Emissions Trading in Kazakhstan

Recommendations for Cap Setting

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Editorial information

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Summary

This country study has been developed and written as a product of a fellowship founded by the Alexander von Humboldt Foundation in co-operation with the German Emissions Trading Authority (DEHSt) at the German Environment Agency (UBA). We refer to the process of setting up a national allocation plan for the national emissions trading system (ETS) in Kazakhstan. We examine especially the longer term perspective until 2030, and what this perspective implies for the coming years.

The report aims at illustrating a systematic approach for how a cap path for the Kazakh ETS until 2030 could be derived, based on existing marginal abatement cost estimations of different mitigation in the ETS and non-ETS sectors. For this, we use cost estimations published by NERA/Bloomberg New Energy Finance in 2011 as an example to make illustrative – and at the same time in our view plausible – suggestions for the ETS cap size. We point out that the data base is from 2011, and furthermore it does not yet include the agriculture and forestry sectors which might affect the final potential of abatement and the cap size. Hence, it would be worthwhile to make new cost estimations of the type presented here but based on current data and including all sectors.

The result of our exemplary estimation is that the ETS cap in 2030 should be about 100 million tons of CO_2eq, if the current scope – power and heat, industry, and oil and gas extraction – is applied also in 2030. This can be compared to the overall Kazakh reduction target (minus 15 percent relative to 1990) which implies a target emission level of 304 million tons CO_2eq. From the current cap size of 154 million tons, the cap should be linearly reduced by 3.92 million tons CO_2eq each year from 2016 onwards.

In this respect, we generally agree with results by DIW Econ – a German consultant to the Kazakh government – regarding the suggestion to include a linear reduction path from today until 2030. However, in contrast to their suggestion, we propose stronger reductions in ETS sectors (and less in non-ETS sectors) because we indicate that there are many more cost-effective abatement options in the ETS sectors.

Similar results had been obtained in Germany from research calculations for the first and second trading period under the European Union's Emissions Trading Scheme (EU-ETS), indicating high emission reductions from ETS sectors when marginal abatement costs are taken as the main criterion instead of other calculation methods.

The primary component in emission reductions in Kazakhstan compared to business-as-usual development according to NERA/Bloomberg is from renewable energy sources, in particular wind energy and hydroelectric, and photovoltaic energy; coupled with efficiency improvements in heat generation. As all these options contribute to reducing emissions in the energy sector (as part of the ETS), this leads to the above-mentioned abatement potentials in the ETS sectors.

1 Introduction

A greenhouse gas emissions trading system (hereinafter referred to as ETS) was launched in Kazakhstan in 2013. Taking into account the already available three years' experience, it is possible to say that there is a set of questions which require clarification, and possibly make even modifications worthwhile considering.

In the first instance, the fundamental issue under discussion is the determination of an overall cap path for the years to come. The cap setting was keenly discussed within the framework of coordination of the second national allocation plan (NAP) for 2014-2015. In the first "pilot phase" in 2013, allowances were allocated for free to enterprises in accordance with the base line emissions of 2010, without a "reduction factor". In the second national allocation plan there was the first attempt made to apply a reduction factor which was set at 1.5 percent (0.985) compared to the average emissions of 2011-2012.

The Government of the Republic of Kazakhstan has initiated a process to suspend the ETS until 2018, in order to gain time to make changes that would render the ETS more robust in the future, and also to account for the impacts of the economic recession in Kazakhstan following global oil price reductions (Carbon Pulse, 2016).

The ETS cap, and its prospective path, is a key issue since companies participating in the ETS need clear indication on how the future rate of reduction is set for the ETS, so that expectations on allowance scarcity and prices can be formed. Besides this, given the national Kazakh emission reduction goals of 15 percent by 2020 and 15 percent/25 percent by 2030 (see details in chapter 3.1), decision on a cap path for the ETS sectors has also a strong impact on the sectors outside the ETS scope ("Non-ETS"): this means that ETS reduction obligations implicitly define the corresponding target for non-ETS sectors. Thus, ETS caps influence the overall efficiency of total abatement measures conducted in Kazakhstan.

A second central issue raised already from the launch of the ETS in Kazakhstan is the role and functioning of the allowance reserve in the NAP. Initially, the main idea of creating such a reserve was to grant assistance to enterprises in cases of expansions or the introduction of new entrant installations. The reserve was considered as the direct source for additional allowances on a free-of-charge basis. However, in the end, it was decided in the Environmental Code of the Republic of Kazakhstan that the reserve is subject to sale rather than free allocation, and designed only for new installations (i.e. not for expansion of capacity/activity). Thus, this design puts new installations in a disadvantageous situation compared to existing installations and, furthermore, an official source of additional allowance allocation for installation expansions[1] disappeared.

The national allocation plan for 2013 foresaw the reserve in the volume of 20.6 million tons of CO_2; the second national allocation plan for 2014-2015 specified 38.5 million tons of CO_2 for both years together. However, this volume was not used for the purpose of issuance of additional allowances (because of the above-mentioned change of rules for its use and because new entrants were in fact exempted from ETS for the respective NAP) and at present it remained unchanged. At the same time, in actual practice during the first three years of ETS operation there were issued additionally 32.6 million allowances for tons of CO_2 on a free-of-charge basis[2]. Issuance of these additional allowances was not made from any reserve, but the allowances were created on top of the "regular" cap, which effectively increased the ETS cap. Such situation exists because of incorrect legislative rules regulating the ETS.

A third issue regarding the current state of the Kazakh ETS is insufficient development of the ETS market, and lack of experience by market participants. As the number of allowances (net demand or net surplus) in the system determines its price, which is the signal for investors at taking the decisions about investments in low-carbon technologies, it may be important for the regulator (government) to adjust the overall supply of allowances. The ETS in Kazakhstan is considered "over-allocated", i.e. additional allowances issued were in substance an excessive measure. The absence of long-term fixed emission limits and a non-operating reserve do not promote the development of the system as a whole.

The main goal of this study is to describe the current situation in the Kazakh ETS, and address how its design could be improved in order to enhance firms' planning reliability and the functioning of the market. This is done with a special focus on the above-mentioned problem of defining a cap path.

For the question of defining a cap path, we focus on possible ways to derive the ETS cap by distributing (absolute) national emission reduction targets between the sectors included in the ETS versus those outside of it (non-ETS sectors). Here the study builds, inter alia, on experience acquired in the EU-ETS, particularly the process of setting up the National Allocation Plan (NAP) in Germany for the first and second trading phase (2005-07 and 2008-12, respectively). In this process, different options for this distribution of reduction effort between the ETS and non-ETS sectors ("effort sharing"), and the consequent derivation of the ETS cap, have been discussed. One of these approaches was the use of marginal abatement cost curves (MACC) of ETS and non-ETS sectors to derive proposals for the effort sharing and for an ETS cap. This study specifically addresses the MACC approach and gives first quantitative suggestions for an ETS cap path.

1 In 2015, changes were introduced to the legislative act, where the reserve was defined as the source for additional allowances issuance.

2 Total sum of additional allowances issued in 2013, 2014 and 2015.

A recent study by DIW Econ[3] also presented different options of an effort sharing (including MACC-based), but in the end uses simple proportional reductions of ETS and non-ETS-sectors based on historic proportions. At the same time, the European Bank for Reconstruction and Development (EBRD) commissioned a study in 2011 with the aim of identifying marginal abatement costs of different sectors in Kazakhstan[4]. The applicability of this latter study for recommendations with respect to a cap-setting process is one of the key discussions in this paper.

At the same time as using German experience for the Kazakh case, a second aim of this country study is to gain insights in key issues of designing an ETS in the context of a fast-growing economy. In comparison to nearly all Member States of the European Union, Kazakhstan projects annual growth rates in the order of five percent after 2020 and until 2030. Plausibly, this affects the relative abatement costs of different emission reduction options throughout the economy, and thereby also affects a cost-based effort sharing between ETS and non-ETS sectors: for example, by allowing for new technologies to be used in new capital investments, such reduction options can be expected to be substantially cheaper than in situations of (nearly) stagnant industrial production.

Methodology

For the purpose of our cap-setting estimations, we use the above-mentioned MACC report developed for the EBRD in 2011 by NERA Economic Consulting jointly with Bloomberg New Energy Finance (henceforth stated as "NERA/Bloomberg" or just "NERA"). To our knowledge, these are the only MACC developed for Kazakhstan on a comprehensive basis, for the whole economy. Based on their mid-term forecasts of GHG emissions and on the business-as-usual projections by DIW Econ, we first determine the emission "gap" – i.e. the additional reduction amount required for achievement of the national Kazakh GHG emissions reduction targets for the year 2030. Using data of MACC it is then possible to identify the potential scale of reduction in ETS and non-ETS sectors and calculate emission limits for each of them. The projections we use have a focus on the year 2030. In order to derive suggestions for a cap path from 2016 to 2030, we also briefly discuss issues related to this analytical step.

As carrying out our own modelling of the forecast of GHG emission for a long-term period (2020 to 2030) is beyond the scope of this study, we consider forecasts from the above-mentioned reports by NERA/Bloomberg and DIW Econ as baseline calculations.

2 Overview: Economic Developments and Emissions Trading in Kazakhstan

This introduction describes the main path and general information about the Kazakh economy; also here we provide information about climate and energy targets which have been set in the long term development strategy of the national government in Kazakhstan. In addition, in this chapter we provide general information about the Kazakh ETS: main elements, overview of the allowance trading, and lessons learnt during three years of ETS functioning.

2.1 Economic Developments in Kazakhstan

Kazakhstan is geographically the second largest of the former Soviet republics (after the Russian Federation) and the largest economy in Central Asia. With a nominal Gross Domestic Product (GDP) of 212 billion USD and over 17 million inhabitants, GDP per capita based on international dollars (PPP)[5] amounts in 2014 to over $24,000 and is comparable to European countries like Hungary or Poland. As such, Kazakhstan is classified as an upper middle income country by the World Bank[6].

3 DIW Econ 2015: Proposal for the National Allocation Plan 2016-2020 for Kazakhstan, published April 2015.

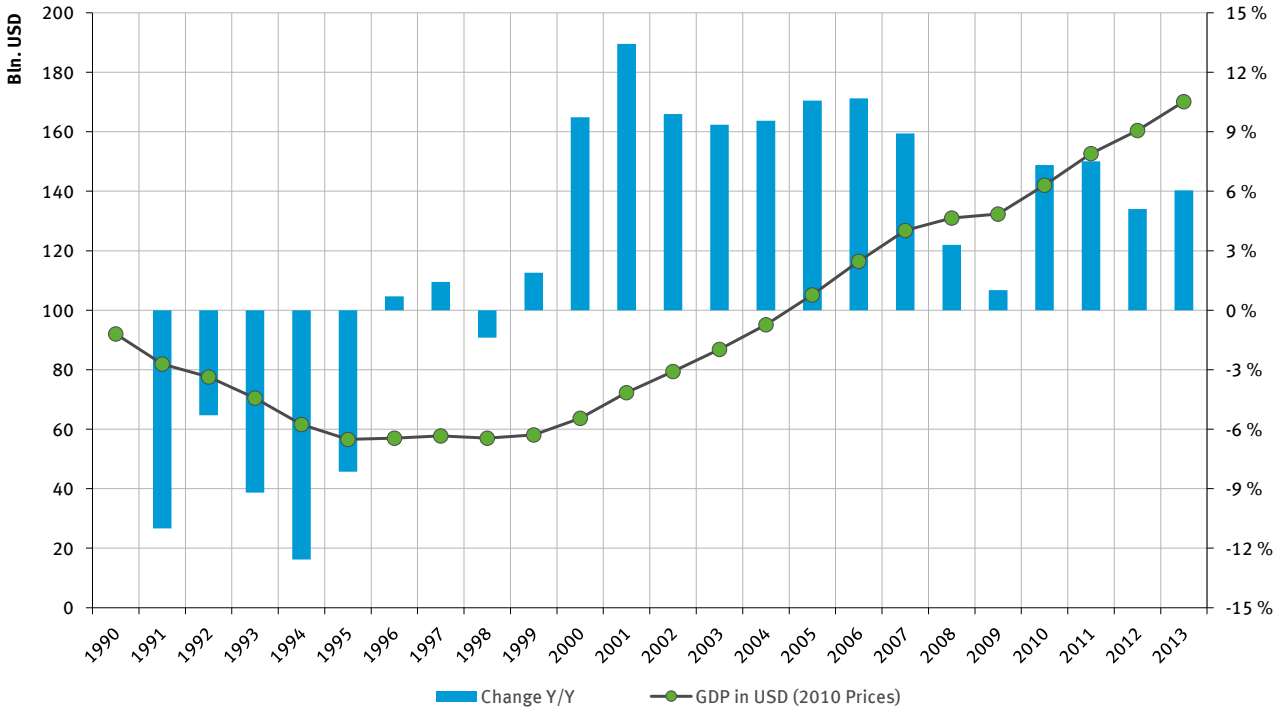
4 Report "Investment demand for GHG emission reduction: Marginal abatement cost curve of investors in Kazakhstan". Prepared for the EBRD. September, 2011.

5 World Bank: GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

6 http://data.worldbank.org/country/kazakhstan

Kazakhstan's economic welfare is mainly derived from the country's vast endowment of natural resources, such as hydrocarbons and numerous types of minerals. Kazakhstan's economy is therefore highly dependent on extractive industries and on the oil & gas sector in particular, which accounts for 60 percent of total exports and more than 25 percent of GDP.

The economy of the Republic of Kazakhstan is thus primarily based on energy-intensive industries. A large number of industrial and energy companies of the country use outdated technology and operate the equipment with a significant degree of wear. Emissions intensity of GDP in Kazakhstan, the total amount of energy related CO_2 emissions necessary to generate one unit of GDP, is among the top ten in the world.[7] In 2014 the CO_2 intensity amounts to 0.65 kg CO_2/$2005PPP (Germany: 0.25 kg CO_2, China: 0.55 kg CO_2).



Source: Thomson Reuters, Oxford Economics

Figure 1: Kazakhstan's GDP in USD since 1990

Kazakhstan has enjoyed robust GDP growth since 2000. Between 2000 and 2007 Kazakhstan's economy had strong and sustained annual growth rates that averaged ten percent. The country experienced rapid growth as it took advantage of its natural resources (oil, gas), which allowed the country to rapidly increase the export values. Further growth sharply dipped to around two percent in 2008 and 2009 due to the global financial crisis. From 2010, growth almost re-assumed its annual increases from before 2008. However, Kazakhstan now is experiencing a recession, resulting primarily from fallen commodities prices. For 2016 to 2020, the economy is expected to accelerate modestly and expand by 2.7 percent annually.

Thanks to robust economic growth, the unemployment rate in Kazakhstan has declined rapidly since 2000. The downward trend rate remained intact also during the global economic crisis between 2008 and 2009, with the unemployment rate at 5.2 percent in 2013, less than half of its level in the early 2000s.

The total trade value of the Republic of Kazakhstan for the first half of the year 2015 amounted to USD 39.5 billion, this is 36.1 percent less compared to the same period of the previous year. Export value decreased by 43.4 percent to USD 24.1 billion, while imports decreased by 19.8 percent to USD 15.5 billion. Overall, the trade-balance now only amounts to plus USD 8.6 billion[8]. Declines in prices as well as output for main export products (resources) contributed to this trend. The following Figure 2 illustrates Kazakhstan's dependency on resource exports during the years 2008 to 2013.

7 http://knoema.de/GESY2015/global-energy-statistical-yearbook-2015

8 "An analysis of Kazakhstan's external turnover". H1 2015 issued by National Export and Investment Agency KAZNEX INVEST.

