MINISTRY OF THE ENVIRONMENT

NATIONAL PROGRAM

TO ABATE THE CLIMATE CHANGE IMPACTS IN THE CZECH REPUBLIC

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National Program to Abate the Climate Change Impacts in the CR

Summary

Climate change is one of the key issues of current global environmental policy. Scientific knowledge indicates that the anthropogenic contribution to increasing of GHGs atmospheric concentrations contributes to the global climate change on the Earth. This subsequently leads to a number of negative impacts on the functioning of ecosystems on a global, regional and national level, indicated at the national level particularly by changes in the water regime and its quality, in agriculture and in forest management. Extreme weather events, like floods or droughts, also constitutes one of the potential consequences of such changes. CR is a country that is well aware of this global issue and that, through completion of the process of ratification of the Kyoto Protocol (hereinafter the "Protocol"), has pledged to accept part of the responsibility for current state of affairs and to contribute actively to a solution.

In order to define the national climate change policy, Government Resolution No. 480/1999 adopted the document "Strategy of Protection of the Climate System of the Earth in the Czech Republic", which included climate change amongst priority environmental issues and simultaneously outlined the main tasks for the effected sectors. However, a number of years have passed since this document was adopted, during which new scientific and research information has been obtained, there have been a number of significant trends in international negotiations and, last but not least, the accession of CR to EU also affects new requirements. The submitted National Program to Abate Climate Change Impacts in CR (hereinafter "National Program") thus constitutes an amended document that reflects the circumstances on a national and international level. Its preparation is based on Act No. 86/2002 Coll., on protection of the air, on requirements following from Council Decision 99/296/EC and from the European Climate Change Program (ECCP), which the European Commission decided to establish in 2000 to identify the main joint EU policies to ensure meeting of common and individual reduction targets according to the Protocol.

The National Program is focused on setting of the main national targets and appropriate policies and measures to ensure meeting of the reduction emission targets to the maximum possible degree in the sense of international agreements, to reflect existing and future social and economic conditions in CR and to promote sustainable development. Its preparation was based on detailed analysis of national trends in greenhouse gas (GHGs) emissions in the 1990 - 2001 period, analysis of key emission sources, i.e. groups of sources that make the maximum contributions to the overall national balance, on updated projections of emission trends over the period to 2020, based on estimation of energy requirements and expected macroeconomic trends, on estimates of probable developments in further international negotiations on the Protocol in the future, on consideration of the impact of the original Strategy on reducing emissions and on preliminary analysis of adaptation requirements at a national level in connection with the increased frequency of occurrence of extreme weather events on the territory of CR in recent years.

In 1990, a total of 190.5 mil. tons of CO_2 eq. (i.e. including CH_4, N_2O, HFCs, PFCs and SF_6) was emitted in the territory of CR. Mostly as a consequence of economic transformation, total GHGs emissions decreased by approximately one quarter over the following four years. In spite of continuing economic growth, with slight inter-annual variations, GHGs emissions remain at this level; in 2001 the overall decrease compared to 1990 equalled 24.3 %. The final emission value is the result of contributions of 86.1 % from CO_2, 7.2 % from CH_4, 5.8 %

from N_2O and a total of 0.9 % from the group of substances HFCs, PFCs and SF_6. In the individual sectors of activities defined by the binding international method, production of energy and transformation processes contributed 41.9 %, the processing industry 24.5 %, trade and services 10.3 %, transport 8.8 %, etc. to the national emission balance.

In accordance with the recommended international methodology, the updated projections of trends in GHGs emissions were processed for three conceptually different scenarios of expected economic and technological developments and in the option "without the effect of measures" (without the effect of the air protection legislation and without extensive conversion to gas in 1995 - 1999), "with measures" (including the effects of measures and programs introduced after 1995) and "with additional measures" (newly proposed measures, which should contribute the most in the near future to reducing of GHGs emissions). The alternative approaches provide the user with a better ability to orient in the area delimited by the estimate of macroeconomic trends. For the 2005 - 2020 period, the low scenario of economic development yields a value of total GHGs emissions that is 2-5 % lower and the high scenario yields a values that is 3.5 – 6 % higher than the reference scenario. As approximation to the economic level of the EU member states at an acceptable rate is ensured by only the high and reference scenarios, the estimates of future developments in the National Program were based only on the reference scenario and forecasted emission trends are termed "expected trends in GHGs emissions".

In the sense of the National Program, additional measures are understood to be prepared measures, i.e. implementation of the National Program of clean energy management and use of renewable and secondary energy sources, such as the complete implementation of Act No. 406/2000 Coll., on management of energy, the prepared environmental tax reform and advantageous purchase tariffs for energy produced from renewable sources.

CR still has a relatively high energy intensity for creation of GDP and a high volume of GHGs per capita emissions . As these indicators may also be taken into account in negotiations on further implementation of the Protocol after 2012, CR must make every attempt to bring these values closer to the values for the EU member states in the near future. This is the main reason for introducing further policies and measures to reduce GHGs emissions, which would lead to a reduction in specific CO_2 per capita emissions after completion of the first commitment period of the Protocol (2008 - 2012) by 30 % to 2020, to a reduction in total aggregate CO_2 emissions by 25 % compared with 2000 over the same period and provision for continuation of the commenced trend to 2030. The National Program also declares an increase in the share of renewable energy sources in consumption of primary energy sources to 6 % by 2010 and to 20 % in 2030, a reduction on the energy intensity of production, distribution and final consumption of energy to a level of 60-70 % of current consumption by 2030 and an increase in the fraction of use of biofuels to 5.75 % in 2010 and attaining of a 20 % share of use of all alternative fuels in transport in 2020.

The National Program also defines conditions for participation of CR in the flexible mechanisms of the Protocol, i.e. joint implementation projects and international emission trading. In relation to the accession of CR to EU, Directive 2003/87/EC will be implemented in CR from 2005 at the enterprise level and provision will be made for interconnection of the EU trading system with proposed Protocol mechanisms.

The preparation of specific sectoral adaptation measures and their detailed economic evaluation can also contribute to abatement of climate change impacts. International experience has indicated that formulation of suitable adaptation measures is very acceptable in a number of cases, especially over the longer term. This area also encompasses support for scientific research on climate change, an improvement in the observation system and an

improvement in forecasting and integrated warning systems on a national level.

As a EU member state, CR must link its actions jointly with the set of policies and measures included in the European Climate Change Program. The National Program thus establishes priorities for formulation of further measures to reduce GHGs emissions, which must be incorporated in a specific form into the conceptual materials of all the sectors that could in any way contribute to reduction of the risk of disturbing the climate system of the Earth or could be affected by such a risk.

Due to rejection of the Protocol by USA and Australia and the continuing uncertainties related to ratification of the Protocol by the Russian Federation, significant progress can be expected in the near future in international negotiations on this subject. Consequently, it is necessary to consider the National Program to be an open document that can be amended in relation to existing requirements.

1. Introduction

Climate change, its impacts and the need to react to these new incentives undoubtedly constitute a key aspect of contemporary environmental policy. Scientific knowledge gained over the past few years indicates that an increase in GHGs concentrations as a consequence of human activity affects the climate change of the Earth, which reacts to the change in these concentrations through global warming and a subsequent change in the whole system. In spite of the existence of uncertainties in the area of mutual interactions of GHGs emissions and the climate system, models concerned with predicting trends in climate change forecast a potential increase in global temperature by 1.4 - 5.8 ^{o}C by the end of the 21st century. This would be the greatest growth over the past 10 000 years. This level of global warming will understandably lead to a number of negative manifestations in the area of the environment and functioning of ecosystems, including impacts in areas such as the water regime and its quality, agriculture, forest management and rising sea and ocean levels. All these effects have consequences that correspond to considerable expenses and thus have a non-negligible economic effect. Extreme weather events, such as floods or droughts, which constitute one of the potential consequences of global climate change, simultaneously have led in recent years to increased interest on the part of the general public in this issue.

Although the specific impacts of global climate change will have different effects and different intensities in various parts of the world, climate change constitutes a truly global problem that must be resolved through cooperation at an international level. CR is a country that is well aware of the importance of this issue and that has thus become one of the developed countries of the world that have pledged to accept part of the responsibility for current conditions and to contribute actively to a solution. As has already been mentioned, not all regions will be affected in the same way by climate change and this is also true of the ability of the regions to react to new instigations, either through preliminary measures or through elimination of potential consequences. In fact, the regions most affected by global climate change are simultaneously the areas that are most affected in other ways, from the standpoint of high rates of population growth in recent years, from the economic standpoint (lack of infrastructure and financial means, poorly functioning state administration) and also from the standpoint of their positions (socially and economically weak states, exposed to the action of droughts or floods, shoreline areas, island states, etc.). Thus, an important element of international cooperation in this area consists in solidarity between states less affected by climate change and states that will be most affected and solidarity between richer states and less economically developed states. Climate change simultaneously represents a comprehensive problem, as it is basically related to all the sectors of the economy, from the viewpoint of GHGs emissions and also from the viewpoint of the impacts of climate change, i.e. adaptation measures. Consequently, the approach of the state in this area must be conceived strategically with a sufficiently long-term outlook, because both climate change and measures preventing or abating its consequences also have a long-term character in a number of cases.

In order to define policy on the area of climate change at a national level, the document "Strategy of Protection of the Climate System of the Earth in the Czech Republic" was prepared and subsequently approved in Government Resolution No. 480/1999, which included climate change amongst priority environmental issues in CR and simultaneously outlined the main tasks for the effected sectors. It contains key elements of strategic directions of reducing GHGs emissions, which must be balanced and interconnected and must respect

both economic requirements and the capabilities of both the state and the population. The main potential can be seen in a broad range of measures related to energy savings and in increased use of renewable energy sources, which are in accordance with the State Environmental Policy, State Program of Energy Savings and Renewable Sources, with the content of the State Energy Policy and with the programs of the Czech Energy Agency. As a number of aspects at an international level had not yet been resolved when this document was adopted, this document was considered to be open and oriented towards the on-going activities of the individual sectors and not to be the subject of a one-off campaign.

Several years have elapsed since the preparation and subsequent adopting of this strategy. Over this time, new knowledge has been gained and significant progress has been made in international negotiations. The accession of CR to EU is an important factor, which understandably entails a number of commitments and obligations in the area of climate change, whose fulfilment must be suitably undertaken in a strategic manner. It is apparent that the existing strategy no longer meets current requirements given by the document. In relation to trends in the general situation, it was decided not to revise or update this document, but to prepare a completely new document.

In the last few years, the strategy has been regularly evaluated in cooperation with the International Panel on Climate Change. In implicit form, the quantitative impacts of activities related to implementation of Government Resolution No. 480/1999 are outlined in Chapter 7 of the Third National Communication of CR (See Chap. 10.2.1) and especially in the differences in projections for the options "with measures" and "without measures" in the values for 2001 (see Chap. 6). The effect of the implemented measures in the sense of the Strategy was reflected in an overall decrease in GHGs emissions in CR to the level of approx. 7 mil. tons of CO_2 eq.

