THE SECOND BIENNIAL REPORT OF THE REPUBLIC OF KAZAKHSTAN

submitted in accordance with the Decision 1/CP.16 of the Conference of the Parties to the United Nations Framework Convention on Climate Change

This report was prepared by the Ministry of Energy of the Republic of Kazakhstan with the support of UNDP/GEF project No 90571 'Development of Kazakhstan's 7th National Communication and Biennial Report'

Astana 2015

CONTENT

List of acronyms, abbreviations, chemical symbols and measurement units

ACIG	Khantau Concrete Plant JSC
AFOLU	Agriculture, forestry and other land-use
BAU	Business as usual
BR1	First Biennial Report
CHPP	Combined Heat and Power Plants
CIS	Commonwealth of Independent States
COP	Conference of the Parties
CRF	Common Reporting Format
CTF	Common Table Format
ECE	Economic Commission for Europe
ES	Emergency situation
EAF	Electric arc furnace
EP	Environment Protection
EXPO-2017	World Exhibition 2017 'Energy of the Future'
FES	Fuel and energy sector
GAW	Global Atmosphere Watch of WMO
GDP	Gross domestic product
GEF	Global Environmental Facility
Gg	Gigagramm,10^9 grams, kilotons, kiloton (Kt)
GIS	Geological information system
GHG	Greenhouse gas
GL	Guidelines
GOS/GCOS	Global Climate Observation System
GSN	Global Surface Network
GST	Global Surface Temperature
GTS	Global Telecommunications System
GUAN	GCOS Upper-Air Network
GVA	Gross value added
GWP	Global warming potential
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
HP	Hazardous phenomena
HPP	Hydro power plant
HQ	Headquarters
IEA	International Energy Agency
INDC	Intended Nationally Determined Contributions
IO	International Organization
IPPU	Industrial processes and product use
IDMS	Integrated databases management system
IPCC	Intergovernmental Panel on Climate Change
JSC	Joint Stock Company
KP	Kyoto Protocol
LLP	Limited liability partnership
LoRK	Law of the Republic of Kazakhstan
LULUCF	Land use, land use change and forestry
MEP	Ministry of Environment Protection
ME RK	Ministry of Energy of the Republic of Kazakhstan
MEWR	Ministry of Environment and Water Resources

MFA	Ministry of Foreign Affairs
MGL	Vojekov Main Geophysical Laboratory, Saint-Petersburg, Russia
MNE	Ministry of National Economy of the Republic of Kazakhstan
MI	Metal Industry
MS	Meteorological station
MSW	Municipal solid wastes
NA	Not available
NE	Not estimated
NHME	Natural hydrometeorological events
NHMS	National Hydrometeorological Service
NMVOC	Non-methane volatile organic compounds
NPP	Nuclear power plant
ODA	Official Development Assistance
ODS	Ozone depleting substances
PFC	Perfluorocarbons
RES	Renewable energy sources
RF	Russian Federation
RIHMI – WDC	All-Russia Research Institute of Hydrometeorological Information – World Data Center
RK	Republic of Kazakhstan
RSE	Republican state enterprise
RLA	Regulatory legal act
R&D	Research and development
SDG	Sustainable development goals
SDPP	State district power plant
SP	State program
SPAIID	State program for accelerated industrial and innovative development
SPIID	State program for industrial and innovative development
SPP	Solar power plant
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	UN Development Programme
UNEP	UN Environment Programme
USAID	U.S. Agency for International Development
USD	United States Dollars
VAT	Value added tax
WAM	With additional measures (scenario)
WCAM	With current and additional measures (scenario)
WCM	With current measures (scenario)
WOM	Without measures scenario
WMO	World Meteorological Organization
WPP	Wind power plant
WWW	World Weather Watch
3-6NC	3rd to 6th National Communication

Chemical formulas

CF4	Perfluorocarbon
C_2F_6.	Perfluoroethane

CH_4	Methane
CO	Carbon oxide
CO_2	Carbon dioxide
CO_2 eq.	CO_2 equivalent
NOX	Nitrogen oxide
N_2O	Nitrous oxide

I. Introduction

The Republic of Kazakhstan presents its second biennial report in accordance with the decision 1/CP.16 of the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC). The report consists of the Common tabular format provided by the Decision 19/CP.18 in electronic format and textual form. The text of the report was prepared in accordance with the 'UNFCCC Biennial Reporting Guidelines for Developed Country Parties' that are included into the Annex 1 to the Decision 2/CP.17 of the Conference of the Parties (COP). This Biennial Report supplements the information contained in the 3-6 National Communication of the Republic of Kazakhstan submitted in accordance with Articles 4 and 12 of UNFCCC and consists of the following sections:

- Introduction that describes national conditions and mechanisms relevant for preparation of national communications and biennial reports on a regular basis in Kazakhstan;
- Information on national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol that is included into the national inventory reports for 1990-2013;
- Quantified economy-wide emission reduction targets;
- Progress in meeting quantified economy-wide emission reduction targets and related information;
- Updated projections of greenhouse gas emissions until 2020 and 2030 by sector of economy;
- The section describing extension of financial and technological support for capacity building of developing country Parties.

Kazakhstan ratified the United Nations Framework Convention on Climate Change (UNFCCC) in May 1995 and became its Party in August of the same year. The Kyoto Protocol (KP) to the UNFCCC was signed by the Decree of the President of Kazakhstan on March 12, 1999. On March 23, 2000 the government of Kazakhstan has notified the Secretary-General of the United Nations of its intention to fulfill its obligations under paragraphs 2 a) and 2) b in accordance with paragraph 2 g) of Article 4 of the UNFCCC. On March 26, 2009 President Nursultan Nazarbayev signed the Law of the Republic of Kazakhstan No 144-IV 'On ratification of the Kyoto Protocol to the UN Framework Convention on Climate Change'. KP officially entered into force for Kazakhstan on September 17, 2009, 90 days after receipt of the ratification document by the KP depositary - UN Secretary-General.

At the Seventh Conference of the Parties (CP7) on December 3, 2011 in Marrakesh (Morocco) the decision was made that in accordance with paragraph 7 of Article 1 of the KP Kazakhstan is to be considered as Annex I Party to the UNFCCC as it submitted a notice in accordance with paragraph 2 g) of Article 4 of the Convention. Implementation of this decision was possible only after ratification of KP by Kazakhstan. Therefore in 2009 the Government of Kazakhstan has started active work on preparation of low-carbon development strategies and creation of the national emissions trading system. In 2012 at the COP18/CMP8 in Doha (Qatar) together with the amendment to the KP it was decided to include Kazakhstan in Annex B of the KP for its second commitment period and to take a commitment to reduce GHG emissions by 2020 by 5% to the level of the base year 1990 (and by 7% if case of expanded ambitions). The Doha amendment set out in Annex I to Decision 1/CMP.8 is subject to ratification. In accordance with Articles 20 and 21 of the KP UN Secretary-General, acting as depositary of the KP, sent the amendment to all parties of the KP. Given that provisions set in paragraph 7-ter to Article 3 of the KP present certain difficulties for fulfillment of obligations stated by the Republic of Kazakhstan for the second period of the KP, the Government of Kazakhstan has not yet made a decision on the ratification of the Doha amendment.[1]

At the 21st COP of UNFCCC in December 2015 in Paris at the 43rd Session of Subsidiary Body for scientific and technological advice under the request of the Republic of Kazakhstan to UNFCC Secretariat on clarification of applicability of Doha amendment (Article 3, paragraph 7-ter), the decision was made about Methodological issues under the Kyoto Protocol and clarification was given of the text in section G (Article 3, paragraph 7 ter) of the Doha Amendment to the Kyoto Protocol, in particular the

[1] 1 FCCC/AWGLCA/2012/MISC.1 and Add.1 and 2, FCCC/TP/2013/7 (Table 1)

information to be used to determine the ‘average annual emissions for the first three years of the preceding commitment period’. The decision sets out that [2] ‘for a Party included in Annex I undergoing the process of transition to a market economy and without a quantified emission limitation or reduction commitment in the first commitment period of the Kyoto Protocol, the positive difference between the total emissions during the second commitment period and the assigned amount adjusted in accordance with Article 3, paragraph 7 ter, of the Doha Amendment shall be added to the quantity of assigned amount unit s to be taken into account for the purpose of the assessment referred to in decision 13/CMP.1, annex, paragraph 14, and that the added quantity shall be limited to the quantity of assigned amount units cancelled by that Party for the second commitment period of the Kyoto Protocol, in accordance with Article 3, paragraph 7 ter, of the Doha Amendment’.

In accordance with INDC (Intended Nationally Determined Contributions) [3] submitted by Kazakhstan to the UNFCCC Secretariat in 2015, the national quantitative contribution to limitation and/or reduction of greenhouse gas emissions for the period from 2021 to 2030 has got an unconditional target of 15% and a conditional target of 25% to the level of the base year 1990. One of the key conditions for achieving this target on 25% limitation and/or reduction of greenhouse gas emissions is access to financial resources and mechanisms of low-carbon technologies transfer as well as access to flexible and efficient funding mechanism of UN Green Climate Fund as a Party that is in a transition period.

At the same time Kazakhstan intends to achieve the following economy-wide emission reduction targets: 15% by 2020 and 25% by 2050 compared to 1990.

For the purpose of fulfilling commitments under Article 12 of UNFCC, in 1998 Kazakhstan prepared and submitted its Initial National Communication and then its Second National Communication in 2009 as a non-Annex 1 Party to UNFCCC. After having become the Annex 1 Party, Kazakhstan had to align submission of its national communications. Therefore the next National Communication was submitted by January 1, 2014 as well as 3-6 National Communication (3-6NC).

3-6NC, as well as the 2nd National Communication, was prepared with the support of UNDP/GEF projects.

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[2] The document is available at the website of UNFCC http://unfccc.int/resource/docs/2015/sbsta/rus/l29a01r.pdf
[3]The document is available at the website of UNFCCC http://www4.unfccc.int/submissions/INDC/Published%20Documents/Forms/AllItems.aspx.

II. GREENHOUSE GAS EMISSIONS AND TRENDS

This report contains a summary of the national greenhouse gas inventory information about emissions and trends over the period from 1990 to 2013 for inclusion into the Second Biennial Report of the Republic of Kazakhstan under UNFCCC.

II. A. Summary of the national inventory of greenhouse gas (GHG) emissions and trends for the period from 1990 to 2013.

2.1 Description and interpretation of aggregated greenhouse gas emissions trends

The latest national inventory of greenhouse gases submitted by Kazakhstan in 2015 shows that in the base year 1990 cumulative greenhouse gas emissions without LULUCF were at a level of 387.21 million tons of CO_2 equivalent, and with LULUCF – 371.01 million tons of CO_2 eq. During the period of economic stagnation, that is until 1999, greenhouse gas emissions decreased to 165.68 million tons of CO_2 eq. without LULUCF, that is by 57%. With LULUCF, emissions decreased to 174.81 million tons of CO_2 eq., or 47%. In 2000 when industrial production was revived, GHG emissions started to grow in Kazakhstan: by 2013 they reached 313.44 million tons of CO_2 eq. without absorption in LULUCF sector, and 302.56 million tons of CO_2 eq. with absorption in LULUCF. However they have not yet reached the base year level. In 2013 GHG emissions in Kazakhstan with absorption in LULUCF were 18% lower than in the base year 1990, without LULUCF – 19% lower (Table 2.1).

2.1.1 Time series of greenhouse gas emissions by sectors

According to the GHG inventory in the base year 1990 Energy sector emitted 319.32 million tons of CO_2 eq., 19.97 million tons were emitted from Industrial Processes and Product Use, 43.55 million tons from Agriculture, 4.4 million tons from the Wastes sector. Absorption in LULUCF was 16.2 million tons of CO_2 eq.

In 2013 total emissions of gases with the direct greenhouse effect, without 2013 absorption in LULUCF, included 260.84 million tons of CO_2 eq. from Energy sector, 18.07 million tons from industrial processes, 28.27 tons from agriculture and 6.25 tons from wastes management. Absorption in LULUCF sector was 10.89 million tons. Net emissions of GHG regulated by Kyoto protocol with LULUCF in 2013 are estimated at a level of 302.56 million tons of CO_2 eq.

The biggest share in GHG emissions has CO_2 which contribution was at a level of 68-78 %. Second biggest is methane (18 - 25 %), third one – nitrous oxide (3 - 9 %). Contribution of fluorine gases is less than 1%.

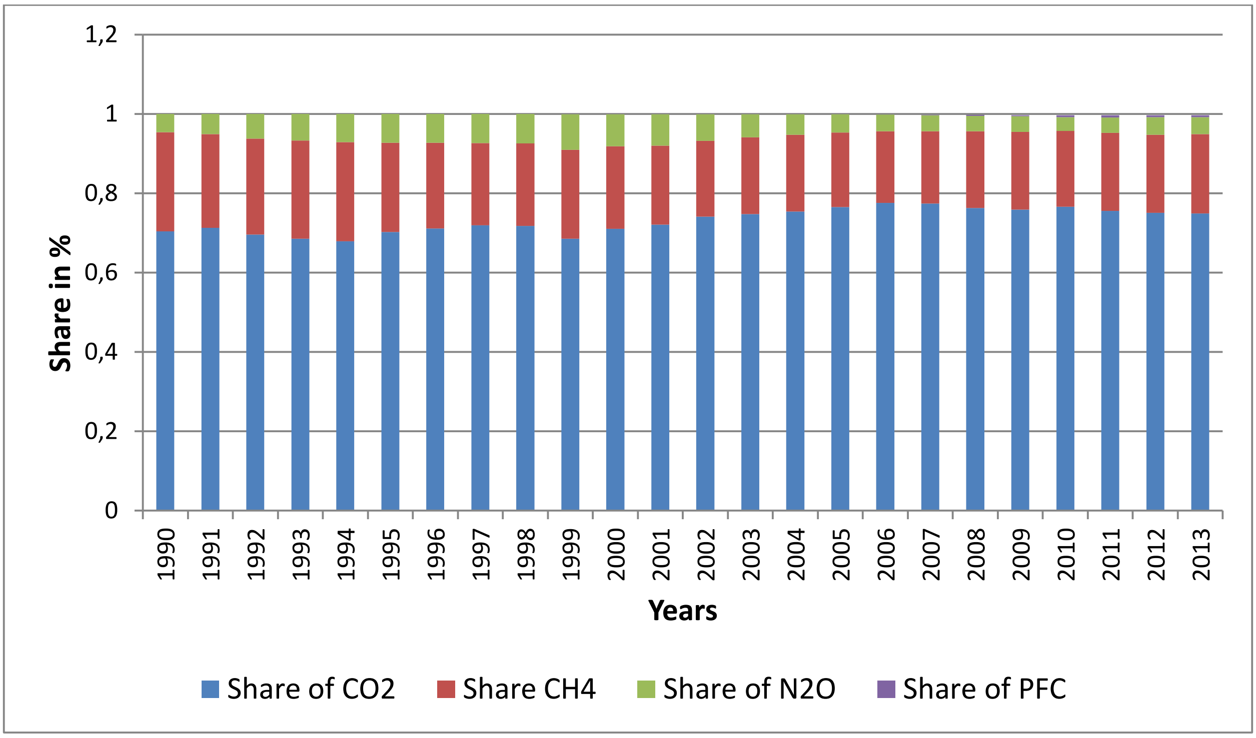


Figure 2.1 – Structure of the national inventory of Kazakhstan by gases, %

In 1990 contribution of CO_2 into total emissions was 70%, methane – 15 %, nitrous oxide –5%. In 2013 the share of CO_2 increased to 75 %, share of methane was 20 %, and contribution of nitrous oxide was at a level of 5 % (Figure 2.1).

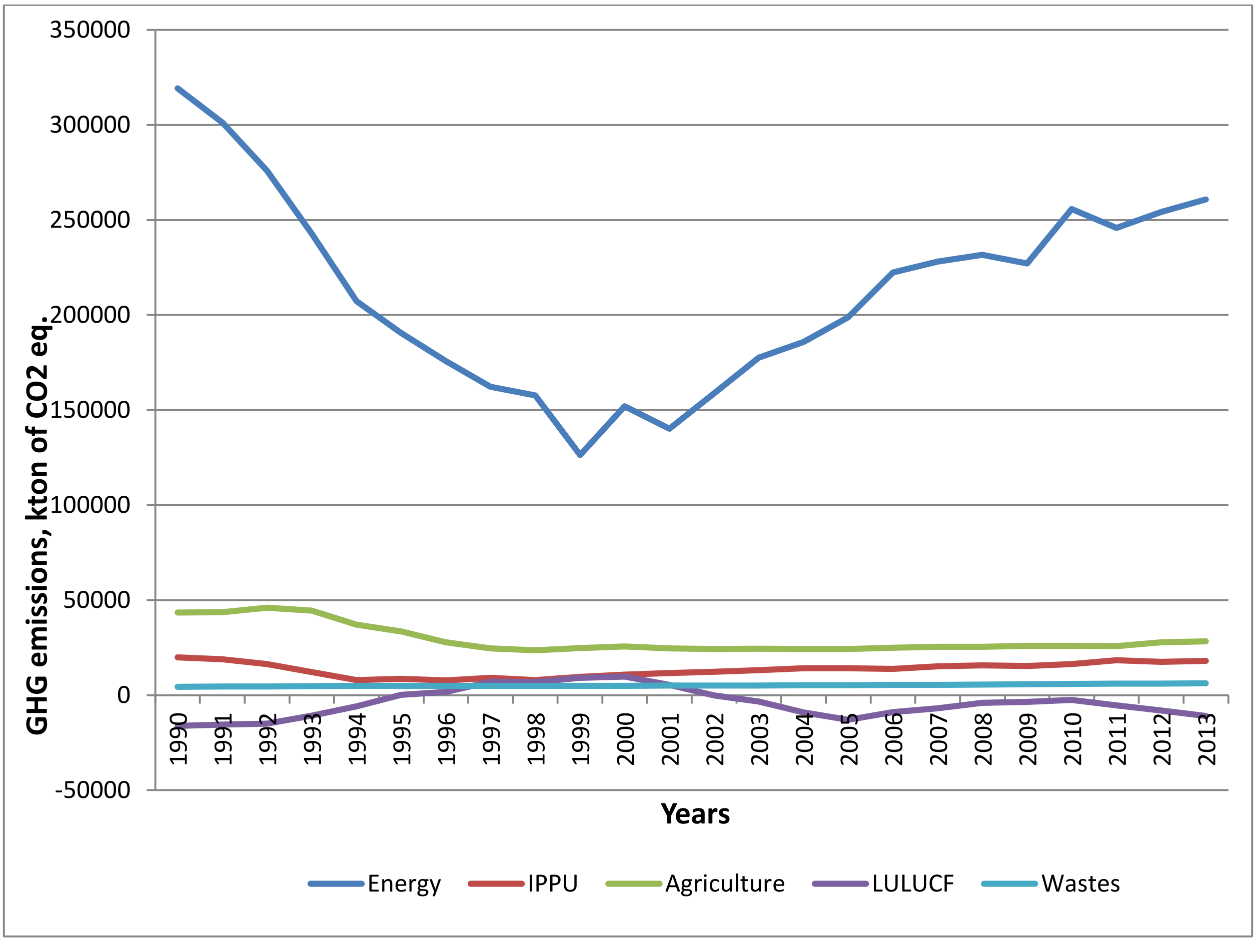


Figure 2.2: Dynamics of emissions of greenhouse gases in the Republic of Kazakhstan by sectors from 1990 to 2013.

As seen on the Figure 2.2, dynamics of total GHG emissions in Kazakhstan throughout the entire period largely depends of the Energy sector emission trend. Its average contribution to national emissions over the years is 81 %. Contribution of Agriculture is significantly lower and it is 11% on average. IPPU and Wastes contribute 5 % and 2 % respectively. In some years contribution of the Energy sector changed from 76 % (1999) to 84 % (2010). Contribution of Agriculture changed from 15% to 10%, and since 2006 it was keeping at a level of 6 %. Contribution of IPPU changed from 3 to 6%. Share of emissions from the Wastes sector was 1 to 3 %.

Biggest relative changes during this period were in the Energy sector, i.e. a sharp drop in 1999 to the amount of 126.37 million tons (Table 2.1), that was only 40 % from the level of 1990 in this sector and it was because of a profound crisis in the economy of Kazakhstan. In 2000, when revival of industrial production started and investments were routed into oil&gas and mining industries, GHG emissions started to grow.

Table 2.1

Emissions of greenhouse gases in the Republic of Kazakhstan from 1990 to 2013, million tons of CO_2 equivalent

	1990	1995	1999	2005	2008	2011	2012	2013	% of 1990 year
Energy	319316,6	190609,5	126374,9	198818,8	231641,7	245802,5	254244,3	260840,5	-18
IPPU	19969,2	8668,6	9595,5	14170,8	15678,5	18428,0	17474,1	18073,7	-9
Agriculture	43551,0	33489,3	24804,1	24324,6	25503,4	25767,1	27803,9	28273,4	-35
LULUCF	-16200,5	219,2	9130,4	-13008,1	-4113,2	-5409,7	-8154,1	-10886,6	-33
Wastes	4377,9	4815,5	4901,6	5298,2	5582,9	6006,4	6111,7	6254,8	43
Total emissions with LULUCF	371014,2	258906,0	174806,5	229604,3	274293,4	290593,3	297480,1	302555,8	-18
Total emissions without LULUCF	387214,7	237583,0	165676,1	242612,4	278406,6	296003,0	305634,1	313442,4	-19

Energy sector

Fuel combustion in the energy sector is a main source of national GHG emissions in the Republic of Kazakhstan. According to the IPCC classification, GHG emission sources in the Energy sector consist of the following categories: energy industry, manufacturing and construction, transport, other sectors and volatile emissions. Contribution of each category into cumulative GHG emissions in this sector is shown on the Figure 2.3.

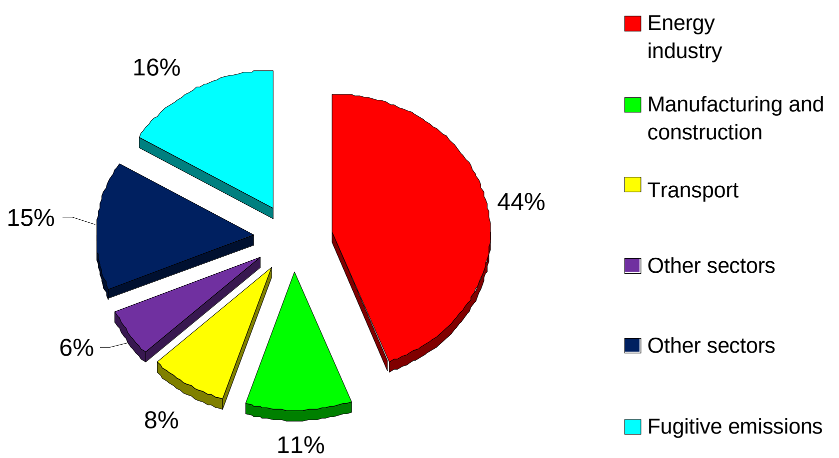


Figure 2.3. – Shares of GHG emission sources in the Energy sector in 2013.

Hard fuel (coal) is most commonly used in Kazakhstan (Figure 2.4). In recent years decrease in liquid and hard fuel consumption is observed due to gasification of populated areas and heat and power plants switching to gas.

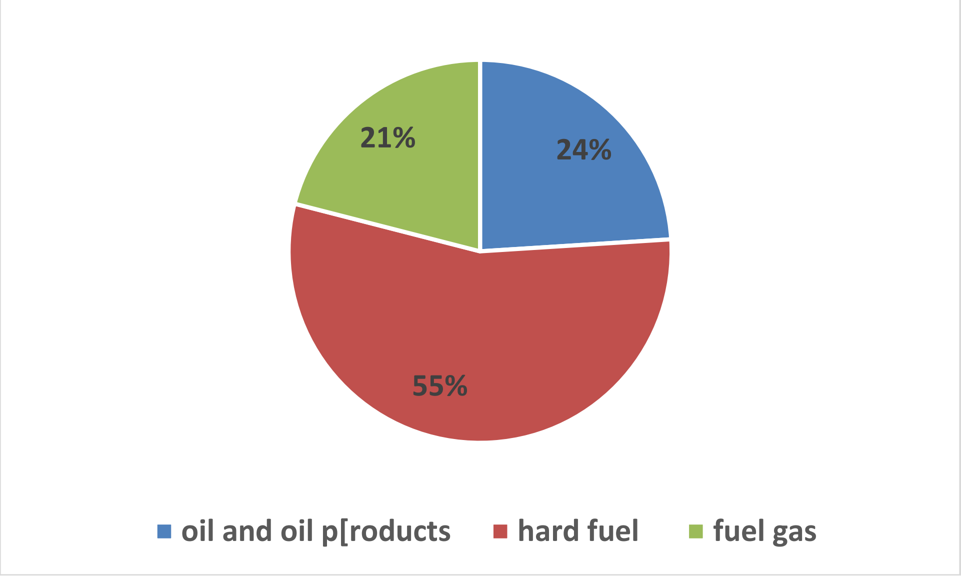


Figure 2.4. Structure of fuel consumption in the Energy sector, 2013.

A severe economic crisis of the nineties last century in Kazakhstan after the collapse of the old socialistic system of economy led to lower consumption of energy resources and inherently lower GHG emissions in the period from 1990 to 1999. Starting from 2000, country's economy was gradually reviving, fuel consumption was growing stably and therefore GHG emissions were growing as well. GHG emissions maximum in the Energy sector was reached in 1990, minimum - in 1999.

Dynamics of GHG emissions in the Energy sector in 1990-2013 correlates with the fuel consumption trend over the same period. In 2013 GHG emissions in the Energy sector amounted to 260.840 million tons of CO_2 eq., that is 16.9% lower in comparison with 1990, and 2.6% higher than in a preceding year 2012. CO_2 emissions contribute 99 % to total GHG emissions. Methane and nitrogen dioxide emissions were insignificant.

The main source of emissions in the Energy sector is the category Energy industry that includes generation of heat and electricity, oil production and distillation and production of solid fuel (Figure 2.5). Every year GHG emissions in this category make a half of all emissions in the Energy sector. GHG emissions in 2013 in this category were 115.510 million tons of CO_2 equivalent, and that is 18,9 % lower compared to 1990, and 4,1 % higher than the level of 2012. There is a general trend observed in combustion of secondary fuel: heating oil, diesel, refinery gas.

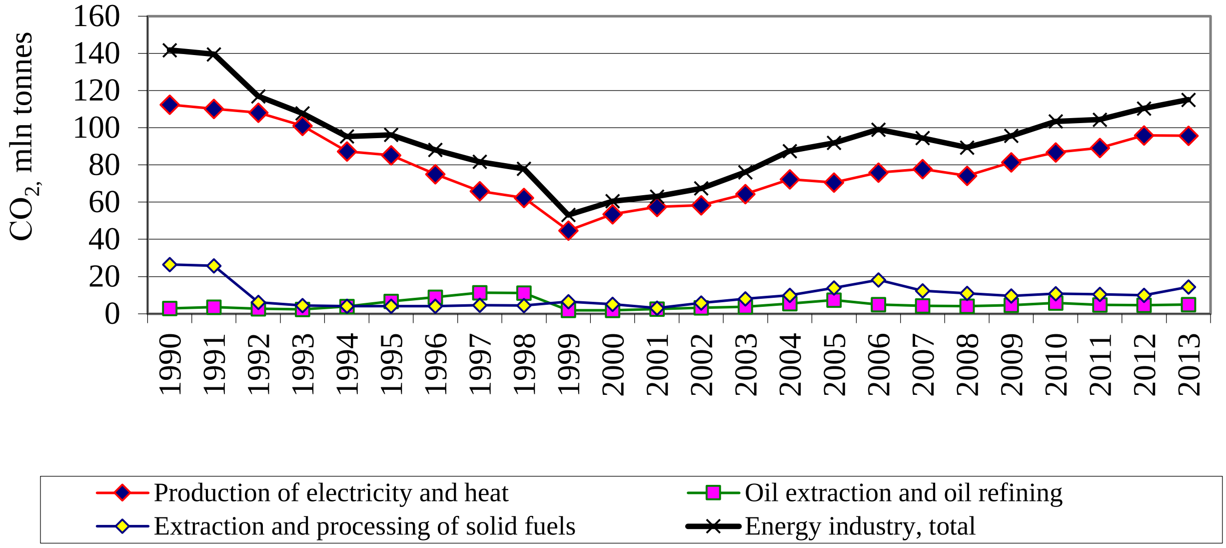


Figure 2.5. – Emissions of greenhouse gases in the category Energy industry, million tons of CO_2 eq.

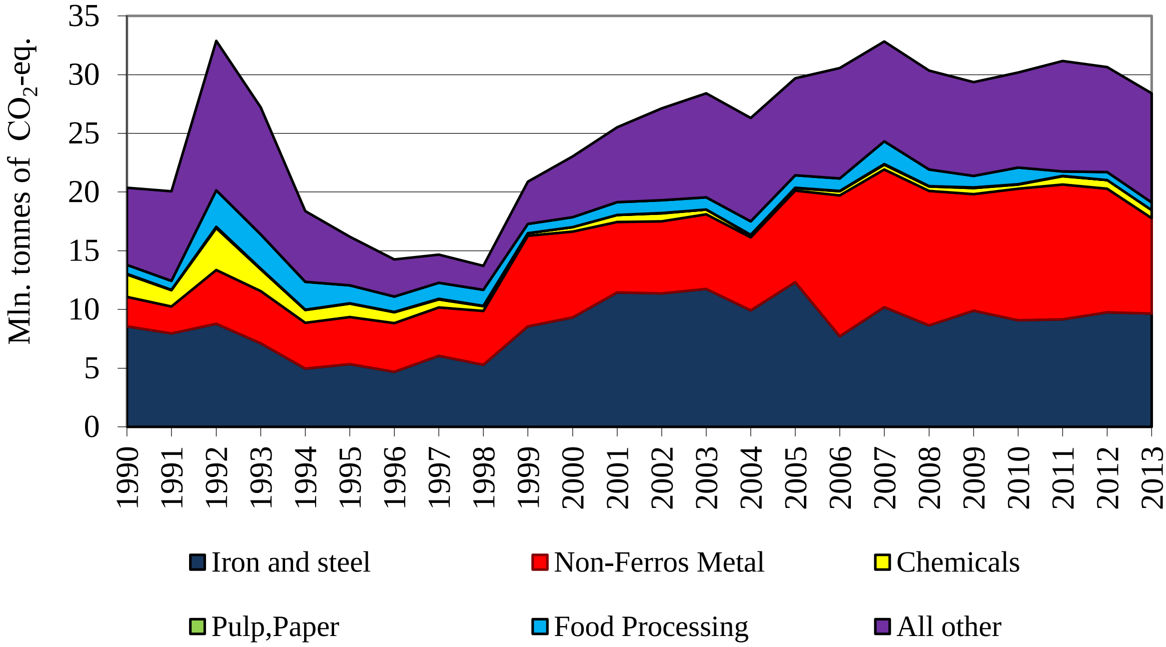


Figure 2.6. – Emissions of greenhouse gases in the category ‘Manufacturing and construction’, million tons of CO_2 eq.

GHG emissions in the category Manufacturing and construction from consumption of fuel in all industries for their own and process needs in 1990…2013 showed a growing trend suggesting a gradual growth of a manufacturing industry in the country (Figure 2.6). In this category coal is key fuel. In 2013 GHG in this category amounted to 28.23 million tons of CO_2 eq., and that is 43,7% higher than a level of 1990 and 7,0 % lower than that in 2012.

Main sources of GHG emissions in this sub-category is ferrous (40%) and non-ferrous (33%) metals industry, non-metallic minerals production and mining as these are leading industries in the economy of Kazakhstan. Contribution of other industries to cumulative GHG emissions is minor in this category due to their poor development in the republic.

In 2013 GHG emissions in the Transport category were 20.5 million tons of CO_2 eq. Compared to 1990 there is a 22.1% decrease in emitted GHG, compared to 2012 the decrease is 11.8% (Figure 2.7). Sources of GHG emissions in this category are automobile transport, off-road vehicles, railway transport, water transport, civil aviation and pipelines for delivery of fuel to the consumer in the form of transportation of oil, petroleum products and natural gas via pipelines.

Automobile transport makes most contribution to GHG emissions in Transport category. Its share was 73% in 1990 and 84% in 2013. GHG emissions from automobile transport in 2013 were 17.1 million tons of CO_2 eq., in 1990 - million tons of CO_2 eq., and by 2013 they increased by 0.5 million tons. In the recent years a moderate growth of GHG emissions from automobile transport was observed. It is explained by the saturation of a domestic market with cars in a relatively good condition. Besides that, the Government of Kazakhstan has undertaken additional measures pertaining to taxation of engines with a high volume and limited import of old cars.

The subcategory Civil aviation experiences a sustainable fuel consumption growth in recent years. Compared to 1990, civil aviation emits much more due to the growth of air transportation over the last 7 years.

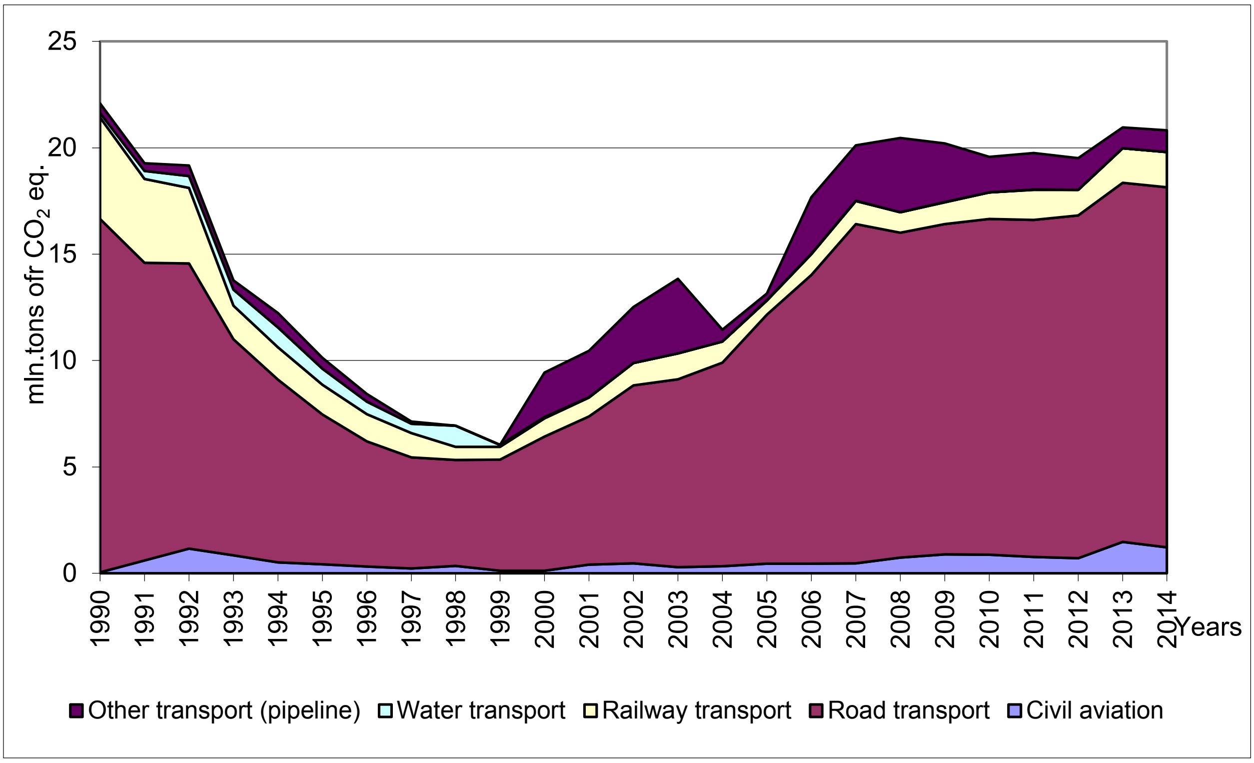


Figure 2.7. Greenhouse gas emissions in Transport category in 1990-2013, mln. tons of CO_2 eq.

GHG emissions in Other sectors subcategory include emissions from fuel combustion in a commercial/institutional sector, residential sector and agriculture (Figure 2.8). During the period from 1990 to 2013 GHG emissions in this category had a downward trend because of lesser coal consumption and larger share of natural gas as result of gasification in the country. GHG emissions in this category in 2013 were 14.57 mln. tons of CO_2 eq., and that is 3.8 times less than 1990 level and 8,7 % less than in 2012.

GHG emissions in Other sources subcategory include emissions from fuel combustion in activities of the government, defense, social insurance and fuel given to enterprises and organizations. Biggest contribution into emissions in this category is made by fuel given to enterprises and organizations. GHG emissions in this category in the years from 1990 to 2013 had an upward trend due to the increase in amounts of fuel given to enterprises and organizations. GHG emissions in the Other sources subcategory in 2013 were 39.294 mln. tons of CO_2 eq., and that is 4.4 times more than in 1990 and 18.7 % higher figure than in 2012.

