

MINISTRY OF ENVIRONMENTAL PROTECTION OF UKRAINE

**UKRAINE'S REPORT ON
DEMONSTRABLE PROGRESS UNDER
THE KYOTO PROTOCOL**

Kiev 2006

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INTRODUCTION

This report demonstrates Ukraine's progress in fulfilling the Kyoto Protocol, as per the Article 3 paragraph 2, and is prepared in accordance with requirements of the Seventh and Eighth Conferences of Parties (decisions 22/CP.7 and 25/CP.8).

As an Annex I Party, Ukraine is obligated to submit to the UNFCCC Secretariat a national report demonstrating the progress under the Kyoto Protocol, including the following main sections:

- Description of domestic measures (including legal and institutional) taken to prepare for implementation of commitments under the Kyoto Protocol to mitigate greenhouse gas emissions;
- Trends in, and projections of emissions;
- Evaluation of how such domestic measures will impact projected dynamics of emissions;
- Description of the activities under Articles 10 and 11 of the Kyoto Protocol.

The report provides summary information on domestic measures to mitigate emissions, regulatory and institutional steps taken to implement Kyoto Protocol requirements. This document includes the latest information on the trends and likely dynamics of emissions, including the situations with or without domestic measures, and provides brief overview of activities under Articles 10 and 11.

Materials of the report correspond to the information submitted in 2006 in Ukraine's National Communication. Compared to the National Communication, description of regulatory documents is expanded to cover the documents recently adopted by Ukraine to fulfil the Kyoto Protocol and concerning the national inventory system and Joint Implementation mechanism. In addition, there is also a quantitative evaluation of expected impact on projected emissions level due to domestic measures and additional measures implemented under the Kyoto Protocol.

1. DESCRIPTION OF DOMESTIC MEASURES RELATED TO IMPLEMENTATION OF COMMITMENTS UNDER THE KYOTO PROTOCOL

1.1. Regulatory and institutional basis for implementation of commitments under the Kyoto Protocol

Kyoto Protocol was ratified by Ukrainian Parliament in February 2004 and since then became an integral part of Ukrainian legislation. After the Protocol's coming in force in February 2005 Ukraine is a Party to it, must fulfil relevant commitments and has an opportunity to participate in the flexibility mechanisms envisioned by the Articles 6, 12 and 17.

According to the Kyoto Protocol, within the period 2008-2012, total greenhouse gas (GHG) emissions in Ukraine should not exceed the 1990 level (assigned amount or quota for Ukraine). Results from the last GHG inventory showed that in 2004 the emissions made up 45% of the 1990 level. Basic forecasts indicate that in 2012 emissions will not exceed 1990 levels. Consequently, Ukraine may not need to undertake any specific measures to fulfil its commitments to the Kyoto Protocol.

At the same time, it should be noted that existing emissions reduction compared to the base year occurred, mainly, due to deep economic recession of the 90s, consequences of which the country only started to overcome in the recent years. The task is not only just to restore previous production output, but also to bring it to a new-quality level implying more efficient usage of energy resources. As a result, sustainable reduction of energy consumption and corresponding reduction of GHG emissions would be achieved.

Participation in the flexible mechanisms of the Kyoto Protocol may contribute to intensifying investment activities for modernization of the economy. This is particularly important for the sectors suffering from under financing due to low financial returns, high risks and other factors. At the same time, it is necessary to ensure that transfer of a part of the national assigned amount does not contradict the needs of the economic growth. Hence, establishment of regulatory, institutional and procedural basis for participation in Kyoto Protocol mechanisms should be accompanied by determination of the most expedient strategy for such participation.

Such an approach was adopted as a basis for the National Plan of Measures on Fulfilment of Provisions of Kyoto Protocol to the UN Framework Convention on Climate Change [1]. The plan envisions achievement of the following main results:

- Creating a national inventory system for greenhouse gas emissions and removals;
- Establishing a national GHG registry;
- Creating an infrastructure for joint implementation (JI) projects;
- Development of a national GHG emissions trading system;
- Regular preparation of National Communications;
- Development of a national and regional plans on climate change mitigation;
- Development of a database of environmentally sound technologies.

To ensure coordinated implementation of these tasks, by the Decree of the President of Ukraine [2] the Ministry of Environmental Protection of Ukraine was appointed as a national coordinator of actions for the fulfilment of Kyoto Protocol and UNFCCC commitments.

1.1.1. National inventory system

Ukraine regularly prepares and submits within required timeframes annual national inventories of GHG emissions and removals. A common and compulsory order for performing such activity was introduced in April 2006 by a decree of the Cabinet of Ministers of Ukraine [3]. Besides, the issues of the national inventory system operation are also addressed in another decree of the Cabinet of Ministers establishing the rules for coordination of measures to implement Ukraine's commitments under the UNFCCC and Kyoto Protocol [4].

The inventory rules introduced in this way are mandatory for all government bodies and all economic entities, and include the following main points:

- Appointment of the Ministry of Environmental Protection as a single national entity with overall responsibility for preparation and submission of inventory in accordance with Kyoto Protocol requirements;
- Determination of the scope and objectives of the national GHG inventory system;
- Development and approval of annual inventory plan;
- Collection of GHG emissions and removals related information from ministries and agencies, central and local government bodies and economic entities;
- Conducting necessary studies to update emission factors;
- Carrying out the works on preparation of annual GHG inventory reports;
- Archiving of the information from national inventory and related materials;
- Publishing annual inventory reports on Ministry of Environmental Protection's website and submitting them to the UNFCCC Secretariat.

Creation of the national inventory system in Ukraine enables not only fulfilling the commitments under the Article 5.1 of the Kyoto Protocol, but also optimizing domestic measures on GHG emissions mitigation. From this viewpoint, important results of the inventory are identification of key emission sources and sinks, determination of existing trends and provision of data for adjustment of future forecasts. This provides an opportunity to determine priority sectors for implementation of measures, with account of returns on invested funds and achievable absolute reduction figures.

1.1.2. National registry

To guarantee participation in the flexible mechanisms from the beginning of the commitment period, Ukraine is going to put into operation the national GHG registry in accordance with the decision 19/CP.7. A detailed description of the registry is to be included in the report on calculation of Ukraine's assigned amount.

In October 2005 the Ministry of Environmental Protection conducted a tender to determine a registry supplier and allocated budgetary financing for implementation of necessary works. Technical specifications for the tender were developed with account of the requirements formulated in relevant decisions of the Parties' Conferences (19/CP.7, 24/CP.8, 16/CP.10,

17/CP.10 etc.), and foresaw registry software compatibility with technical specifications of the international transaction log (ITL) being established by the UNFCCC Secretariat. European experience of registry systems operation (GRETA, SERINGAS, and ECRA) was also taken into account, as well as requirements of the national legislation of Ukraine. Additionally, the registry's functionality will support potential needs of domestic emissions trading system, possibility of creating which is now elaborated in conformity with the National Plan of Measures on Fulfilment of the Kyoto Protocol and UNFCCC.

Basic software for the registry has been developed and passed required expert review in accordance with national procedures. However, the software is yet to be tested for compatibility with the ITL, when possible adjustments may have to be made. Necessary hardware has been purchased and installed, and instructions for system users have been prepared. Presently, testing of the registry system for practical operation is being started. Centre on Climate Change under the Ministry of Environmental Protection has been appointed as registry administrator.

1.1.3. Joint implementation mechanism

Participation in the JI mechanism is additional to emission mitigation efforts taken by Ukraine on its own, under existing domestic programmes like the Comprehensive National Programme on Energy Conservation [5]. Large-scale activity within the framework of JI mechanism implies realization of hundreds of projects. Given available experience in the clean development mechanism, capacity of the similar to it Track 2 JI mechanism may prove to be inadequate for realisation of such number of projects. That is why the strategic priority for Ukraine is to fulfil, as soon as possible, conditions for participation in the Track 1 of JI mechanism in accordance with decision 16/CP.7.

Ukraine has already met some of the conditions for participation in JI Track 1 and completes meeting the rest of them. Ukraine is a Party to the Kyoto Protocol and has appointed the Ministry of Environmental Protection as a national coordinator for activities associated with the Protocol. The formation of the national inventory system is in process and the submission of the annual emission inventory has been achieved. Creation of the national GHG registry is being completed. Main national procedures regulating activity on JI projects in Ukraine have been developed and adopted.

Existing regulatory documents on JI mechanism include, first of all, a February 2006 decree of the Cabinet of Ministers of Ukraine on the procedure for review, approval and implementation of JI projects [6]. The procedure envisions two stages of JI project approval – receiving a letter of endorsement and a letter approval for the project, and also subsequent monitoring and verification of its results.

Provisions of this Cabinet of Ministers' decree were elaborated in more detail in the following three orders of the Ministry of Environmental Protection:

1. Order of 17 July 2006 No. 341 [7], which adopted the requirements to the documents submitted in support of the application for the letter of endorsement. The order establishes the list of relevant documents and requirements to their format and content. The letter of endorsement provides grounds for an owner of potential JI project to proceed with development of full project documentation.

2. Order of 17 July 2006 No. 342 [8], which adopted the requirements to full project documentation submitted in support of the application for the letter of approval. The order establishes the list of relevant documents and requirements to their format and content. Structure of the project documentation corresponds to the requirements established by the JI Supervisory Committee under the UNFCCC Secretariat.

