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TO THE CONFERENCE OF THE PARTIES
TO THE UNITED NATIONS FRAMEWORK CONVENTION
ON CLIMATE CHANGE

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SUMMARY

1. Introduction

On 26 October 1994 Poland became a party to the United Nations Framework Convention on Climate Change (UNFCCC), hereinafter referred to as the Convention, thus joining the group of countries which committed themselves to protect the global climate.

The basic part of this Report contains the results of inventory of greenhouse gas emissions and removals in base year 1988 (corrected with respect to the results presented in the First Report) and for 1990, 1992 and 1994. It also gives the predicted emissions of greenhouse gases in 2010, information on the undertaken and planned activities aimed at emission reduction and removal enhancement and on the ability of the Polish economy to adjust to changed climate conditions.

The ratification of the United Nations Framework Convention on Climate Change imposed on Poland the same obligations as those undertaken by the other countries listed in Annex I to this Convention. The most important commitment is *to return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol*. For this group of countries this would mean a return to the 1990 emission levels. However, Poland has recognised the right for flexible approach to fulfilling its commitments resulting from the Convention in the following issues:

- The adoption of 1988 as the base year for appraisal of Poland's commitments. The 1990 emissions can be used only to assess the state-of-global-emission; they cannot, however, provide a basis for appraisal od Poland's fulfilment of its commitments resulting from the Convention,
- The presentation of greenhouse gas inventories in two-year cycle,
- The preparation of this Report following the guidelines developed for the First Report while giving consideration (where applicable) to the guidelines developed for the Second Report,
- An incomplete presentation of the greenhouse gas emissions projections by sectors and gases,
- The presentation of the Second National Report by 15 April 1998.

2. National circumstances

Since 1989, the Polish economy has been undergoing its essential transformation changes from centrally planned economy to free market economy. Processes had been set up to abandon the system of central budgetary donations provided to enterprises, and also privatisation processes. After two-year recession (1990-1991) caused by the transformation shock, and following the period of gradual economic recovery (1994-1995), in 1995 the Polish economy reached the highest GDP growth rate amounting to 7%, with a further drop in energy consumption required by an increase in the GDP, falling inflation and unemployment. That was accompanied by firm Gobernmental policy for the implementation of measures supporting or correcting the already existing solutions, appropriately to ongoing social and economic transformation and in accordance to gained transformation experience.

The industry share in creation of GDP in 1995 reached the level which was estimated at over 38%. A positive symptom of qualitative and structural changes in the industry was rapid growth of labour efficiency and the production share of processing industries in the total production. It should also be expected that, as a result of the ongoing modernisation of the production processes, the energy use efficiency will continue to improve. The year 1995 brought about a further increase in the production of construction and assembly enterprises, as a result of higher demand for investment projects, particularly the demand for contractors building industrial and service structures as well as those of technical infrastructure.

The privatisation of state-owned enterprises was one of the major processes involved in the transformation of the Polish economy. An overwhelming majority of ownership changes is taking place in industry, agriculture and building. The most important effects of the ownership changes include: a growing proportion of private ownership in the economy, stronger financial markets and higher revenues of the central budget gained on this basis and as well as higher efficiency in privatised state-owned enterprises.

Favourable trends emerged in agriculture. They consisted in intensification and modernisation of agricultural production, involving greater consumption of industrial inputs and a wider range of investments in 1995. Compared with the previous year the total agricultural production grew by about 13%; however, it was still lower than in 1989.

In Poland forests occupy 28.1% of the country's surface area. Compared with 1988 (27.7%) it indicates that the proportion of the country's territory occupied by forests continues to grow. The average annual wood harvesting accounts for 1-3% of the standing biomass of forests, never exceeding the current in the treestand capacity. An unfavourable feature of Polish forests from the point of view biological diversity is the slight differentiation of the treestand composition in terms of species as coniferous treestands dominate (78% of the surface area of forests). However, the species structure of forests changes significantly towards an increase in the proportion of deciduous species.

In general, in recent years favourable trends emerged and stabilised, indicating that the state of the environment had improved. Unfortunately, in 1997 Poland suffered from a flood on an until then unprecedented scale, causing a temporary deterioration of the state of the environment in the southern and western parts of the country. A legal act passed to regulate the fundamental issues of environmental protection and ensure a uniform policy for dealing with these problems was the amended Act on Environmental Protection and Management of 29 August 1997.

3. Inventory of greenhouse gas emissions and removals

Inventories of man-made emission sources and sinks of greenhouse gases provide the basis for an appraisal of the performance of the Parties to the Convention as listed in Annex I to this Convention, including Poland, in fulfilling their commitments imposed on them by the Convention. This Report presents inventories of the emissions and removals of the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Given the significant discrepancies between the estimates developed by different centres this Report does not contain inventories of the other gases, such as nitrogen oxides (No_x), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC).

The changes in the emissions of greenhouse gases between the base year (1988) and 1994 are shown below (in Gig) and indicate a systematic drop in CO_2 emissions, which was particularly significant after 1988 when the Polish economy temporarily collapsed:

	CO_2	CH_4	N_2O
1988	477 584	3 141	70
1990	381 482	2 801	63
1992	372 311	2 474	50
1994	372 293	2 467	50

This falling trend can also be seen in CO_2 emissions per capita: they fell from 12.61 Mg in 1988 to 9.65 Mg CO_2 per capita in 1994. A falling trend can also be seen for CH_4 and N_2O, with the emissions of all the gases stabilising to some extent since 1992. The inventory of greenhouse gas emissions for the base year (1988) presented in this Report have been corrected with respect to those given in the First National Report to the Conference of the Parties to the Convention, following the recommendations of the Mission of the UNFCCC Secretariat which carried out an in-depth review in March 1995. The present version has been prepared in accordance with the IPCC methodology (*IPCC Draft Guidelines for National Greenhouse Gas Inventories 1995*). In order to evaluate the degree of efficiency of the actions undertaken by Poland and for comparison, inventory of greenhouse gas emissions and removals are also presented for 1990, 1992 and 1994. The inventory of greenhouse gas emissions and removals in 1992 was prepared following the OECD/IPCC methodology recommended by the Conference of the Parties to the Convention and published in 1994 in *the Greenhouse Gas Inventory Workbook. IPCC Draft Guidelines for National Greenhouse Gas Inventories* (these inventories were presented in the First Report). The greenhouse gas emissions and removals in 1990 and 1994 were calculated following the methodology of the *IPCC Guidelines for National Greenhouse Gas Inventory 1995* (just as in those for 1988, the 1990 inventories were prepared again on request from the aforementioned Mission of the UNFCCC Secretariat). The factors applied to greenhouse gas emissions and removals in the inventories for all the years are given in Annexes A - D to this Report.

4. Policies and measures to mitigate greenhouse gas emissions

The Government's policies and measures aimed at greenhouse gas emissions reduction and removals enhancement covered the following sectors of the Polish economy: industry and power generation, transport, the municipal sector, agriculture and forestry. Many such actions were undertaken in these sectors, including those aimed at improving the efficiency of energy use. These actions included:

- the reduction of energy and material consumption by industry through its restructuring,
- the improvement of the energy performance of vehicle engines and the promotion of rail, combined and public modes of transport,
- the enhancement of the heat insulation of buildings, permitting a more rational use of the heat energy,
- a change in the fuel consumption structure aimed at increasing the proportion of hydrocarbon fuels, including a wider use of methane from coal beds and landfills,
- a wider use of renewable energy sources,
- intensification of breeding outputs by changing the cattle breed structure and increasing the milk yield rate per cow,
- a change in the fertilisation system with a view to rationalising the consumption of mineral fertilisers (including nitrogen fertilisers) and increasing the proportion of organic fertilisers,
- the enhancement of CO_2 absorption and accumulation in forests by enlarging the extent of the country's territory occupied by forests and improving the forests condition.

In Poland, many activities are undertaken to reduce greenhouse gas emissions within the framework of international co-operation, including the ecoconversion of Polish foreign debt, bi- and multilateral co-operation and co-operative actions carried out within the framework of the Joint Implementation mechanism.

5. Main directions in the development of the Polish economy until and beyond 2000

This chapter presents the main directions in the development of the Polish economy, including, e.g., programmes contributing to the greenhouse gas emission reduction and removal enhancement in particular sectors of the Polish economy.

The development scenario for the Polish economy until 2010 assumes:

- technological and economic progress in the economy leading to further energy efficiency,
- production growth in most existing and modernised production plants,
- change in the primary energy structure towards one more diversified in terms of fuel variety and with a greater proportion of noble energy media,
- the implementation of technology with greater economic efficiency and energy performance,
- rationalisation of fuels and energy use,
- development of public awareness with respect to the need for rational use of primary energy media accumulated in nature,
- the promotion of energy efficient vehicles and transport systems, fuels which pollute the air to a lesser extent, the stimulation of actions for reducing the harmful effects of transport in urban areas,
- enhancement of concentration and specialisation in cattle breeding, milk and beef production and improved efficiency of their production and processing on the assumption that the cattle population will grow and the sheep population will be restored,
- comprehensive conservation of forest resources, the expansion of the proportion of the forest-occupied area in the country, the protection of biological diversity in forests, the transformation of the species structure in forests in order to ensure their contribution to climate regulation, water management and nature conservation.

In addition, this chapter also describes macroeconomic scenarios for the reduction of greenhouse gas emissions based on long-term development predictions for the country's economy using the MERS reference scenario. The predicted CO_2 emissions in Poland until 2010 vary between 429 000 and 502 000 Gg CO_2, depending on the scenario adopted, with the 1988 emissions assumed to be 484 000 Gg CO_2 (according to the data in the First Report).

6. Vulnerability assessment and adaptation strategies to climate change

The vulnerability assessment of particular economic sectors and their adaptability to climate change was developed on the basis of the results of research conducted by independent experts.

It is estimated that the whole of the Polish coast, extending for 2200 km^2 and inhabited by more than 230 000 persons, is threatened by climate change implications. The strategy of full protection of the Polish coast consists in the implementation of all the feasible precautions and protective measures aimed at minimising any losses of land or deterioration of its value, including above all the creation of protection systems along the open coast (dikes, seawalls and offshore breakwaters), renovation of the existing polders and building new ones. It should be noted that for the greater part of the coast the cost involved in its protection is much less than the value of the land that may be lost.

At present, it is yet uncertain how the climate change will affect the water resources and the related needs. In the case of most adverse "dry" scenario, even more drastic summer drought periods should be expected especially in central Poland and the need for agricultural irrigation will grow. The research has shown that water management systems in Poland may be effectively adapted to changing climate conditions by undertaking suitable technical solutions. In turn, the adaptation cost may vary in different regions of the country, depending on the intensity of the predicted water deficit.

It is exoected that the projected climate change in Poland will affect the agricultural production in many ways. On the one hand, when the CO_2 concentration doubles and the temperature grows the crops of most of now cultivated plants may be expected to increase. Longer vegetation period will create conditions favouring extension of the scale of pasture management. Potato growing may be reduced in favour of the cultivation of thermophilous plants such as maize, soybean, oilseed sunflower or oilseed squash. It may be expected that even late maize varieties will mature throughout the country and their yield will be higher than now. On the other hand, however, the diseases and pests of crop plants will propagate and the water deficit will grow, making it, e.g., necessary to intensify amelioration works.

The expected climate change may cause long-term effects for forests in Poland, consisting, e.g., in changes in the biotic environment, water availability, habitat quality as well as reducing the ability to perform social functions, with these functions becoming increasingly more important for environmentally friendly communities. In some areas, the species now assigned to natural plants may not adapt sufficiently to new limited environmental conditions which would result from the climate change in these areas. The newly emerging communities are likely to consist of few species; and it can be expected that they will be more exposed to invasions of better adapted phytophagous and pathogenic species, which will thus restore in an ecological sense the previously partly lost biological diversity.

7. Monitoring of greenhouse gases and scientific research on climate change

In recent years two stations began to measure the concentrations of greenhouse gases and their precursor in Poland. Both stations are situated far from man-made impacts. On Mount Kasprowy Wierch the station for research on the composition of the atmosphere measures the concentrations of CO_2, CH_4, N_2O and SF_6. In turn, at the Station for Complex Monitoring of the Environment located in Puszcza Borecka, which conducts research aimed at assessing man-effected changes of the natural environment, measures the concentration of CO_2. It is planned that this station will extend its range of monitoring of greenhouse gases with studies on the concentration and isotopic composition of CO_2, CH_4 and SF_6.

The climatological research in Poland covers the following basic issues: climate change and variability, and physical, dynamic and regional climatology. The research on climate change and variability is concerned, e.g., with an assessment of the variations of the extreme climate phenomena and long-term climate change in Poland and Central Europe. Some attempts were also made to develop climate change scenarios on a regional scale for Poland. The priority was the work for the UNFCCC, including the development of a strategy for reducing greenhouse gas emissions and adaptation of the economy to climate change.

8. Education and NGOs

Environmental education activities in Poland take two basic forms: formal and informal. The formal environmental education is conducted at all school levels. The 21 fields distinguished in the teaching programmes in the Polish education system include environmental education, covering above all knowledge of hazards to the environment caused by winning and processing forms of energy (including the greenhouse effect). The informal environmental education is mainly conducted by non-governmental organisations and social movements which organise lectures, seminars and scientific conferences for the general public.

In Poland a dozen or so different non-governmental organisations are concerned with the issues of climate protection. The purpose of their efforts is to cause Poland to pursue an active policy of climate protection and meet all its obligations which result from the Convention. They also promote activities which reduce greenhouse gas emissions, e.g., by an efficient use of energy and its production from renewable sources, the development and promotion of public transport and energy-saving lighting, improvement of the extent to which carbon is absorbed by biomass etc.

1. INTRODUCTION

On 26 October 1994 Poland became a party to the United Nations Framework Convention on Climate Change (UNFCCC), thus joining the group of countries which committed themselves to project the global climate.

1.1. Aim of this report

The basic aim of this Report is to present to the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), hereinafter referred to as the Convention, following its Article 12 Paragraphs 1 and 2, the policy scope of the Polish Government aimed at mitigation of greenhouse effect enhance, and also to reveal the inventory of activities aimed at execution of obligations resulting from the Convention.

The main part of this Report contains the results of inventory of greenhouse gas emisssions and removals in base year 1988 (amended in relation to results presented in the First National Report to the Conference of the Parties) and for 1990, 1992 and 1994. It also gives the predicted emissions of greenhouse gases in 2010, information on the undertaken and planned activities aimed at reducing the emissions and increasing their removals and on the ability of the Polish economy to adjust to changed climate conditions.

1.2. Poland's commitments resulting from the United Nations Framework Convention on Climate Change

Having ratified the United Nations Framework Convention on Climate Change, Poland assumed obligations the same as designed for other countries enlisted in Annex I to this Convention. One of the most important is *to return by the end of the present decade to earlier level of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol* (Article 4, Paragraph 2, Item (a) of the Convention). That means for this group of countries to return to emission levels of 1990. However, for Poland that means to stabilise the emission in 2000 on the level of 1988. Consequence of this commitment is a need to preparing and implementation of an appropriate national action programme aimed at achieving such a goal.

1.3. Specific conditions for fulfilling Poland's commitments

In accordance to Article 4.6 of the Convention and Paragraphs 4a and 7, Decision 9 of II Conference of the Parties to the Convention, Poland has recognised the rigth for flexible approach to fulfilling its commitments resulting from the Convention in the following issues:

- 1998 has been assumed as year for appraisal of Poland's commitments; emission volume as defined in 1990 can be only used for the assesment of the state-of-global-emission, it cannot however constitute a basis for any settlements of Poland's commitments resulting from the Convention;
- Greenhouse gas inventories will be presented in two-year cycle;
- This Report was prepared in accordance to guidelines as defined for the First Report, while taking into account (where applicable) the guidelines defined for the Second Report, as specified in the Annex to Decision 9 of the Second Conference of the Parties;
- Projection of greenhouse gas emission by both sectors and gases might has been presented here in a not full manner;
- The Second National Report will be presented by 15 April 1998.

The reason for taking the assumption to change the base year from 1990 to 1988 was the fact, that 1990 was the first year after substantial political and economic transformation in Poland, that led to important change in political system. This apparently resulted in staggering the foundations of Polish economy[1] which had even temporarily collapsed. Therefore, the emission of greenhouse gases of 1990 does not correspond neither to normal emission level, as it has resulted from development needs of Poland, nor to factual economic potential of the country. In othe words, the choice of 1990 would not be authoritative for the Polish economy.

[1] Justification to assume 1988 as the base year for Poland was explained detaily in the National Report to the First Conference of the Parties to the United Nations Framework Convention on Climate Change [1994].

2. NATIONAL CIRCUMSTANCES

2.1. Geographical environment

Poland is situated in medium geographical latitude (49° 00' – 54° 50' j N) of Central Europe. Total country area, including marine inland waters, i.e. the Wisla and the Szczecin Lagoons, and ports, is 312,685 km^2 . Terrain configuration is latitude parallel: from coastal lowlands at the Northern part of the country, throughout lakeland highlands and wide lowland belt, to Southern highlands and mountains, where two major rivers originate to run throughout Poland, i.e. Wisla (1047 km) and Odra (854 km). Polish landscape is dominated by vast lowlands: 54% of the country area is situated lower than 150 metres above sea level, almost 37% – on the altitude of 150-300 metres. Highland and mountain areas (over 300 m above sea level) cover about 8% of the country area, including 0.1% covered by high mountains.

Such latitude parallel terrain configuration, while its altitude grows from the Baltic Sea basin towards the South, constitutes an important factor for the development of climate conditions in Poland, allowing for an unrestrained parallel exchange of air mass. Therefore, the characteristics of climate in Poland is its transience, i.e. impact of as well marine as continental climate features is apparent, depending on current activity of atmospheric pressure configurations occurring over Central Europe. This in turn results in significant variation of climate and weather conditions, occurring year after year and day after day, respectively. Mean annual air temperature in Poland in the period of 1951-1980 was 7.4°C, but during the decade of 1981-1990 it increased up to 7.9°C. Extremely warm were recent five years. Mean annual air temperature in the period of 1991-1995 was 8.2°C. Maximum temperature within 45-year period (1951-1995) varied in particular regions of the country from 30.7°C up to 38.0°C, whilst minimum temperature varied in that period from -18.2°C to -35.4°C. Amplitude of extreme temperature values varied then from 51.9°C in coastal zone up to 70.9°C in Eastern area. Most frequently, the warmest month is July, when mean temperature grows gradually towards the South, and it amounts from 16.3°C in coastal zone up to 18.1°C in Southern lowlands (1951-1980). In the period of 1991–1995, the temperature range had grown from 17.6°C up to 20.2°C, respectively. In the summer, over the highest mountain areas, mean monthly temperature had not exceeded 9°C. January is usually the coldest month of the year, with its mean monthly temperature varying meridionally from -0.1°C in Western coast to -4.2°C in the East. During the five years of 1991-1995 these values amounted from +1.6°C to -1.6°C, respectively. The influence of terrain configuration can be the most apparently perceived in the distribution of annual sums of precipitation: the lowest sums are observed in the lowlands of Central Poland (about 500 mm), and the biggest ones apply to high mountains (about 1,500 mm), while the summer precipitation is prevailing over winter precipitation. Precipitation can be characterised by its both significant spatial variation and strong fluctuation, year after year. Mean annual sums of precipitation in Poland in the period of 1951-1980 (excluding mountain meteorological stations) amounted to 611 mm, and in the decade of 1981–1990 – 578 mm, and during recent five years – amounted to 582 mm. Also, in highland areas a decrease of precipitation has been observed for the last 15 years.

Poland is one of the poorest countries in Europe as concerns water resources, resulting in 1,600 m^3 water per capita annually. Additionally, the characteristics of these resources is their seasonal variation and territorial differentiation. This in turn causes periodical danger of water deficit in many regions of the country. Average drought occurs every three years. During last 50 years, in 1959, 1969, 1982, 1986 and 1992 several droughts occurred, while having significant territorial impact. In July 1997, catastrophic flood affected the Odra and Wis³a river basins, unknown from several hundred years (see Chapter 2.3).

In 1990-1995 water uptake for public and economy purposes decreased by 15%. This resulted because of twofold reason: decline of industrial production in many water consuming plants, and more effective manner of water use by both the industry and the public. Over 83% of water volume used came from surface water resources. Remaining water supply sources are underground waters (15%) and mine waters (2%). Industrial plants have been for many years the major users of water resources, amounting to about 70% of total water uptake (apart from agriculture and forestry).

2.2. Social and economic characteristics

2.2.1. Social characteristics

Demography . Since mid eighties, population growth rate has declined in Poland. During recent 7 years, i.e. in the period of 1988-1995, population number grew by 724 thousand and it amounted to 38,609 thousand at the end of 1995 (8th position in Europe), while birth rate dramatically decreased from 5.7‰ to 1.2‰ (see Table 2.1). In the nineties, a stabilisation is being observed of participation of inhabitants living in urban areas,

while amounting to 61.8%. There are 860 cities in Poland, including 20 cities of over 200 thousand inhabitants. Warsaw, the capital of Poland and the biggest Polish city, has 1,635 thousand population.

Table 2.1. **Selected demographic data for Poland**

Years	Population		Birth rate [‰]	Population in urban areas [%]
	total in thousands	per squere km^2		
1950	25 035	80	19.1	36.9
1960	29 795	95	15.0	48.3
1970	32 658	104	8.5	52.3
1980	35 735	114	9.6	58.7
1988	37 885	121	5.7	61.2
1990	38 183	122	4.1	61.8
1991	38 309	123	3.7	62.0
1992	38 418	123	3.2	61.7
1993	38 505	123	2.6	61.8
1994	38 581	123	2.5	61.9
1995	38 609	123	1.2	61.8

Source: GUS

Change in future demographic situation in Poland will cause specific consequences for social and economic policies. Following the UN estimates, an anticipated change in population in Poland until 2050 is shown in Figure 2.1. This has included three scenarios: ”low”, anticipating a decline in population after 2020; ”medium” (the most likely), anticipating gradual population growth; and ”high”, predicting population number at over 50 millions, in 2045. As results from this long-term UN prognosis, a significant growth in terms of the number of people in ”productive” age can be expected especially in the period of 1995-2005, jointly with growing participation of ”productive” people who are getting elder, and with rapid increase of a number of old people in a ”post-productive” age, particularly in the period of 2010–2025. National demographic prognosis until 2010 goes in line with that ”medium” one of the UN, and it anticipates population number at over 39 million in 2000, and in 2010 – 40 million.

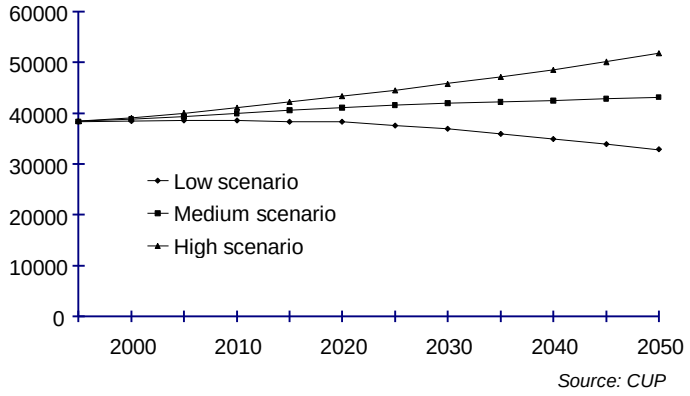

Fig. 2.1. Expected changes in population number [thousands inhabitants]

Economic situation in households. There are over 12.5 million households registered in Poland, each of average number 3.06 members. High economic growth which resulted in 1995 has been reflected by the upgrading of financial (income) situation of families – real income increased for all types of households, however income differentiation between particular household types have got deeper. There are positive tendencies in trends for income allocation, those are reflected mainly by reasonable participation of savings in the income of

the public, and also in the improvement of furnishing the households with household goods. Selected characteristics of household goods per 100 households are following:

- TV set – 114.4 (including colour TV sets – 91.5)
- TV-Sat equipment – 29.8
- Microcomputer – 7.7
- Automatic washer – 61.0
- Refrigerator – 98.2
- Motorbike – 5.8
- Car – 40.6

However, it is still the case, that the Poles used to allocate major part of their income for foodstuffs and permanent housing fees, that has comprised from over 45 up to 64% of total household expenses.

Unemployment. During the transformation period of the Polish economy (1990-1995) substantial changes occurred also in the labour market. Three time periods can be distinguished here:

1) 1990-1991 – Characteristics of this period, pertaining to the collapse of economy and decline of GDP, is a deep decline of labour supply (employment number declined almost by 2 million) and the growth of unemployment number amounting to 2,156 thousand people at the end of 1991 (unemployment rate – 12.2%); over 1 million people changed to retired status.
2) 1992-1993 – Characteristics of this period is diminishing a decline rate of a number of employed people; unemployment number amounted up to 2,890 thousand people, and the growth of unemployment rate amounted to 16.4% in 1993; large number of people being fit to job (about 4 million) changed from production sphere to social one (i.e. pension).
3) 1994-1995 – Characteristics of this period is a growing demand for labour force, followed by the increase of employment; unemployment declined in 1995 by 216 thousand people in relation to 1993; unemployment rate amounted to 14.9% in 1995 (see Figure 2.2).