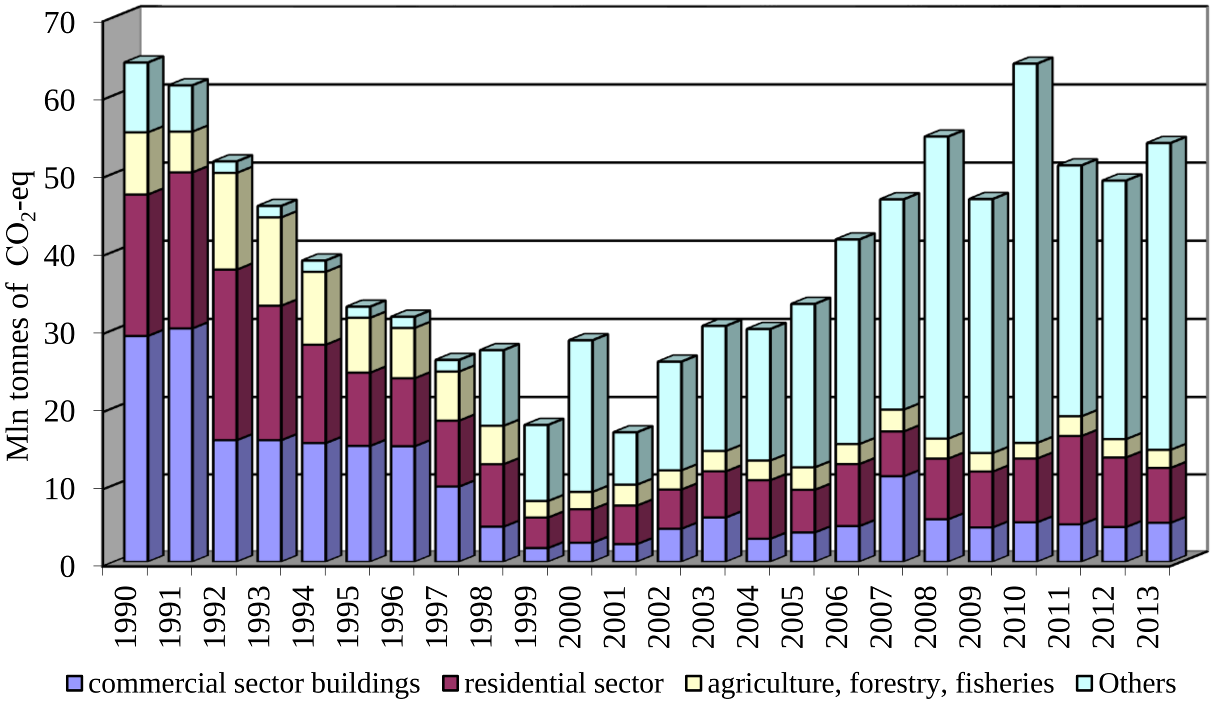


Figure 2.8 GHG emissions in Other sectors and Other sources categories, mln. tons of CO_2 eq.

In 2013 methane emissions from coal production were 30805.8 kilotons of CO_2 eq., or 12 % from total emissions in the Energy sector. The share of this subcategory is 72 %. In comparison with 1990, emissions in 2013 in this subcategory went down to 61 %, but insignificantly grew - 1.1% in comparison with the previous year. The figure 2.9 shows a trend of volatile GHG emissions in CO_2 eq. from coal and oil&gas production in Kazakhstan. In 2013 72 % of emissions in the category Leakage-caused emissions were made by Solid fuel subcategory while contribution of the oil&gas sector was 28%.

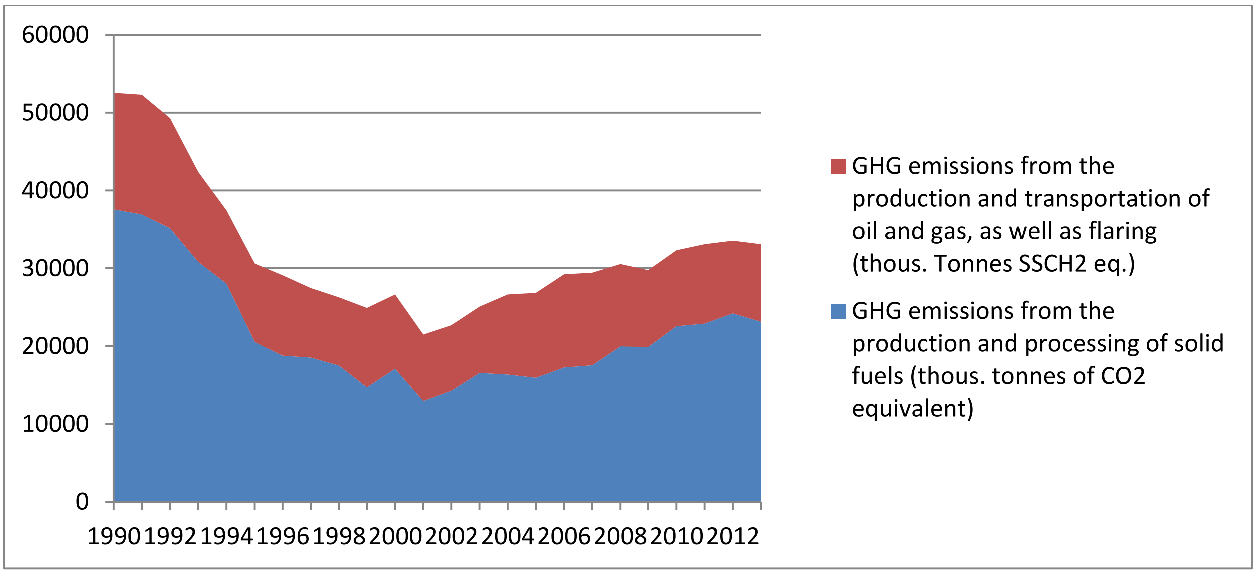


Figure 2.9. – Trend of volatile GHG emissions from activities related to production and transportation of solid fuel, oil&gas, kilotons of CO_2 eq.

Industrial processes and Product Use (IPPU)

Cumulative emissions of greenhouse gases in this sector in 2013 were 18073.738 kilotons of CO_2 eq., that is 9,49 % lower than in 1990. Increase of GHG emissions in this sector from 1990 to 2013 is explained by more intensive metals fabrication and launch of 3 new concrete plants. In comparison with the previous inventories, during this inventory all time series of GHG emissions were re-estimated for the categories: Soda ash use, Ammonia production, Ferroalloys production from 1990 to 2013. Also in 2013 results of GHG inventory of lead and zinc production were added.

Emissions in the manufacturing sector were gradually growing until 2006-2008. In 2009 and 2012 there was a small slowdown in production mainly in the Metal Industry due to the global crisis and metal prices and demand drop. Cumulative emissions of greenhouse gases in the sector Industrial processes and Products Use in 2013 were 2013 **18073.7 kilotons** of CO_2 eq., that is **9,49 %** less than in 1990.

Mineral Industry. Main source of emissions in this category is CO_2 in the subcategory Cement production.

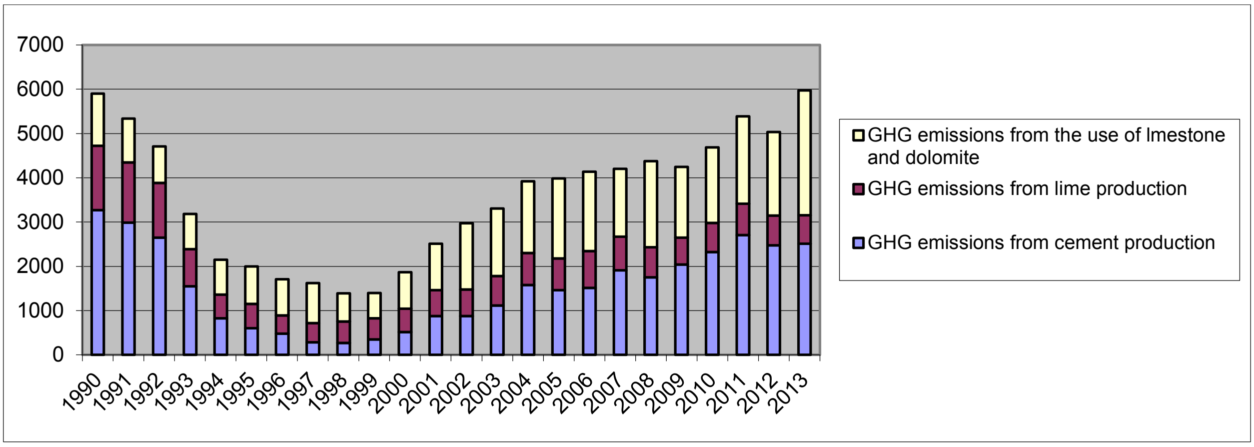


Figure 2.10. GHG emissions trend in the category Mineral Industry in the period from 1990 to 2013, kilotons of CO_2 eq.

Figure 2.10 demonstrates GHG emissions trend in the category Mineral Industry in the period from 1990 to 2013. Cumulative GHG emissions in this category in 2013 were 5975.2 kilotons of CO_2 eq., and that contributes 33.06% into the IPPU sector, and it is 3.14% more than in 1990.

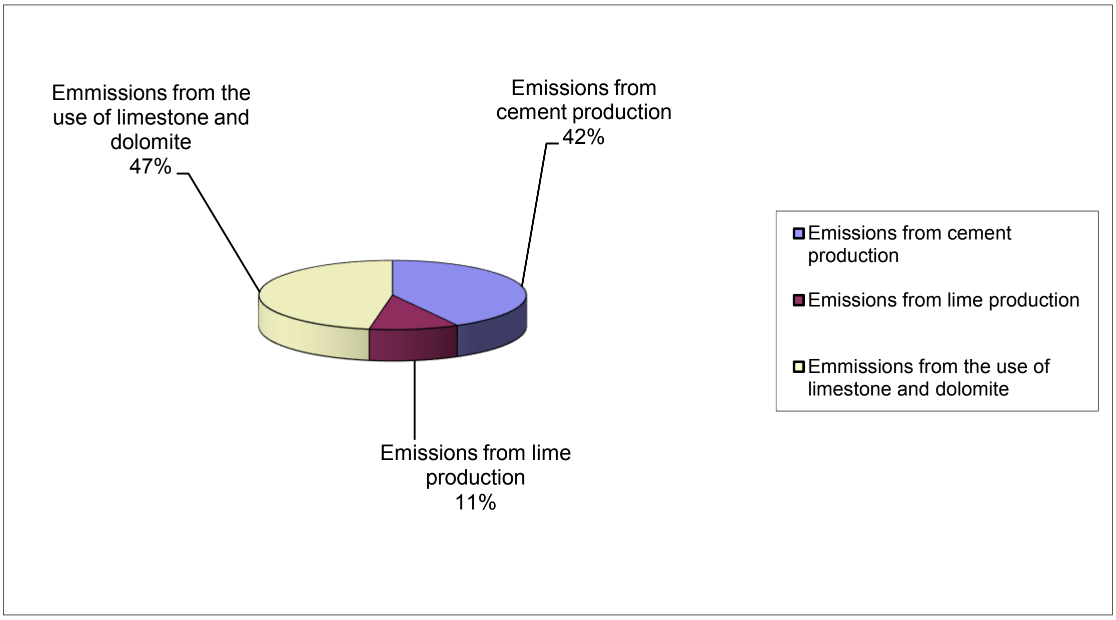


Figure 2.11. – Contribution of GHG emissions from the Mineral Industry category in 2013.

Emissions in this category are distributed as follows: use of limestone and dolomite (47%), cement production (42%) and lime production (11%) (Figure 2.11).

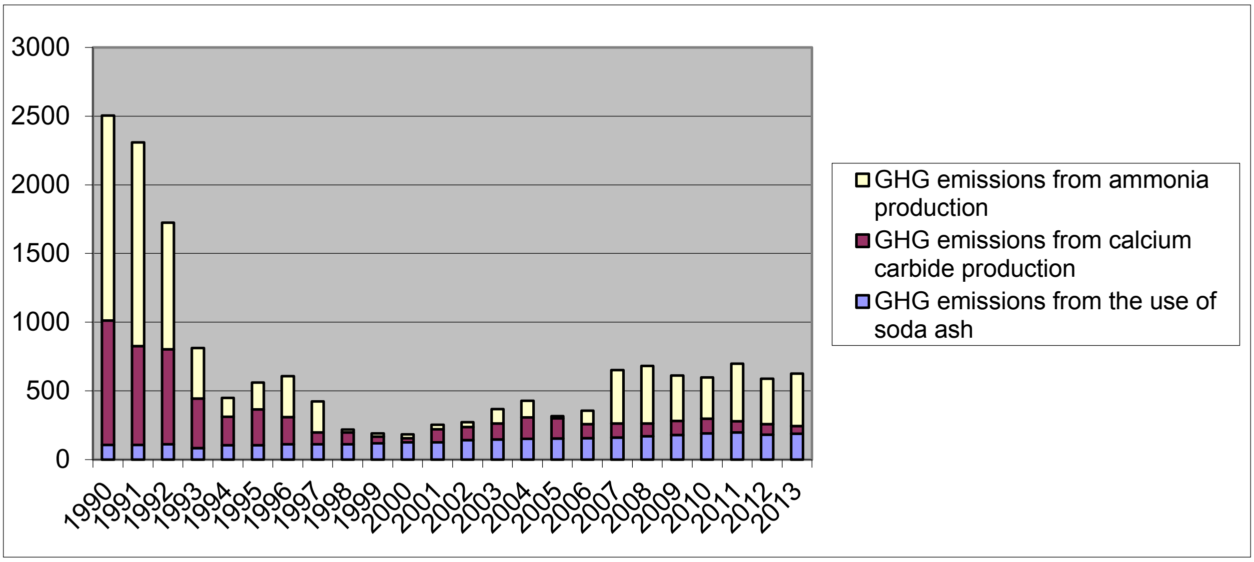


Figure 2.12. GHG emissions trend in the category Chemical Industry in 1990-2013.

Figure 2.12 demonstrates the GHG emission trend in the category Chemical Industry. In 2013 cumulative GHG emissions from the category Mineral Industry were 624.846 kilotons of CO_2 eq. and that is 3.46% from total emissions from IPPU and it is 9.08% less than in 1990.

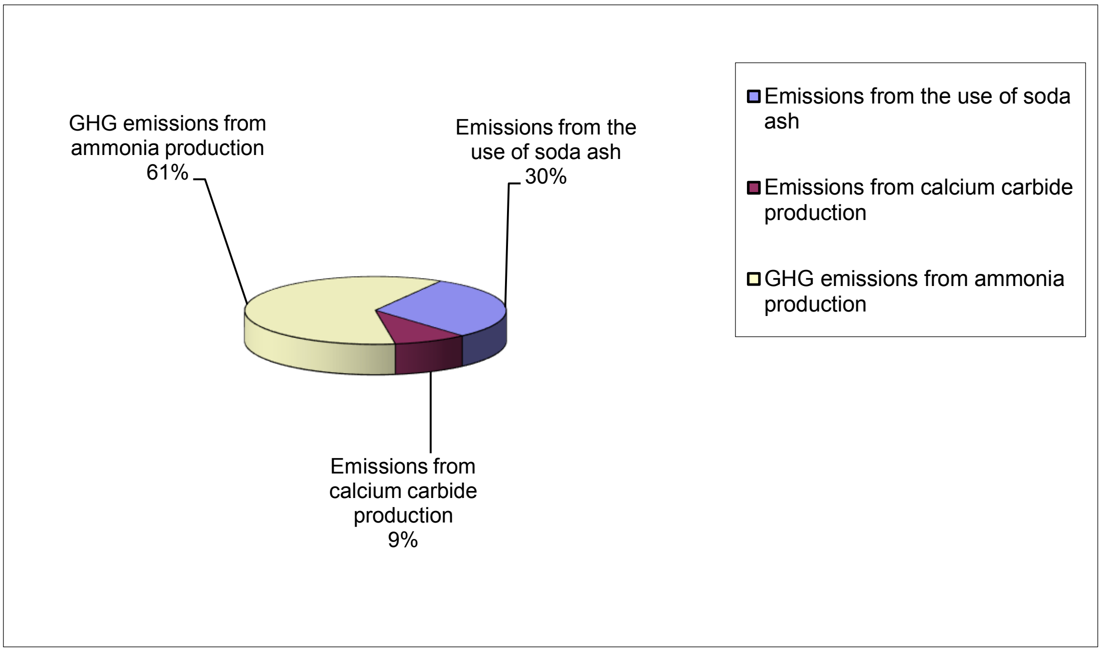


Figure 2.13. Contribution of categories into total emissions in the category Chemicals Industry in 2013.

In 2013 emissions in this category were distributed as follows: emissions from ammonia production (61%), from soda ash (30%) and from calcium carbide production (9%) (Figure 2.13.).

Metal Industry

Emissions from the key source in Metal Industry, which is iron and steel, and also emissions from aluminum production have been estimated for several years on a basis of the best practice (Tier 2 and 3) using the carbon balance, coefficients and data that were received from plants themselves.

Emissions from ferroalloy production were estimated under Tier 1 but with the use of updated emissions.

According to the 2006 IPCC Action Plan, the inventory of 2013 included CO_2 emissions from lead and zinc production.

In 2013 Metal Industry, as well as in previous years, was the biggest source of GHG emissions in the sector: 10475 kilotons of CO_2 eq., its contribution was 58% to total GHG emissions in the IPPU sector. Most of emissions are CO_2 (85%). The remaining 15% are emissions of PFC from aluminum production. Methane emissions are less than 0,01% of emissions in this category.

In Metal Industry category the biggest source of emissions is also fabrication of iron and steel: 53.5 % from total emissions in the category (5 602.53 kilotons of CO_2 eq.). Contributions of ferroalloys and aluminum are almost similar: 21. 4% and 19.4 %, respectively.

Emissions from new sources in total CO_2 emissions in Metals Industry are insignificant: 47.6 kilotons from lead production and 550 kilotons from zinc production (0.5 and 6.2% respectively in 2013). It should be mentioned that contribution of iron and steel production into total emissions of Metal Industry decreased in comparison with 2012 and shares of all other metals went up (figure 2.14).

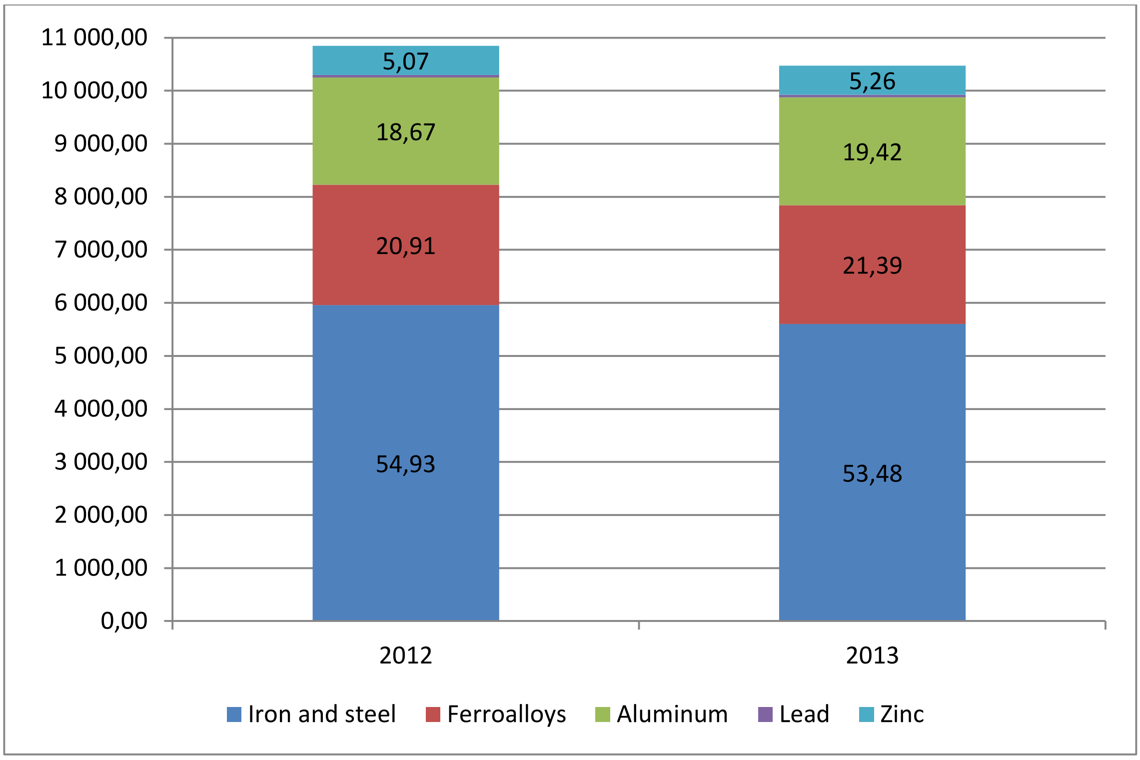


Figure 2.14. – Shares of different metals in total GHG emissions from Metal Industry, %

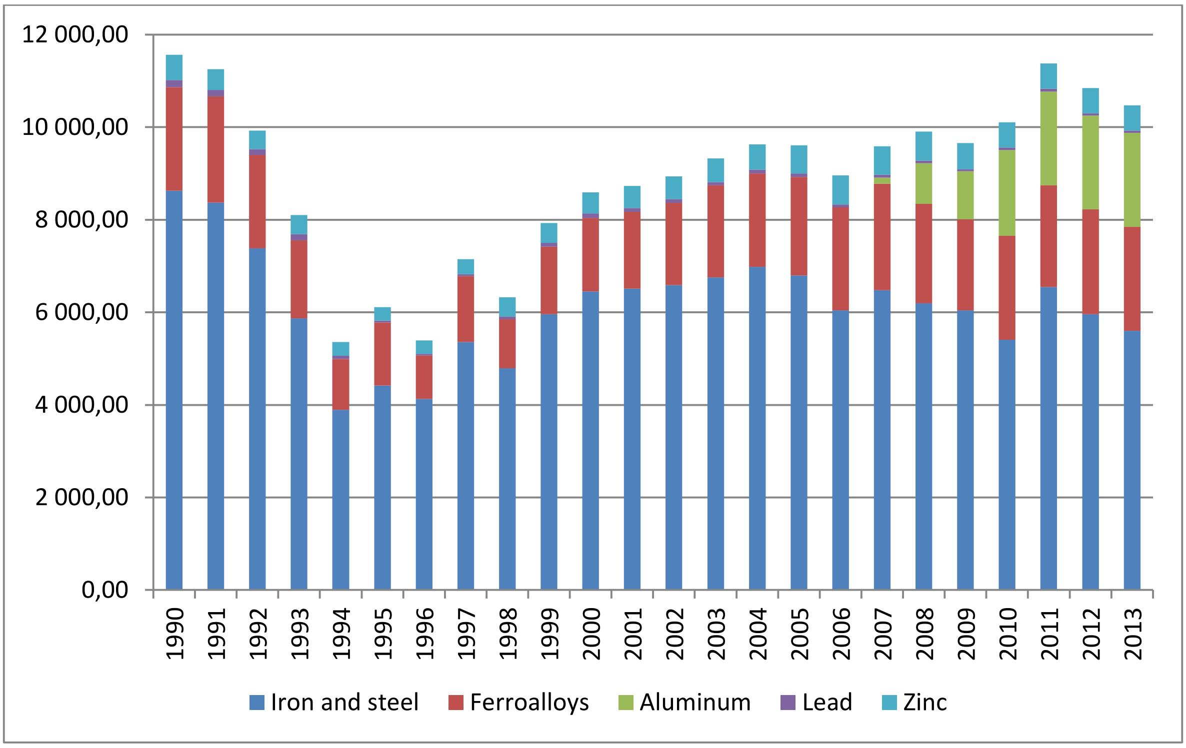


Figure 2.15. GHG emissions trend in Metal Industry, kilotons of CO2 eq.

In 2013 CO_2 emissions from production of some metals decreased in comparison with 2012 due to the economic crisis: by 6% from iron and steel production and 1.2% from ferroalloy production. CO_2 emissions from aluminum production were almost unchanged.

The crisis caused a minor slowdown in metals production in the country, and in 2013 total emissions of CO_2 in this category went 1.6% down in comparison with 2012. On the contrary total PFC emissions from aluminum production increased 0.7%.

In comparison with 1990, total emissions went 9% down despite emergence of aluminum production in 2007 and significant PFC emissions. CO_2 emissions in this category are 23% lower than 1990 level mainly because of reduced production of iron and steel (table 2.2, figure 2.15).

Table 2.2

GHG emission trend in Metal Industry

Years	1990	2012	2013
CO_2	10475,0	8771,9	8909,6
Iron and steel	8628,9	5958,5	5602,5
Ferroalloys	1696,1	2343,2	2240,2
Aluminum	-	468,83	470,29
Lead	-	-	47,36
Zinc	-	-	550,66
PFC, aluminum	-	1329,4	1565,5
Total GHG	10475,0	10101,3	10475,0

2.1.3 Agriculture, forestry and other types of land use

Livestock production. In 2013 methane emissions from enteric fermentation of agricultural animals was 631.64 Gg, and that is 401.46 Gg, or 39%, below the level of a base year 1990. Lowest amounts were observed in 1998 (392.55 Gg). Key emissions sources were cattle and sheep (figure 2.16.).

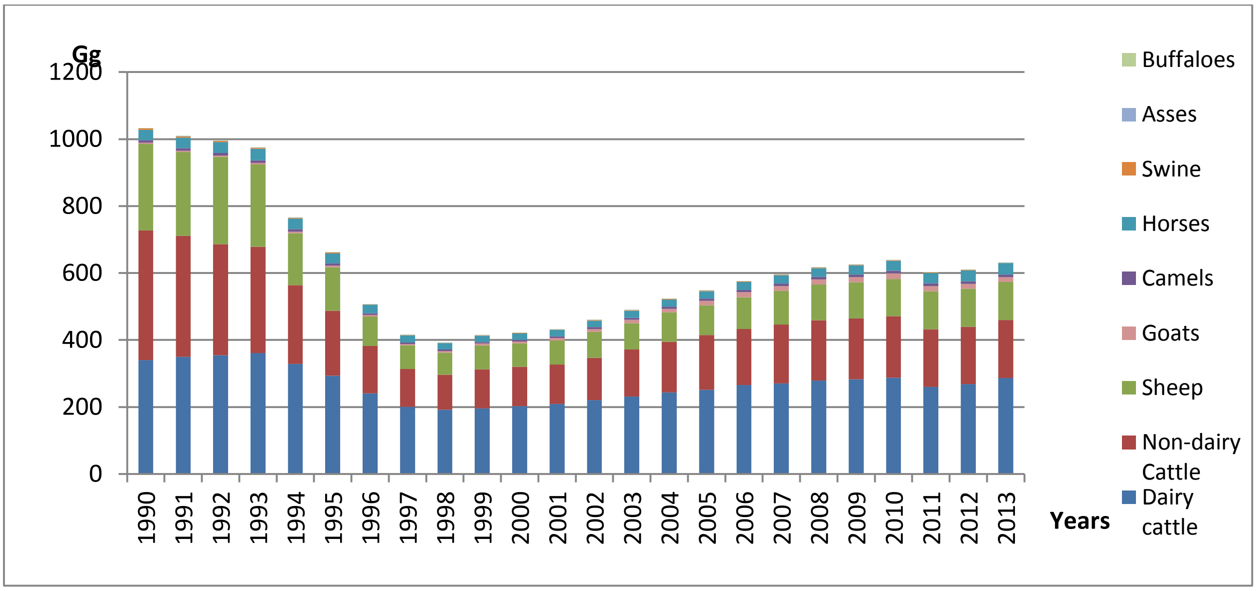


Figure 2.16. Methane emissions (CH_4) from enteric fermentation by animal species

Systems for collection, storage and use of manure. Methane emissions from the system for collection, storage and use of manure in 2013 were 27.17 Gg, that is 20.42 Gg (43 %) lower than in 1990 (47.59 Gg) when biggest amount of CH_4 emission took place (Figure 2.17.). Lowest amounts were observed in 1998 (18.85 Gg.).

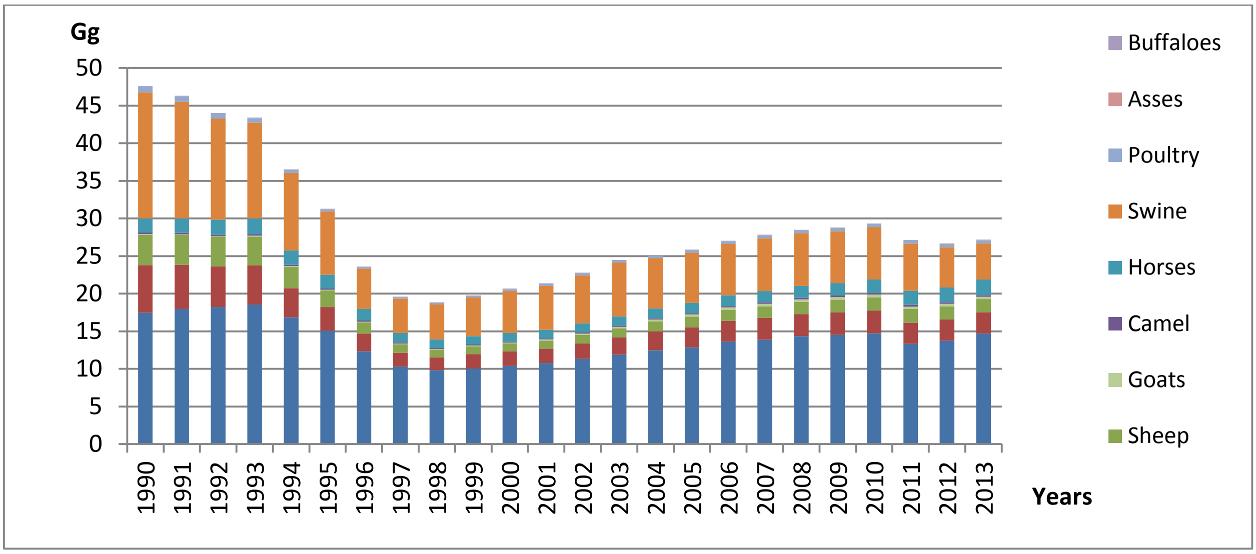


Figure 2.17. – Methane emissions (CH_4) from systems of collection, storage and use of manure.

In this category of activities biggest amounts of methane were emitted from cattle manure (65 %). Methane emissions from swine manure are 18 %, from sheep 6,5 %, other emissions are made by other animals species.

In 2013 nitrous oxide emissions from systems of collection, storage and use of manure were 10.76 Gg, that is 42 % lower than such emissions in 1990 (18.59 Gg). Lowest emissions were observed in 1998 (7.12 Gg) (Figure 2.18).

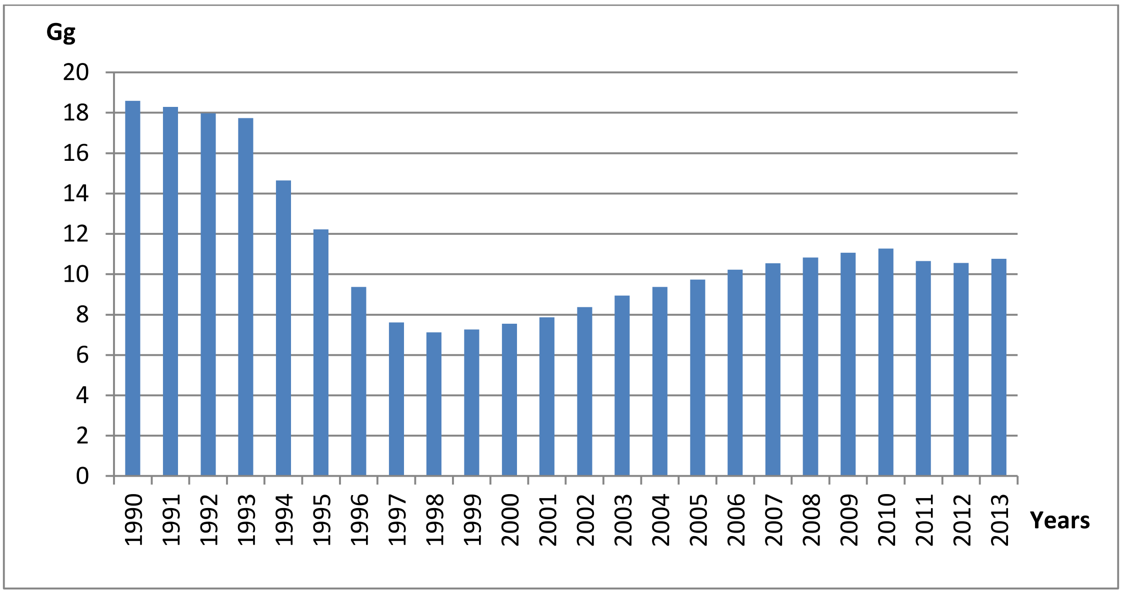


Figure 2.18. – Emissions of nitrous oxide (N_2O) from systems of collection, storage and use of manure

Emissions of N_2O from croplands. For croplands direct and indirect emissions of nitrous compounds were estimated on a basis of additional nitrogen input into soil:

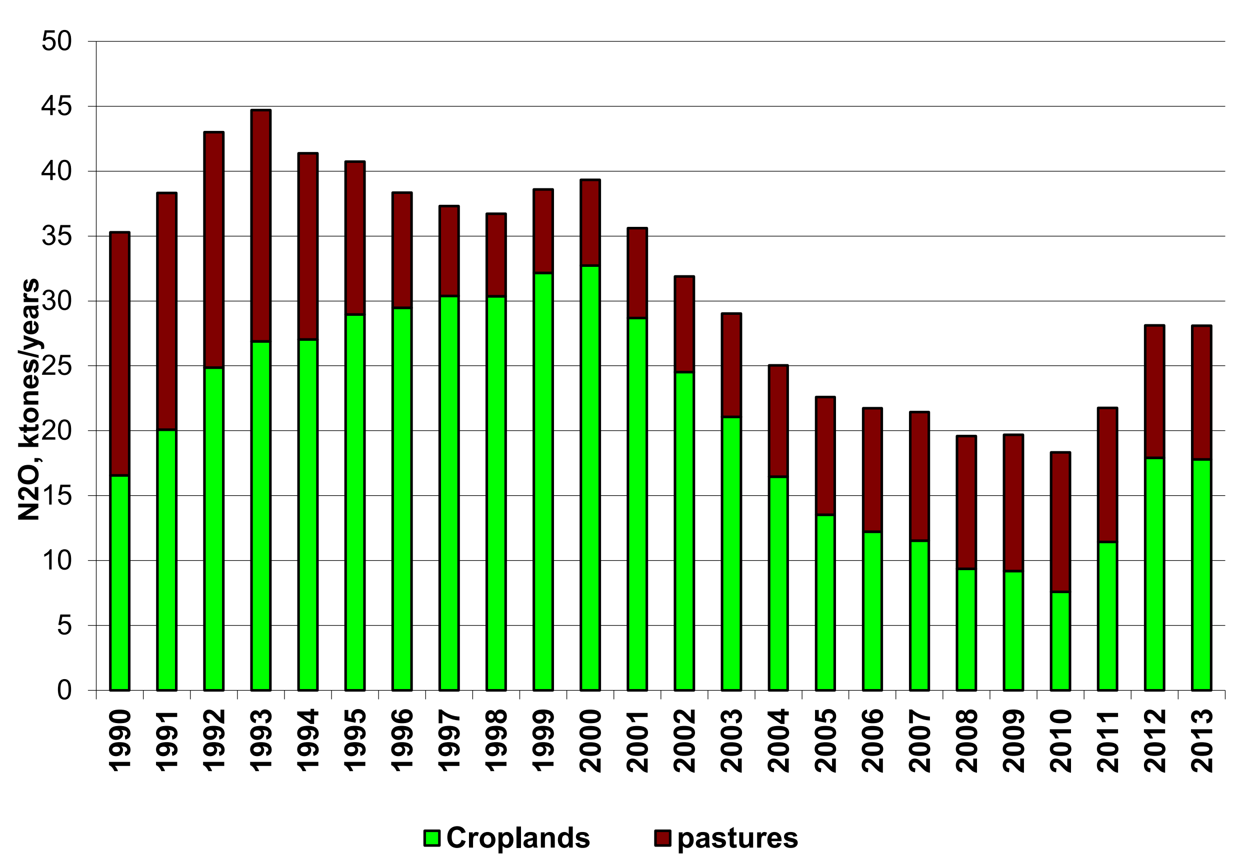
- With synthetic (mineral) nitrogen fertilizers,
- With organic fertilizers,
- With afterharvesting and root residues of agricultural crops,
- In the process of nitrogen mineralization in organic soils.

Grasslands emissions were estimated on a basis of nitrogen input with urine and manure of grazing livestock.

N_2O emissions from mineral nitrogen fertilizers were 1.04 kilotons or 309.92 kilotons of CO_2 equivalent; 00.4 kilotons from organic fertilizers that is 11.92 kilotons in CO_2 equivalent; emissions of nitrous oxide from agricultural crop residues were 3.28 kilotons or 977.44 kilotons of CO_2 equivalent. Significant amounts of N_2O are emitted due to mineralization of organic compounds in the soil: 11.50

kilotons or 3427 kilotons in CO_2 equivalent. In 2013 the atmosphere received 11.80 kilotons of nitrous oxide from urine and manure of grazing livestock and that is 3516.4 kilotons of CO_2 equivalent.