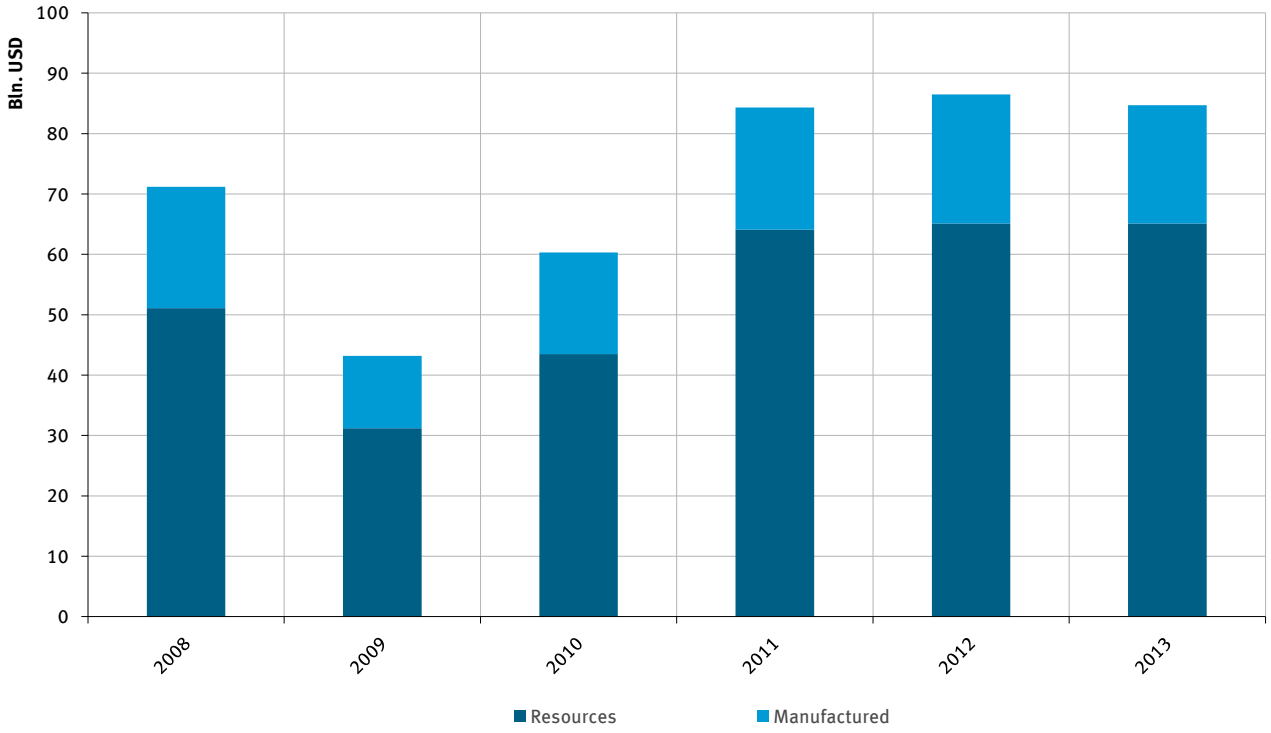


Figure 2: Structure of Kazakhstan's export 2008-2013[9]

Climate and energy targets/policies in the Republic of Kazakhstan

There are several different strategic documents in Kazakhstan which define main climate and energy targets. With the adoption of Strategy "Kazakhstan 2050", Concept of Transition to „Green Economy" and "Energy saving 2020" Kazakhstan has chosen a new way of a sustainable development. The Green economy concept is defined as an instrument for the country's economic development while, at the same time, reducing environmental footprint and degradation of natural resources.[10]

According to the strategic documents mentioned above Kazakhstan's **energy intensity** of GDP should be reduced until 2020 by at least 40 percent from 2008 levels, the share **of alternative[11] energy sources** in power generation should increase to 50 percent until 2050. In 2014, Kazakhstan has generated about 578 GWh of electricity from renewable sources (excluding large hydro power plants), that is only 0.62 percent of the total electricity production in the country[12]. At the end of the third quarter of 2015 the total installed capacity of renewables amounts to 234 MW (solar: 57 MW, wind: 60 MW, small hydro plants: 118 MW, biogas: 0.4 MW).[13] To encourage green investments, Kazakhstan is introducing fixed rates for 15 years on renewable energy: The feed in tariff rate for one MWh of electricity generated by onshore wind farms is KZT 22,680 (€ 69), solar KZT 34,610 (€ 105), small hydropower plants (capacity up to 35 MW) KZT 16,710 (€ 51), biogas KZT 32.230 (€ 98)[14]. Approved fixed feed in tariffs will be indexed annually for inflation rate. The feed in tariff rates for photovoltaic solar energy are similar to the ones in Germany (see BMWi 2016). They are a little lower than the German rates for wind energy (of about € 90); however, wind potential in Kazakhstan is considered very high (NERA/Bloomberg 2011).

9 "Analysis of Kazakhstan trend in a World trade (2014), published by National Export and Investment Agency "KAZNEX INVEST".
10 Concept for transition of the Republic of Kazakhstan to Green Economy, page 6.
11 Alternative energy sources include renewables as well as nuclear energy.
12 In 2014 Kazakhstan generated total 94,6 TWh of electricity.
13 Information provided by the Ministry of Energy of the Republic of Kazakhstan http://en.energo.gov.kz/index.php?id=3
14 http://www.rfc.kegoc.kz/v-kazaxstane-utverzhdeny-tarify-na-zelenuyu-elektroenergiyu/

Implementation of the "Green Economy" Concept should provide a significant step up towards achieving national targets on energy efficiency. Building and heat sectors, industry and transport had been specified in the Concept as major areas for energy saving and efficiency improvements. The power sector is one of the major parts of the "Green Economy" concept as well. Many steps should be done in order to modernize the sector: fuel switch from coal to gas, modernization and efficiency improvements of the power plants, investing in nuclear energy and developing new renewable sources.

According to the Concept the total value of investments required from 2013 to 2050 amounts to USD 3 to 4 billion per year. Investments will peak up to 1.8 percent of the GDP in the period from 2020 to 2024. It is estimated that the average investments until 2050 will be in the order of about 1 percent of the GDP. For the most part, these investments should be raised from private investor's funds. The largest share of these investments (slightly more than USD 90 billion or 3/4 of the total investments over the whole period until 2050) will be used for implementing *energy efficient measures and developing renewable energy* as well as *establishing gas infrastructure*.

Kazakhstan voluntarily pledged a **reduction of its greenhouse gas emissions** to 15 percent below 1990 levels by 2020 and 2030 (see more detailed information in chapter 3). In the context of reducing GHG emissions the most important targets which had been set by the Concept are introduced in the table below.

Table 1: Targets of the "Green Economy" Concept

Indicator	2020	2030	2040
Energy efficiency: reduction of GDP energy intensity, baseline 2008	25 %	30 %	50 %
Share of renewable sources in electricity production (solar and wind)	Not less than 3 %	30 %	50 %
Share of gas power plants in electricity production	20 %	25 %	30 %
Reduction of current CO_2 emissions in electricity production	2012 level	-15 %	-40 %
New power stations		55 %	
Expected electricity demand		136-145 TWh	186-206 TWh

2.2 Kazakhstan's ETS: Evaluation of the First Three Years of ETS Functioning in Kazakhstan

To better understand the design of Kazakhstan's ETS, in this section we provide information about historical GHG emissions in the country, general terms and results from the first three years ETS operation in Kazakhstan.

2.2.1 Historical GHG Emissions in Kazakhstan

According to the last GHG inventory in Kazakhstan, total GHG emissions in 2012 amounted to 283.5 million tons of CO_2eq (excluding LULUCF) – 21 percent below the 1990 level. Historical emissions excluding LULUCF have decreased in the 1990s, with the lowest level achieved in 1999 at 145.4 million tons of CO_2eq. Since then, emissions have been growing rapidly, driven mainly by the energy and industry sectors (see the figure below).

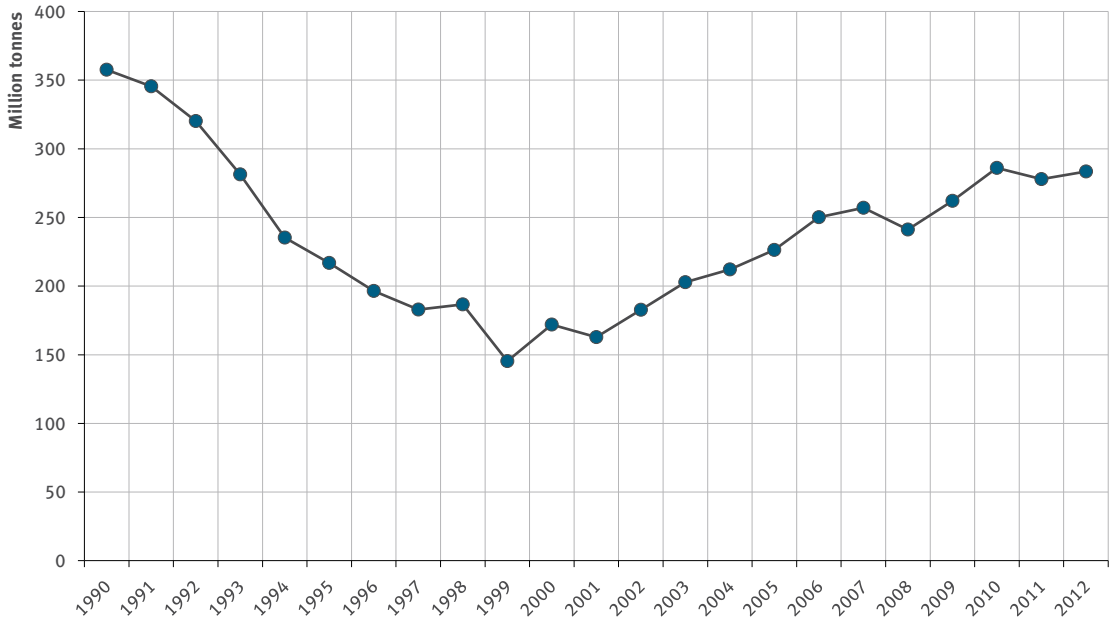


Figure 3: Kazakhstan's total national GHG-Emissions 1990-2012[15]

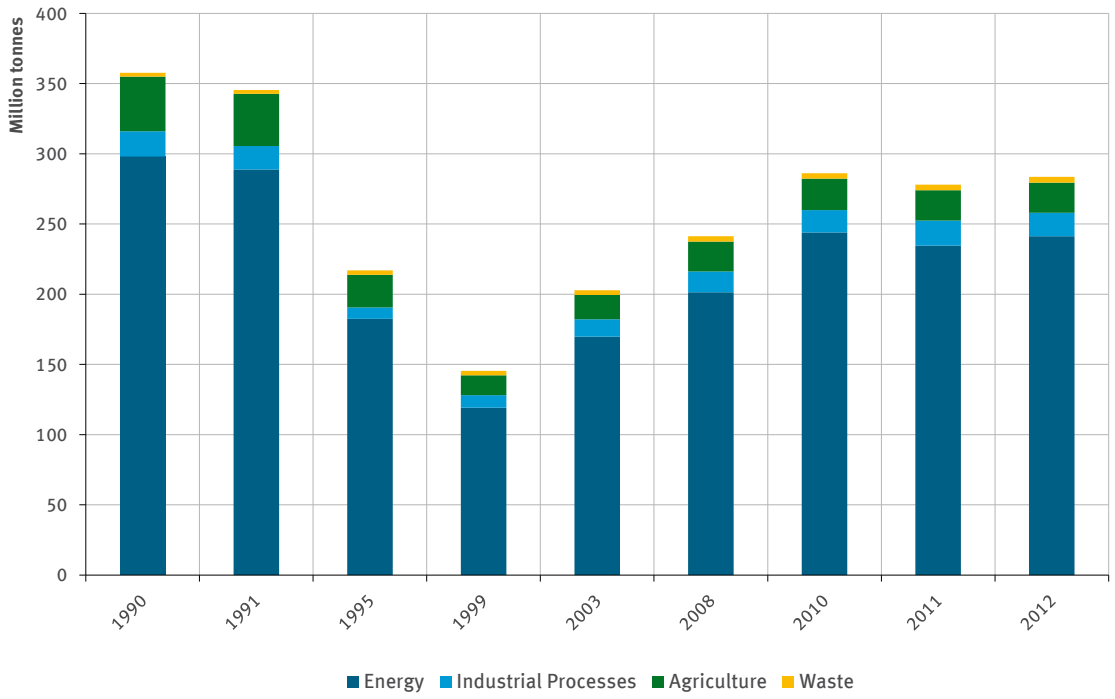


Figure 4: GHG-Emissions by sector 1990-2012[16]

Figure 4 above presents national emissions trends showing the share of each category of UNFCCC emission sources. Since 1990 the use of **energy** (i.e. power and heat, oil and gas, and energy-related emissions in industry, transport, private households, etc.) is the main source of GHG emissions in Kazakhstan and amounted in 2012 to 241.2 million tons of CO_2eq or 85 percent of the total national emissions. By GHG-Categories, carbon dioxide accounts for 86.3 percent of the total emissions, methane for 13.3 percent.

Industrial processes in Kazakhstan are the second largest source of GHG emissions. In 2012, total GHG emissions from the industry sector reached 16.7 million tons of CO_2eq. The largest contributor to total industry-related GHG emissions is the metal industry, accounting for about 60.3 percent; while emissions from the production of minerals account for 29.5 percent.

15 JSC "Zhasyl Damu" "GHG emissions Inventory data for Kazakhstan, 2014" (CRF format). The same information can be found by the following link: http://unfccc.int/di/DetailedByParty/Event.do?event=go

16 The graph has been created on the basis of GHG emissions Inventory data for Kazakhstan, 2014.

Agriculture is the third largest contributor of national emissions of direct greenhouse gases. This sector is the second largest source of methane (CH_4), accounting for 27 percent of total CH_4 emissions in 2012, and the main source of nitrous oxide (N_2O) accounting for 87.1 percent of national N_2O emissions.

Waste is the fourth largest GHG emission contributor in Kazakhstan and is permanently growing. Compared to the 1990 level GHG emissions from this source have doubled.

The ETS in Kazakhstan covers about half of the total national GHG emissions in 2012.

2.2.2 Kazakhstan's ETS Design

In December 2011, the President of the Republic of Kazakhstan signed a law introducing an additional chapter to the Environmental Code, which has been regulating the emissions trading system from January 2013. During 2012, it was prepared by a number of legislative acts which define the basic rules for the ETS.

According to the Environmental Code there are the following main basic elements of the ETS in Kazakhstan:

1. Three main economic sectors take part in Kazakhstan ETS: energy, industry, oil and gas sector (including oil and gas transport and coal mining). Transport and agriculture are also mentioned in the Environment Code as a subject of the ETS but these two sectors are not involved at the present time.
2. Operators whose annual emissions of greenhouse gases exceed the equivalent of 20,000 tons of CO_2eq shall be involved in the ETS; for the first and second national allocation plans (NAPs) it was decided to allocate allowances only for carbon dioxide emissions.
3. Allowances shall be issued in accordance with the NAPs.
4. Allowances should be allocated to the operators of the installations.
5. Allocation principle is based on historical emissions of existing enterprises (grandfathering); Baseline for each NAP defined as the previous two years' emissions level.
6. The 1st April of the year following a reporting period is the date for surrendering emissions allowances. Operators must submit a report on the actual volume of GHG emissions for the reporting period and also information about purchased and sold allowances[17] to the Ministry.
7. The NAP shall contain an allowances reserve that is needed to distribute allowances in case of new entrants in the priority sectors of the economy which are determined by the Government of the Republic of Kazakhstan; total volume of the reserve was amounted to 59.15 million tons of CO_2. Since 2015 the reserve can also be used for expansions of production in plants.
8. Operators are obliged to elaborate monitoring plans and comply with them.
9. Verifiers are getting accreditation for their activity from the authorized body in the area of environment protection[18].
10. Penalty rates for exceeding each ton of CO_2 amounted to five times the monthly calculation index[19].