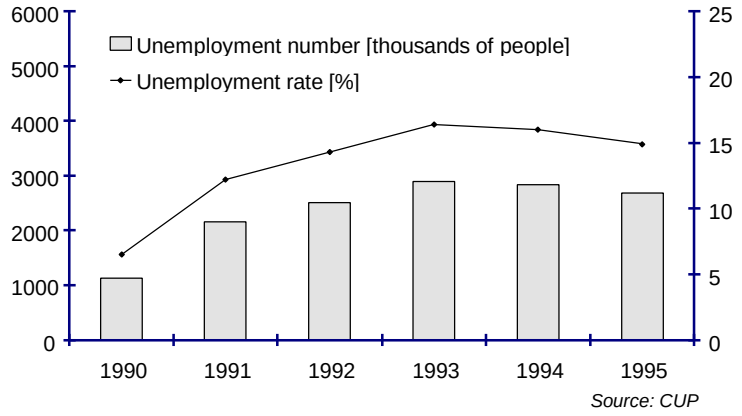

Fig. 2.2. State of unemployment

Despite this positive tendency, unemployment rate in Poland is one of the highest in Europe. During recent five years, situation in labour market was strongly affected by demographic factors – number of people in productive age had grown in this period by about 750 thousand. In forthcoming years, essential impact which will determine the growth of unemployment is demographic peak which is going to enter the labour market. In the period of 1996-2000 an increase of population in productive age will amount to about 1 million people. A positive phenomenon is economic boom, which has caused the growth of demand for labour force, and hence growing is the number of unemployed people who have reactivated their employment, e.g. 914 thousand people in 1995. Hampering of the growth, and in turn causing a decline of unemployment, both the factors resulted to some extent from enhancement of active counteraction forms against the unemployment, while being financed by the Government from the resources of their Labour Fund. The number of unemployed people who are comprised by such activity has increased systematically: from 71 thousand people in 1991 up to over 570 thousand in 1995. However, in the presence of high unemployment, majority of resources coming from the Labour Fund are consumed in the form of allowances being paid directly to unemployed people. The share of the Fund's outlays allocated to active forms of counteraction against the unemployment has undergone its significant fluctuation, amounting from 32.1% in 1990, in the circumstances of yet relatively low unemployment, up to 4.7% in 1991-

1992, and up to 11.9% in 1995. Mostly negative feature of structural unemployment in Poland is its considerable regional differentiation, that is caused firstly by uneven level of economic development of particular regions, and also by their differentiated demographic situation. The highest unemployment rate is the characteristics of Northern and north-eastern regions of Poland, which are weakly economically developed. A considerable share in generating the unemployment in those regions resulted for liquidation of their state-owned farms. Market transformation had badly affected also the conditions for agricultural unemployment. The number of unemployed people living in rural areas in 1995 amounted to 800 thousand, i.e. 35.8% of total unemployment number, while the unemployment rate in rural areas was 12.2%.

2.2.2. Economic characteristics

Specific features of the Polish economy. Since 1989, the Polish economy has been undergoing its essential transformation changes from centrally planned economy to free market economy. Processes had been set up to abandon the system of central budgetary donations provided to enterprises, and also privatisation processes. After two-year recession caused by the transformation shock, and following the period of gradual economic recovery, in 1995 the Polish economy reached the highest GDP growth rate. That was accompanied by firm Governmental policy for the implementation of measures supporting or correcting the already existing solutions, appropriately to ongoing social and economic transformation and in accordance to gained transformation experience. Three stages can be distinguished here:

I. Recession (1990-1991) – a period of implementation of economy stabilisation programme, mainly through controlling the inflation processes and setting up the changes within existing economic system. Basic prerequisites adopted for this programme were aimed at the implementation of radical ownership transformation, initiation of active antimonopoly policy, liberalisation of prices and adjustment of their structure to that functioning in world-wide market, world-wide opening of the Polish economy, setting up the capital market, and allowing for foreign investment in Poland. As the result of those activities, a deep collapse of market conditions occurred. In relation to 1989 level, GDP decreased by 14%, industrial production dropped by 30%, and investment outlay diminished by 14%. Unemployment rapidly increased. Retail prices grew almost 12 times, and real wages in national economy descended by about 25%.
II. Recession breakthrough (1992-1993) – an initial phase of deeper structural changes, limitation of both the employment reduction rate and the unemployment growth, effective restraint of inflation rate and strengthening of growth processes. As the result, in relation to 1991, in 1993 followed the growth of GDP by 6.5%, industrial production by 9.4%, and investment outlay by 2.7%.
III. Improvement of market condition (1994-1995) – a phase of apparent economic growth. Economic changes brought about further strengthening of restructuring processes. Within the two years GDP grew by 12.6%, and the increase of investment rate was also noted. Investment outlay within entire economy grew by almost 30%, including twice as much in private sector.

Gross Domestic Product (GDP). In 1995, while both inflation and unemployment decreased, high rate of economic growth has still persisted. Year 1995 had been the year of further growth of GDP for four years, a factor considered as a measure for national economic development. Its rate grew by 7%, while the GDP energy intensity had still decreased (see Figure 2.3). It is estimated, that in 1995 GDP per capita reached the level amounted to 6,350 USD PPP, in relation to 4,466 USD PPP in 1991.

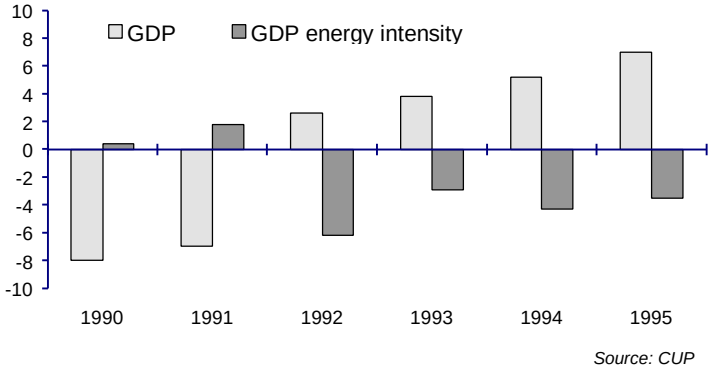

Fig. 2.3. GDP change rate and its energy intensity [previous year = 100]

Industry. The industry share in creation of GDP in 1995 reached the level which was estimated at over 38%. A positive symptom of qualitative and structural changes in the industry was rapid growth of labour efficiency (by 9.8%) and the production share of processing industries (from 81.8 up to 83.3%). The rate of change in industrial production is illustrated in Figure 2.4.

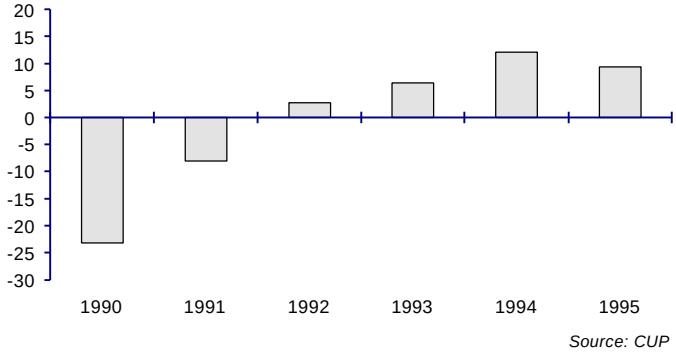

Fig. 2.4. Rate of changes in industrial production [previous year = 100]

Energy and fuel sector. Transformation of economy, that ensued after 1989, caused a significant decline in GDP energy intensity, that was particularly visible in 1995 (see Table 2.2). However, it should be expected, that as a result of continuing modernisation of technology processes, the effectiveness of energy use will be constantly growing.

Table 2.2. **Energy intensity of GDP**

Years	1987	1988	1989	1990	1991	1992	1993	1994	1995
Energy intensity of GDP [kJ/USD'94 PPP]	24.8	23.6	22.4	20.9	22.0	21.3	21.2	19.2	18.5

Source: GUS

Basic factors causing relatively high GDP energy intensity in Poland, while compared with that of European Union member states, are among others: low economy effectiveness in the past, low share of noble energy carriers, i.e. oil and natural gas, within the structure of primary energy (see Tables 2.3), low share of high productivity energy carriers, i.e. electric energy, liquide and gaseous fuels within the structure of final energy and low electric energy use per capita (see Tables 2.4 and 2.5).

Table 2.3. **Structure of the primary energy use in Poland**

Energy carriers	Primary energy use in years [%]									
	1970	1980	1988	1989	1990	1991	1992	1993	1994	1995
Hard coal	81.3	73.0	67.6	66.4	63.5	64.2	62.9	60.7	59.5	59.8
Lignite		5.4	11.1	11.3	13.3	13.9	13.8	13.5	13.4	12.8
Oil	10.3	13.1	11.5	12.4	12.5	11.8	13.0	13.1	13.8	13.4
Natural gas	5.8	7.4	8.1	7.8	9.5	8.7	8.6	8.7	9.1	9.8
Peat and wood		0.4	0.3	0.6	0.5	0.7	0.9	3.2	3.3	3.2
Other fuels	2.6	0.7	1.4	1.5	0.7	0.7	0.8	0.8	0.9	1.0
Total [PJ]		**5189.8**	**5376.2**	**5108.3**	**4247.3**	**4159.1**	**4120.2**	**4262.6**	**4076.7**	**4179.7**

Source: GUS

Table 2.4. **Structure of the final energy use in Poland**

Energy carriers	Final energy use in years [%]									
	1970	1980	1988	1989	1990	1991	1992	1993	1994	1995
Solid fuels	44.9	35.9	34.6	32.5	24.2	26.2	28.2	31.2	34.5	36.0
Liquid fuels	9.8	13.2	13.0	13.7	15.1	15.2	15.4	14.8	15.8	17.4
Gasous fuels	11.8	13.1	14.0	14.4	15.9	14.3	14.1	13.8	14.3	15.5
Electricity	7.9	10.0	12.0	12.7	14.5	14.2	13.6	12.7	12.9	12.9
Heat	22.7	24.6	23.9	24.5	28.5	29.0	26.8	20.1	21.2	16.4
Other fuels (waste)	2.9	3.2	2.5	2.2	1.8	1.1	1.9	7.4	1.3	1.8
Total [PJ]	**2690.5**	**3899.4**	**3953.4**	**3727.5**	**3021.3**	**2928.6**	**2933.1**	**3163.7**	**3144.0**	**3215.1**

Source: GUS

Table 2.5. **Electricity consumption per capita**

Years	1980	1988	1989	1990	1991	1992	1993	1994	1995
Electricity consumption per capita [GJ]	12.34	14.04	14.04	12.60	12.24	11.88	12.24	12.24	12.60

Source: GUS

Unfavourable structure of final energy use has emerged in all three major sectors of national economy in Poland. The share of noble energy carriers, i.e. liquid and gaseous fuels, and electric energy, in industry sector amounts at present to 32%. The same situation can be seen in residential and commercial sectors. The share of hydrocarbon fuels and electric energy in the aforementioned sectors in Poland has only slightly exceeded 50%. Characteristics of both sector is their major share of direct consumption of solid fuels.

The share of electric energy in the structure of final energy use in industry and residential sector increased in 1995 to 14%. Despite higher consumption of electric energy, its use is still low, that can be indicated by the amount of energy use per capita (see Table 2.5).

Energy demand/supply balance. During recent period, the balance of energy demand and supply in Poland shows an equilibrium tendency. Demand for hard coal is entirely covered by domestic supplies. The share of renewable energy sources in national structure of primary energy consumption amounts up-to 1.5%. This includes firstly water power engineering, fuel wood and organic waste, and marginally such sources like wind power and geothermal energy. Some hundred solar installations are also presently in use (used generally to drying of crops and water heating), some dozen wind power plants, two geothermal heating plants, experimental rape bio-refinery, several spirits dewatering and ethanol providing installations, a dozen or so rural and municipal biogas installations (processing liquid and solid manure at methane fermentation process and recovering energy from municipal waste disposal sites), and also heating plants fired with biomass (straw and fuel wood).

Construction. In 1995 economic boom resulted in further production growth of building and construction enter prises (growth by 8-9% in relation to 1994), that was caused by the growth of investment demand, particularly in demand for building industrial and servicing objects and technical infrastructure. One of reasons for this boom was stimulation of building demand by means of tax system, including economic and financial instruments created within the state policy, such like: preferential rates for VAT tax imposed for both construction materials and works pertaining to housing and other public purposes, tax alleviation for individuals and legal entities for housing expenses (housing investment, flat repairs and modernisation), alleviation of investment in general business.

Agriculture. In 1995, favourable tendencies appeared for changes in agriculture, expressed in an intensification and modernisation of agricultural production, thanks to industrial production increase of agricultural production means and wider investment range. Global agricultural output grew in relation to 1994 by about 13%, however it was still lower than in 1989 (see Figure 2.5). Negative factors affecting the agriculture are: significant import of agricultural products and food-stuffs, deep territorial differentiation in production level and technical equipment, and significant unemployment. Low income farm amount to 70% for total 2 million existing farms. However, the area of arable lands in large farms has grown, resulting from the ongoing process of taking over the lands from the Agency for State Treasury Agricultural Ownership, those belonged to former State Farm Enterprises.

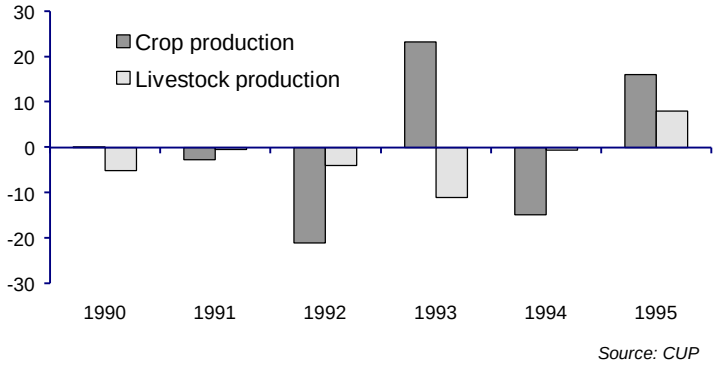

Fig. 2.5. Rate of changes in agriculture production [previous year = 100]

Forestry. Forests cover the area of about 8.8 million hectares, that is 28.1% of total country area. In the past-war period the forestration grew by 35% and it has still risen (in 1988 amounted to 27.7%, in 1993 – 27.9%). Spatial differentiation of forestration ranges from 12.3% in the Plock Voivodship (Central Poland) up-to 48.8% in the Zielona Góra Voivodship (south-western Poland). Forest area per an inhabitant amounts to 0.23 hectare. Major part of forest in Poland are public forests (83%) which are managed by the State Forests Enterprise, whereas private forests amount to 17%. Forest stand resources amount to 1,572 million m^3 (twice as much as in 1956), average age of forest stands amounts to 50 years. Average annual timber recovery ranges between 1-3% of its total amount standing, and this has never exceeded the current level of forest stand log volume. From the point of view of biological diversity, unfavourable feature of forests in Poland is a low differentiation of tree species composition of forest stands, since coniferous stands are prevailing, to cover 78% of total forest area (including pine share amounting to 69%). In the post-war period, species structure of forest has undergone its essential changes, the share of deciduous species has risen from 13% in 1945 up-to 22% at present.

Since many years forests in Poland have been badly affected by permanent hazard to their health, resulting from pests and tree diseases, unfavourable climate conditions, fires (see Table 2.6), and air pollutants. Locally, these factors caused forest decay, and even ecological disasters (e.g. in the Sudety Mountains). Systematic observations carried out since 1989, in the framework of international biological monitoring of forests, have shown, that about 90% trees in Poland have suffered from damages, including about 40% of high degree damage (trees of defoliation rate over 26%).

Table 2.6. **Forests area affected by fires**

Years	1988	1989	1990	1991	1992	1993	1994	1995
Area [ha]	3801	4997	7341	2567	43 755	8290	9171	5306

Source: GUS

Almost a half of resources managed by the State Forests Enterprise (48%) has the status of protective forests. They are soi- and water-protective forests which are situated within the zones of either industrial impact or mass public recreation, and also landscape forests. Managerial processes for managing the protective forests are submitted to special ecological and social functions which the forest have fulfilled in a given specific area. In the framework of upgrading the forest management on its ecological basis, and with the aim to managing in Poland such actions in conformity with international criteria and indicators for sustainable forest development, in the period of 1995-1996 ten objects were delimited, to create so called forest promotional complexes. The complexes are research and experimental in their character and they cover 7% of the resources managed by the State Forests Enterprise. These areas will have the first priority to introduce managerial principles aimed at the integration of the goals of sustainable forest management and active nature protection. Legal basis for the protection of forest lands are assured by the Act on the protection of agricultural and forest lands, adopted in 1995. The principles for the forest resource preservation, protection and extension, and the principles for forest management in relation to other elements of both the environment and national economy, are defined in the Act on Forests (adopted on 28 September 1991), that was amended by the Act on the amendments to the Act on Forests and to some other Acts (adopted on 24 April 1997).

Inflation processes. The most important task of budgetary and monetary policies in 1995, like in preceding years, was the strengthening of macro-economic balance, by means of hampering the inflation processes. Rigorous actions were undertaken to this end, those brought about the limitation of excessive internal demand (in both consumption and investment). Those anti-inflation actions resulted in systematic decline of inflation level. Unfortunately, in every last year a real inflation rate exceeded the level which was assumed in respective Budgetary Acts. 1995 was a successive year of notable decline of the price growth rate in respect to preceding year (see Figure 2.6).

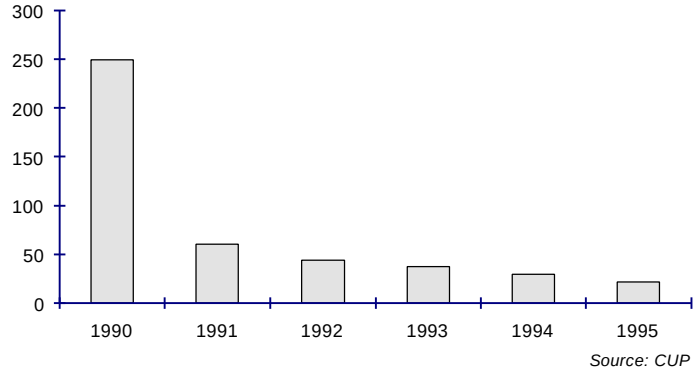

Figure 2.6. Inflation rate [December of previous year = 100]

Ownership transformation. Until the end of 1995 ownership transformation covered 5,205 state owned enterprises, and in the cases of 1,610 enterprises this process was completed. There are yet 4,357 state owned enterprises remaining.

Majority of ownership transformation acts is tightly connected with the activity of the Agency for State Treasury Agricultural Ownership. The taking over processes have been now completed. Present Agency's activity relates to restructuring of the property and managing of land that has been taken over. In total, until the end of 1995 the Agency took over 1,667 state owned enterprises and more than 4.4 million hectares of land (including 3.7 million hectares owned by former State Farm Enterprises). In the same time period, 5.4% of total land resources were already sold, 66.7% remained as tenancy, 13.2% were submitted to their temporary administering, 11% were awaiting their management, 8.1% were passed on into their administering, and 0.8% – into their run and hereditary tenure. There are still 625 farms existing, those were established on agricultural realties, that have remained as the result of closed down and taken over the former state owned agricultural enterprises.

There are two paths possible for conducting privatisation processes in Poland: the capital path and the closing down one. Recently, a number of state owned enterprises increased, those have been transformed into the State Treasury individual partnerships (large and medium companies), that relates to the initiation of the enforcement of the Act on National Investment Funds of 30 April 1993. However, decreased the number of transformation acts aimed at the privatisation. Anticipated is a growth of the number of enterprises privatised by means of a tender, a new privatisation method that is based on the closing down path. The most efficient transformation form appears a company liquidation aimed at its privatisation (this in general regards small and medium-sized enterprises). Until the end 1995 the number of transformation acts those have been entirely finalised through that path amounts to 91.7%. The essence of this path lays upon leasing of the closed down companies to such partnerships, those are managed with the participation of their employees.

Prevailing number of ownership transformation acts arose in agriculture (32%), industry (30%) and construction (16%). The most important effects of ownership transformation are: the share enhancement of private property in national economy, strengthening of financial markets, income growth within the State Budget resulting from these reasons, and the effectivity increase of finally privatised the state owned enterprises.

The scale of advancing the privatisation process can be illustrated by showing the share of private sector in national economy. In 1996, in this sector were employed almost 64% of total employees (in 1995 – 62% respectively). The private sector produced almost a half of GDP, and companies of this sector managed almost 93% of retail sales (92% in 1995) and 62% of exports and 75% of imports (57 and 70% in 1995, respectively).

Foreign trade. The characteristics of the period after 1991 is its deficit in foreign trade. Despite the growth of export by 62% in the period of 1994-1995 the debit balance is still prevailing, that results from relati-

vely high imports, particularly those pertaining to procurement and investment, liberalisation of commodity turnover, and deteriorating profitability of export production. The situation in the period in question resulted in slowing down the pace of export and speeding-up the import. In 1996 export grew by further 8%, and import grew by further 26%, that caused the growth of deficit in foreign trade up-to 12 milliard USD in respect to 1995. Reorientation came about the geographical structure of foreign trade: turnover with West European countries grew from 27.9% in 1989 up-to 70% in 1995, while Germany has been the priority target country. After initial breakdown of trade with the countries of former Council of Mutual Economic Aid, now the turnover with these countries has grown, amounting to about a dozen per cent. However, the increase in export has not reasonably resulted in reduction of the Polish foreign debt (see Table 2.7).

Table 2.7. **Foreign debt in period 1988-1995**

Years	1988	1990	1991	1992	1993	1994	1995
Debt [milliard USD]	30.0	48.5	48.4	47.0	47.2	42.2	43.9

Source: GUS

2.3. State and protection of natural environment

Environmental protection belongs to the priorities, that are included into the Constitution of the Republic of Poland, that has defined environmental protection as the right and the obligation of citizens. The Constitution adopted in 1997 states, that *The Republic (...) assures the protection of the environment, while guided by the principle of sustainable development,* and that *Public Authorities implement their policies aimed at ecological security for the sake of contemporary and feature generations.*

The most important legal and economic regulations aimed at environmental protection. The issues pertaining to complex legal protection of the environment were addressed primarily in the Act on Environmental Protection and Management, that was adopted on 31 January 1980, and which was many times amended in consequent years (last amendment was adopted on 29 August 1997[2]). The aim of this Act is to implement, to the most comprehensive extent, the basic issues of the protection of natural environment, and to assure an uniform policy in respect to this so complex and multidisciplinary issues. The Act on Environmental Protection and Management has imposed on the State Administration Bodies, local self-government, business entities and their employees, and all citizens, the obligation to protecting the environment, as well as the liability for the effects of environmental impact. The Act has also imposed on companies the obligation to obtaining the approvals for taking the use of the environment. Amended the Act on Environmental Protection and Management has taken into account also the realities resulting from current social and economic changes in Poland, and this enables effective execution by economic entities of environmental protection principles. In the scope of water resources use and their protection, clauses included into the Act on Environmental Protection and Management have been supplemented by the provisions of the Act on Water Law (adopted on 24 October 1974, including further amendments).

Financial resources collected from fees and fines imposed for the use of the environment have fed the Voivodship Funds for Environmental Protection, the National Fund for Environmental Protection and Water Management, and since 1993 – also Commune environmental protection funds. These resources are used to financing ecologically sound investments which are the priority in both national and local scale. Legal system for environmental protection has undergone its permanent modernisation by means of its adjustment to changing social, economic and ecological conditions and contains the following Acts:

- the Act on Environmental Protection and Management,
- the Act on Spatial Management,
- the Act on State Inspectorate for Environmental Protection,
- the Act on Forests,
- the Act on Nature Conservation,
- the Act on Retaining the Order and Cleanness in the Communes,
- the Act on Waste,
- the Act on Hunting Law,

[2] Mandatory from 1 January 1998.

- the Act on Geological and Mining Law,
- the Act on Water Law.

Existing legal regulations impose criminal liability for offences and transgressions against the environment. One of sanctions that may be imposed for crass transgression to the environment is a possibility to closing down the manufacturing activity of a given business.

Organisation structure of environmental management bodies. The supreme body of the State Administration to co-ordinating and supervising overall activity in the field of environmental protection is the Minister of Environmental Protection, Natural Resources and Forestry, who fulfils their functions by means of their executive structure – the Ministry. The control upon decisions being undertaken is carried out by the State Inspectorate for Environmental Protection through Chief Inspectorate for Environmental Protection and Voivodship Inspectorates for Environmental Protection. Financial support to ecological activity is assured by the National Fund for Environmental Protection and Water Management, and their respective Voivodship and Commune Funds. Research backup includes the scientific/research institutes supervised by the Minister.

Local bodies of the state administration in the field of environmental protection are the Voivodes making decisions regarding to conditions of environmental use and fees imposed for the use of the environment.

Basic responsibility and choice of concrete actions aimed at environmental protection lay with individual business entities and local self-governments, who have a decisive capacity in respect to the matters in question, and who have financial resources ready, resulting as well from their own funds as passed-on by ecological funds.

Assurance of favourable conditions needed to the enforcement of environmental protection legal regulations lays with respective Ministers managing their particular Sectors.

Organisation chart of environmental management in Poland on both governmental and self-governmental level is shown in Figure 2.7.

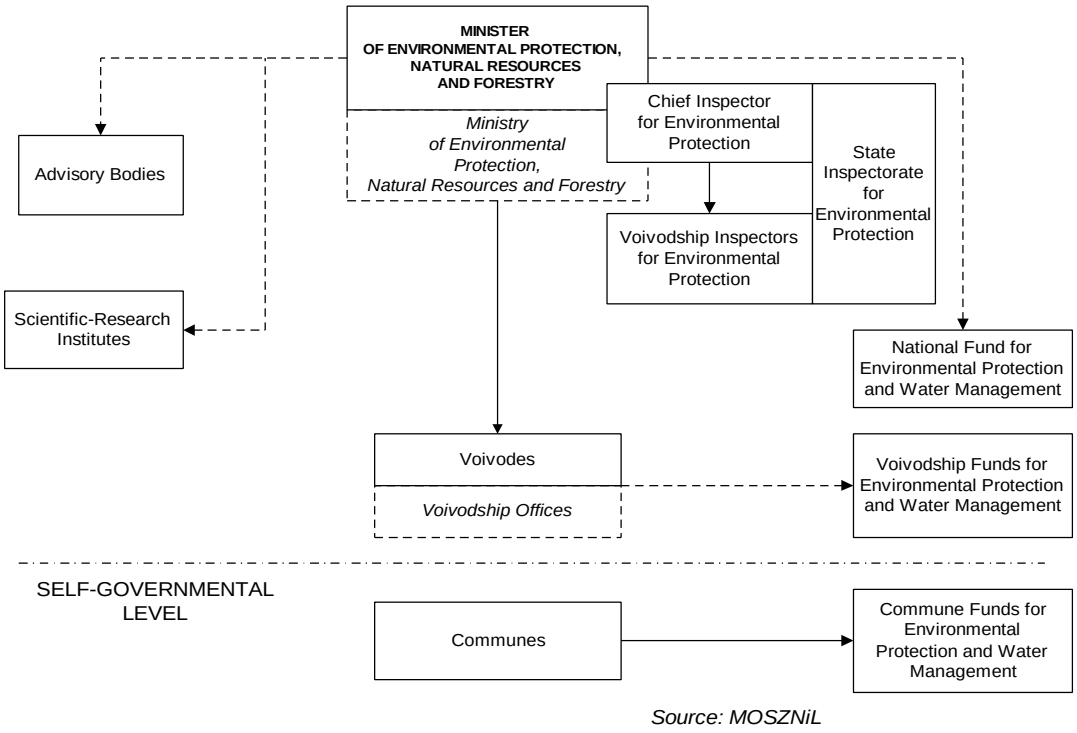

Fig. 2.7. Structure of environmental protection managing bodies

Legal mechanisms stimulating the limitation of greenhouse gas. Amended the Act on Environmental Protection and Management imposes legal authorisation to issuing a set of orders in the sphere of air protection defining the maximum allowable amounts of pollutant emissions. Another legal act indirectly aimed at the climate protection is the Act on Forests, adopted on 28 September 1991 (see Chapter 2.2).