Total direct and indirect emissions of nitrogen compounds into the atmosphere from cultivated soils in Kazakhstan (croplands and pastures), including release of nitrogen in the process of organic compound mineralization, in 2013 were 27.66 kilotons or 8242.68 kilotons of CO_2 equivalent (Figure 2.19).



1 – croplands; 2 - pastures

Figure 2.19. Total emissions of GHG from cultivated lands in 1990-2013.

Rice cultivation. Methane emissions from rice fields were estimated on the basis of initial data on harvested rice acreage in Kazakhstan and IPCC default coefficients. Contribution of rice fields into total methane emissions in the AFOLU category is less than 1 %. In 2013 methane emissions from rice production were 14.04 kilotons and reduced by 27.7 % in comparison with the base year, and that is 351 kilotons of CO_2 equivalent (Figure 2.20.).

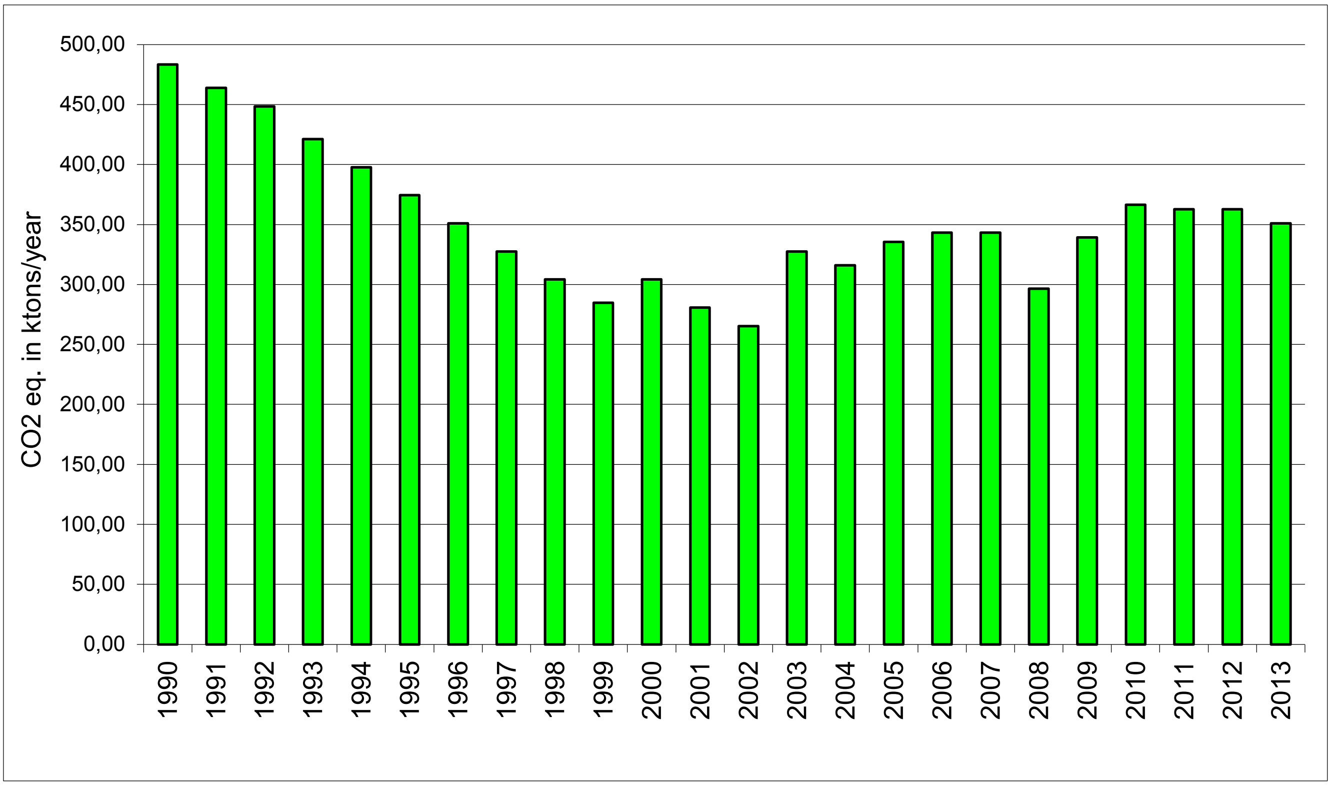


Figure 2.20. Emissions from flooded rice fields in 1990-2013, kilotons of CO2 equivalent

Forestry and land use. During the period of interest (1990-2013) forest lands and especially agricultural lands of Kazakhstan have undergone significant anthropogenic transformations. For instance in 2010-2013 canopy cover increased after trees planting and therefore improved much, forest environment also improved largely as a result of afforestation activities, firefighting and preventive measures. In the first decade of a period in question, commencement of the economic crisis brought significant drop of cultivated lands as some lands were temporarily converted from crop rotation to reserve (fallow land) and pastures. And until 2015 a stable decrease of soil fertility was observed on croplands as well as decrease in crop rotation. Starting from the first decade and until 2005 together with the reduction in livestock there was also decrease in actually used natural pastures, and a part of lands was converted to reserve and this reduced burden on pastures, helped restoration of natural vegetation and in general improved environmental conditions of lands. Those actions led to noticeable changes in carbon reserves, annual changes in absorption/emissions of carbon dioxide and other gases on forest, agricultural and other lands with multiple changes of flux directions (table 2.3).

Table 2.3

Annual changes in absorption (+) / emission (-) of greenhouse gases in AFOLU sector by land use categories in Kazakhstan in 1990-2013, kilotons / year in CO_2 eq.

Years	Forest	Pastures and hay field	Cultivated lands	Wetlands	Settlements	Total
11990	-4 203,94	-9 320,46	-40,33	4,25	-2 640,00	-16 200,49
11995	-2 621,27	-6 513,21	11 553,67	0,00	-2 200,00	219,18
22000	-2 374,77	-13 180,05	27 192,00	0,00	-1 771,00	9 866,18
22005	-2 814,77	-20 456,29	11 616,00	0,00	-1 353,00	-13 008,06
22010	-4 890,95	-9 185,28	12 232,00	314,60	-927,67	-2 465,29
22011	-6 899,13	-8 652,91	10 868,00	114,11	-839,67	-5 409,71
22012	-8 886,14	-8 066,89	9 504,00	46,64	-751,67	-8 154,06
22013	-10 925,24	-7 445,94	8 140,00	11,88	-667,33	-10 886,63

Table 2.3 demonstrates that after 2005 a sustainable absorption of GHG was observed in the *forest lands category* of Kazakhstan, with biggest absorption amounts up to 10 925.24 kilotons/year in

CO_2 equivalent in 2013. In comparison with a previous year 2012, net absorption increased by 2039.1 kilotons/year and in comparison with 1990 by 6721.3.

During the entire observation period at *natural pastures and hay fields* absorption of GHG prevailed with a maximum level of 20456.29 kilotons /year in 2005 (biomass and soil) with subsequent reduction of absorption rate due to partial replenishment of livestock headcount and larger burden on pastures. In 2013 absorption of CO_2 was 7 445.94 kilotons/year in CO_2 equivalent and that is 620.95 kilotons/year lower in comparison with the previous year 2012 and 1874.32 kilotons/year lower in comparison with 1990.

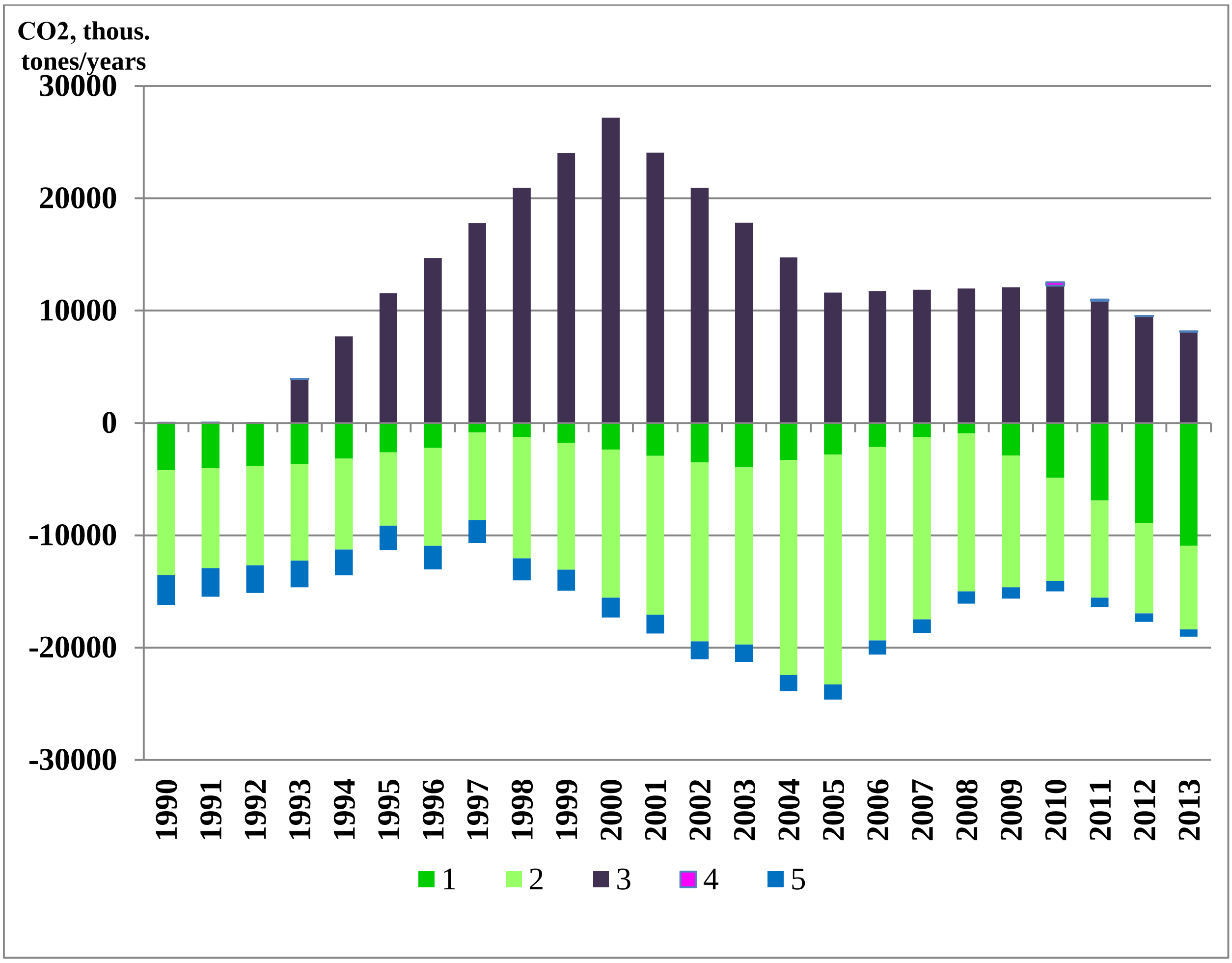
Most visible changes in GHG fluxes in the land use category were observed after 1990 at *cultivated lands* and that was due to catastrophic loss of soil fertility of arable lands in crop rotation because of drastically reduced input into soil of mineral and organic fertilizers, biological residues of after-harvesting remains. Another aspect was a major violation of tillage technologies and domination of a monoculture – spring wheat – in crop rotation.

By 2000 cultivated lands reached maximal CO_2 emissions: 27192.00 kilotons/year (soil and biomass, including absorption of carbon dioxide by arable lands that are temporarily converted to reserve lands or pasture). By 2013 emissions reduced to 8140.00 kilotons/year in CO_2 equivalent that is 1364,00 kilotons/year lower in comparison with 2012 due to partial recovery of soil fertility and biomass accumulation resulted from restored vegetation on arable lands that were temporarily withdrawn from crop rotation. For comparison, in 1990 carbon balance of arable lands soils was assessed as deficit-free (with absorption of carbon dioxide at a level of 40.83 kilotons/year).

In the category *Settlements* biggest amounts of greenhouse gas absorptions - up to 2640.40 kilotons/year in CO_2 equivalent (biomass, soil) – were observed in the period of active lands use for the purpose of settlement construction in early 90-ies last century with further decrease down to 667.33 kilotons/year in 2013.

Artificial reservoirs (as part of wetlands) emitted biggest amounts of greenhouse gases up to 314.60 kilotons/year in CO_2 equivalent in the years when water was put into reservoirs constructed in 2010... 2011. In 2013 emissions were just 11.88 kilotons/year in CO_2 equivalent.

Absorption prevailed in a cumulative flux of greenhouse gases of all land use categories over the last decade: 10886.63 kilotons/year CO_2 eq., that is 2732.57 kilotons more than in 2012 and 5313.86 kilotons/year less in comparison with 1990.



1 – Forest and tree and shrubbery planting 2 –Pastures and hay fields ; 3 – Cultivated lands (arable land under crop rotation, arable land that is temporarily converted into reserve and pasture, arable land returned to crop rotation and perennial plantations); 4 – Wetlands (artificial reservoirs); 5 – Settlements (additionally arranged lands).

Figure 2.21. Annual changes in net absorption (-) / emission (+) of greenhouse gases by forest lands and other types of land use in Kazakhstan from 1990 to 2013

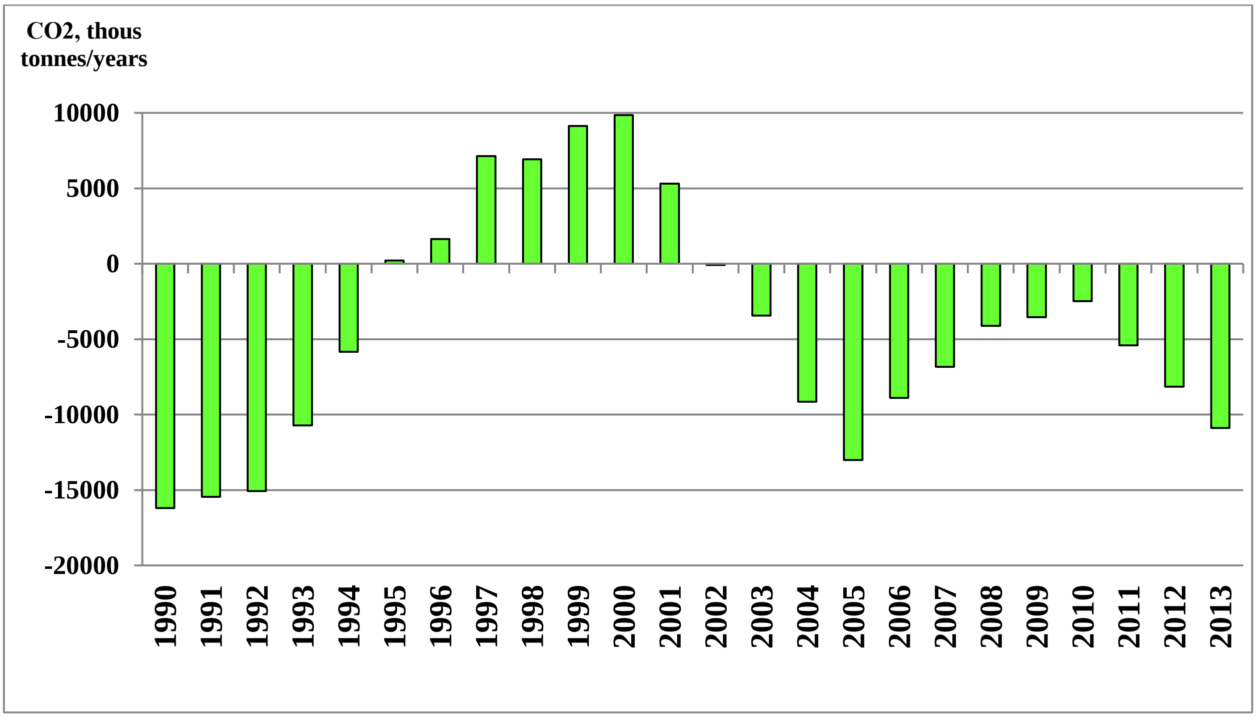


Figure 2.22. Annual changes in net absorption (-) emission (+) of greenhouse gases cumulatively from forest lands and other types of land use from 1990 to 2013.

Wastes. Total greenhouse gas emissions in the Wastes sector in 2013 were 6254.71 Gg of CO_2 eq., that is 130.52 Gg CO_2 eq., or 2,09 %, higher than the level of the previous year 2012. In comparison with 1990, emissions in 2011 in this sector grew more than 1,43 times or by 42,83 %, mainly in the category of municipal solid wastes due to bigger amounts of MSW and share of degradable organic wastes in MSW and population growth. The share of the wastes sector in total national net emissions without absorption in LULUCF in 2013 was 2 %. Cumulative emissions of greenhouse gases in the Wastes sector increased mainly due to landfilling of municipal wastes, growing mass and changing composition of MSW.

In 2013 the biggest contributor into total emissions in the Wastes sector was the category of wastes disposal–52.8 %, and subcategory of unmanaged landfills of MSW: 49,3%.

Contribution of emissions from human wastewaters into total emissions in the wastes sector is 17,7 % in 2013, while in 1990 it was 21 %. Contribution of GHG emissions from incineration of healthcare wastes in total emissions is small and in 2013 it was just 0,5 %.

II. B. Summary of procedures for preparation of the national greenhouse gas inventory in Kazakhstan as well as changes in national procedures that took place after submission of the First Biennial Report and 3rd to 6th National Communication

Kazakhstan’s national legislative framework on inventory of GHG emissions and removals comprises institutional, legal and procedural mechanisms created to estimate anthropogenic emissions from sources and GHG absorption on the basis of IPCC methodology. It was developed in accordance with the paragraph 4 Article 158-1 of the Ecological Code of the Republic of Kazakhstan as of 9th of January 2007 with changes and amendments as of 3rd of December 2011. To make implementation possible, Kazakhstan adopted a ‘Regulation on the state system for inventory and data collection’ approved by the Decree of the Ministry of Environment Protection on 23 of July 2010 No 193-п and Decree of the Government of the Republic of Kazakhstan as of 17 of July 2012 No 943 ‘On approval of Rules on maintenance and management of the state cadaster of GHG emissions and removals’. After introduction of amendments that regulate the state system for GHG emissions, the above regulations were cancelled. To replace them, on 18 March 2015 a Decree of the Minister of Energy of RK No 214 was adopted: ‘Rules for controlling completeness, transparency and reliability of state inventory of greenhouse gas emissions and removals’. These Rules describe an updated procedure of the annual national greenhouse gas inventory and include the list of information necessary for inventory at the country level with the objective to fulfill international reporting commitments of Kazakhstan vis-a-vis UNFCCC. Since 2015 the authorized body responsible for GHG inventory preparation and realization in Kazakhstan is the Ministry of Energy of RK.

The state inventory is prepared with the use of data about production amounts and activities that lead to anthropogenic GHG emissions from sources and their absorption. Such data are submitted by government agencies according to the list mentioned in Annex to these Rules.

The Rules include definitions of the base year, key categories of sources, control of quality and completeness of the cadaster, transparency of the state inventory of GHG emissions and removals with open methodological approaches to estimate emissions and absorption of GHG. The Decree sets out functions of the authorized body in the field of environment protection which govern organization and coordination of the state GHG inventory system. The authorized body arranges preparation of the state inventory of GHG emissions through collection, analysis and processing of data received from government agencies and directly from enterprises who emit greenhouse gases. Government agencies who are requested to submit information for the National report do it within a month after such a request. In accordance with this Decree in 2015 it was possible to collect more comprehensive primary information for the national inventory and to apply a better methodological approach to some categories of data sources.

In accordance with these Rules, for the purpose of quality assurance and control, before submission of the report to UNFCCC Secretariat, not later than 1st of March it is sent by the body responsible for GHG emission and removal inventory to government agencies, independent experts, scientific institutions and other organizations who were not directly involved in preparation of state inventory of GHG emissions and removals. When comments are received, the authorized body organizes finalization of the state inventory taking into account remarks and suggestions of independent experts, scientific institutions and organizations.

Until 2015 GHG emissions inventory in Kazakhstan was in line with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Since 2015 according to a Decision 24/CP.19, all countries of Annex 1 including Kazakhstan have moved to the IPCC methodology of 2006 for preparation of their GHG inventories. Also since 2015 electronic CRF tables are submitted in the new software CRF Reporter. The Decision makes it necessary to use new values of the Potential global warming (PGW) in accordance with the IPCC Fourth Assessment Report.

III. QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS

Table 2 of CTF as well as the table 3.1 below includes description of the economy-wide quantified emission reduction target.

Table 3.1

Description of the economy-wide quantified emission reduction target in the Republic of Kazakhstan

	Section	*Information*
	Base year	1990
	Quantified emission reduction target	15%
	Period for achieving the target	1990-2020
	Gases and sectors covered	All gases and sectors except LULUCF
	The global warming potential, as it has been established in the relevant decisions adopted by the COP	Fourth Assessment Report 24/CP.19
	Approach to accounting emissions and removals from LULUCF, taking into account any relevant decisions adopted by the COP.	Not taken into account
	The use of international market mechanisms to achieve the emission reduction target, taking into account any relevant decisions adopted by the COP, including a description of each source of international units and/or allowances through market mechanisms and possible extent of contribution of each of them	Not used
	Any other information, including the relevant accounting rules, duly taking into account any relevant decisions of the COP	Not available

IV. PROGRESS IN MEETING QUANTIFIED ECONOMY-WIDE EMISSION REDUCTION TARGETS AND RELATED INFORMATION

4.1. Mitigation actions and their impact

4.1.1 Actions in the energy sector (fuel combustion)

On the 29th of October 2014 the **Strategic Plan of the Ministry of Energy of the Republic of Kazakhstan for 2014 – 2018 No 79** was approved. All climate-related strategic areas, outcomes and objectives determined in the Strategic Plan of the MEWR were confirmed in the Strategic Plan of the Ministry of Energy of RK. Climate –related strategic areas and objectives of the plan are as follows:

1. Development of electrical energy, coal industry and atomic energy.

1.1 Supporting energy generation by domestic sources to meet needs of the economy.

3. Stabilization and improvement of the environment.

3.1 Creation of conditions for conservation and restoration of ecosystems and for transition to low-carbon development.

Key tasks and activities are summarized in Table 4.1.

Table 4.1

Outcomes, objectives and activities of the Strategic Plan of the Ministry of Energy of the Republic of Kazakhstan for 2014-2018

Objectives and tasks	Activity
Outcome 1.1 Supporting energy generation by domestic sources to meet needs of the economy. Outcome 1.1.1. Development of electrical energy (infrastructure) Outcome 1.1.3. Development of renewable energy sources	Making proposals for further development of electrical energy
	Construction of the 1st module of Balkash CHPP
	Construction of the Module No 3 of Ekibastuz SDPP-2
	Modernization of Shardary SDPP
	Reconstruction of the Module No 2 of Ekibastuz SDPP -1
	Reconstruction of the Module No 1 of Ekibastuz SDPP -1
	Preparing regulatory and technical documentation in the field of renewable energy sources
	Preparing regulatory legal acts that are necessary to implement the law of the Republic of Kazakhstan on Supporting the use of renewable energy sources
	Implementation of projects in the field of Renewable energy sources (RES)
	Implementation together with local executive authorities of measures on provision of electricity to populated areas an (or) settlements of Kazakhstan where centralized power supply is economically inadvisable
Outcome 3.1 Creation of conditions for conservation and restoration of ecosystems and for transition to low-carbon development Outcome 3.1.3 Implementation of the market mechanism for reduction of	Maintaining state register of carbon units
	Maintaining state cadaster of GHG emissions sources
	Report on preparation of the National report on the inventory of anthropogenic GHG emissions and removal by sinks for 1990 – 2012; 1990 – 2013; 1990 – 2014; 1990 – 2015; 1990 – 2016.
	Preparation of the Biennial report on GHG emissions, climate mitigation actions, financial resources, technologies and capacity building
	Preparation of Communication to the UN Framework Convention on Climate Change
	Supporting functioning of the GHG emission trading market by creating a

greenhouse gas emissions and for transition to the green economy*	relevant legislative framework
	Activities within the framework of Partnership Programme ‘Green Bridge’
	Implementation of the Action plan of the Concept on Transition of the Republic of Kazakhstan to Green Economy for 2013-2020
	Development of regulatory legal acts necessary for implementation of the Law of the Republic of Kazakhstan ‘On supporting the use of renewable energy sources’
	Implementation of projects in the field of RES
	Carrying out measures together with local authorities to ensure provision of electricity to non-electrified settlements of Kazakhstan where centralized power supply is economically inexpedient
Source: Strategic Plan of the Ministry of Energy for 2014 – 2018	

Indicators for the above outcomes are listed in tables 4.2 and 4.3.

Table 4.2

Indicators of direct outcomes

№	Indicators of direct outcomes	Source of information	Meas. unit.	Reporting period		Planned period				
				2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Outcome 1.1.1. Development of electricity (infrastructure)										
1.	Lower depreciation of fixed assets of energy producers	Government data	%	60,1	58,8	58,8	57,8	56,8	55,8	54,8
2.	Share of gas power stations in electricity generation	Government data	%	17,5	18,4	18,5	18,6	18,7	18,8	18,9
Outcome 1.1.3. Development of renewable energy sources										
3.	Amount of electricity generated by renewable energy sources	Government data	bln. kWh	-	0,53	0,57	1,2	1,4	1,6	2
Outcome 3.1.3 Implementation of the market mechanism for reduction of greenhouse gas emissions and for transition to the green economy										
4.	Amount of carbon dioxide emitted by electricity industry as a share of 2012	Government data	%	-	-	100	100	100	100	100
5.	Amount of electricity generated by renewable energy sources	Government data	bln. kWh	-	0,53	0,57	0,7	1	1,6	2

Table 4.3

Indicators of the GHG emission target

Target	In a reporting period		In a planning period				
	2012	2013	2014	2015	2016	2017	2018
Avoid exceeding of GHG emission amounts of the 1990 level, %	73	76	79	81	83	86	89

Concept for development of fuel and energy sector of Kazakhstan

According to the **Regulation of the Ministry of Energy** approved on 19 September 2014 No 994, the mission of the Ministry is development of fuel and energy sector. Decree of the Government as of 28 June 2014 No 724 approved the **Concept for development of the fuel and energy sector of the Republic of Kazakhstan until 2030.** With the approval of the Concept the **Program for development of electrical energy in the Republic of Kazakhstan for 2010-2014** lost its force. The Concept for development of FES of the Republic of Kazakhstan until 2030 links together development of oil&gas, coal, nuclear and electrical energy industries with account of best global practices and latest trends in global energy development.

In the process of Concept drafting the following tasks having direct or indirect influence on emissions reductions were taken into consideration:

- Rapid development of FES industries with the help of XXI century technologies;
- Increasing role of RES and alternative energy sources in the energy balance;
- Energy and resource saving, improving energy efficiency.

High depreciation rates of industrial equipment, use of out-of-date technologies, significant energy consumption by power stations for its own needs and distribution losses mean that there is a big potential to improve energy efficiency and resource saving via transition to more efficient options, given that Energy intensity of GDP in Kazakhstan is much higher than that in most developed countries that are comparable from cold climate and population density perspective. Results of energy audits of several big companies demonstrate that energy saving could be up to 40%.

One of the important aspects of FES functioning is ecological safety of the state, in particular, in the oil and gas and coal generation as main sources of environmental pollution, and also as part of nuclear power generation planned. One of strategic priorities of FES development is better environment via achievement of key objectives of FES development until 2030 that has a direct of indirect input into emission reductions, as follows:

- Upgrading and construction of new assets for generation and transmission of electricity and heat, oil refining;
- Upgrading production and transport sectors, integration of state-of-the-art technologies to improve efficiency of energy carriers and reduce negative impact on the environment;
- Development of technologies and infrastructure for alternative energy application: RES, nuclear energy, associated gas processing, gas transportation and coal chemical manufacturing.

In the recent years energy efficiency and energy saving are given very much attention. Technical potential of energy saving is assessed at a level of 27,75% from total amount of consumed primary energy resources of 17.36 million tons of oil equivalent. In the context of Kazakhstan it is more economically viable to realize only a part of this potential: 19 % or about 12 million tons of oil equivalent. Investments needed for implementation of this economic potential are about 4 billion US dollars.

The main objective when it comes to energy efficiency and energy saving in Kazakhstan is to create conditions for reduction of energy intensity of GDP and improve energy efficiency through more rational energy consumption and more efficient use of fuel and energy resources.

Table 4.4.

Energy efficiency and energy saving objectives in Kazakhstan

Description	2015	2020	2030
Reduce energy intensity of	By 10 % from 2008	By 25 % from 2008	By 30 % from 2008

GDP of Kazakhstan	level	level	level

As part of transition to the green economy, a course toward diversification of generation suggests that coal will continue to be a main energy source until 2030, however its share in the overall power generation structure will be limited. Improvement of coal quality and moderate coal generation growth with simultaneous implementation of modern technologies will help to improve ecology. The main objective for the coal industry development is improvement of coal resource base efficiency to meet the needs of a domestic market of fuel and energy resources and to make the industry more environment friendly in general. It is expected that energy generation from coalbed methane will see growth.

Table 4.5.

Power generation from coalbed methane projections

Description	**2015**	**2020**	**2030**
Development of power generation from coalbed methane	Generation capacity up to 6 MW	Partial satisfaction of producers' needs in power generation	10% of power produced from coalbed methane

For the purpose of meeting objectives on provision of all regions with gas transportation infrastructure the Decree of the Government as of 4th November 2014 No 1171 has approved the **Gasification Master Plan of the Republic of Kazakhstan for 2015 – 2030.** One of the key objectives of the Master Plan in the field of environmental emissions is about creating conditions for larger consumption of gas amongst other fuel and energy resources.

Table 4.6.

Key parameters of the Gasification Master Plan of the Republic of Kazakhstan for 2015 – 2030.

Description	**2015**	**2020**	**2030**
Natural gas production	44.2 billion m^3/year	62.0 billion m^3/year	59.8 billion m^3/year
Domestic consumption of marketable gas	13.6 billion m^3/year	16.2 billion m^3/year	18.4 billion m^3/year

Key objective of the nuclear industry is building a full cycle of nuclear fuel manufacturing with moderate increase of uranium production and distribution channels. One of the key tasks of the industry is elaboration and implementation of the nuclear power plant (NPP) construction project. The following results are expected:

Table 4.7.

Nuclear power generation projections

Description	**2015**	**2020**	**2030**
Development of nuclear power generation	Parameters and a site for NPP construction selected	NPP project elaborated, NPP construction started.	NPP with 100 MW capacity is constructed and provided with the network infrastructure

The Concept for FES Development declares a range of objectives that have to be met and some of them may directly or indirectly reduce greenhouse gas emissions:

- Development of renewable energy sources and their integration to the energy grid
- Bringing the equipment depreciation rates down, increasing power capacity and capacity of power transmission equipment;
- Development of mobile gas generation in the Western energy grid to give capacity to the Southern and Northern energy grids and meeting the needs of North and South peak capacity.
- Improving energy efficiency in Kazakhstan.

Table 4.8.

Expected results for the power generation industry:

Description	**2020**	**2030**
Share of wind power plants (WPP) and solar power plants (SPP) in total power generation	3%	10%
Share of gas power stations in total power generation	20%	25%
Reduction of CO_2 emissions from power industry	Level of 2012	-15 % (to the level of 2012)

List of greenhouse gases

List of Actions of Kazakhstan in the field of climate change should be complemented with the additional information on extension of the list of GHGs that fall under state regulation (carbon dioxide CO_2 and methane CH_4) according to the Decree of the Minister of Energy as of 5th of March 2015 No 177:

1. Carbon dioxide (CO_2);
2. Methane (CH_4);
3. Nitrous oxide (N_2O);
4. Perfluorocarbons (PFC).

In the current year 2015, the government plans to adopt the Mountain Code where it includes methane as an independent mineral resource so that state support could be provided for its production. Besides its use for power generation, methane would be also used for gasification of Astana city.

State Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for 2015–2019

State programs are drafted in line with the list that has to be prepared by a responsible government agency. Such a list of programs and responsible agencies is determined by the President of the Republic of Kazakhstan. The latest list (approved on 19 March 2010 No 957) includes 11 governmental programs. The program that is directly addressing climate change is the State Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for 2015–2019. This program is a continuation of the **State Program for Accelerated Industrial and Innovative Development of the Republic of Kazakhstan for** 2010 - 2014 (hereinafter: SPAIID) and it is based on the outcomes of its predecessor.

To address the climate change issue, the program for industrial and innovative development of Kazakhstan for 2015–2019 has an objective to reduce energy intensity in manufacturing at least by 15% and an objective on petrochemicals development that could be achieved through unleashing resource potential and favorable market environment. Petrochemicals development will help to address the task on efficient use of hydrocarbons e.g. associated gas and dry gas. That helps to reduce non-productive economic expenditures including environmental ones.

When the latest National Communication was submitted, the key industry program with climate change issues integrated was the **Zhasyl Damu Industry Program for 2010-2014** approved by the Governmental Decree on 10 September 2010 No 924. This program’s key objective is to create conditions for conservation and restoration of natural ecosystems. After approval of the Governmental Decree as of 8 July 2014 No 779 ‘On amendment of the Governmental Decree of the Republic of Kazakhstan as of 31 December 2013 No 1592 on Strategic Plan of the Ministry of Environment and Water Resources of the Republic of Kazakhstan for 2014 – 2018’, Zhasyl Damu program lost its force.

On the 4th of July 2009 Kazakhstan adopted the Law ‘**On support of the use of renewable energy sources’**. The Law supports the use of renewable energy sources as one of the instruments for fulfilling country’s international GHG reduction obligations. It provides the national legislation with the basic concepts pertaining to renewable energy sources, sets out approaches, forms and methods of governmental support, determines competences of the Government in this regard, the authorized body, local executive authorities. Competences of government agencies include:

- execution of the state policy in the field of renewable energy sources use;
- development of regulatory legal acts and technical regulations to support renewable energy sources;
- approval of the renewable energy units location plan;
- ensuring connection of renewable energy sources to power grids or heat networks;
- supporting the framework for mandatory purchase of power produced by renewable energy sources;
- creating favorable conditions for construction and operation of renewable energy facilities;
- monitoring the use of renewable energy sources.

When in comes to regulation of generation of power (or) heat from renewable sources, feed-in tariffs are established and targeted assistance is provided. Feed-in tariffs for electrical energy from renewables are approved by the Governmental Decree No 645 on 12 June 2014 as follows:

Table 4.9

Feed-in tariffs for electricity generated by renewable energy sources

No	Renewable energy technology used for power generation	Tariff as KZT/kWh (no VAT)
1	Wind power plants, except for the feed-in tariff for the wind power plant Astana EXPO-2017 with a capacity of 100 MW, for transformation of wind energy	22,68
1-1	Wind power plant Astana EXPO-2017 with 100 MW, for transformation of wind energy	59,7
2	Photovoltaic solar energy transformers, except for the feed-in tariff for solar power projects that use photovoltaic modules made of Kazakh silica (KazPV), for transformation of solar radiation energy	34,61
3	Small hydro plants	16,71
4	Biogas plants	32,23

Rules on targeted support of individual consumers were approved by the Decree of the Minister of Energy of the Republic of Kazakhstan on 28 November 2014 No 161. The Rules describe a procedure of providing targeted support to individual consumers for the purchase of equipment that works on renewable energy sources. The Government provides support to individual consumers in amount of 50% from the cost of equipment working on renewable energy sources with the cumulative capacity not more that 5 kW according to a procedure established by an authorized body. Targeted assistance is paid once such equipment has been put into operation.

List of climate change actions is also presented in Table 3 of CTF.

4.1.2. Actions in the industrial processes sector

Table 4.10

Actions in the industrial processes sector

Actions taken	Short description	2015	2020	2030
		kt. CO2 eq.		

National Allocation Plan for allocation of GHG emission allowances for 2013,2014-2015, 2016-2020, emission trading rules for GHG and carbon units	Limits GHG emissions, when cumulative GHG emissions exceed 20 kilotons a year; all enterprises will reduce emissions by 1,5% in 2015 to the 2012 level, in 2016-2020 enterprises will not exceed an average level of their emissions of 2013-14 (here only non-combustion industrial processes are taken)	-380	-400	-450
Law of RK 'On energy saving and energy efficiency' (2012), mandatory keeping of the State energy register on energy audit	Reduction of GHG emissions through optimization of technological processes in 2013-2019 by 3.5% , in 2020 reduction by 6% from BAU scenario	-860	-1500	-1680
Concept of innovative development of Kazakhstan until 2020 (as of 4 June 2013 No 579)	Integration of progressive technologies in chemistry and petrochemicals industries. Upgrading and modernization of KazPhosphate Plant LLC and KazAzot LLC. Reduction of emissions by 2% until 2020, reduction of emissions by 3% until 2030.	-13	-20	-24
Modernization of Mittal Steel Temirtau JSC as the enterprise has ceased open-hearth steel production; decreased production of ferrosilicon, modernization of Kazzinc JSC	Emissions from steel production decreased by 15 % , the emission factor per ton of zinc = 0, due to transition to the electrolytic process (hydrometallurgy), production of ferrosilicon at a level lower than in 2007	-2500	-2650	2800
State Program for Accelerated Industrial - Innovative Development (SPAIID) for 2015-2019	Modernization of production factors will bring GHG emissions of Kazakhstan to the standards of European countries , transition to new technologies to consume less thermal energy (in the combustion sector)	NA	NA	NA
The Law on Administrative Violations of July 5, 2014 (fine)	Penalty for GHG emissions in excess of the established amount, fine for providing false information on the greenhouse gas inventory	NA	NA	NA
Additional measures	**Short description**	**2015**	**2020**	**2030**
Installation of technology for capturing and storage of CO_2 in the production of clinker and lime (with a coefficient of capturing 80 %)	Coverage of plants for the production of clinker and lime: 10 % until 2017 , 20 % by 2020 , 30 % until 2030	-	-704	-1700
Ammonia production process optimization	Use of low-grade heat of industrial furnaces , energy-efficient catalysts , calciners with lower power consumption (-4.8 %)	-	-32	-36
Calcium carbide production process optimization	Systems for direct gas combustion in closed industrial furnaces, boilers for heat recovery from exhaust gases in semi-closed furnaces and furnace technology that uses gas for lime roasting (up to 9%)	-	-7	-9
Modernization and optimization of iron manufacturing up to European standards	The national average factor of GHG emissions from iron production = 1,89, the European average = 1.35, Modernization of the iron industry in order to reduce the average national emission factor to 1.6 (2016-2020), to 1.4 (after 2021).	-	-963	-1797

Measures for industrial processes are also shown in Table 3 of CTF.