In addition, in Kazakhstan there are several subordinate regulations, which take up the position of the law in more detail.

2.2.3 Allocation

During the first three years of the Kazakh-ETS two national allocation plans (NAP) were adopted. The first NAP (hereinafter NAP1) was adopted for one year – 2013; the second NAP (hereinafter NAP2) covered a two-year period 2014 to 2015. The total number of allowances in the three years amounted to 455[20] million tons of CO_2 (2013: 147.2 million tons CO_2, 2014: 155.4 million tons CO_2, 2015: 153.1 million tons CO_2) which is determined by historical methodology, and is entirely based on the data submitted by the companies in the reports on greenhouse gas emissions for previous years.

17 The date of compliance was postponed to 90 working days after the 1st April, due to this new amendment to the trading rules operators can trade allowances until the beginning of August.

18 Here it means the Ministry of Energy now, previously it was the Ministry of Environment.

19 Monthly calculation index is the indicator which is used for the calculations of pensions, benefits and other social payments, as well as penalties. This indicator is set annually by National legislation „On republican budget". Monthly calculation index for the year 2015 was set at level of KZT 1982 (€ 6).

20 According to the NAP1 and NAP2.

The first year of the introduction of the ETS took place in pilot mode. During this period operators were not penalized for exceeding their assigned limit. Government postponed the introduction of penalties from 2013 to 2014, also the rate of penalties was halved. Besides that, the compliance factor was set as 100 percent of the baseline emissions.

In the first year of issuing allowances the basic procedures such as *delivering of documents from operators, reviewing of the documents by the authorized body, issuing allowances to the operators account in the registry* also have been tested. As the NAP1 was developed on the basis of unverified GHG emissions, during the process of allocation all reports of GHG emissions had been checked again by the authorized body. Since data on GHGs emissions in 2010 were counted incorrectly in some operators' documents, 29 installations with a total allowance volume of 7.2 million tons of CO_2 were identified with lower emissions than the threshold for ETS participation. In this case the installations were excluded from the ETS.

The second trading period and NAP2 differ from the first ones. In the NAP2 the number of companies and the volume of allowances have been changed primarily due to changes in the baseline, as well as requirements for mandatory verification of reports for 2012. The baseline for the NAP2 was an average level of emissions of 2011 and 2012. An obligation for reduction of CO_2 for 2015 was identified at a level of 0.985. In general, allowances have been issued to 164 companies at 305.7 million tons of CO_2 for both years together.

If we consider the sector distribution in the ETS (see Figure 5 below), then the share of GHG emissions in the total allowances enterprises „Energy" sector ranked first, followed by the „Industry" and „Oil and gas, and coal mining" sectors.

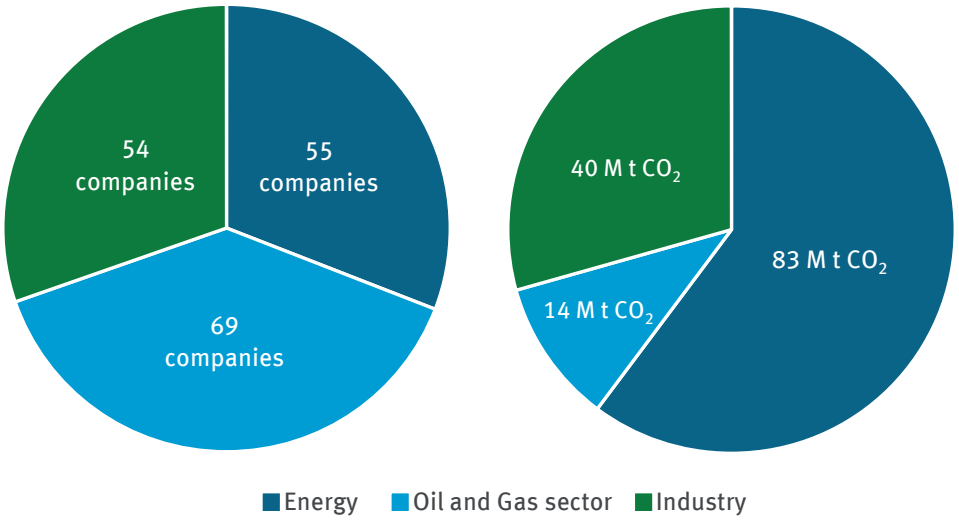


Figure 5: Number of companies (left); Share of CO_2 emissions (right) in 2013

As in Kazakhstan the production of electricity and heat is dominated by cogeneration, we summarise both under "Energy". More than 80 percent of power plants are using coal as primarily fuel, others use gas and heating oil. There are 18 large power plants responsible for 89.4 percent of GHG emissions in this sector, the other 42 medium and small power plants emit 10.6 percent of GHG emissions.

The "Industry" sector in the ETS involved 40 companies from the production of steel, cement, aluminium, ammonia, lime and dolomite, as well as non-ferrous metals, etc. The major share of emissions (48 percent) belongs to steel producer Arcelor Mittal. Unlike the industry sector in the EU-ETS, in Kazakhstan producers of ceramics and glass, pulp and paper are not participating in the ETS.

The sector "Oil and Gas sector, Coal mining" covers firms engaged in oil and gas production and transportation of oil and gas through pipelines.

A remarkable feature of the three-year experience of running a trading system in Kazakhstan was the issuance of additional allowances to existing installations on a free basis. The national legislation provides for a mechanism that gives companies an opportunity to receive additional allowances in cases where they introduce a new source of GHG emissions in the company or an increase in capacity which leads to additional GHG emissions. For three years, 32.6 million additional allowances were issued.

The main applicants for additional allowances are companies from the Energy sector (50 percent), Industry (27 percent), and Oil and Gas (20 percent). The main reasons for applying was increasing power generation for the Energy sector, increasing production capacities for others, and introducing new sources.

Verified data of the emissions reports for 2013 and 2014 have shown that the actual emissions were lower than the allowances issued, taking into account the additional volume (in 2013, total allocation was 137.9 million tons + 18.7 million tons). The difference for 2013 and 2014 is 15.1 million tons of CO_2 each year. Thus, the system can be characterized as over-allocated.

Table 2: Kazakhstan's ETS balance[21]

	2013	2014	2015
Number of companies as listed in NAP	178.0	166.0	166.0
Cap (million t CO_2) as listed in NAP	147.2	155.3	153.2
Number of companies with actual allocation	149.0	164.0	164.0
Allocated allowances by fact (million t CO_2)	137.9	154.1	144.3
Additional allocation (million t CO_2)	18.7	7.5	6.5
Reported verified data (million t CO_2)	141.5	146.5	n/a

2.2.4 Trading of Kazakh Emissions Allowances

Trading of Kazakh emissions allowances (KZQ) started in March 2014 on the secondary market of the "Caspy" Commodity Exchange (COMEX)[22] in Astana. The trading on the COMEX is so far carried out exclusively in the form of "English auctions" with only a single possible winner. The bidding period, usually up to a week, is determined by the auction initiator and the minimum and maximum price must be based on the latest previous auction clearing price on the COMEX.

In the **first year** of Kazakhstan's cap-and-trade scheme trading occurred during two peak periods in March and in June/August, coinciding with the scheme's reporting and compliance deadlines. According to market analysts at Thomson Reuters, absence of trading during other times hints at a nascent market where participants are uncertain of the GHG emissions baseline and unable to buy allowances to plan for compliance. In **2014** market participants traded about **1.27 million KZQ** in 35 transactions at a volume-weighted average price of **143 KZT (€ 0.57)**. Due to a comparatively low market activity the price volatility was high, allowances were traded in a range from 10 to 833 KZT (€ 0.04 to € 3.35). The value of the Kazakh CO_2 market amounted in the first trading year to **182 million KZT (€ 0.73 million)**.

In **2015** the market liquidity improved significantly at a low level and transactions took place from March to August on a continuous basis. Overall, about **1.98 million KZQ** were traded in 40 transactions during the second year. The trading volume increased by 56 percent in comparison to the previous year. The already very wide price range in 2014 continued to broaden even further, with transactions reported from 10 KZT (€ 0.05) per allowance, all the way up to a new all-time high of 1,650 KZT (€ 8.05). The volume-weighted average price of Kazakh allowances in 2015 was **380 KZT (€ 1.85)**, 2.7 times the value of the previous year. The total market value rises sharply year on year to **755 million KZT (€ 3.68 million)**. Large brokers continue to act as buyers while compliance entities are still reluctant to establish their own trading desks.

The figure below illustrates the monthly trading volumes and volume-weighted average prices of KZQ on the secondary market of the COMEX in 2014 and 2015.

21 Own calculations based on data from JSC Zhasyl Damu, 2015.

22 http://comex.kz/en/

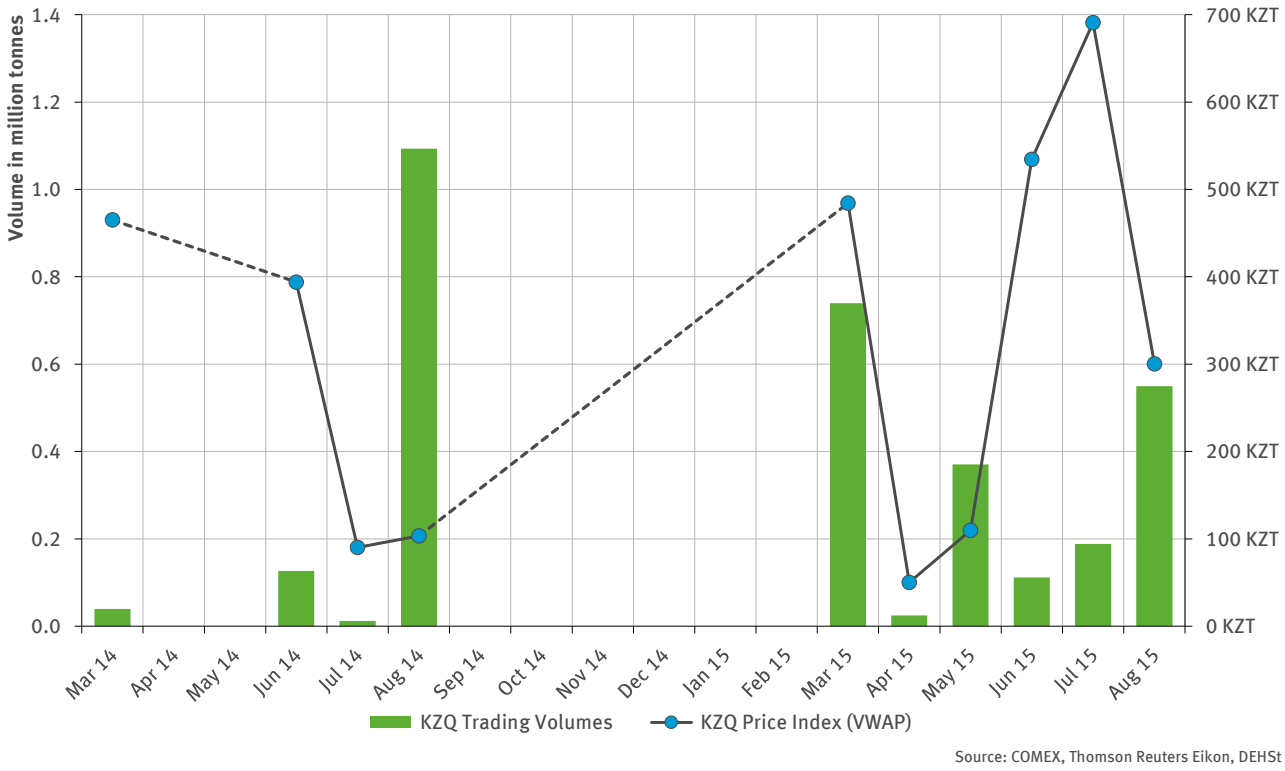


Figure 6: Monthly trading volumes and volume-weighted average price (VWAP) of KZQ

2.2.5 Lessons Learnt

The ETS in Kazakhstan during the first three years of its operation faced many challenges. First of all, it became evident that the further development of the system was necessary through improvement of the national legislation. This initiative was also supported by the operators involved in the ETS. However, the process for amending and supplementing the Environment Code stretched for two years.

In addition, the main difficulty in the development of each new national allocation plan was an absence of officially approved commitments to reduce emissions in the ETS. As mentioned in the introduction, instead the "cap" in the ETS was based on data on GHG emissions obtained from the companies. This method is the most rapid in case that the special arrangements for ETS functioning are correctly set: legislation, methodologies for calculation of GHG emissions, and an institute of verification. However, this approach does not allow having a long term view on the development of the system at all.

The main challenges which have been faced are described below.

Allocation challenges

a. Prior to the generation of a final list of enterprises included into the system, there is no clear understanding of how high the emission limits (cap) will be.
b. If there is no verification of reporting (as during the first pilot year in Kazakhstan), the enterprises often make errors in calculations of the GHG emissions. In this regard, some enterprises were included in the NAP1 by mistake, and this affects an extent of maximum emissions.
c. One of the characteristics of the ETS in Kazakhstan is a "floating" ("rolling") baseline. It means that the baseline is updated from one NAP to the next. Each time, this rule affects the number of enterprises and the total number of allowances.
d. Additional allowances to new sources in existing companies and to capacity extensions were not given from the reserve but by increasing the overall allocation (effectively increasing the cap). The total of these additional allocations amounted to 32.6 million emission allowances.
e. The result of verified emissions reports from companies shows that the system is over-allocated.

f. The current system defines a common approach for all companies, in different sectors of the economy. The same commitments are applied for reducing emissions for new installations and for those who still use old equipment.

g. Benchmarks are still under the discussion with operators.

h. There is no auctioning.

Institutional challenges

a. One of the main challenges that has been faced in Kazakhstan is an inefficient institutional implementation. There are three governmental agencies: the Department on Climate Change in the Ministry, the Environmental Control Committee and JSC ZhasylDamu which are involved to the process of allocation of allowances. Roles and responsibilities between them are not clearly identified.

b. There are not enough experts and capacity to maintain the system.

c. Accreditation procedure of the verifiers is still under the responsibilities of the Ministry of Energy. According to the international experience this function should be transferred to another governmental or independent body which has specialized knowledge on accreditation issues.

MRV challenges

a. The MRV system should be transferred to electronic reporting. Keeping hard copies in store appears inefficient.

b. There are still some companies who miss all deadlines to submit their reports.

Trading challenges

a. Insufficient development of the ETS market.

b. The national legislation regulating the ETS in Kazakhstan foresees that allowances issued within one NAP are not transferable to the next. It means that all extra allowances in 2013 after surrendering in 2014 became zero value in the registry. Surplus from the previous periods does not affect the next periods.

3 Cap Setting for GHG Emissions Trading System in Kazakhstan

The focus of this chapter is the method by which the emission limits in the ETS and non-ETS sectors can be determined, and how an ETS cap path for Kazakhstan can be derived from this.

In principle the cap-setting process for an ETS can include elements of "top-down" as well as "bottom-up" approaches. While bottom-up methods collect (historical or projected) emission figures from all prospective participants and add these up, the top-down approaches start from an overall given reduction goal for the whole country, and then distribute this overall reduction goal to the sectors included in ETS, and those outside. As mentioned above in chapter 2, in Kazakhstan the ETS covers primarily the sectors energy, industry and oil/gas, whereas sectors outside the ETS ("non-ETS") are transport, private households (as far as their own combustion is concerned), agriculture, and waste. We assume that emission reductions in these non-ETS sectors are induced by other climate policies, such as taxes, direct regulation, subsidies, information provision programs, or other measures.[23]

In Kazakhstan the cap for the ETS in the first years of its operation (first and second trading period) was fixed entirely by "bottom-up" principle. Total emissions from all companies in the NAP were considered as a cap. As the first two NAPs were developed for short periods of time (the first for one year, the second for two years), such a method is lacking a view on the long-term perspective. Companies are therefore left with little clarity on what reduction rate will be proposed in the next national allocation plan(s).