Economic mechanisms stimulating the limitation of greenhouse gas. Economic mechanisms which are presently mandatory in Poland, that are favourable for the limitation of greenhouse gas emissions cover the following activities:

1) Introducing the fees for the emissions of greenhouse gas; such fees are imposed on industrial and municipal enterprises for their emissions of carbon dioxide and nitrogen oxides, and since 1993, also for basis greenhouse gases. The amounts of fees for emission to atmosphere of gaseous substances and dust, including CO_2, are annually updated in subsequent Orders issued by the Council of Ministers.
2) Introducing the subventions for implementation of undertakings aimed at the reduction of greenhouse gas, in the form of:
   - donations from the National Fund for Environmental Protection and Water Management and from respective Voivodship and Commune Funds,
   - low interest loans rendered by the National and Voivodship Funds for Environmental Protection,
   - preferential credits provided by the Environmental Protection Bank,
   - donations from the ECOFUND (see Chapter 4.2),
   - donations from Global Environmental Fund and the PHARE Programme

Analyses made so far have shown, that one of basic instruments stimulating the limitation processes of greenhouse gas in Poland in the future should be appropriate fees imposed for the emission of this gas. The amount of these fees should be related to the amount of energy use, and the resources resulting from accumulation of the fees should be devoted for subventions being allocated to energy saving undertakings, and enhancing the capability of carbon dioxide sink by the biosphere. Other mechanisms considered are the ecological surcharges on fuels.

The state and the protection of the environment. During recent years, favourable conditions occurred and consolidated in environmental protection, manifesting the improvement of the state-of-the-environment. So, the share of environmental investment expenditures has risen in GDP, from 0.5% in 1989 up-to 1% in 1994, and up-to 1.1% in 1995 (see Table 2.8). Ecologically sound financial investment has grown, while financed mainly from both own company resources and environmental funds: National, Voivodship and Commune ones. Such projects are co-financed also by banks, e.g. the Environmental Protection Bank, as well as by the ECOFUND, that is the Foundation established by Central Government. The aim of the Foundation is effective management of financial resources resulting from the foreign debt for nature swap (i.e. partial change of Poland's foreign debt into projects pertaining to environmental protection). A list of project types being supported by ecological funds is presented in Table 2.9. Investment expenditures for environmental protection, coming from central ecological funds, including the breakdown of these resources, is shown in Figures 2.8 and 2.9. Moreover, positive effect for environmental protection have resulted from: firm policy of more stringent requirements for businesses polluting the environment, the use of better quality fuels, industrial restructuring, modernisation and privatisation, and production limitation in the sectors being the sources of the largest pollution.

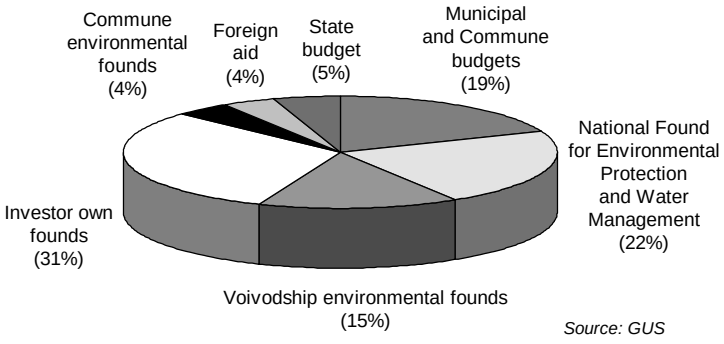

Fig. 2.8. Investment expenditures on environmental protection according to sources of financing

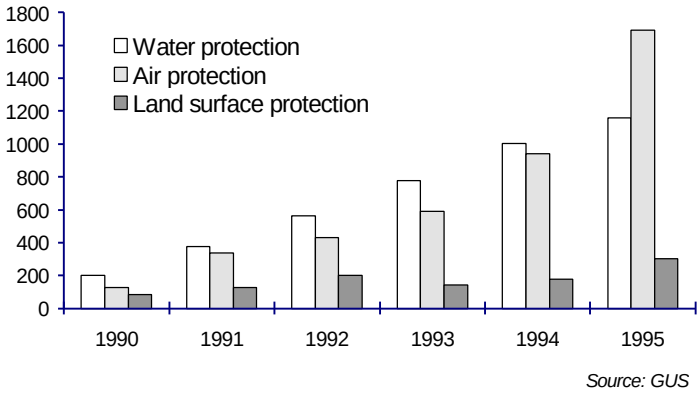

Fig. 2.9. Investment expenditures on environmental protection [million PLN]

Table 2.8. **Expeditures for the environmental protection in Poland in 1988-1995 (excluding expeditures for water management) furrent prices**

Years	1988	1989	1990	1991	1992	1993	1994	1995
Million PLN	20.0	52.3	415.1	840.0	1197.1	1512.1	2127.6	3170.9
% PKB	0.6	0.4	0.7	1.0	1.0	1.0	1.0	1.1

Source: GUS

Table 2.9. **List of projects leading to limitation of the GHGs emission financed by National Fund for Environmental Protection and Water Management, ECOFUND, Bank of Environmental Protection in 1990-1996**

Financing institution	Project type	Amount of co-financing (thousand PLN)	Number of projects
National Fund		**206 096**	**482**
for Environmental Protection	Modernisation of heating systems	138 004	350
and Water Management	Coal conversion to gas	-	-
	Gasification	44 800	114
	Use of waste heat	-	-
	Use of energy renewable sources	23 292	18
ECOFUND		**69 476**	**753**
	Modernisation of heating systems	41 128	20
	Coal conversion to gas	13 309	24
	Gasification	-	-
	Use of waste heat	7 077	9
	Use of energy renewable sources	7 962	700
Bank of Environmental		**42 665**	**167**
Protection	Modernisation of heating systems	7 618	19
	Coal conversion to gas	31 409	124
	Gasification	3 228	17
	Use of waste heat	-	-
	Use of energy renewable sources	410	7
	Total	**318 237**	**1402**

Source: MOSZNiL

In general, the positive tendency to enhance the areas of legally protected nature has been still retained, ranging from 3.5% of total area of the country in 1989 up-to 29% in 1996. Until the end of 1996 in Poland established were 22 National Parks (covering almost 1% total country territory and 3.3% protected areas). Seven areas were put on the UNESCO list of global biosphere reserves. Moreover, the number of other legally protected areas has still risen. 1,183 nature reserves exist (covering 0.4% of total country territory and 1.4% of legally

protected areas), 106 landscape parks (covering 6.8% of total country territory and 22.7% of legally protected areas), and 369 protected landscape areas covering 21.3% of total country territory and 72% of legally protected areas. A new form of nature conservation are ecological usable lands of high importance for the preservation of biological diversity. They include marshes, peat swamps and natural water reservoirs. Inventory of 3 thousand such object has been completed.

Despite the favourable changes that ensued for the sake of nature conservation in Poland, there are still existing the areas of significantly damaged environment, including firstly the heavily industrialised and urbanised areas.

Priorities for environmental protection for the nearest future include the actions aimed at:

- protection an development of naturally valuable areas,
- recultivation of damaged resources,
- reduction of dust and gaseous emissions,
- water protection caused by the growing water deficit,
- regulation of a system for industrial waste disposal and utilisation.

Extreme phenomena affecting the state-of-the-environment in Poland – 1997 FLOOD. In July 1997, on huge territory of south-western Poland occurred flood which was caused by a several-day longing intensive rains in the area of upper sections of the Odra and Wisla rivers. In the mountain areas, the course of flood was impetuous and relatively evanescent, causing however heavy sheet erosion and deterioration the infrastructure. In flat areas, where flood wave increased quickly and its run-off was slow, long lasting water-spills occurred causing the silting up of the terrain.

Once water receded, the Voivodship Inspectorates for Environmental Protection, according to instruction given by the Chief Inspector for Environmental Protection, examined the flood impact on the quality of the environment. The results have shown, that 21 industrial objects had been damaged, including 13 those had become sunk and 8 semi–sunk. Damages in these objects comprised firstly electrical installations, pumping systems and reservoirs.

The State Inspectorate for Environmental Protection examined also 200 wastewater treatment plants which were affected by the flood. 67 objects were totally sunk, 101 partially sunk, and in 32 other objects occurred their periodical shut-down or disturbances in their operation. Examined were also waste disposal sites. For total examined 59 sites, 7 objects were entirely sunk and 36 partially sunk. Local environmental hazard resulted from a part of waste that had been washed out from 13 waste disposal sites. These sites were excluded from their operation for the purpose of their recultivation.

Also, assessment of pollutant concentrations in the Wisla and Odra rivers were carried out in order to enable for an initial assessment of pollutant loads discharged to the Baltic Sea within the flood wave. And so, in the Odra River waters an increase of biogenic load occurred in relation to average load in 1996: nitrate load ranged from 6.1 up-to 8.6 times as much as before the flood wave came, whereas phosphate load rose from 6.2 up-to 17.6 times. In the Wis³a River these loads also increased: nitrate from 3.7 up-to 11.2 times, and phosphates about 5 times. Apart from organic and microbiological pollutants examined, it was found that the coliform count worsen, and decreased the contents of oxygen dissolved in water. In general, these values of the parameters measured proved a better water quality in the Wis³a River than in the Odra River.

The concentrations of biogenic salts those were measured on 1 August 1997 at the outlet of the Odra River had shown an inconsiderable higher phosphate value. Mineral suspension carried on with the flood waters caused the decline of water transparency in the Pomeranian Bay, amounting up-to 0.5 metre in the vicinity of the Odra River outlet, while in the Gdañsk Bay a decreased oxygen contents was noted. However, the Wis³a River waters carried in a significant amount of biogenic salts, which concentration inconsiderably exceeded the average values characteristic in terms of a multi-year period for phosphates and nitrates. A three times higher silicate level was noted, proving that the river transported a considerable amount of mineral suspension, reducing water transparency to 2 metres at the end of July. Results of these findings showed that luckily the sanitary conditions in the Baltic Sea had not been badly affected in the result of the July flood.

Material looses caused by the flood were estimated at about 12 milliard PLN.

3. INVENTORY OF GREENHOUSE GAS EMISIONS AND REMOVALS

Inventories of man-made emission sources and sinks provide the basis for an appraisal of the Parties as listed in Annex 1 to this Convention, including Poland, in fulfilling their commitments imposed on them by the Convention. This chapter presents inventories of the emissions and removals of the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Given the significant discrepancies between the estimates developed by different centres this Report does not contain inventories of other gases, such as nitrogen oxides (NO_X), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOC).

The changes in the emissions of greenhouse gases between the base year (1988) and 1994 are shown in Table 3.1. It indicates a systematic drop in carbon dioxide emissions which was particularly significant after 1988 when the Polish economy temporarily collapsed. This falling trend can be also seen in CO_2 emissions per capita: they fell from 12.61 Mg in 1988 to 9.65 Mg CO_2 per capita in 1994. A falling trend can also be seen for both methane and nitrous oxide, with the emissions of all the gases stabilising to some extent since 1992.

Table 3.1. **Total greenhouse gas emissions in 1988-1994 in Poland [Gg]**

Years	1988	1990	1992	1994
CO_2	477 584	381 482	372 311	372 293
CH_4	3 141	2 801	2 474	2 467
N_2O	70	63	50	50

Source: MOSZNiL

Despite dynamic economical development after 1992 and constant growth rate of GDP, emission CO_2 per GDP unit shows falling tendency from 2.11 in 1988 to 1.77 kg CO_2 /USD'94 PPP (see Figure 3.1). This results as the effect of more effective energy use, since almost 97% CO_2 emissions result from fuels combustion and their use in various economic sectors, and only more than 3% come from industrial processes.

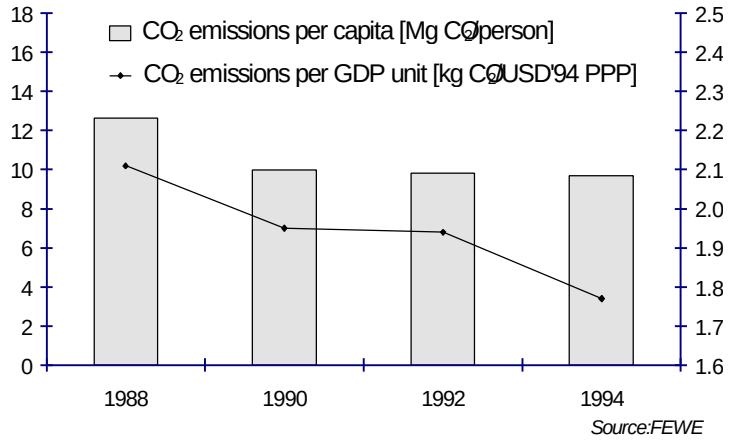

Figure 3.1. CO_2 emissions per GDP unit and per capita

The inventories of greenhouse gas emissions for the base year (1988 – see Table 3.2) presented in this Report have been corrected with respect to those given in *the National Report to the First Conference of the Parties to the UNFCCC,* following the recommendations of the Mission of the Convention Secretariat which carried out an in-depth analysis in March 1995. The present version has been prepared in accordance with the IPCC methodology *(IPCC Draft Guidelines for National Greenhouse Gas Inventories 1995).* Following the aforementioned methodology, applied have been the structures of categories of emission sources and sinks of the greenhouse gases, except for the presentation of collective Tables which have been elaborated in the IPCC Standard formula. The activity of emission sources and sinks were defined according to the data from official statistics acquired from the Central Statistical Office (general statistic yearbook, sectorial yearbooks, *The Energy Statistics*) and from the Directorate General, the State Forests Enterprise. Final calculations of greenhouse

gases emission were performed on the basis of data published in the mentioned above *The Energy Statistics* [1996] having adjusted them to the structure of emission source categories *IPCC Draft*. Emission factors were

Table 3.2. **Summary Report for National Greenhouse Gas Inventory in 1988**

Greenhouse Gas Source/Sink Categories	Emissions/removals [Gg]			
	CO_2 emissions	CO_2 removals	CH_4 emissions	N_2O emissions
TOTAL DOMESTIC EMISSIONS/REMOVALS	**477 584**	**35 705**	**3 141**	**70**
1. All Energy (Fuel Combustion + Fugitive)	463 051	NA	**1 295**	**7**
1.A. Fuel Combustion	462 998	NA	47	7
1.A.1. Energy and Transformation Industries	260 537	NA	11	4
1.A.2. Industry (ISIC)	60 900	NA	18	1
1.A.3. Transport	28 238	NA	7	1
1.A.4. Commercial/Institutional	31	NA	0	0
1.A.5. Residential	103 137	NA	10	1
1.A.6. Agriculture/Forestry	8 061	NA	0	0
1.A.7. Other	2 094	NA	1	0
1.B. Fugitive Emissions from Fuels	53	NA	1248	0
1.B.1. Coal Mining	NA	NA	1043	NA
1.B.2. Oil and Natural Gas	53	NA	205	NA
2. Industrial Processes	13 574		**16**	**20**
2.A. Iron and Steel	699	NA	4	NA
2.B. Non-Ferrous Metals	39	NA	NE	NA
2.C. Inorganic Chemicals	29	NA	12	20
2.D. Organic Chemicals	0	NA	NA	NA
2.E. Non-Metalic Mineral Products	12 036	NA	NA	NA
2.F. Other	771	NA	NE	NA
3. Solvent Use				
3.A. Paint Application	NA	NA	NA	NA
3.B. Degreasing and Dry Cleaning	NA	NA	NA	NA
3.C. Chemical Products Manufacture/Processing	NA	NA	NA	NE
3.D. Other	NA	NA	NA	NA
4. Agriculture			863	**43**
4.A. Enteric Fermentation	NA	NA	806	NA
4.B. Manure Management	NA	NA	56	NA
4.D. Agricultural Soils	NE	NA	NE	43
4.E. Field Burning of Agricultural Residues	NA	NA	1	0
5. Land Use Change & Forestry	959	**35 705**	**1**	**0**
5.A. Changes in Forest and Other Woody Biomass Stocs	NA	24 990	NA	NA
5.B. Forest and Grassland Conversion	959	NA	1	0
5.C. Abandonment of Managed Lands	NA	10 715	NA	NA
5.D. Other	NE	NE	NE	NE
6. Waste			966	
6.A. Landfils	NE	NA	835	NA
6.B. Wastewater	NA	NA	131	NE
6.D. Other Waste	NE	NA	NE	NE

0 - Values Estimated Less than 0.5 Gg, NA - Not Applicable, NE - Not Estimated.

Source: MOSZNiL

in general taken from *the Country Case Study on Sources and Sinks of Greenhouse Gases in Poland* [1992] while appropriate corrections have been made base on IPCC and CORINAR publications, as well as other available published reports (see Annex A). Factors of emissions and sinks in the category 5: *Land Use Change and Forestry* were taken from official elaborates published by the Directorate General, the State Forests Enterprise.

In order to evaluate the degree of efficiency of the actions undertaken by Poland and for comparison, inventories of greenhouse gas emission and removal are also presented for 1990, 1992 and 1994. Emission values regarding 1990, those were presented in the First National Report had been based on the CORINAIR methodology. While recognising the need to presenting the data in a manner enabling the comparison of the results for

all the countries listed in Annex I, Poland has presented hereby the inventories of greenhouse gas emission and removal performed in accordance to the mandatory IPCC methodology.

The inventories for greenhouse gas emission and removal in 1992 (see Table 3.4) were prepared following the OECD/IPCC methodology recommended by the Conference of the Parties to the Convention and published in 1994 in *The Greenhouse Gas Inventory Workbook. IPCC Draft Guidelines for National Greenhouse Gas Inventories* (these inventories were presented in the First Report). The factors applied to greenhouse gas emissions and removals during the elaboration of the inventories in 1992 are given in Annex C to this Report.

Table 3.3. **Summary Report for National Greenhouse Gas Inventory in 1990**

Greenhouse Gas Source/Sink Categories	Emissions/removals [Gg]			
	CO_2 emissions	CO_2 removals	CH_4 emissions	N_2O emissions
TOTAL DOMESTIC EMISSIONS/REMOVALS	**381 482**	**45 448**	**2801**	**63**
1. All Energy (Fuel Combustion + Fugitive)	**371 485**	NA	**1031**	**6**
1.A. Fuel Combustion	371 433	NA	37	6
1.A.1. Energy and Transformation Industries	236 582	NA	9	3
1.A.2. Industry (ISIC)	49 820	NA	15	1
1.A.3. Transport	29 103	NA	7	1
1.A.4. Commercial/Institutional	40	NA	0	0
1.A.5. Residential	51 841	NA	6	1
1.A.6. Agriculture/Forestry	3 868	NA	0	0
1.A.7. Other	179	NA	0	0
1.B. Fugitive Emissions from Fuels	52	NA	994	0
1.B.1. Coal Mining	NA	NA	799	NA
1.B.2. Oil and Natural Gas	52	NA	195	NA
2. Industrial Processes	**9 212**		**13**	**16**
2.A. Iron and Steel	507	NA	3	NA
2.B. Non-Ferrous Metals	37	NA	NE	NA
2.C. Inorganic Chemicals	29	NA	10	16
2.D. Organic Chemicals	0	NA	NA	NA
2.E. Non-Metalic Mineral Products	7 715	NA	NA	NA
2.F. Other	924	NA	NE	NA
3. Solvent Use				
3.A. Paint Application	NA	NA	NA	NA
3.B. Degreasing and Dry Cleaning	NA	NA	NA	NA
3.C. Chemical Products Manufacture/Processing	NA	NA	NA	NE
3.D. Other	NA	NA	NA	NA
4. Agriculture			**850**	**41**
4.A. Enteric Fermentation	NA	NA	793	NA
4.B. Manure Management	NA	NA	55	NA
4.D. Agricultural Soils	NE	NA	NE	41
4.E. Field Burning of Agricultural Residues	NA	NA	2	0
5. Land Use Change & Forestry	**785**	**45 448**	**0**	**0**
5.A. Changes in Forest and Other Woody Biomass Stocs	NA	34 514	NA	NA
5.B. Forest and Grassland Conversion	785	NA	0	0
5.C. Abandonment of Managed Lands	NA	10 934	NA	NA
5.D. Other	NE	NE	NE	NE
6. Waste			**907**	
6.A. Landfils	NE	NA	767	NA
6.B. Wastewater	NA	NA	140	NE
6.D. Other Waste	NE	NA	NE	NE

0 - Values Estimated Less than 0.5 Gg, NA - Not Applicable, NE - Not Estimated.

Source: MOSZNiL

Table 3.4. **Summary Report for National Greenhouse Gas Inventory in 1992**

Greenhouse Gas Source/Sink Categories	Emissions/removals [Gg]			
	CO_2 emissions	CO_2 removals	CH_4 emissions	N_2O emissions
TOTAL DOMESTIC EMISSIONS/REMOVALS	**372 311**	**41 535**	**2474**	**50**
1. All Energy (Fuel Combustion + Fugitive)	**360 988**	NA	**821**	**6**
1.A. Fuel Combustion	360 927	NA	28	6
1.A.1. Energy and Transformation Industries	223 009	NA	8	3
1.A.2. Industry (ISIC)	37 259	NA	10	0
1.A.3. Transport	30 475	NA	8	2
1.A.4. Commercial/Institutional	18	NA	0	0
1.A.5. Residential	64 933	NA	2	1
1.A.6. Agriculture/Forestry	5 233		0	0
1.A.7. Other	NA	NA	NA	NA
1.B. Fugitive Emissions from Fuels	61	NA	793	0
1.B.1. Coal Mining	NA	NA	628	NA
1.B.2. Oil and Natural Gas	61	NA	165	NA
2. Industrial Processes	**10 603**		**8**	**13**
2.A. Iron and Steel	302	NA	1	NA
2.B. Non-Ferrous Metals	35	NA	NE	NA
2.C. Inorganic Chemicals	1 493	NA	7	13
2.D. Organic Chemicals	0	NA	NA	NA
2.E. Non-Metalic Mineral Products	7 971	NA	NA	NA
2.F. Other	802	NA	NE	NA
3. Solvent Use				
3.A. Paint Application	NA	NA	NA	NA
3.B. Degreasing and Dry Cleaning	NA	NA	NA	NA
3.C. Chemical Products Manufacture/Processing	NA	NA	NA	NE
3.D. Other	NA	NA	NA	NA
4. Agriculture			**704**	**32**
4.A. Enteric Fermentation	NA	NA	647	NA
4.B. Manure Management	NA	NA	56	NA
4.D. Agricultural Soils	NE	NA	NE	32
4.E. Field Burning of Agricultural Residues	NA	NA	1	0
5. Land Use Change & Forestry	**720**	**41 535**	**0**	**0**
5.A. Changes in Forest and Other Woody Biomass Stocs	NA	30 460	NA	NA
5.B. Forest and Grassland Conversion	720	NA	0	0
5.C. Abandonment of Managed Lands	NA	11 075	NA	NA
5.D. Other	NE	NE	NE	NE
6. Waste			**941**	
6.A. Landfils	NE	NA	844	NA
6.B. Wastewater	NA	NA	97	NE
6.D. Other Waste	NE	NA	NE	NE

0 - Values Estimated Less than 0.5 Gg, NA - Not Applicable, NE - Not Estimated.

