment costs in sectors not modelled per year (US$ $_{2016}$ million)	-127	292	565	2,613	5,310
Total additional investments per year (US$ $_{2016}$ million)	0	744	3,008	12,169	20,872

Calculating investment costs to meet NDC targets

The cumulative additional investments to 2030 were evaluated by linearly interpolating the investment costs between each data point and summing these values as shown in Table 17. This table shows that a total of $US $_{2016}$ 142 billion in additional investments is needed for 134 $MtCO_2$ of emission reductions in the WAM scenario. Of this amount, US$ $_{2016}$ 50 billion is related to investments in the power sector. The emission reduction in the uncodntional and conditional NDCs are respectively 98% and 126% of the total WAM emission reduction. These scaling factors were applied to the $US $_{2016}$ 142 billion total investment cost to obtain the additional investment costs for the NDC targets as displayed in Table 6. The same scaling factors were also applied to the power sector additional investments shown in Table 17.

Table 17 Additional investment costs for all sectors calculated in Table 16 are indicated in bold, with intermediate years calculated via linear interpolation. Investments in the power sector are also displayed.

Year	Total investment costs (US$$_{2016}$ million)	Power sector investment costs (US$$_{2016}$ million)
2010	**0**	**0**
2011	149	22
2012	298	43
2013	447	65
2014	596	86
2015	**744**	**108**
2016	1,197	254
2017	1,650	400
2018	2,102	546
2019	2,555	693
2020	**3,008**	**839**
2021	4,840	1,587
2022	6,672	2,336
2023	8,504	3,084
2024	10,337	3,832
2025	**12,169**	**4,581**
2026	13,909	5,145
2027	15,650	5,709
2028	17,390	6,274
2029	19,131	6,838
2030	**20,872**	**7,402**
Total	142,219	49,844

NDC costs as a percentage of GDP

Following scaling up, as described above, the investment costs needed to achieve the unconditional and conditional NDC targets were contextualised by evaluating the share of these costs as a percentage of GDP. Historical GDP figures (2010–2016) were obtained from the World Bank [2017d] and inflators [World Bank, 2017e] were applied to convert these from annual USD units into real US$$_{2016.}$ GDP was projected forward to 2030 using the growth rates used in the TIMES modelling. The average additional investment costs over 2010 to 2030 from BUR-TIMES were then divided by the average GDP over this period to calculate the average investment cost as a percentage of GDP. A summary of the investment costs as a share of GDP over 2010–2030 is displayed in Table 18. This table shows that to meet the NDC, additional investments of 4% or 5% of GDP are needed on average for the unconditional and conditional targets, respectively.

Table 18 Summary of investment costs as a share of GDP 2010–2030 based on BUR-TIMES. All figures displayed are average annual values over the period indicated.

	2010–2015	2016–2020	2021–2025	2026–2030	2010–2030
Average annual GDP (million US$2016)	217,666	142,816	172,930	210,827	184,962
Average additional annual investment costs to meet unconditional NDC (million US$2016)	439	2,067	8,363	17,101	6,659
Average additional annual investment costs to meet conditional NDC (million US$2016)	563	2,650	10,719	21,919	8,536
Investment costs to meet unconditional NDC as % of GDP	0%	1%	5%	8%	4%
Investment costs to meet conditional NDC as % of GDP	0%	2%	6%	10%	5%