The submitted National Program thus constitutes a document replacing the existing Strategy, which is intended to newly define the policy of CR in the area of climate change in connection with new knowledge and trends in international negotiations. Its structure is derived from the requirements following from Council Decision 99/296/EC and contains in particular:

- brief information on global climate trends and scientifically based projection to the end of the 21st century,
- reactions of the international community to global climate change and developments in international negotiations,
- information on climate change in CR,
- information on GHGs emissions in CR,
- a list of the most important measures to reduce emissions and increase the level of sinks of GHGs and estimation of their effectiveness,
- predictions of trends in emissions and sinks of GHGs for 2005, 2010, 2015 and 2020,
- specification of targets and measures in the area of climate change in CR, including specification of basic priorities in this area.

Preparation of the National Program is also based on Act No. 86/2002 Coll., on protection of the air, in which Chapter IV (Protection of the Climate System of the Earth), § 34 (1) states that "… the reduction targets for substances affecting the climate system of the Earth and deadlines for achieving them shall be laid down by the National Program to Abate Global Climate Change", approved by the Government. It is stated in Annex No. 2 to the Act on Protection of the Air, describing national, regional and local programs to reduce emissions, in Part 1 (e) that "… the National Program to reduce emissions shall contain a relationship to the National Program to Abate Global Climate Change …".

2. Climate Change and its Global Impacts

Over the last 400,000 years the climate of the Earth has never been very stable and warm periods have alternated with ice ages in cycles with periods of about 100,000 to 130,000 years. According to paleoclimatic measurements, above-average carbon dioxide concentrations always existed simultaneously with the warm periods. In fact, humans can be grateful for the natural amount of these gases in the atmosphere, so that the average temperature of the Earth is approximately 33 ^{o}C higher than it would be if no GHGs existed. The present epoch tends to belong to the warmer periods of this fluctuation. Nonetheless, in the historically warmest periods, the concentration of CO_2 was about 280 ppm. However, its concentration has increased enormously over the last few decades and attained a value of over 360 ppm[1] at the beginning of the 21st century; there has also been a significant increase in the concentration of methane and new gases are present that did not even exist in the past.

Contemporary scientific knowledge indicates that anthropogenic production (i.e. caused by human activities) of GHGs affected the climate system of the Earth. Because of the complexity of the whole system, including all the complex mutual interconnections, it is, however, extremely difficult to quantify the contribution of mankind to the overall climate change at the present time. However, a further increase in temperature will destabilise the climate system even further, which will be manifested in different ways in various parts of the planet and the individual components of the natural environment will react differently to this.

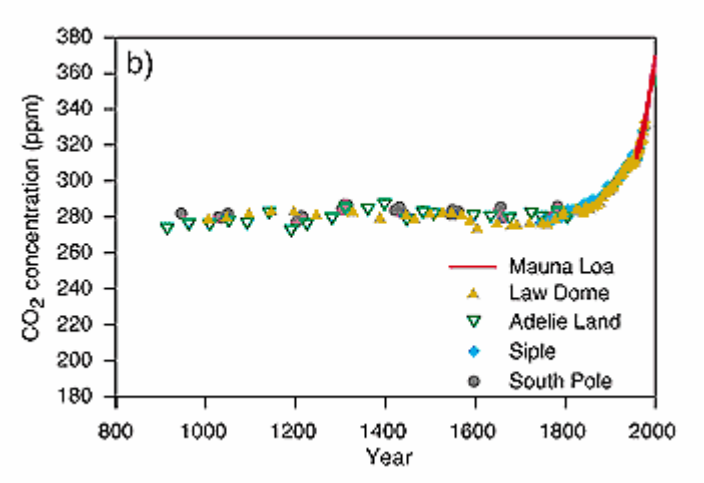
In assessing the global impact of the increase in anthropogenic GHGs emissions, it is necessary to be aware of the fact that an attempt to reduce GHGs emissions to the preindustrial level of about 280 ppm would require a reduction in current emissions by more than 50 %. However, developments to date in negotiations around the Protocol (a reduction in emissions of an average of 5.2 %) indicate that this is not currently very realistic.

2.1. The Greenhouse Effect

The temperature of our planet is determined by the equilibrium between energy coming from the Sun in the form of short-wave radiation and energy radiated by the Earth into the surrounding universe. The short-wave radiation passes through the Earth's atmosphere and heats the surface of the Earth. The long-wave radiation from the Earth's surface is partly absorbed by the atmosphere and re-irradiated. Thus, part of the energy returns to the surface of the Earth and heats it together with the lowest parts of the atmosphere. This phenomenon is frequently compared to the function of a greenhouse and is thus termed the greenhouse effect and the gases that cause it are called greenhouse gases. If the greenhouse effect did not exist, the temperature of the surface of the Earth would be 33 ^{o}C lower than at the present time and the planet Earth would be completely unsuitable for life in its present form. However, at the present time, GHGs concentrations are much higher than the preindustrial level (around year 1750) and continue to increase. The climate is also affected by particulate matter of anthropogenic origin, which scatters the Sun's energy, reflects it back into the universe and thus, in contrast, contributes to cooling of the atmosphere.

[1] ppm (parts per million) expresses the concentration of gases in the air; this is the concentration in volume units per million; 1 ppm is one particle in one million particles of air or one ten thousandth of a volume percent.

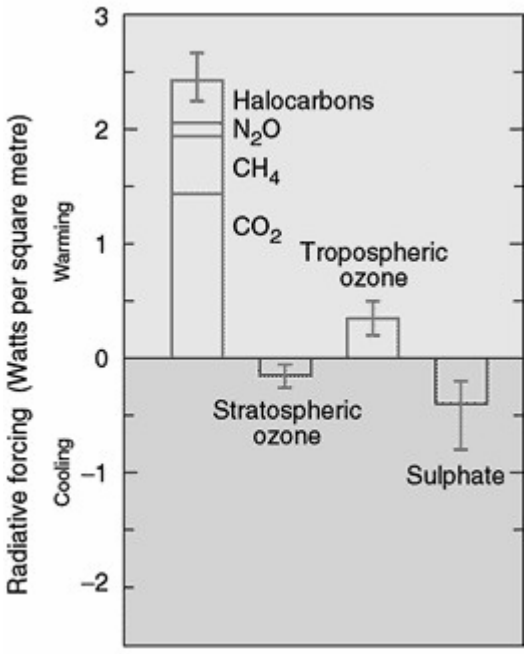
Fig. 2.1 Variation in atmospheric CO2 concentrations



Source: IPCC, ČHMI

The main anthropogenic GHGs subject to international control in the framework of the Protocol are carbon dioxide, methane, nitrous oxide, partly and fully fluorinated hydrocarbons and sulphur hexafluoride. The concentration of carbon dioxide increased since 1750 by 31 % to a value of 367 ppm in 1999 and is thus probably the highest value that has been attained over the past 400,000 years. Over the same period, the methane concentration increased by 151 %, the nitrous oxide concentration increased by 17 % and the concentration of tropospheric ozone increased by 35 %. Fluorinated hydrocarbons and sulphur hexafluoride are new substances that were not present at all around 1750.

Fig. 2.2 The global mean radiative forcing of climate system for most powerful substances for the year 2000, relative to 1750



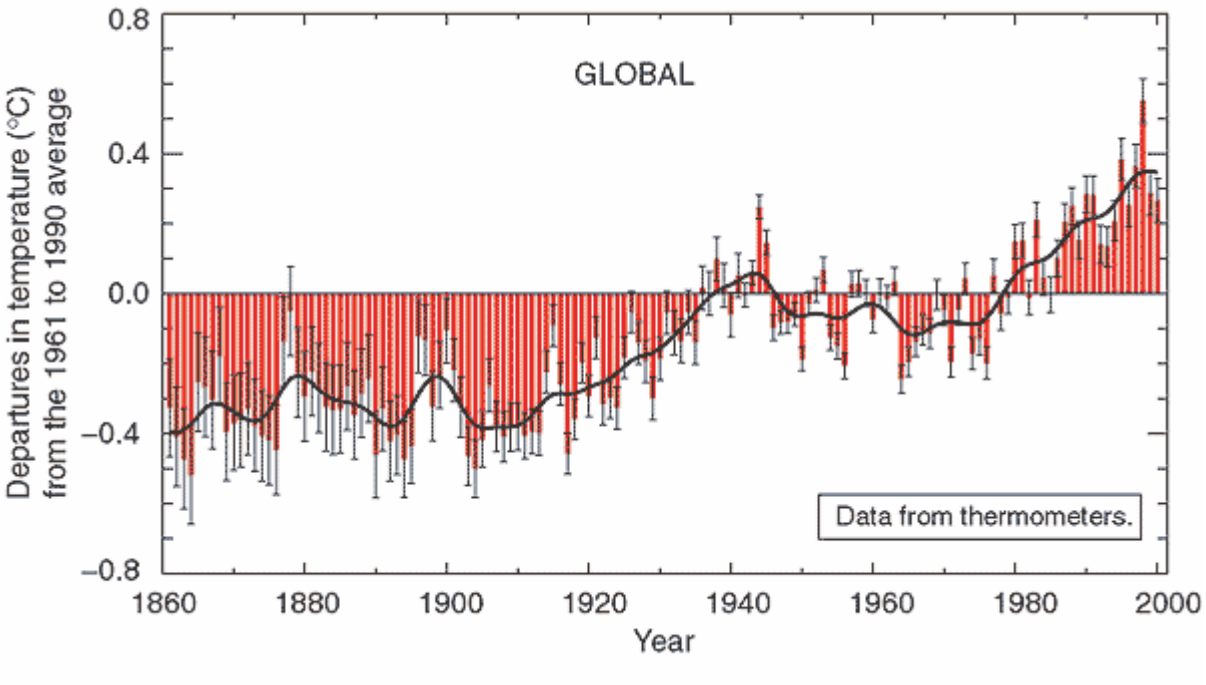
Source: IPCC, CHMI

Each of these gases is capable of affecting the climate and this depends on the radiation properties, molecular weight, content and survival time for the given gas in the atmosphere. This effect is expressed in terms of the global warming potential (GWP), defined as the radiation effect of the given gas over a certain period of time[2]. On a global scale, from the standpoint of anthropogenic substances, carbon dioxide is responsible for approximately 60 % of the total warming of the planet, methane for 20 %, nitrous oxide for 6 % and halogenated hydrocarbons for 14 %.

2.2. Observed Climate Change and Expected Trends

According to the measurements and observations of the Intergovernmental Panel on Climate Change (IPCC), the average global temperature has increased over the past century by 0.6 °C; over the past 140 years, seven of the ten warmest years occurred in the last decade of the 20th century. In the 20th century, a decrease in all continental ice fields was also observed and, in the second half of the past century, the extent of oceanic ice fields decreased by 10 to 15 % and this process continues to increase sea level by 1.5 mm annually, resulting in a rise in sea level of 10 to 20 cm during the 20th century. Total precipitation has increased at medium and higher latitudes on the continents of the northern hemisphere and an increase has also been observed over the contents in tropical areas; there has been a decrease in precipitation in subtropical areas of the northern hemisphere. There was an increase in the occurrence of extreme precipitation situations at medium and higher latitudes in the second half of the 20th century.