Source: MOSZNiL

Table 3.5. **Summary Report for National Greenhouse Gas Inventory in 1994**

Greenhouse Gas Source/Sink Categories	Emissions/removals [Gg]			
	CO_2 emissions	CO_2 removals	CH_4 emissions	N_2O emissions
TOTAL DOMESTIC EMISSIONS/REMOVALS	**372 293**	**42 658**	**2467**	**50**
1. All Energy (Fuel Combustion + Fugitive)	**362 166**	NA	**955**	**6**
1.A. Fuel Combustion	362 083	NA	59	6
1.A.1. Energy and Transformation Industries	200 331	NA	8	3
1.A.2. Industry (ISIC)	66 282	NA	14	1
1.A.3. Transport	29 533	NA	9	1
1.A.4. Commercial/Institutional	64 151	NA	28	1
1.A.5. Other	1 786	NA	0	0
1.B. Fugitive Emissions from Fuels	83	NA	896	0
1.B.1. Coal Mining	NA	NA	724	NA
1.B.2. Oil and Natural Gas	83	NA	172	NA
2. Industrial Processes	**9422**		**11**	**14**
2.A. Iron and Steel	319	NA	3	NA
2.B. Non-Ferrous Metals	40	NA	NE	NA
2.C. Inorganic Chemicals	29	NA	8	14
2.D. Organic Chemicals	0	NA	NA	NA
2.E. Non-Metalic Mineral Products	8292	NA	NA	NA
2.F. Other	742	NA	NE	NA
3. Solvent Use				
3.A. Paint Application	NA	NA	NA	NA
3.B. Degreasing and Dry Cleaning	NA	NA	NA	NA
3.C. Chemical Products Manufacture/Processing	NA	NA	NA	NE
3.D. Other	NA	NA	NA	NA
4. Agriculture			**646**	**30**
4.A. Enteric Fermentation	NA	NA	596	NA
4.B. Manure Management	NA	NA	49	NA
4.D. Agricultural Soils	NE	NA	NE	30
4.E. Field Burning of Agricultural Residues	NA	NA	1	0
5. Land Use Change & Forestry	**705**	**42 658**	**0**	**0**
5.A. Changes in Forest and Other Woody Biomass Stocs	NA	31 427	NA	NA
5.B. Forest and Grassland Conversion	705	NA	0	0
5.C. Abandonment of Managed Lands	NA	11 231	NA	NA
5.D. Other	NE	NE	NE	NE
6. Waste			**855**	**0**
6.A. Landfils	NE	NA	761	NA
6.B. Wastewater	NA	NA	94	NE
6.D. Other Waste	NE	NA	NE	NE

0 - Values Estimated Less than 0.5 Gg, NA - Not Applicable, NE - Not Estimated.
Source: MOSZNiL

Presented in Tables 3.3 and 3.5 the calculations results of emission and removal of the greenhouse gases for 1990 and 1994 were performed in accordance to methodology of *The IPCC Guidelines for National Greenhouse Gas Inventory* [1995]. In terms of the category structure of emission sources and sinks, this methodology was fully followed. Activity of particular emission sources and sinks was defined following the data of the aforementioned official statistics acquired for the Central Statistical Office, and the publication *Forest in Figures* [1997] and a study drawn up by the Institute of Motor Transportation, prepared as the assignment from the Ministry of Transportation and Marine Economy. Finally, the calculations of greenhouse gas emissions were made on the basis of data published in *The Energy Statistics* [1997]. Some consultations regarding the data were provided by the Energy Information Centre. The reason for these consultations was lacking statistical data, that made impossible a full adjustment to the emission sources structure according to IPCC, in relation between the category *1.A.1 Energy and Transformation Industries* and the category *1.A.2 Industry*. Most of emission factors were taken from *The Country Case Study of the Greenhouse Gas Sources and Sinks in Poland* [1992], while appropriate corrections were made on the basis of IPCC and CORINAIR publications, and also available reports published (see Annex B and D). The values of emissions and removals in category 5. *Land Use Change and Forestry* were elaborated on the basis of data published by the Directorate General, the State Forests Enterprise.

4. POLICIES AND MEASURES TO MITIGATE GREENHOUSE GAS EMISSIONS

4.1. Governmental policies and measures to mitigate greenhouse gas emissions and removals

4.1.1. Industrial policy

Situation at the industry and structural changes within national economy. In the period of 1992-1995 the following positive tendencies were noted at industrial sector:

1) growth of production sold (by 8.5% in 1995, in relation to 1992),
2) changes in production structure towards the increase of the share of processing industries in total industry participation (from 77.6% in 1992 up to 82% in 1995),
3) growth of industrial competitivity expressed in terms of share of industrial branches based on technologies characterised by higher innovation degree (production levels of these branches increased in 1996 by 28.8%, in relation to 1995, and their share in production increased from 8.6% up to 10.1%),
4) progressing technological and managerial restructuring (reduction of share in production sold from capital– and energy-consuming sectors: mining by 2.4% in 1995, in relation to 1992, power, gas and water supply by 2% in the same period),
5) increase of productivity (by 6.5% in 1995, in relation to 1994),
6) structure improvement of fuel use (increase of oil share from 13.4% in 1995 up to 14.4% in 1996, high methane concentration natural gas from 7.3% up to 7.7%, decrease of hard coal share from 59.8% to 59.2%, and lignite from 12.8% to 12.4%).

Implementation of industrial policy programme was focused primarily at two following areas:

1) actions undertaken in the field of technical policy pertaining to increasing international industrial competitivity,
2) continuation of such structural changes which have conditioned the increase of industrial competitivity.

Actions in the field of technical policy implemented in the period of 1995-1997. In 1996 the Agency for Techniques and Technologies was established, with its basic aim to promoting and supporting the implementation of innovative techniques and technologies, commercialisation of applied research, particularly in the sphere of up-to-date technologies (including ecologically sound ones), and actions aimed at implementation of schemes and programmes designed for national policy in the field of applying new techniques and technologies to national economy. Regional institutions have been also benefiting from this support, whose aim is to implement new technology transfer (research-production consortia, technology parks, innovation centres).

Developed were and consequently implemented: the programme for management and procedures for supporting small and medium-sized enterprises (SMEs), to comprise initiation and establishing new capital institutions, and programme for accessing the results of scientific research by means of co-financing from the resources of foreign assistance. Suitable information system was also developed. The National Services System was created to supporting SMEs, that is being now consequently developed into a form of network of mutually co-operating institutions supporting small and medium-sized enterprises who are interested in benefiting from advisory, training, financial and information services, and also technological audits, cleaner, up-to-date production, etc. In 1996, a training course was held, that was designed for several dozen local advisors and consultants servicing the companies being under development. During the training course a company development strategy was elaborated for and consultation was provided to several dozen companies. In the framework of a project titled *Company Technological Assessment* technology audits were carried-out in several dozen companies and tools were developed such as *Technology Audit* and *Technology Investment* , and several dozen business experts/consultants and researchers from R&D institutions were trained in this regard.

Thanks to the *Cleaner Production Programme* which has been promoting since 1991 the implementation of cleaner production principle, intensification of ecologically sound activity ensued in company manufacturing and development. There are two national and eight regional Cleaner Production Centres in Poland which are dealing with the idea of cleaner production. The Centres are concerned with training and upgrading engineering personnel in the field of cleaner production issues, limitation of water resources and energy use, and implementation of environmental management system in industries, while based on the procedure for waste minimising, and pollutant reduction at source, including gaseous pollutants, and also minimising water and energy use (about 20-25% reduction of air pollutants, solid waste, and raw materials and energy consumption during those 5 years). In the framework of these activities co-operation has been developed between the Ministry of Environmental Protection, Natural Resources and Forestry, National Fund for Environmental Protection and Water Management, enterprises and various national and international institutions and organisations, aimed at the creation of a system stimulating generalisation of industrially practical the principles of both cleaner pro-

duction and ecologically sound management. Investors in cleaner production have presently the access to preferential financial credits available from ecological funds. Almost 300 industries have implemented the cleaner production principle, including ironworks, power plants, cement industries, chemical enterprises, oil product consortia, and municipal power heating companies. Over 400 projects were already implemented so far, aimed at the limitation of the amount of raw material used, water resources, energy media, as well as plants abating their environmental hazards. Financial effect accomplished in 1995 is estimated at 87 million PLN.

A lot of various project were implemented to promote the recycling of industrial waste. Works were carried out aimed at the creation of national system for recycling and recovery of reusable raw materials from used cells, mercury-discharge lamps and car bodies. Research have been also carried out aimed at recycling of plastic raw materials by means of their cooking at cookeries, and also at rubber waste utilisation systems. In 1996 the amount of industrial waste increased by 1.5% in relation to preceding year, while waste amount disposed to the environment was reduced by 1.4%. In 1996 the amount of economically managed waste increased by 3.9% in relation to 1995.

Actions pertaining to structural changes. In the framework of changes within industry, aimed at the restructuring of environmentally nuisant an energy intensive sectors, restructuring programmes have been commenced in hard coal and oil industries. Industrial restructuring is focused at reduction of production potential to achieve reasonable demand level and to modifying and replacement the technologies used. A programme has been also pursued for restructuring of iron and steel and pharmaceutical industries. Also coke industry restructuring programme has been implemented, while aimed at the protection of the environment, firstly by means of gaseous emission abatement. Restructuring of intensive energy and capital consuming industrial sectors is pursuant to implementation of a programme adopted in December 1992 for iron and steel industry and it has also comprised a programme designed for heavy chemical industry.

Power and lignite sectors. Internal company restructuring has been completed within this sector. Highest voltage power transmission networks were restructured into the State Treasury owned a joint stock company – the Polskie Sieci Elektroenergetyczne S.A. (The Polish Power Networks Inc.). Power plants and power heating plants have been restructured in the same manner. Their back-up support enterprises have undergone commercialisation and privatisation processes. A system has been created for controlling the supplies of "networking" energy carriers in order to assure competitive behaviour of companies which are active within natural monopoly (gas, power, heating). On 1 May 1996, regional diversification was introduced of power prices for energy providers, and also for energy end-users on 1 January 1997. Since 1 January 1998 heating energy prices have been commercialised. One of goals assumed for restructuring energy supply sources within national economy is to diversify primary energy carriers and increase the share of hydrocarbon fuels in total fuel consumption. A license for conducting the activity within fuel and energy production, gaseous and liquid fuel storage, fuel transmission and distribution, and general fuel and energy turnover, has defined the securing of environmental protection as well in the course as after cessation of the license activity. The use of low-capacity steam and water boilers has been gradually discontinued. Power heating plant network has been enhanced, resulting in liquidation of a number of minor local heating plants. Due to modernisation of technological facilities and increasing of co-generation power and heat production, efficiency of fuel use in energy sector has been upgraded (see Table 4.1).

On 17 September 1996 the Council of Ministers adopted document titled *Demonopolisation and Privatisation of Energy Sector* covering the issues of demonopolisation and privatisation of power and energy sector in Poland, which is to create favourable conditions towards the development of modern electrical power engineering. Development of local power markets will be ensued by means of integrated development planning which will be conductive for modernisation of existing power plants and will then enforce the compliance with environmental protection requirements.

Since 5 December 1997 the Act on Energy Law has been enforced. This is the basic legal act to define principles for development of national fuel and energy policies, covering heating and power supply enterprises, and also the methods for execution of regulation function within fuel and energy sector (except for mining and nuclear branches, those are controlled by means of separate legal acts). The Energy Regulation Agency was established to this end whose aim is to control individual company activity dealing with the issues of power and gas supply. The essence of the Act mentioned is to introduce a free market economy to fuel and energy sector. The Act has created the conditions to economic and rationale fuel and energy use with respect to environmental protection requirements. It has imposed mandatory rationalisation of issues pertaining to fuel and energy use for the purpose of governmental strategies, dealing particularly with the promotion of energy saving building and construction undertakings. Enterprises dealing with energy, while concerned with transferring and distribution of gaseous fuels and power, are now obliged to drafting relevant development plans in the scope of gas and power supplies, while taking into account a local spatial management plan designed for a Commune in question. Drafting their development plans, the enterprises should be aware of modernisation and enhancement or

construction of the networks, and of possible new sources of gaseous fuels and power, including those unconventional ones, and projects aimed at rationalisation of energy use by end-users. Possibly existing energy surpluses and local energy resources should be also taken into account while drafting these plans, with respect to co-generated heat and power production, and managing waste heat from industrial installations. Tariffs for gaseous fuels, power and heat should ensure covering rationale cost of the activity of power plants, including environmental protection cost, and they can include the cost of projects aimed at the reduction of energy consumption by end-users, those are economically rational in terms of avoiding construction of new energy sources.

Table 4.1. **Modernization of production and manufacturing processes in industry branches**

Processes and products	Percent share					
	1990	1991	1992	1993	1994	1995
Cathalytic processes in general oil processing	44.3	49.4	50.2	51.4	55.0	59.6
Superphosphate dust in total fertilisers production	13.6	8.0	4.3	3.0	2.3	3.1
Multi-element fertilisers in total fertilisers production	10.8	9.0	16.8	19.1	24.4	25.8
Strand cast steel in total steel production	7.6	8.5	7.5	9.8	10.3	21.9
Open-hearth steel in total steel production	29.1	25.3	18.5	16.7	14.7	12.8
Arc-steel in total steel production	18.0	19.6	18.2	21.3	22.0	22.5
Converter-oxygen furnace steel in total steel production	52.9	55.1	63.3	62.0	63.3	64.6
Cogenerated heat and power production in total power production from professional heat and power plants	9.0	9.5	10.4	10.8	11.4	11.6
Energy produced in hard coal fired plants in total power production from professional power heating plants	57.4	55.3	57.2	56.5	57.7	60.0
Energy produced in lignite fired plants in total power production from professional power heating plants	41.5	42.5	42.8	43.0	41.5	40.0
Technology and heating heat in total heat production from power plants, heat and power plants	24.3	29.1	24.1	22.7	22.6	23.6

Source: GUS

Renewable energy sources. One of strategic goals of environmental protection is to create the conditions favourable to the use of renewable energy sources. Legislation pertaining to the energy has imposed the obligation calling for assumption of the State energy policies to be developed accordingly to the principle of national sustainable development, while defining the development of the use of unconventional energy sources, including renewable energy sources. When drafting a local plan for the demand development of power it is now necessary to take into account potentially possible unconventional sources. The Minister of Economy has the right to impose on a power distribution enterprise an obligation to purchase power from an unconventional source. At the beginning of nineties, exemption and alleviation was introduced into income taxes and rural taxes imposed on individuals managing their private businesses when using renewable energy sources (exemption from income tax up to 5 years by virtue of providing power) and for farmers using renewable energy sources in their agricultural production (rural tax alleviation up to 15 years by virtue of investment cost incurred). Since July 1993 preferential rates have become obligatory for the purchase of power from renewable energy source, if introduced to a power distribution network. Investments aimed at development of renewable energy sources are financially supported from environmental protection funds, including both the National and the Voivodship Environmental Protection and Water Management Funds and the ECOFUND. Utilisation of renewable energy sources, with exempt to heat obtained from burning the fuel wood and power from water power plants, has been yet still on its initial stage.

Hard coal mining sector. Programme for restructuring of hard coal mining sector is aimed at closing down permanently unprofitable mines, creation of independent, competitive coal production partnerships, commercialisation and privatisation of their respective back-up companies, elimination of coal trading monopolists, and technical restructuring of mines.

In 1990, Hard Coal Union, which so far managed entire hard coal branch, was replaced with the State Hard Coal Agency. The aim of the Agency is to provide services aimed at the co-ordination of restructuring activity within hard coal mining branch. In the framework of the first restructuring stage of mining enterprises, that is aimed at the creation of competitive structure of mining companies, seven State Treasury partnership companies were established to include total 57 mines. Four mines were restructured into self sustaining State Treasury partnerships, three – into limited liability companies, and five remained as state owned enterprises. Nine mines have undergone their final closure because of unprofitability reasons, and five other have been partially closed down.

In April 1994 a programme was formulated for implementation of the second restructuring stage. It was stressed in this programme, that profitability retaining of hard coal exploration is indispensable, however this should be achieved without further donations, and their restructuring process has to be carried out in stages. However, implementation of the second restructuring stage appeared hard to finalise. Delays occurred in liquidation process of unprofitable mines, less efficient appeared the programmes for reduction of employment, problems also emerged in economical relations caused by minor than expected the income from coal sales.

In 1996 completed was the transformation process of state owned enterprises into partnership companies. Major number of mines had undergone their restructuring into the State Treasury partnerships. Implementation was initiated of hard coal mining adjustment programme aimed at its conformity with both free market economy and international competitivity. The programme was adopted by the Council of Ministers on 30 April 1996. Restructuring of employment, and also technical and financial restructuring, and managerial and ownership transformation, all are assumed to their implementation by 2000.

Aimed at the abatement of environmental nuisance in hard coal mining sector, a variety of measures have been applied, including construction, enhancement and modernisation of coal flotation plants, methane emission reduction, waste management at mining headings. In 1996 methane sink amounted to 195.5 milliard m^3 methane, including 143.8 milliard m^3 finally managed, that is by 4.8% more than in 1995.

Oil sector. Within the restructuring framework of this sector, Polish refineries and the Oil Product Company (CPN) were restructured into joint stock companies. In 1996 POLSKA NAFTA (The Polish Oil Company) was established, which has included two major Polish refineries: the Plock Petrochemia Inc. (Oil Processing Enterprise) and the Gdansk Refinery Inc., and also five other refineries active in Southern Poland. Restructuring of the Oil Product Company Inc. (CPN) is still under way. Up-to-date and more efficient, less energy and material intensive technologies had been introduced to crude oil processing in refineries (see Table 4.1). Actions have been begun aimed at quality upgrading of engine fuels, in order to achieve parameters complying the European Union standards in the scope of both their usefulness and environmental compliance. Assumed has been a production growth of lead-free fuel additives in order to upgrade the octane number of petrol, and production of petrol with ethyl alcohol as an additive.

Oil and gas mining sector. Restructuring of this sector involves the creation of partnership companies aimed at exploration and recovery of gas resources, as well as managing countrywide gas transfer network, promotion of participation of foreign companies in exploration and recovery of gas and oil resources, and commercialisation and privatisation of sectorial back-up enterprises. One of goals of this restructuring programme is to change the structure of primary fuels consumption by means of intensification of gas use from own domestic resources, including recovery and management of methane from coal beds. Assumed has been an increase of gas supplies to both households for their heating purposes and to other minor consumers, and also use of gas as an alternative fuel in electrical power engineering.

Sector of "heavy chemical synthesis". Restructuring programme is focused in this sector at both limitation of environmentally hazardous manufacturing processes, and ecologically sound sectorial development. Actions have been commenced towards the reduction of energy consumption by final products, liquidation of economically ineffective production objects, rationale use of raw materials, and reduction of environmental nuisance of manufacturing facilities. Liquidation or modernisation is planned for both some energy intensive technologies and some out-dated installations. Anticipated is also an introduction of modern, energy saving technological processes, upgrading the product quality (e.g. sulphur and fertiliser granulates), further air-tight sealing of production installations and reloading facilities, afterburning the post-reaction gases, waste incineration, energy carriers change into oil and gas, and improved use of coal (see Table 4.1). It is foreseen, that these actions will enable limitation of energy use growth rate by up-to 10%, while sectorial production growth rate will amount up-to 60%. These actions will contribute to reduction of energy carriers use by 27%, and to reasonable reduction of dust and gaseous (SO_2 and NO_X) emissions, and reduction of industrial solid and liquid waste.

Iron and steel industry. Technical restructuring is carried out by means of implementation of up-to-date production methods, including continuous steel casting, alternative methods for steel production, and rationale steel processing to manufacture final products necessary on markets (see Table 4.1). Basic transformation directions are: reduction of material and energy consumption, reduction of environmental nuisance, and setting-up new products designed for domestic and international markets. Having implemented these basic restructuring goals, in the period of 1989-1995, obsolete and environmentally nuisant production processes were abandoned. As the result, production was reduced of: pig iron by 1,820 thousand tonnes, ordinary steel, produced mainly in open-hearth process, by 6,955 thousand tonnes, rolled steel products by 860 thousand tonnes, and steel tubes by 70 thousand tonnes. At the end of 1996, production capacity in terms of continuous steel casting reached the index of about 60% of share in total steel production. Application of continuous steel casting resulted in upgra-

ding of steelworks output[3] by 12-15%, and it has also allowed for reduction of energy consumption by 40-75% in relation to conventional process. In the period of 1990-1995 significant decrease was noted of ordinary steel production (agglomerate by 3,133 thousand tonnes, pig iron by 1,213 thousand tonnes) while converter steel (by 478 thousand tonnes) and arc-steel (by 25 thousand tonnes) increased. At the same time reasonable reduction was achieved for unit energy consumption production processes (see Table 4.2). Total energy use for manufacturing basic products in iron and steel industry was reduced from 247 PJ in 1990 to about 170 PJ in 1992, and it has stabilised on this level, having a minimum growth tendency in the period of 1993-1995.

The use of better quality coal, heat recovery from metallurgical processes, utilisation of technological gases (converter and iron-alloy gases), rationalisation of energy use, and more intensive use of fluidal bed boilers, all these are planned in detailed environmental protection programme.

Table 4.2. **Energy intensity of production of selected products in ferrous metallurgy in 1990-1995**

Products	Energy intensity of production in years [MJ/t]					
	1990	1991	1992	1993	1994	1995
Aglomerat	2168	1938	1868	1881	1780	1327
Pig iron	14881	14795	14186	14853	14392	13614
Open-hearth steel	7236	7248	6923	6254	5890	5040
Arc-steel	2905	2950	2936	2845	2651	2545
Converter steel	814	1183	1017	986	936	1057
Manufactured Hot--rolled products	4407	4720	3233	3010	2815	2670

Source: GUS

Non-ferrous metallurgy. The aim of restructuring this industry sector is to extend the competitivity of manufactured products, enhance the range of highly sophisticated products, increase production profitability, and reduce its environmental nuisance (see Table 4.3). These actions are focused at applying modern equipment to technological installations, and modernisation of facilities in basic production lines. In the cases those requirements cannot be complied with, production processes are being closed down and even large metallurgical installation are being excluded from use. The most important modernisation actions include: modernisation of dry precipitators, liquidation of processes for concentrate dewatering in gas fired rotary kilns in zinc-lead ore plants, and air-tight sealing of lead heating in rocking-rotary furnaces.

Table 4.3. **Energy intensity of production of selected products in non-ferrous metallurgy in 1990-1995**

Products	Energy intensity of production in years [MJ/t]					
	1990	1991	1992	1993	1994	1995
Electrolytic copper	18025	14662	14358	12452	11470	11471
Aluminium	57888	55826	56469	57878	56129	55823
Iron castings	13082	13640	13898	13526	13117	12896

Source: GUS

It has been assumed, that in the period of 1997-2000 average annual outlay allocated to ecologically sound investments will amount to 100 million PLN.

Cement industry. Following the restructuring programme, privatisation of cement plants has ensued. At present, the plants undergo their modernisation aimed at energy intensity reduction in manufacturing processes. Modification of cement production technology was introduced to change from wet method to dry method (now, 50% of cement is manufactured with dry method). This in turn resulted in 50% reduction of unit demand for heat, whereas reduction of dust decreased 20 times (see Table 4.4). Introduction of modern technologies created favourable conditions to utilising a huge quantity of reusable raw materials (mineral and flammable) in cement production process, those have been resulting from other industry branches (up to 25% of clinker cement manufactured) which majority is waste. It is anticipated, that having completed the investments intended (inc-

[3] Output - amount of product manufactured from an amount of raw material.

luding setting-up new installations for dry method), after 2000, energy intensity of cement industry will be reduced, e.g. heat used per 1 kg clinker will amount to 3.3 MJ/kg.

Table 4.4. **Energy intensity of production of selected products in cement industry in 1990-1995**

Products	Energy intensity of production in years [MJ/t]					
	1990	1991	1992	1993	1994	1995
Clinker - dry method	4268	4462	4183	4229	4205	4216
Clinker - wet method	7181	7180	7126	7001	6945	6537
Cement	278	245	249	234	212	210
Lime (burnt lime, lumps)	4758	4638	4835	4676	4749	5331

Source: GUS

CO_2 and CH_4 emission change in selected industrial processes. In the first half of nineties a continuation was noted of a trend, that ensued at the end of eighties, i.e. reduction of carbon dioxide and methane emission in industry sector. This reduction regards the majority of manufacturing branches. Based upon the state system of statistical information, changes in reduction were defined of carbon dioxide and methane emissions for selected products, industrial and energy processes and technologies. Examples of emission change values for these two gases are shown in Table 4.5.