23 In principle, an ETS can cover all sectors within a country. In this case, sectors such as (road) transport and private households which include many small individual emitters could be covered indirectly (instead of direct participation, as practiced for the large installations in industry and electricity generation), in order to reduce the transaction costs of participation. Such indirect coverage would ideally be achieved by an "upstream" approach in which the suppliers of fuels (imported or domestically produced) must cover the emissions that result from their fuel sales to transport and private households. Such an approach has been implemented, for example, in California (see ICAP 2015 https://icapcarbonaction.com/en/ets-map). Sectors covered by an upstream approach can be linked to the direct emissions ETS covering industry, electricity generation, or fuel extraction. However, even in this case, a systematic conceptual derivation of the caps for the direct emission ETS on the one hand, and the indirect (upstream) ETS, on the other hand, would be necessary.

This study focuses on developing a "top-down" approach for setting a Kazakh ETS cap. Since Kazakhstan has an absolute emission reduction goal for 2020 and 2030 (see next section), top-down would take the following steps:

1. Determine the overall nationwide emission goal, and derive the "allowed" total remaining emissions in the target year (here: 2030).
2. Set up a projection of nationwide emissions for the target year, under the assumption of "business-as-usual" emissions (i.e. without, or with no sufficient, emission abatement policies).
3. The difference between the projected and allowed emissions in the target year makes up the "reduction gap", i.e. the nationwide remaining reduction effort.
4. Distribute this gap (share the effort) between the ETS and non-ETS sectors, according to a systematic method; and thereby determine the ETS cap for the target year (here: 2030).
5. From the ETS cap for the target year and considering current emissions in the ETS sectors, determine a cap reduction path from today until the target year.

A special focus in this study is placed on step 4, i.e. distribution of the effort between the ETS sectors and the non-ETS sectors. Here, we present different possible approaches, which were discussed during the development of the first and second German National Allocation Plans (2005-07 and 2008-12, respectively). Also the above-mentioned paper by DIW Econ (2015) lists some of these options. We then describe in detail the possible application of one of these options, namely the distribution according to abatement potential and costs.

A further important issue is that even within the ETS sectors, often a mix of instruments can be efficient – namely, when important market imperfections or failures exist which cannot be addressed by an ETS system alone. Such important market imperfections are learning effects, which can significantly reduce the long-term costs of new technologies (such as different renewable energy technologies). Also, these technologies are often in very different stages of maturity and cost reductions, so that leaving them open to the ETS price as the only source of finance would put their expansion at high risk (see Umweltbundesamt 2007, page 301). Related to this, positive spill-overs are important – i.e. when action by one firm generates positive effects for other firms, but without compensation. Also, current costs for certain technologies (e.g. renewable energies) might be so high that they would not be politically acceptable (or endanger international competition of many ETS-covered firms). These issues lend support for additional policies. Also, information barriers can provide justification for subsidy programs as well as provision of information to firms and households about the existence and viability of abatement options. Such policies can be very helpful in combination with an ETS. However, when determining the effort sharing between ETS and non-ETS sectors, as a rule we must count the abatement effect of these policies as part of the ETS sectors, since they contribute to emission reductions in ETS sectors (ibid., p. 302).

Regarding the underlying costs of abatement, the ultimate perspective of a proposal for an effort sharing is a social one, i.e. the resource costs to society of implementing certain abatement options. Nonetheless, the study by NERA/Bloomberg, which is the main basis for this report, explicitly uses marginal abatement cost curves from the perspective of private investors – which means that hurdle rates, discount rates for investment, and transaction costs are seen from their perspective. It is a contentious issue to what degree these private perspectives have to be taken as "given" or to which degree they can be influenced by the government, or (if unchangeable) should constitute also the social perspective. This makes the question tricky which of NERA's scenarios is most appropriate for the effort sharing we aim at. We therefore address this issue explicitly in sections 3.4.3 and 3.4.4. Also, in the private perspective, transfers from the government to firms (subsidies) or vice versa (taxes or allowance expenses) would be included in the costs of abatement measures, while they should not matter from a social perspective.

3.1 Long-term Goals on GHG Emissions Reduction in Kazakhstan

The Republic of Kazakhstan fixes the national target of GHG emission reduction **at 15 percent by 2020 and at 25 percent by 2050** in comparison with baseline indices of 1990. In compliance with item 4 of Copenhagen Accord accepted at 15th Conference of the UNFCCC Parties, the Republic of Kazakhstan determined these national targets in the official statement dated January 27, 2010, sent to the Secretariat of the United Nations Framework Convention on Climate Change (hereinafter referred to as the UNFCCC). In compliance with Article 4, Item 2 a) of the UNFCCC, Kazakhstan is obliged to take corresponding measures on mitigation of climate change by way of limitation of its anthropogenic emissions as well as protection and improvement of the quality of GHG sinks and reservoirs.

Reduction of GHG emissions is considered a strategic objective of Kazakhstan and was included into the Strategic Development Plan of the Republic of Kazakhstan up to 2020. Accomplishment of this objective shall be carried out in the context of technological modernization of the Energy sector and development of energy efficiency, as well as initiating a new policy on the sustainable use of natural resources taking into account the task on environmental protection. As a strategic goal it is planned to reduce energy intensity of Gross Domestic Product (GDP) by 2020 at least by 25 percent, and energy intensity of GDP shall be reduced by 2015 at least by ten percent.

At the UN climate change summit held in September 2014 in New York, Mr Erlan Idrissov, the Minister for External Affairs of the Republic of Kazakhstan also officially confirmed the intentions on maintenance of the goal to reduce GHG emissions by 15 percent by 2020 and by 25 percent by 2050[24].

According to the COP decision (1/CP.19) countries have agreed to publicly outline what post-2020 climate actions they intend to take under a new international agreement, known as their Intended Nationally Determined Contributions (INDCs). Kazakhstan presented its INDC[25], where the following goals were defined:

1. Unconditional goal – Kazakhstan makes commitments to reduce GHG emissions by at least 15 percent until 2030 in comparison with 1990.
2. Provisional goal – reduction of GHG emissions by 25 percent by 31. December 2030, in relation to 1990 on the assumption of additional international investments, access to the mechanism on transfer of low-carbon technologies, Green Climate Funds and flexibility mechanism as for the country in transition.

Thus, within the context of this investigation we will use the main "pre-Paris" goals: minus 15 percent from 1990 in 2020 and 2030, i.e. 304 million tons of CO_2eq (GHG emissions in the base year 1990 were 357 million tons excluding LULUCF).

3.2 Projections of GHG Emissions in Kazakhstan

In this paper we use forecasts of GHG emissions modelled by NERA/Bloomberg and DIW Econ. NERA/Bloomberg and DIW Econ use forecasts of economic development from the International Monetary Fund (IMF) Report "World Economic Outlook" for 2010 and 2013 as the basis for GHG emissions forecasting.

According to the IMF Report for 2010, the cumulative growth of real GDP in Kazakhstan was expected to be 35 percent between 2009 and 2015, or 5.2 percent annually, and even six percent annually in the period from 2015 to 2020. As the DIW Econ Report was issued in the year 2015, for the projection "corrected business", as usual they had used the IMF report 2015, which was updated to the current economic situation in Kazakhstan.

24 http://www.mfa.kz/index.php/en/last-news/1939-statement-by-h-e-mr-erlan-idrissov-minister-of-foreign-affairs-of-the-republic-of-kazakhstan-at-the-un-climate-summit

25 http://www4.unfccc.int/submissions/INDC/Published%20Documents/Kazakhstan/1/INDC%20Kz_eng.pdf

NERA uses the method of extrapolation to forecast the GHG emissions up to 2030, based on historical values of GHG emissions taken from data from the national inventory of 2010. A real annual economic growth rate of six percent up to 2020 was taken as a basis of this extrapolation. Economic growth forecasted at that point in time was connected with high oil prices, which on average were 110.9 USD per barrel in 2011, and GDP growth was fixed at 7.5 percent[26]. However, today the economic situation has changed, economic growth slowed down, and so we presuppose that the forecast of GHG emissions in NERA/Bloomberg will probably be overstated. Nevertheless, for the purpose of this paper we will use results obtained by NERA/Bloomberg as the basis, as the marginal abatement cost curve was built on them.

NERA/Bloomberg in their study propose several scenarios of GHG emissions development. There are four scenarios in their report: The baseline scenario (called "Frozen Technology"); "Status Quo"; "Planned Policy" and "Enhanced Policy".

The baseline (Frozen Technology) scenario presupposes the increase of GHG emissions in conditions of economic growth during the period from 2010 to 2030, but at the same time the carbon intensity remains fixed. The Status Quo scenario presupposes that the carbon intensity will reduce as a result of market-driven technological improvements for new and replaceable equipment (i.e., from measures that are profitable to private investors even without climate policy). The Planned Policy scenario also will reduce carbon intensity by reason of support for renewable energy development and improvement of energy efficiency measures in relation to buildings. The Enhanced Policy scenario presupposes the introduction of an ETS or, alternatively, fixed subsidies with comparable abatement effect.

DIW Econ offers its own viewpoint on the projection of GHG emissions until 2030 which takes into account the slowed down GDP growth as it started in 2014[27].

As their business-as-usual (BAU) scenario with adjusted growth assumptions of GHG emissions from DIW Econ takes into account the current situation (i.e. slowed down GDP growth in Kazakhstan observed since 2014), we presuppose that it is the most realistic choice. DIW Econ in their report make reference to the factors GDP change, decrease of crude oil prices and a change of the rate of exchange of the national currency Tenge towards the Russian Ruble. On the basis of modelled projections, DIW Econ projects a total business-as-usual emission level in 2030 of 391 million tons of CO_2eq, and presupposes that therefore achievement of the goals on GHG emissions (304 million tons CO_2eq) is quite realistic in 2020; however, during the next decade they expect an increase of GHG emissions by 2030 by 100 million tons. At that, starting from 2022 the GHG emissions will exceed all goals fixed by Kazakhstan.

In reality today we can see the deceleration of economic activity in Kazakhstan which results from reduction of world market prices for basic export commodities, decline in extraction of oil, coal and lignite; decline in production of non-ferrous metals; deterioration in demand from private households; and deterioration of external demand, which resulted in a decrease in exports by 6.2 percent. According to the forecasts of social and economic development of the Republic of Kazakhstan examined at the Session of the Government of the Republic of Kazakhstan as of August 29, 2015, economic growth will keep a positive trend but in slow rates. According to this document, the rates of economic growth in 2016 to 2020 will be 2.7 percent on average[28].

Thus, it is possible to suppose that GHG emissions will grow in the future, but overall rates of their growth will be not so high. In particular, the slower growth from 2016 to 2020 means "delayed" growth overall (see DIW Econ 2015, p. 10) since the lower GDP figures in 2020 mean that even if growth rates from 2021 to 2030 are unchanged at the high levels of 7.5 percent assumed in NERA/Bloomberg, overall GDP in each year will be lower than previously expected. A summary of results on forecasts of GHG emissions can be found in the following Table 3.

26 Table A4, p.157 Emerging Market and Developing Economies: Real GDP, World Economic Outlook, Transitions and Tensions, IMF. October 2013.

27 The figure of 391 million tones CO_2eq in Table 3 does not yet include efficiency improvements, especially from the Green Economy Concept. These are treated in a second projection which leads to 26 million tons CO_2eq lower emissions (see DIW Econ 2015, p. 17).

28 Forecast of social and economic development of the Republic of Kazakhstan for 2016-2020, http://economy.gov.kz/economyabout/9940/67673/

Table 3: Long-term forecasts of GHG emissions (million tons of CO_2eq)[29]

		NERA			DIW Econ (BAU)
	Historic emissions	Frozen Technology	Status Quo	Planned Policy	
1990	357				
2010	286				
2020		350	340	320	290
2030		490	451	434	391
Goal					304

3.3 Determination of the "Gap in Emissions Levels"

As stated above, Kazakhstan made official statements at international level to reduce GHG emissions by 15 percent by 2020 and between 15 percent and 25 percent by 2030, i.e. the quantitative objective for Kazakhstan is at least to stabilize emissions from 2020 onwards at 304 million tons of CO_2eq (based on the -15 percent target). Using forecasts of GHG emissions up to 2020 and 2030, we can determine the difference (the "gap") in emissions that would then have to be reduced.

Depending on the scenario from NERA/Bloomberg and the forecasts made by DIW Econ, the gap between the levels of emissions and the goal will be different. According to these figures Kazakhstan should take measures to reduce emissions until 2030 by an additional **87 to 186 million tons of CO_2eq** compared to the business-as-usual development.

Table 4: The Gap in Levels of Emissions (million tons of CO_2eq)

	NERA			DIW Econ (BAU)
	Frozen Technology	Status Quo	Planned Policy	
2020	44	34	14	-16
2030	186	147	130	87

For the purpose of this paper we will – for reasons described below – consider two scenarios from NERA (Status Quo and Planned Policy), as well as the projection from DIW Econ.

3.4 Effort Sharing: MACC Analysis of GHG Emissions Reductions

3.4.1 Options for Determining the Effort Sharing between ETS and Non-ETS sectors

The following options for assigning abatement contributions to the ETS and non-ETS sector can be named (see Umweltbundesamt 2007, pp. 50f. and 128ff.; European Commission 2008, p. 21):

a. Emission reductions only in the ETS sectors (so the emissions in the non-ETS sectors stay constant from current levels)
b. Emission reduction only in the non-ETS sectors (so the emissions in the ETS sectors stay constant from current levels)
c. Equal percentage reductions in ETS and non-ETS sectors, either from current (or past) emissions, or from projected business-as-usual emissions. In the case of projections, the sectors with higher projected emission growth are in effect assigned smaller reduction requirements than in the case where contributions are based on current emissions

29 For the NERA scenarios see NERA/Bloomberg "The demand for GHG emissions Reduction Investments: an Investors' MACC for Kazakhstan", page xvii, figure ES8. For the DIW Econ scenario see "Proposal for the National Allocation Plan 2016-2020 for Kazakhstan (A top down approach)", page 10. Note that apart from economic growth, projections by DIW Econ and NERA/Bloomberg also differ in other assumptions.

d. Reductions according to projected abatement costs (so that marginal abatement costs in both groups are at the same level and abatement in both sectors together meets the reduction requirement)

e. Reductions in the ETS sectors according to (other) political decisions, for example based on existing voluntary reduction agreements with industry associations in Germany

The above-mentioned study by Umweltbundesamt made first indicative quantitative comparisons of the above-mentioned options' impacts. These revealed that the variant d. – based on abatement costs – led to considerably stronger abatement requirements for the ETS sectors for the first trading period (leading to a cap of 470 million tons) than all other variants (which led to caps between 491 and 505 million tons, see Umweltbundesamt 2007, p. 135).[30] Actually, in the end the decision was largely based on option e., on existing voluntary agreements between the government and the industry associations was chosen (p. 145), not least for political reasons.

In contrast, in the second trading period, marginal abatement costs in effect played an important role for the cap-setting in several EU Member States including Germany, due to the centralized process of the European Commission checking all Member States' NAPs. These checks were guided by the provisions of the EU ETS Directive which stipulated, inter alia, that the total allocations of each Member State would have to be consistent with projections on emissions and their reduction potential in the ETS sectors. For this, the Commission used an EU-wide general equilibrium model (PRIMES) which contained abatement potentials and costs of ETS and Non-ETS sectors. In the end, several Member States, including Germany, had their overall allocation cut because the Commission deemed abatement potential in the ETS larger than the Member States' total NAP allocations indicated (see European Commission 2006). Also for the EU-wide decision on the ETS cap in the third trading period, abatement costs of ETS and non-ETS sectors played a key role (European Commission 2008, p. 21).