3. Order of 1 June 2006 No. 273 [9], which adopted methodological guidelines concerning development and submitting of JI projects. It addresses important points for initiating JI project, and contains practical recommendations with respect to overall project cycle planning and procedures for obtaining the letters of endorsement and approval. The order expands on the requirements to project documentation as per the two above-mentioned orders, and provides additional recommendations for JI project developers and hosts.

Adopted regulations are already being actively applied in practice. Their practical efficiency is testified by the fact that the Ministry of Environmental Protection has already issued 43 letters of endorsement and 4 letters of approval for JI projects. To intensify and facilitate cooperation with potential investors in JI projects, inter-government memoranda of understanding are being concluded. To date, such memoranda are already signed with Canada, Denmark, Netherlands and the World Bank, and are being prepared for signing with France, Austria, Italy and Portugal.

1.1.4. Emissions trading

Domestic emissions trading system does not yet exist in Ukraine. Ukraine has no formal international commitments to introduce it, and considering the forecasted surplus of assigned amount as compared to actual emissions over the period of the Kyoto commitments, the development of such system is not an economic necessity. At the same time, implementation of such a system in Ukraine is not excluded currently in connection with the following main factors:

- Necessity to stimulate improvement of energy efficiency to reduce dependence on external supplies of energy resources;
- Appearance of real constraints as a result of possible sale of a considerable portion of the national assigned amount surplus; and
- Possibility to increase economic return from participation in the JI mechanism.

To consider options for a domestic emissions trading system, Ukraine initiated a study on development of the national plan for allocation of emission allowances among enterprises and industrial sectors. The study is considering how the allowance allocation could be accommodated to the plan for the social and economic development of the country, with account of peculiarities of the national economy and other important aspects.

The decision about participation in international emission trading under Article 17 of the Kyoto Protocol and its possible volumes will be made on the basis of detailed economic forecasts for 2008-2012 and following periods. Development of such forecasts is prescribed to relevant ministries by special instruction of the Prime-Minister of Ukraine, and is also envisioned as a part of development of the national emission allowances allocation plan.

1.1.5. Institutional issues

Key ministry on all the issues related to the Kyoto Protocol is the Ministry of Environmental Protection in accordance with the Decree of the President of Ukraine of 12 September 2005 [2]. First of all, this relates to the inventory issues and JI mechanism. Thus, according to the Decree of the Cabinet of Ministers of 22 February 2006 [6], the Ministry of Environmental Protection is authorised to issue the letters of endorsement and approval for JI projects, determine requirements to project documentation and procedures, and supervise the process of projects implementation. In accordance with the Decree of the Cabinet of Ministers of 21 April 2006 [3], the Ministry of Environmental Protection is responsible for preparation and submission of annual inventories. According to the Decree of the Cabinet of Ministers of 10 April 2006 [4], the Ministry of Environmental Protection coordinates preparation of national and regional plans of actions on climate change mitigation.

The Ministry of Environmental Protection also plays a key role in providing for the operation of the national GHG registry. In accordance with the ministry's order of 1 September 2005 No. 313, a state company, the Centre on Climate Change, is founded by the Ministry of Environmental Protection, State Ecological Institute and Ukrainian Scientific Research Institute of Hydrometeorology. Among others, the Centre is vested with the responsibility for maintaining and operating (administering) the registry.

To ensure inter-agency coordination and supervision of the measures relating to the UNFCCC, the Cabinet of Ministers' Decree of 14 April 1999 [10] created a special inter-agency commission. Apart from the Ministry of Environmental Protection, the commission is composed of the representatives of the Ministry of Economy, Ministry of Finance, Ministry of Fuel and Energy, Ministry of Industrial Policy, Ministry of Agrarian Policy, Ministry of Construction, Architecture and Housing and Communal Services, Ministry of Transport and Communication, Ministry of Foreign Affairs, Ministry of Justice, Ministry of Education and Science, State Committee on Statistics, State Committee on Forestry, State Committee on Land Resources, Council of National Security and Defence, National Academy of Sciences, parliamentary commission on environment. The commission is chaired by a Vice-Prime Minister, and commission's first deputy chairman is the Minister of Environmental Protection of Ukraine. The Inter-agency Commission is a high-level political body, meeting as necessary to resolve strategic issues related to the Kyoto Protocol and UNFCCC, coordinate activity of state bodies, consider materials received from foreign governments and international financial institutions, prepare proposals and supervise implementation of commitments under the Kyoto Protocol and UNFCCC.

1.2. Measures to reduce emissions of greenhouse gases and increase their removals

1.2.1. Implementation of tasks on energy saving

Covering more than a half of its energy demand through external supplies and having one of the world's most energy intensive economies, Ukraine makes persistent efforts towards energy conservation and improvement of production energy efficiency. National energy saving tasks for all economic sectors were formulated in the Comprehensive National Programme on Energy Conservation (CNPEC) [5]. These tasks were revised and finalised in Supplementary Measures and Adjusted CNPEC Performance Indicators (2000) [11]. Energy saving tasks have received particular priority in connection with recently started process of

price growth for imported natural gas, which account for three fourths of total Ukraine's gas consumption. This priority is emphasized in Ukraine's Energy Strategy for the Period Until 2030, adopted in March 2006 [28].

Planned and ongoing energy saving measures are either of technological or structural nature and, in their turn, are subdivided into sector-specific and inter-sectoral ones.

Technological measures include replacement and modernization of existing energy intensive technologies, improvement of energy efficiency of industry and utilities and reduction of energy losses. These measures are aimed at better energy efficiency of production, processing, transportation and consumption of energy resources and, accordingly, reduction of carbon intensity of production and services.

Inter-sectoral technological measures include, for example, introduction of modern metering and automatic control systems for energy consumption, utilization of waste energy, use of economical electric lighting systems and appliances, improvement of heat supply systems etc. Sector-specific technological measures are listed below in the sections addressing relevant sectors.

Structural measures are connected with the change of macroeconomic proportions and envision large-scale shifts in order to create less energy and resource intensive economy. They are undertaken to reduce the share of energy intensive sectors (inter-sectoral aspect) and energy intensive production facilities in industry, transport and other sectors (sector-specific aspect).

Despite the fact that due to a shortage of financial resources CNPEC tasks are not fulfilled as planned, starting from 1998 there is a stable trend of decreasing GDP energy intensity (by 35%) (Table 1.1).

Table 1.1. Dynamics of Ukraine's GDP energy intensity over the period 1990-2004 (cost parameters are in 2005 prices without account of hard currency's purchasing power parity)

Source: [12]

	Years										
	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fuel and energy consumption, mtce	340.6	216.5	206.7	204.3	195.3	191.1	185.4	183.1	184	189.3	185.2
GDP, billion USD	119.2	62.3	56.1	54.4	53.4	53.3	56.4	61.6	64.8	71.0	79.6
Energy intensity, tce per USD1000	2.86	3.47	3.68	3.76	3.66	3.59	3.29	2.97	2.84	2.67	2.33
Energy intensity in percentage to previous year	-	-	106.1	101.9	97.4	98.0	91.6	90.4	95.5	93.9	87.3

CNPEC envisioned achieving energy savings of 7.9 million tons of coal equivalent (mtce) in 2004 due to implementation of energy efficiency measures at enterprises and organisations. Data from the State Committee of Ukraine for Energy Conservation [12] indicated 6.1 mtce of fuel and energy savings in 2004, that is, 77% of CNPEC planned figure and 12% more than in 2003.

Indicated savings were received as a result of about 14 thousand of energy efficiency measures in all regions of Ukraine. Based on the reports from regional administrations, value of saved energy resources in 2004 made up USD 332 million, or USD 69.5 million more than in 2003. For implementation of measures in 2004, USD 263 million were allocated (including 15 million from the state budget, 53 million from local budgets, 154 million from enterprises' own resources, 41 million from loans and foreign investments).

1.2.2. Energy

Power industry. In this sector, a programme on rehabilitation of thermal power plants was developed and approved in 2002. The measures planned under this programme are oriented towards usage of modern equipment and technologies for heat and electricity production with lower technogenic impact on the environment. The main measures include:

- Improving quality of the coal used in traditional coal energy and introduction of boiler equipment based on circulating floating bed technology;
- Improving the state of electricity grid, reduction of electric energy losses during transmission and distribution;
- Installing compensating devices on electric mains;
- Using combined heat and power production.

Non-traditional and renewable energy sources. Ukraine adopted a programme on state support of development of non-traditional and renewable energy sources [13]. The estimated annual technically achievable potential of non-traditional and renewable energy sources in Ukraine is approximately 79 mtce, which includes 63 mtce from renewable energy sources, and 16 mtce from waste energy. The strategic task of the programme is to achieve 8-10% share of non-traditional energy sources and alternative fuels in the total fuel and energy consumption of Ukraine.

Promising areas for development of non-traditional and renewable energy in Ukraine are bioenergy (waste wood and agricultural waste combustion, use of biogas, fuel briquettes, ethanol, biodiesel), extraction and utilization of coal bed methane, use of thermal energy from environment, development of wind power plants, utilization of economically feasible hydro potential of small rivers in Ukraine.

In particular, for development of wind energy special regulations were adopted [14-15]. Besides, to finance construction of wind power plants, a separate law [16] introduced targeted 0.75% surcharge to tariffs on electricity sold on wholesale electricity market of Ukraine. This law contributed to wind energy development. Thus, at the end of 2003, installed capacity of wind power plants reached 57.4 MW.