Table 4.5. **CO_2 and CH_4 emission changes within the period of 1991-1995 resulting from the manufacture of selected products [Mg]**

Industrial processes	CO_2	CH_4
Fuel industry		
Hard coal - extraction	-558493	-5.56
Lignite - extraction	49547	0.61
Lignite briquete	-5739	-0.04
Coke oven coke	-308187	136.05
Petroleum - extraction	11389	0.48
Petroleum and petroleum products pumping	38152	0.23
High-methane natural gas - extraction	12071	0.35
High-methane natural gas - pumping	46466	-0.17
City gas, propane-butane	-779	-0.02
City gas from gas-works	-39875	-0.82
Pernitrated natural gas - extraction	-349	-0.01
Coke-oven gas-pumping	-55394	-0.41
Total	**-811191**	**130.69**
Metallurgical industry		
Iron ore agglomerates	-612516	-12.16
Ferrosilicon 75%	148522	1.56
Pig iron (open-hearth steel)	52688	27.45
Open-hearth steel	-850332	-22.91
Arc-steel	-39198	0.46
Converter steel	232227	6.28
Hot rolled semi finished products and products	-320412	-9.57
Cold rolled products	105190	0.99
Steel seamless tubes	-63940	-0.99
Steel seamed tubes	3414	-0.16
Copper ore - extraction	-78461	0.19
Copper ore - processing	15292	-0.17
Zinc-lead ores - extraction	-10214	-0.04
Zinc-lead ores - processing	-18121	-0.28
Refined zinc and crude lead from shaft furnace	84776	1.52
Electrolytic aluminium	58503	0.34
Sintered zinc oxide	7586	0.09
Electrolytic zinc	37879	0.42
Rolled products from non-ferrous metals	24667	-0.13
Non-ferrous metal product extruded and drawn	21426	0.16
Non-ferrous metal castings	52691	0.62
Electrolytic copper	-192426	-1.49

Iron castings	57154	-1.61
Steel castings	-27107	-0.42
Total	**-1310712**	**-9.85**
Chemical industry		
Technical carbon black	-5973	1.33
Concentrated superphosphate	6457	0.20
Technical sulphur, Marsh method	-2503259	-75.23
Evaporated salt	3538	-1.03
Ammonia from natural gas	1116447	3271.27
Ethylene and propylene	-306949	-21.63
Butadiene	-1383275	-0.27
Chlorine - mercury cathode method	-238004	-1.49
Chlorine - diaphragm method	-77623	-0.73
Sulfuric acid (contact process)	-224901	-5.15
Crude soda	45553	0.63
Calcined soda 98%	-1923803	-0.23
Caustic soda 100%-lye	240325	10.34
Raw carbide 75%	102866	1.01
Caprolactam	-5037	-1.10
Synthetic rubbers	9348	0.17
Polyvinyl chloride	14811	0.29
Phosphoric acid	265275	7.12
Carbon disulfide	-8903	-0.39
Titanium white	-65205	-2.10
Urea	71976	1.41
Nitro-chalk	-8619	0.78
Ammonium nitrate	27426	0.56
Separate superphosphate, dust	-880	0.00
Granular superphosphate	12911	15.32
Nitric acid	-150730	-4.02
Benzene	2883	0.06
Nitrophosphates NP - phosphates	25740	0.64
Ammonia-potassium phosphate NPK	57984	50.31
Oxygen	42064	-0.70
Total	**-4857557**	**3247.37**
Mineral and wood industry		
Cement clinker - dry method	648012	10.74
Cement clinker - wet method	107629	1.88
Cement - milling	50324	-0.01
Burnt limestone, lumps	-138903	-1.48
Gypsum binder (burnt gypsum)	1424	0.14
Drawn glass, flat	-93019	-1.58
Flat glass	-6918	0.30
Fibreboards	51226	0.92
Chpboards	81059	11.45
Wood pulp	6133	0.15
Total	**706967**	**22.51**
Paper industry		
Sulphate pulp, paper	118108	2.08
Sulphate pulp, viscose	-11089	-0.37
Paper	200610	3.30
Board	-57635	-0.88
Total	**249994**	**4.13**
Food industry		
Sugar	-222369	-4.72
Beer	-5016	-0.53
Malt	-13873	-0.37
High wines 100%	-574703	-15.07
Rectified spirit 100%	-4725	-0.12
Total	**-820686**	**-20.81**
Energy sector		
Public cogeneration plants (electricity generation)	-1785094	-10.46
Public cogeneration plants (heat production)	86358	-0.59

Industrial cogeneration plants (electricity generation)	463996	-8.11
Industrial cogeneration plants (heat production)	-2824905	-7.30
Public heating plants	-2518155	-24.16
Industrial heating plants	-10110597	-261.91
Municipal heating plants	1305735	40.82
Oil refining industry	473718	31.18
Total	**-14908944**	**-240.53**
Others		
Production of processed solid fuels	-411532	129.14
Production of processed solid fuels, coking	-358577	130.22
Hard-coal industry	2733491	76.99
Lignite industry	128560	0.50
Petroleum industry	-84245	-1.68
Total	**2007697**	**335.17**

- Reduction of gaseous emissions.
Source: IOS

4.1.2. Transportation policy

In 1995 a document was elaborated, titled *Transportation Policy* in which directions have been defined for the development of transportation sector in Poland, in accordance with requirements of market economy and towards new conditions for economic co-operation in Europe. This document was adopted by the Council of Ministers and now it has to be approved by the Parliament. Some environmental protection issues were addressed in this document, these have been expressed firstly in terms of priority assigned to the development of ecologically sound transportation branches and means, such like: railway and combined transportation, and public transportation. Much more stringent requirements were imposed on industries manufacturing transportation means in the scope of such production methods, those guarantee emission reduction of harmful substances resulting from engines. Also instruments were formulated of ecologically sound effects, in a form of more stringent technical standards imposed on vehicles, and also economical and fiscal instruments (see Table 4.12).
Since 1992 many actions have been undertaken in transportation sector aimed at more efficient energy use. These resulted in CO_2 emission reduction to atmosphere (see Table 4.6) while being focused at decreasing of fuel use by vehicles, and in upgrading energy efficiency of engines. The following actions are being undertaken in favour of those achievements:

- introduction of requirements in the scope of pollutant emission by vehicles having total allowable mass up-to 3.5 tonnes, while equipped in spark ignition engines (registration of vehicles equipped with such engines was banned, of their total mass exceeding 3.5 tonnes); in order to comply with these requirement in practice such vehicle must be equipped with catalytic reactor,
- compliance with ECE/UN regulations pertaining to pollutant emission for certification of a vehicle type in question,
- introduction of fees for CO_2 emission caused by vehicles used for business purposes,
- introduction of energy certificates relating the amount to fuel used by vehicles both manufactured in Poland and imported,
- preferential attitudes towards the carriers, who dispose ecological stock having a *green lorry* certificate, in the process of license issuance for carriage aimed at transboundary road transportation,
- elimination from operating of steam locomotives (while coal consumption decreased from 860 Gg in 1988 to 10 Gg in 1994),
- significant share reduction of rail motor traction (while gas oil use for traction purposes decreased from 550 Gg in 1988 to 209 Gg in 1994; 90% railway transport has been managed through electric traction),
- introduction to railways of ”rail-buses” of lower energy intensity in order to replace traditional trains,
- replacement of planes in the Polish airlines by modern ones, having lower fuel consumption, and also other actions (see Table 4.12).

Table 4.6. **CO_2 and CH_4 emission changes in transportation sector in 1995 in relation to 1991 [Mg]**

Transportation type	CO_2	CH_4
Public transport - trams	-19817	-0.12
Public transport - trolleybuses	-940	0.00
Public transport - airlines (passengers and cargo)	57936	34.77
Public transport - buses in municipal transport	3060	1.06
Steam traction - standard-gauge track - trains	-119193	-2.87
Motor traction - standard-gauge track - trains	-196018	-19.15
Electric traction - standard-gauge track - trains	-370772	-2.20
Ships - passengers and cargo	-1426758	-166.78
Marine fishing fleet	-116590	-13.39
Stevedoring - marine harbours	-10104	-0.32
Inland water ships - cargo	-4316	-0.42
Inland water ships - passengers	-216	-0.21
Stevedoring - inland harbours	360	-0.02
Branch transport - road haulage	1024454	252.00
Branch transport - passenger road conveyance	733892	100.99
Total	**-445022**	**183.34**

- Reduction of gaseous emissions
Source: IOS

Moreover, the Ministry of Transportation and Marine Economy has additionally financed also a modernisation of technical back-up enterprises, laying upon the replacement of energy carriers in local heating plants (change from coal to heating oil or gas).

In the governmental document *Transportation Policy* a number of clauses have been included pertaining to the development and promotion of public transportation, including a necessity to radical improvement of municipal transport (qualitative and quantitative offers): assigning a priority to investments aimed at the enhancement of highly efficient public transportation offer (underground railways, up-to-date fast trams), and expansion of infrastructure used by individual motorization, such like: ring roads, tunnels, underground carparks and multi-storey garages, and systems for smooth traffic control. In addition, the State will be conductive to creating new private municipal transport enterprises and it will create favourable conditions towards an interest in this transportation branch potentially expressed by private capital, and it will endeavour local self-governance authorities to benefiting from existing legal opportunities to privatisation of municipal transport.

Environmental protection principles for highway design, construction and maintenance have been also prepared. Application of these principles has been reflected in actions which are being undertaken in cities and settlements, laying upon the displacement of transit road traffic onto uninhabited areas (i.e. by means of building road rings), modernisation of highways and their crossings according to road traffic needs, etc. All these actions are focused firstly at road traffic improvement and its smoothness, to result in better combustion conditions and reduction of fuel consumption. In 1996, ten ring-roads were constructed, of which three were already commenced. Municipal traffic management in cities is controlled by the Commune Authorities, who have created their own transportation policy, solving local problems by means of decisions upon traffic control on local roads, delimitation of areas for limited traffic and parking, and lying out parking areas, etc.

In the period of 1991-1995, in the result of some actions undertaken within transportation sector aimed at the abatement of carbon dioxide and methane emissions, these emissions were reduced. Emissions of these gases were also affected by change in demand for transportation, and this had resulted from transformation processes in Polish economy (see Table 4.6). Changes in freight and passenger transportation structure in the period of 1990-1995 are shown in Figures 4.1 and 4.2.

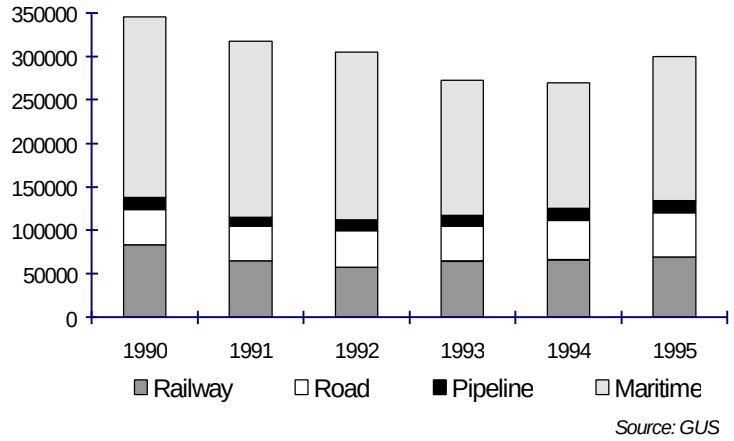

Fig. 4.1. Structure of goods transportation [million tonnes by kilometers]

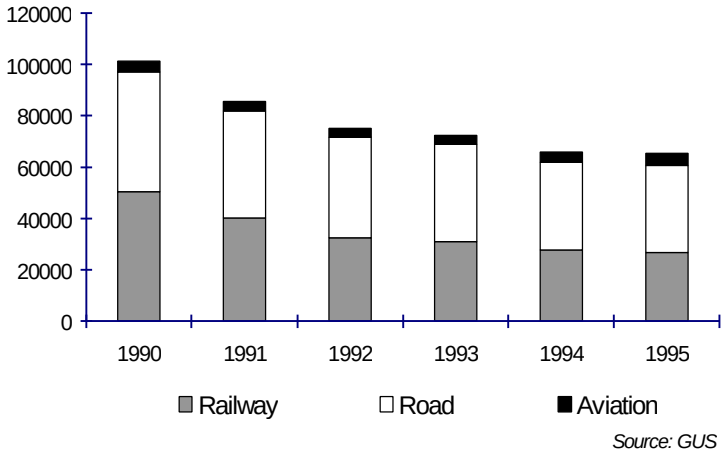

Fig. 4.2. Structure of passenger transportation [million passangers by kilometers]

4.1.3. Municipal policy

The main aims of municipal policy were elaborated in 1996 by the Ministry of Spatial Planning and Construction (today the Office for Housing and Urban Development). The municipal policy is understood as creation of conditions which help to meet the local society total demand for municipal services while preserving the environment. Such policy aims at:

1) development of municipal infrastructure relevant for the housing development rate,
2) assurance of common access to and continuity of good quality water supply;
3) removal of sewage from urban areas and ensuring sewage treatment in accordance with environmental standards;
4) removal of solid waste from urban areas and ensuring their full disposal in accordance with environmental standards;
5) provision of the supply for municipal needs of energy carriers, electrical power, and heat of required parameters and in accordance with environmental standards;
6) provision of acceptable level of local public transport as well as development, modernising and maintenance of urban roads which provide access to workplaces, schools, recreational sites for all urban inhabitants. This should take into account development of environmentally friendly transport means causing possibly low diverse impact on the environment.

The above listed objectives are implemented through a division of competencies between state and local governmental bodies. The state is responsible for creation of legal, economic, educational and research tools, while local self-governments have to choose the right policy suitable for local conditions.

Implementation of municipal policy is also supported by legislative work, mostly preparation of a set of legal regulations resulting from *Assumption for state policy on rational use of energy* , implementation of mentioned before acts: on waste, and on retaining the order and cleanness in the communes. In the Act on Waste principles of sustainable waste management are set out, in particular rules for preventing waste production or minimisation of waste, removal from sites of their origin as well as rules for use or disposal that is safe for human life and health as well as for the environment. The Act on Retaining the Order and Cleanness in the Communes sets out tasks for communes and obligations of property owners concerning cleanliness and tidiness in their premises as well as types of activity related to maintenance of sanitary state in cities.

Activities towards reduction of greenhouse gases in the municipal sector are undertaken in two main areas:

- energy conservation (see Table 4.12)
- management of municipal waste and municipal sewage treatment residues (see Table 4.13)

In terms of energy conservation, activities foreseen in the adopted by the government document *Assumptions for state policy on rational use of energy in the municipal sector* are already implemented, such as: improvement of thermal insulation of residential buildings (see Chapter 5.1), improvement of efficient energy use in public buildings, and upgrading of local heat generators and heating sector. The Order of the Minister of Spatial Planning and Construction of 14 December 1994 on technical requirements for buildings and their location was amended. The change introduces a new way of formulating requirements as to thermal insulation of buildings through setting up maximum values for seasonal demand for heat which result in significant savings of energy supplied to buildings.

Moreover, numerous activities are carried out in the municipal sector aimed at efficient use of energy sources and the reduction of greenhouse gas emission, especially CO_2 and CH_4 . Some of those activities are co-financed by environmental funds, such as the National Fund for Environmental Protection and Water Management, Voivodship Funds for Environmental Protection and Water Management, and ECOFUND. Selected projects leading to CO_2 reduction funded by the NFOSiGW and ECOFUND are listed in Table 4.7.

Environmental effect gained through implementation of about 270 other projects is difficult to assess. The projects include upgrading of heating systems in public and municipal buildings (hospitals, schools, nursing homes, orphanages, offices). In total, in the period between 1991 and 1995, CO_2 emission related to heat generation in heating and boiler plants both industrial and municipal dropped by about 10,000 Gg, while CH_4 emission by about 230 Mg.

Steps towards greenhouse gas emission reduction (mainly CH_4) undertaken under the municipal waste management concern mostly municipal waste landfills generating landfill gas that consists mainly of methane and carbon dioxide. Elaboration of a programme for *Monitoring of municipal waste landfills* was initialled in order to examine in detail and reduce nuisance caused by municipal landfills. This is being elaborated by the Research and Development Centre for Urban Ecology (OBREM) in Lódz. One of the tasks to be implemented under this programme in the near future is preparation of guidelines for design, construction and operation of landfill gas disposal installations for different stages of landfill operation – both for new and existing sites. During recent years installations for landfill gas removal were built in 27 sites, 5 of which are equipped in installations for economic utilisation of the gas.

Another way of CH_4 emission mitigation from landfills is prevention its generation through composting i.e. using aerobic processing of easily decomposable organic matter. The level of composting of municipal waste in Poland is systematically growing (e.g. from 1.1% of total waste volume in 1993 to 1.8% in 1994).

A selective collection of waste (waste segregation) is introduced in order to reduce volume of waste in landfills. This aims at recycling of some groups of materials, such as paper, glass, metals, plastics, cloth. It is estimated that about 20% of communes have introduced waste segregation systems.

Another source of greenhouse gas emission is methane fermentation process from sludge in municipal sewage treatment plants. Flammable digestive gas (60-70% of CH_4 , 30-40% of CO_2 and up to 3% of H_2S) originating in old plants usually goes into the atmosphere. In newly built treatment plants the gas is captured and used for heating of closed sludge digestion chambers, and buildings of the plant, as well as for electric power production.

Table 4.7. **Reduction of CO_2 emission in the municipal sector resulting from projects co-financed by environmental funds in 1991-1995**

Project	Reduction [Gg]
Heating system upgrading	
Liquidation of solid fuel boiler plants in Kraków	146.3
Liquidation of local boiler rooms through their connection with heating systems of Kraków heat and power plant	169.3
Upgrading of heating system in Augustów health resort	40.0
Upgrading of heating system in Opole	153.0
Upgrading of heat management in Huta Bankowa	28.6
Upgrading of heating system in Dabrowa Górnicza	20.0
Upgrading of heating system in Koscierzyna	13.4
Fuel conversion	
Coal to gas conversion in Kraków boiler plants	106.7
Coal to oil conversion in Kraków boiler plants	26.8
Coal to gas conversion in heating system of Puszczykowo	136.0
Gasification of Lesko town and commune	18.6
Gasification of Swieradów health resort	15.6
Gasification of Rabka health resort	16.0
Utilisation of waste heat	
Utilisation of waste heat in the heating system of Walbrzych hospital	4,5
Utilisation of waste heat in Carbochem - Gliwice	15.0
Utilisation of waste (excess) coke gas (deeply cleaned) in Blachownia power plant	1115.0
Utilisation of renewable energy sources	
Use of geothermal energy in Pyrzyce	60.0
Use of geothermal energy in Podhale - number of towns and villages	30.0
Construction of wind power station in Zawoja	0.7
Construction of hydropower station on Brda canal	2.9
Construction of hydropower stattion in Nowy Targ commune	1.5
Use of biomass for heating in Grabowiec commune	1.5
Total	**2121.4**

Source: IOS

4.1.4. Agricultural policy

In 1994 the Ministry of Agriculture and Food Economy adopted *Assumptions for social and economic policy for rural areas, agriculture and food economy until the year 2000* [1994]. Priority tasks in the agricultural sector, supported by tasks related to greenhouse gas emission reduction are:

1) activities towards development of research into abatement of greenhouse gas emission in agriculture through an adoption of priority research projects covering inter alia: elaboration of modern, cost- effective technologies of plant production, research into energy saving methods of drying, processing and storing agricultural products of various nature and use, controlling CO_2 and other gas balance in the atmosphere through relevant technologies in plant and stock production. Such priorities should be adopted by the Forest and Agricultural Science Department of Scientific Research Committee in agreement with the Ministry of Agriculture and Food Economy;
2) spreading of knowledge in agricultural developments as part of agricultural school curricula and in the Agricultural Advisory Centres;
3) support of activities towards sustainable use of fertilisers (advisory services in regional chemical and agricultural centres, implementation of integrated system of fertiliser application where mineral fertilisers are supplementary to organic fertilisers); works have been initiated towards drafting of an act on fertilisers that would create legislative basis for proper fertiliser management to ensure high yields together with protection against environmental damage caused by fertiliser misuse;
4) financial support from the state budget for liming of soils in order to prevent their degradation caused by high acidity and to compensate for adverse processes in the soil environment.

During recent years the agricultural and food sector has been influenced by new development conditions, where agricultural production has dropped if compared with the 80-ties and earlier period. One of the demand barriers for agricultural products is withdrawal of state budget subsidies and rise of prices. In this situation part of the production capacity is not used and acts as a reserve which could be activated providing certain condi-

tions are fulfilled (i.e. continuation of economic growth or rise in export). Volume of crop production and livestock in the recent years is presented in Tables 4.8 and 4.9.

Table 4.8. Volume of crop production [million tonnes] in 1988-1995

Years	1998	1990	1991	1992	1993	1994	1995
Crops - total including:	24.5	28.0	27.8	20.0	23.4	21.8	25.9
• wheat	7.6	9.0	9.3	7.4	8.2	7.7	8.7
• rye	5.5	6.0	5.9	4.0	5.0	5.3	6.3
Potato	34.7	36.3	29.0	23.4	36.3	23.1	24.9
Sugar beetroo	14.1	16.7	11.4	11.1	15.6	11.7	13.3

Source: GUS

Table 4.9. Volume of livestock [thousands animals] in 1988-1995

Years	1988	1990	1991	1992	1993	1994	1995
Cattle	10 322	10 049	8 844	8 221	7 643	7 696	7 306
Pigs	19 605	19 464	21 868	22 086	18 860	19 466	20 418
Sheep	4 377	4 159	3 234	1 870	1 268	870	713

Source: GUS

These are the following types of greenhouse gas emissions related to agricultural production:

- CO_2 emission being a result of use of energy carriers in rural households and production activity,
- CH_4 emission resulting from enteric fermentation and manure management,
- N_2O emission as a result of nitrogen fertilisers application.

Estimated CO_2 emission resulting from combustion of fuels in rural households is about 32 million tonnes per year, and solid fuel combustion prevail in the emission (see Table 4.10).

Table 4.10. Consumption of energy carriers in agriculture in 1993-1995

Types of energy carriers	Unit	Total consumption in:		
		1993	1994	1995*
Solid fuel	thousand tonnes	8500	8480	8450
Liquid fuel	thousand tonnes	1670	1730	1740
Gas fuel	million m^3	340	350	360

* Estimated data
Source: MRiGZ

Steps are being undertaken towards reduction of fossil fuels in the total balance of energy carriers consumption. For example: Foundation for Assistance Programmes in Agriculture supports activities aimed at wider use of straw fired boilers. First installations of that type are already in operation. The main source of methane in agriculture are enteric fermentation of livestock, especially ruminants (cattle and to less extend sheep). Bearing in mind the diminishing tendency for cattle stock and almost dramatic drop of sheep stock in the 90-ties, emission of methane from intestine digestion of animals has been significantly reduced: from 950 Gg in 1988 to nearly 600 Gg in 1994.

Emission of methane from manure management depends on their collection and storage. The way that increases the emission through creation of anaerobic conditions is the collection and storing of excrement as fermented liquid manure in deep tanks. Liquid manure constitutes 2-3% of total organic fertilisers and growth of its production is not expected. As litter rearing and grazing of animals is more popular in Poland, the main organic fertiliser is manure. It can therefore be said that methane production in Polish stock rearing systems is relatively low when compared with countries using technologically organised litter-free (liquid manure) rearing system.

Between the end of the 80-ties and 1992, consumption of mineral fertilisers, including nitric fertilisers was diminishing, while since 1993 it has been systematically growing (see Table 4.11). In order to achieve required yields and ensure sustainability of food supply it is necessary to increase mineral fertiliser application to 112-115 kg per hectare of agricultural land by the year 2000. It is estimated that this level (resulting from justifiable needs) will still be lower than mineral fertiliser consumption in the Western Europe.

Table 4.11. **Use of nitrogen fertilisers in thousand tonnes of pure nitrogen in 1988-1995**

Years	1988/ /1989	1989/ /1990	1990/ /1991	1991/ /1992	1992/ /1993	1993/ /1994	1994/ /1995
Total [thousand tonnes]	1520	1274	735	619	683	758	836
per 1 ha of agricultural land in kg	82.0	68.9	39.9	33.9	37.7	42.0	46.6

Source: GUS

4.1.5. Forestry policy

The superior objective of the national forestry policy is to set out a comprehensive plan of action aimed at preservation of conditions to maintain sustainable multifunctional forests, their multiple use and protection as well as the role in shaping of the environment in accordance with social expectations. Forest sustainability and multifunctional character will be achieved through enlargement of forest resources, improvement of their state and complex protection, reorientation of forest management into more environmentally friendly, economically viable and multifunctional. Enlargement of forest resources will be done through afforestation of set aside agricultural lands, restructuring of existing treestands, and regeneration of devastated or damaged stands (see Table 4.12). Forest resources increase will also be assisted by programmes of planting of trees, hedges, plantations in agricultural landscape as well as in areas degraded by industrial, mining or military activities. Improvement of health state and protection of forests is one of the priorities of forestry policy which aims to develop various functions played by forest ecosystems. A prerequisite for this objective is further reduction of all chemical and physical pollutants affecting forests.

4.2. International co-operation aimed at the mitigation of greenhouse gas emissions

Conversion of the Polish foreign debt. In the period between 1992 and 2010 Poland may convert part of foreign debt for financing of environment protection projects (so called eco-conversion). This is the result of the agreement with Paris Club from 1991. ECOFUND Foundation was established for managing the debt eco-conversion. Till the end of 1995 Poland had signed agreements with five countries: the USA, Switzerland, France, Sweden and Finland. ECOFUND is managing resources agreed with the first four countries. The agreement with Finland has a strictly bilateral character and is realised by the special joint Polish – Finnish committee.

In the period between 1992 and 1995 the Management Board of ECOFUND decided to finance 139 environmental protection projects for the total amount of 146.9 million PLN (ca. 60 million USD). The largest share (34%) of those funds was allocated for co-financing of the projects for greenhouse gas emission reduction. Activities have commenced aimed at: promotion of energy saving in heating systems, waste-heat utilisation and liquidation of inefficient energy sources. Special attention was given to promotion of renewable energy sources and economic utilisation of methane from mines and from municipal landfills.

Under the Finnish eco-conversion agreement, 76 projects had been approved for implementation till March 1997. These are environmental investments with participation of Finnish technologies and equipment for different environmental protection sectors and energy conservation. 65 of those projects have started. The total cost of co-financing was 22.4 million PLN.

Bilateral and multilateral co-operation. At the moment there are several projects conducted under an international co-operation and financial support of foreign institutions. These projects promote activities for rational energy consumption in Poland. For example, projects were implemented in bilateral co-operation with countries of the European Union and the USA concerning heat conversion from coal to other energy sources, methane utilisation, termo insulating and energy savings, as well as renewable energy sources utilisation.

A few projects are implemented under the PHARE programme, which contribute to reduction of greenhouse gas emission and their absorption, for example: assistance program for the protection and restoration of treestands, production of electric power and thermal energy from methane (from hard coal mines) and modernisation of boiler houses and energy management in a selected hard coal mine.