4.1.3. Actions in the forestry sector

Dry summer of 2014 with higher risks of fire resulted in larger areas destroyed by fires compared to 2013 year. 578 cases of forest fires were identified on the area of 3.0 thousand hectares including 1.2 thousand hectares of forest plantations. In 70% of cases forest fires occurred because local executive bodies failed to take appropriate measures to prevent and combat wildfires that were moving to the state forest territory. During 2014 there were 18 cases of fire movement from the steppe to forests of Akmola, Almaty, Atyrau, Kostanai, Zhambyl and Pavlodar regions that led to forest fires on the area of about

2,000 hectares. Insufficient firefighting equipment in administrations of rural districts does not allow to extinguish wildfires in a timely manner.

The second leading cause of forest loss is deforestation. The largest volume of illegal felling in 2014 was found in Zhambyl, East Kazakhstan, Kyzylorda, Kostanai, Pavlodar and North Kazakhstan regions.

Despite the fires and felling, a tendency of reforestation and afforestation must be mentioned. Considerable work has been done on the dried bottom of the Aral Sea, in the green zone of Astana and Irtysh. Most silviculture activities were implemented on the territory of forest institutions of South Kazakhstan region (24.6 thousand ha), Kyzylorda (24 thousand ha), as well as RSE Zhasyl Aimak (5 thousand ha) and Semei and Ertysormany reserves (4.2 and 2.8 thousand ha). The smallest amounts of forest plantations are in the Pavlodar region - 19 hectares, Atyrau - 215 hectares and Karaganda - 240 hectares).

There is a plan to draft by the end of 2015 a national program for development of the forest sector of Kazakhstan till 2020.

Emissions in the forestry sector are caused by fires when burning wood produces carbon dioxide emissions, and by the rotting wood in wetlands.

Thus, measures to protect existing forests, planting new forests, as well as prevention and reduction of areas under fires help to achieve emission reductions in the forestry sector. Legislative framework and measures in this area may include: improved logging practices to reduce damage to forests and soil, encouraging forest plantations, financial incentives for new activities in the field of forest protection.

The main program under which a persistent achievement of increased GHG absorption in the forestry sector took place was the program ‘Zhasyl Damu’ for 2010 - 2014 years. This program was meant to regulate and coordinate action on adaptation to climate change and environmental protection. In place of this document MEWR of Kazakhstan has developed the ‘Strategic Plan of the Ministry of Environment and Water Resources of the Republic of Kazakhstan for 2014-2018 years’. Although the MEWR of Kazakhstan was dissolved in 2014, the Strategic Plan continues to operate with the transition of some functions of the MEWR to the Ministry of Energy and Ministry of Agriculture. According to this plan, the area of unforested lands converted into the ‘forest’ category will increase.

Table 4.11.

Projected afforestation

	Measurement unit	2013	2014	2015	2016	2017	2018
The area of unforested lands that was converted into forest lands	Thousand ha	6	6,5	7	7,5	8	8,5
The area of reforestation and afforestation	Thousand ha	53	54	55	56	57	58
Reducing the average area under forest fires	Ha	10,9	10,8	10,7	10,6	10,5	10,4
Reducing the average volume of 1 case of illegal felling	m3	7,1	7	6,9	6,8	6,7	6,6

There are also many special programs for forestry development such as the Program for the forest sector development of Kazakhstan till 2020 (2015), Concept of conservation and sustainable use of biodiversity in the Republic of Kazakhstan till 2030 (2015) and others. These programs complement a Strategic plan of the MEP for 2014-2018 and serve to protect and restore forests of Kazakhstan.

Forestry measures are also given in Table 3 of CTF.

4.1.4. Actions in the wastes sector

Table 3 of CTF provides information about actions that Kazakhstan is undertaking for climate change mitigation in the waste sector.

These actions were officially approved (adopted) in 2014[4] and had not been declared in the 3-6 National Communication and First biennial report (BR1).

As indicated in the Program for modernization of the solid waste management system for 2014 - 2050 the country has no sorting stations where it would be possible to perform deep waste sorting to extract secondary materials as well as the biodegradable fraction for its disposal for production of ‘green’ energy and compost. Also the system for separate waste collection and (or) sorting at the source of solid waste generation is underdeveloped. The country currently has no centralized enterprises for wastes incineration or biological treatment, and thus production of ‘green’ energy from MSW has not been arranged. The first pilot project to build a plant for mechanical and biological treatment of wastes is planned to be implemented in the city of Aktau. Start of construction of the waste processing plant is planned for 2014, and this plant will be the first company that can produces ‘green’ energy from MSW using the technology of anaerobic decomposition of the organic fraction of the waste.

In 2015, in Astana[5] a pilot project was launched on the separate collection of wastes. As part of the project since 1st of March 36 homes and 17 condominiums of the city received special colored wastes containers for separate collection of paper, plastic, glass and mixed waste.

Since 2011, a similar project is being implemented in Kazakhstan's largest city Almaty[6].

In 2007 a recycling plant was built in Almaty which worked for two years, but now it is not functioning due to the unsettled (low) tariff for waste recycling[7].

A wastes recycling plant in Astana (built in 2012) sorts only 7 percent of wastes[8] (paper, plastic, glass) of the total volume of incoming solid waste. The remaining mass is compressed and sent to a landfill. At the current level of processing only a slight decrease in methane emissions is achieved. The companies plan to produce energy from organic wastes.[9]

The executive director of the Association of Legal Entities ‘Kazakhstan Association of Waste Management KazWaste’ Vera Mustafina [10] believes that: Kazakhstan has got very low tariffs on disposal of solid wastes. They do not include sorting, recycling, waste reloading, equipment at collection platforms, upgrading the vehicle fleet, containers and others. Tariffs vary in different cities several times (from 70 to 300 tenge per person per month). Currently the Ministry of Energy has prepared a draft methodology for the tariff calculation which includes all of the above components. International experience shows that it is not possible to introduce a rational system of collection and recycling unless the tariffs are raised. After the introduction of new methods and calculations it will be clear as to how much rates will rise. At the same time some compensation must be provided to vulnerable people, similar to other utilities tariffs.

4.2. Changes in institutional mechanisms

On August 6th, 2014 President of Kazakhstan Nursultan Nazarbayev signed a decree ‘On the reform of the public administration system of the Republic of Kazakhstan’ No 875. This reform was conducted as it was necessary to form a compact Government with the shift a of decision-making center

[4] Resolution of the Government of the Republic of Kazakhstan ‘On approval of the program of modernization of the solid waste management system in 2014 – 2050’ as of June 9, 2014 No 634

[5] http://astana.gov.kz/ru/modules/material/7640

[6] http://tengrinews.kz/strange_news/musora-almatintsev-delayut-detskie-ploschadki-prischepki-203174

[7] http://mir24.tv/news/society/3715240

[8] http://tengrinews.kz/kazakhstan_news/musoropererabatyivayuschiy-zavod-astane-obvinili-260272

[9] http://24.kz/ru/tv-projects-2/umnyj-gorod/item/68337-umnyj-gorod-razdelnyj-sbor-musora

[10] http://informburo.kz/stati/vyvoz-musora-v-kazahstane-podorozhaet--9824.html

to the level of ministries and regions, in order to increase efficiency and effectiveness of the state machine, cut red tape and bureaucracy. For the purpose of modernization and improvement of public administration efficiency, optimization of the state machine and formation of the compact Government a decision was made to create a new structure of government consisting of 12 ministries and about 30 committees. 5 new ministries were created: 1) Ministry of National Economy; 2) Ministry of Culture and Sports; 3) Ministry of Investment and Development; 4) Ministry of Energy of the Republic of Kazakhstan. The following are the parts of the reform that directly or indirectly affect the issues of mitigation.

The Ministry of Agriculture of the Republic of Kazakhstan was reorganized and received functions and powers in the field of formation and implementation of state policy in the following sectors: fishery, water management, forests, wildlife - from the Ministry of Environment and Water Resources of the Republic of Kazakhstan.

The Ministry of Investment and Development of the Republic of Kazakhstan was formed and received functions and powers of the Ministry of Transport and Communications of the Republic of Kazakhstan.

The Ministry of Energy of the Republic of Kazakhstan was created and it received functions and powers from the Ministry of Oil and Gas, Ministry of Industry and New Technologies in the field of formation and realization of state policy in the sphere of electric power, nuclear energy, as well as from the Ministry of Environment and Water Resources in the formation and implementation of public policy for protection, control and supervision of natural resources management, municipal solid waste management, renewable energy, monitoring the state policy on ‘green economy’.

This reform abolished the Ministry of Industry and New Technologies of the Republic of Kazakhstan, Ministry of Transport and Communications of the Republic of Kazakhstan, Ministry of Oil and Gas of the Republic of Kazakhstan and Ministry of Environment and Water Resources of the Republic of Kazakhstan;

It was decided that the newly formed and restructured state agencies are successors to the rights and obligations of the abolished state bodies in accordance with functions and powers transmitted.

The Ministry of Energy of Kazakhstan is the authorized body in the field of environment and according to the new wording of Article 17 of the Environmental Code (dated September 29, 2014):

• organizes keeping of the state register of carbon units;

• organizes maintenance of the state cadaster of emissions and removals of greenhouse gases;

• defines a list of measures to encourage wastes recycling and reduce their generation;

• is responsible for issuing permissions for import and export of ozone-depleting substances and products containing them to and from the territory of the Republic of Kazakhstan;

• prepares lists of best available technologies and arranges keeping of the register;

• develops a procedure for monitoring and control of greenhouse gas inventories;

• develops a procedure for implementation of project-based mechanisms in the field of regulation of emissions and removals of greenhouse gases;

• develops a National Plan of allocation of allowances for greenhouse gas emissions;

• develops a procedure for allocation of allowances for greenhouse gas emissions;

• develops a procedure for development of the wastes management program;

• approves a methodology for determining standards for emissions into the environment and wastes classification;

• develops a procedure for inclusion of nature management considerations into the permit for emissions into the environment;

• prepares a typical list of actions for the environment protection;

• prepares a methodology for calculating fees for emissions into the environment;

• prepares a procedure for converting units of project-based mechanisms in the field of regulation of emissions and removals of greenhouse gases into units of allowances;

• develops a procedure on elaboration of internal projects to reduce greenhouse gas emissions and the list of industries and sectors in which they can be carried out;

• the procedure for mutual recognition of allowances and other carbon units on the basis of international agreements of the RK;

• develops a procedure for emissions trading: greenhouse gases and carbon units;

• the procedure of monitoring, accounting and reporting of carbon emissions units for the purpose of trading;

• the procedure for standardization of measurement and accounting of greenhouse gas emissions;

• methodologies for estimation of emissions, emission reductions and removals of greenhouse gases;

• Rules on treatment of persistent organic pollutants and wastes containing them;

• the procedure for keeping the state register of carbon units;

• lists of the best available technologies;

• a list of pollutants and wastes for which emission standards are set;

• procedure of trading and commitments to reduce emissions into the environment;

• qualification requirements for the licensed activity in the field of environmental protection;

• technical regulations in the field of environmental protection;

• procedure for keeping the state register of polluted sites;

• procedures for monitoring and control of greenhouse gas inventories;

• procedure for implementing project-based mechanisms in the field regulation of emissions and removals of greenhouse gases;

• rules for development of waste management programs;

• procedure of greenhouse gases and ozone-depleting substances inventory;

• the allowance (quota) for greenhouse gas emissions for participants of the market mechanism on reduction of emissions and absorption of greenhouse gases;

• procedure for determining environmental quality targets;

• the procedure for issuing integrated environmental permits and the list of types of industrial facilities, for which it is possible to obtain integrated environmental permits instead of permits for emissions into the environment;

• A list of greenhouse gases, which are subject to government regulation;

• procedure for the issue of allowances for greenhouse gas emissions;

• procedure for implementing environmental (green) investments;

• international cooperation in the field of environmental protection;

• approves projects on emission reduction and absorption of greenhouse gases implemented in the territory of the Republic of Kazakhstan;

• certifies independent organizations performing verification and validation of professional (determination) activities in the field of reducing emissions and removals of greenhouse gases, as well as confirmation of the report on greenhouse gas inventory.

4.3. Economic and social consequences of response measures

4.3.1. Energy sector (fuel combustion)

Accepted feed-in tariffs for the supply of electrical energy produced by renewable energy sources and targeted assistance to individual consumers for the purchase of plants under five kilowatts working on renewable energy sources in the amount of fifty percent of costs can positively influence the social and economic development of remote and sparsely populated areas of the Republic of Kazakhstan by creating jobs and improving well-being of the population.

The Gasification Master Plan of the Republic of Kazakhstan for 2015 – 2030 aims to create conditions for sustainable socio-economic development of the country through development of the gas transportation system and meeting gas supply needs with its own resources of natural gas as a clean fuel.

Successful implementation of the planned project on commercial production of methane from mines will help to solve a number of important tasks. Firstly, the degassing has a positive impact on the safety of miners. Secondly there will be an opportunity to develop new fuel and energy and chemical industries, generating a multiplier effect through creation of new industries and innovative technologies associated with attraction of new investments. Third, the degassing has an immediate positive effect on the environmental situation. State support will help to generate sufficiently large tax deductions in 7-10 years.

4.3.2. Wastes management

Almaty experience has shown that separate collection of waste requires a significant investment from local budgets. So, 1 underground container costs $ 4.000[11]. By the end of 2012 1000 underground containers were installed in Almaty. Costs were 4 million US dollars. Sorted wastes are distributed to 20 enterprises that process wastes such as waste paper, glass, textiles, polyethylene and metal.

One of these companies specializes in processing of tires: rubber is crushed into small chips and the coating is produced for children's playgrounds, tennis courts, speed bumps. Another organization is involved in disposal of household and office equipment from which they produce clothespins, basins, buckets and hangers. Fillers for mattresses and heaters are produced from textile wastes.

Some experts believe that Kazakhstan should not pursue separate waste collection because it would be too expensive for the end user and they offer to introduce a line of automatic sorting of wastes[12]. Profitability of plants can be ensured by secondary raw materials and fuels that can be produced from wastes. In addition, automated process will reduce a number of staff. The technology allows to identify in the total mass such hazardous waste items as electronics and mercury-containing products.

Other experts suggest to build sorting areas [13] from where wastes could be delivered to recycling sites. Head of Environmental Union ‘Tabigat’ Mels Eleusizov criticized the idea of landfills construction, wastes accumulation and subsequent sorting. He stressed that it would be better to build a sorting area in the cities from where wastes could be transported to recycling sites. He calculated that, for example, 800 sorting areas would be enough for Almaty. According to a feasibility study, their construction will require 12 billion tenge. Eleusizov noted that with the wastes recycling system working, costs will be repaid in ten years. In addition, the project provides 2400 jobs. According to the ecologist, 95 percent of municipal solid wastes are subject to processing.

Wastes treatment plants can increase employment. For example, a waste recycling plant in Astana employs more than 350 people [14].

4.4. Progress in meeting emission reduction targets

Kazakhstan is not yet able to reduce overall emissions: relatively high rates of economic growth have led to a situation when the emissions trading system is not able to limit emissions of controlled companies to the 2010 level (in 2013) and the average value of 2011-2012 (2014). Kazakhstan is not using the unit emissions through market mechanisms.

According to estimates, the level of GHG emissions in 2015 in Kazakhstan will be about minus 15% from the 1990 level. To avoid exceedance of this indicator in 2020 and 2030, Kazakhstan needs to stabilize emissions at current levels.

Additional information is provided in section V ‘Projections’ and Tables 4, 5 and 6 of CTF.

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[11] http://tengrinews.kz/kazakhstan_news/almatyi-ustanovili-600-konteynerov-novogo-tipa-musora-227105
[12] http://tengrinews.kz/kazakhstan_news/razdelnyiy-sbor-musora-neeffektiven-slishkom-dorog-nemetskiy-261904
[13] http://tengrinews.kz/kazakhstan_news/eleusizov-raskritikoval-programmu-po-pererabotke-musora-261162
[14] http://tengrinews.kz/kazakhstan_news/musoropererabatyivayuschiy-zavod-zarabotal-v-astane-225679

V. PROJECTIONS

5.1. Updated Projections for 2020 and 2030

Below is an updated outlook of greenhouse gas emissions in Kazakhstan until 2030 (Figure 5.1).

According to the projection, only in the scenario with additional measures it is possible to achieve by 2030 the goal to reduce emissions by 15% of the 1990 level.

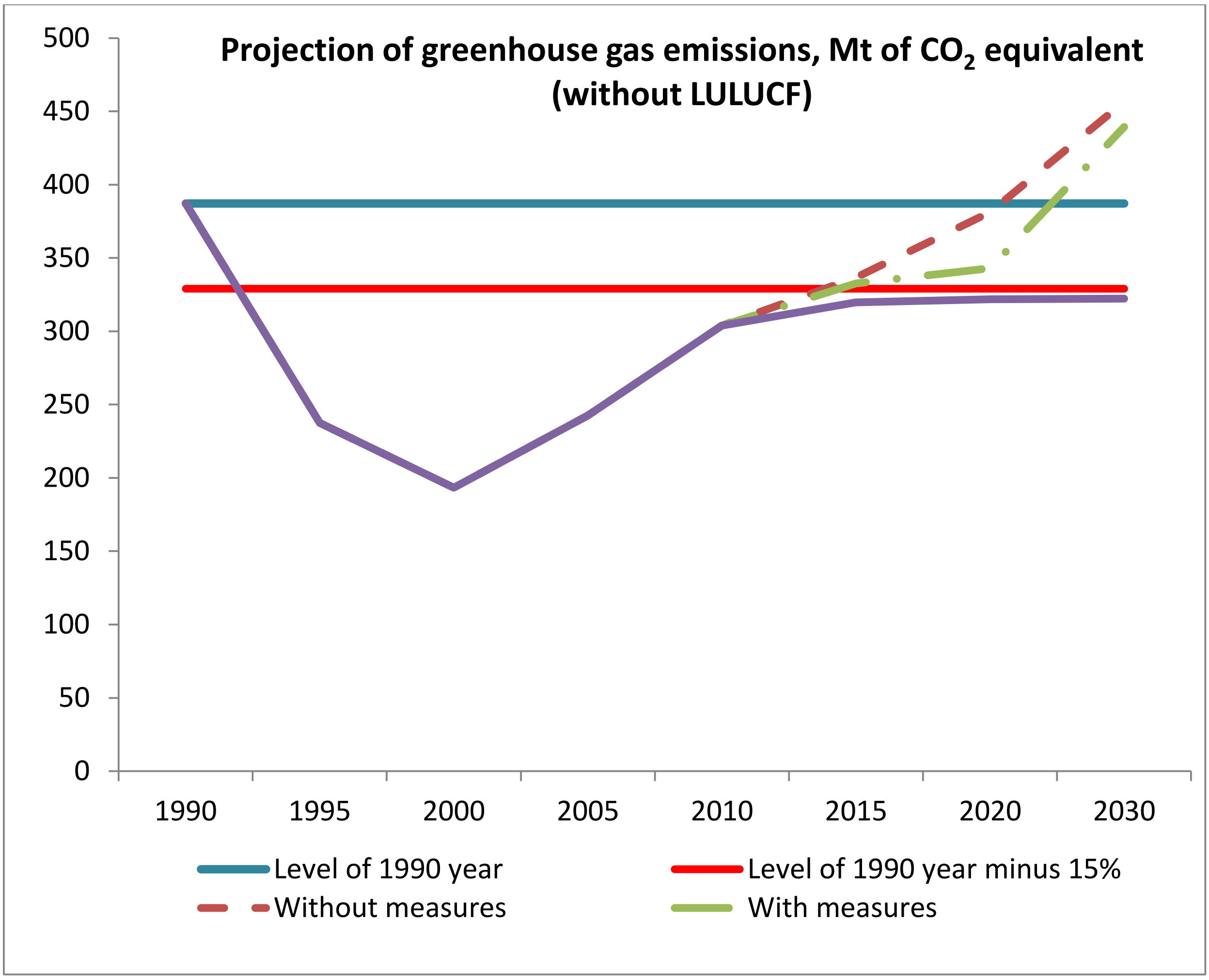

Figure 5.1. GHG emissions projection, kt of CO_2 equivalent without LULUCF

5.1.1 Projections in the energy sector (fuel combustion)

To predict greenhouse gas emissions associated with fuel combustion in a scenario with current measures, without measures, with additional measures, a model of the energy system of the Republic of Kazakhstan was used based on TIMES tool (The Integrated MARKAL-EFOM System) which gives a technical and economic description of processes in the energy sector (‘bottom-up’). TIMES is a tool for technical and economic modeling of energy systems which allows to perform scenario analysis of the dynamics of energy systems in the long term. Emissions from sectors not related to the energy sector were evaluated by the expert.

Business as usual (BAU) – without measures scenario.

This scenario reflects possible changes in amount of greenhouse gases when no measures are taken to reduce them, and the main objective is to reduce costs. Further growth is achieved through the use of cheap coal as a fuel for energy production.

Scenario without measures has been prepared based on an analysis of emission categories. This scenario assumes that greenhouse gas emissions are dependent on the overall GDP growth rate, population and current transition towards less energy-intensive sectors of economy.

It is assumed that this scenario includes several measures and policies that have been implemented in the country in recent years (National Allocation Plan for 2013 and 2014-2015). It is expected that Balkhash thermal power plant with capacity of 1.32 GW will be constructed by 2020 and will generate electricity in the future. This assumption is valid for the entire projection period and for all scenarios.

With current measures scenario (WCM)

This scenario differs from the scenario without measures as it includes measures and policies to reduce greenhouse gas emissions that have been taken and are planned to be adopted in the near future. These measures include the planned National Allocation Plan for 2016 - 2020, growing share of renewable and alternative energy sources in the energy mix and feed-in tariffs set for the supply of electricity produced from renewable energy sources.

The National Allocation Plan for 2016 - 2020 suggests carbon dioxide emission allowances for companies in the oil and gas, energy, mining and chemical industries in the amount of 738 121 767.24 in 2016-2020. According to the plan, a baseline is set as the average value of cumulative carbon dioxide emissions in 2013-2014. The number of allowance units allocated for years 2016-2020 is calculated on the basis of commitments to reduce carbon dioxide emissions at a rate of 0% from the baseline until 2020.

The action plan for development of alternative and renewable energy in Kazakhstan for 2013 - 2020 years suggests putting into operation about 106 renewable energy facilities with a total installed capacity of 3054.55 MW (34 WPP - 1787 MW, 41 HPP - 539 MW, 28 SPP - 713,5 MW, 3 bio power plants - 15.05 MW) and the Concept for development of fuel and energy sector of Kazakhstan till 2030 is planning to launch a nuclear power plant with capacity up to 1000 MW.

Feed-in tariffs for the supply of electricity generated from renewable energy sources were introduced in the form of subsidies for the respective plants.

With current and additional measures scenario (WCAM)

This scenario takes into account not only policies and measures of the scenario with current measures but also additional ones that have not been yet spelled out in the action plan but most likely will be planned and undertaken to achieve targets set by various policy documents and concepts. Since it is not known from official sources what measures will be taken, the assumptions were made.

It is expected that after the end of the National Plan of allowances allocation for 2016 - 2020, the next National Plan of allowances allocation for 2021 - 2025 will be adopted, and the total amount of emissions for 5 years will be 10% more than in the previous plan. When it comes to development of alternative and renewable energy in Kazakhstan for 2020 - 2030, it has been assumed that the same amount of capacity will be commissioned as in the period 2013-2020. Commissioning of the nuclear power plant with 1.5 GW capacity is expected.

In the scenario with current and additional measures a measure was suggested which was described in the previous National Communication of Kazakhstan. This measure suggests a tax[15] on greenhouse gas emissions at a rate of $ 20 per 1 ton of greenhouse gas emissions in CO_2 equivalent from 2015 to 2020, US $50 from 2020 to 2025, and then an upward trend starting from US $150 in 2025 to US $300 by 2030.

Greenhouse gas emissions from wastes incineration

WOM, WCM and WCAM scenarios are based on technical and economic modeling of processes associated with fuel combustion. All three scenarios are presented on Figure 5.2. The blue line on the graph represents a level of greenhouse gas emissions in 1990, the red line represents 85% of emissions in 1990 and illustrates the defined contributions at the national level by 2030 (Intended Nationally Determined Contributions - INDC). The black line shows the level of the energy sector in 1990.

[15] This refers to the cost of certain measures to reduce greenhouse gas emissions. GHG tax is not planned and is not considered. (The term "tax" is used for convenience of projection (hereinafter))

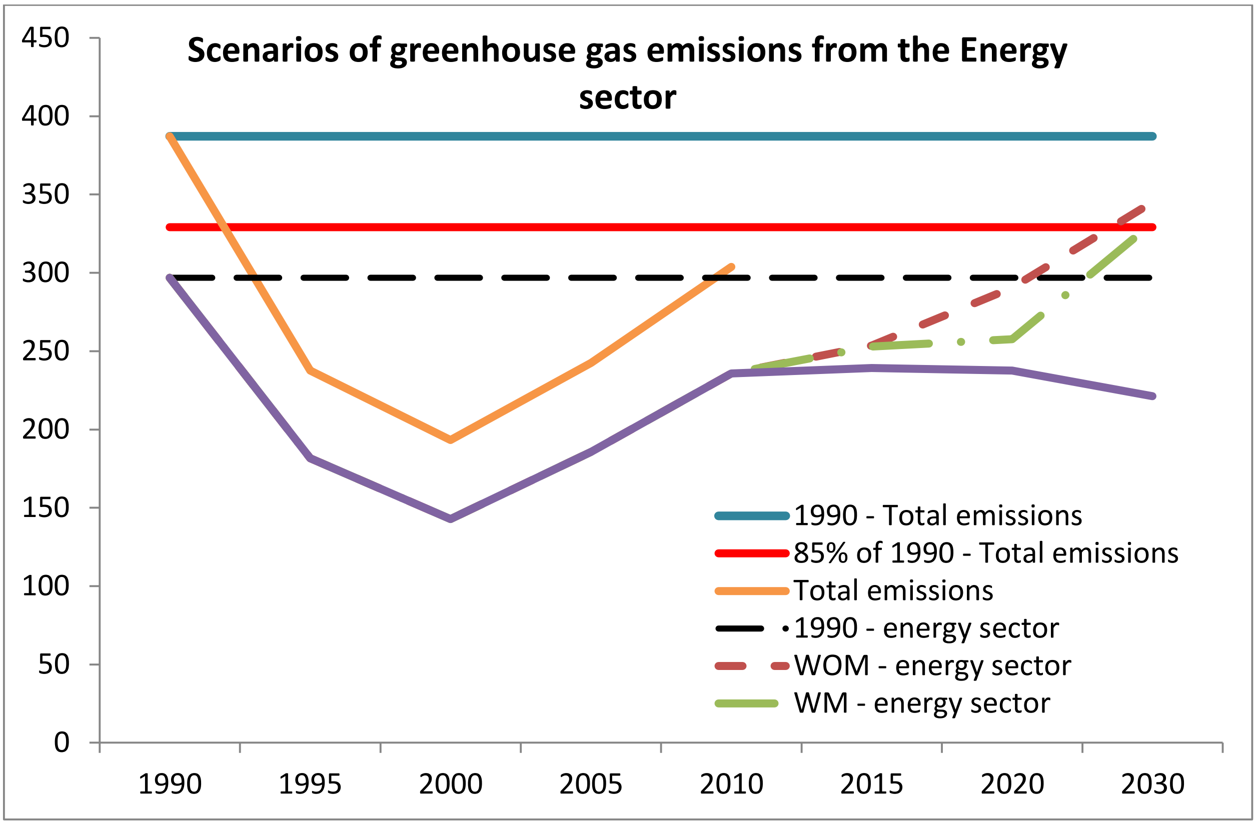

Figure 5.2 Development scenarios for greenhouse gas emissions from the energy sector

As seen on Figure 5.2, emissions in the energy sector in the WOM scenario grow throughout the projection period and reach the 1990 level (sector Fuel combustion) approximately by 2020. Main source of emissions in the combustion sector is Energy (58% of the total combustion sector) in which the key categories are electricity and heat. In the WCM scenario the main factor that affects reduction of emissions from fuel combustion is implementation of the proposed National Plan of Allowances Allocation for 2016-2020. Construction and commissioning of renewable energy facilities helps to stabilize the trend in the projection of emissions from fuel combustion sector in the WCAM scenario. In the scenario with additional measures a downward trend is observed in the 20-ies due to high taxes on CO2 emissions.

The results of the WOM, WCM and WCAM scenarios from processes associated with fuel combustion as well as results of the inventory (by type of greenhouse gas) are listed in Table 5.1.

Table 5.1

Historical data and projections of cumulative emissions of greenhouse gases by type

Million tons of CO_2 equivalent	**Historical data, inventory**						**WOM scenario**		
Types of gases	1990	1995	2000	2005	2010	2013	2015	2020	2030
CO_2	272.71	167.00	137.37	185.77	232.91	234.88	231.01	256.71	295.57
CH_4	1.50	0.92	0.42	0.62	0.86	0.83	44.78	58.78	83.57
N_20	0.92	0.57	0.44	0.58	0.75	0.76	0.92	1.05	1.38
HFC	NO,NA	NO,NA	0.17	0.26	0.96	1.00	NE	NE	NE
PFC	NO,NA	NO,NA	NO,NA	NO,NA	1.42	1.57	NE	NE	NE
Total	275.12	168.49	138.40	187.23	236.90	239.03	276.71	316.54	380.52
Million tons of CO_2 equivalent	**Historical data, inventory**						**WCM scenario**		
Types of gases	1990	1995	2000	2005	2010	2013	2015	2020	2030

CO_2	272.71	167.00	137.37	185.77	232.91	234.88	230.39	228.71	282.47
CH_4	1.50	0.92	0.42	0.62	0.86	0.83	44.89	53.02	84.25
N_20	0.92	0.57	0.44	0.58	0.75	0.76	0.92	0.96	1.32
HFC	NO,NA	NO,NA	0.17	0.26	0.96	1.00	NE	NE	NE
PFC	NO,NA	NO,NA	NO,NA	NO,NA	1.42	1.57	NE	NE	NE
Total	275.12	168.49	138.40	187.23	236.90	239.03	276.20	282.69	368.04
Million tons of CO_2 equivalent	**Historical data, inventory**						**WAM scenario**		
Types of gases	1990	1995	2000	2005	2010	2013	2015	2020	2030
CO_2	272.71	167.00	137.37	185.77	232.91	234.88	206.74	206.08	185.66
CH_4	1.50	0.92	0.42	0.62	0.86	0.83	32.16	32.06	31.89
N_20	0.92	0.57	0.44	0.58	0.75	0.76	0.81	0.85	0.91
HFC	NO,NA	NO,NA	0.17	0.26	0.96	1.00	NE	NE	NE
PFC	NO,NA	NO,NA	NO,NA	NO,NA	1.42	1.57	NE	NE	NE
Total	275.12	168.49	138.40	187.23	236.90	239.03	239.72	238.99	218.45

The following table shows the cumulative effect of current and additional measures.

Table 5.2

Cumulative effect of current and additional measures

	Emission amounts, million tons of CO_2 equivalent		
	2015	2020	2030
Without measures scenario	276.7	316.5	380.5
With current measures scenario	276.2	282.7	368.0
Effect from measures	0.5	33.9	12.5
With additional measures scenario	239.7	239.0	218.5
Effect from additional measures	36.5	43.7	149.6

Figure 5.3 shows a diagram of C02 emissions associated with fuel combustion by sector.

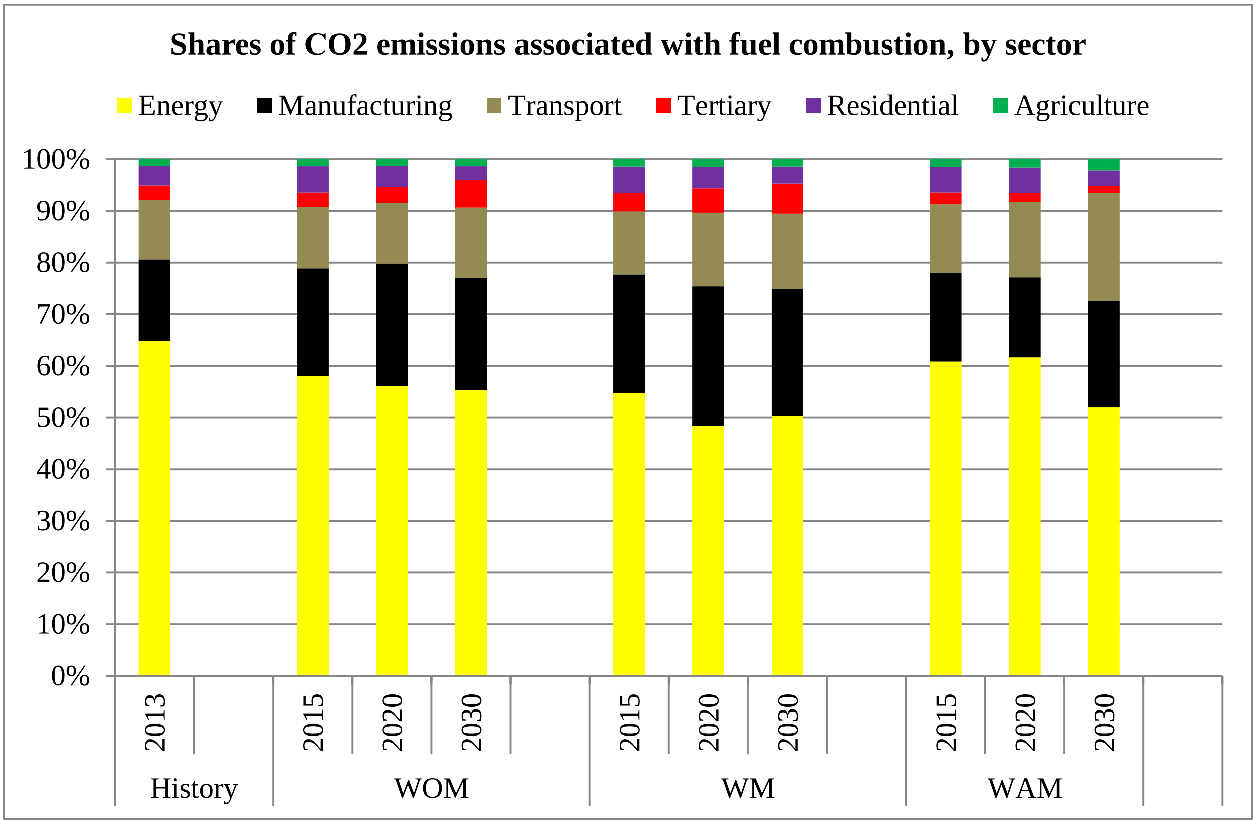

Figure 5.3 Shares of $C0_2$ associated with fuel combustion by sector

The main fuel for energy generation today is coal. In all scenarios coal will remain to be a leading fuel in the future but its share in total consumption has reduced in scenarios with current measures and with additional measures (Figure 5.4). In the scenario with additional measures the share of natural gas combustion significantly increases.