Coal industry. Reduction of methane emissions from operating mines is achieved through industrial extraction and use of coalbed methane, as well as through supplementary measures envisioned by a programme of coal-bed degasification, which is an integral part of a programme to increase coal mines safety levels [17]. As a result, 10% reduction of methane emissions by mines is achieved.

Implementation of these measures is financed primarily from targeted budgetary funds. Some types of activities (such as slaking of waste dumps, their reformation, equipping emission sources with filters etc.) are financed at enterprises' own expense.

Oil and gas, and oil-processing industry. Measures to reduce energy consumption and emissions during production, transportation and processing of oil and gas are planned and implemented. Principal measures include:

- Installation of new gas compressor units with 32-36% efficiency;
- Introduction of co-generation;
- Utilization of gas from condensate degasification;
- Utilization of oil associated gas;
- Introduction of advanced oil processing techniques, etc.

Issue of biofuels usage development is considered. The volume of fuel ethanol production is expected to be 1 million tons in 2010, provided that the majority of operating distilleries and sugar-refineries will be involved in production, and that the raw materials base of agricultural complex will be sufficient. Activities on producing biodiesel fuel from rape seeds are also ongoing.

1.2.3. Transport

More than a half of light oil products used by the country's economy, about 5% of furnace oil, and the same share of electricity are used for the transport needs of the national economy. The transportation technologies need improvement because they do not meet world standards. For example, specific fuel consumption by cars exceeds by a factor of 1.4-1.5 the figures of industrially developed countries.

In order to reduce detrimental impact of transport on the environment, a plan for implementation of the principal governmental environmental protection policy in the transport sector was developed. In 2005-2010, the following energy saving technologies and measures will be implemented in the transport sector:

Road transport:

- Use of modern energy efficient engines;
- Use of petrol with chemical agents and biofuels;
- Improvements in road cover quality;
- Optimization of freight and passenger transport routes, etc.

Railway transport:

- Increase of average loading and seating capacity of trains;
- Use of regenerative breaking;
- Shifting of railway sector to electric traction;
- Improvement in the state of tracks;
- Optimization of freight and passenger transport routes, etc.

1.2.4. Industry

Improvement of efficiency of fuel and energy usage is a priority direction for development of Ukrainian industry. Implementation of measures leading to reduction of energy consumption

and corresponding decrease in GHG emissions is based on the regulatory documents such as: Concept of the State Industrial Policy [18], State Programme on Industry Development for 2003-2011 [19], Laws of Ukraine “On Innovative Activity” [20] and “On Priority Directions of Innovative Activity in Ukraine” [21], CNPEC [5] and others. For the most energy intensive industries such measures are listed below.

Ferrous and non-ferrous metallurgy. Increase in fuel and energy use efficiency in ferrous metallurgy during the period 2005-2020 will be achieved through the following principal measures:

- Replacement of open-hearth steel smelting technology with basic oxygen one;
- Increase of waste energy use;
- Installation of continuous casting machines;
- Upgrading blast-furnace technology through the use of in-blown coal-dust mixture and hot reducing-agent gases with cold technological oxygen;

Chemical industry. In this sector, the principal measures for reducing energy consumption and greenhouse gas emissions are:

- Introduction of automated technological complexes for ammonia production;
- Introduction of the diaphragm method of sodium hydrate production using bi-polar type electrolyzers;
- Improvement of processes for drying, dehydrating and dosing loose materials;
- Use of plasma chemical methods in acids production;
- Increase of waste energy utilization, etc.

Construction materials industry. Priority energy saving measures in this sector are:

- Expansion of the dry method of concrete production;
- Increase in the use of waste heat from revolving cylindrical kilns;
- Introduction of energy saving technologies of light filler production;
- Increase in the production of cavitated bricks and cellular concrete;
- Improvement of concrete thermal processing regimes.

1.2.5. Housing and communal services

The policy regarding development of housing and communal services in the near future is reflected in the National Programme for Reforming and Development of the Housing and Communal Services for 2004-2010 [22]. One of the main activities under this programme is a technical re-equipment of housing and communal facilities, in order to bring them closer to environmental requirements and standards of the European Union.

Heat supply and heat consumption systems. Use of energy saving materials, technologies and equipment is the principal direction for technical modernization of communal enterprises. Estimated achievable potential of energy saving in communal heat supply is 10-15% due to quick payback measures (i.e., replacement of burners, introduction of heat recovery, air heaters, and upgraded furnaces) and up to 35% through implementation of more costly measures, such as replacement of heat pipelines with pre-insulated ones, introduction of co-generation, and utilization of flue gases. An important component of energy saving is the

provision for economical spending of energy and material resources by consumers (in buildings). The Programme stipulates staged equipping of the existing housing stock with metering and controls of water and heat energy consumption.

As a result of entering into force in July of this year of the Law of Ukraine “On Heat Supply” [23] the legislative provision of the reformation tasks in this sector improved greatly. The Law defines principal legal, economic and institutional grounds for activities on heat supply-related issues and regulates relations associated with production, transportation, supply and consumption of heat energy for the purpose of increasing efficiency and reliability of heat supply systems, and decreasing harmful impacts on the environment.

Waste. The major component of emissions in this area is methane from municipal solid waste (MSW) landfills. The amount of MSW taken to landfills is increasing. For example, in 1999 its amount was 26 million m³ and in 2004 it was 43 million m³, with Ukraine’s population decreased during this period from 50.1 million to 47.3 million people respectively.

In 2004, a programme on treatment of MSW [24] was developed. Objective of this programme is to create conditions favourable for full collection, transportation, utilization, neutralization and disposal of domestic waste, and to limit their harmful impact on the environment and human health. To achieve these tasks the following measures will be taken:

- Decrease of MSW disposal to landfills through introduction of modern, high efficiency methods for waste collection, transportation, utilization, and neutralization;
- Development and installation of new equipment for MSW treatment;
- Sanitary purification system reforming; and
- Creating conditions for the efficient use of MSW as an energy resource, and pilot and large-scale introduction of complex processing and utilization of the components having resource value.

Fulfilment of these tasks will be performed in the following directions:

- Organization of separated collection of MSW components;
- Use of modern high-efficiency garbage trucks;
- Creating a system of two-stage MSW transportation (with construction of reloading stations);
- Use composting of MSW organic components, pyrolysis, combustion and other on-site utilization methods; and
- Creating of modern MSW landfills with neutralization of filtrate and bio-gas utilization.

1.2.6. Agriculture

In agriculture, introduction of energy efficient technologies of primary land cultivation and preparation for seeding, structural optimization of the area under crops through increase of less energy intensive crops and decrease of more energy intensive provide an opportunity to reduce fuels and oils consumption by 15-25%. Also, good prospects are considered for shift to minimal technologies of land cultivation, which, in addition to fuel savings, enable increasing carbon content in soil and prevent its release to atmosphere.

1.2.7. Forestry

In the context of Kyoto Protocol implementation in Ukraine, high importance is attached to activities on GHG removal through reforestation, expansion and management of forest lands. One of the principal regulatory documents in forestry sector is the national programme “Forests of Ukraine” for 2002-2015 [25]. According to this programme, the principal focuses of forestry development are the following:

- Increase of the share of forest areas in natural zones to an optimal level;
- Increase of forests’ nature-conservation potential, and preservation of their biological diversity;
- Improvement of forest eco-systems resistance to negative environmental impacts and climate change;
- Increase of productivity, and improvement of quality of forest plantations; and
- Refining the regulatory basis of the forestry sector and its harmonization with international principles of sustainable development and forest management.

The state of the forest stands will improve greatly and the volumes of logging necessary for the national economy will increase. It is expected that forest areas will increase by 0.5 million hectares, which is equivalent a percentage increase from 15.6 to 16.1%, and the total wood stock – by 16.7%. Along with an increase (by 15-20%) of forest loggings, the provision to ensure biodiversity of forests will contribute to positive change of the environment. The threat of soil degradation will decrease, and the level of GHG concentrations in the atmosphere will reduce. This, in its turn, will contribute greatly to Ukraine’s fulfilment of the UNFCCC and Kyoto Protocol.

2. TRENDS IN, AND PROJECTIONS OF GREENHOUSE GAS EMISSIONS

2.1. Past trends in greenhouse gas emissions and removals

Ukraine regularly prepares annual national GHG inventories and submits them within established timeframe to the UNFCCC Secretariat. The most recent of the submitted inventories [26] covers the period 1990-2004. Information from this inventory is used both in this report and in the latest Ukraine's National Communication.

2.1.1. Total emissions

Table 2.1 presents trends in total GHG emissions in 1990-2004 with breakdown by sectors and gases. The values are in CO₂ equivalent (CO₂-e), based on established global warming potentials of greenhouse gases.

Table 2.1. Trends in total direct GHG emissions by sectors and gases, mtCO₂-e.