Table 4.12. **Selected measures to mitigate greenhouse gas emissions - CO_2 by economic sectors**

Strategies/Measures	Sector	Objective and/or method	Instruments	Implementation status
1	2	3	4	5
Increase of sequestration and accumulation of CO_2 by 10% (4.5 million tonnes) till 2020 and by 20% (9 million tonnes) till 2050	forestry	• increase of the country forest ratio to 30% in the year 2020 and to 33% in the year 2050 through afforestation of about 27 thousand ha per year (financed mostly by state budget, with support of the National Fund for Environmental Protection and Water Management and PHARE) • improvement of the sanitary state of forests • increase of timber resources in forests by 15% by 2020 and 20% by 2050	• *National Afforestation Programme* [1995] being and element of implementation of *National Environmental Policy as well as the Act on Forests* [1991]	1995-2050 (the programme has commenced and will be continued)
Reduction of fuel consumption by vehicles and improvement of energy efficiency of engines	transport	• introduction of stringent requirements for vehicles registered for the first time in Poland., which will force better combustion efficiency in engines • introduction of a ban on import of old cars (over 10 years old), trucks (over 3/6 years old) and combine harvesters (over 4 years old) • introduction of a ban on import into Poland of two-cycle engine vehicles and engines as well as a ban on first time registration of such vehicles • introduction of a category for gas-fuelled vehicles and defining relevant technical parameters for them • growth of combined transport (rail-road system) • promotion of public transport, especially in urban-industrial agglomerations (mass public transport preferred) and improvement of quantity and quality of public transport	• Order of the MTiGM of 1993 • Order of the Council of Ministers of 1993/1994 • Order of the Council of Ministers of 1993 • Order of the MTiGM of 1993 • signing of AGTC Agreement, state guaranties to back the World Bank loan, subsidising of combined transport by the state budget, establishment of a company Polkombi on the initiative of MTiGM • subsidies from MTiGM for carrying passengers (public rail, national bus operator) and for upgrading and purchase of new vehicles that meet environmental standards	under execution since 1993 under execution since 1993/94 under execution since 1993 under execution since 1993 the Agreement ratification process underway since 1995 implementation activities ongoing
Fuel conversion	agriculture	• reduction of solid fuel share (mostly hard coal) and its exchange with gaseous or liquid fuels • promotion of renewable energy	• subsidies, tax vacations and soft loans • Scientific Research	implementation activities ongoing till 2010

		sources (including technological preparation for the production of bio-fuel from spring rape)	Committee projects	
Rationalisation of heat consumption	municipal	• improvement of thermal insulation of buildings through removal of technological faults and upgrading of heat installations • introduction of new requirements as to thermal protection of buildings • support of energy efficient construction projects leading to modernisation of the existing building resources	• subsidies for housing co-operatives • amendment of the order concerning technical regulations on buildings issued by the Minister of Interior Affairs and Administration • preparation of an act to create organisational and financial conditions (loans for modernisation projects supported by guarantees from the Guarantee and Premium Fund)	since early 80-ties till 1997 since 1996 after adoption by the Parliament
Technological restructuring	industry	• establishment of the Agency for Technique and Technology to support implementation of modern technologies • development of regional institutions transferring new technologies • building of the National Service System for small and medium enterprises to support them in gaining access to advisory, training, financial, information services as well as technological audits • introduction of clean production principles in enterprises as well as environmental management system • promotion of recycling (research projects on waste recycling, developments of a national system of waste recycling and recovery)	• Order of The Minister of Industry and Trade • programme of support for regional institutions active in technology transfer • programme for organisation and support of enterprises • economic instruments (access to soft credits)	under execution since 1996
Reduction of energy intensity in industry	industry	• restructuring of the most energy-intensive industrial sectors: iron and steel industry, heavy chemical industry	• restructuring programmes for individual sectors	under execution since 1992
Environmental investments	oil industry	• improvement of liquid fuel quality • production of petrol with ethanol content • increase of production of lead-free additives for rising the calorific value of petrol	• programme for restructuring and privatising of the oil industry	
Environmental investments	oil mining and gas industry sector	• change of the primary fuel consumption structure towards growth of gas consumption • increase of gas supplies for heating of households and use of gas as an alternative power source in power energy sector	• programme for sector restructuring	
Rise of energy savings and improvements in	chemical synthesis sector	• liquidation of energy-intensive technologies, introduction of modern high energy efficient	• programme for restructuring of "Great chemical synthesis" for the years 1995-2005	

sustainnable use of resources		processes, exchange of energy carriers into oil and gas • improvement of product quality, air-tight sealing of production installations and handling facilities, final combustion of post-reaction gases, incineration of waste		
Rationalisation of energy consumption	iron and steel industry	• liquidation of environmentally damaging production branches (production of pig iron, pipes, rolling of products) • growth of continuous steel casting (currently 60%) share • use of coal of better parameters • recovery of heat from metallurgical processes • utilisation of technological gases	• programme for restructuring of the iron and steel industry sector	
Abatement of environmental impact	zinc and lead industry	• closure of large metallurgical installations • air-tiht sealing of lead melting process • resignation from concentrate drying process in rotary, gas-fuelled furnaces	• programme for restructuring of zinc and lead industry sector	
Reduction of energy and resources consumption	cement industry	• shift of technology of wet cement production into dry process (reduction of heat demand by 50%) • research into environmentally sound and energy efficient technologies of lime and cement production • utilisation of large volumes of side products (mineral and combustible) from other industries (up to 25% of the production volume of cement clinker)	• programme for restructuring of cement industry	
Support for environmental projects	coal mining	• increase of hard coal calorific value and reduction of pollutants in coal	• programme *Hard coal mining, state and sectoral policy for the years 1996-2000*	since 1996

Table 4.13. **Selected measures to mitigate greenhouse gas emissions - CH_4 and N_2O by sectors**

Strategies/Measures	Sector	Objective and/or method	Instruments	Implementation status
Abatement of CH_4 emission from intestine digestion of animals stock	agriculture	• intensification of farming practices (restructuring of resource base in beef market towards specialisation of production and change in cattle breed structure, rise of milk efficiency leading to reduction of cattle stock)	• programmes for modern animal farming	since 1990, ongoing
Abatement of N_2O emission	agriculture	• rational use of nitric fertilisers, increase of organic fertiliser use (including manure)	• fertiliser advisory services, draft on the Act on fertilisers	since mid 90-ties, ongoing
Abatement of CH_4 emission from coal mines	hard coal mining	• capturing and utilisation of methane from coal beds	• programme *Hard coal mining, state and sectoral policy for the years 1996-2000*	implementation since 1996 till 2000 and further on
Abatement of CH emission from landfills and sewage treatment plants	municipal	• introduction of installations for degassing of landfills together with power production • waste composting (chamber and open-field composting facilities) • utilisation of bio-gas in sewage treatment plants (upgrading of the existing plants and providing new ones with facilities for biogas capture and utilisation; this should lead to reduction of greenhouse gas emissions between 52 and 92% depending on the number of operating installations)	• guidelines for monitoring landfill gas (OBREM) • instructions on waste management for communes (CUMiRM, OBREM) • CUMiRM project	since 1991, ongoing since 1991, ongoing ongoing, until 2030

Two projects promoting energy-efficient lighting have been successfully completed: GEF project (PELP) of the total amount of 5 million USD resulted in selling of 1.28 million energy saving light bulbs; the second project conducted by WWF (total amount of 150 thousand DM) resulted in energy consumption reduction (20-40%) in selected schools.

Table 4.14 shows the number of projects currently in progress or already completed in co-operation with other countries, resulting in the greenhouse gas emission reduction.

Table 4.14. **Projects implemented under international co-operation for greenhouse gas emissions mitigation in 1993-1996**

Country	Number of projects	Share of foreign partners [million]
Denmark	7	18 328 DK
Finland	2	2 567 FIM
Netherlands	2	0.808 NFL
Norway	2	3.758 NOK
Germany	1	45 000 DM
Sweden	2	11 402 SEK
USA	1	0.05 USD

Source: NFOSiGW

Activities Implemented Jointly (AIJ) . This group includes a Polish-Norwegian project of coal to gas heating conversion. The objective of this, conducted by GEF, project is to stimulate technological and institutional changes leading to demonstration of efficiency of exchange of coal for fuels with lower carbon content.

The project includes:

- investments into coal-to-gas heating conversion in 30 non-industrial small and medium boiler-houses supplying heat for households and offices,
- fitting of energy saving installations in several hundred new flats,
- assistance for project participants through education and environment monitoring.

The project is financed jointly by the Government of Norway (1.1 million USD), the Government of Poland (22 million USD) and GEF (25 million USD). It is expected that this project (started in 1997) will result in reduction of carbon dioxide emission in the amount of 141,698 Mg from the first twelve projects completed.

5. MAIN DIRECTIONS FOR THE DEVELOPMENT OF POLISH ECONOMY UNTIL AND BEYOND 2000

5.1. Introduction

This chapter presents main directions in the development of Polish economy, which include inter alia programmes towards greenhouse gas emission reduction and their removal enhancement in individual sectors of Polish economy – industry, construction, transport, agriculture, and forestry. In addition, macroeconomic scenarios are also presented for greenhouse gas emission reduction that take into account long-term development of the country economy, based on the Macroeconomic Reference Scenario (MERS).

5.2. Main directions for the development of Polish economy until and beyond 2000 by economy sectors

5.2.1. Industry

The main objectives of industry development by the year 2010 shall be the growth of its international competitiveness and bridging the development gap between Polish industry and this of the developed countries. That should be done through development of creativeness, entrepreneurial skills and efficiency. Sectoral structure of the industry shall undergo systematic changes towards higher share of processing industries that will hold the focus of practically entire growth of industrial production.

In general, the national industrial policy until the year 2010 will be characterised by two options:

1) transformation option (in the period necessary for finishing system changes);
2 strategic option, implemented once Poland becomes a member of the European Union.

Transformation option that should slowly be withdrawn before Poland's full membership in the European Union takes into account the necessity for the state to participate in programmes of adjustment of key economy sectors to market economy. This is relevant for governmental programmes for: coal mining, iron and steel industry, pharmaceutical industry, oil sector, defence and aviation industry, oil and gas mining.

Strategic option assumes that once Poland becomes a full member of the European Union, unified legal and economic solutions will be applied to all industrial enterprises, consistent with European Union regulations.

Industrial policy assumes that the key objective for economic infrastructure is to improve its quality, and in particular: ensure provision of energy carriers to the country, sustainable management of minerals, and reduction of adverse environmental impact caused by mining, as well as improvement of transport system.

In the scenario for the development of energy management in Poland till the year 2010 the following factors were assumed:

1) technical and economic development will have energy efficient nature;
2) there will be an intensive production growth in most of the existing and modernised plants;
3) economic and environmental incentives will be developed towards wider use of noble energy carriers of higher productivity;
4) integration with the European Union will cause a transfer of more cost-effective and less energy intensive technologies into Poland.

Assumptions of Poland's energy policy. As the requirements in terms of energy efficiency and environmental protection are growing, a change of primary energy structure into more fuel-diversified and more heavily based on noble energy carriers, will be the key priority in the long-term energy policy of the country. Other priorities will include rationalisation of fuel and energy consumption. An important task for the energy policy in the nearest future will be maintenance of coal mining at the level ensuring its viability without state budget subsidies and compliance with environmental standards, as well as sustainable use of lignite resources.

Main tasks of the national energy policy in the area of natural gas consumption will be:

- increase of country extraction of gas to the level economically justifiable, including gas resulting from removal of methane from hard coal beds;
- increase of gas supplies from Russia, including construction of a new pipeline from Russia to Western Europe;
- construction of gas storage facilities in the area of Poland as well as creation of reserves of gas;
- seeking gas supplies from other geographical directions.

The key task of the state energy policy in terms of energy costs is creation of economic and regulatory mechanisms that will ensure:

- gradual quality improvement of final energy towards increase of share of electric power and liquid and gaseous fuels;
- increase of efficiency of electric power sector enterprises;
- rationalisation of energy use throughout the economy.

A significant decrease in the energy intensity in all sectors of the country economy is expected caused first of all by:

- rise of prices of various energy carriers to real economic levels that will force energy conservation by end-users;
- creation of possibility for energy enterprises to invest in the energy demand sector which will improve a process of energy use rationalisation;
- general economic development towards elaboration and implementation of energy saving technologies in production and construction;
- regulatory policy of the state towards elimination of energy intensive facilities from the market;
- development of social awareness concerning the necessity for sustainable use of natural carriers of primary energy.

Energy supply and demand balance. According to the prognosis of energy situation in Poland, presented in *the Assumptions for Poland's national energy policy until the year 2010* [1995], expected demand for primary energy in 2000 and in 2010 will be greater than its consumption in 1990 but smaller that the consumption in 1988 (see Table 5.1).

Table 5.1. **Demand for primary energy till 2010**

Energy carriers	Primary energy demand [PJ]			
	1988	1990	2000	2010
Hard coal[a]	3548.9	2576.8	2576.8	2421.8
Lignite	590.8	561.5	511.2	507.0
Natural gas	406.4	372.9	473.5	628.5
Oil[b]	741.6	645.3	913.4	1064.3
Nuclear energy	0	0	0	0
Other[c]	100.6	54.5	129.9	326.8
Total	**5388.3**[d]	**4211.0**	**4604.8**	**4948.4**

[a] Country demand, coke export deducted
[b] Together with the foreign trade balance of liquid fuels
[c] Wood, peat, water energy plus import/export balance of electric power
[d] Differences between data for 1988 and 1990 in Table 5.1 and Table 2.3 do not exceed 1% and result from different level of calculation detail

Source: MG

Demand for hard coal will be decreasing – in 2010 it will be 30% lower than demand in 1988 and slightly lower than in 1990 (see Table 5.1). Reduction of hard coal production to 120 million tonnes is foreseen by the year 2000. Out of this, 98 million tonnes would be sold in the country. It is expected that further reduction of hard coal mining will follow after the year 2000.

Demand for lignite will largely be determined by power output and expected load of the existing power plants. According to prognosis until the year 2010, because of large resources of lignite and its significant value for the energy sector resulting from high share of this carrier in the total energy production (about 40%) and low cost of energy produced from lignite, its exploitation should be continued at the current level. Construction of new power plants using lignite is not expected before the year 2000.

Demand for natural gas will be growing to reach in 2010 56% of the 1990 demand. The main source to meet this growing demand will be import, while country resources will cover about 42% of supply. Apart from currently exploited beds utilisation of local beds of gas with nitrogen content is foreseen. It is also projected that after 2000, gas produced as a result of removal of methane from hard coal will be utilised to higher extent. Currently about 200 million m^3 of this gas is used annually, while existing resources are estimated at 350 milliard m^3.

Demand for oil derived products will grow until 2010 by 66% as compared to the 1990 demand. Oil demand will be met entirely by import. In-country oil supply of about 300 thousand tonnes per year (about 1-2%) will have only marginal importance.

It is estimated that the demand for electric power will amount to about 180 milliard kWh in 2010 if an average 5% growth in economic development as well as related changes in production structure and used technologies are assumed. Demand for the electric power till 2010 can be met by the energy sector extension and upgrading, based on traditional resources and import. In the further perspective, development of nuclear energy sector should be considered.

Demand for renewable energy in all discussed prognoses is marginal both because of its low resource in the country (water energy production) and relatively high cost of final energy production (wind, solar energy, biogas, geothermal). In 1996 an interdisciplinary team of experts appraised possibilities of utilisation of renewable energy sources and presented proposals for solutions. A programme for use of renewable energy sources is expected to be developed. It is expected that the renewable energy share in the energy balance of the country in 2000 will be between 1.2% and 2.6%, in 2010 between 1.7% and 5.5%. Possibilities of energy production from alternative resources till the year 2030 were evaluated as 161 PJ, which will be around 5% of the total consumption of primary energy carriers, and even up to 24% of the consumption in rural areas.

It is estimated that because of the change of industry structure into less energy intensive and introduction of new highly energy efficient technologies, consumption of final energy by industry in 2000 will be by 29% lower than in 1988 and by 14% lower than in 1990, while in 2010 the drop will be by 24% and 8% respectively (see Table 5.2). In the municipal sector it is foreseen that energy consumption in 2000 will be lower than that in 1988 by 11% but higher than in 1990 by 35%. In 2010 energy consumption will be 8% lower than in 1988 but almost 40% higher than in 1990. In agriculture, a growth of energy consumption in 2000 by 8% of 1990 consumption is expected and by 22% in 2010. In construction, energy consumption will drop by 43% in 2000 against 1988, and by 20% against 1990. In 2010 the figures will be respectively 28% and 20%. In transport, on the other hand, consumption in 2000 will grow by 13% against 1988 figures and in 2010 by 37%.

Table 5.2. **Final energy demand in Poland to 2010**

Sectors	Final energy demand [PJ]			
	1988	1990	2000	2010
Industry	1399.5	1160.7	993.0	1064.3
Construction	58.7	41.9	33.5	33.5
Agriculture	79.6[a]	205.3	222.1	251.4
Transport	209.5	159.2	180.2	217.9
Residential	1784.9	1173.2	1588.0	1634.1
Total	**3532.2**	**2740.3**	**3016.8**	**3201.2**

[a] Only state and co-operative agriculture

Source: MG

It is foreseen that the structure of demand for final energy carriers will positively change (see Table 5.3). The share of solid fuels by the year 2010 will drop by over 50% against 1988 figures and by 20% against 1990. They will be replaced by more environmentally friendly fuels. Energy demand will grow by 33% against 1988 level and by over 40% against 1990. Because of foreseen savings, consumption of centralised heat will be reduced by the year 2010. It is expected that heating systems will be developed using combined production of electric power and heat. Growth of direct consumption of gaseous fuels is also expected.

The national energy base (understood as both resources and production process) and the existing import/export agreements ensure meeting the country energy demand until the year 2000. After that, the problem of balancing the energy supply and demand will gradually grow. Its solution will be possible providing the following steps are undertaken:

- activities towards reduction of energy intensity of GDP, in both the production sector and households. The activities should lead to the reduction of energy intensity factor by about 30%;
- changes in the structure of primary energy supply – liquid fuels replacing solid ones.

Table 5.3. Structure of final energy consumption in Poland to 2010

Energy carriers	Final energy consumption							
	1988		1990		2000		2010	
	[PJ]	[%]	[PJ]	[%]	[PJ]	[%]	[PJ]	[%]
Solid fuels[a]	1307.3	37.0	699.7	25.5	745.8	24.8	574.0	18.0
Gasous fuels	440.0	12.5	435.8	15.9	465.1	15.5	557.3	17.4
Liquid fuels	490.2	13.9	440.0	16.1	536.3	17.8	670.4	21.0
Electricity	381.3	10.8	356.2	13.0	398.1	13.2	507.0	15.8
Centralised heat[b]	842.2	23.8	779.3	28.4	796.1	26.5	808.7	25.3
Other fuels	71.2	2.0	29.3	1.1	62.8	2.1	79.6	2.5
Total	**3532.2**	**100.0**	**2740.3**	**100.0**	**3004.2**	**100.0**	**3197.0**	**100.0**

[a] Excluding solid fuels for technical steam production and centralised heat in the industry

[b] Including centralised heat in the industry

Source: MG

Pricing policy. Hard coal prices should be in line with world market tendencies. Prices for lignite will be kept under regulatory control as this carrier do not have a market character and because of prices of network energy carriers. In accordance with energy legislation, price lists for gaseous fuels, electric power and heat will be set by energy enterprises themselves and approved by the Energy Regulatory Agency. The Minister of Finance and relevant ministers will maintain the right for setting price lists for those fuels by maximum 24 months since the effective date of the Law (i.e. since 5 December 1997). The Minister of Economy, in agreement with the Minister of Finance and after consultations with the Energy Regulatory Agency, will specify detailed principles for setting prices and financial operations in trading of gaseous fuels, electric power and heat.

Rationalisation of energy consumption. Achieving the correct structure of prices for primary and final energy carriers will trigger initiative of end-users to rationalise consumption and substitute some energy carriers with more efficient ones. In parallel the state will undertake steps to achieve sustainable management of energy resources.

Policy for the support of activities towards rationalisation of energy consumption is presented in *Assumptions for state policy in the field of rationalisation of energy consumption in the municipal sector* [1995]. The policy includes elaboration of an act on support for activities on thermal modernisation, which will be presented to the Parliament as part of budgetary regulations for 1998. An expected environmental effect of the Act is for example a reduction of carbon dioxide emission by about 17.5 million tonnes, methane emission by 11.4 thousand tonnes, and nitrate oxides by 35.3 thousand tonnes per year.

Modernisation projects in building substance will have to be co-ordinated with necessary actions in the sphere of production and distribution of thermal energy. Savings resulting from lower demand for energy are only possible if transmission lines and heat sources are fully automatic. For this reason the Support System for Energy Efficient Investments was elaborated to cover sources and networks that supply buildings and facilities undergoing the process of thermal renovation. The primary forms of financing under this programme will be commercial loans and soft loans from funds for environmental protection and water management as well as money from ECOFUND. Institution responsible for elaboration of the programme and promotion of activities towards rationalisation of energy consumption in construction sector is the Polish National Energy Conservation Agency (KAPE[4]). The Agency has as its primary tasks preparation of drafts for comprehensive policy in terms of rationalisation of energy consumption and development of projects for financing of activities towards implementation and promotion of modern technical solution in this field.

Under the act on support for activities resulting in thermal modernisation it is also planned to introduce a professional energy audit which will replace administrative decisions (concerning distribution of grants) with economic decisions (concerning effectiveness of the investment) since 1998 and will therefore enable selection of the most profitable investments dealing with thermal modernisation (see Table 4.12).

Regulations are being developed in accordance with the energy law to control requirements towards energy efficiency of facilities and equipment traded on the domestic market. Energy enterprises will be obliged by the Energy Act to include in their planning the development of organisational and investment activities in the energy demand sphere and will be allowed to incorporate costs of those activities in energy prices. The end-u-

[4] KAPE was established in 1994 by Ministers of : Industry and Trade, Spatial Planning and Construction, Environmental Protection, Natural Resources and Forestry and the Agency for Industrial Development, Bank for Country Economy and the National Fund Environmental Protection and Water Management.

sers will in turn be interested in such activities because of expected benefits from energy consumption reduction and lower costs.

As part of the promotion of energy consumption rationalisation the state will support pilot commercial projects leading to higher energy efficiency.

It is foreseen that activities undertaken will lead to significant reduction of energy intensity in all sectors of the national economy (see Table 5.4).

Environmental protection. One of the primary tasks listed in the document *Assumptions for Poland's national energy policy until the year 2010* was environmental protection, including reduction of carbon dioxide emission. Abatement of environmental pollution is to be achieved through steps consistent with proposed assumptions of the energy policy and the national environmental policy adopted by the Parliament. The activities should result in:

- increase of efficiency in energy consumption and gradual switch into energy carriers less damaging for the environment;
- improvement of fuel quality, especially hard coal, and wide use of environmental technologies of combustion;
- strengthening of relations between management of water resources and their use for energy production;
- creation of conditions for sustainable use of renewable energy resources.

Activities aimed at abatement of environmental pollution will be controlled by, inter alia, environmental legislation consistent with the relevant law of the European Union and Poland's international obligations.

Table 5.4**. Expected dynamics of changes in energy intensity of added value* until the year 2010 (energy intensity in 1990 was assumed as 100)**

Sector of economy/branch	% of energy intensity of added value	
	2000	2010
Industry:		
Iron metallurgy	82.2	73.6
Non-iron metal industry	96.5	88.9
Electric/Machine-building industry	83.9	71.4
Chemical industry	84.8	73.5
Mineral industry	88.1	81.2
Other industry branches	77.7	64.9
Construction	82.6	68.3
Agriculture	98.2	94.5
Transport	84.6	73.3
Other industry sectors	79.7	63.2

* Change in energy intensity of added value was elaborated based on the net output

Source: MG

5.2.2. Transport

In the transport sector further growth of the demand for carrying both goods and passengers is expected. In the period between 1993-2010, with 4.99% annual growth of GDP, land transport of goods is foreseen to grow by 3.49% annually (in tonnes). Broken down by individual modes of transport the annual growth will be the following: railway – by 3.23%, vehicles – 3.54%, pipelines – 3.69%, inland water – by 2.88%, marine transport – 2.82%. Average increase of land transport (in tonnes by kilometres) will amount to 3.95% and will result from increase of transport distances. In 2010 the role of railway in land transport will diminish from 54.6% to 50.2% and marine transport from 56.8% to 51.3%. In turn, vehicle carriers will grow in share from 34.5% to 39.5% of land transport. Prognosis for carrying goods and branch structure of transport in Poland in 1990-2010 is presented in Table 5.5.

Carrying of passengers (in millions of passengers) will be growing by 3.31% annually, including: rail – 2.96%, coaches – 1.74%, aviation – 11.1%, inland water – 1.68%, maritime – 5.94% and individual cars – 3.91% per annum. In 2010 individual vehicles may carry 69.8% of passengers carried by all means of transport (see Table 5.6) and count for 62.3% of passenger-kilometres. In terms of passenger carrying work (in passan-

gers by kilometres) importance of railway will drop by 2010, from 16.4% to 14.7% and coach transport from 20.1% to 17.0%. Individual vehicles will gain importance from 61.5% to 62.3%, and the same is true for air transport – growth from 1.9% to 5.8%.

Table 5.5. **Prognosis for carrying goods and their structure by type of transport (according to number of tonnes) in Poland in 1990-2010**

Type of transport	Goods carried							
	1990		2000		2005		2010	
	million tonnes	%	million tones	%	million tonnes	%	million tonnes	%
Railway	281.7	**17.4**	289.7	**16.0**	336.3	**15.5**	367.9	**15.5**
Road	1292.3	**79.9**	1459.8	**80.9**	1769.8	**81.5**	1935.9	**81.5**
Pipeline	33.0	**2.1**	44.3	**2.5**	53.3	**2.4**	57.8	**2.5**
Inland water	9.8	**0.6**	11.1	**0.6**	12.4	**0.6**	14.1	**0.6**
Total land transport	1616.8	**100.0**	1804.9	**100.0**	2171.8	**100.0**	2375.7	**100.0**
Maritime (% land + maritime transport)	28.5	**1.7**	29.0	**1.6**	35.4	**1.6**	38.4	**1.6**

Source: MTiGM

Table 5.6. **Prognosis for carrying passengers and branch structure (according to number of passengers) in Poland in 1990-2010**

Type of transport	Number of passengers							
	1990		2000		2005		2010	
	million tonnes	%	million tonnes	%	million tonnes	%	million tonnes	%
Railway	789.9	**15.8**	638.2	**9.7**	750.7	**9.5**	888.4	**9.8**
Coach	2084.7	**41.9**	1618.4	**24.6**	1800.6	**22.7**	1850.1	**20.3**
Aviation	1.7	**0.0**	2.9	**0.1**	5.1	**0.1**	8.4	**0.1**
Inland water	3.8	**0.1**	0.7	**0.0**	0.7	**0.0**	0.8	**0.0**
Maritime	0.6	**0.0**	0.9	**0.0**	1.2	**0.0**	1.6	**0.0**
Individual car	2099.0	**42.2**	4309.5	**65.6**	5351.9	**67.7**	6352.6	**69.8**
Total	4979.7	**100.0**	6570.6	**100.0**	7910.2	**100.0**	9101.9	**100.0**

Source: MTiGM

Public transport of passengers will have to be significantly improved both in terms of quality and volume in order to successfully compete against dynamically developing individual transport by cars. In order to promote railway transport of passengers the state will have to further subsidise selected areas of passenger service.

The prognosis for road vehicles until the year 2005 foresees growth of their number against 1990 figures: buses by 47%, trucks by 85%, passenger cars by 140% (see Table 5.7).