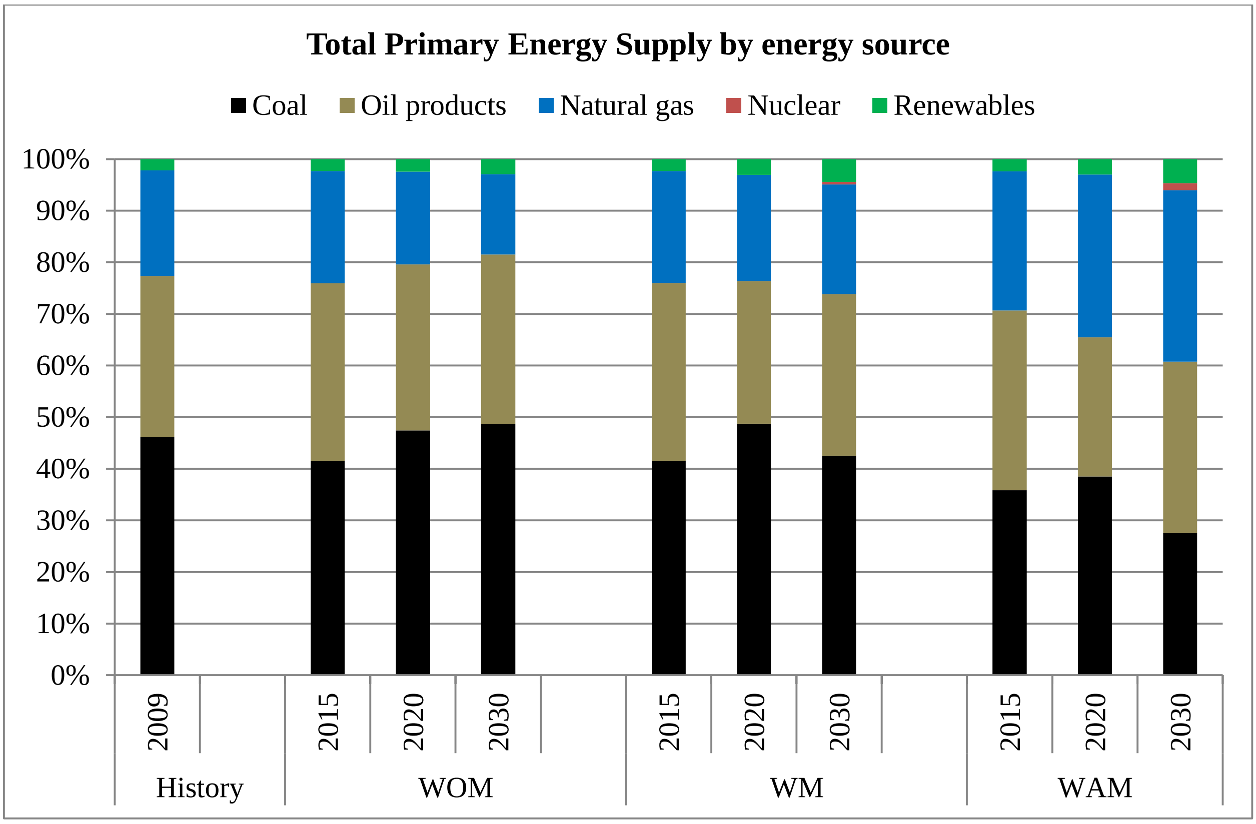

Figure 5.4 Emissions of $C0_2$ associated with combustion by types of fuel

Agriculture (fuel combustion)

CO_2 emissions from the agricultural sector are negligible compared to emissions from other sectors and they vary in all three scenarios. According to projections, in the agricultural sector 2.8 million tons of CO_2 will be emitted by 2020 and 3.4 million tons of CO_2 by 2030. Average emissions growth will be about 2% per year for the entire period from 2012 to 2030 and that is lower than expected growth of GDP.

Manufacturing (fuel combustion)

Table 5.3 presents the inventory data for the period from 1990 to 2013 and projections for 2015-2030. The emissions growth will depend on changes in technology used in the manufacturing sector. In the WCM scenario emissions from this sector will increase by 4 million tons of CO_2. This increase is explained by the fact that reduction of heat generation by a non-manufacturing sector leads to increased self-consumption of coal to produce heat for industrial purposes. The change in emissions across industries will be uneven. Additional measures will reduce CO_2 emissions compared to a scenario without measures by approximately 24 million tons of CO_2 because the share of natural gas grows and thus it is possible to use the heat from the CHPP working on natural gas instead of the CHPP on coal.

Table 5.3

Total CO_2 emissions from the manufacturing sector by categories of emissions, by years and projection by scenarios

Million tons of CO_2	**Historical data, inventory**						**WOM scenario**		
Emission categories	1990	1995	2000	2005	2010	2013	2015	2020	2030
Iron and steel	8.5	6.7	9.3	12.3	9.0	9.6	11.7	13.8	18.2
Non-ferrous metals	2.5	4.0	7.3	7.7	11.1	8.1	15.2	16.2	8.0
Chemicals	1.9	1.1	0.4	0.2	0.3	0.7	1.3	3.0	4.6
Pulp, paper and printing	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5
Food processing, beverages and tobacco	0.8	1.5	0.8	1.1	1.4	0.6	0.0	0.0	0.0
Non-metallic minerals	4.8	0.7	0.8	2.4	3.0	3.9	2.9	3.2	5.3
Other	1.0	2.5	4.0	5.4	4.9	5.2	11.6	18.1	24.1
Total	19.5	16.6	22.5	29.1	29.9	28.1	42.7	54.5	60.7
Million tons of CO_2 equivalent	**Historical data, inventory**						**WCM scenario**		
Emission categories	1990	1995	2000	2005	2010	2013	2015	2020	2030
Iron and steel	8.5	6.7	9.3	12.3	9.0	9.6	11.7	13.8	18.2
Non-ferrous metals	2.5	4.0	7.3	7.7	11.1	8.1	15.2	15.7	12.1
Chemicals	1.9	1.1	0.4	0.2	0.3	0.7	1.3	2.0	4.5
Pulp, paper and printing	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5
Food processing, beverages and tobacco	0.8	1.5	0.8	1.1	1.4	0.6	0.0	0.0	0.0
Non-metallic minerals	4.8	0.7	0.8	2.4	3.0	3.9	2.9	3.2	5.3
Other	1.0	2.5	4.0	5.4	4.9	5.2	11.8	14.3	24.1
Total	19.5	16.6	22.5	29.1	29.9	28.1	43.0	49.2	64.7
Million tons of CO_2 equivalent	**Historical data, inventory**						**WAM scenario**		
Emission categories	1990	1995	2000	2005	2010	2013	2015	2020	2030
Iron and steel	8.5	6.7	9.3	12.3	9.0	9.6	11.7	13.8	21.0
Non-ferrous metals	2.5	4.0	7.3	7.7	11.1	8.1	9.7	3.3	4.7

Chemicals	1.9	1.1	0.4	0.2	0.3	0.7	0.6	1.0	1.3
Pulp, paper and printing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Food processing, beverages and tobacco	0.8	1.5	0.8	1.1	1.4	0.6	0.0	0.0	0.0
Non-metallic minerals	4.8	0.7	0.8	2.4	3.0	3.9	1.7	2.3	4.9
Other	1.0	2.5	4.0	5.4	4.9	5.2	8.7	8.7	5.3
Total	19.5	16.6	22.5	29.1	29.9	28.1	32.4	29.2	37.2

Residential sector (fuel combustion)

In these scenarios all measures to reduce emissions from fuel combustion are concentrated in the energy sector, therefore emissions in the residential and utilities sectors do not change in different scenarios. The main fuel causing CO_2 emissions was and remains coal. Basically emissions will increase 1.5 times and will amount to 22.5 million tons of CO_2 equivalent in the scenario with measures. In the scenario with additional measures combustion of coal is reduced to zero by 2030, natural gas is combusted only for hot water supply in the utilities sector and for cooking. All the other energy needs are met by electricity generation.

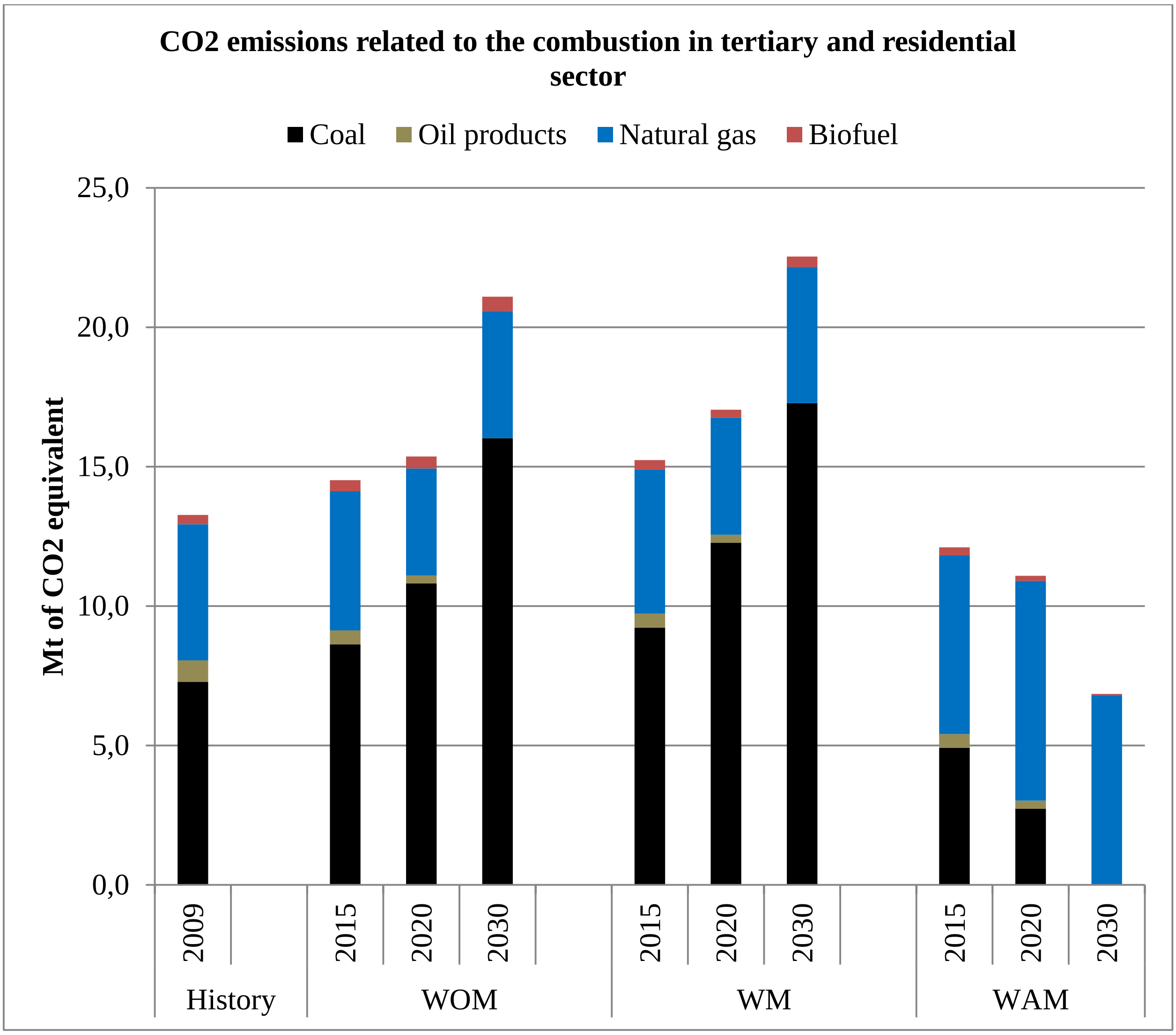

Figure 5.5. CO_2 emissions associated with combustion in residential and utilities sectors

Emissions from power and heat plants (fuel combustion)

Emissions from power plants and heat plants make 30 - 35% of total emissions and 46 - 50% of emissions associated with fuel combustion. Although emissions and their shares are changing, Figure 5.6 shows that the main fuel for generating electrical and thermal energy is coal, regardless of the scenario. Table 5.4 shows that the proportion of plants that produce electricity only goes down in all scenarios, which can be explained by the fact that co-generation of electricity and heat is beneficial in the context Kazakhstan and for emission reduction. At the same time in the scenario with additional measures the share of power plants producing electricity increases only. This is due to a growing share of electric power from wind, solar and nuclear energy (see Figure 5.7 and Figure 5.8). Contribution to emission reduction from the sector of electric and thermal power plants is one of the biggest and most fundamental.

Table 5.4

Total CO_2 emissions associated with combustion of fuel at power and heat plants by years, projections by scenarios

Million tons of CO_2 equivalent	**Historical data, inventory**					**WOM scenario**		
Technology type	1990	1995	2000	2005	2010	2015	2020	2030
Power plants	N/A	N/A	N/A	N/A	N/A	30.19	11.55	5.56
CHPP	N/A	N/A	N/A	N/A	N/A	38.08	56.96	80.67
Boilers	N/A	N/A	N/A	N/A	N/A	17.09	15.25	17.06
Total	112.39	85.26	53.56	70.61	86.84	85.35	83.77	103.29
Million tons of CO_2 equivalent	**Historical data, inventory**					**WCM scenario**		
Technology type	1990	1995	2000	2005	2010	2015	2020	2030
Power plants	N/A	N/A	N/A	N/A	N/A	30.19	6.21	5.56
CHPP	N/A	N/A	N/A	N/A	N/A	38.08	51.54	44.93
Boilers	N/A	N/A	N/A	N/A	N/A	16.36	15.11	34.77
Total	112.39	85.26	53.56	70.61	86.84	84.63	72.86	85.26
Million tons of CO_2 equivalent	**Historical data, inventory**					**WAM**		
Technology type	1990	1995	2000	2005	2010	2015	2020	2030
Power plants	N/A	N/A	N/A	N/A	N/A	30.19	35.75	17.95
CHPP	N/A	N/A	N/A	N/A	N/A	38.70	39.47	38.91
Boilers	N/A	N/A	N/A	N/A	N/A	12.48	10.95	1.10
Total	112.39	85.26	53.56	70.61	86.84	81.37	86.17	57.95

N/A – not applicable as inventory by Zhasyl Damu provides no breakdown by types of plants

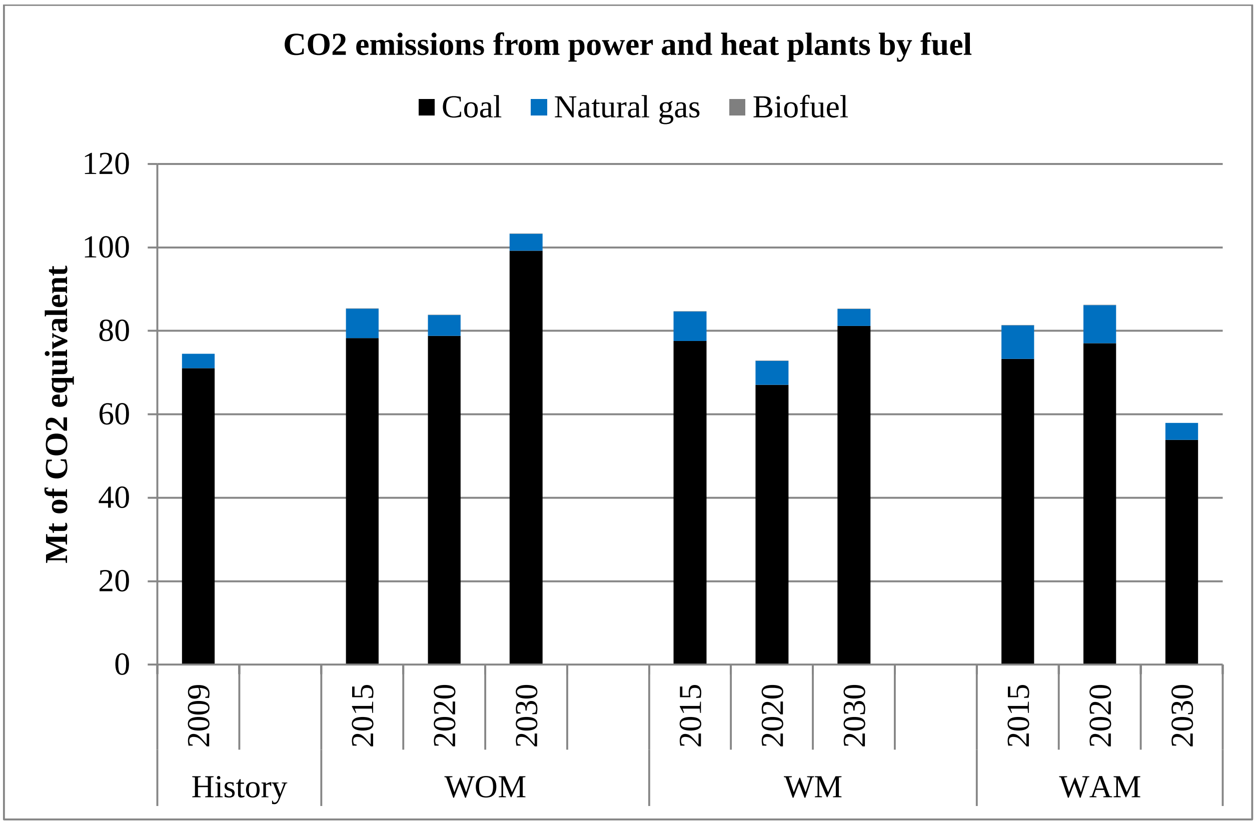

Figure 5.6 CO_2 emissions associated with combustion of fuel at power and heat plants by types of fuel

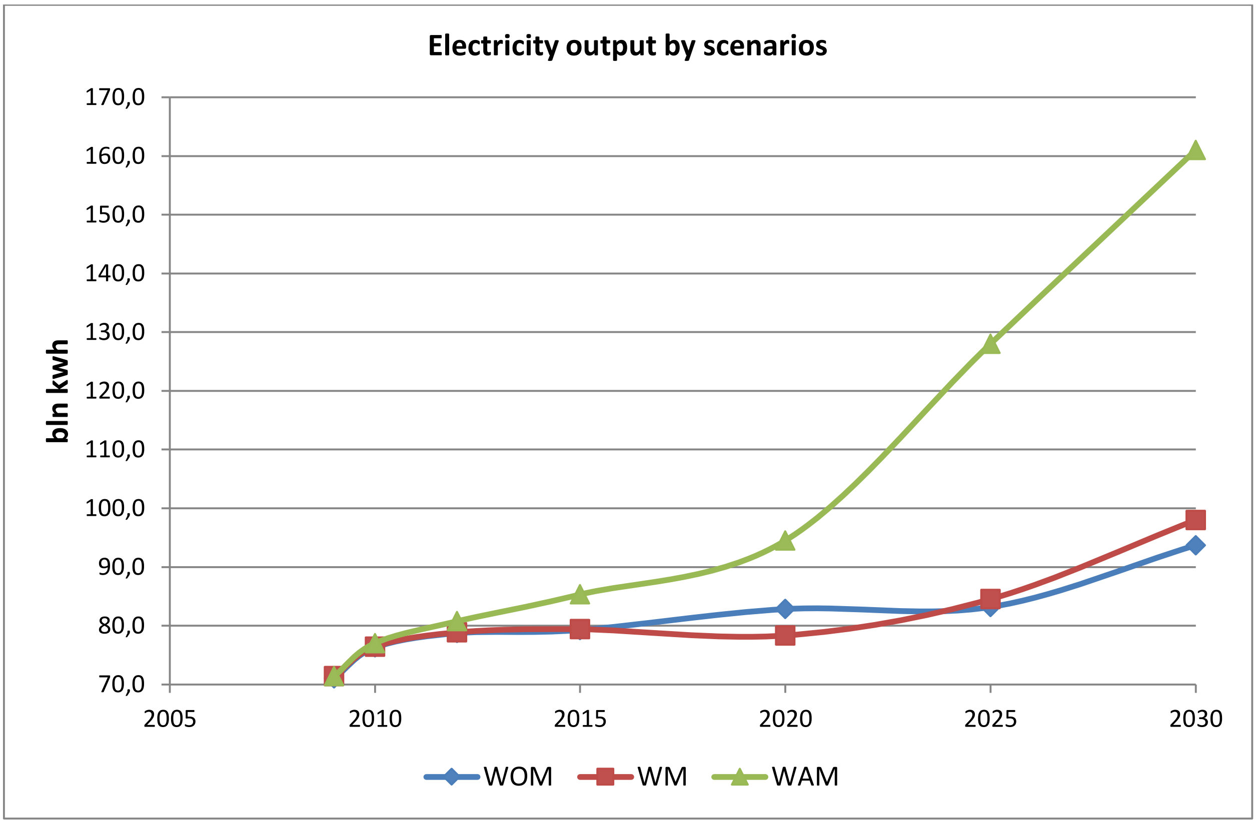

Figure 5.7 Power generation by scenarios

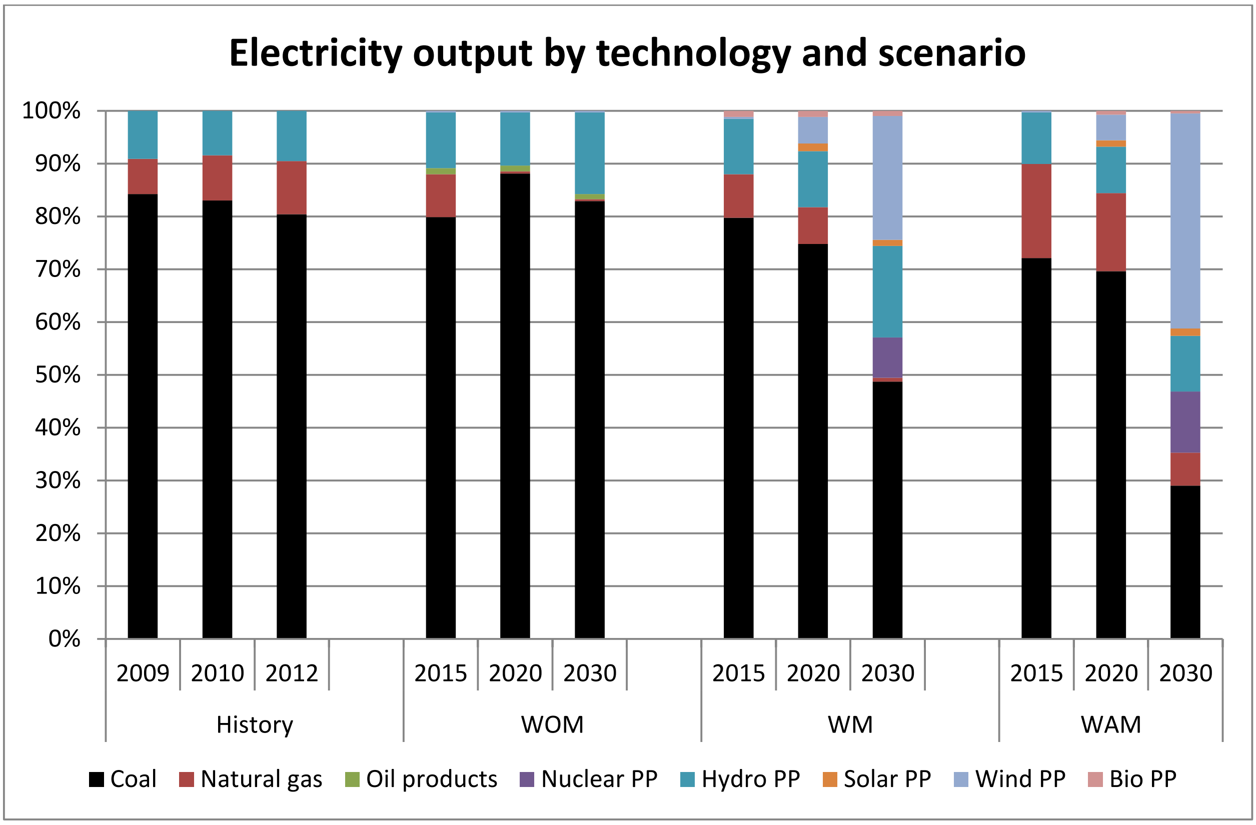

Figure 5.8 Shares of power generation technologies by scenarios

5.1.2. Projections in the industrial processes sector

Emissions from the sector Industrial Processes and Product Use (hereinafter - IPPU) according to the 2006 IPCC Guidelines are divided into categories:

- Mineral Industry;
- Chemical Industry;
- Metal Industry;
- Non-energy products from fuels and solvents use;
- Product Uses as Substitutes for Ozone Depleting Substances

GHGs of the Mineral Industry are emitted from three source categories: cement, lime and glass. In the Chemical Industry it is production of ammonia and calcium carbide. In the Metal Industry it is production of iron, steel, coke, ferroalloys (ferrochrome, ferrosilicon, ferrosilicochrome and ferrosilicon manganese); non-ferrous metals: production of aluminum, lead, magnesium, zinc. Non-energy products from fuels and solvent use include the use of lubricants, asphalt production and use, use of solvents in paints.

In 2014 the Manufacturing sector saw a growth of 1.6% (including food processing by 2.8%, beverages by 0.3%, clothing by 8.0%, coke and products of oil refining by 2.9%, mineral products by 7.9%, ferrous metals by 9.4%). Mining of metallic ores by 7.3%, non-ferrous metal ores by 10.1%. The most significant increase in the manufacturing sector is observed in the Metal Industry - by 15.6%: ferrous metals increased by 0.7%, non-ferrous metals by 25.7%, chemical industry by 1.8%, mineral industry by 18%.

In January-December 2015 in the manufacturing sector the most significant growth of 14.4 % was observed in the Metal industry: ferrous metals increased by 0.9%, non-ferrous metals by 23.6%, chemical industry by 2.6%, other non-metallic mineral products by 4.8%.

According to the Ministry of Economy forecast, GVA of the manufacturing sector will grow at 2.1% on average in 2016-2020 (Table 5.5). GVA of the mining industry during the forecast period will have an annual average increase of 2.5%. GVA of the processing industry will grow in the range of 1,1-

3,9% in 2016-2020. The increase in GVA of the chemical industry will be 2.2% per year on average. The average annual growth of GVA of the construction industry will be 3.3% (with the commencement of the State Program Nurly Jol for 2015-2019 construction works may have higher growth rates).

Projection of greenhouse gas emissions for the sector of Industrial processes, subsector Metals, is made on a basis of an analysis of historical data and forecast of the Ministry of Economy until 2020. To forecast the production of iron, steel, sinter, ferroalloys up to 2030 the following formula was used.

$$Production=Constant*GDP^{Elasticity}$$

where GDP means Gross domestic product of the Republic of Kazakhstan,

Elasticity means elasticity of GVA in Metal production growth to GDP.

It is assumed that in the period of 2020-2030 real GDP growth will be 3% per year on average. The elasticity of production in ferrous and nonferrous metallurgy of Kazakhstan is 0.15 and 0.13 respectively.

Greenhouse gas emissions in the subsectors Mineral Industry and Chemical Industry for the years 2020-2030 were estimated with a similar approach. For a short term period, forecast of the Ministry of Economy for 2016-2020 and a preliminary assessment of the economy of Kazakhstan in 2015 were used. Population growth projection is taken from the report of the Institute of Economic Research Demographic projection of Kazakhstan till 2020.

Solvent use and non-energy products from fuels, fluorinated substitutes of ODS, use of HFCs and PFCs were estimated using the average per capita indicators.

Table 5.5

Forecasted growth of indicators used

Indicator, in % to the previous year	**Fact**	**Estimation**	**Forecast of the Ministry of Economy of Kazakhstan**					
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**After 2020**
Real GDP	104,1	101,2	102,1	103,6	102,9	103,0	103,2	103,0
Population, mln.people	17 417.7	17656.3	17891.2	18120.2	18341.2	18554.0	19045.27	
Population growth	101,5	101,37	101,33	101,28	101,22	101,16	101,10	101,0
GVA of economic industries								
Production	100,8	98,5	100,4	103,3	101,8	102,0	104,0	102,0
Manufacturing	101,6	100,2	101,2	103,7	101,2	102,4	102,0	102,0
Chemical Industry	101,6	102,6	101,0	102,0	102,0	103,0	103,0	103
Non-metallic minerals	107,9	104,8	101,0	101,5	102,0	102,5	103,0	102
Metal Industry	99,6	114,4	99,6	100,0	100,0	103,2	101,5	101
Construction	104,6	104,3	103,3	103,7	103,8	103,9	104,0	103,0

Resource: Forecast of the Ministry of Economy for 2016-2020 (http://economy.gov.kz)
Demographic projection of Kazakhstan until 2020 (akorda.kz)

Detailed analysis of the latest inventory of 1990-2013 (as of October 13, 2015) was conducted to re-estimate GHG emissions in this sector. The difference of 6-9% was found in 2010 and 2011 in the production of zinc, iron, glass and clinker. According to the 2006 IPCC Guidelines, GHG emissions from zinc production do not take place in case of hydrometallurgical method application (however they were included into the inventory), but during melting in the Waelz kiln non-energy CO_2 emissions are formed. For the forecast of GHG emissions, emissions from production of pellets in the ferrous metal industry were taken into account. When calibrating the base period (2010-2013) for the prediction of emissions from clinker production, data were taken from the Committee of Statistics of Kazakhstan. Emissions from glass production were forecasted.

Without measures scenario (WOM)

This scenario reflects possible changes in the amount of greenhouse gases when no measures are taken to reduce them, modernization does not take place, national factor per unit of output is at the same level. This scenario assumes that greenhouse gas emissions are dependent on the overall GDP growth rate, population and transition towards less energy-intensive sectors of the economy. It is assumed that this scenario does not include any measures and policies which have already been implemented in the country in recent years. It is assumed that production of open-hearth steel continues; ferrosilicon production is not reduced; JSC Kazzinc has not been upgraded.

With current measures (WCM) scenario

This scenario differs from the scenario without measures as it includes measures and policies to reduce greenhouse gas emissions that have been taken and are planned to be adopted in the near future. These measures include the National Allocation Plan for 2016-2020, adoption of the Law 'On energy saving and energy efficiency' (requirement to conduct the energy audit) and Law 'On administrative violations': a fine for GHG emissions in excess of the defined amount, Concept of innovative development of Kazakhstan till 2020, Modernization of JSC Mittal Steel Temirtau; lower production of ferrosilicon; modernization of JSC Kazzinc, adoption of SPIID for 2015-2019.

With additional measures scenario (WAM)

This scenario takes into account current policies and measures with the assumption of possible additional measures. It is expected that additional measures will be launched in 2016. The following additional measures are considered: phased introduction of plants for capturing and storage of CO_2 in production of mineral materials, process optimization in the chemical industry, modernization and optimization of iron production up to European standards.

Figure 5.9 shows actual GHG emissions in the sector Industrial processes and product use for 1990-2014 and forecast until 2030 by sub-categories. As can be seen from the graph, the main influence on the GHG growth is from the categories of Metal Industry and Minerals Industry. In 2014, the IPPU sector emissions exceeded the level of the base year 1990 by 420 kt of CO_2 equivalent.

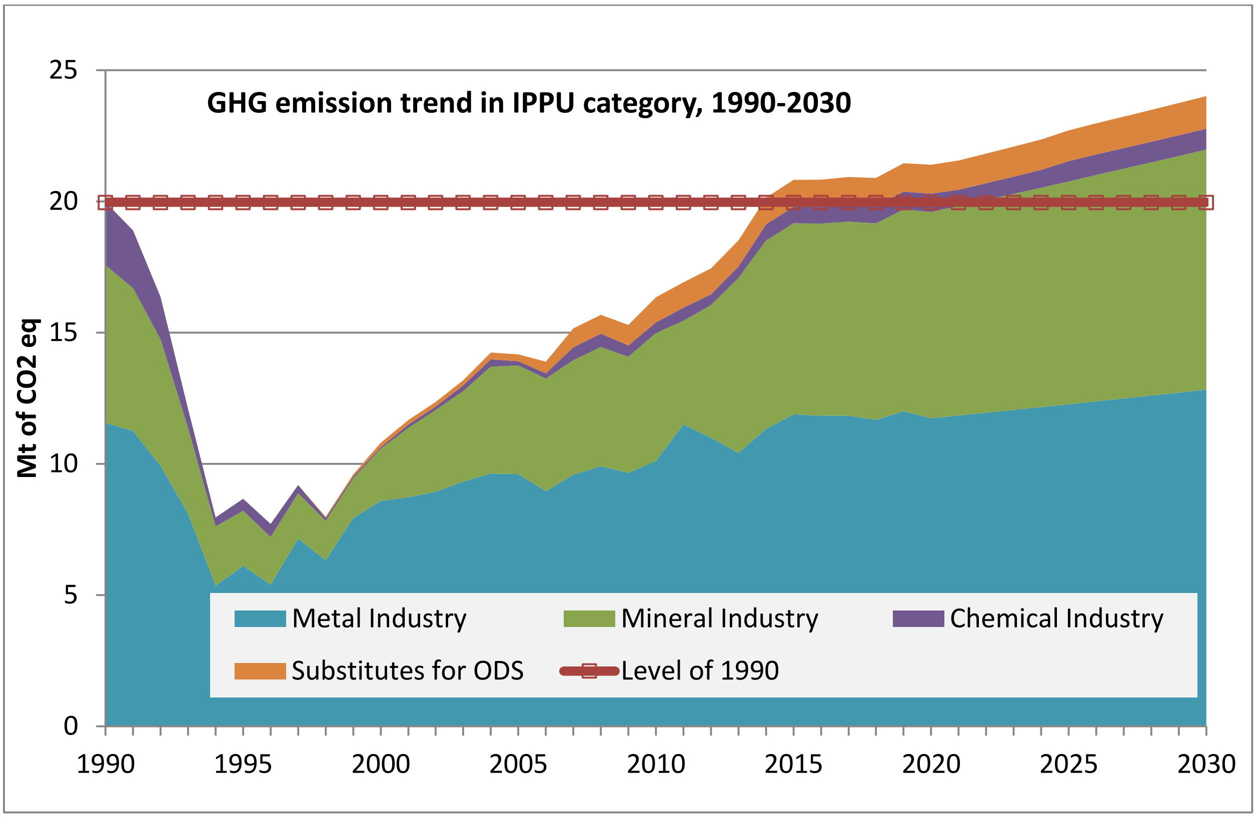

Figure 5.9- Dynamics of GHG emissions in the IPPU sector in 2009-2030

Updated projections of greenhouse gas emissions under the scenario without measures (WOM) and under the scenario with additional measures (WAM) are shown on Figure 5.10. During a projected period, emissions under the scenario with current measures (WCM) are going to increase. With the adoption of additional measures from 2016 there is an opportunity to remain lower than the baseline until 2028. Fig. 5.10 shows the dynamics of emissions inventories, and recalculated values are different in 2011 and 2012.

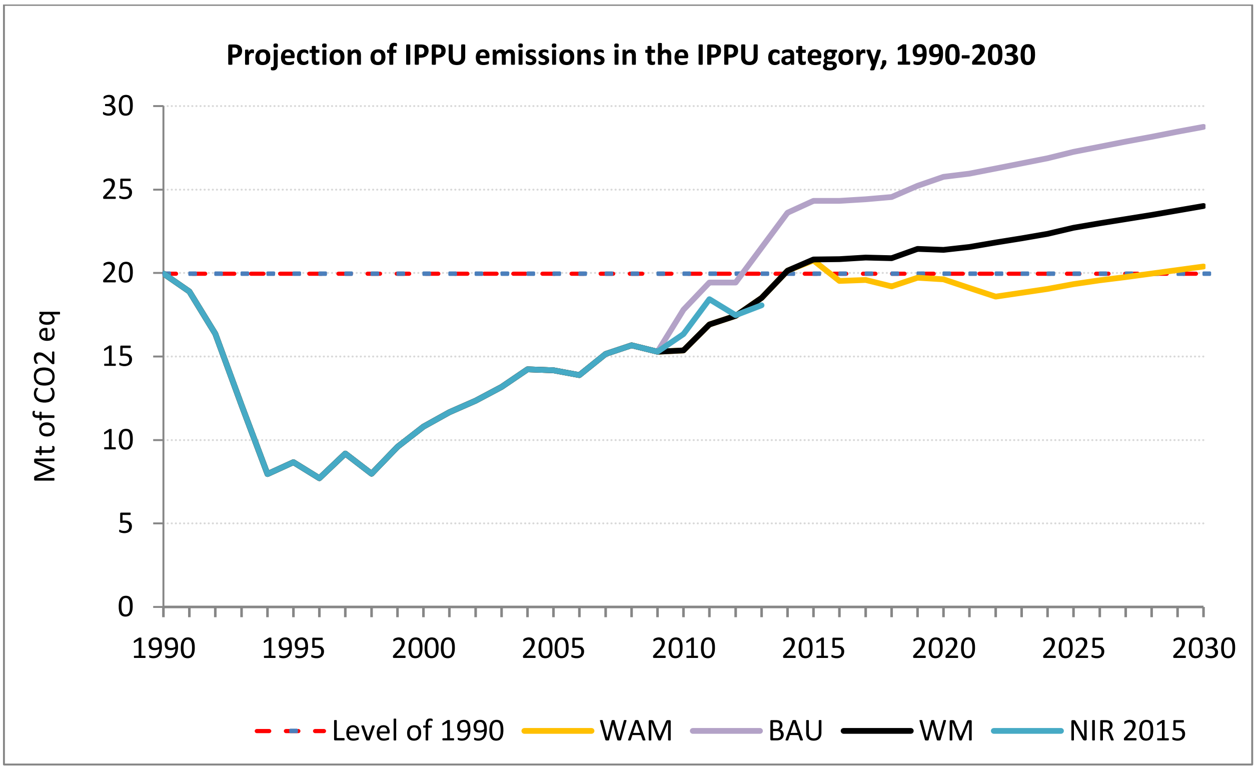

Figure 5.10- Scenario analysis: actual and projected emissions in IPPU category in 1990-2030

In the IPPU sector the biggest share of GHG emissions comes from Metal Industry (Figure 5.9).