Source: [26]

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. Energy	687.6	595.1	508.3	465.5	427.7	387.2	351.1	327.5	287.9	285.4	270.7	271.4	272.5	287.2	282.5
2. Industrial Processes	128.1	112.0	109.7	86.4	68.9	63.4	62.9	72.1	73.3	77.0	82.7	83.5	84.3	89.6	91.4
3. Solvent and Other Product Use	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3
4. Agriculture	101.4	93.6	86.2	80.3	69.9	62.0	50.2	43.2	40.1	36.9	32.9	35.1	34.7	30.1	30.4
5. LULUCF	-33.8	-36.0	-31.8	-30.9	-39.2	-42.4	-48.4	-46.9	-52.5	-43.5	-38.0	-42.0	-37.3	-39.2	-32.1
6. Waste	7.9	8.0	8.1	8.2	8.2	8.2	8.2	8.2	8.3	8.3	8.4	8.5	8.7	8.7	8.9
Total (including net removal in LULUCF)	891.5	773.2	680.8	609.9	535.9	478.7	424.3	404.5	357.6	364.5	357.1	357.0	363.2	376.8	381.3
Total (without LULUCF)	925.4	809.2	712.6	640.8	575.1	521.1	472.7	451.5	410.1	408.0	395.1	398.9	400.5	416.0	413.4

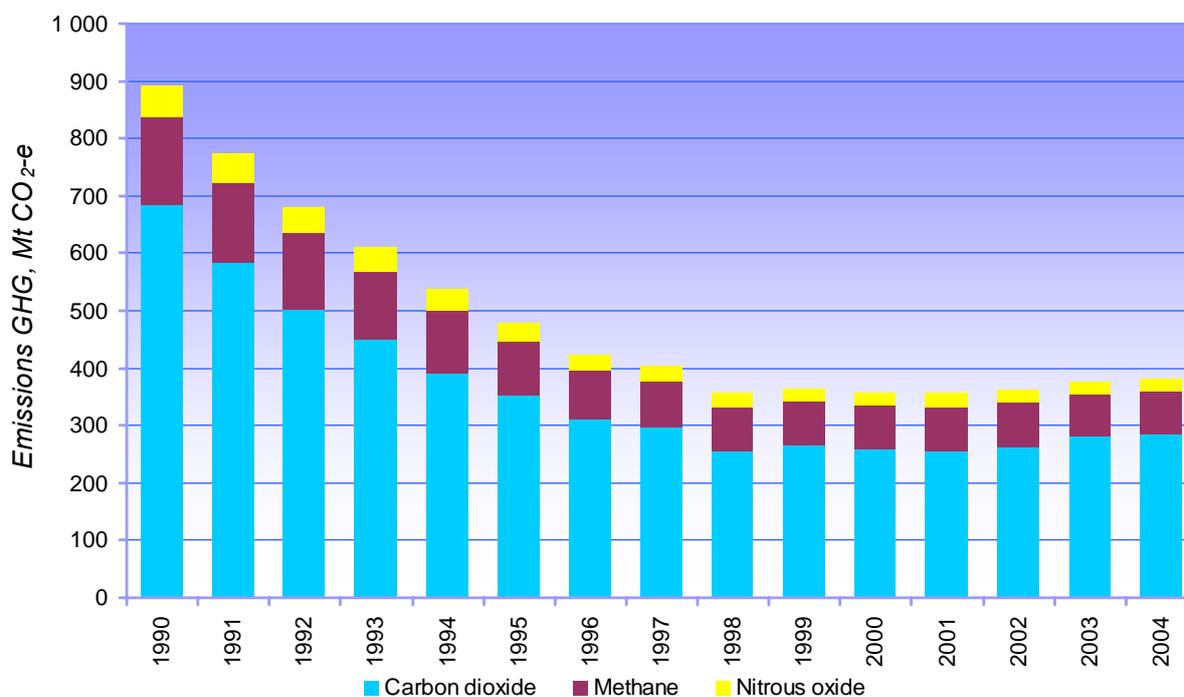
Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO ₂ emissions (excluding net CO ₂ from LULUCF)	719.4	620.2	535.1	480.5	431.0	393.5	357.9	344.6	308.2	309.3	296.5	298.9	301.3	320.5	316.9
CH ₄	151.2	138.3	131.3	118.6	107.3	94.4	86.9	80.0	76.6	75.5	76.9	76.5	75.8	74.5	74.1
N ₂ O	54.6	50.6	46.1	41.6	36.7	33.2	27.9	26.8	25.2	23.1	21.6	23.5	23.3	20.9	22.3
HFCs															
PFCs	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SF ₆															
Total (excluding net CO ₂ from LULUCF)	925.4	809.2	712.6	640.8	575.2	521.2	472.8	451.5	410.1	408.1	395.1	399.0	400.5	416.0	413.4
Net CO ₂ from LULUCF	-33.8	-36.0	-31.9	-30.9	-39.3	-42.4	-48.4	-46.9	-52.5	-43.6	-38.0	-42.0	-37.3	-39.2	-32.1
CO ₂ emissions (including net CO ₂ from LULUCF)	685.5	584.2	503.3	449.5	391.7	351.1	309.4	297.7	255.7	265.7	258.5	256.9	264.0	281.3	284.8
Total (including net CO ₂ from LULUCF)	891.5	773.2	680.8	609.9	535.9	478.7	424.3	404.5	357.6	364.5	357.1	357.0	363.2	376.8	381.3

Figure 2.1 illustrates carbon dioxide, methane and nitrous oxide emissions in Ukraine for the period 1990-2004. At present, there are no data on PFCs and SF₆ emissions in Ukraine, and

estimated HFCs emissions, as seen from Table 2.1, account only for hundredths of percent of total emissions. So the Figure 2.1 presents emissions of only three gases. The largest share of GHG emissions is due to carbon dioxide, which accounted for 77.7% of total emissions in 1990 (without account of removal in Land-Use, Land-Use Change and Forestry (LULUCF) sector). Methane emissions in 1990 were equal to 16.3% and nitrous oxide emissions accounted for 5.9% of total emissions.

Figure 2.1. Greenhouse gas emissions in Ukraine, 1990-2004, mtCO₂-e.

Source: [26]



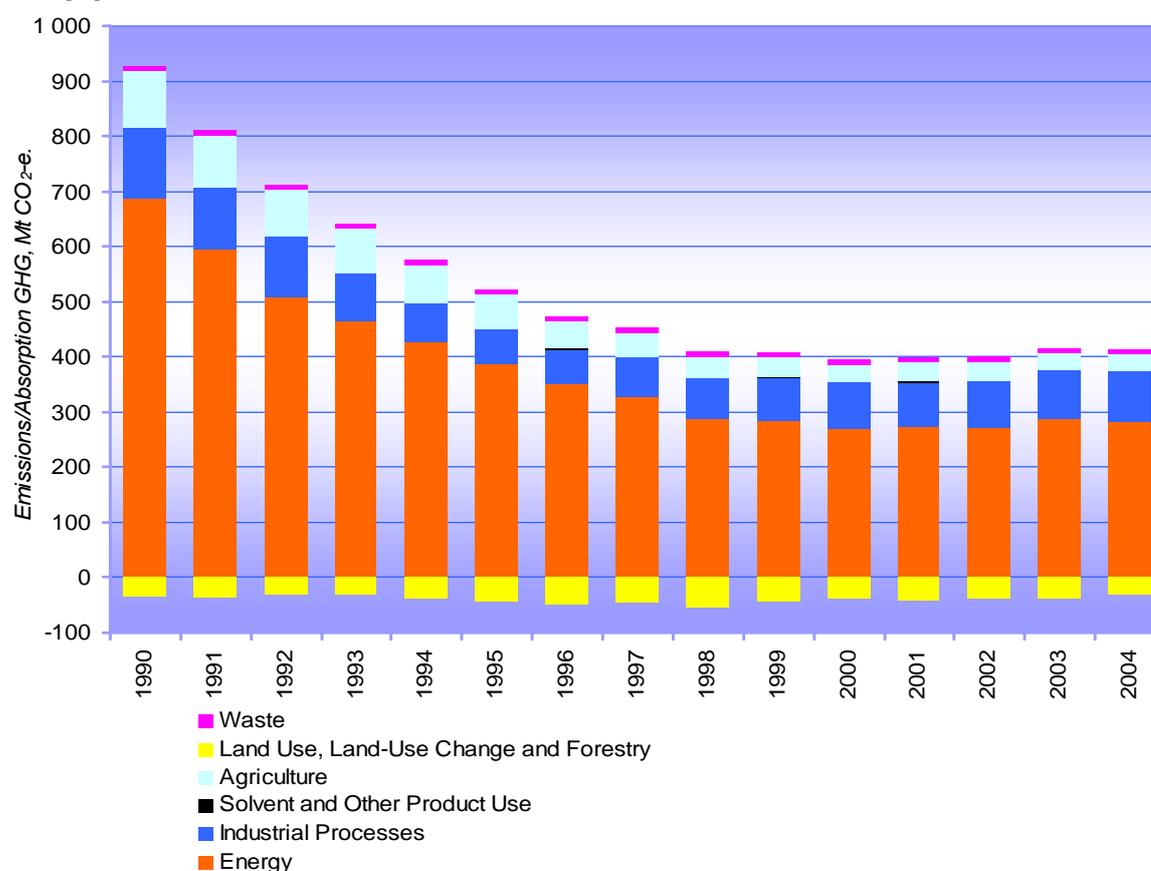
In 1990, GHG emissions (with account of CO₂ removal in LULUCF) made up about 891.5 mtCO₂-e. During the period 1990-2004, GHG emissions decreased by a factor of 2.2; of which, carbon dioxide emissions decreased by 2.3 times, methane by 2 times, and nitrous oxide by 2.45 times. GHG emissions reduction was a result of decreasing production output. The results of the analysis of Figure 3.1 illustrate the significant contribution of CO₂ emissions to the total balance of GHG emissions (about 75-77.7%), abrupt decrease of these emissions between 1990 and 2000 (by more than a half) as a result of economic recession, and subsequent increase in CO₂ emissions in 2002-2004 with economic growth.