Table 5.7. **Prognosis for number of vehicles in Poland until 2005 [thousand vehicles]**

Vehicles	Number of vehicles		
	1990	2000	2005
Buses	90	116	132
Trucks	1043	1569	1928
Individual cars	5261	9459	12659
Total	6394	11144	14719

Source: MTiGM

Care for the environment in Polish transport policy is proved by the fact of signing by the Minister of Transport and Minister of Environmental Protection of the declaration of European conference "Transport and Environment", organised by ECE UN in 1997 and the declaration of the Ministers of Environment of Central Europe. Both initiatives aim at diminishing of adverse impact made by transport on the environment and human health, including integration of transport, environmental and health policies, as well as incorporation of sustainable management principles into the transport policy. Poland has also taken up an obligation to promote energy saving vehicles and transport systems, less polluting fuels, to initiate activities towards mitigating adverse impact of transport means in urban agglomerations and safe carrying of hazardous loads.

5.2.3. Agriculture and forestry

Agricultural policy until the year 2000 will be directed towards increase of concentration and specialisation in cattle rearing, milk and beef production as well as improvement of efficiency of their production and processing. The plans are based on the assumption that the cattle stock will grow to 9.5-10 million animals and the sheep stock will be restored.

In the prognosis until 2010 a reduction of solid fuels share (mainly hard coal) in agriculture is foreseen and their replacement with gaseous and liquid fuels (see Table 5.8). Researches are also carried out into a production of diesel oil substitute from rape oil.

The Ministry of Agriculture and Food Economy has initiated works over voivodship programmes of small water retention for the years 1997-2010 that will lead to investments and other activities related to development of water resources in Poland. This has as its main goals the supply of water for agricultural irrigation, to households, and the use of water for energy production on a local scale. The programme will be financed largely by funds for environmental protection and water management, funds from the Agency for Restructuring and Modernising of Agriculture, state budget, funds of land protection, local governments, and foreign assistance funds (e.g. the World Bank).

Table 5.8. **Prognosis for use of individual energy carriers in agriculture in the years 2000, 2005, 2010**

Energy carriers	Energy consumption [PJ/year]		
	2000	2005	2010
Fossil fuels - total	**322.2**	**324.6**	**323.5**
Hard coal	157.5	146.8	135.9
Heating oil	8.8	10.2	12.1
Natural gas	25.2	29.3	34.1
Electric power	33.3	35.1	35.0
Heat	4.6	6.5	7.8
Diesel oil	63.5	66.3	68.0
Petrol	24.1	24.6	24.8
Propane-butane gas	3.3	3.9	3.9
Other	1.9	1.9	1.9
Renewable - total	**25.9**	**38.4**	**50.8**
Timber	12.2	13.5	14.7
Straw	0.5	1.3	2.1
Solar air collectors	2.5	4.0	6.5
Solar water collectors	2.6	4.6	6.5
Wind power plants	0.2	0.5	0.7
Water power plants	3.2	5.9	8.1
Geothermal heating plants	0.9	1.3	2.3
Ethanol	3.2	5.8	7.7
Biogas	0.6	1.5	2.2
Total - fossil and renewable	**348.1**	**363.0**	**374.3**

Source: MriGZ

The state forestry policy in the next years will be implemented according to the following schedule:

- By the year 2000 programming work will be completed concerning implementation papers to assist the National Forestry Policy in the areas of a complex protection of forest resources, an increase of forest ratio of the country, and a protection of forest biodiversity. An amendment to the Act of Forests will be prepa-

red as well as the Strategic Governmental Plan and Programme of Development of Forest Promotional Complexes. A system of planting trees will be initiated.

- By the year 2020 the process of transformation of a resource-based model of forestry into a multifunctional model will be completed, the forest ratio will grow to 30%, the programme for Forest Promotional Complexes will be implemented, health conditions of forests will improve, forest biodiversity will be protected in a systematic way, and activities towards mitigation of global warming effect will be initiated.
- Until the second half of 21st century all planned goals of forestry policy will be reached, including restructuring of species composition of forest stands and effective participation of forests in climate regulatory mechanism, water management and nature preservation.

Factors that threat to disturb implementation of the forestry policy include unforeseeable changes in the social and economic policy of Poland and uncertainty as to future climatic conditions.

5.3. Macroeconomic scenarios of greenhouse gas emission reduction

Analyses of macroeconomic greenhouse gas abatement scenarios were based upon Macroeconomic Reference Scenario (MERS). This is a hypothetical scenario of the country development on a macro scale, which does not include measures specially oriented to greenhouse gas emission reduction, and to adaptation of the economy and the society to expected climate changes. Prepared scenarios include long-term vision of the country (in this case the horizon is 2010) and constitute a reference within macroeconomic costs and greenhouse gas emission abatement for development scenarios for reduction which define long-term strategies of greenhouse gas emission abatement. The MERS scenarios formed a basis for preparation of reduction scenarios. Three reference scenarios were adopted to reflect uncertainty concerning strategies for the future country development:

- *base-line scenario,* based on political assumptions currently declared by the state authorities;
- *scenario of chance,* based on the assumption that faster and more thorough structural changes will be possible in the economy and the social life than it was assumed within the base-line scenario; and
- *scenario of stagnation,* based on the assumed lack of public acceptance for structural changes in the economy and related costs; this is the scenario with a lower rate of transformation than this assumed in the base-line scenario.

Assumptions as to the following actions were made for the purpose of preparation of the base-line scenario:

- change of the economy towards decrease of share of metallurgy and coal industries and increase of share of processing industries with advanced and energy efficient technologies and services; change of production and structure of agriculture;
- privatisation of industrial sector;
- strengthening of the role of a market as a regulator of economy;
- opening of the economy into international exchange, through exchangeability of polish currency, gradual phasing out of custom barriers, influx of foreign capital, and approximation of law to the EU requirements;
- reduction of energy intensity of production, rationalisation of energy resources consumption;
- decrease of environmental pollution through environmentally sound investments in the economy, in particular in the energy sector and the industry.

The reference scenario of chance was created with an assumption of possible deeper and faster changes than those assumed in the base-line scenario, i.e.:

- accelerated changes in the economic structures towards less energy and material intensive and an increase of highly degree of processing in production;
- full opening of the economy into external markets;
- significant growth of share of hydrocarbon fuels in energy production.

The reference scenario of stagnation assumed:

- freezing of technological and organisational structure of production;
- preservation of material– and energy-intensive nature of the economy;
- restricted co-operation and international exchange;
- protection and development of hard coal mining;
- slow restructuring of the economy.

Changes in emission and selected characteristics until the year 2010 for macroeconomic reference scenarios are presented on Figure 5.1 and in Table 5.9. It should be stressed that the reference scenarios do not take into account strategies for greenhouse gas emission reduction in forestry sector, while in the case of agriculture they include only some options of plant production.

Changes of foreseen CO_2 emission in Poland until the year 2010, according to the base-line scenario and broken down by sectors are presented on Figure 5.2. It shows that the highest share in the total CO_2 emission is held by energy sector and the industry (which also shows the highest growth in this period).

In order to select reduction options from individual sectoral scenarios and to incorporate them in a national scenario two modelling tools of decision making analysis were applied: Cross Impact Analysis (CIA) and Hierarchy Preference Analysis (HIPRE3+). The same models were also used for ranking the scenarios of greenhouse gas emission reduction. Selected results of macroeconomic reduction scenarios (base-line and chance) until the year 2010, assuming moderate activities towards climate protection, are presented in Table 5.10.

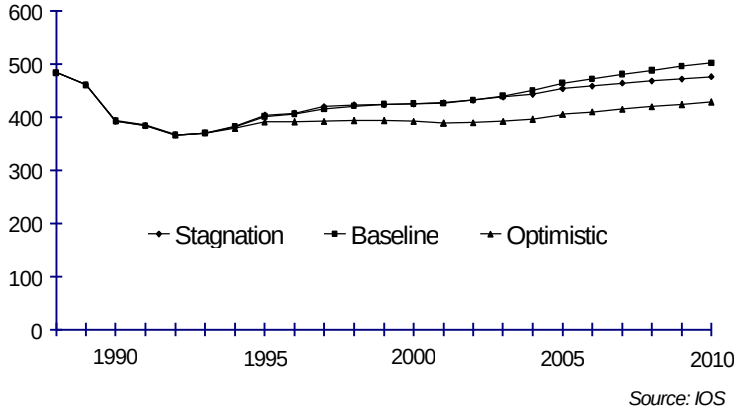

Fig. 5.1. Expected CO_2 emissions according to three scenarios [thousands Gg CO_2]

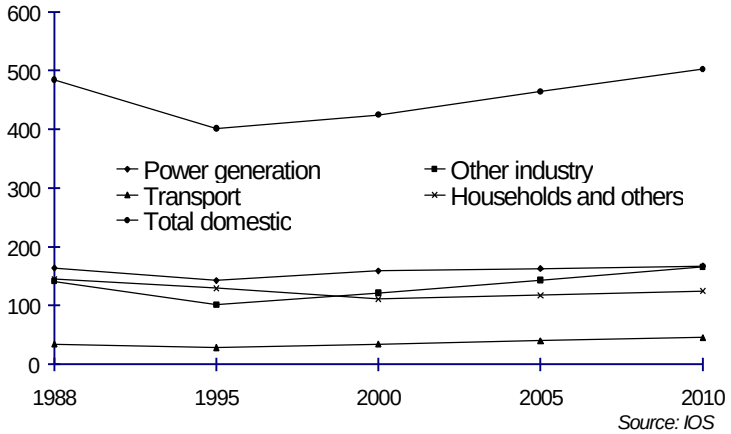

Fig. 5.2. Expected CO_2 emissions according to baseline scenario by economic sectors [thousands Gg CO_2]

Table 5.9. **Basic characteristics of macroeconomic reference scenarios**

Year	Use of energy supplying the country [PJ]			GDP emission intensity [Mg CO_2/million z³'90]			Domestic CO_2 emission [thousand Gg CO_2]		
	stagnation	baseline	chance	stagnation	baseline	chance	stagnation	baseline	chance
1988	5386	5386	5386	0.69	0.69	0.69	484	484	484
1990	4323	4323	4323	0.64	0.64	0.64	393	393	394
2000	4606	4624	4281	0.53	0.62	0.43	425	425	392
2010	5112	5629	5121	0.44	0.38	0.29	476	502	429

Source: IOS

Table 5.10. **Main parameters of macroeconomic reduction scenarios for the year 2010**

Scenario	GDP [billion z³'90]	Energy use [PJ]	GDP energy intensity [GJ million z³'90]	Total investments in the economy [billion zl'90]	Investments for GHG emissions reduction [billion z³'90]	Domestic GHG emissions [million Mg CO_2]	GHG emissions reduction [million Mg O_2]
Base-line	1184	5289	4,5	253	11.68	469	33
Chance	1343	4663	3.5	308	21.85	389	40

Source: IOS

Analysis of the base-line scenario leads to the following conclusions:

1) economic transformation period causes disturbance in tendencies present so far and makes it difficult to estimate parameters for modelling purposes. At least a couple of years is still needed before such attempts can be fully reliable because of difficulties that relate back to the period before 1989, e.g. excessive employment (hidden unemployment) existed in the economy before 1989 which disturbs estimates for parameters of production function;
2) the major dilemma for Polish economy development in a long-term is on one hand brining down unemployment growth rate and the necessity of structural changes (energy, heavy industry, agriculture sectors) on the other hand;
3) slowing down the unemployment growth can at the same time slow down structural changes rate. Therefore in order to enable large scale structural changes very high economic growth should be ensured (high GDP value) which requires high investment outlays;
4) results of macroeconomic prognoses for greenhouse gas emission should give indications as to the scale of changes in the economy that are necessary in order to achieve required results in greenhouse gas emission reduction. The main indicators will be: value and structure of GDP, value and structure of investment outlays, level and structure of energy carriers consumption, employment and unemployment ratio, expected loses in GDP resulting from e.g. taxation on fuel carbon contents;
5) comparison with results of sectoral scenario analyses should enable evaluation of feasibility of long-term country development strategies in terms of expected climatic changes as well as elaboration of an ultimate development strategy. This strategy should be acceptable to political decision makers and feasible for implementation. It should take into account international obligations, including those concerning greenhouse gas emission reduction.

6. VULNERABILITY ASSESSMENT AND ADAPTATION STRATEGIES TO CLIMATE CHANGE

6.1. Introduction

Evaluation of vulnerability of individual economic sectors and their adaptation to climate change was based on the results of research carried out be independent experts. Topics elaborated in further chapters will be continued under the National Climate Programme, currently being prepared for implementation.

6.2. Poland's coast vulnerability to climate change and adaptation assessment

Researches conducted has proved that the entire Polish coast is threatened by climatic changes implications. It was discovered that 2,200 km^2 of the coastal zone and over 230,000 people are under threat, and the total cost of areas lost in case the sea level rise by 100 cm will be 172.8 billion z³ '90 (and 103.7 billion z³ '90 in areas threatened by periodical floods). The total cost of protection reaches 34.5 billion z³ '90.

The strategy for full protection of Polish coastal zone is based on implementation of all feasible precautions and protective measures aiming at minimising of losses of land or drop of its value. It encompasses:

1) establishment of protective systems; total length of new protective systems along the open coast equals 16.3 km of dikes, 21.7 km of seawalls, and 1 km of offshore breakwaters;
2) full protection of the Odra river estuary which means preservation of polders on peripheries of the estuary;
3) construction of between 100 and 280 km of new dikes and reconstruction of dikes of length equalling to between 243 and 342 km, from Gdynia to the eastern border;
4) modernisation of the existing and construction of new polders. On the central coast the new polders require new facilities such as pumping stations, drainage and other infrastructure, while older polders must be redesigned by rising the dikes, adding new pumping stations, increase of the rate of pumping.

It should be stressed that in all cases except protection of middle stretch of the coast, the cost of protection is much lower than the value of potential losses in land. The cost of protection of the middle coast is in turn higher than the value of lost land, but the area contains sections whose protection is a priority (e.g. Slowiñski National Park). The cost of protection of such areas is however not comparable with their measurable value.

6.3. Vulnerability analysis and adaptation assessment of water management to climate change

Surface water resources per capita in Poland – 1600 m^3 /year – are three fold lower than the European average which already threatens with water deficit. There is a high changeability of surface water resources during the year which includes alternate periods of low and high levels leading to extreme conditions such as droughts and floods. Total capacity of water retention reservoirs constitutes about 6% of the average annual outflow, while the total potential capacity is only about 15%.

Currently one can not be sure what will the impact of climate change be on water resources and needs. In the case of most adverse ”dry” scenario, even more drastic summer drought periods should be expected especially in Central Poland and the need for agricultural irrigation will grow. Researches show that water-economy systems in Poland can be effectively adapted to changing climatic conditions through correct technical measures. Costs of adaptation may vary between the country regions depending on the scale of deficit projected.

Vulnerability of water-management systems is closely dependant on the level of development and water resources management. Improvement in management, including full implementation of a new instrument – rules for utilisation of water within a basin, is a main condition for strengthening the water systems against expected climatic changes.

6.4. Vulnerability and adaptation of agriculture to climate change

Agriculture is a branch of the economy most sensitive to the effects of climate changes. This results from the fact that growth and development of crops, being a major element of primary agricultural and food production, depends heavily on changes of temperature, precipitation, and concentration of CO_2 in the atmosphere. These, in turn, are the main factors of anticipated climate change of anthropogenic nature. Due to poorer soils,

which are more sensitive to water management changes, a scale of climatic change impact in Poland will be higher than in the current European Union member states.

It is expected that the projected climate change will have a multidirectional impact on agricultural production in Poland. If the concentration of CO_2 doubles and temperature rises one can expect a growth of yield in most of the currently grown crops. Longer vegetation period will create conditions favouring extension of the scale of pasture management. Reduction of the area taken up by potato production is expected along with an increase of the area under thermophilous crops, such as maize, soybean, oilseed sunflower and oilseed squash. It can be expected that even late maize varieties will mature throughout the country and their seed production will be higher than now by three tonnes per hectare. On the other hand however, intensity of various diseases and plant pest infestations will grow as will the water deficit. The latter will require intensified drainage works.

A resultant impact of climate changes on global net agricultural production is difficult to estimate. Higher yields in some regions (or years) might counterbalance a drop of yield in other regions (or years). This will however depend on many factors – both under and outside producers' control. Extend of potential losses related to climate changes and threatening food producers are also difficult to predict as well as their influence on changes in production profile and structure.

6.5. Vulnerability of forest ecosystems and adaptation of forestry to climate change

Expected changes of climate may result in long-term effects for Polish forests including inter alia: changes of biotic environment, water availability, habitat quality, deterioration of social functions that will be growing in importance for pro-environmental part of the society. Changes in availability of habitat resources and frequency of forest fires and other extreme factors will initially influence genetic diversity at the population level. Directed selection will probably lead to a creation of new species communities, which will in turn have impact on processes at the ecosystem level. Chances that the currently existing ecosystems will ”migrate” as a whole in changing environmental conditions are very low. Modifications in the biomass caused by climatic changes and economic use of land will most probably lead to fragmenting of plant populations and reduction in landscape and biological diversity. Species which at present compose the natural vegetation in some areas might not adapt to new adverse environmental conditions resulting from climatic changes in those areas. Those species might found themselves to grow in locations too distant from newly developed locations suited to their needs. In this situation the species will not be able to colonise those new locations. Newly developed plant communities will probably consist of small number of species and it can expected that they will be vulnerable to invasions from better adapted species, herbivorous species and pathogens which, in ecological meaning, will restore species numbers and biodiversity.

Alike the entire economy, forestry should be prepared for adaptation to changing climatic conditions in a way that would allow minimisation of adverse impacts of those changes. Therefore the steps set out in the national forestry policy reducing the risk of forest management conducted in adverse climatic changes situation, should be undertaken now. Activities complying with the principles of sustainable development of forestry, especially those promoting development of forest biodiversity, should enable permanent evolution of forest ecosystems towards better adaptation to changing climate.

Adaptation strategies in the forestry should promote indigenous species and ecotypes and avoidance of monocultures. Use of non-indigenous species and ecotypes can be justified if climatic changes exceed the tolerance margins of local species. It is also necessary to create a system of natural corridors enabling free migration of plant and animal species along with changing climatic conditions.

7. MONITORING OF GREENHOUSE GASES AND SCIENTIFIC RESEARCH IN THE FIELD OF CLIMATE

7.1. Monitoring of greenhouse gases

The European continent is one of the largest sources of carbon dioxide emission into the atmosphere. Therefore, effective modelling of circulation and transport of this gas on a global scale can only be achieved if the emission level and its impact on local CO_2 contractions are known. Recently two greenhouse gas monitoring stations were established in Poland. Both stations are situated far from man-made impacts.

Kasprowy Wierch monitoring station for the atmosphere. This station was organised by the Institute for Environmental Physics of the Department of Physics and Nuclear Technique AGH as part of Mountainous Meteorogical Observatory on the Kasprowy Wierch, in co-operation with two other scientific centres: Institute of Environmental Physics of the University of Heidelberg and Institute of Nuclear Physics in Kraków. Since October 1994 this station has conducted measurements of CO_2 and CH_4 concentrations and since March 1995 also N_2O and SF_6 concentrations. Since July 1996 the station have measured permanently CO_2, CH_4 and SF_6 concentrations in the atmosphere using automatic gaseous chromatograph. The station have been running a number of research programs aimed at:

- measurement of long-term changes and daily fluctuations of CO_2 and CH_4 concentration to define participation of local sources in the air on the Kasprowy Wierch;
- observation of long-term changes and daily fluctuations of isotopic composition of CO_2 ; this observations facilitate the assessment of quantity composition changes of gaseous concentration of the atmosphere and are necessary to formulate the model of air composition changes on the Kasprowy Wierch;
- measurement of CH_4 isotopic conditions and concentration of this gas; the results will serve as a basis for estimation of the methane circulation balance in Europe and Southern Poland;
- continuous registration of SF_6 concentration changes and interpretation of these changes in order to define origins of air-masses and their contamination.

Complex environmental monitoring station – Puszcza Borecka. This station was established by the Institute of Environmental Protection and is located in Puszcza Borecka (Borecka Primeval Forest) in the Mazurian Lakes. It is the first regional station in Poland monitoring background pollution of terrestrial environment. The main object of research is a long-term valuation of environmental quality changes related to human activity. Since mid 1992 systematic air and rainfall pollutant emission measurements have been taken. Since 1995 the station have been conducting automatic daily measurements of meteorological components. In 1996 the station begun automatic tropospheric ozone concentration measurements and in April 1997 – measurements of carbon dioxide. The station is planning to extend greenhouse gas measurements as to include CO_2 , CH_4 and SF_6 concentrations and isotopic composition. This will aim at defining anthropogenic sources participation in regional balance of those gases.

7.2. Scientific research in the field of climate

Climatic scientific researches are conducted by many scientific institutions such as universities, Polish Academy of Sciences, agricultural academies, Institute of Meteorology and Water Management, Institute of Environmental Protection and, to some extent in polytechnic schools. The research encompass: climate variability and change as well as physical, dynamic and regional climatology. So far Poland does not have an integrated climatic program, however arrangements of preparation and implementation of the National Climate Program have commenced.

Climate variability and change . The object of the research is inter alia: assessment of extreme climatic phenomena variability and long-term climatic changes in Poland and Central Europe. The statistical method of detection of climatic phenomena cyclic nature has been developed. The scientist are particularly interested in current changes of hydro-meteorological conditions, especially rainfalls. Works are also conducted on defining

cyclic nature of changes in atmospheric circulation and variability of vertical ozone profile in the atmosphere and its influence on UV-B radiation. A few attempts, financed by KBN, were undertaken to define climate change scenarios for Poland in regional scale.

Priority was given to works related to the UNFCCC, encompassing: preparation of greenhouse gas emission reduction strategy and adaptation of the economy to climate change, preparation of factors for carbon dioxide and methane emissions originating from industrial processes and energy sector, and elaboration of greenhouse gas emission and removal inventory.

Applied climatology. The researchers concentrated their work on wind power resources assessment, agrometeorology and biometeorology. Tendencies in changes of agrometeorological indices were tested as well as their effect on agriculture, especially the impact of drought on crop yield. In terms of biometeorology heat exchange model (between human organism and environs) was elaborated as well as an assessment of climatic conditions of Poland in the context of human body thermal requirements.

Physical Climatology . Researches encompassed mostly processes of climate formation, such as energy exchange and water cycle in boundary layer, interaction of substratum with the atmosphere, and determination of the role of vegetation in heat and water flow. In addition, examinations of human influence on local climate, especially urbanisation processes and urban heat-islands are conducted. Important role in this research is played by an assessment of air pollution in cities and around large industrial facilities and its impact on energy balance depending on meteorological conditions.

Dynamic climatology. Research in dynamic climatology deal with preparation of new atmospheric circulation indicators; circulation relations in the upper part of the atmosphere with temperature of Earth surface; assessment of impact of solar activity on atmospheric circulation in a course of time.

Regional climatology. Examinations of regional climatic conditions generate information used by different sectors of the economy and the society. Climatic analyses have been drawn up for a number of Poland's regions: Carpathian Mountains, Tatra Mountains, Karkonosze Mountains, Swietokrzyskie Mountains, Lublin Highland, Wielkopolska Lowland and Biebrza river basin. Synthetic results of research on Poland's climate have been included in the *Atlas of Poland's resources, values and degradation of geographical environment* , the *Atlas of Republic of Poland* and the work *Climatic outline of Poland.*

8. EDUCATION AND NGOs

8.1. Development of public awareness in the scope of climate

Formal education. Among 21 other subjects, Poland's educational system include ecological education which encompasses knowledge on environmental threats resulting from energy production and transformation (including global warming and pollution of the atmosphere and waters). In primary and secondary school curricula, teaching about climate is a part of biology, geography, physics and chemistry curricula. Broader scope is covered in secondary schools of environmental profile. Curricula of many colleges and universities include wide range of environmental problems. Special courses on environmental protection have been introduced recently in many schools of higher education. Climate issues are encompassed in their programmes to large extent. Post-graduate environmental studies for specialists of various fields are also part of formal education. They give a chance to students to hear about global environmental threats including problems of climatic changes.

Informal Education. Apart from formal education conducted and directed by the government, more and more important role is played by informal education conducted by environmental NGOs and social movements, both on local and national scale. This type of education is directed to the entire society, especially to those people who do not take part in official environmental education. The forms of informal education are: meetings, lectures, seminars for teachers and local government activists and scientific conferences (also international).

8.2. Popularising activity

In order to achieve success in climate protection in Poland it is very important to make people think that activities for climate protection are important and useful. Both governmental and non-governmental organisations related to the UNFCCC implementation undertake various publicity activities. NGOs run wide publicity programmes, organising press conferences, meetings with Parliament and local government representatives, preparing exhibitions and open meetings with the public. The prime objective of activities conducted by NGOs is convincing the public that although climate change is a global problem, its solution as well as sustainable environmental policy will bring Poland measurable benefits.

8.3. Role of NGOs

There are about 1000 environmental NGOs active in Poland at the moment. Some of them relate back to before World War II, others has just began their activity in the 80-ties and 90-ties. This convention is a fine example of co-operation between NGOs and governmental bodies. NGOs have a very important input in implementation of the convention tasks (preparation of emission inventories, reduction strategy, participation in transport policy elaboration, etc.).

Climate change is dealt with by a number of different NGOs. The most important activities undertaken by NGOs in the recent years are listed below:

- activities supporting Poland's active policy of climatic protection and execution of the convention provisions;
- activities towards wider representation of NGO opinion in official papers and documents related to climate protection and towards participation of NGO representatives in the Conference of the Parties to the Convention sessions;
- activities towards inclusion of requirements resulting from ratification of the UNFCCC in sectoral programmes, especially energy, transport, nature conservation policies;
- assessment of effectiveness of National Environmental Policy implementation and it's promotion;
- assessment of environmental results and effectiveness of project financed by GEF and international development banks (WB, EBRD);
- publicity for activities towards reduction of greenhouse gas emission through sustainable energy use and its production from renewable sources, development and widespread of mass transport, promotion of the efficient lighting, improvement of carbon absorption by biomass, etc.;

- information actions about advantages and disadvantages of Activities Implemented Jointly concerning projects to be implemented in Poland;
- conducting educational campaigns to promote knowledge about climate, its threats and protective actions.