Fig. 2.3 Variations of the Earth's surface temperature for the past 140 years



Source: IPCC, CHMI

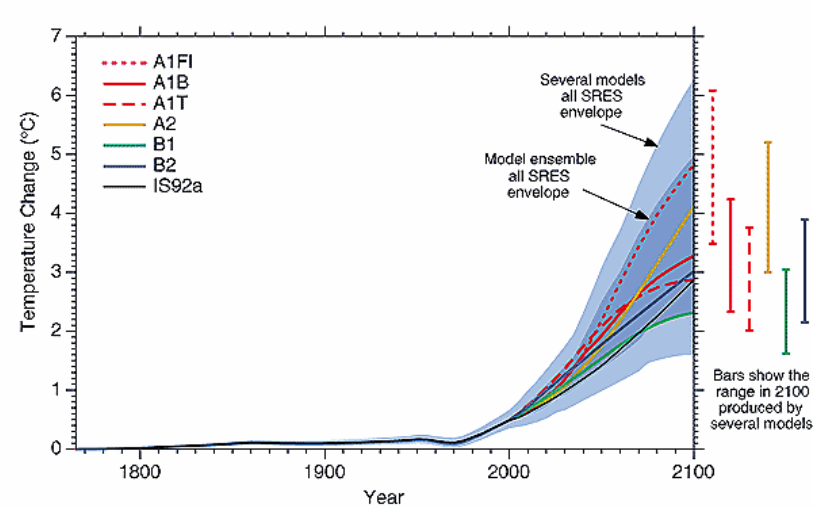
Model simulations of projected trends indicates an increase in the average temperature towards the end of the 21st century by an additional 1.4 to 5.8 °C. This range encompasses both a broad spectrum of concepts of trends in GHGs emissions in the future, and also the

[2] Most frequently, a time period of 100 years is employed

varying sensitivity of climate models. It can be assumed that the reduction of continental and oceanic ice fields will continue and that the sea level will rise by an additional 10 to 90 cm. The weakening of the North Atlantic circulation will lead to a reduction in transfer of heat to the higher latitudes of the Northern hemisphere. The increase in the concentration of water vapours in the atmosphere and the amount of atmospheric precipitation will continue at higher latitudes and this will be compensated by a reduction in precipitation in subtropical and equatorial regions.

Climate change impacts will be manifested to the greatest degree in coastal regions and in small island states and especially in the sectors of agriculture and water management, in natural ecosystems and in endangering of human life. Coastal regions and small island states will be significantly endangered by flooding following the expected rise in sea levels. Lower total precipitation and increasing temperatures will lead to a decrease in the area of tropical rainforests, which are also been drastically felled as a consequence of the increase in population levels, leading subsequently to a more rapid increase in carbon dioxide concentrations[3]. A significant reduction in average agricultural yields can be expected especially in Africa, in the Middle East and in India. There will be a lack of water resources for approximately 3 billion people in Northern Africa and the Middle East. In China and Central Asia, up to 300 million people more than at the present will be at risk from malaria. It is necessary to expect increased "environmental" migration of the population because of increased danger in some regions.

Fig. 2.4 Anthropogenic global mean temperature change and future changes for the six illustrative SRES scenarios



Source: IPCC

[3] At the present time, e.g., tropically rainforests annually absorb approximately 2 to 6 Gt of carbon; it can be expected that, in contrast, in the second half of the 21st century, tropical rainforests will become producer of emissions of approx. 2 Gt of carbon annually.

2.3. Measures to Abate the Impacts of Climate Change

The extent of climate change impacts depend on the abilities and capabilities for utilisation of all the available measures to abate climate change, i.e. direct reduction of GHGs emissions and also choice of suitable adaptation measures. However, unfortunately, even an immediate and significant reduction in total GHGs emissions would not be able to stop the impacts of climate change immediately. Climate systems react to a change in the GHGs concentrations with a certain delay, especially due to the effect of inertia in seas and oceans, as GHGs remain and are still active in the atmosphere for tens to hundreds of years. GHGs emissions produced in the past and at the present time will thus contribute to climate changes that will occur during the 21st century. Natural systems and human society are naturally very sensitive to the extent and degree of these changes. Thus, although attempts to reduce emissions are important, they must be combined with minimising of the impacts of climate change and adaptation measures.

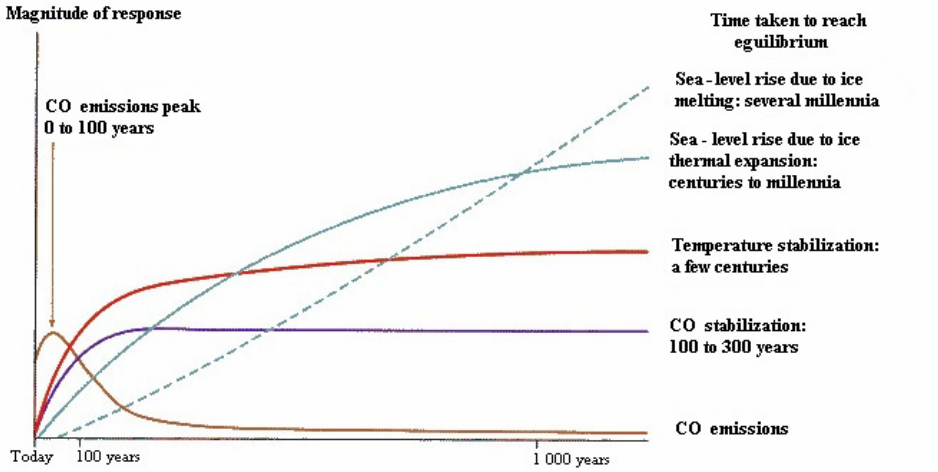
Adaptation measures are intended to prepare natural and anthropogenic systems to gradually changing climatic conditions; however, in contrast to reducing emissions, they will not act against the increasing impacts of the greenhouse effect. They must be employed to reduce the negative and increase the positive impacts of climate change, but cannot be employed to prevent all impacts. The ability to adapt in the individual countries depends on the availability of financial resources, technologies, levels of education, available information, suitable planning and the overall infrastructure. It holds in general that the economically and socially more developed countries have disproportionately greater potential for adaptation compared to developing countries. The regional differences in technical progress, natural circumstances and financial resources determine the potential for application of adaptation measures.

Estimation of the total annual potential for reducing GHGs emissions up to the year 2020 corresponds to 3600 to 5000 Mt C, while the estimate of global emissions for the year 2020 equals 12 000 to 16 000 Mt C according to the IPCC SRES[4] scenario. Consequently, economically developed countries should prefer attempts to minimise their own GHGs emissions.

In areas with lack of water resources, adaptation measures can be concentrated particularly on increasing the effectiveness of water usage, increasing supply capacities and improving planning in the area of water management. Flood prevention measures will have to be further improved in areas affected by floods by increasing the safety of water facilities against overflowing, a change in the controllable retention space, and especially in improving the water regime in the landscape through restoration of river systems and the landscape. It is important to reduce water pollution and thus prevent a decrease in its quality. This would increase the potential for recycling water.

[4] *Special Report on Emissions Scenarios*, IPCC, 2000 - the IPCC report contains and describes scenarios for further trends in greenhouse gas emissions; according to the name of the report, the term "SRES report" is used.

Fig. 2.5 Rate of response of the climate system to a reduction in emissions



Source: IPCC

Adaptation measures in the agricultural sector can be concentrated on changes in cultivation procedures in order to reduce losses in soil moisture, use of new crops, an improvement of plants with lower water requirements and greater resistance to water and temperature stress and an improvement in the use of irrigation systems. The potential for employing adaptation measures in this sector differs considerably from region to region and depends particularly on financial resources. Consequently, Africa must be considered to be the region most in danger.

Climate change will be a serious danger, especially for those natural ecosystems that are already weakened by civilisation pressures and have a generally low adaptation potential. The main adaptation measures consist in effective protection of naturally valuable territories and active assistance for endangered species (relocation, artificial breeding). In shoreline areas, adaptation will include an entire set of measures, not only of a technical character, although some parts of the world, especially those where danger from an increase in sea level can be expected, have limited potential for adaptation.

Natural ecosystems act as a carbon source and thus must be protected and their adaptation potential must be promoted. The most important biological measure for abating impacts consists in increasing CO_2 sinks through expansion of forest ecosystems and carefully considered use of biomass as a source of energy.

Anthropogenic systems will be affected directly as a consequence of more frequent occurrence of extreme weather events. The main adaptation measures include suitable land-use planning and construction technology and the implementation of technical measures in all areas of human activity, especially in the sectors of industry and energy production. Impacts can also be reduced through improving projections and introducing or improving the functioning of warning systems, which would draw attention to the occurrence of these phenomena sufficiently far in advance. Improved international cooperation is also important in predicting their occurrence and developments and in remedying consequences. Consequently, it is desirable to also implement adaptation measures in the sectors of insurance, in financial and banking services, in tourism, etc. and also to concentrate on the education system.

Human health is also affected by climate change impacts, although the degree will differ from region to region. In this case, adaptation measures entail affecting human behaviour and social, institutional and technical measures. The main and highly effective instruments in this sector consist in access to health care for the general public and implementation of precautionary measures.

3. Climate Change as an International Issue

3.1. Brief Survey of Developments

The issue of climate change appeared on the international scene in a broader extent in 1979 during the First World Conference on the Climate held by the World Meteorological Organisation (WMO) in Geneva. Significant progress in the area of recognising and regular monitoring of climate change and its impacts was achieved in 1988, when WMO and the UN Environmental Program (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) as an independent scientific and technical body, which is intended to summarise scientific results to date and create a professional base for subsequent policy negotiations. In 1990, the First Assessment Report was published and was updated in 1992. The Second Report was published in 1995, the Third Report was completed in 2001 and the Fourth Evaluation report will be prepared by 2007. The latest IPCC Report has provided an update of internationally accepted scientific results on climate change, oriented towards the scientific nature of the issue, impacts and the options for emission reductions.

3.1.1. The UN Framework Convention on Climate Change

On the instigation of the UN General Assembly in 1990, preparatory negotiations were held, leading in 1992 to adopting of the UN Framework Convention on Climate Change (hereinafter the "Convention"), which came into force on March 21, 1994 and had been signed by 188 states by October 2003. It was intended to create preconditions for accelerated stabilisation of GHGs concentrations in the atmosphere at a level that would prevent dangerous interference of anthropogenic effects with the climate system.