The LULUCF sector in Ukraine is a net sink of greenhouse gases. In 1990, this sector removed about 3.7% of total carbon dioxide emissions, and in 2004 – about 7.8%. GHG emissions in energy, industry, solvents, agriculture and waste sectors, which totalled 925.4 mtCO₂-e in 1990; exceeded total GHG emissions by the value of net GHG removal in LULUCF sector (Figure 2.2).

The energy sector is the largest contributor to total GHG emissions and accounted for approximately 74.3% of total emissions in 1990.

Figure 2.2. Greenhouse gas emissions/removals in Ukraine by emission sources in 1990-2004, mtCO₂-e.

Source: [26]



2.1.2. Emissions of individual greenhouse gases

Carbon dioxide emissions. CO₂ is emitted in energy and industry sectors and also in LULUCF sector (where it is also removed). In 1990, net CO₂ emissions (GHG emissions minus GHG removals) in Ukraine were approximately 685.5 million tons, which is over 2.4 times more than net emissions in 2004.

CO₂ emissions in energy and industry sectors in 1990 made up 719.4 million tons and were primarily (82.8%) composed of fuel combustion emissions. Such CO₂ emissions structure is due to high energy intensity of the economy. Economic recession, which occurred after the collapse of the USSR, resulted in a considerable decrease in energy consumption. It produced a decrease in CO₂ emissions by 367 million tons in energy sector from 1990 through 2004. Economic revival in recent years has resulted in some increase of energy consumption and, correspondingly, CO₂ emissions.

Methane emissions. CH₄ emissions are the second largest contributor to GHG emissions. In 1990, CH₄ emissions in Ukraine were 7.2 million ton (151.2 mtCO₂-e). The principal sources of CH₄ emissions were the energy sector (60% in 1990), agriculture (35%) and waste (4.2%).

Energy sector-related CH₄ emissions occur primarily from coal mines and gas leakage during the production, transportation, storage and distribution of natural gas – 57.3% in 1990 and 70.8% in 2004. The major source of CH₄ emissions in agriculture is cattle enteric

fermentation (22.8% of total CH₄ emissions in 1990). Economic recession was accompanied by a decrease in agricultural production, which resulted in a decrease of methane emissions in this sector in 2004 by a factor of 4.3 compared to 1990.

In the waste sector, the largest CH₄ emissions occur from anaerobic decomposition of municipal solid waste (3.1% of total CH₄ emissions in 1990). Compared to 1990, emissions from MSW landfills increased in 2004 by 73 thousand tons. This is due to large content of degradable organic compounds in the landfill layers formed by the waste disposed from 1990.

Nitrous oxide emissions. In 1990, nitrous oxide emissions in Ukraine were 176.3 thousand ton. The emissions occur in energy, industry, solvents, agriculture, and waste sectors.

The principal sources of nitrous oxide emissions in Ukraine are agricultural soils (74.3% of total N₂O emissions in 1990) and manure (14.4%). In energy sector, nitrous oxide emissions (2.9% of total N₂O emissions in 1990) result from fuel combustion. In waste sector (2.8%) emissions are released from domestic wastewater, and in industry (4.8%) – from production of nitric and adipic acid. In 2004 as compared to 1990, annual nitrous oxide emissions reduced by 104 thousand tons, mostly due to agricultural production decline.

2.2. Projected emissions of greenhouse gases

2.2.1. Regulatory and informational basis of projections

Decree of the President of Ukraine of 27 December 2005 [27] has led to revision of principal directions of the national policy in the area of Ukraine's energy security. This document envisions increasing the use of domestic fuels (first of all, coal and uranium), reducing natural gas imports, and intensifying energy saving processes by means of improving production energy efficiency. In conformity with this decree, Energy Strategy of Ukraine Until 2030 was developed and approved by a decree of the Cabinet of Ministers of Ukraine on 15 March 2006 [28].

The Energy Strategy includes long-term forecasts of macroeconomic indicators and related dynamics of primary energy consumption. Taking into account that majority of Ukraine's emissions are generated in the energy sector, the Energy Strategy presents a basis for long-term projections of GHG emissions.

The strategy is developed for three periods differing from each other by social-economic development conditions, depth of division of labour, ratios of reproduction process, character of existing constraints on development, and practical measures of macroeconomic policy.

These periods are: until 2010 – a period of innovative reconstruction; 2011-2020 – a period of accelerated development of the Ukrainian service sector; 2021-2030 – a starting period of transfer to a post-industrial society with corresponding changes in economic structure. For each period, three scenarios were developed: pessimistic, baseline and optimistic (I, II, III). All these scenarios include implementation of domestic measures on production energy efficiency.

During the first period (until 2010) significant inter-sectoral structural shifts are not planned. Reconstruction of the economy will be connected with improvement of technological basis

within sectors and consolidation of market reforms. Innovative way of development implies decreasing the share of material expenditures, which will create conditions for increased expenditures on research and development, market studies, improvement of production management systems. This will push the demand more towards service providers. Further development of financial and crediting sector will contribute to re-distribution of capital in the economy and increased investments in the sphere of services.

During the second period (2006-2010) service-providing sectors will develop quicker than the sectors producing goods. Economic growth will be accompanied by changes in main sectoral and reproductive ratios. This period will be characterized by slower growth rates in all economic branches in accordance with world-wide trends. Economic production basis, restored by that time, will secure high level of production output and population welfare.

The essence of the third period (2021-2030) will be the transfer to a post-industrial economic system as a logical continuation of the previous development. Leading role will be taken first by the service sector and then by the information sector and the knowledge economy. Stability reached during the previous development stages will enable maintaining reasonable GDP annual growth rates.

Taking into account significant uncertainty in economic development figures for the period until 2003, this report considers only the first two of the indicated stages with breakdown by 5-year periods. Principal macroeconomic development indicators for the period until 2020 are presented in Table 2.2.

Table 2.2. Actual figures and projected dynamics of Ukraine's GDP for the period until 2020.

Source: [28]

Indexes	Past figures				Scenarios	Future periods		
	1990	1995	2000	2005 ¹		2010	2015	2020
GDP (in 2005 prices), USD billion	119.2	62.3	56.4	81.7	I	94.0	115.0	136.5
					II	103.3	133.7	168.2
					III	113.5	156.3	209.0
GDP growth rates compared to the previous period, %	-	52.3	90.5	144.8	I	115.1	122.3	118.7
					II	126.5	129.4	125.8
					III	138.9	137.7	133.8
Average annual GDP growth rates, %	-	-12.2	-1.95	7.74	I	3.0	4.5	3.7
					II	5.3	5.9	5.2
					III	7.8	7.5	6.8
GDP per person, USD thousand	2.30	1.20	1.14	1.73	I	2.0	2.6	3.1
					II	2.3	3.0	3.9
					III	2.5	3.5	4.8

¹preliminary data

2.2.2. Forecasted fuel and energy consumption

Forecasting of the volumes of fuel and energy resources consumption took into account the necessity of increasing energy efficiency by 2030 to the levels of industrially developed countries, and tasks connected with strengthening of Ukraine's energy security.

Coalfields are the major fuel basis of the country. This situation makes it important that rational volumes for coal use be established. Consequently, the forecasts considered the

following factors: existence of and prospects for the introduction of new technologies for coal combustion and processing; prospects for technical re-equipment of coal industry enterprises and construction of modern coal mines; resource capacity to increase coal production and its import. In forecasting coal consumption, possibility of reducing the losses during production, processing, transportation and use were also considered. Coal consumption in 2002 is estimated to be 63-92 mtce, which is 1.3-2.5 times greater than in 2005.

In comparison to other fuel types, natural gas is more environmentally safe and a universal energy resource. However, due to limited gas reserves, its domestic production equals approximately one quarter of the total gas consumption. The target of the gas saving strategy is to decrease the GDP gas intensity. It is forecasted that in 2020 gas consumption in Ukraine will make up 56-60 billion m³, i.e., will decrease by 26-32% compared to 2005 level.

Ukraine's domestic production of oil is insufficient to meet its internal needs. In the future, the share of domestically produced oil in the country's oil consumption will decrease significantly. In 2020, oil consumption (including gas condensate), together with its processing, is forecasted to be 29-32 million tons compared to 25.7 million tons in 2005.

Forecasted consumption of primary energy resources in 2020 is 212-269 mtce, compared to 205.2 mtce consumed in 2005, or 3-31% greater. It is important to note that in 1990 primary energy consumption totalled 353 mtce. In 2020, with 1.4 times GDP growth compared to 2005, forecasted baseline consumption will increase only by 19%. This may be explained by the impact of two main factors: structural shifts towards more energy and resources efficient economy, and implementation of energy saving policies.

2.2.3. Projections of greenhouse gas emissions

Of the total GHG emissions, more than a half is accounted for by fossil fuel combustion. According to forecasts, total volume of fuel combustion for baseline scenario will increase in 2020 by 13% compared to 2005, including almost doubling of coal combustion, liquid fuels combustion increase by 81% and gas combustion reduction by 33%. As a result, fossil fuel combustion related CO₂ emissions under baseline scenario will increase by almost a quarter over this period.