For Kazakhstan, DIW Econ suggest in their NAP proposal identical percentage reductions for ETS and non-ETS sectors, compared to their respective business-as-usual emissions in 2030. While the authors give no clear rationale for this choice, it can be presumed that the exercise of estimating comprehensive sets of marginal abatement costs for various abatement options was considered too much effort in the specific context of their analysis.

In this country study, we aim at illustrating how an effort-sharing estimation analysis based on marginal abatement costs could look like. For this we use the existing marginal abatement cost curves (MACC) from the above-mentioned study by NERA/Bloomberg.

As far as we are aware, such an analysis with a view to assigning cost efficient abatement "effort sharing" between ETS and non-ETS sectors, has not been undertaken for Kazakhstan yet.

3.4.2 Marginal Abatement Cost Curves as used in this Paper

Marginal abatement cost curves illustrate different options to abate emissions, ranking them by their abatement costs per unit of emission reduction. Usually, the height of a block representing an abatement option in the curve illustrates the abatement costs, while the block's width represents the abatement amount achievable at this cost. As there can be different applications of the same technology (e.g. wind power in high-wind areas as well as in low-wind areas), these different applications can be plotted by different blocks in the MACC.[31]

30 These calculations also included possible ETS caps for the second trading period. Here the difference between the methods was even much larger than in the 1st trading period: based on abatement costs, the ETS cap was estimated with 418 million tons, while in the scenarios based on the other above-mentioned options, the cap was between 473 and 505 million tons (see Umweltbundesamt 2007, p. 135).

31 When adding up the abatement amounts of the different abatement options along an MACC, it is important that abatement options do not mutually exclude each other (for example, wind power could replace either coal or gas-fired generation; but only one of these should be plotted in the MACC, or if both are plotted, only one of them can be counted when determining overall abatement potential). It is also important to address whether abatement amounts interact with each other in a significant way: for example, total abatement of wind power replacing coal is lower when, at the same time, electricity savings occur, so the combined abatement effect from both abatement options is lower than the sum of each single effect. Regarding mutual exclusion, NERA's MACCs appear to avoid this, as no identical options can be found in the curves. Interactions could possibly occur for the District Heating and the heat consumption in Buildings; but interactions are in fact likely to be small since in both scenarios presented below, abatement through reductions in the use of heat are small (see NERA/Bloomberg 2011, p. 57 and 78).

The abatement costs themselves are determined as follows: the costs of implementing a technology (including investment costs and operational costs) are compared to the costs of an alternative technology with higher emissions. The difference in total costs between both alternatives are then divided by the difference in emissions, leading to the abatement costs per unit of emissions. To add (up-front) investment costs and operational costs (which occur over many years), the operational costs must be discounted – meaning that the assumed discount rates can have a substantial influence on abatement costs and must be chosen carefully.[32]

The main advantage of this method is projects' visualization in one picture, and discovering the reduction potential in each of the set sectors in a cost-effective perspective.

As noted above, we use MACC for Kazakhstan developed by NERA Economic Consulting in association with Bloomberg New Energy Finance on request of the European Bank for Reconstruction and Development (EBRD) in 2011. The report titled "The demand for GHG emission reduction Investments: An Investors' Marginal abatement cost curve for Kazakhstan" analyses the technical opportunities to reduce Kazakh emissions in the year 2030 and evaluates the costs in several sectors.

We use the MACC modelling results in order to define the efforts of ETS and non-ETS sectors that are cost-effective according to this MACC. In general, MACC allows detecting the sectors with the most economically viable reduction of GHG emissions. Considering the results obtained, we can define the part of national goals each sector may take for itself.

As mentioned earlier, the NERA document presents one baseline scenario – called "Frozen Technology" – and three political scenarios for the 2010-2030 period: The Frozen Technology scenario is assumed as follows: *a hypothetic basic scenario when the Kazakh economy increases as it is forecasted, but the emissions intensity is fixed at the current levels*[33]. The MACC is not given for this scenario and only a graphical illustration of the possible future GHG emissions (490 million tons CO_2 in 2030) is presented.

The two political scenarios that we apply in our study – "Status Quo" and "Planned Policy" – have the following features:

1. Status Quo scenario: within this scenario, all the current policies and institutions continue working as they are in the year 2011. There are no new policies adopted to encourage the rational use of energy, use of renewable energy sources and other actions aimed to reduce the GHG emissions. However, market-driven investment in new, more efficient production capital, and market-driven uptake of new technologies are included, resulting in 40 million tons CO_2 lower emissions in 2030 (451 Mt) than in the Frozen Technology scenario.
2. Planned Policy: in this scenario, the development of renewable electric power is supported by the government; improvement of the enforcement of energy-efficiency standards is introduced; and prices for the final heat consumers are made more transparent via more user-related tariffs.

It is not feasible to also consider NERA's "Enhanced Policy" scenario as it assumes (in one version) the implementation of a Kazakh ETS, and the marginal abatement costs therefore include a carbon price of 40 euro per ton of CO_2eq. This reduces the investors' costs of various low-emission options compared to their alternatives with higher emissions intensity. As we are interested in the "real" resource costs from a social perspective, using the Enhanced Policy scenario would make it necessary to calculate fictitious costs excluding the ETS carbon price.

The measures proposed to reduce the GHG emissions are implemented in different sectors of the economy, but NERA/Bloomberg do not relate them to ETS or non-ETS sectors. Therefore we must propose which of them are ETS-related and which are not. On a general level, we can rely on the general legal prescriptions on which sectors are included in, and excluded from, the ETS:

32 A further key issue is that technologies usually cannot be applied by all firms instantly. Rather, they will be applied more and more over time – e.g., when replacing firms' old equipment. As a result, abatement (at given costs) is higher in later years than in earlier years (see NERA/Bloomberg 2011, p. 2). For Kazakhstan, we suggest that if GDP growth occurs with roughly the high rates projected, also new installations – and higher abatement – could be applied earlier, and to a larger degree, than it would be possible in Europe, where new installations usually only come into play when old ones must be replaced.

33 NERA/Bloomberg 2011, page ix.

1. ETS: Power (electricity production, including RES – for the rationale for this, see below), heat production (see below); industry (cement production, ferrous and non-ferrous metallurgy, lime, bricks and ceramics production), as well as oil and gas (oil production, gas flaring, oil refining, coal mining)
2. Non-ETS: transport (without pipeline transport), waste treatment, and buildings (direct emissions)

Although the chapter 9-1 "State regulation in the area of emissions and absorptions of greenhouse gases" of the Environmental Code of the Republic of Kazakhstan defines the transport and agricultural industry as areas subject to allocation, the Ministry has practically decided not to include these sectors in order to optimize the ETS[34]. A work on an Environmental Code for these sectors is in progress with a proposed complete exclusion of these two sectors. In this regard, we assign "transport" and "forestry and agriculture" to the non-ETS sector.

Windmills and solar panels cannot directly participate themselves in the ETS, their emissions are equal to zero. But in our case we included the expected abatement effect from RES into the ETS cap as the energy produced by RES will substitutes the supply by fossil fuel energy (coal, gas, residual oil) electricity suppliers. This logic is in line with the conclusions drawn in the context of the first German NAP (see Umweltbundesamt 2007[35], p. 301f.) and the European Commission's Climate Policy Package, e.g. for the third trading period.[36]

Regarding heat supply, NERA/Bloomberg (2011, p. 18) state that about 60 percent of it is generated from combined heat and power (CHP) plants and large heat-only boilers, and transmitted via centralized heat networks. The remaining 40 percent are transmitted through decentralized heat systems. A significant proportion of these 40 percent are generated by large boilers often exceeding 20 MW. Even though the residential sector is thus not directly included in the ETS, much of the heat generation is, so that reductions in heat use related to this heat generation are measures that we can relate to the ETS sectors.

We assume that, at any rate, the large boilers in centralized networks are all ETS participants. We also assume that all the larger boilers in decentralized systems are included in the ETS (20 MW of rated thermal heat input can easily generate 20,000 tons of CO_2eq which is the minimum ETS threshold). In sum, our rough estimation is that between 80 percent and 100 percent of all heat generation units would indeed be included in the ETS.

To check this estimate, we compare the last national UNFCCC inventory for GHG emissions with data for the installations included in the ETS. This shows that inventory CO_2 emissions from the Public Electricity and Heat Production sector in 2012 amounted to 91.6 million tons, which directly corresponds to the verified emissions from the Energy sector included in the NAP: operators from the Energy sector reported their emissions at the level 91.8 million tons in 2013, and 92.8 million tons in 2014. The inventory also states emissions from the residential sector with 8.6 million tons, and commercial sector with 4.4 million tons. We thus conclude that about 87 percent of all emissions in the heat/buildings sector are included in the ETS, which confirms our estimate from above of 80 to 100 percent.

From the description of the heat/buildings sector in NERA/Bloomberg's Planned Policy scenario (see NERA/Bloomberg 2011, p. 76ff.), we can presume that they do in fact make a distinction as well: only measures clearly related to heat savings in direct combustion (i.e. outside of heat networks) are listed as buildings (with bright grey colour), while all measures related to savings in heat that was delivered by networks are assigned to "district heating – DH" (with dark grey colour), If this is the case, we can directly translate this to the matching ETS/non-ETS. However, we note that we cannot be completely sure that our assumption based on this understanding of NERA/Bloomberg's distinction is correct.

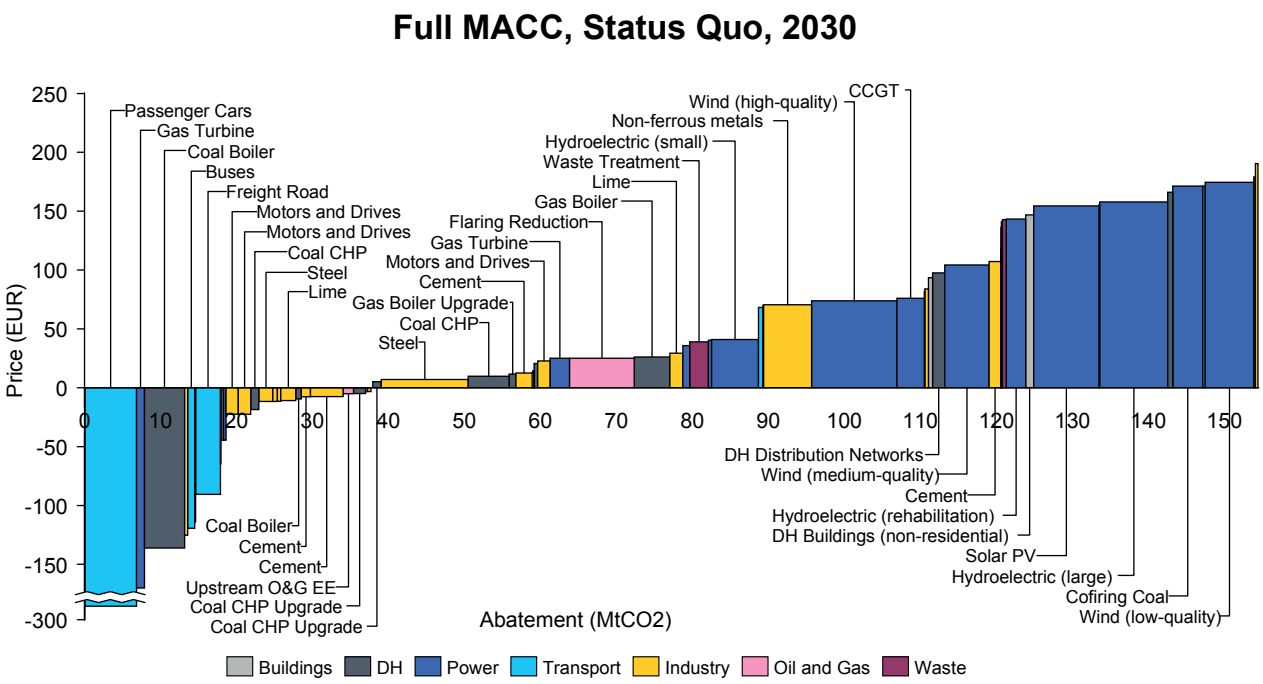
3.4.3 Status Quo Scenario from NERA/Bloomberg

As mentioned above, this scenario assumes that there will be no changes in environmental or energy policies – or institutional arrangements – for the next 20 years (see NERA/Bloomberg 2011, p. 44). A limit on the implementation of building energy efficiency rules continues to exist and there are no policies for emissions reduction in industry and in the waste sector. NERA/Bloomberg derive the following MACC for this scenario.

34 This is, not least, a result of expected high transaction costs relative to emission amounts of each participant.

35 For citation see above.

36 See, for instance, the Joint Impact Assessment accompanying the Package of Implementation measures for the EU's objectives on climate change and renewable energy for 2020 - http://ec.europa.eu/clima/policies/strategies/2020/documentation_en.htm



Source: NERA/Bloomberg

Figure 7: MACC for the Status Quo scenario, 2030

As can be seen, a large part of the abatement options is made up of renewable energy sources (RES) replacing fossil fuel-based power. On the other hand, there is relatively little shift among fossil fuels (e.g. from coal to gas-fired generation). This is a result of the cheap and abundant coal in the North of the country (which is also the location of the majority of fuel use), combined with the location of natural gas primarily in the West, and a limited power transmission grid and gas pipelines (see NERA/Bloomberg 2011, p. 13).

For the transport sector significant abatement is projected with negative abatement costs, but hardly any options are shown with positive abatement costs. Here it is also worth noting that changes in the modal split (e.g. from private to public transport or from road to rail) as well as issues related to affecting the transport amount by land-use planning are not plotted by any measures.

The Status Quo scenario generally defines the possibility to reduce emissions by 155 million tons of CO_2eq at a price range of up to 200 euro per ton. However, this includes around 38 million tons with negative costs (see NERA/Bloomberg 2011, p. 45), which are already included in the projected emissions of the Status Quo Scenario of 451 million tons. So only the remaining 117 million tons (155 million – 38 million) can contribute to achieving the reduction target of **147 million tons CO_2eq** by the year 2030. As a result, with growth projections as included in NERA/Bloomberg (2011), achievement of the -15 percent goal by 2030 would not be reached with measures up to 200 Euro.