The Convention is based on the following five main principles:

1. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities. This means to protect the climate system to the benefit of not only the present, but also future generations and to react to the fact that, in contrast to issues of local pollution or transboundary transfer of pollution, this issue cannot be resolved by simply implementing legal regulations within the framework of a single country or smaller regions. Resolving the issue of climate change requires a global approach. Countries that acceded to the Convention must work together to combat the danger to the atmosphere, where their attempts must be differentiated according to the magnitude of their contribution to causing present conditions. The economically developed countries must bear special responsibility.
2. The specific needs and special circumstances of developing country Parties. Emphasis is placed on the increased needs of developing countries and especially those that are substantially more vulnerable and more sensitive to climate change impacts and would bear disproportionately high costs for remedying of these changes (especially African countries and countries of Southern and South-Eastern Asia and the small island states of the Pacific).
3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its effects. It is necessary that suitable measures should be adopted sufficiently far in advance, as the fact that there are not, at the

present time, sufficient strong, scientifically based arguments must not be a reason for postponing of tackling later problems. Although the causes of some long-term manifestations of the weather events have not yet been fully demonstrated, the scientific results fully demonstrate the linkages between the atmospheric GHGs concentration level and global climate changes. Postponement of a solution to the future and waiting for "sufficiently clear and sound scientific results " could lead to irreversible changes in ecosystems.

4. The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system must correspond to specific circumstances in the individual Party countries and must be integrated with national development programmes, taking into account their economic and social development.
5. The Parties should cooperate to promote a supportive and open international system that would lead to sustainable economic growth and development in all Party countries.

Unfortunately, the Convention of 1992 did not set any specific tasks and emission targets for individual countries. These were to be negotiated in further meetings of the regular conferences of parties to the Convention.

3.1.2. Kyoto Protocol to the UN Framework Convention on Climate Change

The Third Conference of the Parties to the Convention (Kyoto, 1997) was, in a certain sense, a turning point, as the text of a Protocol to the Convention was adopted. Although it was drawn up following complex deliberations, it did not resolve aspects connected with its implementation and established binding reduction targets only for economically developed countries, where the details of their implementation would be resolved subsequently. The Protocol will come into effect when it has been ratified by at least 55 Annex I Parties[5] to the Convention, whose total GHGs emissions correspond to 55 % of the total GHGs emissions from all economically developed countries[6], based on the situation in 1990.

At the beginning of 2001, there was a change in the position of the Government of USA in relation to further negotiations on the Protocol. The new state administration stated that the Protocol is regionally unbalanced (the developing countries would not currently participate in reducing emissions), economically expensive and currently insufficiently based on scientific knowledge and consequently USA stated that it is economically unacceptable.

The Seventh Conference of the Parties to the Convention (Marrakesh, 2001) progressed somewhat in negotiations and almost completed preparation of technical documents that could constitute the content of the Protocol after it comes into force[7]. Completion of these documents constituted the main precondition for successful progress of the ratification process. The individual points in the concluding document deal with aspects of financial sources and support, development and transfer of suitable technologies, the quality and implementation of emission inventories, improve description of the impact of the land use, land use change and forestry sector on GHGs emissions, specification of the rules of the Kyoto mechanisms and control mechanisms for compliance regime of agreed obligations.

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[5] The Parties named in Annex I to the Convention; these are economically developed countries of the world and countries in transition to a market economy.

[6] These are 39 states named in Annex B to the Protocol, including the Czech Republic (also Annex I Countries to the Convention).

[7] As of October 2003,, the Protocol had been ratified by 119 countries producing 44.2 % of emissions.

The Eighth Conference of the Parties to the Convention (New Delhi, 2002) did not bring any significant progress but only completed work on some technical documents related to specification of compliance regime to the Protocol. The adopted Ministerial Declaration urges the Parties to the Convention to incorporate the subject of climate change in their national strategies of sustainable development. It also advocates further development, expansion and investment into other new technologies enabling access to energy, diversification of energy sources and an increase in the fraction of renewable energy sources.

Currently the last, Tenth Conference of the Parties to the Convention (Milan 2003) adopted a total of 22 resolutions, but the conclusions of the Conference are somewhat contradictory because, while significant progress and consensus was achieved in some points, this was not true of other points. Significant progress was evident for professional aspects, e.g. in the framework of work on the principles of good practice in LULUCF (land use, land use change and forestry) sector –and similarly in the definition and modalities for inclusion of afforestation and reforestation in the clean development mechanism (CDM) according to Article 12 to the Protocol. Similarly, in the area of support for science and research and methodologies for GHGs emission inventories of , updated documents were prepared for approval at COP/MOP-1 (first Conference of the Parties after the Convention comes into force). On the other hand, a consensus was not attained in subject areas sensitively related to developing countries, which require a greater rate of transfer of technologies and financial assistance from the developed countries (*Special Climate Change Fund*). There was a certain attempt on the part of the developed countries to force the developing countries to exert at least some of their own efforts in this respect. The continuing obstinate position of the USA towards ratification of the Protocol and the still unclear position of the Russian Federation were additional disappointments in the Kyoto process.

As of November 23, 2003, the Protocol had been ratified by 120 Convention countries; however, this covers only 44.2 % of the required 55 % of emissions. The position of the Russian Federation is thus now a key moment for entrance of the Protocol into force; its prescribed contribution of 17.4 % would be sufficient for satisfying the second condition. However, in the light of the last statement by the President of the Russian Federation at the World Conference on Climate Change, which was held on September 29 to October 3 in Moscow, and also in relation to the conclusions of the Ninth Conference of the Parties to the Convention, the further fate of the Protocol in the next few years remains uncertain.

3.1.3. Flexible Mechanisms of the Protocol

Three mechanisms[8] have been proposed to promote compliance with the obligations following from the Protocol; they can be implemented by the Parties in addition to their own implementation of measures to reduce emissions. These consist in JI projects according to Article 6, emission trading according to Article 17 and clean development mechanisms (CDM) according to Article 12 to the Protocol. These mechanisms are intended to minimise the costs of reducing GHGs emissions. They are based on the physical and chemical nature of GHGs, which have a sufficiently long period of time during which they remain unaltered in the atmosphere, are evenly dispersed in it and thus it is not important when they were emitted into the atmosphere and when the emissions are actually reduced. As the costs of reducing emissions differ considerably in the individual states, attempts are naturally made for reduction measures to be implemented where the costs are lowest.

[8] The term "Kyoto mechanisms" is also frequently used.

Nonetheless, JI projects and international emission trading according to the Protocol are intended to be only supplementary instruments to direct measures to reduce emissions in the framework of the individual states. Through creation of financial sources, flexible mechanisms are intended to assist in implementation of measures at a national level, which could not be implemented without this assistance. Their gradual introduction will contribute, not only to meeting the reduction targets by the developed countries, but also to development of international cooperation, to participation of the developing countries in the issue of climate change, to facilitation of transfer of technologies between economically developed countries and developing countries and to an improvement in protection of the environment in the developing countries.

The Protocol only mentions these mechanisms and gives framework definitions, but does not define the rules for their practical implementation and use in practice. Consequently, very complex negotiations were held in 1998 to 2001 on their form and the proposal of rules for implementation of JI and CDM was approved in 2001. The resultant proposal has been prepared for submission and approval at the first COP/MOP-1 conference (MOP - Meeting of the Parties), which will be held immediately after the Protocol comes into force.

3.1.3.1. Joint Implementation Projects

JI projects are based on the different costs of reducing emissions between the Annex I Parties. The target of the project is to create credit units that are based on quantification and confirmation of savings in GHGs emissions through implementation. The investor and host of the project share these created emission units according to the concluded agreements. Implementation of this type of project leads to certainty in the implementation of active measures to reduce emissions. AIJ (*Activities Implemented Jointly*) projects in the pilot phase have been implemented since 1995 to gain experience and to test the potential for use of these mechanisms and were carried out without the right to transfer of credits. Subsequently, this experience was utilised to prepare JI projects and clean development mechanisms (CDM). More than 180 such AIJ pilot projects were implemented throughout the world.

The main investors in AIJ pilot projects were particularly the economically developed countries of OECD (with the exception of countries with economies in transition) , in particular, USA, Canada, Australia, Japan and some EU states. The host countries included mostly countries with economies in transition, states of the former Soviet Union and some developing countries. In the framework of the pilot phase, projects were implemented to reduce GHGs emissions through technical measures (increased efficiency, change in the type of fuel, use of biomass or renewable energy sources, etc.) or increasing sinks of GHGs through measures with a biological base (LULUCF sector).

Implementation of such a project makes it necessary to prepare developmental emission baselines, defined as the hypothetical emission level that would be achieved if the project were not implemented. Determination of the baseline is employed to calculate the number of emission units saved, and equals the difference between emissions that would hypothetically have been emitted using the old technology and that will be emitted with the new technology. Emission monitoring is a necessary precondition for determining emission savings; this should employ all the available information on real emissions and should be carried out through processes similar to those used for GHGs emission inventories. The obligations of monitoring and submitted reports are part of the Protocol. Reporting of information on implementation of projects and the savings achieved is carried out in a uniform manner. The final stage of the project consists in control and verification of all the data by an independent entities, which is necessary to create emission credits.

According to the results obtained in AIJ projects, excessive costs for their implementation could constitute a fundamental obstacle in the future. These costs must encompass the necessary preparation process including creation of the emission baseline, emission monitoring, verification and validation of emissions saved. However, a potential does exist for reducing these costs, e.g. through preparation of a greater number of projects of the same or similar type in the framework of a single preparatory procedure.

Projects commenced in 2000 can be considered JI projects, but the emission credits (ERU units) may be transferred between the relevant countries only up to 2008, if both Parties comply with the requirements given by annexes to Decision 16/CP.7.

The Annex I Parties that are interested in transferring ERU units have to meet the following eligibility requirements by January 1, 2007 at the latest:

- ratify the Protocol,
- submit information to the UNFCCC Secretariat on the establishing of a national focal point authorised to approve projects, national guidelines and procedures for approving projects and, including requirements on investors,
- submit information to the UNFCCC Secretariat on the manner of monitoring and verification,
- carry out calculation of national emission targets (AAU units) pursuant to Articles 3.7 and 3.8 to the Protocol and in the sense of the rules laid down in Decision 19/CP.7,
- have in place national system for GHGs emission inventories and submit complete information on of GHGs emission inventories throughout the entire period since 1990, in CRF (Common Reporting Format),
- describe the functioning of the national system of GHGs emission inventories (National Report on GHGs Inventories),
- determine the base year for HFCs, PFCs and SF_6 emissions,
- calculate the commitment period reserve pursuant to 19/CP.7,
- submit supplementary information on calculation parameters for sinks pursuant to Decision 11/CP.7, and
- have in place and describe the function of the national registry system pursuant to Decision 19/CP.7.