In calculating forecasted values of leaks – methane emissions resulting from coal production and natural gas related activities, both forecasted coal consumption and technical improvement of coal production and processing, leading to relative decrease of leaks in time were considered. As a result of technical progress in coal industry, increased utilization of coalbed methane, upgrades of the gas transmission and distribution systems, etc. under the baseline scenario, leaks are estimated to increase by 4 mtCO₂-e, or by 7% in 2020 compared to 2005.

GHG emissions from industrial processes are projected to increase with steadily decreasing growth rates due to structural changes in favour of accelerated development of processing industries, accompanied by reduction in GDP's materials and metals intensity. As a result, industrial emissions will increase in 2020 by a quarter compared to 2005.

It is expected that GHG emissions from agricultural activities will be changing in line with changes in the gross added value in this sector and will increase by a factor of 2.5.

Methane emissions from municipal solid waste and wastewater until 2020 will be practically unchanged (about 8.9 mtCO₂-e), that is, at the level of average annual emissions over 2000-2005.

In total, GHG emissions in CO₂ equivalent for the sectors of Annex A to the Kyoto Protocol (excluding combustion) are estimated to increase from 2005 through 2040 by a factor of 1.4 or by 75 million tons. Share of these sectors in total emissions will grow from 43% to 46% over this period.

Projected values of total GHG emissions in percentage of 1990 level for the three scenarios of economic development are shown on the Figure 2.3. Figure 2.4 presents projections of total GHG emissions with breakdown by Kyoto Protocol Annex A sectors for the baseline scenario.

Figure 2.3. Projected Ukraine's GHG emissions in percentage to 1990 level for the scenarios of economic development until 2020.

Source: [29]

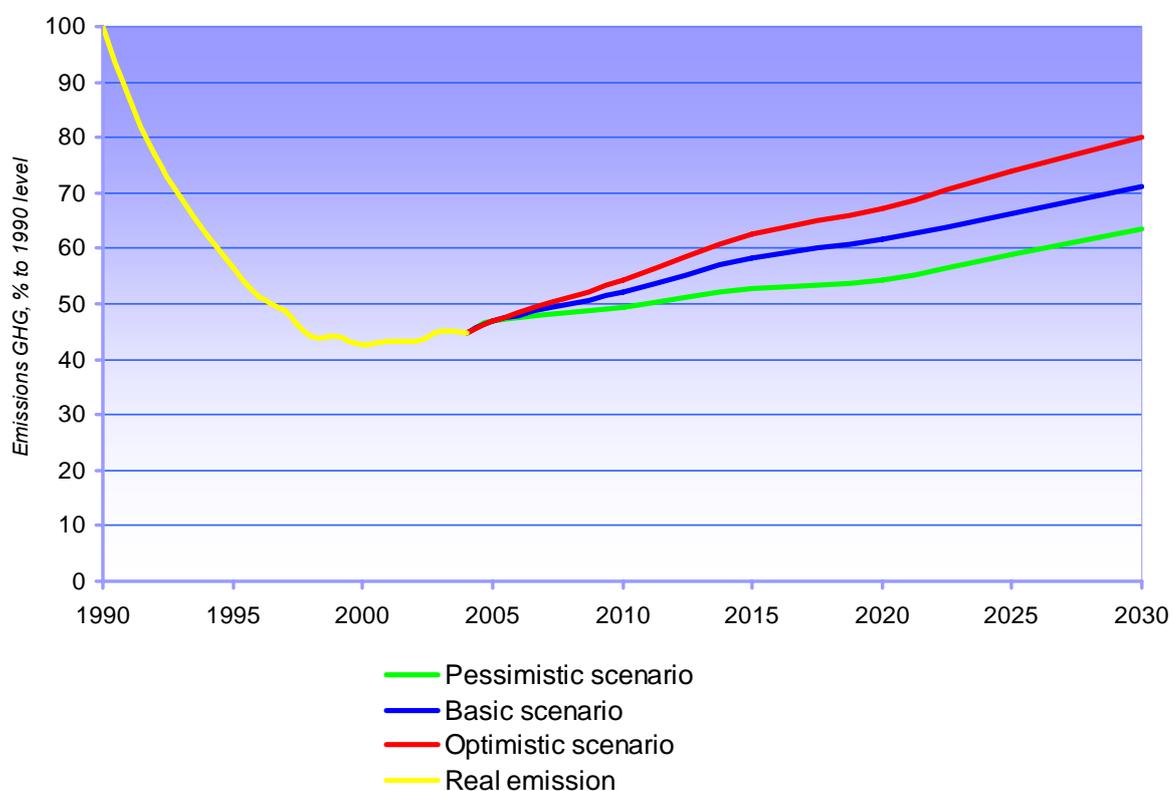
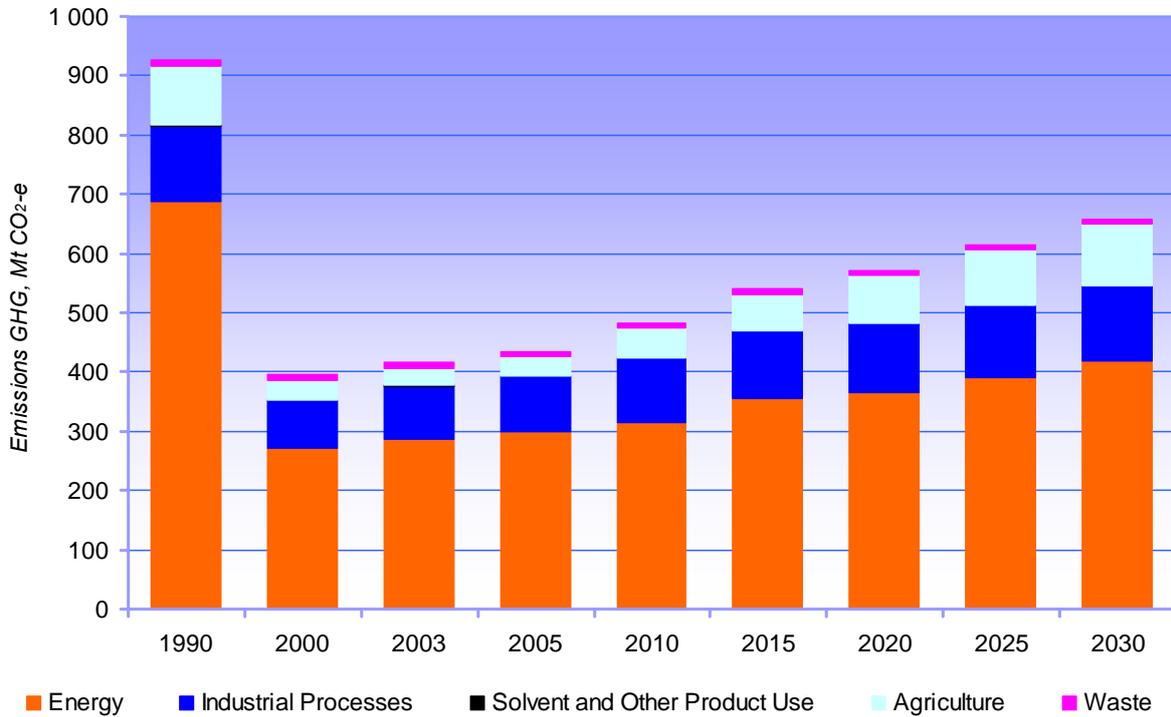


Figure 2.3. Projected changes in Ukraine's GHG emissions by Kyoto Protocol Annex A sectors for the baseline scenario, mtCO₂-e.

Source: [29]



According to the above projections of total GHG emissions, Ukraine will fulfil its commitments under the Kyoto Protocol, that is, in the first commitment period (2008-2012) will not exceed its aggregate GHG emissions in 1990 multiplied by five, since in this period annual emissions will not exceed 55% of the 1990 level. Moreover, as follows from presented projected data, Ukraine until 2020 will not exceed the 1990 level of GHG emissions even in case of optimistic scenario of economic development accompanied by the largest emissions.

3. ANALYSIS OF THE IMPACT OF DOMESTIC MEASURES ON GHG EMISSIONS

3.1. Tasks on reducing carbon intensity of the economy

According to the Energy Strategy of Ukraine Until 2030 [28], in order to reach world levels of energy efficiency in the end of forecasting period, the country should ensure reduction of annual energy consumption by 318 mtce by 2030. This should be achieved through structural energy saving (198 mtce) and technological energy saving (120 mtce).