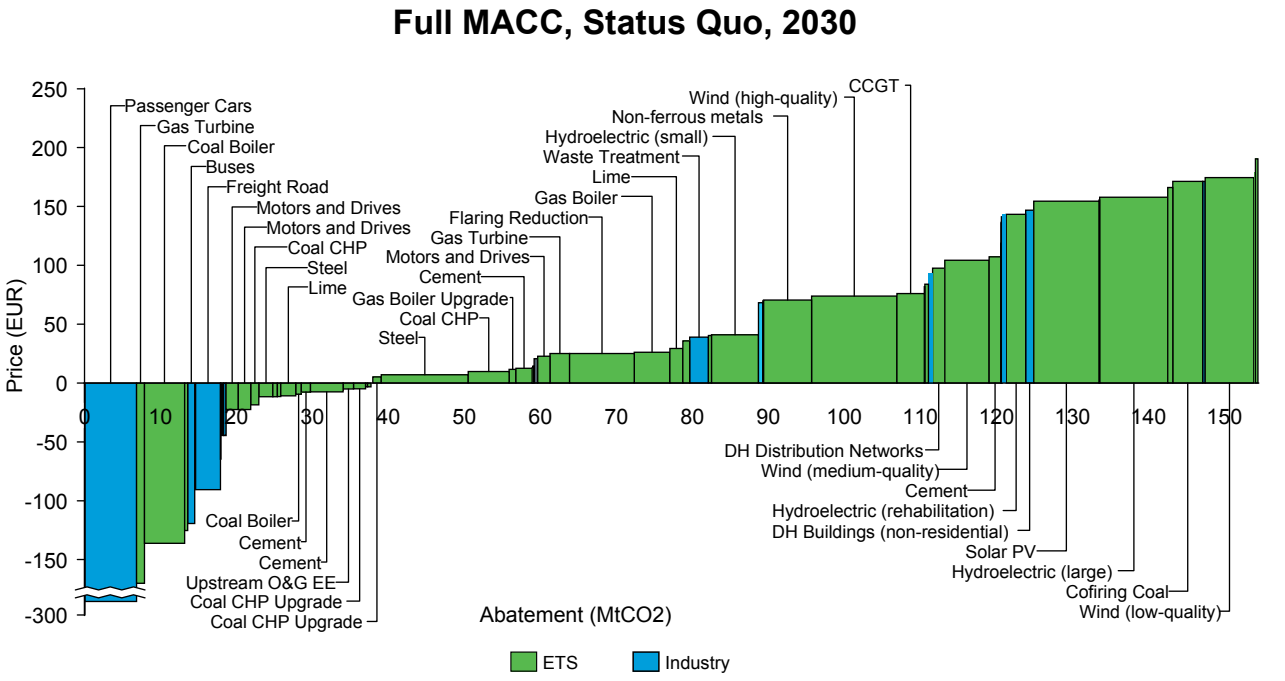
However, as indicated in previous sections, growth has been slower than projected, and DIW Econ (2015) project that due to these changes, the total gap in emissions in 2030 is far smaller – in their projection at about 87 million tons. We take this gap estimation as the basis for our further analysis.[37]

The main question of this scenario is what price per ton of CO_2eq is necessary to achieve abatement of these 87 million tons, and which sector has the best potential of reduction.

In line with the considerations in section 3.4.2., we have "matched" the sector classification by NERA/Bloomberg (buildings, district heating (DH), power, transport, industry, oil and gas, and waste) as follows: DH, power, industry, oil and gas are assigned to the ETS sector; while buildings, transport and waste are assigned to the non-ETS sectors. For the exact classification of all single measures, see our Annex.

37 Alternatively, as a more conservative value one could assume that the remaining gap is 117 million tons, i.e., exactly the amount that is achievable for up to 200 euro per ton. This would still make it possible to use the whole range of abatement options as described by NERA/Bloomberg. However, it is very difficult to derive robust business-as-usual figures at sector level from NERA/Bloomberg while DIW Econ provide a business-as-usual emissions split for ETS and Non-ETS. We thus decide to apply the DIW Econ gap estimation for consistency with this.

This makes it possible to draw up the following Figure 8 for the division between ETS and non-ETS sectors in the Status Quo scenario:



Source: own illustration based on data from NERA/Bloomberg 2011

Figure 8: Abatement in the ETS and non-ETS sectors for the Status Quo scenario

Table 5 below shows the aggregated data on possible reduction volumes and the breakdown of the associated costs. For example, the column "0" refers to all measures with a marginal cost of up to 0 euro/ton CO_2eq (i.e. all measures with negative costs).

Table 5: Abatement potential in ETS and non-ETS at different abatement prices, Status Quo scenario

Marginal cost euro/ton of CO_2eq	0	1-40	41-200	Total
Abatement, million tons of CO_2eq				
ETS	26.8	42.0	68.8	137.6
Non-ETS	11.0	2.5	4.2	17.7
Total	37.8	44.5	73.2	155.3

Source: own calculation based on NERA/Bloomberg 2011

According to these data and their ranking in Figure 9, the scenario expects the main part of reduction to be for the ETS sector -88.6 percent, and non-ETS is 11.4 percent (including negative cost). The "no-regret" investments – with negative net abatement costs to the investors – will reduce emissions in total by 37.8 million tons of CO_2eq (see column "0" above); the potential abatement volume with marginal costs between 1 and 40 euro per ton of CO_2eq is 44.5 million tons of CO_2eq; and the main part of reduction is related to 41 to 200 euro per carbon ton cost category, which is 73.2 million tons.

Although there are no explicit government policies in this scenario, it can be said that the sector power has the greatest potential of emissions reduction (63.12 million tons CO_2eq), largely because of the large projected abatement possibilities from RES (40.8 million tons CO_2eq). The RES with the highest potential are wind stations – 58 percent, hydroelectric power stations and the solar panels have the same share – 21 percent and 21 percent, respectively. In terms of this scenario, the main role of the government shall be in facilitating the RES development.

Regarding all options with positive costs, the industry sector accounts for 25.4 million tons of CO_2eq potentially reduced at an average cost of 66.2 euro per ton. Emissions reduction actions are most efficient in the steel industry where the potential reduction is equal to 11 million tons of CO_2eq at a marginal price of seven euro per ton. Possibilities of reducing GHG emissions in ceramics and paper production were also taken into account when plotting the MACC. The total estimated reduction potential in these areas is not high, however, with only 0.21 million tons of CO_2eq. While the Kazakh ETS currently does not include ceramics and paper, we consider also their potential reductions as part of the ETS for simplicity reasons and because they might be included in the future.

Cogeneration processes producing electric and heat energy prevail in Kazakhstan. However, for the purposes of the MACC, the "heat production" sector is accounted for separately. Furthermore, buildings are also included in this sector as final heat users. The main reason for considering buildings as a part of the heat production category is that the measures aimed to decrease the consumption of heat energy (heat insulating and glazing of buildings; increasing the control that final heat users get over their consumption by installing heat meters, adjustable radiators and changed approaches to heat charges) decrease also the production of energy at energy plants. Although there may be a large potential for reductions in heat consumption in the buildings sector, the NERA's MACC considering the proposed measures for the sector has shown the possibility of reducing emissions only by 1.59 million tons of CO_2eq. At that, the cost of emissions reduction is estimated by NERA to be quite high: the measures for the residential and commercial sector would cost 93 euro per ton and 147 euro per ton, respectively.[38]

In terms of the choice among state-implemented policies, increasing the energy efficiency, changing the tariff setting and implementing building construction standards will be related to command-and-control instruments of emissions reduction which will, however, facilitate achieving ETS goals. Although the measures are less cost-effective (from a private perspective) than the market-based ones, they are important where market imperfections exist – such as lack of information and scarcity of time, management attention or investment capital.

Therefore, when defining maximum emissions for the ETS it is necessary to also consider the policies the government implements to support the development of RES and energy efficiency.

The most attractive non-ETS options will be the reduction of GHG emissions in the transport sector. Having negative costs, measures for the increase of fuel efficiency as well as upgrades of public passenger, and cargo transport may achieve emission reductions of 11 million tons of CO_2eq.

Table 6 below shows the volume of possible reductions in the different sectors and also the average unit costs associated with these measures for the "Status Quo" scenario (not including negative costs).[39]

Table 6: Reduction potential of different sectors

	Sector	Reduction potential (million tons CO_2eq)	Average costs per ton of reduction (euro/ton CO_2eq)
1	Power	61.4	105.0
2	Industry	25.4	66.0
3	Heat production	15.1	64.0
4	Oil and gas sector	8.9	103.0
5	Transport	2.2	99.4
6	Wastes	2.9	91.0
7	Buildings and structures	1.6	120.0

Source: own calculation based on NERA/Bloomberg 2011

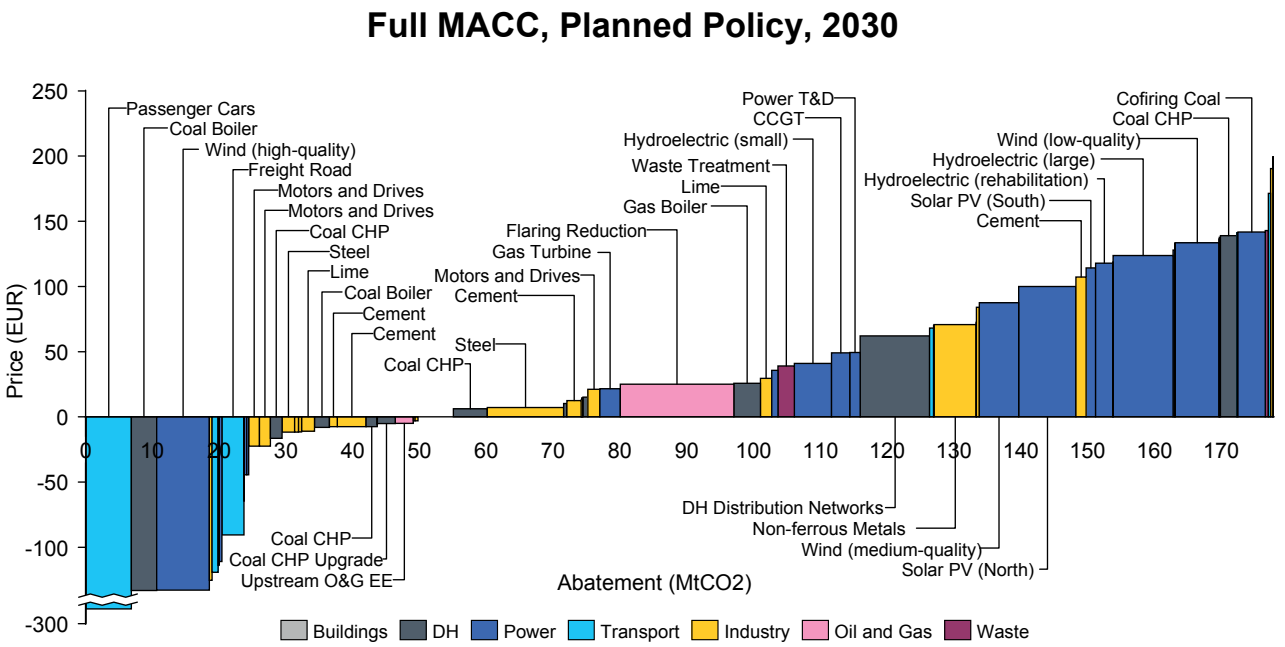
38 For the Status Quo Scenario.

39 Average unit costs have been calculated for all measures with costs between 0 and 200 euro per ton CO_2eq – see the Annex for the lists containing these measures.

3.4.4 Planned Policy Scenario from NERA/Bloomberg

In contrast to the Status Quo scenario from NERA/ Bloomberg, this scenario already foresees the development of renewable energy resources, *supported by regulated tariffs*, improvement of enforcement of requirements to energy efficiency, and it is suggested to raise heat tariffs for the end consumer. It also includes measures to raise energy cost awareness by heat users, especially heat tariffs in relation to real consumption (by installing metering devices) (see NERA/Bloomberg 2011, p. 77). According to this scenario, emissions in 2030 will be 434 million tons of CO_2eq, which exceeds the fixed goals by 130 million tons of CO_2eq.

See the marginal abatement cost curve in the picture below.

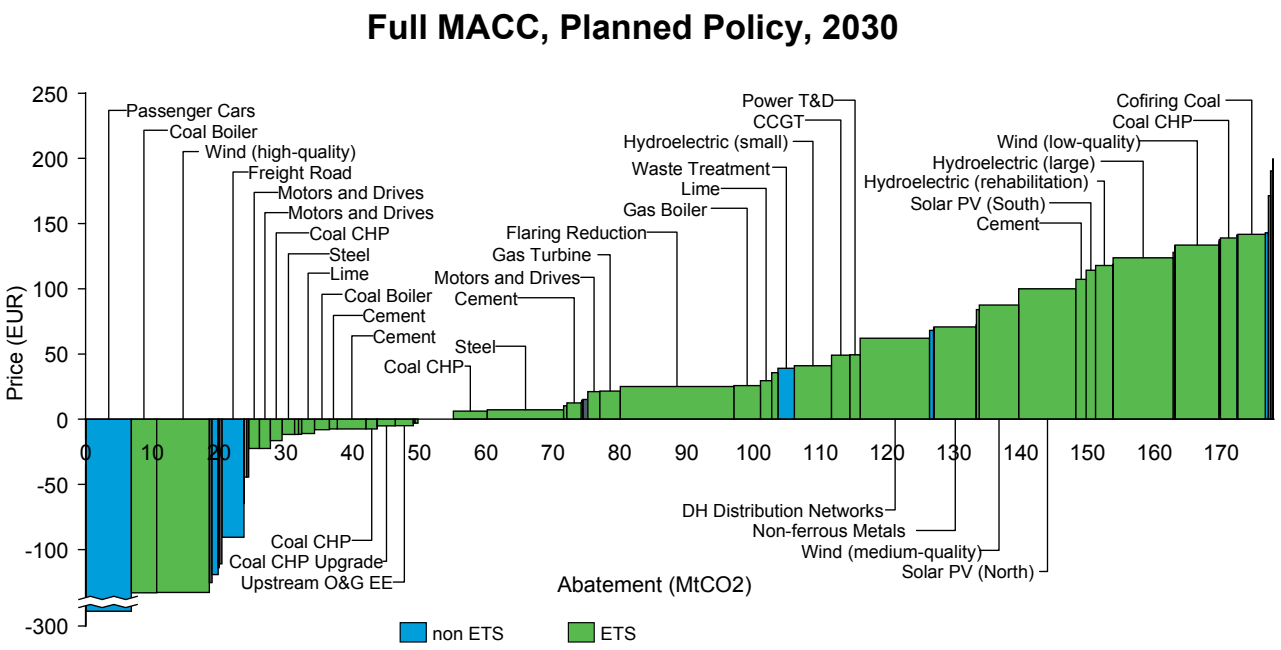


Source: NERA/Bloomberg

Figure 9: MACC for the Planned Policy scenario

Results of the MACC for the scenario Planned Policy in whole identify the possibility to reduce emissions by 177.7 million tons of CO_2eq for up to 200 euro per ton. Of this, 55 million tons are no-regret measures with negative abatement costs, resulting in abatement measures with positive costs leading to 123 million tons (177.7 million – 55 million). As the gap in GHG emissions reductions in this scenario is 130 million tons of CO_2eq, on the whole the national reduction goal can almost be achieved even under the (now outdated) growth assumptions used by NERA/Bloomberg. In the Planned Policy scenario, the reduction potential in such sectors as power and industry remains almost on the same level as in the Status Quo scenario, but there is a higher possibility to reduce emissions with negative costs. As well, owing to introduced measures on support of RES, the average marginal price (from a private investor's perspective) decreases up to 70 euro per one ton of CO_2eq. There is a notable increase in the volume of GHG abatement in the heat production sector due to the introduction of measures on energy efficiency in heat use, which will result in the reduction of 4.5 million tons of CO_2eq (see NERA/Bloomberg 2011, p. 78).

Using the same matching procedure as for the Status Quo scenario, we derive the following MACC with "assignments" to ETS and non-ETS sectors.



Source: own illustration based on NERA/Bloomberg 2011

Figure 10: MACC for ETS and non-ETS sectors for the "Planned Policy" scenario

The following Table 7 presents aggregated data on possible volumes of emissions reduction with breakdown by prices.