The Seventh Conference of the Parties to the Convention decided to introduce a "two-track approach" for cases where one of the partner countries would not be capable of meeting all the above requirements. The "Track I" procedure is substantially simpler; here, both parties must demonstrate that they are capable to meet all eligibility requirements without any exception. Under these preconditions, the transfer of ERUs is only a matter of agreement between the two Parties to the agreement. If one of the Parties does not meet all the requirements, then the entire extensive process set forth by Decision 16/CP.7 must take place, to be supervised by the special body (Article 6 Supervisory Committee), entailing a substantial increase in financial costs for the individual projects (i.e. Track II). Nonetheless, in any case, both Parties to the agreement must meet the minimal eligibility requirements , i.e. (a) ratify the Protocol, (b) calculate AAU units, (c) have a national registry system in force (d) have a national GHGs inventory system in force. If these eligibility requirements are not met, the Article 6 Supervisory Committee will not allow ERU transfer .

3.1.3.2. International Emission Trading

Emission trading, utilising tradable allowances, has been found to be a very effective economic instrument for reducing environmental impacts that, however, has never been fully tested in an international context. Several examples exist at a national level, the most important of which is trading in emission allowances for SO_2 in USA. The savings accrued through emission trading compared to the classical administrative procedure for reduction of emissions have been estimated at 3 bil. USD. Emission trading has also been successfully tested in the private sector as a suitable method for minimising the costs for implementing measures to reduce GHGs emissions.

International emission trading (pursuant to Article 17 to the Protocol) should be based on national trading and information systems that are mutually interconnected through international institutions, on which minimal requirements should be imposed. The system should begin to function from the beginning of the first commitment period, i.e. from 2008. Similar as for JI projects and CDM, international emission trading is also based on the different financial costs of reducing GHGs emissions. It will be possible to sell the emissions saved (AAU units) on the international market in emissions. Broader utilisation of this principle can lead to meeting of emission targets with minimisation of expected costs.

States that want to transfer AAUs through this mechanism are obliged to meet eligibility requirements that are identical with the requirements given for JI projects (see above). Violation of any of these eligibility requirements leads to exclusion from international trading and potentially also cancelling of already transferred AAUs.

3.1.3.3. Clean Development Mechanism

The clean development mechanism CDM is similar to JI projects, where the investor state is an Annex I Party and the host state is a developing country. Simultaneously, these projects are intended to assist developing countries in achieving sustainable development and thus meet one of the basic principles of the Convention. These projects enable control of the use of expended financial means, as funds are released for specific projects. On the basis of an agreement between the investor and host countries on sharing of emission credits created through the implementation of such projects, developing countries can participate in international emission trading. Monitoring and verification of CDM projects would be based on the same principles and rules as for JI projects.

The potential for utilisation of CDM mechanism projects is greater than for JI projects, as the costs per unit GHGs emissions saved are much lower. It has been estimated that, of the total emission savings that would lead to compliance with the obligations of the Protocol, up to 50 % of emission reductions could be implemented through CDM projects. If all the principles following from the Protocol are maintained, there should not be an overall increase in GHGs emissions into the atmosphere. In spite of the significant economic benefits for economically developed and developing countries, CDM use should be limited, because preference for CDM projects will not reduce emissions by developed countries, measures at a national level will not be implemented and there could even be a reduction in support for new technologies.

3.2. The Position of the European Union on Climate Change

The European Union has been concerned with the issue of climate change for a number of years and this subject is also part of its Sixth Framework Program. The Protocol has been ratified by the individual EU member states and also by the European Commission as an

expression of their intent to deal with this issue. In March 2000, the European Commission decided to establish the European Climate Change Programme (ECCP), which identified the main joint approaches and measures of EU and the individual member states so as to ensure joint and individual meeting of the reduction targets of the Protocol[9]. The Program attempts to identify environmentally sound, cost-acceptable measures to reduce GHGs emissions. The ECCP is intended to allow the European Community to more readily identify the capabilities of the individual EU member states and contribute towards formulation of fundamental documents and legal regulations.

It follows from a number of economic analyses of potential implementation of the Protocol that the aspect of the amount of economic costs for meeting this criterion is accompanied by a number of uncertainties. The average costs in the EU member states for implementing measures to reduce GHGs emissions by 2010 are estimated in the range 0.06 to 0.3 % GDP. Thus, logically, attempts are being made to achieve the required reduction in GHGs emissions for the lowest possible costs. According to the latest emission data for 2001, presented by the European Environmental Agency (EEA) in September 2003, the EU member states have so far reduced their emissions by 3.3 %, while total emissions have again increased over the past two years. However, with the existing reduction measures, emission projections indicate a gradual increase to the 2008 - 2012 period. The estimated need for a further reduction in emissions in the next few decades equals approx. 330 Mt CO_2 eq., i.e. a further 7.5 %[10].

The proposed and approved ECCP is preparing a wide range of measures to reduce emissions, including preparation for internal emission trading in EU from 2005, similar to reduction of the risk of the impacts of climate change. All the EU member states, the European Commission, and stakeholders and environmental associations co-operatively participate in the development of instruments. For closer identification of policies and measures to reduce GHGs emissions, the ECCP cooperates not only with other EU bodies, but also with private entities. In this way, EU is attempting to create optimal the environment to ensure the required reduction in emissions in the coming decades and to thus to provide the preconditions for meeting the EU obligations in relation to the Protocol.

Consequently, on the basis of evaluation of the first phase of ECCP activities, the EU member states have agreed on a preliminary set of policies and measures, which the European Commission will implement over the next two years. In addition, experience in recent years has indicated that the formulation of strategic plans always requires a certain amount of time so that the results can be transposed and implemented through legal regulations in the member states. It is necessary to commence these activities sufficiently far in advance in view of the approaching date for commencement of the first commitment period of the Protocol in 2008 and of the necessity of meeting reduction obligations. In addition, some of the proposed reduction instruments (e.g. emissions trading) are entirely new under situation in the EU states and no practical experience has been gained in this area.

The activity of the program is structured into seven special working groups, which are expected to identify and propose the most effective policies and measures to reduce emissions

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[9] According to the Protocol, the EU Countries as a whole should reduce total greenhouse gas emissions by 8 % by the 2008 - 2012 period compared to levels in 1990, utilising the possibility of establishing individual emission targets for the individual states so as to ensure balanced economic development and simultaneously so that the EU reduction target is achieved.

[10] A CO_2 eq. unit expresses the aggregated value of GHGs emissions controlled by the Protocol. Expression of this value takes into account the global warming parameter (GWP), which, e.g., equals 1 for CO_2, 21 for CH_4 and 310 for N_2O; the values for substances containing fluorine are of the order of 10^3.

in the given sector. The individual groups specialise in energy sources, energy consumption, transport, industry, research, agriculture and flexible mechanisms. The first phase of the program was completed in June 2001 through issuing of an annual report[11], which evaluates existing results over the first year of activity and analyses the potential for finding further policies and measures to reduce GHGs emissions and minimise the impacts of climate change under the EU circumstances. The outputs of the program were employed by the European Commission in preparing specific proposals for the Council of Ministers and for the European Parliament. The Report contains 41 specific proposals for measures, whose implementation could reduce GHGs emissions by approximately 660 to 760 mil. tons of CO_2 eq., where the costs for saving of one ton CO_2 eq. should not exceed a value of €20.

Of the measures listed in the ECCP, the following are the most important:

energy production	further developments in the internal market in electricity and gas including environmental priorities, access to distribution networks including decentralised electricity production, an increase in the share of renewables in energy production, an increased share of combined production of heat and energy, reduction in CH_4 emissions in mining and extraction of coal, CO_2 sequestration, support for a change in technology using more effective and cleaner fossil fuels, an increase in energy efficiency in production of energy.
industrial sector	an increase in the standards of energy efficiency of electrical appliances, an increase in the standards of efficiency in industrial processes, an increase in energy efficiency reducing CO_2 emissions (energy furnaces, distribution networks) development of policies to reduce emissions of partly and fully fluorinated hydrocarbons and emissions of sulphur hexafluoride, creation of conditions for introduction of emissions trading, creation of conditions for adopting voluntary agreements.
energy consumption	increasing public awareness of energy-efficient end appliances, energy audits and certification of heating systems, improvement of insulation of buildings, lighting systems and improvement of land-use planning and infrastructure construction.
energy consumption in transport	modification of transport price policy, extension of concepts of environmentally sound operation of passenger vehicles and light trucks, introduction of an information campaign to support environmentally sound means of driving motor vehicles.
transport policy	revision of conceptual material in the transport sector, increased capacities of transport routes, especially highway transport, use of satellite navigation systems.
waste management	improved processing of biological waste, increased efficiency of waste water treatment, revision of packaging management and use of packaging technology.
research	implementation of the 6th Framework Program, especially in the area of energy production, the environment and programs of sustainable development.

However, it is already apparent that it will not be possible to implement all the proposed measures in the framework of the EU member states and that the cited estimates of emission savings are at the upper probability limit. In the period prior to preparation of the Protocol, in 1997 at international negotiations, the European Commission strongly emphasised higher reduction targets (up to 15 %) with reference to the environmental policies prepared in the

[11] European Climate Change Programme, June 2001 (http://europa.eu.int/comm/environment/climat/eccp.htm)

individual states. However, it has been found that the demonstrable reduction in emissions over the decade since 1990 attained only the above-mentioned 3.3 % in the EU states. Consequently, this remains a political priority for EU, together with meeting the aggregated targets of the Protocol, and thus the European Commission places great emphasis on finding further measures that, however, must be economically acceptable.

The basic direction to be followed by the ECCP in the coming years will consist in activities oriented especially towards support for programs for production of heat from renewables, energy audits and introduction of new management methods in the energy sector, fundamental changes in the structure of transport policy, framework fiscal measures in the area of operation of passenger motor vehicles, an increase in the level of sinks for GHGs emissions by afforestation, reforestation and use of new methods of forestry management and creation of technical and legislative conditions for accelerated implementation of flexible mechanisms according to Articles 6, 12 and 17 of the Protocol, of which the most useful will probably be introduction of trading in GHGs emissions.

In July 2003, the European Union approved a Directive 2003/87/EC on emission trading, which will be binding for the Czech Republic. Implementation of this Directive is very demanding, especially from the standpoint of time, because a model for allocation of emission allowances to the individual enterprises (the National Allocation Plan) should be submitted to the European Commission by May 1, 2004.

Another important document consists in Council Decision No. 1999/296/EC, amending Decision 93/389/EEC for a monitoring mechanism of CO_2 and other GHGs emissions, of July 26, 1999, which establishes the following mechanisms:

- monitoring of all anthropogenic GHGs emissions[12] that are not regulated in the member states by the Montreal Protocol, and
- evaluation of all activities directed towards compliance with obligations related to the Protocol.

Amongst other things, it requires that the EU member states draw up, publish, implement and regularly update national programs directed towards controlling and reducing anthropogenic emissions of all GHGs and increase their sinks so that, by 2000, this contributes to stabilisation of CO_2 eq. emissions at their 1990 level and contributes to meeting the EU obligations to reduce all GHGs emissions in the sense of the Convention and the Protocol.