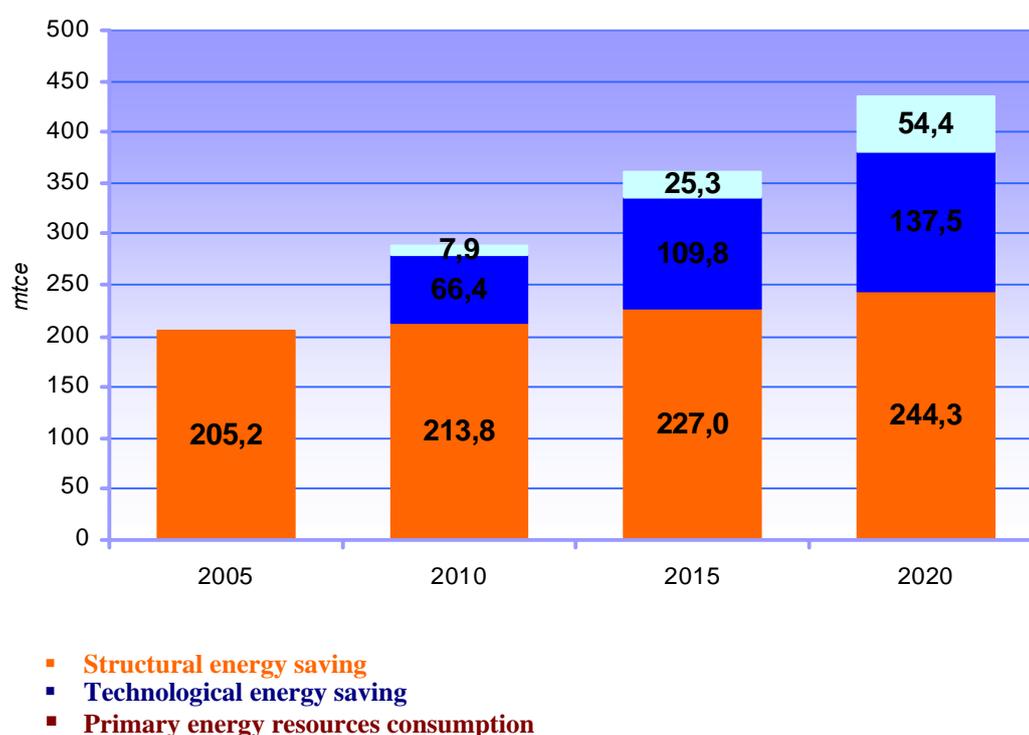
Under the baseline scenario of economic development, by 2020 it is forecasted for the GDP to more than double, while for the primary energy consumption to grow only by 19% (from 205.2 mtce in 2005 to 244 mtce in 2020). Due to realised energy saving potential, carbon intensity of the GDP in 2020 will be about 2.1 tce per USD1000, or 42% lower than 2005 level (3.67 tce per USD1000). In 2010, the carbon intensity is planned to be 3 tce per USD1000, and in 2015 – 2.6 tce per USD1000.

Both structural and technological energy saving measures contributing to achievement of these carbon intensity reduction tasks have sector-specific and inter-sectoral aspects and are described in detail in section 1.2.

Figure 3.1 presents forecasted dynamics of primary energy consumption and potentials of structural and technological energy saving, which would be realised in case of full implementation of policies and measures pertaining to baseline scenario of economic development.

Figure 3.1. Projected primary energy consumption under the baseline scenario and potentials of structural and technological energy saving until 2020, mtCO₂-e.

Source: [28]



3.2. Impact of structural and technological energy saving measures

GHG emissions reduction figures due to technological and structural energy saving are presented in Table 3.1. As seen from this table, the most significant direction is technological energy saving. It encompasses measures to improve production energy efficiency in economic sectors and sub-sectors of industry.

Table 3.1. GHG emissions reduction due to technological and structural energy saving measures, mtCO₂-e.

Source: [28] (input data for calculation of the table)

Components of energy saving	2010	2015	2020
Technological energy saving measures	104.1	177.9	213.1
including:			
sector-specific energy saving	79.3	146.6	181.6
inter-sectoral energy saving	24.9	31.3	31.5
Structural energy saving measures	12.5	41.0	84.3
including:			
sector-specific energy saving	5.1	15.9	41.5
inter-sectoral energy saving	7.4	25.1	42.8
Total	116.6	218.9	297.4

Due to the measures of technological energy saving in economic sectors and sub-sectors of industry, GHG emissions will reduce by 79.3 mtCO₂-e in 2010, by 146.5 mtCO₂-e in 2015, and by 181.6 mtCO₂-e in 2020 (Table 3.2).

Table 3.2. Realisation of GHG emissions reduction potential due to sector-specific technological energy saving measures, mtCO₂-e.

Source: [28] (input data for calculation of the table)

Sectors	2010	2015	2020
Measures to reduce primary energy consumption			
Industry - total	32.9	55.2	76.7
including:			
power industry	8.6	14	18.9
fuel industry	5.1	9.1	13.5
ferrous metallurgy	12.8	21	28.4
non-ferrous metallurgy	0.4	0.8	1.3
chemical and petrochemical	3.3	5.4	7.3
machine-building and metals processing	0.6	1.1	1.7
construction materials	0.7	1.2	1.8
light industry	0.1	0.1	0.2
food industry	1	1.7	2.3
other industries	0.4	0.8	1.3
Agriculture	9.6	18.4	22.2
Construction	0.5	1	1.3
Transport	9.2	17.6	21.3
Housing and communal services	8.1	15.4	18.7
Total	60.4	107.6	140.1
Measures to reduce electricity consumption			
Industry - total	7.5	16.9	15.4
including:			

Sectors	2010	2015	2020
power industry	1.1	2.5	2
fuel industry	1	2	2.2
ferrous metallurgy	2.6	5.7	5
non-ferrous metallurgy	0.4	0.9	0.8
chemical and petrochemical	0.6	1.3	1.2
machine-building and metals processing	0.5	1.2	1.1
construction materials	0.2	0.5	0.6
light industry	0.1	0.2	0.3
food industry	0.3	0.7	0.7
other industries	0.8	1.7	1.6
Agriculture	0.2	0.4	0.4
Construction	0	0.1	0.1
Transport	0.2	0.4	0.4
Housing and communal services	2	4.5	4.2
Total	10.0	22.1	20.5
Measures to reduce heat energy consumption			
Industry - total	4.8	11.8	14.5
including:			
power industry	0.1	0.1	0.2
fuel industry	0.6	1.5	1.6
ferrous metallurgy	1.3	2.9	3.5
non-ferrous metallurgy	0.3	0.7	1.0
chemical and petrochemical	1.0	2.3	2.8
machine-building and metals processing	0.4	1.0	1.3
construction materials	0.1	0.3	0.4
light industry	0.1	0.2	0.3
food industry	0.9	2.3	2.9
other industries	0.2	0.5	0.7
Agriculture	0.0	0.0	0.0
Construction	0.0	0.0	0.0
Transport	0.1	0.1	0.1
Housing and communal services	4.1	4.9	6.5
Total	9.0	16.8	21.1
Total for sector-specific technological energy saving measures	79.3	146.6	181.6

GHG emissions reduction potential due to inter-sectoral technological energy saving measures, as compared to sector-specific is more cost-effective (2-4 times). Table 3.4 presents estimated GHG emissions reduction potential that can be realised as a result of implementing technological energy saving measures having inter-sectoral applicability.

Table 3.3. Realisation of GHG emissions reduction potential due to inter-sectoral technological energy saving measures, mtCO₂-e.

Source: [28] (input data for calculation of the table)

Measures/ Energy resources	2010	2015	2020
1. Use of modern means of metering energy consumption			
Electricity	0.2	0.3	0.3
Heat energy	0.4	0.7	0.8
Fuel	1.6	1.8	1.8
Total	2.2	2.7	2.8
2. Development and introduction of automated systems to control energy consumption			

Measures/ Energy resources	2010	2015	2020
Electricity	0.4	0.5	0.4
Heat energy	0.1	0.2	0.2
Fuel	0.5	0.6	0.6
3. Use of economical electric lighting systems and appliances			
Electricity	2.4	3.0	2.9
4. Introduction of variable speed drives			
Electricity	10.1	12.3	12.1
5. Improvement of the structure of electric engines pools in sectors			
Electricity	1.8	2.1	2.1
6. Use of modern technologies of low-quality coal combustion			
Fuel	1.1	1.3	1.3
7. Improvement of heat supply systems			
Heat energy	2.6	4.5	4.9
8. Increasing the level of waste energy usage			
Fuel	4.1	4.8	4.7
Total for inter-sectoral technological energy saving measures	24.9	31.3	31.5
including reduced consumption of:			
Electricity	14.9	18.1	17.8
Heat energy	3.2	5.4	5.9
Primary energy	6.8	7.8	7.8

3.3. Development of non-traditional and renewable energy

In case of implementation of the planned measures to increase the share of non-traditional and renewable energy sources in the country's energy balance, substitution of primary energy carriers is estimated as 30.1 mtce per year in 2020. Such substitution will lead to annual GHG emissions reduction by 48 mtCO₂-e. Estimates of distribution of GHG emission reduction potential by the areas of non-traditional and renewable energy development and the years of forecasting period are presented in Table 3.4.

Table. 3.4. Realisation of GHG emissions reduction potential due to non-traditional and renewable energy development, mtCO₂-e.

Source: [28] (input data for calculation of the table)

Area	GHG emissions reduction		
	2005	2010	2020
Biofuels	2.0	4.2	9.9
Off-balance (waste) energy	21.7	23.6	24.7
Helioenergy	0.0	0.1	0.5
Small hydroenergy	0.2	0.8	1.3
Geothermal energy	0.0	0.1	0.3
Coalbed methane	0.1	1.5	4.4
Wind energy	0.0	0.3	0.8
Energy of the environment	0.3	0.5	6.1
Total	24.4	31.1	48.0

3.4. Dynamics of GHG emissions in situations without measures, with domestic measures and with additional measures

Projected GHG emissions for different situations concerning the implementation GHG emissions mitigation measures are presented on the Figure 3.2.