Table 7: Abatement potential in ETS and non-ETS at different abatement prices, Planned Policy

	Abatement in million tons of CO_2eq at euro/ton of CO_2eq			
	0	1-40	41-200	Total
	Million tons of CO_2eq			
ETS	39.50	48.51	70.17	158.18
Non-ETS	15.54	2.53	1.51	19.58
Total	**55.04**	**51.04**	**71.68**	**177.76**

Source: own calculation based on NERA/Bloomberg 2011

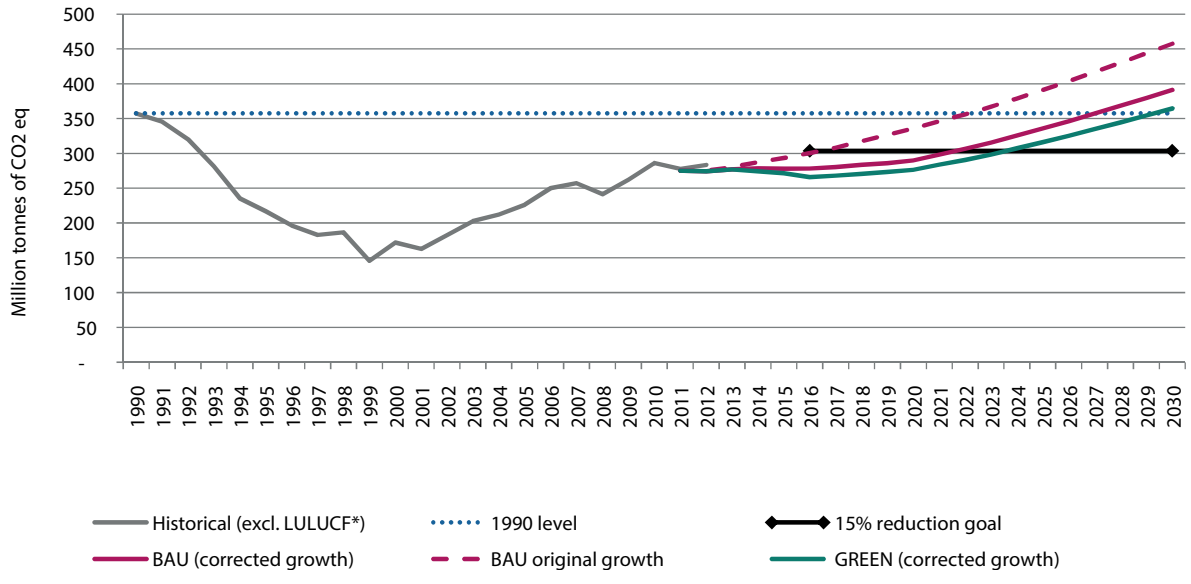
As in the Status Quo scenario, the major part of GHG emissions reductions (including measures with negative costs) also relates to sectors included in the ETS – 88.9 percent, so only 11.1 percent of potential reductions refer to sectors which are not included in the trading system. The implementation of new climate or energy policies in this scenario (not least, institutional measures leading to better enforcement of building regulations and better incentives for heat savings) resulted in more cost-efficient GHG emission reductions, leading to additional 17.1 million tons of CO_2eq reduced.

In the end, neither of the two scenarios clearly fits better than the other for our goal of determining the "least cost" effort sharing between ETS and non-ETS sectors: The Planned Policy scenario appears more appropriate in terms of its inclusion of some "enabling" policies such as heat use tariffs depending on actual heat use and better enforcement of building regulations. These measures change the relative costs of some abatement options in the MACC and private investors usually have little influence over them, so their inclusion seems appropriate. On the other hand, the Planned Policy scenario includes the promotion of renewable energy sources. This implies the methodical risk that transfers to the private investors (here, mainly feed-in-tariffs from the government) could reduce the costs to private investors, while in reality they do not reduce the costs to society. This risk matters for the ETS cap only if more abatement by RES is thus motivated, so that the private perspective would indicate an even lower optimal ETS cap. Comparing the abatement figures from the Appendix D in the NERA/Bloomberg report, total abatement from RES seems almost identical between the Status Quo and the Planned Policy scenario, so this issue seems to be negligible. However, it could, in principle, exist for other abatement options and in other sectors, too, and we cannot determine with high certainty these details in the NERA/Bloomberg investigation.

The difference in total abatement (after subtracting no-regret options with negative costs) is relatively small, however. We choose the Status Quo scenario for our further calculations, mainly because the cost table in section 3.4.6 is more "realistic" then. In the end, the main purpose of this study is an exemplary use of MACC curves for deriving a least-cost effort sharing proposal, and we do not attempt a final "verdict" on this issue. As we will outline in the Conclusions, instead we suggest the set-up of revised MACC curves that take into account the current developments in Kazakhstan which can affect emission projections and estimates of abatement costs. Here, the MACC could be designed in such a way that they fit better to this precise question.

3.4.5 Scenario "Increase of GHG Emissions" from DIW Econ

In their report "Proposal for the National Allocation Plan 2016-2020 for Kazakhstan", DIW Econ lay out model-based projections of GHG emissions until 2030 (see Figure 11). Apart from the BAU scenario with (downward) corrected growth that we present above in Tables 3 and 4, Figure 11 also contains a further BAU scenario with "original growth" numbers based on IMF's 2013 data, and a "GREEN" scenario that covers policies included in the Kazakhstan Green Economy Concept (DIW Econ 2015, p. 4 and 10).



Source: DIW Econ

Figure 11: Projections by DIW Econ of GHG emissions up to 2030

According to assumptions of DIW Econ, the increase of GHG emissions up to 2020 will be slight, allowing achieving the national emission goals until then. However, from the figure above it is obvious that until 2030 emissions will exceed all national reduction goals. Achievement of the goals until 2020 is possible because of the current decline in economic activity. At that, DIW Econ note that emissions from non-ETS sectors increase faster and their volume will be larger than from ETS sectors (ibid., p. 12).

DIW Econ also suggest that it is more useful to start activity on reduction of GHG emissions not after 2020, but before, starting from 2016, so that the burden on ETS and non-ETS sectors is not so large in the next decade (2021-2030). As the "gap" between the projections and the emission goal in the year 2030 is 87 million tons CO_2eq, it is then necessary to reduce total emissions by 5.8 million tons of CO_2eq annually. The main proposal from DIW Econ for this is a reduction of GHG emissions by even rates, both for ETS and for non-ETS. This corresponds to option c. of the effort sharing options listed in section 3.4.1.

The overall task is simplified for the DIW Econ scenario, because the BAU emission projections are not as high as those by NERA/Bloomberg and the gap is only 87 million tons of CO_2eq. The Kazakhstan goals for GHG emission reductions are in this case achievable at costs of up to 100 euro per ton of CO_2eq, according to the MACC in NERA's Planned Policy scenario and 143 euro per ton of CO_2eq, according to the MACC for the Status Quo scenario.

These MACC indicate that most of the reduction measures for achieving these 87 million tons are possible in the ETS sector, and the reduction potential of non-ETS is only 5.3 million tons of CO_2eq (according to the Status Quo scenario). This is why our results based on MACC indicate relatively larger reductions for the ETS, and less for the non-ETS sectors, than those by DIW Econ.

3.4.6 Summary on the use of MACC in both NERA Scenarios and for the DIW Econ Projection

1. Both scenarios have quite a high potential of reducing GHG emissions. The Status Quo scenario MACC predicts a reduction potential of 155.4 million tons of CO_2eq for costs up to 200 euro per ton of CO_2eq; for the Planned Policy the potential is 177.8 million tons of CO_2eq.
2. Implementing state policies which support the RES development are likely to increase the long-term potential of GHG emissions reduction and also decrease the long-term marginal costs. Additional policies such as feed-in-tariffs should complement the ETS because today many renewable energies still need assistance to be deployed on a wider scale, while in the long-run, substantial cost reductions for them can be expected.
3. Energy produced by RES reduces the supply by fossil fuel energy (coal, gas, residual oil) electricity suppliers. This, in turn, reduces their demand for allowances, so without a tighter ETS cap there would be no net GHG emissions reduction effect from the RES. Because of this, the future effect of RES should be considered when planning maximum emissions for the ETS sector: the cap should be reduced accordingly.
4. The larger part of the potential GHG emissions reduction relates to the sectors included in the GHG Emissions Trading System (88.5 percent on average).
5. Based on the NERA projections, the emissions goal of both scenarios could only be achieved by exceeding the maximum price of 200 euro per ton of carbon. However, their projected high increase rates of GHG emissions are in part the consequences of the high economic growth supposed at that moment. In the four years since 2011, Kazakhstan's economic situation worsened in terms of a decrease in prices for export goods, which led to a dramatic decrease of economic forecasts up to 2020.
6. MACC had been developed before Kazakhstan implemented the ETS and applied the policy of transition to the "Green Economy". This means the necessity of a new MAC curve considering all the new policies and measures Kazakhstan has already taken until now.

3.4.7 A Cap for the Year 2030

It is important that ETS caps are always fixed prior to the trade period, so that they can be predicted by the participants. When the "effort-sharing" of emission reductions between ETS and non-ETS sectors is calculated, it is necessary to take into account the economic development of a country, a tendency of prices for fuels, heat and electricity, an influence of RES support and development policies and policies promoting energy savings and energy efficiency. These questions are inextricably linked and, for example, the European Union considers them in the same context for climate change mitigation.

As indicated above, in NERA/Bloomberg's Status Quo or Planned Policy scenarios the emission goal for 2030 of 304 million tons CO_2eq will not be reached at costs up to 200 euro per ton, but the growth figures assumed by them have not materialized. Therefore, because of "delayed" growth or even constantly slower growth, all emissions in future years will be lower. DIW Econ project that business-as-usual emissions in 2030 will be at about 391 million tons – resulting in a gap in emissions of 87 million tons. Taking over their projection, we have to divide these 87 million tons across the ETS and non-ETS sectors according to the costs of the abatement options in these sectors. The following table illustrates this for NERA's Status Quo scenario.

Table 8: Marginal abatement volume in the Status Quo scenario

Abatement price euro per ton CO_2e	Abatement in ETS	Abatement in non-ETS	Sum
1-40	42.05	2.53	44.58
41- 100	29.60	1.11	30.71
101-120	7.40	1.05	8.45
121-143	2.61	0.63	3.24
Total	***81.60***	***5.32***	***86.90***
Share	**93.90%**	**6.10 %**	**100 %**

Total abatement at the price of 143 euro per ton (86.9 million tons CO_2eq) is very close to our reduction target of 87 million tons. To achieve it just 0.1 million ton is missing. We assume that the ETS could generally reduce emissions by 0.1 million ton more, so we consider that 81.7 million tons of abatement – compared to BAU – should take place in the ETS. The remaining 5.3 million tons to fill the gap should then be reduced by the non-ETS sectors.
As the next step for determining the ETS cap for 2030, we furthermore need a projection for the business-as-usual (BAU) emissions of the sectors included in the ETS. For consistency with the above estimation of the total gap in 2030 (87 Million tons), we use DIW Econ's recent projection, which is 177 million tons (i.e. significantly below those projected by NERA/Bloomberg).

From this figure, we subtract the reduction requirement according to the derived effort sharing from section 3.4, to derive an **ETS cap for 2030 of 95.3 million tons (177 to 81.7 million tons)**.

3.5 Considerations for a Cap Path from 2016 to 2030 in the Kazakh ETS

In order to determine the cap reduction path for the ETS, it is necessary to start with the current cap, and make a decision on the path towards the target cap in 2030. As indicated in chapter 1, the national allocation plans for 2014 and 2015 set caps at a level of 155.4 and 153.1 million tons of CO_2, respectively. The average amount of these two numbers – 154.2 million tons – we consider as the basis for the cap path until 2030.

This means that over 15 years (beginning in 2016) the ETS emissions should be reduced by 58.9 million tons CO_2eq in total. There are two options for how to distribute these obligations over time:

1. Linear reduction supposed to reduce emissions by the same amount every year until 2030. This method reduces emissions by 3.92 million tons every year from 2016 (2.5 percent of the cap in 2014/15). For the NAP 2016 to 2020 total reductions are 19.6 million tons.
2. The second method involves softer conditions until 2020 and larger reductions later, when renewables start generating significant amounts of electricity. In this case we can suggest to set a compliance factor for the NAP 2016 to 2020 of one percent annually, which means that in this period 2.9 million tons in total will be reduced. During the period 2021 to 2030, the ETS then has to reduce 55.9 million tons, which would mean a linear decrease of 5.59 million tons each year.

In line with DIW Econ's recommendation, we also propose that it is reasonable to start activities on reducing GHG emissions not after 2020, but in 2016, so that the reduction in later years is not so large that is becomes politically impossible. The following Figure 12 illustrates this case.

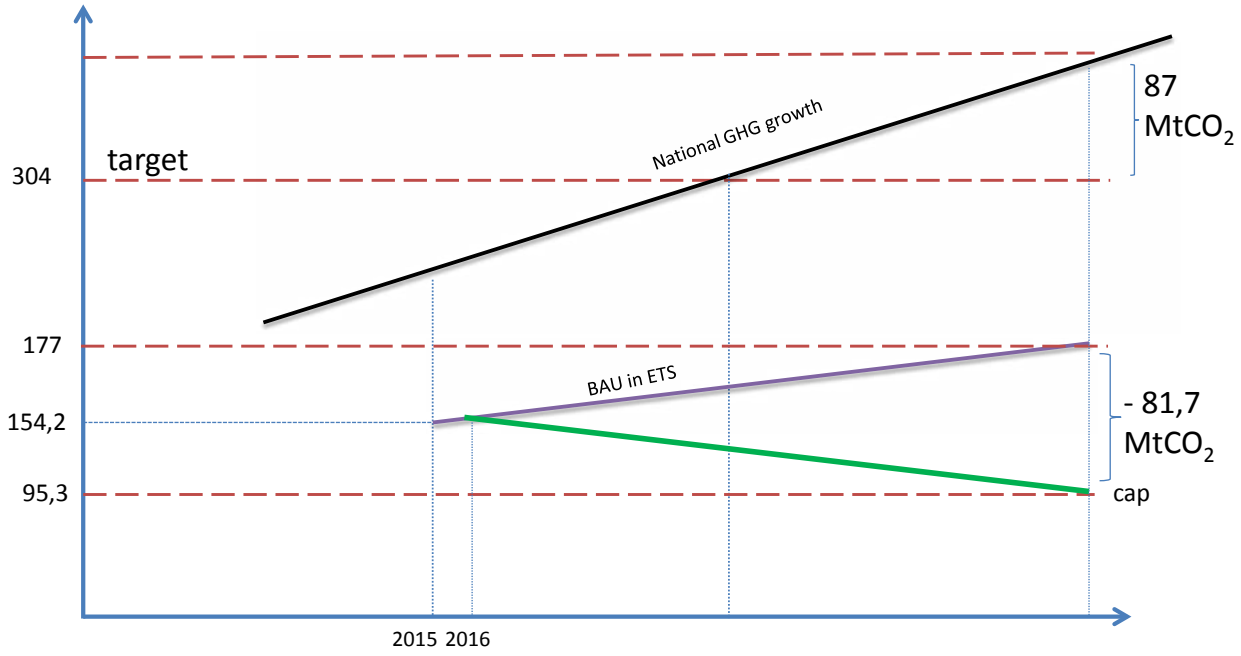


Figure 12: Path of projected emissions and of a linear ETS cap reduction

4 Conclusions

Kazakhstan made an attempt to establish an ETS cap for companies from three larger emitters sectors using a bottom up method. On the basis of this method the first and second national allocation plans have been developed and approved by the Government.

In this report we analyzed MACC for Kazakhstan to identify the possibilities to reduce GHG emissions by ETS and non-ETS sectors. We examined two main scenarios suggested by NERA/Bloomberg: “Status Quo” and “Planned Policy”. Analyzing MACC for Kazakhstan we can see that the main potential GHG reductions come from the ETS for both scenarios. Total abatement volume grows when the government starts implementing supporting renewable energy and increasing requirements for the energy efficiency policy in building sectors.