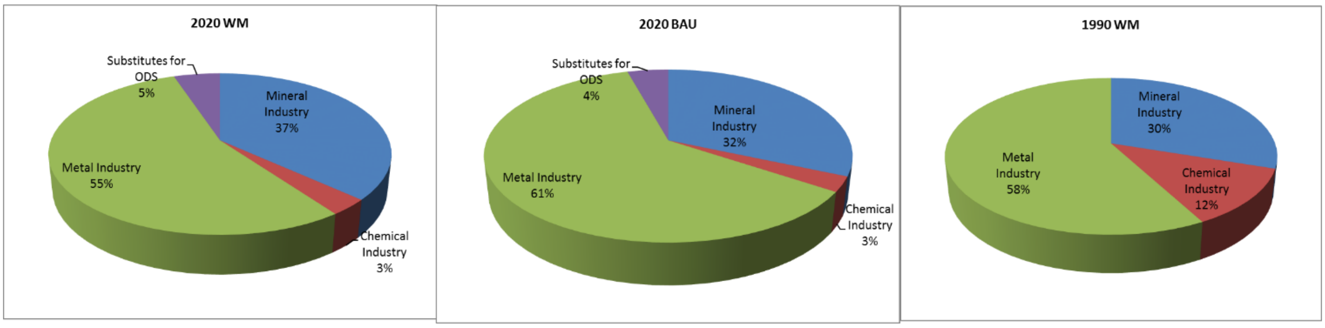

Figure 5.11 - Comparison of the share of GHG emissions in the categories in 1990 and 2020.

As shown on Figure 5.11, the main contribution to total emissions was made by the Metal Industry category. Adoption of timely measures significantly reduced GHG emissions from Metal Industry and that helped to expand the construction industry. In 1990 no data were available on emissions of fluorinated substitutes for ozone-depleting substances (ODS). Fig. 5.12 shows the dynamics of Metal Industry in three scenarios. The graph shows that in the scenario without measures emissions exceed the base year in 2009.

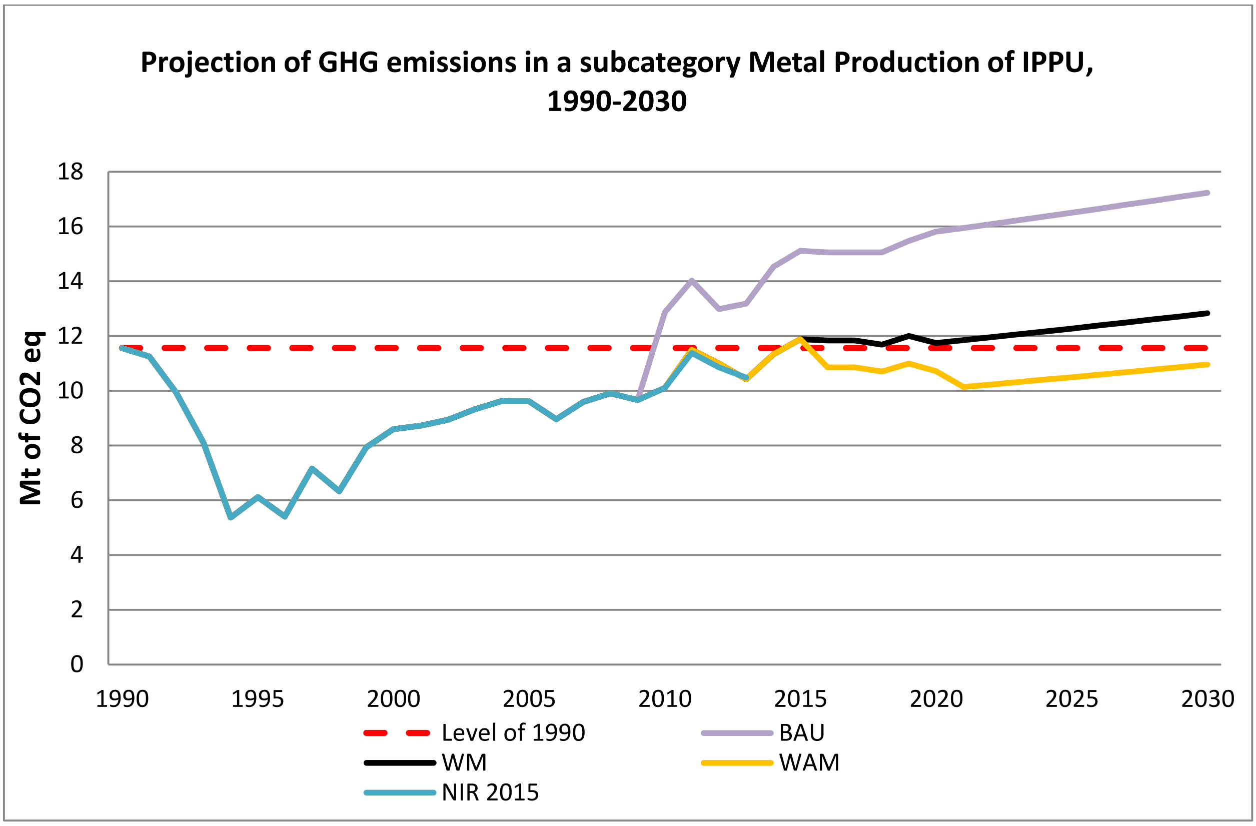

Figure 5.12 - Scenario analysis: the forecast of GHG emissions in the IPPU in Metal Industry category

The calculations to assess the impacts of response measures (Table. 5.6) show that policies and measures taken by Kazakhstan to reduce GHG emissions significantly reduced indicators in this category. In the WAM scenario, overall GHG emissions do not reach the level of the base year 1990 neither in 2020 nor in 2030. Table 5.6 shows the projected emission values in industrial / commercial processes by scenarios.

Table 5.6

Sector Manufacturing/Industrial processes by scenarios

	Actual				With current measures			With additional measures			Without measures		
	1990	1995	2000	2010	2020	2025	2030	2020	2025	2030	2020	2025	2030
Total	19.9	8.67	10.8	15.37	21.40	22.71	24.01	19,63	19,34	20,40	25.8	27.27	28.77
Non-metallic minerals	6.01	2.10	1.99	3.58	7.86	8.49	9.15	7,15	6,94	7,45	8.13	8.78	9.47
Chemical Industry	2.40	0.45	0.06	0.41	0.70	0.78	0.79	0,66	0,74	0,75	0.72	0.81	0.82
Metal Industry	11.56	6.11	8.59	10.42	11.74	12.27	12.83	10,71	10,49	10,96	15.81	16.50	17.23
Use of substances as substitutes of ODS			0.17	0.96	1.10	1.18	1.25	1,10	1,17	1,24	1.10	1.18	1.25

5.1.3. Projections in the agricultural sector

Projection of greenhouse gases from the agriculture sector is based on large and small cattle trend. Increased industry funding under the program Agribusiness-2020 led to an increase of livestock at organized farms, but due to the drop in the stock of cattle in private households overall livestock increment is insignificant. Therefore, projected emissions were based on headcount dynamics. On the basis of livestock changes the trend was analyzed for 10 years from 2004 to 2013. Current funding of the industry was also taken into account. It is expected that the number of key species of livestock will grow as follows: cattle at + 1.3%, sheep and goats at + 3.5%, -3% swine, camels and poultry + 1%, horses + 6% per year.

Table 5.7.

Livestock projection

Annual average livestock, thousand heads	2013	2014	2015[16]	2020	2025	2030
Cattle	5 851,2	6 032,7	6 068,6	5 905	5 943	5 981
Dairy cattle	4 143,9	4 176,1	4 253,5	2 760	2 778	2 796
Other cattle	1 707,3	1 856,6	1 815,1	3 145	3 165	3 185
Sheep and goats	17 560,6	17 914,6	17 791,8	22 191	26 228	31 001
Camels	160,9	165,9	169,5	171	178.5	186
Horses	1 784,5	1 937,9	1 984,2	2 683	3 591	4 805
Swine	922,3	884,7	861,0	746	641	550
Poultry	34 173,1	35 020,0	36 635,3	36 893	38 967	41 158

The following are predictions of emissions from the various sub-sectors of agriculture.

Without measures scenario

In the scenario without measures, projections of emissions in the following three tables are based on changes in the livestock.

[16] *Operational data for January-December 2015. Annual data for 2015 will be ready in April 2016.*

Table 5.8.

Emissions of CH_4 from the manure collection and utilization (manure management) systems

Emissions of CH_4 from the manure management systems, kilotons	**2013**	**2015**	**2020**	**2025**	**2030**
Dairy cattle	14,70	14,74	14,84	14,93	15,02
Other cattle	2,83	2,83	2,85	2,87	2,89
Sheep and goats	2,06	2,19	2,60	3,07	3,64
Camels	0,22	0,22	0,23	0,24	0,26
Horses	2,08	2,32	3,11	4,18	5,58
Swine	4,80	4,51	3,87	3,32	2,85
Poultry	0,43	0,43	0,46	0,48	0,51
Total	27,17	27,29	27,98	29,13	30,78
Methane emissions, kilotons of CO_2 equivalent.	679	682	699	728	769

Table 5.9.

Direct emissions of N_2O from manure management systems

	2013	**2015**	**2020**	**2025**	**2030**
Direct emissions of N_2O from manure management systems, kilotons	10.76	10.99	11.71	12.59	13.66
Emissions of N_2O, kilotons of CO_2 equivalent	3207	3276	3491	3754	4072

Table 5.10.

CH_4 emissions as a result of enteric fermentation.

CH_4 emissions as a result of enteric fermentation, kilotons	**2013**	**2015**	**2020**	**2025**	**2030**
Dairy cattle	286,34	287,07	288,95	290,84	292,72
Other cattle	173,24	173,67	174,84	175,96	177,07
Sheep and goats	127,79	136,63	161,50	190,88	225,61
Camels	7,85	7,97	8,33	8,70	9,06
Horses	34,37	38,61	51,68	69,17	92,57
Swine	1,20	1,12	0,96	0,82	0,71
Poultry	631,64	645,10	686,29	736,39	797,76
Methane emissions in kilotons of CO_2 equivalent.	15791	16128	17158	18410	19945

Projections of emissions of nitrogen compounds from croplands and pastures.

The projection of emissions from croplands and pastures has suggested that the amount of fertilizers added to soils will be proportional to the GDP growth and will increase by 3% per year.

Table 5.11.

Emissions of nitrous oxide from croplands and pastures

	2013	2015	2020	2025	2030
Direct N_2O emissions from croplands and pastures, kilotons	28.1	29.81	34.55	40.06	46.44
N_2O emissions, kilotons of CO_2 equivalent	8242	8743	10133	11749	13621

Table 5.12.

Methane emissions from rice cultivation

	2013	2015	2020	2025	2030
Methane emissions from rice cultivation, kilotons	14.04	14.85	17.21	19.96	23.13
Methane emissions, kilotons of CO_2 equivalent	351	372.37	431.68	500.44	580.15

Cumulative emissions from the agricultural sector are shown below.

Table 5.13.

Emissions from the agricultural sector

	2013	2015	2020	2025	2030
Cumulative CO_2 emissions, kilotons	28 273,3	31 319,68	34 451,44	38 118,15	38 987

The following two scenarios with measures and with additional measures include the use of biogas facilities. The use of biogas facilities in these scenarios leads to a reduction of CO_2 emissions. In these scenarios the effect of their use on reduction was estimated.

With current measures scenario

The scenario with measures suggests a growing number of biogas facilities at farms. In addition to general reduction via reducing CH_4 emissions, there is an assumption that emissions will go down as a result of better use of fuel for heating and electricity generation. The assumptions made in the scenario are presented below:

Suggestions in the WCM scenario[17]:

1) Coverage of livestock with biogas facilities reaches 1% in 2020, 3% in 2025 and 5% in 2030.
2) Amount of manure per 1 cow is 10 tons per year, one horse - 7 tons per year, sheep and goats - 1 ton per year.
3) Production of gas per ton of manure is projected to reach 22 m^3 per ton of manure.
4) The reduction of CO_2 emissions from generation of heat and electricity, instead of coal, is 2 kg CO_2 eq. / m3 of biogas.
5) Reduction of CH4 emissions is 26 kg of CO2 eq. / ton of CO_2 eq, or 1.2kg / m^3
6) Biogas facilities do not affect the level of N_2O emissions

Table 5.14.

Emissions reduction via biogas facilities application

[17] Jørgensen, Peter Jacob. Biogas-Green Energy: Process, Design, Energy Supply, Environment. Researcher for a Day, 2009.

	2013	2015	2020	2025	2030
Cattle stock, thousand heads	5 851	5 866	5 905	5 943	5 981
Horses stock, thousand heads	1 784	2 005	2 683	3 591	4 805
Sheep and goats stock	17 560	18 774	22 191	26 228	31 001
Percentage of livestock covered by biogas facilities	0%	0%	1%	3%	5%
Total manure utilized, million tons/year	0	0	0.998	3.323	6.222
Production of biogas in million m^3/year	0	0	21.97	73.106	136.884
Reduction of CO_2 as a result optimal heat and power generation (tons of CO_2/year)	0	0	43940	146212	273768
CH_4 emissions reduction in CO_2 equivalent. (tons of CO_2/year)	0	0	26354	87727	164261
Reduction of N_2O emissions in CO_2 eq. (tons of CO_2/year)	0	0	0	0	0
Cumulative reduction of tons of CO_2 equivalent/year	**0**	**0**	**70294**	**233939**	**438029**

The burning of methane reduces greenhouse gas emissions in CO_2 equivalent. On the other hand the use of gas for heating and electricity generation instead of coal also reduces overall emissions. Assessment of CO_2 emissions reduction as a result of reduced methane emissions as well as a result of the optimal use of gas for heating and electricity was estimated[18].

In this scenario total emissions in the agricultural sector will be a result of emission scenarios without measures minus reduction of CH_4 emissions in CO_2 equivalent (Table 5.15). The effect of reduced CO_2 emissions as a result of the optimal generation of heat and electricity shall be deducted from the fuel combustion sector (Table 5.15).

Table 5.15.

Total emissions in the scenario with current measures in the agriculture sector with biogas plants included

	2013	2015	2020	2025	2030
Cumulative emissions of CO_2, kilotons	28 273,3	31 319,68	34 425,1	38 030,42	38 822.8

With additional measures scenario

In the scenario with additional measures, it is assumed that the coverage of farms with biogas plants will increase 3% by 2020, 5% by 2025 and 7% by 2030.

Table 5.16.

Emissions reduction via biogas plants application

	2013	2015	2020	2025	2030
Cattle stock, thousand heads	5 851	5 866	5 905	5 943	5 981
Horses stock, thousand heads	1 784	2 005	2 683	3 591	4 805
Sheep and goats stock	17 560	18 774	22 191	26 228	31 001

[18] Jørgensen, Peter Jacob. Biogas-Green Energy: Process, Design, Energy Supply, Environment. Researcher for a Day, 2009.

Percentage of livestock covered by biogas installations	0%	0%	3%	5%	7%
Total manure utilized, million tons/year	0	0	3.006	5.537	8.710
Production of biogas in million m^3/year	0	0	66.132	121.814	191.62
Reduction of $\mathbf{CO_2}$ as a result optimal heat and power generation (tons of $\mathbf{CO_2}$/year)	0	0	132264	243628	383240
CH_4 emissions reduction in $\mathbf{CO_2}$ equivalent. (tons of $\mathbf{CO_2}$/year)	0	0	79358	146760	229944
Reduction of N_2O emissions in $\mathbf{CO_2}$ eq. (tons of $\mathbf{CO_2}$/year)	0	0	0	0	0
Cumulative reduction of tons of $\mathbf{CO_2}$ equivalent/year	**0**	**0**	**211622**	**390388**	**613184**

In this scenario total emissions in the agricultural sector will be a result of emission scenarios without measures minus reduction of CH_4 emissions in CO_2 equivalent (Table 5.16). The effect of reduced CO_2 emissions as a result of the optimal generation of heat and electricity shall be deducted from the fuel combustion sector.

Table 5.17.

Total emissions in the scenario with additional measures in the agricultural sector with biogas plants included

	2013	**2015**	**2020**	**2025**	**2030**
Cumulative CO_2 emissions in kilotons	28 273,3	31 319,68	34 372,05	37 971,34	38 751,1

5.1.4. Projections in the LULUCF sector

Emissions and removals of greenhouse gases in the forestry sector depend mainly on anthropogenic activities. Since reclassification of forest plantations, according to IPCC principles, into the forest lands is possible only 20 years after planting, the current pace of forests planting will not affect the growth of forests in the next 20 years. Thus, the forest growth rate will be the same as over the past years. This formed a basis of a projection method. A projection for this sector is based on changes in forest area and growing stock in the last 15 years. In all three scenarios, forest growth is 0.8% per year and is based on the growth of the forest stock. Important factors that affect the absorption of greenhouse gas will be fires and logging that are affected by measures and policies.

According to the forecast of the government of the Republic of Kazakhstan in the agricultural sector, real GDP growth in 2015-2020 will be about 3% per year. In this analysis it has been assumed that GDP growth rate will remain unchanged after 2020, i.e. 3% per year. In WOM scenario expected area of fires and logging will increase in proportion to the GDP, i.e. by 3% per year. In the scenario with current measures, it is assumed that fire management will be more efficient as a result of better financing, while at the same time logging will remain at the same level, despite the GDP growth. In the WAM scenario it is assumed that sector funding will go up and that will entail reduction of fires, and a number and volume of fellings will be reduced proportionally to GDP growth. The following table shows a dynamics of forest change in Kazakhstan for the period of a little more than 15 years.

Table 5.18.

Forests dynamics in Kazakhstan

	1998	**2003**	**2008**	**2013**
Timber stand (mln. m3)	373.6	376.7	375.8	380.7

Forest area (mln. ha)	14.232	14.326	14.320	14.573

Without measures scenario. Business as usual.

The WOM scenario assumes the increase of area under fire and reduction of afforestation and reforestation.

Currently the annual felling is about 60 thousand ha and fires cover an area of about 10 thousand ha[19]. 11.5 thousand ha of young plants were reclassified into the category of valuable forest of the state stock in recent years. Reforestation was about 20 thousand ha + plantation of 8.8 thousand ha. Thus, the forest is losing about 30 thousand ha per year.

Table 5.19.

Business as usual, no measures.

	2013	**2015**	**2020**	**2025**	**2030**
Carbon growth in forests per year, million tons	-2.984	-3.031	-3.155	-3.283	-3.41
Area under fires, thousand hectares		10	11.5	13.225	15.208
Carbon losses caused by fires, million tons		0.234	0.271	0.314	0.364
Carbon losses as a result of felling, million tons		0.46	0.53	0.618	0.716
Carbon absorption/emission, million tons	**-2.989**	-2.337	-2.354	-2.351	-2.33
Cumulative absorption/emission in million tons CO_2	-10.925	-8.553	-8.615	-8.604	-8.528

With current measures scenario

With current measures scenario suggests that the volume of felling remains at the 2013 level, in spite of annual GDP growth, at the same time it is assumed that the area under fire will be reduced in proportion to GDP growth.

Table 5.20.

With current measures scenario.

Dynamics for a year	**2010**	**2015**	**2020**	**2025**	**2030**
Carbon growth in forests per year, million tons	-2.984	-3.031	-3.155	3.283	3.41
Area under fires, thousand hectares		10	8.69	7.56	6.57
Carbon losses caused by fires, million tons		0.234	0.224	0.216	0.207
Carbon losses as a result of felling, million tons		0.46	0.46	0.46	0.46
Carbon absorption/emission, million tons	-2.989	-2.337	-2.471	-2.607	-2.743
Cumulative absorption/emission in	-10.925	-8.553	-9.04	-9.542	-10.04

[19] Statistical yearbook on environment of Kazakhstan, 2014

million tons CO_2					

With additional measures scenario

The forecast implies additional measures reducing the number of fires to the level of 1990. It is expected that felling will decrease in proportion to GDP growth. In the long term with large stands of birch and pine forests it can be expected that forest will increase the carbon sink. The optimistic forecast implies full restoration of the forest after events of fires, fellings, insects.

Table 5.21.

With additional measures scenario

	2013	2015	2020	2025	2030
Carbon growth in forests per year, million tons	-2.984	-3.031	-3.155	-3.283	-3.41
Area under fires, thousand hectares		10	5	2.5	1.25
Carbon losses caused by fires, million tons		0.234	0.117	0.058	0.029
Carbon losses as a result of felling, million tons		0.46	0.395	0.339	0.291
Carbon absorption/emission, million tons	-2.984	-2.337	-2.643	-2.886	-3.09
Cumulative absorption/emission in million tons CO_2	-10.921	-8.553	-9.673	-10.56	-11.31

Thus, Kazakhstan's forests are a sink (absorber) of greenhouse gases. The greatest harm for the absorption process is caused by deforestation and fires.

LULUCF sector without forestry

Estimation of emissions from land use, land use change and forestry (LULUCF) is part of the preparation of the biennial report. LULUCF sector includes several sub-categories, namely: forestry, croplands, grassland, wetlands, settlements and other land. According to the IPCC Guidelines a key subcategory of LULUCF is the forestry sector. This chapter gives a forecast of greenhouse gases from LULUCF sector without Forestry.

In the LULUCF sector as a whole there are no policies and measures to reduce greenhouse gas emissions with the exception of the forestry sector. Therefore to estimate emissions from sectors other than forestry in LULUCF it has been suggested that emissions will grow in line with the GDP growth. In 2013, according to the latest inventory, emissions from the LULUCF sector without forestry were 37.7 kilotons. Below is the forecast of emissions from the LULUCF sector without forestry and with current measures.

Table 5.22.

Emissions from the LULUCF sector without forestry

	2013	2015	2020	2025	2030
Cumulative CO_2 emissions, kilotons	37.3	39.57	45.87	53.18	61.65

When the forecast of emissions from all sectors is prepared, the LULUCF sector without forestry will be added to the scenarios without measures, with current measures and with additional measures.

5.1.5. Projections in the wastes sector

Table 6 of CTF as well as Figures 5.13 - 5.15 below shows the updated projections for 2020 and 2030 in the sector of waste management

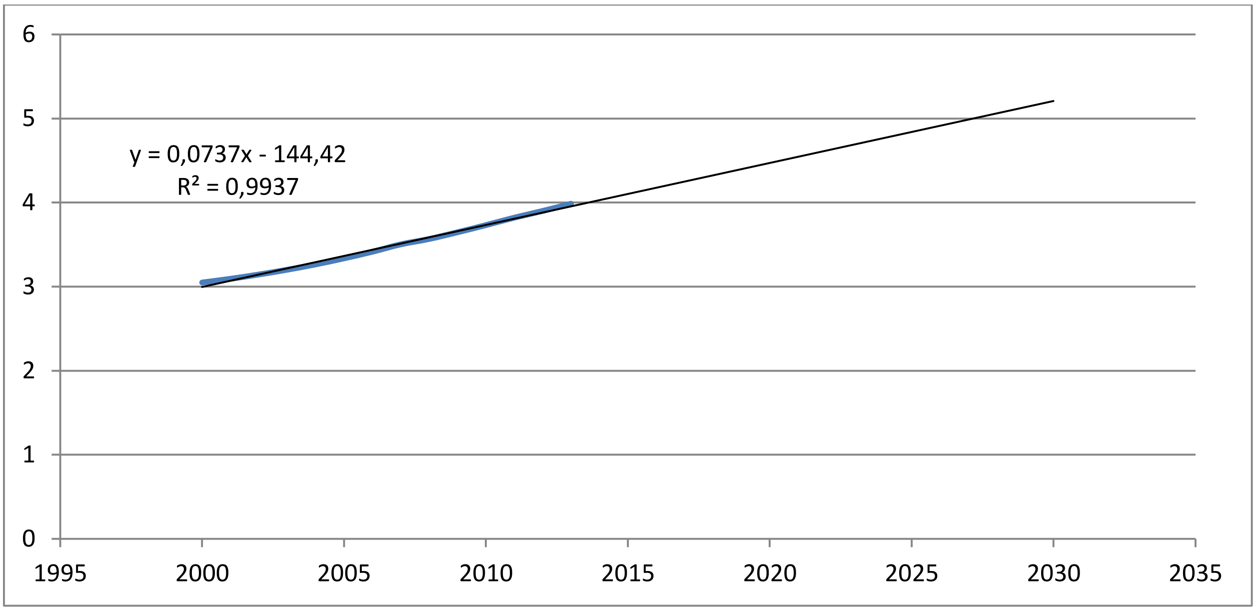

Figure 5.13. Projection of methane emissions, disposal of municipal solid wastes, million tons of CO2-eq.

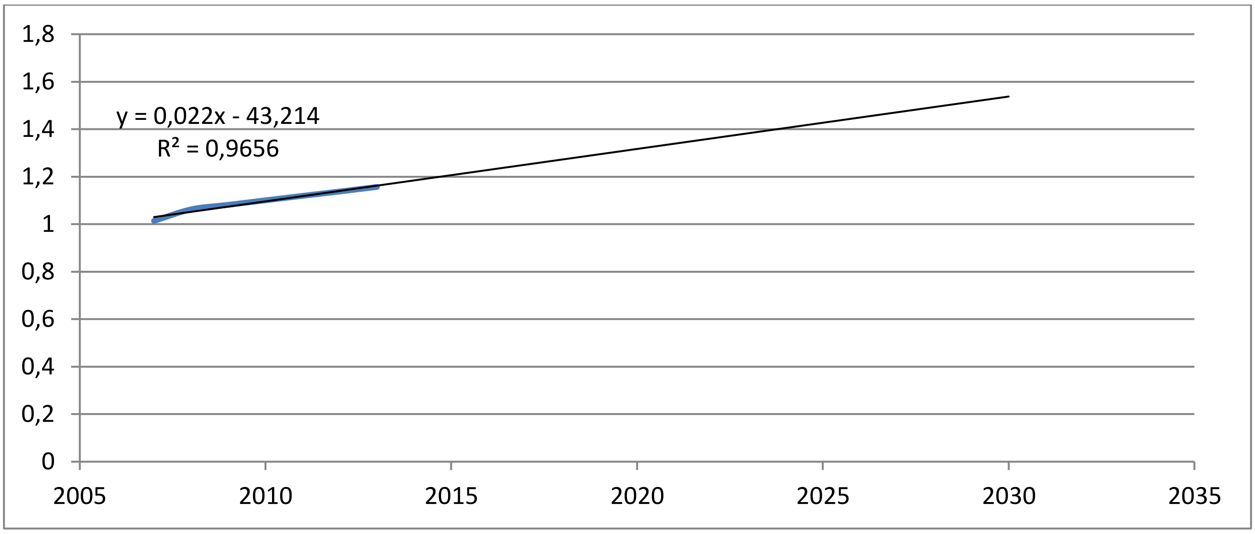

Figure 5.14. Projection of methane emissions, wastewaters treatment, million tons of CO_2 equivalent.

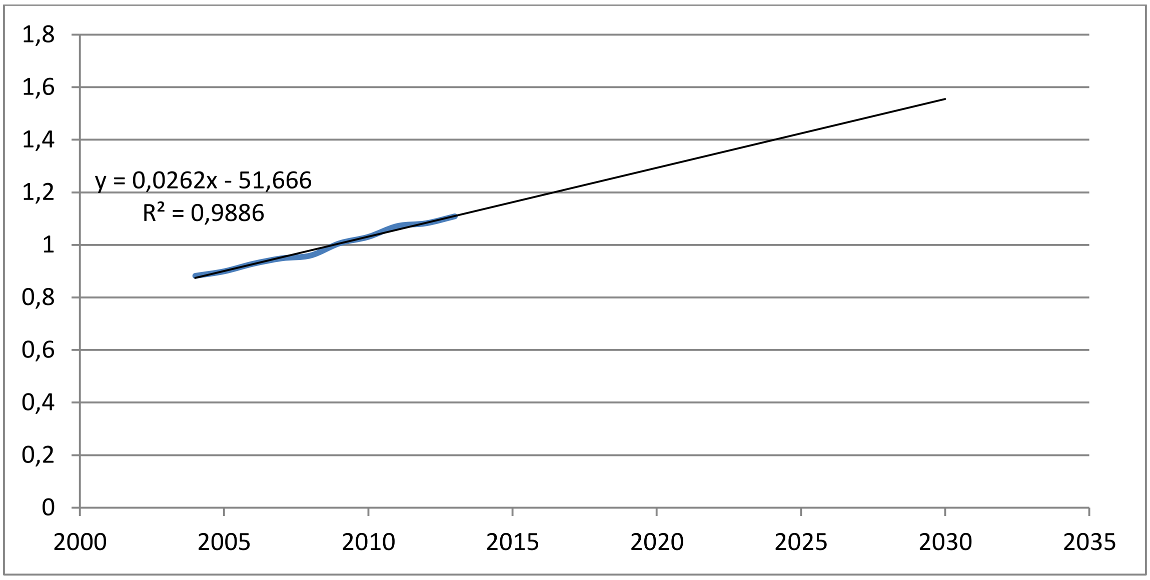

Figure 5.15. Projection of N_2O emissions from household wastewaters, million tons of CO_2 eq.

5.2. Methodology

5.2.1. Methodology for the energy sector (fuel combustion)

Model TIMES-KZ, used in this study, analyzes a period from calibrated 2009 year until 2030. The model is built around 1,600 products and processes. The annual amounts of electricity and heat are distributed by seasons and time of day and have a total of nine time intervals. The technical and economic model TIMES-KZ largely depends on a combination of plants, infrastructure, demand for devices that exist in the country in the base year (2009) and on technological improvement that can possibly be achieved in the simulated time horizon (2030). The curves of supply and demand of most commodities in the model are technologically precise: instead of the usual econometric profile of quantitative pricing functions depending on certain elasticity, there are linear stepwise functions where each step corresponds to a specific technology or demand for the product. Since the model is only slightly dependent on the time series of macroeconomic variables, the results are affected by the youth of Kazakhstan's economy much less than in econometric models.

Model TIMES-KZ presents a demand for 33 different energy services. The demand was projected until 2030, and it varies depending on the population size, GDP and GDP per capita as well as other drivers of demand.

Simulation results depend largely on the existing and proposed data of the base year. Total emissions associated with fuel combustion calculated for 2009 by applying national emission factors to the new edited energy balance are slightly different from the total emissions listed in the national inventory; at the sectoral level differences are more significant. Since the model TIMES-KZ is based on the edited energy balance, in some cases the projections of the model start with values of 2009 that differ from the national inventory. Amounts in the latest emission inventory (13 October 2015) are higher than previously estimated emissions that have been published on the UNFCCC website.

In order to be in line with national inventories, emission projections of the model were moved up or down so that the values at the beginning of 2009 matched. Given the limitations of the model TIMES-KZ, results for the year 2015 are less accurate; therefore, the values in 2015 listed in the tables and graphs are sometimes interpolated between the actual values in 2011 and the results of the model in 2020.

Energy balance used in the model was reclassified according to the IEA format and updated according to the data provided by relevant agencies and ministries. This allowed to reallocate energy resources from the category Other to other sectors. This is the reason why estimations of emissions are different in sectors.

5.2.2 Methodology for the industrial processes sector

Mineral Industry

Carbon dioxide (CO_2) in the Mineral Industry is formed by three types of sources: production of cement, lime and glass. All these categories relate to the processes of calcination of carbonate materials. According to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, other greenhouse gases in these categories are not counted.

Cement production

In the cement production process CO_2 is formed on the stage of clinker production - an intermediate product used for cement manufacturing. According to the Committee of Statistics of the Republic of Kazakhstan (CS of RK) clinker is produced in the East Kazakhstan, South Kazakhstan, Zhambyl and Karaganda regions. Data on clinker are shown in the Table 5.23

Table 5.23

Data on clinker production

	1990[20]	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Clinker production (kilotons) in Kazakhstan	6162	657.4	675	903.8	1134.3	1870.3	1772.4	1948.3	2026.4	4411.3	5759.1	6153.2

With the increase in construction to meet demand and diversification of the economy within SPAIID in late 2014 new industries were launched - JSC Hantausky cement factory (ACIG) in Zhambyl region (capacity of 360 kilotons/year of clinker and 500 kilotons/year of Portland cement), Caspian Cement JSC in Mangistau region (capacity of 1 mln. tons/year), KoksheTsement LLP (to be commissioned in 2016), BI-Cement (will be put in operation in 2017) in Akmola oblast (capacity of 2 million tons/year.), Rudny cement factory Ltd (capacity of 200 kilotons/year). In 2014 cement production was modernized with the transition to a ‘dry process’ at Shymkent Cement JSC (South Kazakhstan region) and restoration of the line ‘dry process’ of cement production at Karcement JSC (Karaganda region). Switching to a dry process will reduce GHG emissions in terms of fuel economy. In Zhambyl region ACIG LLP (2014), Plant of building materials Zhanatas Ltd which produces cement (50 kilotons a year) and lime (up to 30 tons) is planning construction of a cement plant by 2017.

To assess the amount of clinker, historical dynamics of the total clinker output from 2004 and forecasted growth of non-metallic mineral products (Table 5.23) were used. Numerical series dependencies have been identified for clinker production projection until 2030 under the following assumptions on GDP growth: average growth of three percent in the period from 2021 to 2030 inclusive. Table 5.24 presents the results of clinker production projections until 2030. To forecast emissions of carbon dioxide from clinker production, a single weighting factor of CO_2 emission for clinker produced was calculated, equal to 0.51 * 1.02 (calculated in accordance with the Tier 2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Table 5.24

Forecast of clinker production and associated emissions of CO_2

	1990[21]	**2015[22]**	**2020**	**2025**	**2030**
Clinker production, kilotons	6162	6650,1	6997	10653	12958
CO_2 emissions, kilotons	3271.02	3296.9	3639.6	5541.5	6740.9

Lime production (CRF subcategory 2.A.2)

[20] *1) State Committee on Statistics and Analysis of the Republic of Kazakhstan "Regional Statistical Yearbook of Kazakhstan", Kazinformcentre, Alma-Ata, 1991., 1992., 1993. ....*
2) The Agency of the Republic of Kazakhstan on Statistics "Regional Statistical Yearbook of Kazakhstan", Almaty, 1999.
3) The Agency of the Republic of Kazakhstan on Statistics "Industry of Kazakhstan and its regions", Almaty, 2007.
[21] *Please see 20*
[22] *Operational data for January-December 2015. Annual data for 2015 will be prepared in April 2016.*

Calcium oxide or quicklime is made by heating limestone with high calcium content (calcite). The process is accompanied by the release of CO_2. According to the Committee of Statistics of the RK lime is produced in eleven regions and in Almaty. The table below shows the dynamics of lime production in the country and the forecast. To forecast carbon dioxide emissions from lime production a single weighting factor of CO_2 was estimated as 0.75 (Table 5.25, calculated in accordance with the Tier 2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Table 5.25

Lime production amounts, projected and associated CO_2 emissions

	1990	2005	2010	2011	2012	2013	2014	2015[23]	2020	2025	2030
Lime production, kilotons.	1943	993.5	886.6	959.8	908	869.2	923.3	854,1	1017.6	1092.1	1166.6
CO_2 emissions, kilotons	1413	745.1	665.0	719.9	681.1	651.9	692.5	702.9	763.2	819.1	875.0

Kazakhstan imports 100% of flat glass. SAF Glass Company, a plant for glass containers production, was founded in April 1999. The overall output of two branches is 210 million of conventional bottles per year (1 bottle = 0.4 kg of glass). In 2017 the project will be completed in Kyzylorda region for the construction of a glass factory with energy-saving coating, to create a vertically integrated high-tech production of energy-efficient glass products with a capacity of 98 kilotons per year (OrdaGlass Ltd, launching in 2017, planned capacity from 2024 is 197.1 kilotons per year). There is a plan to build a plant for production of glass in Aktobe region near the Alazharskoe field. Glass company SAF LLP projected a decline in demand for glass containers. Table 5.26 presents the projected glass production until 2030. To forecast carbon dioxide emissions from glass production a single weighting factor of CO_2 was estimated as 0.2 (in accordance with the Tier 1 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Table 5.26

Glass production amounts, projected and associated CO_2 emissions

	2005	2010	2015	2020	2025	2030
Glass production, kilotons	33.0	48.0	61.7	154.3	160.4	242.7
CO_2 emissions, kilotons	6.6	9.6	12.3	30.9	32.1	48.5

In the inventory of greenhouse gas emissions glass production was not considered because of high uncertainty and low amounts of emissions.

For other carbonates-related processes statistics is not provided.
Other types of mineral products are described in the respective production category.

Possible additional measures to reduce emissions from production of mineral products

Installation and use of technologies to capture and store CO_2 (capturing and storage of carbon dioxide from gas streams released into the atmosphere and its transfer into geological depository, such as gas and oil fields and deep horizons of salt water for indefinite storage) is an expensive measure, collection efficiency varies between 60-90% depending on technology.

CHEMICAL INDUSTRY

Chemical industry of Kazakhstan is represented by two main productions: ammonia at the plant KazAzot and calcium carbide at the enterprise Temirtau Electro Metallurgical Plant. Ammonia production is characterized primarily by the low price of natural gas. Production of calcium carbide is characterized by a low cost of coal and coke. Greenhouse gas (GHG) emissions in the chemical industry of Kazakhstan come from production of ammonia and calcium carbide.

[23] *Operational data for January-December 2015. Annual data for 2015 will be prepared in April 2016.*

Ammonia production (CRF category 2.B.1)

The only producer of ammonia and ammonium nitrate in Kazakhstan is KazAzot (http://kazazot.kz). The company was created in November 2005 on the basis of the nitrogen fertilizer plant and a chemical complex Prikaspijsky Mining and Metallurgical Plant. KazAzot LLP in 2014 had production of liquid ammonia at a level of 169.1 kilotons, which is 45% more than in the previous year. Modernization costs were 5.6 billion tenge for installations of KazAzot in 2013 in the framework of the state program of accelerated industrial and innovative development for the production of ammonia, nitric acid and ammonium nitrate to increase production capacity by 50%. Gas is delivered from the Kazakh gas processing plant.