Forecast scenario “without measures” (or “business as usual”) reflects the effect of absence of any measures envisioned by government programmes and strategies, such as Comprehensive National Programme of Energy Conservation [5], Supplementary Measures and Updated Indicators of the Comprehensive National Programme of Energy Conservation [11], Energy Strategy of Ukraine Until 2030 [28] etc. It should be noted that definition of the concept “business as usual” as a scenario with complete absence of targeted measures is to a certain degree theoretical, because part of measures envisioned by previously adopted programmes and decisions is already in implementation phase.

Baseline, or most probable, scenario includes full spectrum of domestic measures envisioned by programme documents together with expected results of their implementation, and also measures, which are likely to be implemented due to working market mechanisms (first of all, in connection with sharp growth of energy prices) and structural changes in the economy.

Scenario with account of additional measures includes the effect of use of joint implementation mechanism, which enables achieving emissions reductions by the projects that would not be implemented without this mechanism.

As indicated in [11], practically achievable cost-effective potential of energy saving in 2010 makes up 40.5 mtce per year. Total cost-effective potential makes up about 85.5 mtce per year. This leaves beyond the scope of the programme additional cost-effective energy saving potential of about 45 mtce per year in 2010, for realisation of which it is necessary to involve non-traditional financial sources. Additional investment requirements until 2010 for generating energy savings of 45 mtce per year are approximately USD 4.8 billion.

JI projects are only partly financed by revenues from ERUs transfer. Therefore, the degree to which the indicated investment potential can be realised depends on the ERUs-related revenue share in the total investment. According to requirements set by the Ministry of Environmental Protection, the share of such revenues should not be less than 10% of required project investment. For majority of JI projects, external ERUs-related financing will most probably be in the range of 10-15% of required capital investment. It is estimated that with such share of financing from ERUs transfer, investments in energy saving under JI projects could make up USD 0.7-1.1 billion. This means that under the above assumption, external financing of the cost-effective (and thus not financially additional) projects due to ERUs transfer may be in the range USD 70-160 million.

The above estimate does not concern financially additional (i.e., not cost-effective) projects, whose possibility of implementation depends only on the size of revenues from ERUs transfer. Analysis of the pool of already identified potential JI projects shows that about half of them can be considered as financially additional. With account of the assumption made, such projects can attract, on the average, about the same financing as cost-effective JI projects. So, total potential external financing for JI projects can be estimated in the range of USD 140-320 million. Total capital financing for JI projects may make up USD 1.4-2.1 billion.

Given the capital intensity of energy saving measures at about 106 USD/tce indicated in [11], full realisation of JI projects potential may result in annual energy savings from 13 to 20 mtce. Dynamics of fuel consumption reduction and GHG emissions reduction by years of the first commitment period is estimated as shown in the Table 3.5.

Table 3.5. Dynamics of fuel consumption and emissions reduction and as a result of additional measures.

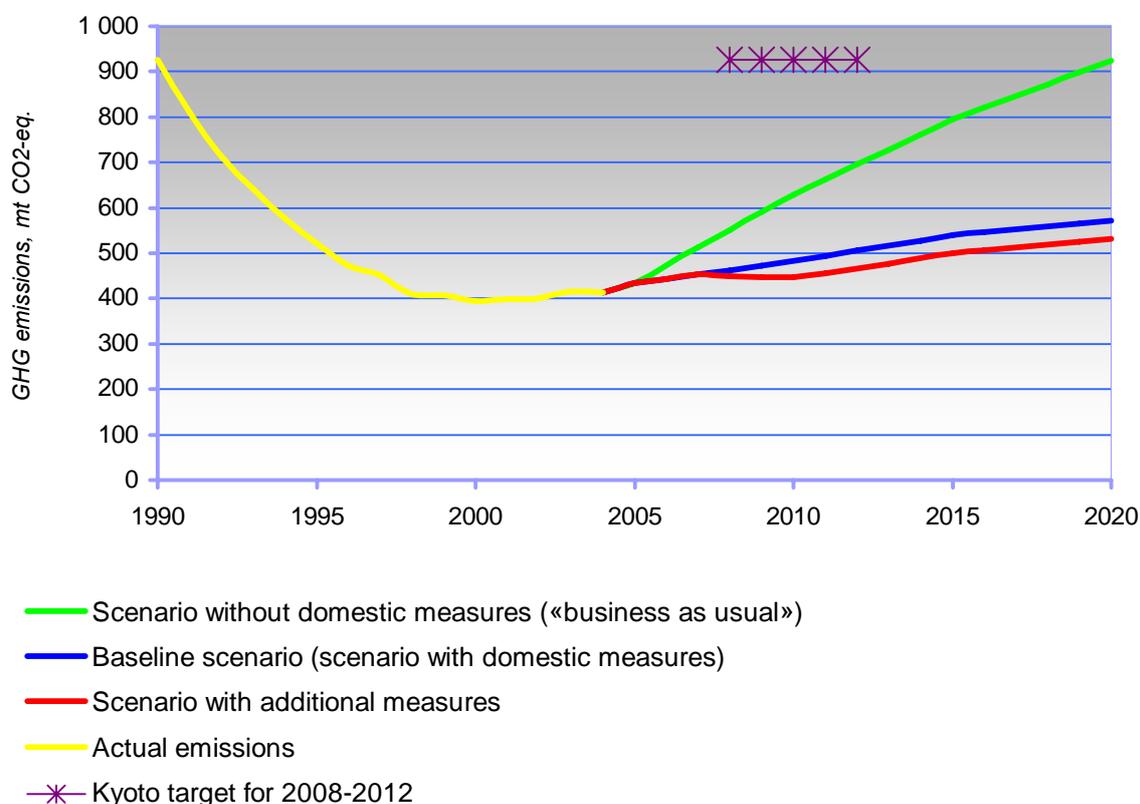
Source: expert estimates

	2008	2009	2010	2011	2012
Reduction of fuel consumption as a result of JI projects, mtce	7	14	20	21	22
Reduction of GHG emissions as a result of JI projects, mtCO ₂ -e	13	25	36	39	40

Projected GHG emissions under “business as usual” scenario (without domestic measures on energy saving, reduction of methane emissions from coal and gas related activities, and development of non-traditional and renewable energy), under baseline scenario (with domestic measures), and under scenario with additional (Kyoto mechanisms) measures is presented on the Figure 3.2. As can be seen from it, Ukraine will fulfil its commitments under the Kyoto Protocol even under “business as usual” or “without measures” scenario. During the first commitment period (2008-2012) annual emissions under baseline scenario with measures will be in the range 50-55% of 1990 level, and under “without measures” scenario – 60-75%.

Figure. 3.2. Projected GHG emissions until 2020 for different scenarios of measures implementation, mtCO₂-e.

Source: [28], [29], expert estimates



4. ACTIVITIES UNDER ARTICLES 10 AND 11 OF THE KYOTO PROTOCOL

In conformity with the requirements of Articles 10 and 11 of the Kyoto Protocol, Ukraine implements systematic activities in the following main areas.

Improvement of the quality of national GHG emissions and removals inventory. With the purpose of creating a common state-wide framework for national inventory, two decrees of the Cabinet of Ministers of Ukraine were adopted [3, 4]. During the last two years all existing annual inventories were converted to required format (CRF), and all gaps in the time series starting from 1990 were filled. Lacking estimates for the sectors “Solvents and Other Products Use” and “Land-Use, Land-Use Change and Forestry” (LULUCF) were developed, and thus required sectoral completeness of the inventory was reached. For LULUCF sector, transition from IPCC 1996 Guidelines to 2003 Good Practice Guidance was performed. For the most part, transition was performed from applied earlier Tier 1 methodologies to Tier 2 in accordance with 2000 Good Practice Guidance requirements. Studies on national emission factors are conducted, and further financing for them is planned. Within the framework of the latest inventory [26], a plan for GHG inventory quality control and quality assurance was developed and realised. In September 2005, international expert team of the UNFCCC Secretariat carried out in-country review of 1990-2003 inventory. All recommendations of the experts have been taken into account and are abided by.

Development and implementation of national and regional programmes. Ukraine has developed and implements national, regional and sectoral programmes aimed at reduction of fuel consumption, GHG emissions reduction and increase of GHG removal (section 1.2). Additionally, in conformity with the National Plan of Measures on Fulfilment of Provisions of Kyoto Protocol to the UN Framework Convention on Climate Change [1], development of a national action plan and regional plans of measures on climate change mitigation and adaptation to climate change has begun.

Promotion of environmentally sound technologies. In conformity with the National Plan of Measures [1], creation of the data base of environmentally sound technologies has started, together with exchange of technologies information between Ukraine and Parties to the Kyoto Protocol.

Cooperation in scientific and technical research and observation systems. As presented in the National Communication [29], Ukrainian academic and science research institutes widely participate in international research programmes and observation systems, such as Global Climate Observing System of the World Meteorological Organisation.

Education and training programmes. Development of environmental education is considered as a priority direction for modernisation of education in Ukraine. Currently education for the specialty “Ecology” is provided by 102 state and private higher educational institutions. For this specialty, components of sectoral standards of higher education have been approved. To improve environmental education and upbringing, high schools are creating modern environmental laboratories, banks of audio-visual programmes, slides, and popular science films on environmental protection, issuing ecology-related textbooks and manuals. In 2004-2005 only, 12 environmental manuals and textbooks for higher education were prepared for publishing. Wide range of general educational literature is being published – newspapers and popular science journals for teachers of schools, colleges and universities. Climate change

related information is provided to the public on the permanent basis, and there is ongoing cooperation with it on the global environmental problems connected with climate change.

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