Every EU member state must include in its national program, amongst other things:

- estimation of the effects of adopted policies and measures in reducing GHGs emissions and a description thereof,
- information on GHGs emissions according to the list given in Annex A to the Protocol, related to
    - anthropogenic emissions of carbon dioxide, methane and nitrous oxide for the initial year of 1990[13],
    - anthropogenic emissions of partly and fully fluorinated hydrocarbons and sulphur hexafluoride for the initial year of 1990, and/or, as appropriate, 1995,

[12] Carbon dioxide CO_2, methane CH_4, nitrous oxide N_2O, partly and fully fluorinated hydrocarbons HFCs, and PFCs, and sulphur hexafluoride.

[13] The base year of the Protocol (for CR, 1990 for emissions of CO_2, CH_4 and N_2O and 1995 for emissions of HFCs, PFCs and SF_6).

  - a survey of anthropogenic emissions of all GHGs for the period from the initial year to the present time, carried out according to the valid IPCC methodology,
  - a survey of precursors of GHGs emissions[14] for the period from the initial year to the present time
- information on measures contributing to reduction of GHGs emissions, adopted from the initial year of the Protocol,
- information on expected and potential future policies and measures contributing to reducing GHGs emissions,
- evaluation of the effectiveness of these policies and measures at least to the year 2005, with the maximum possible scope and
- where possible, estimation of the economic impacts of all the policies and measures.

In addition, the program should contain information on the impacts of climate change on a national scale, on progress in scientific knowledge and in systematic observation and on the level of education and public awareness.

In the EU, deliberations are being carried out on a draft new Council Decision for mechanisms for GHGs monitoring at the level of the Communities and implementation of the Protocol, to supplement and extend the original Council decision 199/296/EC. Other documents currently being deliberated include:

- Draft Directive on Project Mechanisms for the Protocol,
- Draft Regulation of the European Parliament and Council on F-gases[15].

Another document that should be mentioned consists in Directive of the European Parliament and Council 2003/30/EC, on promotion of the use of biofuels or other renewable fuels in transport. Amongst other things, the Directive requires that the member states ensure that their markets contain a minimum fraction of biofuels and other renewable fuels and that they set national indicative targets for this purpose. The reference value calculated on the basis of the energy content for these targets equals 2 % of all petrol and diesel fuel for transport purposes on their markets by December 31, 2005 and 5.75 % by December 31, 2010. In this respect, CR is exerting efforts to ensure implementation and transposition of this Directive.

[14] Carbon monoxide CO, nitrogen oxides NO_X, non-methane volatile organic compounds NMVOC and sulphur dioxide SO_2.

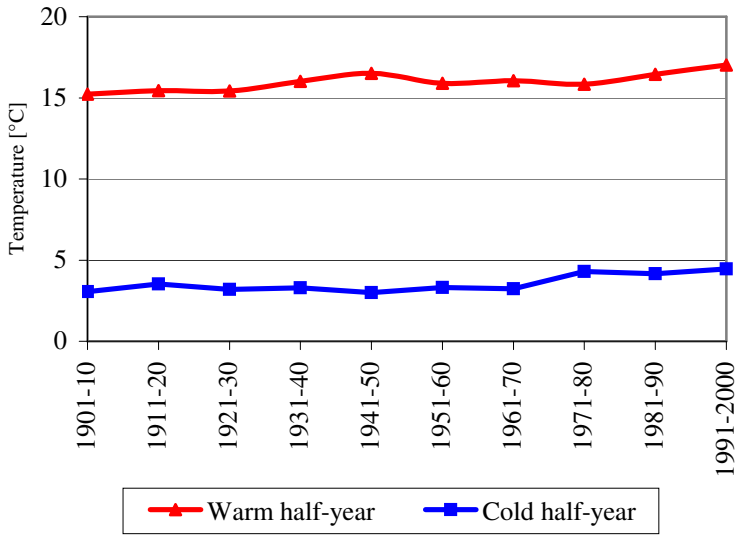
[15] Partly fluorinated hydrocarbons HFCs, fully fluorinated hydrocarbons PFCs and sulphur hexafluoride SF_6

4. Climate Change and its Impacts in the Czech Republic

In CR, research on the impacts of climate change on the basic activity sectors is carried out primarily through the National Climate Program of CR (an association of legal persons established in CR on January 1, 1994). Estimation of impacts is based on calculation of changes in selected aspects of the climate (e.g. the ground-level air temperature, precipitation, wind speed, global radiation, humidity, etc.) in the 1961 - 1990 period and a selected thirty-year period, usually in the middle or at the end of the 20th century.

Temperature changes in the 1961 - 2000 period were analysed based on changes in ten-year averages, changes of deviations from the average, trends in time, etc. A homogenised time series of air temperatures measured at selected stations was employed for the evaluation. According to analysis of trends, the annual averages of maximum, minimum and average temperatures increased in a statistically significant manner; the seasonal averages of maximum and average temperatures exhibited similar behaviour with the exception of the autumn season. Winter and spring average minimum temperatures exhibited statistically significant trends especially at heights above sea level above 700 m.

Fig. 4.1 Changes in the ten-year average temperatures in the warm and cold half years in CR in the 20th century (Prague-Klementinum)



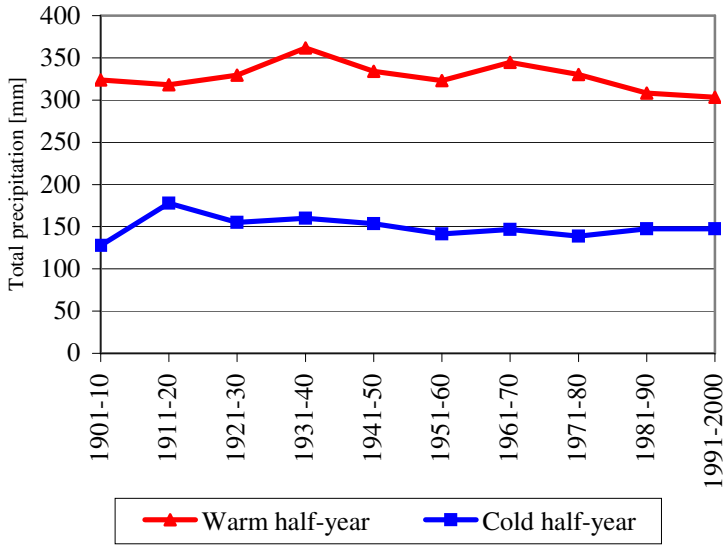
Source: CHMI

On the basis of all the usual temperature characteristics, the 1981 - 2000 period was warmer than the 1961 - 1980 period and the past decade (1991- 2000) was unambiguously the warmest in the past 40 years. The current usual annual variation in precipitation is simple with a maximum in the summer months (June to August); in a number of cases, a lesser maximum also occurred in November. The minimum total precipitation in the 1961 - 2000 period remained in January and February with a secondary minimum in October.

Analysis of changes in the variability and frequency of occurrence of selected extreme weather events indicates an increase in maximum air temperatures over the past decade. Changes in the maximum daily temperatures, number of days with extreme temperatures and alternation of extremely warm or cold periods are statistically significant, especially in the

summer season. Similarly, analysis of the characteristics of extreme precipitation indicates certain changes over the past decade. For example, there is a clear decrease in the number of days with precipitation over a given limit in the spring and a slight increase in the autumn. Analysis of seasonal changes indicates that, in the spring, there is an overall decrease and, in the autumn, an overall increase in the number of days for practically all the limiting values. This mostly consists in a shift towards higher total precipitation in the summer and winter. Because of the considerable spatial variability of precipitation in the territory of CR, the results to date must be interpreted carefully, and similarly as for temperature, cannot currently be extrapolated in a simple manner to yield the general regional climate in the 21st century.

Fig. 4.2 Changes in the ten-year average precipitation in the warm and cold half years in CR in the 20th century (Prague-Klementinum)



Source: CHMI

The climate change scenarios for CR are based on the outputs of two or more climate models, whose creation requires adoption of assumptions on future trends in GHGs concentrations and on the temperature sensitivity of the climate[16]. The updated regional scenario for CR with probable projections of changes to the year 2050 formed the basis for related studies of the impacts of climate change on a national scale. They are based on the outputs of two global circulation models (HadCM2[17] and ECHAM4[18], which were chosen as most appropriate for this country, as the model outputs sufficiently reliably describe the current regional climate. The time trends in the concentrations were described on the basis of two IPCC SRES emission scenario. Emission scenario A2[19] describes the pessimistic variant, while scenario

[16] The equilibrium temperature sensitivity of the climate refers to the annual average global temperatures for a two-fold increase in the concentration of CO_2 eq.

[17] Global circulation model of the atmosphere and ocean, developed at Hadley Centre, Bracknell

[18] Global circulation model of the atmosphere and ocean, developed at Max-Planck-Institut für Meteorologie, Hamburg

[19] Scenario of trends in global GHGs emissions based on assumptions of markedly regionally oriented economic development, a rapid increase in the number of inhabitants of the Earth and slow resolving of global environmental problems.

B1[20] describes a relatively optimistic variant. The values 1.5 °C (low sensitivity) and 4.5 °C (high sensitivity) were chosen for the temperature sensitivity. By combining these factors, two scenarios of climate change can be obtained for each of the models (upper and lower estimate), i.e. a total of four scenarios. The scenario does not encompass natural variations in the climate; the contributions of natural and anthropogenic climate variability may be mutually compensated or may be additive. Analysis of the results of the model scenarios indicates that, on a regional scale, an increase in the annual average of the mean daily air temperatures by 0.9 to 3.0 °C can be expected to the year 2050, with a small decrease in total annual precipitation by 0.2 to 0.6 %, where the variations in the annual course of precipitation may be far more marked.

All the model values of the changes are accompanied by a certain level of uncertainty. Because of the uncertainties connected with the outputs of global climate models, regional changes in climatic quantities in the territory of CR are connected with a higher degree of uncertainty than over the territory of the continent or even the whole planet. In general, a change in the temperature characteristics is accompanied by a lower level of uncertainty than the change in precipitation. The degree of uncertainty decreases from the change in daily values, through monthly and yearly values to values for decades.

The outputs of the individual scenarios were employed to estimate the impacts in the sectors of hydrology, agriculture, forestry and human health. Identical input data were employed for all the sectors, permitting comparison of the extent and magnitude of the impacts on the individual sectors.

4.1. Hydrology and Water Management

The scenarios and the hydrological model employed indicate a decrease in average flow rates of 15 to 40 %. Similar decreases have been recorded for minimum flow rates and minimum outflow of ground waters. The higher temperatures in the winter months lead to a reduction or disappearance of water supplies from snow and greater evaporation from the ground. This leads to a shift of elevated flow rates and addition to groundwater supplies from the spring to the end of winter and to a significant reduction in their amounts. Flow rates will mostly decrease as a consequence of greater evaporation from the ground from spring to autumn. Because of reduced flow rates and increased evaporation, water reservoirs will have reduced ability to provide for and balance withdrawals. Water courses with large accumulation areas in the form of groundwater stocks or artificial reservoirs are more resistant to the impacts of climate change. The danger of eutrophication of water courses increases with a decrease in flow rates and warming of the water. In connection with the increased variability of the distribution of precipitation and extreme weather events , there will be an increasing risk of floods and periods of drought.