KazAzot is a producer in the following industries:

• Production of ammonia
• Production of weak 46% nitric acid
• Production of ammonium nitrate

Processes that affect CO_2 emissions from ammonia production: CO conversion at two temperatures in the presence of a catalyst of iron oxide, copper oxide and / or chromium oxide to form CO_2; conversion of residual CO_2 to methane in the presence of nickel catalysts to purify the synthesis gas. The company has not installed CO_2 capturing technology. Ammonia production is a major source of non-energy industrial emissions of CO_2. The major amount of CO_2 emissions takes place at plants using catalytic steam reforming of natural gas that occurs during the CO_2 regeneration from the scrubber's wash liquid. To forecast carbon dioxide emissions from ammonia production a single weighting factor of CO_2 was estimated as 3.273 (Table 5.27, in accordance with the Tier 1 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

Table 5.27

GHG emissions from ammonia production in the periods 1990, 2010-2015 and forecast until 2030 (Source: Zhasyl Damu JSC and CS RK http://stat.gov.kz)

	1990	**2010**	**2011**	**2012**	**2013**	**2014**	**2015[24]**	**2020**	**2025**	**2030**
2.B.1.Ammonia production, kilotons	455.9	91.9	128.1	101.5	116.1	169.1	170,8	190,4	250.0	250.0
CO_2 emissions in tons	1492,16	137.89	192.2	332.2	380.0	553.5	559,0	623,2	818.3	818.3

It is expected that the chemical industry growth would be 3% per year. But it will reach the limit of capacity of 250 kilotons / year by 2025

Production of calcium carbide (category 2.B.5)

Greenhouse gases are emitted in the course of calcium carbide production. Calcium carbide is formed by reduction of burnt lime (CaO) and carbon (anthracite, coke) in a special carbide electric arc furnace at a temperature of 2000-2300ºC endothermic reaction. In the production of CaC_2 CO_2 is emitted from limestone and during recovery of lime and use of carbide. Technical calcium carbide is widely used in engineering, mainly for industrial production of acetylene and its products. It is used to recover metals, reduce content of oxygen (deoxidizing) and sulfur (desulfurization) of steel for the manufacture of a carbide powder reagent. Silicon carbide SiC is produced from quartz sand or quartz and coke. In the the course of SiC production CO_2 is emitted.

Calcium carbide is produced by JSC Temirtau Electrometallurgical Plant. The total change in the production of calcium carbide, projected production and emissions are shown in Table 5.28. Source - KazNIIEK, estimation was done in accordance with TIER 1, 2006 IPCC

Table 5.28

GHG emissions from calcium carbide production (kilotons) 1990, 2010-2015, projection

	1990	**2010**	**2011**	**2012**	**2013**	**2014**	**2015[25]**	**2020**	**2025**	**2030**

[24] *Оперативные данные за январь-декабрь 2015 года. Годовые данные за 2015 год будут сформированы в апреле 2016 года.*

2.B.5 Calcium carbide production (kilotons)	306,72	31,18	27,57	25,86	18,33	22,43	26,67	25,25	29,27	33,93
CO_2 emissions from calcium carbide production (kilotons) k=2.62	803,6	93,5	72,2	67,8	48,0	58,8	59,3	66,2	76,7	88,9

Calcium carbide produced in Kazakhstan is fully consumed for the manufacturer's own needs. This is due to the fact that calcium carbide is fully consumed in the Metal Industry. According to forecasts, the Metal Industry will develop at low rates, annual growth of less than 2% until 2020, to 1% after 2020. As can be seen from Table 5.28 in 2014 GHG emissions from production of calcium carbide decreased with respect to 1990, more than 15 times. According to estimates, in 2030 production of CaC_2 will reach 34 kilotons per year.

GHG emissions from carbide production were estimated using default factors, taking into account specific consumption of limestone for production of 1 ton of calcium carbide, CO_2 emission factors at limestone application and reducing agent for calcium carbide production and use. According to estimates made by JSC Zhasyl Damu, one ton of calcium carbide produced and consumed emits 2.62 ton of CO_2 equivalent.

Other types of emissions from chemical industry

In Kazakhstan there is no domestic production of soda ash, therefore CO_2 emissions from application of imported soda ash (sodium carbonate Na_2CO_3) were counted only in relevant industries of nonferrous metals production.

In Kazakhstan there are no industrial processes and hence no GHG emissions from the process of production of petrochemicals and carbon black, i.e. methanol, ethylene and propylene, ethylene dichloride, ethylene oxide, acrylonitrile and carbon black; from fluorinated compounds, i.e. HFC-23 emerging in HCFC-22 production, fugitive products and by-products when generating other fluorinated compounds including hydrofluorocarbons (HFCs), sulfur hexafluoride (SF6) and uranium hexafluoride (UF6).

This section gives estimates of PFCs, HFCs and SF6 emissions from application of these substances in the refrigeration and air conditioning equipment, fabrication of foams and others. In Kazakhstan there is no production of HFCs, PFCs and SF6, these substances used in the Republic are imported. The contribution of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) to cumulative GHG emissions is negligible: 0.30% and 0.48% respectively. Emissions of sulfur hexafluoride (SF6) do not take place.

The coke industry provides valuable raw materials to ferrous and nonferrous metallurgy and chemical industries. Most of the coke produced in Kazakhstan is metallurgical coke for production of iron or special ferroalloy coke. Pitch coke is imported and used for production of the graphite electrodes anode mass, various carbon materials for construction. As recommended by 2006 IPCC Guidelines for National Greenhouse Gas Inventories most of the coke is to be included into the power section. However due to the fact that coke is used in the metallurgical industry, emissions are recorded in a relevant process.

Possible additional measures in the chemical industry

Additional measures that can be applied to ammonia production may be application of low-grade heat industrial furnaces, new energy-efficient catalysts, calciners with lesser power consumption, energy-efficient synthesis columns.

Currently the demand for natural gas per ton of ammonia produced is one thousand cubic meters which is approximately 31.8 GJ / ton of ammonia. This leads to emissions of 1.78 tons of CO_2 equivalent per ton of ammonia. When applying maximum energy saving measures and reducing gas consumption to the level of European standards this amount may be reduced to 30.2 GJ / ton of ammonia. With these measures the best value of greenhouse gas emissions could reach 1,695 tons of CO_2 equivalent per ton of ammonia. Thus there will be a potential to reduce emissions by 4.8%.

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[25] *Оперативные данные за январь-декабрь 2015 года. Годовые данные за 2015 год будут сформированы в апреле 2016 года.*

Additional measures that can be applied to calcium carbide production: boiler system for direct gas combustion in closed industrial furnaces, boiler system for heat recovery from exhaust gases of semi closed furnaces and technology that uses furnace gases for lime burning. Estimates of this report show that for one ton of calcium carbide there are 2.62 tons of CO_2 equivalent. However in accordance with the IPCC Guidelines for National Greenhouse Gas Inventories the factor for calcium carbide production is equal to 1,090 tons of CO_2 / ton of calcium carbide produced, and for consumption of calcium carbide - 1,100 tons of CO_2 / ton of calcium carbide consumed. With effective compilation of production statistics and energy efficiency there is potential to reduce GHG emissions by 9% in this activity.

General description of measures to reduce greenhouse gas emissions:

• implementation of common energy saving measures (cost optimization, compliance with technical standards and regulations, implementation of modern instrumentation and control);

• introduction of new energy-saving technologies, powerful industrial and power equipment for production of calcium carbide and synthetic ammonia;

• modernization and improvement of existing technologies, facilities and equipment for production of calcium carbide and synthetic ammonia;

• improvement of product quality and reduction of raw materials losses.

METAL INDUSTRY

GHG emissions in the ferrous industry: production of iron, steel, coke, ferroalloy (ferrochromium, ferrosilicon, ferrosilicochrome and ferrosilicon manganese); non-ferrous metallurgy: production of aluminum, lead and zinc.

The comprehensive plan for development of the mining and metallurgical industry for 2014-2018 (May 28, 2014) suggests construction of new facilities which according to the law on subsoil and subsoil use (from June 24, 2010) have to use best technologies for deep and clean recycling, innovative extraction technology and complex processing of raw materials, development of new products and active involvement of scientific and technical potential of the industry in innovative processes, reducing harmful effects on the environment. There are plans: to launch in 2017 production of nickel products under Vanyukov melting technology (melting in a liquid bath) with a production capacity of 1.9 million tons / year, in 2015 - construction of the Zhezkazgan plant for hydrometallurgical processing of flotation tailings of mixed ores and preparation of oxidized ores, construction of Karaganda copper concentrate flotation plant with a capacity of 16 million tons / year, construction of a modern complex for production of high-quality gravity barite concentrate with a capacity of 30 kilotons / year in Zhambyl region in 2016, processing of iron ore to produce iron under innovative technology in Almaty region with a capacity of 3 million tons / year.

Particular attention is paid to development of improved technology for leaching of gold, nickel, copper-zinc ores, processing of collective concentrates, alumosilicamagnanese, processing technogenic deposits and others. Deep processing, application of advanced clean technologies in the industry helps Kazakh market to reduce impact on the environment. According to the plan for development of rare metals in the Republic of Kazakhstan for 2015-2019 (November 26, 2014) there will be production of light rare metal (lithium), refractory rare metals (titanium, zirconium, vanadium, niobium, tantalum, molybdenum and wolfram) scattered rare metals (gallium, indium, thallium, germanium, selenium, tellurium, rhenium), rare earth metal (scandium, yttrium and the lanthanides). It should be noted that there is no production of magnesium in RK which is a potential source of GHG.

Iron and steel production (CRF subcategory 2.C.1)

In Kazakhstan iron and steel are produced in the steelworks of ArcelorMittal in Temirtau. Basic data on production capacities operating at the moment:

• 6 coke ovens with a total capacity to 3.5 mln. tons per year;

• 3 sintering machines with a capacity of up to 6.5 mln. tons per year with a direct feed to blast furnaces;

• 4 blast furnaces with a capacity of up to 5.00 mln. tons of iron per year;

• 3 converters with a capacity of up to 6 million. tons per year;

• hot rolled strips plant (mill 1700) with a capacity to 5.2 million. tons per year;

• cold rolled strips plant (mill 1400) with a capacity up to 0.8 million. tons per year;

• workshop for electrolytic tinning (three coating lines) with a capacity up to 375 kilotons per year; two lines for covering stripes with aluzinc and profiling with a capacity of 320 kilotons per year each.

Iron and steel industry is key to Kazakhstan. The formula to estimate CO_2 emissions was used from the Tier 2 (IPCC Guidelines for National Greenhouse Gas Inventories) for the iron and steel industry.

Data on carbon content in raw materials are taken from the enterprises: production of iron and steel and amount of reducing agent used in production of a specific metal and carbon content in the iron and steel industry. Enterprise data were presented on production of coke, its characteristics and amount that was used directly in the manufacturing process. Total production of iron and steel and GHG emissions are presented in Table 5.29.

Data on production of electric steel, direct-reduced iron (0.7 tons of CO_2 per ton of direct-reduced iron), iron ore pellets (CO_2 emission factor= 0.03) were received from metallurgical enterprises of Kazakhstan. Methane emission factor for sinter production is 0.07 kg / ton of sinter (2006 IPCC Guidelines for National Greenhouse Gas Inventories). Methane emission factor for iron production is accepted as equal to 0.5 kg per ton of iron.

Data on production of steel and iron were compared with those of the Committee on Statistics of the Republic of Kazakhstan. Production of iron is associated with reduction of iron ore, mainly in blast furnaces. Coal coke is used as a reducing agent and fuel for iron production in Kazakhstan, and it is produced directly at the enterprise producing iron, steel and other metal products.

Table 5.29

GHG emissions from iron and steel production

	1990	**2010**	**2011**	**2012**	**2013**	**2014**	**2015[26]**	**2020**	**2030**
Iron and steel production, kilotons	11978,4	7222,34	7935,16	6465,2	6124.1	7185.6	7139,93	7489.0	8272.5
CO2 emissions from iron and steel production, kilotons	11348.7	5877.5	6627.9	6086.6	5522.8	6721.9	6721.9	7005.7	7738.6
CH4 emissions from iron and steel production, kilotons	7,39	3,30	4,22	3,70	3,37	4,05	4,05	4,22	4,66
Steel production, kilotons	6752,0	4328,46	4794,08	3758,19	3489,67	4000,78	3905,56	4169,71	4605,95
Emissions from steel production (national factor = 1,46)	946,00	464,85	588,94	601.3	558.3	640.1	640.1	667.2	737.0
Iron production, kilotons	5226,40	2893.88	3141.08	2707.01	2 634.5	3 184.8	3234.37	3319.26	3666.52
CO2 emissions from iron production, kilotons (national factor =.1,858)	7745,29	5412.6	5960.89	5411.73	4895.22	6019.2	6019.2	6273.4	6929.7
Preparation of iron ore pellets, kilotons (k=0,01)	13681.31	9500,96	7 803.2	7 360.4	6 919.7	6 250.5	6250.50	6514.43	7195.98
Emissions from preparation of sinter and pellets, kilotons	2 523.1	1752,18	78.0	73.6	69.2	62.5	62.5	65.1	72.0

[26] Оперативные данные

of CO2									
CH4 emissions from preparation of pellets, kilotons (0,7 kg of CO2/ton of pellets)	7,39	3,30	4,22	3,70	3,37	4,05	4,05	4,22	4,66

Iron production

To estimate CO_2 emissions from iron production, the following formula is used:

$$M_{CO2} = k_{CO2} \cdot M_k - M_{\div} \frac{M_C}{100} \cdot \frac{44}{12} \text{ (6.1)}$$

Where: M_{CO2} = emissions of CO_2, in kilo

Where k_{CO2} – CO_2 emission factor for coal coke, ton of CO_2/ton of coke;

M_k – amount of coke used for iron production, kilotons;

M_C – carbon content in conversion iron, %;

$M_{\div}$ – amount of iron produced, kilotons

CO_2 emission factor when coke is used is estimated with the formula 3.1.2:

$$k_{co2} = \left(\frac{d_c}{100}\right) \cdot \frac{44}{12}, \text{ (6.2)}$$

Where d_c – share of carbon in coke that goes to coke production, %.

The amount of iron and steel produced as well a percentage of carbon in the coke arriving to the iron production process is taken from data provided by Mittal Steel Temirtau JSC. Data on carbon balance in production of iron and steel are shown in Table 5.30.

In accordance with the Decision 24 / SR.19 Revised UNFCCC guidelines for the reporting of annual inventories of Parties included in Annex I to the Convention there is a new conversion factor of methane emissions into CO_2 equivalent equal to 25 (instead of 21).

Table 5.30

Carbon balance in iron production in ArcelorMittalTemirtau JSC (2013)

Inflow				**Outflow**			
Material	**C, %**	**kg/t**	**%**	**Material**	**C, %**	**kg/t**	**%**
Coke	83,0	570,2	95,53	Cast iron	4,10	41,0	6,8
Fuel oil	87,0	26,7	4,47	Flue dust	20,4	1,50	0,3
Total		596,9	100,0	Gas		554,40	92,9
				Total		596,9	100,0

The value of the national CO_2 emission factor is 3.04 t CO_2 / ton of coke. Carbon content in iron is taken from data provided by JSC Mittal Steel Temirtau (4.1-4.5%).

$M_{ккс}$

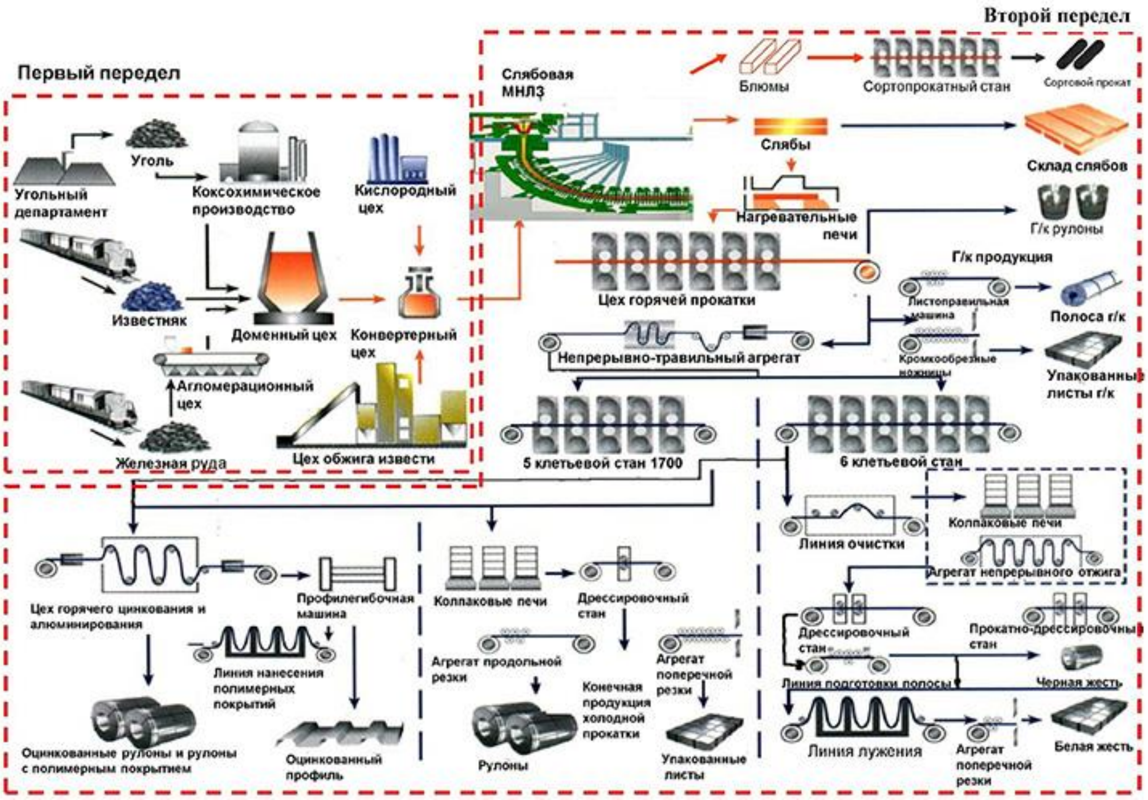

Figure 6.1 - Ferrous metals production flow at JSC ArcelorMittal Temirtau.

Steel production

In Kazakhstan basic oxygen steel and steel are produced from scrap in the EAF. The amount of carbon dioxide emitted during combustion of electrodes in electric arc furnaces was taken as a default value of 5 kg CO_2 per ton of steel. CO_2 emissions in the production of steel is determined by the formula 3.1.3, taking into account the specific consumption of iron and carbon content of each type of steel, the Tier 2 method.

$$M_{CO2} = k_{ЭДП} \cdot M_{ЭДП} + \left(M_ч - M_с\right) \cdot \frac{44}{12} \cdot M_{ккс} \qquad (6.3)$$

Where:

M_{CO2} – annual CO_2 emission from steel production (t);

$k_{ЭДП}$ – emission factor for electrical steel (tons of CO_2/ton of electrical steel);

$M_{ЭДП}$ – steel mass produced in EAF (t);

$M_ч$ – carbon mass in iron (t);

$M_с$ – carbon mass in steel (t);

$M_{ккс}$ – mass of basic oxygen steel (t); *BOS*

44/12 – carbon to carbon dioxide conversion factor (molecular weight is 44 g/mol, CO_2 – 12 g/mol), or 44/12 = 3,667.

Carbon balance in steel production at ArcelorMittalTemirtau in 2013 is presented in Table 5.31.

Table 5.31

Carbon balance in steel production at ArcelorMittalTemirtau in 2013

Inflow				**Outflow**			
Material	**C, %**	**kg/t**	**%**	**Material**	**C, %**	**kg/t**	**%**
Iron	4,1	35,6	90,1	Steel	0,04	0,4	1,0
Scrap	0,4	1,1	2,9	Carbon in gas		39,1	99,0
Coke	83,0	1,6	4,0	Total		39,5	100,0

Lime	12,0	0,4	1,0				
Dolomite	13,0	0,8	2,0				
Total		39,5	100,0				

Thus the national CO_2 emission factor for steel is estimated at a level 0,149 t CO_2/t of steel.

Ferroalloys Production (CRF category 2.C.2)

Main producers of ferroalloys in Kazakhstan are transnational company KazChrome which includes manufacturers Aktobe Ferroalloys Plant and Aksu Ferroalloys Plant, core products of the enterprise are ferrochrome, ferrosilicon (45%), ferrosilicochrome and ferrosilicon manganese. Ferroalloy production is key to Kazakhstan, the formula was applied to estimate carbon dioxide emissions under Tier 2 (2006 IPCC Guidelines for National Greenhouse Gas Inventories) for production of ferroalloys. The factors for estimation of carbon dioxide emissions are determined on the basis of data on consumption of raw materials at Aksu Ferroalloy Plant. The data of CS of Kazakhstan on produced ferroalloy products were used.

The formula to estimate greenhouse gas emissions:

$$E_{CO2,ferroalloys} = \sum \mathrm{M}_{reducing\ agent} * EF_{reducing\ agent} + \left[\sum \mathrm{M}_{ore} * C_{ore} - \sum \mathrm{M}_{product} * C_{product}\right] * \frac{44}{12} \quad (6.4)$$

$$E_{CH4,ferroalloys} = \sum_i MP_i * EF_i \quad (6.5)$$

where:

$E_{CO2,\ ferroalloys}$ = CO_2 emissions from ferroalloy production, tons

$E_{CH4,\ ferroalloys}$ = emissions from silicon alloy *i*, tons

$M_{reducing\ agent}$ = total mass of reducing agents, tons

$EF_{reducing\ agent}$ = emission factor for reducing agents, tons of CO_2 /ton of a reducing agent

M_{ore} = total ore mass, tons

C_{ore} = carbon content in ore, ton of C/ton of ore

$M_{product}$ = mass of product, tons

$C_{product}$ = carbon content in the product, ton of C/ton of product

MP_i = production of silicon alloy *i*, tons

EF_i = emission factor for silicon alloy *i*, ton of CH4/ton of silicon alloy products.

Emissions from ferroalloys were estimated under the formula provided in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories separately for each type of ferroalloys, and in accordance with the data of Statistics Committee based on default emission factors. CO_2 emission factors have undergone some changes in comparison with 2012 and amounted to the following values: 1.5 tons of the / ton of ferromanganese; 2.5 ton of CO_2 / ton of 45% ferrosilicon; 1.3 tons of CO_2 / ton of ferrochrome; 1.4 tons of CO_2 / ton of silicomanganese, etc., IPCC Guidelines, 2006 (Table. 4.5 p. 4.3.2.2 t.3). CO_2 emission factor per ton of ferroalloys prepared as total CO_2 emissions from each subcategory of ferroalloys divided by the total production of ferroalloys, Table 5.32.

According to SPAIID starting from 2015 the Aktobe plant for ferrochrome production will operate at 30% of design capacity. The forecast reflects growing production of ferrochrome and ferrosilicon manganese according to SPAIID. It is projected that by 2025 the plant will operate to its full design capacity.

Table 5.32

Total production and GHG emissions from ferroalloys.

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2020**	**2030**
2.C.2 ferroalloys, tons	1590.52	1468.79	1701.79	1668.69	1724.07	1706.93	1715.14	2010.93	2220.91
Ferrochrome, tons	1220.32	1173.29	1311.30	1289.92	1305.34	1336.63	1351.80	1634.55	1805.56
Emission factor 1,6 t CO_2/t	1952.50	1877.26	2098.08	2063.87	2088.55	2138.61	2163.03	2615.28	2888.90
Ferrosilicon 45%, tons	54.96	33.10	4.81	1.68	0.49	0.47	0.40	0.34	0.23

Default emission factor 2,5 t. CO_2/t	137.41	82.75	12.03	4.21	1.24	1.18	1.12	0.86	0.57
Ferrosilicon manganese, tons	179.94	200.37	224.63	232.04	251.53	203.99	200.38	209.28	231.18
Default emission factor 1,4 t CO_2/t.	251.91	280.52	314.48	324.85	352.14	285.58	281.12	292.99	323.65
Ferrochrome silicon, tons	133.83	60.83	159.77	143.30	164.85	165.20	158.83	165.53	182.85
Default emission factor 1,3 t CO_2/t.	173.98	79.08	207.69	186.28	214.31	214.75	206.47	215.19	237.70
Other ferroalloys, tons	1.47	1.21	1.28	1.75	1.85	0,081	3,74	1.22	1.10
Default emission factor 1,6 t CO_2/t	2.36	1.93	2.05	2.81	2.95	1.03	1.13	1.96	1.76
Total emissions of CO_2, kilotons	2518.2	2321.5	2634.3	2582.0	2659.2	2641.2	2652.9	3126.3	3452.6

Aluminum production

Production of primary aluminum (CRF category 2C.3)

The only aluminum producer in Kazakhstan is Kazakhstan Electrolysis Plant JSC with capacity of 250 kilotons a year. The plant uses central pre-sintering technology. In this technology preroasted anodes electrolyzers are used. Aluminum production is key to Kazakhstan. To estimate carbon dioxide emissions the formula was used from Tier 2 (2006 IPCC Guideline for National Greenhouse Gas Inventories) for aluminum production.

At Kazakh plants primary aluminum is produced by electrolysis decomposition of alumina from cryolite-alumina expansion **by Hall–Héroult process**. In the aluminum industry, electrolytic cells of various designs and capacity are used. One of the most advanced technologies for primary aluminum production, based on achievements of the world's leading companies and the practical experience of the last few years, is the technology of electrolytic decomposition of alumina in cryolite-alumina melt in electrolytic cells with prebaked anodes, central loading and point-fed alumina. The most significant emissions are carbon dioxide (CO_2) from reaction of the carbon anodes with aluminum oxide to form aluminum metal; and perfluorocarbons (PFCs) - CF4 and C2F6 emissions as a result of anode effects CF4 and C2F6. In smaller quantities there are emissions of CO, SO2 and NMVOC from industrial processes. Kazakhstan Electrolysis Plant was put into operation in early 2008. Table 5.36 lists the changes in GHG emissions from aluminum production in key years.

Table 5.36

GHG emissions from aluminum production in key years

	2009	2010	2011	2012	2013	2014	2020	2030
2.C.3 Aluminum production, kilotons	127.14	227.31	249.158	250.269	250.16	207.85	250.0	250.0
CO_2 emissions from aluminum production, kilotons (national factor=1,87)	246.72	436.61	465.2	465.5	468.8	388.7	467.5	467.5
CF_4 emissions, kilotons (national factor =0,68)	0.086	0.155	0.169	0.169	0.171	0.141	0.100	0.100
C_2F_6 emissions, kilotons (national factor=0,1)	0.013	0.023	0.025	0.025	0.025	0.021	0.010	0.010
CF_4 emissions in CO_2 equivalent from aluminum production, kilotons	638.90	1142.27	1250.10	1251.01	1260.00	1044.76	739.00	739.00
C_2F_6 emissions in CO_2 equivalent from aluminum production, kilotons	155.11	277.32	303.50	303.72	305.12	253.58	122.00	122.00

Total emissions in CO_2 equivalent, kilotons	1040.7	1856.2	2022.91	2025.02	2034.32	1686.8	2000	2000

In the period of 2011-2013 the company has reached its design capacity of 250 kilotons of aluminum per year and production increase is not foreseen in the nearest future. It is expected to minimize anode effects (reduction of PFC emissions - CF4 and C2F6) from 2020. Anode effect is a failure of process parameters when alumina dissolved in the electrolyte is insufficient which leads to an increase in voltage above the normal operating limit, resulting in formation of emissions of gases containing PFCs.

Data on the number of aluminum produced were obtained from the only producer of aluminum - Kazakhstan Electrolysis Plant. Historical data (Table 5.37) were collected by JSC Zhasyl Damu, an assignee of RSE Kazakh Research Institute of Ecology and Climate. Pre-baked anode consumption is the main source of carbon dioxide emissions from production of primary aluminum (electrolytic decomposition of alumina in cryolite-alumina melt in electrolysis cells).

Table 5.37

Mass of a reducing agent used for aluminum production in tons by types

Type of material	2008	2009	2010	2011	2012	2013
Alumina	207797,2	249360,4	444426,2	481677,9	248947,7	483792,0
Roasted anodes	59559,4	71255,2	127041,1	135545,7	135825,8	135405,3
Cryolite	531,7	565,0	449,4	159,0	0,0	0,0
Aluminum flouride	1724,6	2001,5	3543,1	4221,6	5509,6	5246,0
Calcium flouride	164,1	102,0	247,5	252,7	243,7	204,2
Soda ash	49,5	6,3	–	–	0,0	0,0
Electrolyte	8,0	–	–	–	0,0	0,0
Caustic magnesite	34,8	0,1	–	–	0,0	0,0
Flux for slag removal	19,7	74,3	108,8	102,82	90,5	100,2

The formula for GHG emissions estimation

$$E_{CO2} = NAC * MP * \frac{100-S_a-ash_a}{100} * \frac{44}{12} \quad (6.6)$$

where:

E_{CO2} = CO2 emissions from consumption of prebaked anodes, CO2 emissions

MP = total metal production, tons of Al

NAC = net consumption of prebaked anodes per tons of aluminum, C/ton of Al

S_a = sulfur content in prebaked anodes, % of weight

Ash_a = ash content in prebaked anodes, % of weight

$$E_{CF4} = S_F * AEM * MP$$

$$E_{C2F6} = E_{CF4} * F_{C2F6/CF4}$$

where: E_{CF4} = CF4 emissions from aluminum production, kg of CF4

E_{C2F6} = emissions of C2F6 from aluminum production, kg of C2F6

MP = metal production under i, tons of Al

S_{CF4} = slope factor for CF4, (kg of CF4/ton of Al)/(anode effect minimum/bath-days)

AEM = anode effect minimum / bath-days

$F_{C2F6/CF4}$ = weight fraction of C2F6/CF4, kg of C2F6/CF4

Factor for estimation of CO_2 emissions on the basis of international and national research on prebake electrolyzers are presented in Table 5.38

Table 5.38

CO_2 emission factors for primary aluminum production.

Process parameters for electrolytic cells with the prebaked anode	Factors on the basis of data from the International Aluminum Institute (IAI)	Factors recommended for use at the enterprises of RK using electrolysis technology in the electrolysis cells with prebaked anodes, equipped with highly efficient gas removal, central loading and point-fed alumina		
		Lower	Mean	Upper
Net pre-baked anode consumption per ton of aluminum, ton of C / t of Al	0,56	0,415	0,43	0,44
S_a – sulfur content in prebaked anodes, % of weight	2	0,6	1,8	3,0
Ash_a– ash content in prebaked anodes, % of weight	0,4	3,0	3,77	4,54

Soda ash application

Carbon dioxide (CO_2) is released during soda ash application; these emissions are taken into account as the source in the industry where soda ash is used (see chapter 2 Volume 3 IPCC, 2006). In Kazakhstan there is no domestic production of soda ash, so only CO_2 emissions from soda ash application were counted. Soda ash (sodium carbonate Na2CO3) is used as a raw material in many industries: glass industry, chemical industry, production of detergents, manufacture of pulp and paper, metals and oil refining and others. Carbon dioxide (CO_2) is released during soda ash application; these emissions are taken into account as a source in the industry where it is applied. CO_2 emissions from soda application were estimated in accordance with the 2006 IPCC Guidelines for National GHG Inventories (Tier 1) at a default CO_2 emissions factor of 0,415 per unit of used soda. Data on soda ash application were presented by enterprises of JSC Aluminum of Kazakhstan and the Committee on Statistics of Kazakhstan MNE. According to forecasts, non-ferrous metals production and chemical industry will develop at low rates, annual growth of less than 2% until 2020 and up to 1% from 2020.

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Table 5.39

Soda ash application: actual, projected and associated CO_2 emissions

	1990	2010	2015	2020	2025	2030
Soda ash application, kilotons	259,53	460,67	472.3	521.5	564.5	564.5
CO_2 emissions, kilotons	107,71	191,18	196.0	216.4	234.3	234.3

Lead production (CRF category 2C.5)

The biggest producer of lead is JSC Kazzinc which uses a technology of direct lead smelting Isasmelt. In the direct smelting process there is no sintering step, so that lead concentrates and other materials are fed directly into the furnace where they are melted and oxidized. Greenhouse gases are contained in interim gases. Sulfur and heavy metals are removed from intermediate gases by filters. Greenhouse gases are emitted into the atmosphere.

The sintering / melting process consists of sequential sintering and melting and takes about 78% of primary lead production. During sintering / melting on the first step of sintering lead concentrates are mixed with the recycled agglomerate, limestone and silica, oxygen and lead-containing slag to remove sulfur and volatile metals by combustion. The lead melting process is an oxide reduction reaction that forms CO_2.

The formula to estimate carbon dioxide emissions under the Tier 1 (2006 IPCC Guideline for National Greenhouse Gas Inventories) was used for lead production.

In the course of lead production CO_2 is released. Emissions of other greenhouse gases are insignificant. The formula to estimate GHG emissions from lead production:

$$M_{CO2} = M_{Pb} * K \quad (6.7)$$

Where: M_{CO2} –CO2 emissions from lead production, tons

M_{Pb}– annual amount of lead produced, tons

K – default emissions factor, tons of CO_2/ ton of lead products

(Factor equal to 0,52 was used from the Table 4.21 T.3 Section 4.6.2.2 page.4.81 2006 IPCC Guideline for National Greenhouse Gas Inventories)

Table 5.40

Lead production: actual, projected and associated CO_2 emissions

Activity	1990	2010	2011	2012	2013	2014	2015	2020	2030
2.C.5 Lead production, kilotons	290,3	103,4	111,518	88,099	91,072	127,064	119,89	132,43	146,28
CO_2 emissions from lead production, kilotons	150,956	53,768	60,069	45,812	47,357	66,073	66,07	68,86	76,07

At the moment, lead plant in Ust-Kamenogorsk is running at full capacity. In the near future increase in production is not expected.

Zinc production

The main producer of zinc is Kazzinc. Kazzinc zinc plant applies the electrolytic process for production of zinc that relates to hydrometallurgy. In this process zinc sulphide is calcined and zinc oxide is obtained. Zinc oxide is then treated with sulfuric acid and purified to remove iron impurities, copper and cadmium. Then zinc is removed from the solution by electrolysis. The electrolytic process does not emit non-energy CO_2 emissions according to 2006 IPCC Guidelines (Metal Industry Emissions). Prior to 1997 zinc production was concentrated in three nonferrous metals factories of East Kazakhstan: Ust-Kamenogorsk Lead and Zinc Plant, Leninogorsk Polymetallic Plant and Zyryanovsky Lead Plant. In the base year 1990 zinc production amounted to 314.9 kilotons for which CO_2 emissions were estimated using default coefficient (k = 1,72) at 541.63 kilotons of CO_2. Since 2000 we believe that the electrolytic process does not emit non-energy CO_2 emissions in this category.

Possible additional measures to reduce emissions from Metal Industry

Installation and use of CO_2 capturing and storage in the process of coke production. This is a costly measure, capturing efficiency varies between 60-90% depending on the technology.

Use of solvents and other products is a source of emissions of non-methane volatile organic compounds (NMVOCs) and nitrous oxide (N2O). The main sources of greenhouse gases in Kazakhstan in this sector is the category SNAP 0601 (use of paints), SNAP 0602 (degreasing and dry cleaning), SNAP 0604 (other use of solvents and related activities). Only emissions of volatile organic compounds (NMVOCs) are classified as indirect greenhouse gases and therefore they are not included into cumulative national emissions.

Solvents and energy products from fuels (CRF category 2.B)

Use of solvents and other products is a source of emissions of non-methane volatile organic compounds (NMVOCs) and nitrous oxide (N2O). The main sources of greenhouse gases in Kazakhstan in this sector are categories SNAP 0601 (use of paints), SNAP 0602 (degreasing and dry cleaning), SNAP 0604 (other use of solvents and related activities). Only emissions of volatile organic compounds (NMVOCs) are indirect greenhouse gases and therefore they are not included into the overall national emissions.

The main sectors of Kazakhstan in which Paint application processes are found are woodworking industry, light industry, repair and construction industry. At the same time NMVOCs are emitted into the atmosphere - xylene, mineral spirits, toluene and others. NMVOC emissions from dyes application in the manufacturing, construction and households were assessed under the simplified procedure described in the manual EMEP/CORINAIR Emission Inventory Guidebook (The European Environment, 2005). This method uses an average emission factor of NMVOC per capita calculated for European countries. It was used to estimate the emission factor of 4.5 kg NMVOC / per capita / year

The subcategory ‘degreasing and dry cleaning’ includes emissions from degreasing of surfaces (at work and at home), and the use of solvents, dry cleaners. This method uses an average emission factor of NMVOC per capita calculated for European countries that adopted NMVOC of 0.85 kg / per capita / year. Other use of solvents and related activities cover areas like coating of glass wool and mineral wool, printing industry, extraction of oils and fats, use of glues and adhesives, wood preservation, domestic solvent use (other than paint), and anti-corrosion coating of cars and dewaxing (in cars).