To show how the MACC results can affect the process of cap setting, we integrate emissions projections for 2030 from DIW Econ, which indicate a gap in emissions in 2030 of 87 million tons CO_2eq. Based on the MACC from NERA/Bloomberg Status Quo scenario, total abatement for abatement options costing up to 143 euro per ton amounts to nearly 87 million tons of CO_2eq, 93.9 percent of which (81.7 million tons) belong to the ETS. With such a high proportion it is obvious that the ETS will play the main role to achieve the national target. To determine the ETS cap for 2030, we apply the business-as-usual projection for the ETS from the DIW Econ report, who project that they will grow until 2030 to the level of 177 million tons of CO_2eq. Reducing emissions from this value by 81.7 million tons gives an ETS cap of 95.3 million tons in 2030.

From the average ETS cap in 2014/15 of 154.2 million tons CO_2eq, the cap path has to achieve a total reduction of 58.9 million tons. When equally distributing these over 15 years starts from 2016, this results in reducing emissions by 3.92 million tons annually.

The MACC by NERA/Bloomberg which we used in this report were developed in 2011. We propose to undertake work to set up a revised MACC that includes recent developments:

Firstly, current economic growth projections should be used. As in the report by DIW Econ, this affects (reduces) the business-as-usual projections. We presume that in addition, it also reduces the abatement amount of certain abatement options (however, only to a limited degree), because reduced economic activity implies that each abatement option has a slightly smaller effect.

Secondly, fuel price assumptions should be revised, affecting both the incentives for fuel savings and potential shifts in the fuel mix. Shifts in the fuel mix, however, are probably limited by the availability and very low prices of local coal (and missing international market for it) combined with the localization of natural gas in the west of the country, whereas the bulk of fuel consumption is in the North and South (see NERA/Bloomberg 2011, p. 13).

Thirdly, recent developments in the costs of capital equipment should be integrated. This refers especially to renewable energy sources (RES) which make up for the lion's share in total abatement in the NERA/Bloomberg report. Costs of wind and photovoltaic equipment have fallen strongly over the past years.

In addition to equipment costs, costs for setting up transmission from RES generation sites to the consumption areas, as well as costs for potential back-up for fluctuations in RES-based power generation are relevant factors.[40] All these "infrastructure" costs may not matter very much from a private investors' perspective, and this may be the reason why they have not been included to a large degree in the NERA/Bloomberg report. Given the large potential indicted by NERA/Bloomberg we expect that often, even including such "system costs", RES abatement options are the cheapest options. Also, once sufficient transmission is set up, it may enable further RES developments with higher (private) costs. As a result, it can be expected that also in new MACC curves the total abatement from the implementation of RES instead of fossil fuels will be at least as large as it is in the NERA/Bloomberg figures used in this paper.

Fourthly, if shifts in the sector coverage of the ETS are planned or projected, this will affect the effort-sharing between ETS and non-ETS sectors. Another possible change could result from projected shifts in the "outreach" of the use of electricity instead of direct combustion. For example, if Kazakhstan were to decide on an ambitious plan to expand on electricity-driven transport instead of internal vehicle combustion, then this would mean higher emissions in the (ETS covered) electricity generation compared to the transport sector. The cap for the ETS would then have to be raised, and the allowed emissions for the non-ETS sectors reduced accordingly. Also the ETS share of abatement in the heat/buildings sector (which we indicate as an ETS share of 87 percent and non-ETS share of 13 percent, see above) may change in the future – however, we do not expect large changes here.

Fifthly, the scope of sectors and measures included in the MACC might be extended. NERA/Bloomberg investigated abatement measures in the agriculture and forestry sector, but did not include them in the overall MACC. Possibly, if these measures are included, the reduction share of non-ETS sectors could be increased, allowing a higher ETS cap. The feasibility of this might depend, however, on the reference of the Kazakh emission goal of -15 percent (namely, whether it includes LULUCF).

Other measures which could, in our view, be analyzed in more detail than so far are changes in non-technical areas, and/or areas not related to the private investors' perspective. For instance, behavioral changes (e.g. in transport), changes in the modal split, or land-use planning affecting transport volume.

Also, when constructing new MACC, we suggest that it is very important to carefully address from which perspective the MACC have to be set up. NERA/Bloomberg deliberately apply MACC from the perspective of private investors, while the ultimate question in determining an "effort sharing" between ETS and non-ETS sectors is the social costs of emission reductions. Nonetheless, factual barriers to investment are a very important factor and should be accounted for when constructing MACC even from a social perspective. This also means that the investment discount rate is a very sensitive factor. However, transfers from the government to firms or vice-versa (subsidies, or tax/allowance payments to the government) must be excluded at any rate in order not to mix costs with payments.

Also, we believe that a systematic development of an MACC from a social perspective can make the choice of which policies to include easier: for example, in the NERA/Bloomberg study, the Status Quo scenario does not include some measures that reduce barriers to investment; on the other hand, the Planned Policy scenario includes transfers which should not be counted from a social perspective.

40 For the latter, only the additional costs of generation technologies with good back-up feasibility compared to alternative generation technologies are relevant – e.g., additional costs of gas-fired generation compared to coal-based generation.

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21. Concept for transition of the Republic of Kazakhstan to Green Economy.

Annexes

Table 1 MACC by ETS and Non-ETS sectors for the Status Quo Scenario [41]

	ETS	Abatement Million tons	Abatement costs Euro/T. CO_2
1	Gas/oil CHP rehabilitation - de-mothballing of existing, non functional capacity	0.04	-300
2	CCGT Power (Upgraded Existing plants)	1.04	-170
3	New coal heat-only boiler, serving District Heating networks	5.28	-136
4	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.4	-125
5	Ceramics (improved drying and firing)	0.06	-114
6	Ceramics (improved drying and firing)	0.07	-114
7	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	0.37	-44
8	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	0.3	-44
9	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors	1.64	-23
10	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors	1.63	-22
11	New coal Combined Heat and Power (CHP), serving District Heating networks	1.06	-18
12	Lime (shell heat loss reduction, improved kiln combustion, process control)	0.45	-12
13	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	1.85	-12
14	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	0.59	-12
15	Lime (shell heat loss reduction, improved kiln combustion, process control)	1.94	-11
16	New coal heat-only boiler, serving District Heating networks	0.76	-9
17	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	1.18	-8
18	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	4.3	-8
19	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements)	0.03	-6
20	Energy Efficiency measures in upstream Oil and Gas production: efficient pumps, motors, turbines, heaters and drives, measures to avoid pipeline fouling, and process controls including optimised pressure maintenance	1.35	-5

41 Note that for simplicity reasons, measures in the ceramics and paper sector are listed here under "ETS" although they are currently not included in the Kazakhstan ETS. Their absolute estimated reduction potential until 2030 is small compared to other sectors. Furthermore, they might be included in the future.

21	Upgrade of coal Combined Heat and Power (CHP), serving District Heating networks	1.6	-5
22	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces.	0.27	-3
23	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces.	0.42	-3
24	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.24	-
	Marginal price up to 40 Euro		
1	Upgrade of coal Combined Heat and Power (CHP), serving District Heating networks	1.12	5
2	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	11.43	7
3	New coal Combined Heat and Power (CHP), serving District Heating networks	5.38	10
4	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.91	12
5	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	2.13	13
6	Bricks (improved drying and firing)	0.1	14
7	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements)	0.08	14
8	Upgrade of coal heat-only boiler, serving District Heating networks	0.45	21
9	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors	1.64	23
10	CCGT Power (Existing plants)	2.58	25
11	New gas/oil heat-only boiler, serving District Heating networks	4.69	26
12	Reduction of natural gas flaring in Oil extraction industry	8.5	25
13	Lime (shell heat loss reduction, improved kiln combustion, process	1.71	29
14	CCGT Power (Existing plants)	0.9	36
15	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	0.43	40
	Marginal price 41-200 Euro		
1	Hydroelectric power (small)	6.17	41
2	Paper (waste heat recovery, process control and pinch analysis)	0.08	70
3	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces	6.34	71
4	Wind (High-quality sites)	11.23	74
5	CCGT Power (New plants)	3.6	76
6	New gas/oil heat-only boiler, serving District Heating networks	0.09	82
7	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.45	84
8	District Heating networks upgrades: replacement with pre-insulated pipes or retrofitted insulation, burying of pipes underground, leakage reduction	1.64	98
9	Wind medium-quality sites)	5.82	104
10	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	1.54	107

11	Bricks (improved drying and firing)	0.04	119
12	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements)	0.03	137
13	Hydroelectric power (rehabilitation of currently non-functioning capacity)	2.58	143
14	Solar PV power generation	8.56	154
15	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.09	155
16	Hydroelectric power (large)	8.97	158
17	District Heating networks upgrades: replacement with pre-insulated pipes or retrofitted insulation, burying of pipes underground, leakage reduction	0.65	166
18	Coal power generation - Biomass co-firing	3.95	171
19	Wind (Low-quality sites)	6.44	174
20	Coal Power (New plants)	0.18	179
21	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	0.32	190
22	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.02	200
	Total	***137.71***	
	Non-ETS Negative cost		
1	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	6.82	-289
2	Public transport (modernised buses)	0.92	-119
3	Freight Road transport (increased fuel efficiency, preventative maintenance)	3.26	-90
4	Municipal and Industrial wastewater treatment (flaring, waste treatment, anaerobic digestion), and Landfill Gas management (composting, waste treatment, energy generation)	0.04	-65
	Marginal price up to 40 Euro		
	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	0.08	13
	Municipal and Industrial wastewater treatment (flaring, waste treatment, anaerobic digestion), and Landfill Gas management (composting, waste treatment, energy generation).	2.45	39
	Total	***2.53***	
	Marginal price 41-200 Euro		
	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	0.58	68
	Residential District Heating buildings: installation or retrofit of Building Level Substations and metering devices, heat controls, and energy efficiency measures (insulation, external cladding)	0.53	93
	Freight Road transport (increased fuel efficiency, preventative maintenance)	1.05	104
	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	0.15	141
	Total non-ETS	***17.72***	

Table 2 MACC by ETS and Non-ETS sectors for the Planned Policy Scenario

	ETS	Abatement Million tons CO_2	Abatement costs Euro/T. CO_2
1	Gas/oil CHP rehabilitation - de-mothballing of existing, nonfunctionalcapacity	0.04	-300
2	New coal heat-only boiler, serving District Heating networks	3.78	-133
3	Wind (High-quality sites)	7.9	-133
4	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.4	-125
5	Ceramics (improved drying and firing)	0.06	-114
6	Ceramics (improved drying and firing)	0.07	-114
7	CCGT Power (Upgraded existing plants)	0.45	-111
8	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	0.37	-44
9	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	0.3	-44
10	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors.	1.64	-23
11	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors.	1.63	-22
12	New coal Combined Heat and Power (CHP), serving District Heating networks	1.76	-16
13	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	1.85	-12
14	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	0.59	-12
15	Lime (shell heat loss reduction, improved kiln combustion, process control)	0.45	-12
16	Lime (shell heat loss reduction, improved kiln combustion, process control)	1.94	-11
17	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	1.18	-8
18	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	4.3	-8
19	New coal heat-only boiler, serving District Heating networks	2.23	-8
20	New coal Combined Heat and Power (CHP), serving District Heating networks	1.65	-8
21	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements)	0.03	-6
22	Upgrade of coal Combined Heat and Power (CHP), serving District Heating networks	2.7	-5

23	Energy Efficiency measures in upstream Oil and Gas production: efficient pumps, motors, turbines, heaters and drives, measures to avoid pipeline fouling, and process controls including optimised pressure maintenance	2.7	-5
24	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces	0.27	-3
25	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces	0.42	-3
26	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.79	0
	Marginal price up to 40 Euro		
1	New coal Combined Heat and Power (CHP), serving District Heating networks	5.08	6
2	Steel (process improvements including coal moisture control, heat recovery, energy monitoring and management, hot blast stove automation)	11.43	7
3	New coal heat-only boiler, serving District Heating networks	0.49	10
4	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	2.13	13
5	Bricks (improved drying and firing)	0.1	14
6	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements	0.08	14
7	Upgrade of coal heat-only boiler, serving District Heating networks	0.74	15
8	Efficient use of electricity in Industry - modern motors, variable speed drives, pumps, compressors.	1.82	21
9	CCGT Power (Upgraded existing plants)	3.03	22
10	Reduction of natural gas flaring in Oil extraction industry	17	25
11	New gas/oil heat-only boiler, serving District Heating networks	4	26
12	Lime (shell heat loss reduction, improved kiln combustion, process control)	1.71	29
13	CCGT Power (Existing plants)	0.9	36
	Marginal price 40-200 Euro		
1	Hydroelectric power (small)	5.58	41
2	CCGT Power (New plants)	2.74	49
3	Power Transmission and Distribution (improved monitoring, control and fault detection, reduced losses)	1.54	49
4	District Heating networks upgrades: replacement with pre-insulated pipes or retrofitted insulation, burying of pipes underground, leakage reduction	10.38	62
5	Paper (waste heat recovery, process control and pinch analysis)	0.08	70
6	Non-ferrous metals production: improved monitoring and targeting (copper), modern furnaces	6.34	71
7	Wind (High-quality sites)	0.01	73
8	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.45	84
9	Wind (Medium-quality sites)	5.88	87
10	Solar PV power generation (Northern regions)	8.56	100

11	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	1.54	107
12	Solar PV power generation (Southern regions)	1.42	114
13	Hydroelectric power (rehabilitation of currently non-functioning capacity)	2.57	118
14	Bricks (improved drying and firing)	0.04	119
15	Hydroelectric power (large)	8.97	124
16	Coal Power (New plants)	0.27	128
17	Wind (Low-quality sites)	6.63	133
18	New coal heat-only boiler, serving District Heating networks	0.02	133
19	Ammonia (energy management, hydrogen recovery, low pressure synthesis, process improvements)	0.03	137
20	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.15	138
21	New coal Combined Heat and Power (CHP), serving District Heating networks	2.46	139
22	New gas/oil heat-only boiler, serving District Heating networks	0.01	140
23	Coal power generation - Biomass co-firing	4.09	142
24	Cement (high clinker substitution, fuel switching and waste firing, kiln modernisation, process improvements)	0.32	190
25	District Heating networks upgrades: replacement with pre-insulated pipes or retrofitted insulation, burying of pipes underground, leakage reduction	0.03	193
26	Oil refineries (energy management, improved process controls, pumps / motors / compressed air, waste heat recovery)	0.02	200
27	Upgrade of gas/oil heat-only boiler, serving District Heating networks	0.04	200
	Total	***158.18***	
	Non-ETS Negative cost		
1	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	6.82	-289
2	Public transport (modernised buses)	0.92	-90
3	Freight Road transport (increased fuel efficiency, preventative maintenance)	3.26	-90
4	Commercial / Public District Heating buildings: installation or retrofit of Building Level Substations and metering devices, heat controls, and energy efficiency measures (insulation, external cladding)	1.32	0
5	Commercial / Public District Heating buildings: installation or retrofit of Building Level Substations and metering devices, heat controls, and energy efficiency measures (insulation, external cladding)	3.18	0
6	Municipal and Industrial wastewater treatment (flaring, waste treatment, anaerobic digestion), and Landfill Gas management (composting, waste treatment, energy generation).	0.04	-65

	Marginal price up to 40 Euro		
1	Freight Road transport (increased fuel efficiency, preventative maintenance)	0.08	13
2	Municipal and Industrial wastewater treatment (flaring, waste treatment, anaerobic digestion), and Landfill Gas management (composting, waste treatment, energy generation).	2.45	39
	Marginal price 40-200 Euro		
1	Freight Road transport (increased fuel efficiency, preventative maintenance)	0.58	68
2	Passenger Road transport (increased fuel efficiency, hybrid and electric vehicles)	0.15	141
3	Municipal and Industrial wastewater treatment (flaring, waste treatment, anaerobic digestion), and Landfill Gas management (composting, waste treatment, energy generation).	0.48	143
4	Freight Road transport (increased fuel efficiency, preventative maintenance)	0.3	171
	Total	***34.15***	

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