4.2. Agriculture

In comparison with forestry and water management, the impacts on agriculture can be affected more by the composition of crops and management methods. Due to the short vegetation period of most agricultural crops, the use of intensive technologies, rapid changes in cultivated varieties, changes in variety compositions, etc., exact description of the expected impacts is a complicated issue. Because of the character and quality of the areas, the current

[20] Scenario of trends in global greenhouse gas emissions based on global cooperation and high orientation towards protection of the environment.

condition of agricultural land is not very favourable, caused primarily by the considerable loss of soil humus. Its content in the soil also plays a substantial role for soil moisture content as it limits, amongst other things, the rate of heating and subsequent drying out of the soil in the summer. In the winter, its lower thermal conductivity reduces the depth of freezing of the soil.

The positive consequences of climate change include prolonging of the frost-free period by 20-30 days and a shift in the beginning of the vegetation period to the beginning of March and in the end of this period to the end of October in the warmer areas. The higher temperatures will extend the vegetation period and affect the growth and development of crops so as to allow earlier germination and onset of further phenophases so that, compared with current situation, the time of ripening or harvesting could be postponed by at least 10 to 14 days. Another of the positive climate change impacts consists in the accelerated rate of photosynthesis with increasing carbon dioxide concentrations and increased utilisability of water in the soil. However, the formation of biomass will lead to its increased consumption so that, in spite of the above-mentioned better utilisability, this could lead in certain areas to exhausting of water supplies before the end of the vegetation period.

The expected increase in temperatures should create sufficient temperature security for growing thermophilic species (e.g. semi-early varieties of corn for grain, early varieties of grapes). However, there is a serious danger of thermal stress connected with frequent occurrence of extremely high temperatures. With the expected increase in evaporation and without a significant increase in atmospheric precipitation, a substantial part of central and southern Moravia, central and north-western Bohemia, and the regions around lower and central parts of the Labe and Vltava will be in danger of drought, which could have a detrimental effect on harvest yields in the most productive agricultural areas. Under the warmest conditions and on extremely damp soils, it can be expected that locations will appear that are not suitable for economic production. Higher areas, where agricultural production is currently limited by low temperatures, should gain in productivity under the expected changes in climatic conditions, as they will probably not be affected by the lack of precipitation. On the other hand, it can be expected that there will be increased probability of the occurrence of total daily precipitation over 10 mm, which can be dangerous for erosion and must be expected with greater frequency especially in May, June and September; the area of the land endangered by erosion will increase by at least 10 %.

Climate change will also change the conditions for greater spreading and extensive effects of agricultural pests and diseases, which have, until now, been typical for warmer areas. The variation in air temperature will be decisive as the critical phases in the development of diseases, fungi and insects will be dependent on this factor. As a consequence of warming, the more rapid onset of the individual phases in some years could result in favourable conditions for completion of the full second summer generation of fungi and insects. It must be expected that the occurrence of viral diseases will be more extensive and that there will be a greater occurrence of fungal diseases (e.g. potato or hop blight).

4.3. Forestry

If the scenario of climate change occurs, impacts on forest ecosystems can also be expected, i.e. long-lived formations with limited adaptation potential. With the exception of the relationship to potentially harmful biotic factors, it can be expected that there will be a predominantly positive effect of increased carbon dioxide concentrations on growth conditions and growth activity of forest tree stands. However, the increased average temperatures will lead to increased evapotranspiration, which, especially at sites with lower precipitation, could lead to a worsening of the water balance. It can be expected that the

change in habitat conditions and the occurrence of extreme weather events could act as a predisposition stressor. The rotation period will be shortened, both because of earlier maturity (economic advantage) and also because of deterioration in the condition of stands (economic losses).

Due to the longer vegetation period and increased temperatures (occurring since the sixties of the last century), there will be a shift in the vegetation level and thus natural changes in species compositions. At lower altitudes, the worsened water balance will lead to a shift in the natural boundaries of forests. This will have a significant impact, especially on secondary spruce stands at lower and medium positions. As a consequence of climate change, approximately 20 % of existing spruce stands are at risk; cultivation can be designated as risky for a further 53 % of spruce stands; on the whole, this corresponds to 45 % of the area of the forests of CR. These stands will have a greater tendency to destruction of the root system by honey fungi and layered red root rot and to disturbance of physiological processes in tree species by vascular mycosis. The deterioration in the state of health, together with favourable conditions for insect populations, exacerbates the risk of an increase in the occurrence of bark and leaf-eating insects, especially spruce bark beetles. This will be manifested in various forms of decline, where it will not be possible to unambiguously determine the mortality factor. The limiting factor for the condition of forests will be primarily extreme weather events, i.e. excessive "overheating" of the tissues in combination with summer dry spells.

4.4. Human Health

At the present time, it is extremely difficult to assess the consequences of climate change for human health effects, as most complications in human health are caused by a number of factors and occur on a background of economic, social, demographic and overall changes in the environment and in life style. On the basis of information obtained to date, it can be stated that the main negative impacts of climate change on health in Central Europe can apparently be connected with changes in stress caused by heat (and potentially also in connection with worse air quality).

5. Greenhouse Gas Emissions in CR in 1990 to 2001

The National Program to Abate the Impacts of Climate Change in CR is concerned with:

- meeting the targets of CR for GHGs emission reduction, coming from the Protocol, which means reduction of total aggregate GHGs emissions expressed as emissions of carbon dioxide by 8 % compared to situation in 1990 by the end of the first commitment period (2008 - 2012),
- building of all the preconditions to meet national target in the subsequent commitment period[21] and
- gradual approximation of majority of emission and energy production indicators[22] to the level of the average values in EU in an attempt to achieve most values in 2012 at the level of the EU values in 2000 and to equalise all values in 2020.

In the sense of Resolution of the Government of the Czech Republic No. 38/2001, which adopted the State Environmental Policy, it is necessary by 2005 to maintain their production at a level 20 % lower than in 1990, which is the existing national target beyond the framework of the Protocol.

5.1. Basic Characteristics of the IPCC Methodology and Key Sources

For the purposes of national inventories of anthropogenic GHGs emissions and sinks, a standardized methodology was prepared by the Intergovernmental Panel for Climate Change (IPCC). The first version was published in 1995[23] and later updated in 1997[24]. The methodology is still being developed and supplemented and a new version is to come into effect in 2004 (for the LULUCF sector) and in 2007 for all sectors. It is concerned primarily with CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, and also with precursors - NO_X, NMVOC, CO and SO_2. The methodology prescribes two independent approaches, based on the national energy balance. The reference approach is simpler and is based on the balance calculation of the consumption of individual types of fuels from primary sources. The sectoral approach is more complex and is based on knowledge of the actual end consumption of fuels in the individual sectors and also respect transformation processes. The reference procedure is highly transparent and is thus used especially for control of the correctness of calculations, where the difference in the results for CO_2 emissions does not usually exceed 2 %. Other CO_2 sources or sinks are connected with changes in the LULUCF sector[25] (e.g. felling of forests or afforestation).

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[21] International negotiations on the second commitment period will be commenced in 2005.

[22] CO_2 emissions/inhabitant, CO_2 emissions/GDP, energy consumption/inhabitant, consumption of primary energy sources/GDP, etc.

[23] *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, Vol. 1-3, IPCC 1997

[24] *Good Practice Guidance and Uncertainty Management in National GHGs Inventories,* IPCC 2000

[25] The amount of carbon contained in felled wood is considered to be an emission and the amount of carbon contained in growing wood is considered to be a sink. However, wood as a construction material and wood products with long lifetimes are considered to be a temporary sink in the form of conserved CO_2.

In relation to the character of the most important sources of CH_4 and N_2O emissions (coal mining, animal breeding, landfills and waste waters, agricultural land, management of animal wastes, production of nitric acid, fluid-bed and local combustion, automobiles with catalysers, etc.), it is only exceptionally possible to employ the most exact determination method, based on continuous measurements, in inventories of CH_4 and N_2O emissions. Consequently, calculations based on statistical activity data are employed and the corresponding emissions factors are used as further parameters. According to the complexity of calculations and different types of emission factors (generally recommended, territorial, local and technologically specific), the methodology differentiates three levels. The first level is characterised by simpler calculations, based on fundamental statistical indicators and generally recommended emission factors of a global or continental character. The second level is based on a more detailed calculation and usually requires more detailed statistical data that is more difficult to obtain. Territorial or technically specific emission factors are usually derived from more complex research and are based on more detailed knowledge of emission sources, which can be generalised. The results of direct measurements carried out under local conditions determine the locally and technologically specific emissions factors and the procedures according to the third level are based on their use. It is apparent that procedures at higher levels are usually more exact and correspond better to actual conditions, but are more expensive.

Although the Protocol has not yet come into force, many of its stricter requirements imposed on national GHGs emission inventories are already employed. For example, since 2000, a uniform CRF form has been introduced to facilitate control of the results of inventories and contains an electronic form with tables of emission data, emission factors, activity data and other indicators.

As the original IPCC methodology was completely unsatisfactory from a technical standpoint, the handbook "Good Practice Principles" came into effect, based especially on the requirement of increasing the quality of calculations and description of the degree of "uncertainty" associated with the preparation of inventories. It is intended to ensure that the calculated emissions are not over-estimated or under-estimated and that the uncertainty in emission determinations is minimal. It also constitutes an instruction for ensuring the transparency of inventories, the consistency of time series, the completeness of the evaluated emission sources and sinks, the accessibility of the requested documents to ensure mutual comparability of the national inventories, and the verifiability and effectiveness of use of the expended financial means. The handbook takes into account sectoral aspects, reflecting the specific features of the individual categories of sources and general methodological aspects, related particularly to determination of uncertainty, choice of optimum strategy and provision for adequate control mechanisms. For sectoral aspects, it is necessary to determine an unambiguous algorithm that, in the given sector, enables maximum consideration of local conditions in choice of the method or level, optimum procedure in choice of emission factors, inclusion of all emission sources and sinks, ensuring time series consistency and uncertainty determination. The methodological aspects contribute, in particular, to quantification of uncertainties during the inventory preparation, based on rules and reporting guidelines in the given sectors and rules for the inventory review process.

Methodological provisions for time series consistency are also an important aspect. If the method employed is corrected, it is usually necessary to also recalculate historical values. Recalculation must also be carried out if an error is found in the original calculations or in the use of inappropriate methods. The inventories that have been carried out to date in CR are based primarily on the methodology of 1997 and are now being gradually recalculated. One of

the obligations is to complete time series recalculations by 2005 [26].