Table 5.41

NMVOC emissions in the sector Use of solvents and other products

Factor	Use of solvents and energy products from fuel, tons of NMVOCs	**1990**	**2010**	**2014**	**2015**	**2020**	**2025**	**2030**
	Population, thousand people	16452	16440	17418	17656	18758	19664	20494
0.0045	Use of dyes	74.033	73.980	78.380	79.453	84.411	88.489	92.223
0.00085	Degreasing and dry cleaning	13.984	13.974	14.805	15.008	15.944	16.715	17.420
0.00065	Printing industry	0.04812	0.04809	0.05095	0.05164	0.05487	0.05752	0.05994
0.0006	Use of glues and adhesives	0.00909	0.00908	0.00962	0.00976	0.01036	0.01086	0.01132
0.0018	Domestic use of solvents	0.00009	0.00009	0.00009	0.00009	0.00010	0.00010	0.00011
0.0036	Other	0.00003	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004
	Total tons of NMVOCs	88.074	88.012	93.245	94.523	100.421	105.272	109.714

5.2.3. *Methodology for the forestry sector*

Fellings

Emissions from fellings were estimated in accordance with IPCC principles using the formula.

$$L_{trees\ felled}=\{H*BCEF_R*(1+R)*CF\},$$

Where, $L_{trees\ felled}$ is a mass of carbon lost due to fellings,

H= annual amount of round wood taken; m^3/year,

$BCEF_R$= biomass conversion and expansion factor for conversion of felling in product volume into felling in total weight (including bark).

CF is a carbon share in dry matter [nondimentional value].

R is a ratio of belowground biomass to aboveground biomass, takes into account the growth of tree roots [nondimentional value].

R and CF were taken from IPCC tables.

In Kazakhstan different types of wood are felled. For different types different estimations were used, the total mass of carbon was summed up.

$$L_{trees\ felled} = 55*10^3*0.8*(1+0.29)*0.5=0.28*10^6 \text{tons of C.}$$

$$L_{trees\ felled} = 71.2*10^3*1.17*(1+0.46)*0.5=0.031*10^6 \text{tons of C. (conifers)}$$

674.7 thousand m^3cut.

$$L_{wood\ fuel}=\{FG_{part}*D*CF\}$$

Preparation of raw and fuel wood. 674,7 thousand m^3 cut.

$$L_{wood\ fuel} = 674.7*10^3*0.5*0.5=0.168*10^6 \text{ tons of C.}$$

Fires

$$L_{disturbance}=\{A_{disturbance} * B_W * (1+R)* CF*fd\}$$

Where, $A_{disturbance}$ *is the area of disturbance (fire),* B_W =average value of aboveground biomass at areas under effect of disturbance; tons of c. B. /ha.

CF is a share of carbon in a dry matter [nondimentional value].

R is a ration of belowground biomass to aboveground biomass, takes into account the growth of tree roots [nondimentional value].

Fd is a share of biomass lost as a result of disturbance.

There is an assumption that the area under fires in 2015 was 10 thousand hectares

$$L_{disturbance} = 10*10^3*91*(1.29)*0.5*0.4=0.234*10^6 \text{ tons of C.}$$

5.2.4. Methodology for the wastes sector

When forecasting emissions from disposal of municipal solid wastes and wastewaters, linear extrapolation until 2030 was used.

When forecasting emissions from medical waste incineration, it was assumed that emissions will stabilize at the 2013 level.

VI. EXTENTION OF FINANCIAL AND TECHNOLOGICAL SUPPORT FOR STRENTHENING CAPACITY OF PARTIES WHICH ARE DEVELOPING COUNTRIES

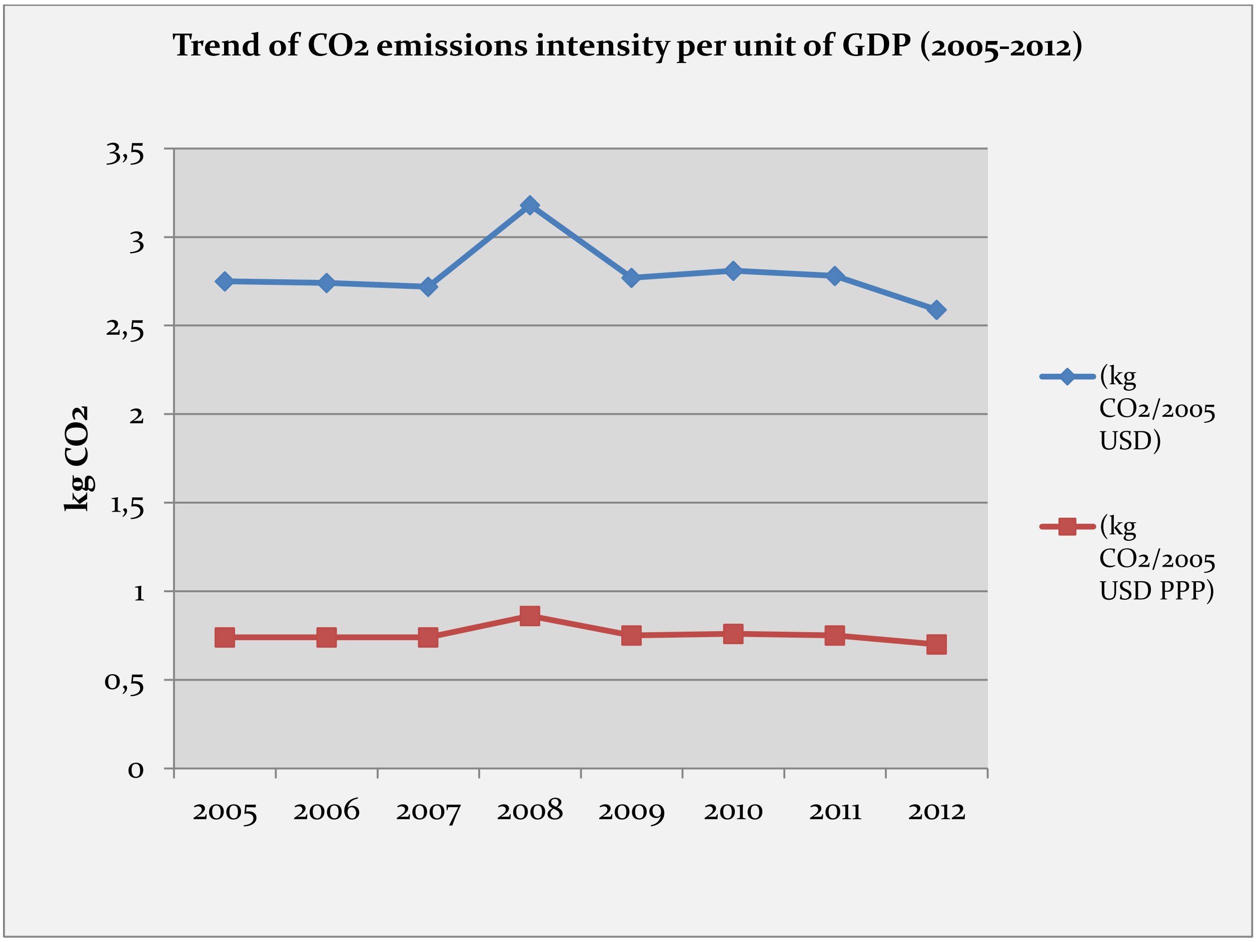
Financial resources and transfer of technology are important means of implementation and play an crucial role in effectiveness of the global response to climate change. By definition of the Secretariat of UNFCCC[27], 'technology transfer' is a wide range of processes covering the transfer of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders[28]. These stakeholders are, by definition of the IPCC[29], the government, private sector entities, financial institutions, non-governmental organizations, research institutes and educational institutions.

Outdated technology is a source of greenhouse gases, so the global GHG reduction requires innovation to transform existing technologies into clean and resistant to climate change ones. For this reason innovation is a foundation of sustainable economic development. At the same time, a broad and inclusive term 'transfer' implies the spread of technology and technological cooperation between countries and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition, and also includes the transfer of knowledge and capacity-building for the implementation and use of innovative technologies with the ability to select and adapt them to local [30]conditions[31]. It is important to ensure local integration with existing technologies. National initiative for investment and development, foreign direct investment, official development assistance (ODA), commercial lending and equity investment is an important channel through which technology transfer is funded.

During the reporting period Kazakhstan joined the group of countries with upper-middle income by the definition of the World Bank classification[32]. In 2013 GDP per capita was almost 13 thousand dollars. Large amounts of specific greenhouse gas emissions per unit of GDP [33]are continuing. According to the International Energy Agency Enerdata at the end of 2013 Kazakhstan was ranked first in the world from the standpoint of intensity of carbon dioxide emissions per unit of GDP. Figure 6.1. shows the trend of emissions intensity from 2005 to 2012.[34]

Figure 6.1. Trend of CO_2 emissions intensity per unit of GDP (2005-2012)

[27]http://unfccc.int/essential_background/glossary/items/3666.php#T
[28]http://unfccc.int/essential_background/glossary/items/3666.php#T
[29]Intergovernmental Panel on Climate Change
30Technology owned and used by the indigenous population, and associated and naturally developing in a certain area or environment, in particular climate zone in accordance with the way of life.
[31]https://www.thegef.org/gef/Technology_Transfer
[32] http://data.worldbank.org/country/kazakhstan
[33]Online newspaper Kursiv of 13 February 2015 (available at link http://www.kursiv.kz/news/top_ratings/Kazakhstan_zanimaet_pervoe_mesto_v_mire_po_intensivnosti_vybrosov_uglekislogo_gaza/)
[34]http://www.iea.org/statistics/statisticssearch/report/?country=KAZAKHSTAN&product=Indicators&year=2005



Source: International Energy Agency, country statistical data

VI. A. Financial resources

The Republic of Kazakhstan is not an Annex II country to the UNFCCC, therefore has no direct obligation to provide financial and technological support in the field of capacity building for developing countries not included in Annex I to the Convention.

At the same time, as a country in transition, Kazakhstan is steadily increasing domestic efforts to implement decisions of the Conference of the Parties to the UNFCCC, and provides below the information on how funds are received and allocated to countries in the course of implementation of country's voluntary commitments.

A. Republic of Kazakhstan and GEF

Since its founding in 1991, the GEF provides assistance in technology transfer to help developing countries deal with the global problem of climate change. GEF has a mandate from the Conference of the Parties (COP) to the UNFCCC to finance the transfer of environmentally sound technologies[35]. In recent years, the GEF allocated for this purpose about $ 250 million per year[36]. GEF-5 (2010-2014) funding for mitigation of the effects of climate change has a priority to transfer technology, either directly or through indirect projects.

Kazakhstan is not a donor country for the GEF so as the recipient country receives grants from the Global Environment Facility for projects in the field of sustainable development, environmental

[35]https://www.thegef.org/gef/Technology_Transfer, *"The GEF has a mandate from the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) to finance the transfer of Environmentally Sound Technologies (ESTs)..."*
[36]https://www.thegef.org/gef/Technology_Transfer

management and climate change on an annual basis since 2007. Table 6.1 shows the data on the allocation of funds for targeted projects in Kazakhstan since 2007 within the framework of GEF 4 - GEF 6.

Table 6.1.

Approved national projects of GEF in Kazakhstan[37]

Action area	GEF grant, USD	Co-financing, USD	Number of projects
Biodiversity	16 618 364	56 840 300	7
Ozone screen depletion	5 433 452	748 839	1
Climate change	32 675 500[38]	162 106 768	8
Cross-sectoral	10 074 000	21 255 000	4
POPs	17 550 000	85 711 000	4
Soil degradation	7 986 986	70 223 200	4
TOTAL	**90 338 302**	**396 885 107**	**28**

Source: *GEF website.*

GEF funds activities on adaptation and mitigation of climate change in more than 156 developing countries and countries with economies in transition. According to the GEF website in Kazakhstan it implements eight national projects on climate change in the amount of 15,076,950 US dollars, the co-financing from the government was about 180%[39]. Thus, the Government of the Republic of Kazakhstan allocates significant domestic financial and technical resources for effective implementation of the projects in the field of climate change. Data on GEF grants provided to Kazakhstan are presented in Table 6.2[40].

Table 6.2.

GEF projects in Kazakhstan on climate change, USD

	Date of grant approval	GEF grant	Commission fee of UNDP/GEF[41]	Total amount
	14.06.2007	144 546	5 454	150 000
	24.06.2009	4 568 500	456 850	5 025 350
	23.12.2008	100 000	10 000	110 000
	21.04.2009	432 692	17 308	450 000
	17.03.2010	4 886 000	488 600	5 374 600
	15.09.2009	136 364	13 636	150 000
	08.06.2010	3 400 000	340 000	3 740 000
	28.04.2010	70 000	7 000	77 000
	Total:	**13 738 102**	**1 338 848**	**15 076 950[42]**

Source: *GEF website.*

To assist developing countries in getting environmentally sustainable technologies, the GEF has developed a strategic program for investment in technology transfer which was approved by the GEF

[37]https://www.thegef.org/gef/country_profile/KZ?countryCode=KZ&op=Browse&form_build_id=form-3OaZgiQLHfrI8OUdHedl7vj_bRNDBZR7a0Nph-t5I3U&form_id=selectcountry_form

[38]It includes funds under GEF5 and GEF6, including in the framework of regional projects on climate change and multisectoral projects.

[39]https://www.thegef.org/gef/country_profile/KZ?countryCode=KZ&op=Browse&form_build_id=form-3OaZgiQLHfrI8OUdHedl7vj_bRNDBZR7a0Nph-t5I3U&form_id=selectcountry_form

[40]https://www.thegef.org

[41]All grants are made through the agency UNDP / GEF.

[42]It includes contributions only from GEF-4.

* Relevant exchange rates used were from the website http://www.x-rates.com/average/

Council and relevant funds in November 2008. At COP 14, the program was approved and renamed as Poznan strategic program on technology transfer.[43]

In 2011, the Republic of Kazakhstan in the framework of UNEP launched the project on technology needs assessments in the sector of climate change mitigation with funding from the Global Environmental Facility[44]. This report has identified and analyzed the most relevant technological needs of the country's major economic sectors. Information obtained as a result of this assessment is used to form a portfolio of projects and programs to mitigate climate change. Also these documents represent a basis for action plans for the technology, to overcome barriers and promote the transfer, deployment and diffusion of certain technologies in participating countries.

B. Kazakhstan and international climate change organizations

The Republic of Kazakhstan has actively participated in the international process to develop a global climate agreement and has been working steadily in the country to meet its international obligations. According to INDC (Intended Nationally Determined Contributions) submitted by Kazakhstan to the UNFCCC Secretariat, the national quantitative contribution to limit and / or reduce greenhouse gas emissions for the period from 2021 to 2030 has an unconditional target to limit and / or reduce greenhouse gas emissions by 15%, and a conditional target to limit and / or reduce greenhouse gas emissions by 25%, to the level of 1990 base year. One of the key conditions for implementation of the objective to reduce emissions by 25% is to have access to additional financial resources and mechanisms for the transfer of low carbon technologies, as well as a flexible and efficient mechanism for participation of countries with economies in transition in the financing by the UN Green Climate Fund. Table 6.3 below shows information on implementation of financial obligations in the framework of Kazakhstan's participation in international organizations and bodies.

Table 6.3.

Compulsory membership fees of Kazakhstan in the international organizations (IOs) and other international bodies

	Name of IO, universal international treaty, an international body	**Size of contribution, USD**		
		2013	**2014**	**2015**
	UN	3 083 421	3 087 872	3 283413
	Vienna Convention for the Protection of the Ozone Layer	1 992	5 158	5 158
	Kyoto protocol	15 000	14 887	13 124
	UN Framework Convention on Climate Change	23 761	23 778	24 186
	Multilateral Fund for the Implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer	-	128 906	128 906

Source: Ministry of Foreign Affairs of the Republic of Kazakhstan (in response to the request of the Ministry of Energy of the Republic of Kazakhstan, outgoing *№ 18-05-5935/4 as of 28/05/2015)*

[43] https://www.thegef.org/gef/TT_poznan_strategic_program
[44] Part I – Technology needs assessment Report - Mitigation available at http://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNR_CRE/e9067c6e3b97459989b2196f12155ad5/447548a763b44013a124ceecc8bd26f5.pdf

In addition to obligations imposed by international climate change processes, Kazakhstan attaches great importance to participation in relevant UN processes on a voluntary basis. In the reporting period Kazakhstan has increased voluntary contributions to international organizations more than 15 times.

Table 6.4.

Voluntary contributions of the Republic of Kazakhstan to international organizations

	Name of International Organization	Size of contribution, USD		
		2013	2014	2015
.	United Nations Environment Programme (UNEP)	30 000	30 000	30 000
.	UNDP		200 000	435 000

Source: Ministry of Foreign Affairs of the Republic of Kazakhstan (in response to the request of the Ministry of Energy of the Republic of Kazakhstan, outgoing № 18-05-5935 / 4 of 05.28.2015)

C. Assistance to countries particularly vulnerable to climate change

Following the Decision of the 17th Conference of the Parties to the UNFCCC in terms of enhanced action on mitigation of climate change, the countries of Annex II are intended to support the Annex I countries with economies in transition. This assistance may be rendered through bilateral and multilateral channels taking into account technical aspects of biennial reports preparation.[45]

Within the framework of bilateral relations Kazakhstan supports the non-Annex I parties to the Convention. In accordance with Article 12, paragraph 4 the Republic of Kazakhstan provides assistance on a voluntary basis as far as possible to countries that are particularly vulnerable to adverse effects of climate change and countries with less developed economies. For each budget period an emergency reserve is formed by the Government of the country for mitigation of emergency situations i.e. natural and man-made disasters on the territory of the Republic of Kazakhstan and other states. Decisions on the allocation of humanitarian aid are made by the Government on the basis of recommendations from the International Humanitarian Aid Commission which is an advisory body to the Government of the Republic of Kazakhstan on issues of international humanitarian assistance[46]. It should be noted that there is no separate accounting and allocation of funds specifically for adaptation and mitigation of climate change in other countries, as the international financial aid system is in the process of reforming, so this assistance during the reporting period is classified generally as humanitarian aid. So in the reporting period financial aid provided by Kazakhstan on a bilateral basis was nearly 7.5 million dollars in money terms (including in-kind). The assumption is that about 30% of these funds were allocated to efforts somehow related to adaptation to adverse effects of climate change and help with disaster relief.[47]

Table 6.5.

Information on official humanitarian assistance by Kazakhstan in 2013-2015.

[45] In accordance with the decisions of the COP 17 in 2011, available at link http://unfccc.int/resource/docs/2011/cop17/eng/09a01.pdf

[46] In accordance with the decisions of the COP 17 in 2011, Rules on the use of reserves of the Government of the Republic of Kazakhstan and local executive bodies, approved by the Government of the Republic of Kazakhstan from April 25, 2015 № 325 (available at link http://www.karzhy.astana.kz/node/42245)

[47] Calculations based on data provided by the Ministry of Interior of the Republic of Kazakhstan.

The name of the state to which humanitarian aid was provided	**Period of emergency**	**Character of emergency**	**Commodity form**	**Monetary form**
		2013		
The Republic of Guatemala	January	Earthquake	In money terms	For amount of 50.000 USD
Republic of Afghanistan	March	Financial and economic hardship	Supplies	Equivalent about 528 thousand USD
Republic of Lebanon		Financial and economic hardship	In money terms	For amount of 200 000 USD
The Democratic Socialist Republic of Sri Lanka		Financial and economic hardship	In money terms	For amount of 200 000 USD
		2014		
Republic of the Philippines			In money terms	For amount of 100 000 USD
Islamic Republic of Afghanistan			Supplies	Equivalent of 1 985917 USD
Russian Federation	April	For construction of a kindergarten	In money terms	Equivalent of 2084065 USD
Saint Lucia and Saint Vincent and Grenadines	May	Natural disaster	In money terms	100 000 thousand USD (50 thousand USD to each country).
Republic of Serbia	July	Flood	Goods of first priority	Total amount equivalent to 202 488 USD
Islamic Republic of Afghanistan	July	For construction of 4 types of bridges in the city of Aibak and reinforcement of Aibak riverbanks	In money terms	Total amount of 1 474 083,38 USD
Islamic Republic of Afghanistan (BadaKhshan and Jowzjan provinces)	July	Landslide	Supplies and clothing	Total amount equivalent to 775 085 USD
Bosnia and Herzegovina	July		In money terms	100 000 USD
Republic of Tajikistan	July		Supplies	Equivalent of 627 465 USD
Central African Republic	July		In money terms	50 000 USD

Source: Ministry of Interior of the Republic of Kazakhstan (in response to the request of the Ministry of Energy of the Republic of Kazakhstan, outgoing № 18-05-5935/4 as of 28/05/2015)

For the purpose of development of a national policy on provision of financial, technical and other assistance to foreign countries designed to promote social and economic development of recipient countries, in 2013 the Concept of the Republic of Kazakhstan in the field of official development assistance (hereinafter - ODA) was developed and adopted. This concept is consistent with the norms of national and international legislation and best international practices. In order to promote the ODA concept, the KazAID agency was created with the support of UNDP. One of the main objectives of the emerging ODA system of the Republic of Kazakhstan is to contribute to solving global and regional sustainable development problems.[48]

Kazakhstan also has got a wide experience in international development assistance projects being implemented under the auspices of the United Nations and through voluntary contributions and participation in the trust funds. According to the Concept, in 2011 the extent of such cooperation has exceeded $ 2 million. In 2012, the total amount of voluntary contributions of the Republic of Kazakhstan to the international organizations, which can be defined as development assistance, amounted to more than 2.11 million US dollars. However, according to statistics from the United Nations for the period from January 2006 to July 2011, Kazakhstan has allocated US $ 53.7 million as humanitarian aid to foreign countries, most of which was sent to the Central Asian region[49]. According to the Ministry of Foreign Affairs of the Republic of Kazakhstan, Kazakhstan provided humanitarian aid and ODA in the amount of approximately US $ 100 million.[50]

VI. B. Technology development and transfer

Cooperation and exchange of experience and capacity building

One of the international initiatives in the field of climate change mitigation by reducing greenhouse gas emissions is the Covenant of the European Mayors joined by several cities of Kazakhstan. Under the Covenant, cities of Kazakhstan develop and adopt the Action Plan for sustainable energy development. The aim of such a plan is to reduce greenhouse gas emissions from municipal facilities by 20% by 2020. By August 2015 9 cities of Kazakhstan including Aksu, Astana, Lisakovsk, Petropavlovsk, Satpayev, Taraz, Temirtau, Zhezkazgan and Karaganda signed this agreement and have begun drafting their plans. Their plans are expected to include projects for low-carbon development which will be implemented at the city level in order to reduce GHG emissions.

Assistance for capacity-building in Kazakhstan for transition to a green economy is provided by the UN Economic Commission for Europe (UNECE). In particular during the period from 2015 to 2018 UNECE has routed through the United Nations Development Programme funds in the amount of 7.1 mln. Euros[51]. It is expected that the capacity and cooperation necessary for transition to a green economy will be strengthened both within the country and in other Central Asian countries. This will be done through efforts on improvement of legislation, development of mechanisms to encourage sustainable management of water resources as well as the development of methodological approaches and tools.

Kazakhstan's program on climate change mitigation is a three-year project of the US Agency for International Development (USAID) aimed to support Kazakhstan in the long-term and sustainable reduction of specific emissions of greenhouse gases. In this project USAID has supported the government and business community of Kazakhstan in the implementation of policies and measures to reduce greenhouse gas emissions at the project, corporate and national levels. The program also contributes to improvement of specialized training programs for a new generation of professionals in the field of energy and climate in Kazakhstan. One of the initiative's goals is development of professional training programs in energy conservation and climate change through delivery of training seminars, supporting professional accreditation and establishing extension centers to distribute modern knowledge and technology.[52]

48 Same as 37.
49 Same as 37.
50 Same as 37.
51 http://vlast.kz/novosti/11459-7-mln-evro-vydelaut-mezdunarodnye-organizacii-na-perehod-kazahstana-k-zelenoj-ekonomike.html
52 http://kazccmp.org/kccmp/

VI. C. Capacity building

At the same time the issues of peace and development have been put high on country's development agenda and Kazakhstan plans to increase further its participation in international development processes. According to the MFA in 2016 Kazakhstan plans to increase its contributions to international organizations up to 55 million dollars, as with higher levels of income the Republic is changing its status from recipient countries to donor countries[53].

As part of the recent initiatives to promote international cooperation in the framework of the 70th session of the UN General Assembly which took place late September in New York, Kazakhstan jointly with the UNDP adopted a program to assist 45 African countries in the implementation of sustainable development goals (SDGs) approved at the same session of the UN General Assembly. It is expected that the initiative 'Kazakhstan - Africa Partnership for the SDG' will allow African countries to increase the level of participation and exchange information both within Africa and with other regions of the world. The program will enter the stage of processing and preparation and further can be started.

At this stage Kazakhstan embarked on economic diversification to support a low-carbon development strategy towards sustainability. In the concept of transition to a 'green' economy until 2050, Kazakhstan provides for measures for the transition to low-carbon development.

In July 2013 Kazakhstan launched a national system of GHG emissions regulation in accordance with the rules of allowances trade and obligations to reduce emissions into the environment, approved by Decree of the Minister of Energy of the Republic of Kazakhstan dated 31 March 2015 № 250. Allowances are issued to 178 businesses which are responsible for cumulative emissions of 147 mln. tons per year. The system includes companies whose emissions exceed 20 kilotons per year. The allowance market was launched with the system Cap & Trade. Similar systems are used in China, Australia, India, Korea, New Zealand and other countries. Further information on the system of greenhouse gas emissions trading in Kazakhstan was given in the section on the country's progress in achieving the quantified economy-wide emission reduction targets.

Kazakhstan has some international and regional initiatives for technology and best practices transfer. One such example is the initiative 'Green Bridge' that was supported by other countries in the Central Asian region. In June and September 2017 Kazakhstan will hold the international exhibition EXPO-2017 with the theme 'Future Energy'. Preparation and hosting of EXPO in Astana will give impetus to strengthening measures for transition to low-carbon development and will promote sustainable development and fulfillment of obligations taken by Kazakhstan under the UNFCCC.

53 International news agency KAZINFORM online version of 16 February 2015, available at link http://www.inform.kz/rus/article/2746842

VII. SUMMARY OF SYSTEMATIC CLIMATE OBSERVATIONS IN THE REPUBLIC OF KAZAKHSTAN

Systematic climate observations are performed within the framework of existing national programs of the Republican State Enterprise ‘Kazhydromet’ which is a subdivision of the Ministry of Energy of the Republic of Kazakhstan. Activities of the National Hydrometeorological Service of the Republic of Kazakhstan are aimed at providing information on weather, climate, water resources and the environment, notification of dangerous and extreme weather phenomena and extremely high levels of pollution.

7.1. Systematic observations

Systematic observation, data collection, processing and dissemination of data and management of observational data. The program supports network development and technological modernization of stations, hydrometeorological and heliogeophysical observations, development of technologies for collection, processing and dissemination of operational and routine observations, maintenance and development of the National Fund of data on hydrometeorology and environmental pollution.

Climate monitoring in Kazakhstan: supporting climate data keeping and management. Preparation of regime and reference information as well as providing various sectors of the Kazakh economy with climate information for forecasting purposes.

The National Hydrometeorological Service of Kazakhstan manages the observation network (Table 7.1), logistics, planning and funding for research and development (R&D) works on methods and means of measurement, methods of observation, data collection and processing. The Global Climate Observing System (GCOS) has two networks: a network of upper-air and ground-based meteorological network. The GCOS ground subsystem on the territory of Kazakhstan includes surface synoptic stations on land which SYNOP reports are delivered to the Global Telecommunication System (GTS) at four basic terms, upper-air stations which deliver the CLIMAT TEMP summary report, climatological stations that generate CLIMAT reports (Table 7.1).

Table 7.1.

RSE Kazhydromet observation network

№	Types of observations	Number of observation stations	Global network
I.	Ground meteorological station:		
1	Meteorological observations	328	82 (SYNOP), 44 (CLIMAT)
	Aerological observations	9	9 (CLIMATTEMP)
	Actinometric observation	40	
	Ozonometric observations	5	
	Weather stations	12	
II.	Agrometeorological network:		
1	Agrometeorological observations	203	
III.	Hydrological network:		

1	Rivers	262	
	Lakes	36	
	Sea	8	
2	Observations at snow-measuring routes	25	
III.	Network of environmental monitoring:		
1	Air pollution observation stations	146	
2	Automated buoy stations	7	
3	Water pollution Observations		
	River	83	
	Lakes	26	
	Channel	4	
	Reservoir	14	
	Sea	1	
4	Soil pollution monitoring:		
	City/town	65	
IV.	Radiation monitoring		
	Gamma background	86 stations	
	Beta activity	43 stations	

Source: Technical specifications for government programs 031 – 'Maintenance of hydrometeorological monitoring', 018 – 'Observations of the state of the environment'

7.2. 7.2. Possibility of free and open international data exchange.

The National Hydrometeorological Service of Kazakhstan ensures a free and open international exchange of data:

1. World Data Center (Volume A) on meteorology (National Climatic Data Center, US);
2. SI 'RIHMI – WDC': the exchange of meteorological data on a regular basis as current regime information is processed by 22 international exchange stations.

According to a joint action plan on implementation of the hydrometeorological safety concept of CIS member states, Kazhydromet RSE supports bilateral cooperation in the exchange of information on hazardous weather (HW) and extreme weather phenomena (EWP). In the event of the extreme weather events threat on the territory of Kazakhstan Kazhydromet directs storm warnings to the NHMS of Russia, Uzbekistan and Kyrgyzstan.

7.3. Principles of climate monitoring in GCOS/GOOS/GTOS.

In its national programs for systematic observations the Hydrometeorological Service of Kazakhstan adheres to principles and best practices of climate monitoring. Systems and programs of the observation network in Kazakhstan are based on those of the Global Observing System (GOS) of the World Weather Watch (WWW), Guide to the Global Observing System, WMO Technical Regulations, Guide to Instruments and Methods of Measurement.

On January 1, 2016, 328 meteorological stations will operate in Kazakhstan, including 71 unmanned stations with automatic meteorological observations, the information comes every hour to the central server in the city of Astana. In the period from 2011 to 2015 70 automatic weather stations were set up and opened. Growth dynamics of the state monitoring network is shown on Fig. 1.

40 meteorological stations perform actinometric monitoring of the intensity of direct, diffuse, total solar radiation as well as effective radiation, radiation balance and albedo; in 2014 27 automatic weather stations with actinometric sensors were installed.

Ozone content in the atmosphere is observed by 5 stations - Almaty, Aral Sea, Atyrau, Karaganda, Semipalatinsk. The measured data are sent monthly to the Central Geophysical Observatory of St. Petersburg.

One of the major tasks of NHMS is upper-air observations at standard and special levels up to 30-40 km heights. Today upper-air observations are performed by 9 upper-air stations. In the period from 2009 to 2014 as part of modernization of upper-air observation network 7 new upper-air systems were acquired.

Observations of ground station networks on the territory of Kazakhstan are monitored and archived by the software PERSONA-MIS (Automated System for meteorological information, developed by RIHMI-WDC, Obninsk, Russian Federation).

Stations' representative location is controlled by a program 'inter-station control', developers are Voeykov MSO, St. Petersburg, Russian Federation (RF). Later on the climatological information processing stage, the historical series are analyzed for homogeneity using a variety of methods for detecting and eliminating climatological heterogeneity.

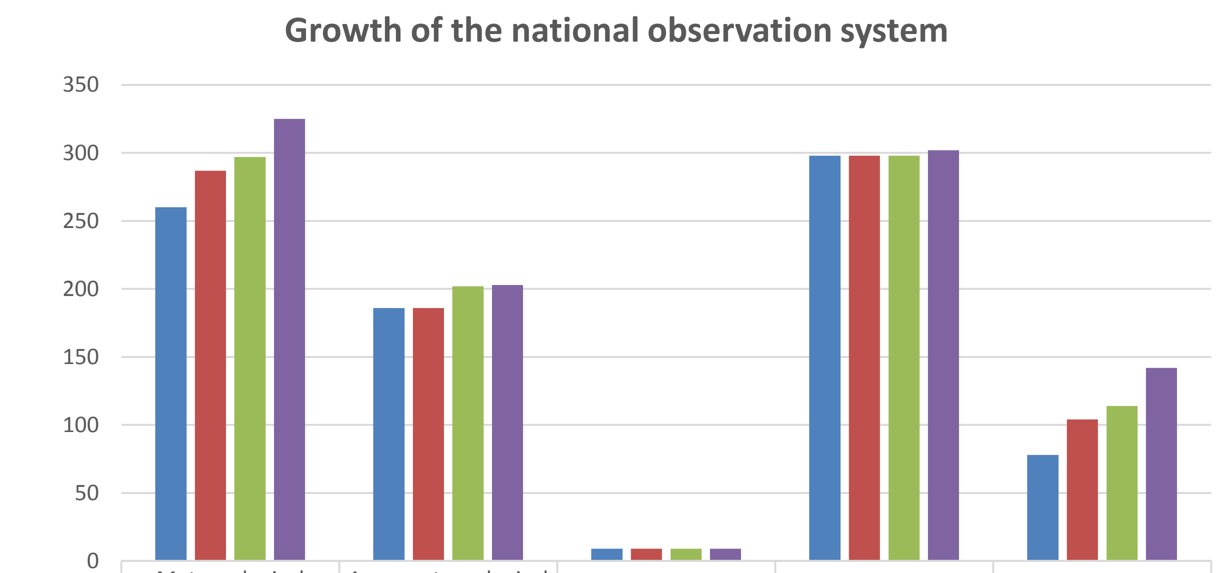
An important element of monitoring is a climate data management system. Currently work is underway on updating the database of all meteorological stations in Kazakhstan in the hardware-software complex 'integrated database management system' of CliWare (ACS CliWare).

7.4. Monitoring network in the Republic of Kazakhstan.

A primary and systemic problem of the NHMS of Kazakhstan at the present stage is a mismatch between capabilities of NMHS and increasing demand of society for hydrometeorological and other information about the state of the environment, as well as seriously outdated technical, technological and human resources in comparison with developed countries' Hydrometeorological Services.

NHMS work depends on the State observation network. After the collapse of the Soviet Union and until 1999 the state monitoring network has been steadily declining. The number of meteorological stations (MS) decreased from 361 to 244, the number of weather stations performing agro-meteorological observations - from 246 to 111, the number of hydrological stations from 457 to 159, upper-air stations from 15 to 8[54]

Increase in the number of environmental and meteorological stations and posts is shown on Fig. 7.1.



	Meteorological stations	Agro-meteorological stations	Upper-air stations	Hydrological stations	Air pollution stations
2012	260	186	9	298	78
2013	287	186	9	298	104
2014	297	202	9	298	114
2015	325	203	9	302	142

Figure 7. 1. Growth of the national observation system.

Sources: Technical specifications of government programs: 031 – 'Maintenance of hydrometeorological monitoring', 018 – 'Observations of the state of the environment'

Currently, despite the ongoing efforts to expand the State observation network, coverage of the national observation network of NHMS of Kazakhstan does not meet the requirements of the World Meteorological Organization. For example, the minimum number of observation points shall be:

- 421 meteorological stations;
- 15 upper-air stations;
- 500 hydrological stations;
- agro-meteorological observations should be conducted at 280 stations;
- 250 air pollution stations.

As a result today 78% of the Republic is covered by meteorological monitoring, 73% by agrometeorological, 61% by hydrological, 58% by environmental (air, soil, surface water), which is not enough for full coverage of the territory with all kinds of monitoring, as well as for qualitative assessment of regional and global environmental and climate change. / 3 /.

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[54] Feasibility study 'Implementation of an integrated system of environmental and hydrometeorological monitoring the Republic of Kazakhstan on the basis of a national GIS' 2013.

7.5. Meteorological and atmospheric observations

Currently ground-based meteorological network of Kazakhstan, area of 2756 thousand km^2, includes 328 stations of which 71 stations are operating in an automated mode providing information every hour, 257 stations perform regular regime observations at 8 synchronous time points: 00,03,06, 09,12,15,18 and 21 hour of universal coordinated time, it allows to describe accurately a daily variation of main meteorological parameters (temperature, humidity, wind speed and direction, barometric pressure, soil temperature, visibility, number and shape of clouds, height of their bottom boundary) / 4 /.

Thus precipitation is measured at 9^{th} and 15^{th} hour of universal coordinated time.

Intensity and development of atmospheric processes and phenomena are observed continuously.

At 9 upper-air stations atmospheric sounding is performed, 9 upper-air stations are GCOS (GCOS Upper Air network - GUAN).

SYNOP summary reports in GST (GST-Global Surface Network) from the Republic of Kazakhstan contain information from 82 stations: Region RA-2: seventy-nine (79) stations, region RA-6: three (3) stations in four basic time points: 00, 06, 12 and 18 hours UTC. 44 of 82 stations submit monthly CLIMAT reports, 9 upper-air stations submit CLIMAT TEMP summary reports.

Table 7.2.

Participation in the Global Atmosphere Watch

Stations	GSN	GUAN	GAV	Other
How many stations is the Party responsible for?	82	9		
How many of them are functioning now?	82	9		
How many stations are expected to function in the future?				
How many stations are now providing data to international data centers?				RIHMI-WDC 22 stations[55]

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[55] On a regular basis

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