A seminar was organised in Warsaw in the spring 1997 by Polish Ecological Club in order to discuss directions and goals of joint actions conducted by different NGOs. It also created opportunity for an assessment of Polish policy in the field of climate protection. The seminar concluded that the following NGO actions are necessary:

- implementation of less energy intensive solutions in Poland and promotion of renewable energy sources development;
- support for pro-environmental directions in the transport development (public, railway, combined);
- strengthening of the role of ecosystems in carbon absorption;
- activities aimed at execution of the convention provisions by Poland, in particular elaboration of comprehensive greenhouse gas emission and sequestration inventories; regular updating of reduction scenarios, and evaluation of governmental programme on greenhouse gas emission reduction.

Apart from that, since 1996 the Polish Ecological Club has been co-ordinating the Climate Action Network for East and Central Europe and published two reports concerning climate protection policy in the countries of our region.

ABBREVIATIONS

AIJ	Activities Implemented Jointly
AGH	Academy of Mining and Metallurgy
AGTC	European Agreement on Important International Combined Transport Lines and Related Installations
BOD_5	Biological Oxygen Demand (in five days period)
CIA	Cross Impact Analysis
CORINAR	COordination d'INformation Environmentale AIR emissions inventory
CPN	Oil Product Company
CUMiRM	Central Office for Housing and Urban Development
CUP	Central Planning Office
EBRD	European Bank for Reconstruction and Development
ECE	European Commission for Europe
FEWE	Polish Foundation for Energy Efficiency
GDP	Gross Domestic Product
GHG	greenhouse gases
GEF	Global Environment Facility
GIOS	Chief Inspectorate for Environmental Protection
GUS	Central Statistical Office
HIPRE3+	Hierarchy Analysis of Preferences
IMGW	Institute of Meteorology and Water Management
IOŒ	Institute of Environmental Protection
IPCC	Intergovernmental Panel on Climate Change
KAPE	Polish National Energy Conservation Agency
KBN	Committee of Scientific Research
MERS	Macroeconomic Reference Scenario
MG	Ministry of Economy
MGPiB	Ministry of Construction and Spatial Planning
MOSZNiL	Ministry of Environmental Protection, Natural Resources and Forestry
MPiH	Ministry of Industry and Trade
MRiGZ	Ministry of Agriculture and Food Economy
MTiGM	Ministry of Transportation and Marine Management
NFOSiGW	National Fund for Environmental Protection and Water Management
NGO	Non-Governmental Organisation
OBREM	Research and Development Centre for Urban Ecology
OECD	Organisation for Economic Co-operation and Development
OZE	Renewable Energy Sources
PELP	Polish Efficient Lighting Project
PHARE	Poland and Hungary Assistance for Restructuring of the Economy
PLN	Polish new zloty
PWN	State Scientific Publishers
SME	Small and Medium Enterprises
UN	United Nations
UNESCO	United Nations Economic Scientific and Culture Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UV-B	ultraviolet radiation (wave length from 280 to 320 nm.)
WWF	World Wild Fund
VAT	value added tax
zl '90	Polish zloty from 1990

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ANNEX A

AGREGATED EMISSION/REMOVAL FACTORS

EMPLOYED IN 1988 GREENHOUSE GAS INVENTORY

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.A. All Energy	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	**N_2O Emission Factors [kg/GJ]**
1.A.Fuel Combustion Activities:	91.84	0.0093	0.0014
Oil	73.96	0.0133	0.0028
Gas	55.61	0.0450	0.0001
Coal	99.69	0.0035	0.0013
Biomass	0.00	0.1121	0.0020
Other			
1.A.1. Energy and Transformation	95.86	0.0039	0.0013
Industries:	74.66	0.0017	0.0005
Oil	55.65	0.0013	0.0001
Gas	98.20	0.0040	0.0014
Coal	0.00	0.0150	0.0020
Biomass			
Other			
1.A.2. Industry (ISIC):	91.64	0.0277	0.0007
Oil	78.89	0.0026	0.0006
Gas	55.15	0.0722	0.0001
Coal	117.88	0.0036	0.0011
Biomass	0.00	0.0150	0.0020
Other			
1.A.3. Transport:	75.06	0.0190	0.0034
Oil	73.61	0.0200	0.0036
Gas			
Coal	100.07	0.0024	0.0000
Biomass			
Other			
1.A.4. Commercial/Institutional:	91.91	0.0159	0.0014
Oil	0.0000	0.0000	0.0000
Gas	55.77	0.0014	0.0023
Coal	98.37	0.0077	0.0013
Biomass		0.1970	0.0022
Other			
1.A.5. Residential:	89.52	0.0083	0.0013
Oil	56.78	0.0014	0.0001
Gas	56.51	0.0014	0.0001
Coal	96.55	0.0024	0.0014
Biomass	0.00	0.2100	0.0020
Other			
1.A.6. Agriculture/Forestry:	77.65	0.0042	0.0034
Oil	73.83	0.0046	0.0038
Gas	55.09	0.0014	0.0001
Coal	96.19	0.0024	0.0014
Biomass	0.00	0.0006	0.0020
Other			
1.A.7. Other:	80.22	0.0221	0.0022
Oil	72.57	0.0282	0.0025
Gas	55.74	0.0014	0.0001
Coal	107.34	0.0024	0.0014
Biomass			
Other			
	CH_4 Emission Factors [kg/Mg]		
1.B. Fugitive Emissions from Fuels	Production	Processing	
1.B.1. Coal mining:			
1.B.1.a. Underground mining	4.363	1.038	
1.B.1.b. Surface mining	0.013	0.000	
1.B.2. Oil and Natural Gas	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	
1.B.2.a. Oil:	0.01169	0.00011	

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
i. Exploration	6.31500	0.06180	
ii. Transport	0.00000	0.00000	
iii. Rafining/Storage	0.00000	0.00000	
iv.a. Wholesale Distribution	0.00000	0.00000	
iv.b. Retail Distribution	0.00000	0.00000	
1.B.2.b. Natural Gas:	0.01889	0.34837	
i. Production	0.00022	0.06463	
ii+iii. Consumption	0.02569	0.45165	
2. Industrial Processes	**CO_2 Emission Factors [kg/Mg]**	**CH_4 Emission Factors [kg/Mg]**	**N_2O Emission Factors [kg/Mg]**
2.A. Iron and Steel Production:			
Contact Processes:			
Sinter	8.100		
Open Hearth Steel	52.000		
Steel Casting	62.000		
Iron Casting	61.000	0.200	
Non-Contact Processes:			
Blast Furnace Charging	0.220		
Converter Steel	11.260		
Electric Steel	4.300	0.120	
Ferroalloys	541.900		
Coke		0.200	
2.B. Non-Ferrous Metals Production:			
Aluminium Production	804.340		
2.C. Inorganic Chemicals:			
Nitric Acid Production			3.400
Nitrogen Fertiliser Production[1]	1.500		
Ammonia Production	1.000	4.900	5.000
Sodium Carbonate Production	25.000		
Carbon Black Production		10.000	
Agricultural Liming	0.440		
Urea Production			1.000
2.D. Organic Chemicals:			
Ethylene Production	0.300		
2.E. Non-Metalic Mineral Products:			
Cement Production	500.000		
Lime Production	800.000		
2.F. Other			
Sugar Production	232.800		
Wine Production[2]	58.000		
Beer Production[2]	10.000		
Spirits Production[2]	100.000		
	CH_4 Emission Factors [kg/Animal]		
4.Agriculture	4.A. Enteric Fermentation	4.B.Manure Management	
4. A&B. Enteric Fermentation[3] & Manure Management			
(Total Number of Livestock 101.56 million):	22.78	0.553	
1. Cattle	69.563	2.002	
a. Non-dairy	47.976	1.220	
b. Dairy	94.336	2.900	
3. Sheep	8.889	0.190	
4. Swine	1.500	1.430	
5. Horses[4]	18.000	1.390	
6.Other	0.000	0.078	
4.D. Agricultural Soils	**N_2O Emission Factors (N_2O Released from 1 ton of Used Fertilizer) [Mg N_2O/Mg N]**		
Fertilizers	0.0125		
Manure	0.0181		
Papilionaceous Plants	0.0157		
Mineralization	0.0157		
	CH_4 Emission Factors [kg/Mg dry mass]	**N_2O Emission Factors [kg/Mg dry mass]**	
4.E. Field Burning of Agricultural Residues	0.0030	0.0002	
5.Land Use Change and Forestry	**CO_2 Emission Factors [tC/ha]**	**CO_2 Removal Factors [tC/ha]**	
5.A. Changes in forest and other woody biomass stocs		2.88	
5.B. Forest and grassland conversion	61.01		
5.C. Abandonment of managed lands [tC/ha/year]		2.38	
6. Waste	**CH_4 Emission Factors**		
6.A. Landfils [kgCH_4/kg]	0.090		
6.B. Wastewater [kgCH_4/kgBOD_5]	0.220		

GHG Source/Sink Categories	Agregated Emission/Removal Factors
6.D. Other Waste	

[1] Emission factors in NH_3 [kg/t] used for nitrogen fertiliser production
[2] Emission factors in [kg/hl]
[3] Emission factor for enteric fermentation relates to total livestock number: 35.37 million
[4] Estimated data

ANNEX B

AGREGATED EMISSION/REMOVAL FACTORS

EMPLOYED IN 1990 GREENHOUSE GAS INVENTORY

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.A. All Energy	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	**N_2O Emission Factors [kg/GJ]**
1.A.Fuel Combustion Activities:	91.55	0.0092	0.0014
Oil	75.50	0.0144	0.0029
Gas	55.82	0.0411	0.0001
Coal	99.78	0.0033	0.0013
Biomass	0.00	0.1065	0.0020
Other			
1.A.1. Energy and Transformation	96.41	0.0036	0.0013
Industries:	83.27	0.0017	0.0005
Oil	55.19	0.0013	0.0001
Gas	98.25	0.0036	0.0014
Coal	0.00	0.0150	0.0020
Biomass			
Other			
1.A.2. Industry (ISIC):	92.49	0.0283	0.0007
Oil	78.16	0.0027	0.0006
Gas	55.42	0.0754	0.0001
Coal	118.20	0.0024	0.0010
Biomass	0.00	0.0150	0.0020
Other			
1.A.3. Transport:	74.20	0.0192	0.0035
Oil	73.51	0.0196	0.0036
Gas			
Coal	100.08	0.0024	0.0000
Biomass			
Other			
1.A.4. Commercial/Institutional:	84.49	0.0053	0.0011
Oil	72.22	0.0029	0.0006
Gas	55.92	0.0014	0.0023
Coal	97.57	0.0077	0.0013
Biomass			
Other			
1.A.5. Residential:	83.37	0.0092	0.0011
Oil	56.78	0.0014	0.0001
Gas	56.50	0.0014	0.0001
Coal	95.16	0.0024	0.0013
Biomass	0.00	0.2100	0.0020
Other			
1.A.6. Agriculture/Forestry:	80.50	0.0041	0.0031
Oil	73.79	0.0049	0.0038
Gas	55.12	0.0014	0.0001
Coal	95.85	0.0024	0.0014
Biomass	0.00	0.0006	0.0020
Other			
1.A.7. Other:	91.69	0.0024	0.0012
Oil	76.81	0.0029	0.0006
Gas	55.80	0.0014	0.0001
Coal	98.48	0.0024	0.0014
Biomass	0.00	0.0006	0.0020
Other			
	CH_4 Emission Factors [kg/Mg]		
1.B. Fugitive Emissions from Fuels	Production	Processing	
1.B.1. Coal mining:			
1.B.1.a. Underground mining	4.363	1.038	
1.B.1.b. Surface mining	0.013	0.000	
	CO_2 Emission Factors [kg/GJ]	**CH_4 Emission Factors [kg/GJ]**	

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.B.2. Oil and Natural Gas			
1.B.2.a. Oil:	0.01565	0.00015	
i. Exploration	6.31500	0.06180	
ii. Transport	0.00000	0.00000	
iii. Rafining/Storage	0.00000	0.00000	
iv.a. Wholesale Distribution	0.00000	0.00000	
iv.b. Retail Distribution	0.00000	0.00000	
1.B.2.b. Natural Gas:	0.01941	0.37295	
i. Production	0.00019	0.05981	
ii+iii. Consumption	0.02393	0.44672	
2. Industrial Processes	**CO_2 Emission Factors [kg/Mg]**	**CH_4 Emission Factors [kg/Mg]**	**N_2O Emission Factors [kg/Mg]**
2.A. Iron and Steel Production:			
Contact Processes:			
Sinter	8.100		
Open Hearth Steel	52.000		
Steel Casting	62.000		
Iron Casting	61.000	0.200	
Non-Contact Processes:			
Blast Furnace Charging	0.220		
Converter Steel	11.260		
Electric Steel	4.300	0.120	
Ferroalloys	541.900		
Coke		0.200	
2.B. Non-Ferrous Metals Production:			
Aluminium Production	804.340		
2.C. Inorganic Chemicals:			
Nitric Acid Production			3.400
Nitrogen Fertiliser Production[1]	1.500		
Ammonia Production	1.000	4.900	5.000
Sodium Carbonate Production	25.000		
Carbon Black Production		10.000	
Agricultural Liming	0.440		
Urea Production			1.000
2.D. Organic Chemicals:			
Ethylene Production	0.300		
2.E. Non-Metalic Mineral Products:			
Cement Production	500.000		
Lime Production	800.000		
2.F. Other			
Sugar Production	232.800		
Wine Production[2]	58.000		
Beer Production[2]	10.000		
Spirits Production[2]	100.000		
	CH_4 Emission Factors [kg/Animal]		
4.Agriculture	4.A. Enteric Fermentation	4.B.Manure Management	
4. A&B. Enteric Fermentation[3] & Manure Management			
(Total Number of Livestock 95.92 million):	22.918	0.576	
1. Cattle	70.670	2.042	
a. Non-dairy	47.976	1.220	
b. Dairy	94.336	2.900	
3. Sheep	8.889	0.190	
4. Swine	1.500	1.430	
5. Horses[4]	18.000	1.390	
6.Other	0.000	0.078	
4.D. Agricultural Soils	**N_2O Emission Factors (N_2O Released from 1 ton of Used Fertilizer) [Mg N_2O/Mg N]**		
Fertilizers			0.0125
Manure			0.0181
Papilionaceous Plants			0.0157
Mineralization			0.0157
	CH_4 Emission Factors [kg/Mg dry mass]	**N_2O Emission Factors [kg/Mg dry mass]**	
4.E. Field Burning of Agricultural Residues	0.0030	0.0002	
5.Land Use Change and Forestry	**CO_2 Emission Factors [tC/ha]**	**CO_2 Removal Factors [tC/ha]**	
5.A. Changes in forest and other woody biomass stocs		3.98	
5.B. Forest and grassland conversion	57.15		
5.C. Abandonment of managed lands [tC/ha/year]		2.43	
6. Waste	**CH_4 Emission Factors**		

GHG Source/Sink Categories	Agregated Emission/Removal Factors
6.A. Landfils [$kgCH_4/kg$]	0.090
6.B. Wastewater [$kgCH_4/kgBOD_5$]	0.220
6.D. Other Waste	

[1] Emission factors in NH_3 [kg/t] used for nitrogen fertiliser production
[2] Emission factors in [kg/hl]
[3] Emission factor for enteric fermentation relates to total livestock number: 34.61 million
[4] Estimated data

ANNEX C

AGREGATED EMISSION/REMOVAL FACTORS

EMPLOYED IN 1992 GREENHOUSE GAS INVENTORY

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.A. All Energy	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	**N_2O Emission Factors [kg/GJ]**
1.A.Fuel Combustion Activities:	90.710	0.007	0.001
Oil	73.700	0.016	0.003
Gas	55.679	0.034	0.000
Coal	98.393	0.003	0.001
Biomass	99.396	0.004	0.002
Other	94.726	0.010	0.002
1.A.1. Energy and Transformation	95.524	0.003	0.001
Industries:	74.135	0.002	0.000
Oil	54.881	0.001	0.000
Gas	97.247	0.003	0.001
Coal	104.532	0.015	0.002
Biomass	94.726	0.010	0.002
Other			
1.A.2. Industry (ISIC):	92.917	0.026	0.001
Oil	78.333	0.002	0.001
Gas	54.712	0.083	0.000
Coal	111.994	0.001	0.001
Biomass			
Other			
1.A.3.1. Transport - mobile sources:	73.460	0.022	0.003
Oil	73.436	0.022	0.003
Gas			
Coal	100.069	0.002	0.000
Biomass			
Other			
1.A.3.2. Transport - stationary sources:	98.451	0.002	0.001
Oil			
Gas	55.030	0.001	0.000
Coal	99.179	0.002	0.001
Biomass			
Other			
1.A.4. Commercial/Institutional:	91.264	0.002	0.001
Oil	79.095	0.003	0.001
Gas	56.087	0.001	0.000
Coal	98.131	0.002	0.001
Biomass			
Other			
1.A.5. Residential:	84.446	0.002	0.001
Oil	56.778	0.001	0.000
Gas	56.536	0.001	0.000
Coal	96.765	0.002	0.001
Biomass	97.989	0.001	0.002
Other			
1.A.6. Agriculture/Forestry:	83.305	0.004	0.003
Oil	73.687	0.005	0.004
Gas	55.099	0.001	0.000
Coal	95.818	0.002	0.001
Biomass	97.989	0.001	0.002
Other			
	CH_4 Emission Factors [kg/Mg]		
1.B. Fugitive Emissions from Fuels	Production	Processing	
1.B.1. Coal mining:			
1.B.1.a. Underground mining	4.363	1.038	

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.B.1.b. Surface mining	0.013	0.000	
1.B.2. Oil and Natural Gas	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	
1.B.2.a. Oil:	0.028	0.000	
i. Exploration	6.315	0.062	
ii. Transport	0.000	0.000	
iii. Rafining/Storage	0.000	0.000	
1.B.2.b. Natural Gas:	0.025	0.473	
i. Production	0.000	0.065	
ii+iii. Consumption	0.025	0.452	
	CO_2 Emission Factors [kg/Mg]	**CH_4 Emission Factors [kg/Mg]**	**N_2O Emission Factors [kg/Mg]**
2. Industrial Processes	181.502	0.139	0.221
2.A. Iron and Steel Production	30.550	0.056	0.000
2.B. Non-Ferrous Metals Production:	59.927		
Aluminium Production	804.340		
2.C. Inorganic Chemicals:	179.956	0.911	1.557
Nitric Acid Production			3.400
Other	216.117	1.094	1.187
2.D. Organic Chemicals	0.080		
2.E. Non-Metalic Mineral Products:	552.530		
Cement Production	500.000		
Lime Production	800.000		
2.F. Other (ISIC)	33.180		
	CH_4 Emission Factors [kg/Animal]		
4.Agriculture	4.A. Enteric Fermentation	4.B.Manure Management	
4. A&B. Enteric Fermentation & Manure Management			
(Total Number of Livestock 121.13 million):	5.341	0.459	
1. Cattle	73.186	2.109	
a. Non-dairy	49.432	1.220	
b. Dairy	94.336	2.900	
3. Sheep	8.889	0.190	
4. Swine	1.500	1.430	
5. Horses	18.000	1.390	
6.Other	0.000	0.069	
4.D. Agricultural Soils	**N_2O Emission Factors (N_2O Released from 1 ton of Used Fertilizer) [Mg N_2O/Mg N]**		
Fertilizers	0.0125		
Manure	0.0181		
Papilionaceous Plants	0.0157		
Mineralization	0.0157		
	CH_4 Emission Factors [kg/Mg dry mass]	**N_2O Emission Factors [kg/Mg dry mass]**	
4.E. Field Burning of Agricultural Residues	0.003	0.000	
5.Land Use Change and Forestry	**CO_2 Emission Factors [tC/ha]**	**CO_2 Removal Factors [tC/ha]**	
5.A. Changes in forest and other woody biomass stocs [Gg CO_2/Gg dry mass]	1.650		
5.B. Forest and grassland conversion [Mg C/ha]	5.133		
5.C. Forest Management			
5.C.1. Annual Wood Growth [Mg C/1000 trees]:			
Reforestation		0.045	
Trees out of the Forests		4.950	
5.C.2. Wood Harvest [Mg C/Mg dry mass]	0.450		
6. Waste	**CH_4 Emission Factors**		
6.A. Landfils [kgCH_4/kg]	0.090		
6.B. Wastewater [kgCH_4/kgBOD_5]	0.220		
6.D. Other Waste			

ANNEX D

AGREGATED EMISSION/REMOVAL FACTORS

EMPLOYED IN 1994 GREENHOUSE GAS INVENTORY

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
1.A. All Energy	**CO_2 Emission Factors [kg/GJ]**	**CH_4 Emission Factors [kg/GJ]**	**N_2O Emission Factors [kg/GJ]**
1.A.Fuel Combustion Activities:	87.81	0.0142	0.0015
Oil	73.33	0.0151	0.0026
Gas	55.88	0.0379	0.0001
Coal	99.23	0.0032	0.0014
Biomass	0.00	0.1694	0.0022
Other	96.09	0.0024	0.0014
1.A.1. Energy and Transformation	96.37	0.0036	0.0013
Industries:	74.48	0.0017	0.0005
Oil	55.97	0.0181	0.0001
Gas	98.26	0.0035	0.0014
Coal	0.00	0.0150	0.0020
Biomass			
Other			
1.A.2. Industry (ISIC):	90.76	0.0194	0.0011
Oil	75.21	0.0110	0.0026
Gas	55.26	0.0760	0.0001
Coal	104.95	0.0028	0.0012
Biomass	0.00	0.0150	0.0020
Other	96.09	0.0024	0.0014
1.A.3. Transport:	73.47	0.0219	0.0031
Oil	73.46	0.0219	0.0031
Gas			
Coal	100.08	0.0024	0.0000
Biomass			
Other			
1.A.4. Commercial/Institutional:	72.10	0.0314	0.0016
Oil			
Gas	56.51	0.0014	0.0001
Coal	97.29	0.0027	0.0016
Biomass	0.00	0.1932	0.0022
Other			
1.A.5. Other:	78.95	0.0078	0.0020
Oil	72.62	0.0120	0.0027
Gas	55.83	0.0014	0.0001
Coal	95.73	0.0024	0.0014
Biomass	0.00	0.2100	0.0020
Other			

	CH_4 Emission Factors [kg/Mg]	
1.B. Fugitive Emissions from Fuels	Production	Processing
1.B.1. Coal mining:		
1.B.1.a. Underground mining	4.363	1.038
1.B.1.b. Surface mining	0.013	0.000
	CO_2 Emission Factors [kg/GJ]	**CH_4 Emission Factors [kg/GJ]**
1.B.2. Oil and Natural Gas		
1.B.2.a. Oil:	0.02397	0.00023
i. Exploration	6.31500	0.06180
ii. Transport	0.00000	0.00000
iii. Rafining/Storage	0.00000	0.00000
iv.a. Wholesale Distribution	0.00000	0.00000
iv.b. Retail Distribution	0.00000	0.00000
1.B.2.b. Natural Gas:	0.01765	0.35314
i. Production	0.00023	0.06806
ii+iii. Consumption	0.02400	0.45722

GHG Source/Sink Categories	Agregated Emission/Removal Factors		
2. Industrial Processes	**CO_2 Emission Factors [kg/Mg]**	**CH_4 Emission Factors [kg/Mg]**	**N_2O Emission Factors [kg/Mg]**
2.A. Iron and Steel Production:			
Contact Processes:			
Sinter	8.100		
Open Hearth Steel	52.000		
Steel Casting	62.000		
Iron Casting	61.000	0.200	
Non-Contact Processes:			
Blast Furnace Charging	0.220		
Converter Steel	11.260		
Electric Steel	4.300	0.120	
Ferroalloys	541.900		
Coke		0.200	
2.B. Non-Ferrous Metals Production:			
Aluminium Production	804.340		
2.C. Inorganic Chemicals:			
Nitric Acid Production			3.400
Nitrogen Fertiliser Production[1]	1.500		
Ammonia Production	1.000	4.900	5.000
Sodium Carbonate Production	25.000		
Carbon Black Production		10.000	
Agricultural Liming	0.440		
Urea Production			1.000
2.D. Organic Chemicals:			
Ethylene Production	0.300		
2.E. Non-Metalic Mineral Products:			
Cement Production	500.000		
Lime Production	800.000		
2.F. Other			
Sugar Production	232.800		
Wine Production[2]	58.000		
Beer Production[2]	10.000		
Spirits Production[2]	100.000		

4.Agriculture	**CH_4 Emission Factors [kg/Animal]**	
	4.A. Enteric Fermentation	4.B.Manure Management
4. A&B. Enteric Fermentation[3] & Manure Management (Total Number of Livestock 82.27 million):	20.815	0.595
1. Cattle	71.246	2.063
a. Non-dairy	47.976	1.220
b. Dairy	94.336	2.900
3. Sheep	8.889	0.190
4. Swine	1.500	1.430
5. Horses[4]	18.000	1.390
6.Other	0.000	0.078

4.D. Agricultural Soils	**N_2O Emission Factors (N_2O Released from 1 ton of Used Fertilizer) [Mg N_2O/Mg N]**
Fertilizers	0.0125
Manure	0.0181
Papilionaceous Plants	0.0157
Mineralization	0.0157

	CH_4 Emission Factors [kg/Mg dry mass]	**N_2O Emission Factors [kg/Mg dry mass]**
4.E. Field Burning of Agricultural Residues	0.0030	0.0001

5.Land Use Change and Forestry	**CO_2 Emission Factors [tC/ha]**	**CO_2 Removal Factors [tC/ha]**
5.A. Changes in forest and other woody biomass stocs		3.85
5.B. Forest and grassland conversion	48.36	
5.C. Abandonment of managed lands [tC/ha/year]		2.72

6. Waste	**CH_4 Emission Factors**
6.A. Landfils [$kgCH_4/kg$]	0.090
6.B.1. Industrial Wastewater [$kgCH_4/m^3$]	0.078
6.B.2. Municipal Wastewater [$kgCH_4/m^3$]	0.007
6.D. Other Waste	

[1] Emission factors in NH_3 [kg/t] used for nitrogen fertiliser production
[2] Emission factors in kg/hl
[3] Emission factor for enteric fermentation relates to total livestock number: 28.65 million
[4] Estimated data