Emissions are evaluated according to the individual gases and summarily through use of total or aggregate GHGs emissions[27], which is subject of the review process according to the Protocol. They are expressed as the equivalent amount of CO_2 with the same radiation absorption effect as the sum of the individual gases.

Relatively less attention is devoted in the preparation of the inventory to emissions of precursors (NO_X, CO, NMVOC and SO_2), whose control is the subject of the Convention on Long-range Transboundary Air Pollution (CLRTAP). The corresponding data from the CLRTAP database are converted into categories according to the IPCC methodology, which differs slightly from the CLRTAP categories.

5.1.1. Key Sources

From a practical perspective, identification of key sources is highly important; these are sources that significantly participate in total emissions or contribute to an error in their determination to a decisive degree at a national level. Substantially greater attention is devoted during the inventory preparation to key sources and their categories than to other sources or categories. Key sources are sources that usually contribute up to 95 % of total emissions in the level or trend. This procedure is illustrated in Tab. 5.1 (determination on the basis of emission levels) and Tab. 5.2 (determination on the basis of trend analyses), prepared on the basis of analysis of 2001[28].

Tab. 5.1 Choice of key sources based on total emission levels for 2001

Source (category of sources)	gas	emissions [Gg]	share [%]	cumulative [%]
Energy: *stationary combustion of solid fuels*	CO_2	85 143	57.7	57.7
Energy: *stationary combustion of gas*	CO_2	17 884	12.1	69.8
The energy industry: mobile sources - *road transport*	CO_2	10 344	7.0	76.8
The energy industry: *stationary combustion of liquid fuels*	CO_2	9 909	6.7	83.5
Energy: *fugitive emissions from coal mining*	CH_4	5 019	3.4	86.9
Agriculture: *direct emissions from the soil*	N_2O	2 868	1.9	88.9
Industry: *decarbonisation of mineral products*	CO_2	2 251	1.5	90.4
Agriculture: *indirect emissions*	N_2O	1 863	1.3	91.7
Agriculture: *enteric fermentation*	CH_4	1 701	1.2	92.8
Wastes: *landfills*	CH_4	1 596	1.1	93.9
Energy: *mobile sources - off-road incl. water*	CO_2	1 461	1.0	94.9
Industrial: *nitric acid*	N_2O	1 128	0.8	95.7

Source: CHMI

On the basis of emission levels, 12 key sources were determined and, on the basis of trend analysis, this was extended to include emissions of substances containing fluorine (HFCs, PFCs and SF_6), which have exhibited an increasing trend in recent years in CR, in contrast to the overall trend in GHGs emissions.

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[26] Emission inventories have already been carried out for 1999 - 2001 in CR according to these principles; identification of key sources has also been carried out since 2000.

[27] The sum of the emissions of the individual gases multiplied by the relevant conversion coefficients (the global-warming potential for a time period of 100 years), indicating how much more efficient the gas is in absorbing thermal radiation than CO_2 (1 for CO_2, 21 for CH_4 and 310 for N_2O). The values for F-gases, containing fluorine, are 2-4 orders of magnitude larger than for these basic gases.

[28] The differences in the individual years are minimal and do not affect the choice of key sources.

Tab. 5.2 Choice of key sources based on trend analysis for 2001

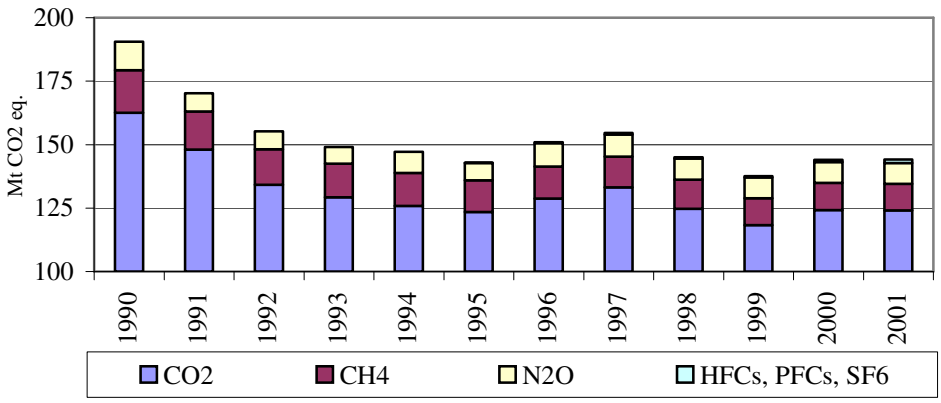
Source (category of sources)	gas	1990 emissions [Gg]	2000 emissions [Gg]	share [%]	cumulative [%]
Energy: *stationary combustion of solid fuels*	CO_2	124 441	85 143	32.8	32.8
Energy: *stationary combustion of gas*	CO_2	12 933	17 884	25.2	57.9
Energy: *mobile sources - road transport*	CO_2	5 995	10 344	18.2	76.1
Energy: *stationary combustion of liquid fuels*	CO_2	14 407	9 909	3.6	79.7
Industrial: *use of F-gases*	HFCs	0	890	2.8	82.5
Energy: *fugitive emissions from coal mining*	CH_4	7 600	5 019	2.6	85.1
Agriculture: *enteric fermentation*	CH_4	3 271	1 701	2.6	87.7
Agriculture: *direct emissions from the soil*	N_2O	4 529	2 868	1.9	89.6
Energy: *stationary combustion of fuels*	CH_4	1 174	362	1.7	91.3
Agriculture: *indirect emissions*	N_2O	3 041	1 863	1.5	92.8
Energy: *mobile sources - road transport*	N_2O	71	508	1.4	94.2
Industrial: *decarbonisation of mineral products*	CO_2	3 380	2 251	1.1	95.3

Source: CHMI

5.2. Inventory of GHGs Emissions and Trends

In 1990, GHGs aggregate emissions equalled 190.5 mil. tons of CO_2 eq. Following commencement of economic transformation, they decreased over four years by approximately 25 % and remained at this level with slight inter-annual variation until 2001, when the total decrease equalled 24.3 % (Tab. 5.3, Fig. 5.1). Net CO_2 emissions exhibited a similar trend, with a decrease of 23.6 % to 2001 from a value of 162.5 mil. tons in 1990. The values for total emissions have included HFCs a PFCs and SF_6 since 1995.

Fig. 5.1 Trend in GHGs emissions in the 1990 to 2001 period



Source: CHMI

The shares of the contents of the individual greenhouse gases changed only insignificantly in the individual years, within the framework of the precision of the calculations. CO_2 predominates with 86.1 %, CH_4 contributes 7.2 %, N_2O 5.8 % and HFCs, PFCs and SF_6 as a whole 0.9 %.

Tab. 5.3 GHGs emission inventories for the 1990 to 2001 period[29]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2 emissions [mil. t]	162.5	148.1	134.2	129.2	125.9	123.4	128.8	133.1	124.7	118.2	124.2	124.1
CH_4 [mil. t CO_2]	16.8	14.9	14.0	13.3	13.0	12.6	12.6	12.1	11.4	10.7	10.7	10.4
N_2O [mil. t CO_2]	11.3	7.3	7.0	6.6	8.3	6.7	9.2	8.8	8.4	8.1	8.2	8.3
HFCs, PFCs, SF_6 [mil. t CO_2]	inventory not carried out					0.2	0.3	0.6	0.5	0.5	0.9	1.3
total CO_2 eq. [mil. t]	190.5	170.3	155.2	149.1	147.2	142.8	150.9	154.6	145.1	137.6	144.0	144.1
relatively [in % of 1990]	100.0	89.4	81.5	78.3	77.3	75.0	79.2	81.2	76.2	72.2	75.6	75.7

Source:CHMI

5.2.1. GHGs Emissions in Selected Sectors

The IPCC methodology works with exactly defined activity sectors. Tab. 5.4 gives the shares of the individual sectors in the overall balance according to situation in 1990 and 2001.

Tab. 5.4 Shares of the sectors in the overall balance of GHGs emissions in 1990 and 2001

Sectors	Shares of the sectors in overall emission balance (%)	
	1990	2001
Energy Industries and Transformation	31.6	41.9
Manufacturing Industries and Construction	31.5	24.5
Transport	3.9	8.8
Commercial/Institutional/Residential	18.7	10.3
Fugitive emissions from solid fuels	4.0	4.0
Fugitive emissions from liquid and gaseous fuels	0.4	0.3
Industrial processes	2.5	4.0
Solvent Use	0.4	0.4
Agriculture and forestry	- 5.5	- 3.0
Waste management	1.6	1.8

Source: CHMI

While the shares of the sector of " Energy Industries and Transformation " (production of electricity and heat in public sources, refineries and other fuel improvement - coke plants, gas works, internal consumption in mining) and of the sector of " Manufacturing Industries and Construction " (including production of heat and electricity in factory sources) were practically equal in 1990 (31.6 % and 31.5 %), the share of energy production equalled 41.9 % and the share of the manufacturing industries decreased to 24.5 % in 2001. A significant change was also recorded in the transport sector, where the fraction of 3.9 % in 1990 increased to 8.8 % in 2001. On the other hand, the share of the Commercial/Institutional/Residential sector decreased from 18.7 % in 1990 to 10.3 % in 2001 and the share of agriculture and forestry also decreased by 2.5 percentage points. There were only slight changes in the other sectors in the evaluated period.

[29] As minor changes have been constantly made in the calculation method in recent years, these values can differ from the values given in previous years and slight changes will probably occur in the future as well. The final form of the time series for each individual country must be completed by January 1, 2007 and must respect all internationally valid methodical procedures. Tab. 5.3 and fig. 5.1 give the recalculated values for 1990, 1994 and the period from1996 on.

5.3. Trend Tables of GHGs Emissions in the 1990 to 2001 Period[30] [31]

Tab. 5.5 Trends in CO_2 emissions

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1994	1996	1997	1998	1999	2000	2001
	(thous. t)							
1. Energy	160 080	127 116	129 592	134 166	124 903	118 038	124 960	122 798
A. Fuel Combustion (Sectoral Approach)	160 080	127 116	129 516	133 925	124 486	117 501	124 420	122 246
1. Energy Industries	59 171	55 768	57 818	59 180	58 706	53 848	60 160	59 538
2. Manufacturing Industries and Construction	59 457	44 199	43 867	43 341	35 376	34 156	36 130	34 879
3. Transport	7 275	7 605	9 896	11 392	10 779	12 016	11 110	12 061
4. Other Sectors	34 177	19 544	17 936	20 013	19 624	17 481	17 019	15 769
5. Other								
B. Fugitive Emissions from Fuels	0	0	76	241	417	537	540	551
1. Solid Fuels		0	76	241	417	537	540	551
2. Oil and Natural Gas								
2. Industrial Processes	**3 380**	**2 772**	**2 479**	**2 498**	**2 661**	**2 362**	**2 251**	**4 524**
A. Mineral Products	3 380	2 772	2 479	2 498	2 661	2 362	2 251	2 000
B. Chemical Industry								
C. Metal Production								2 524
D. Other Production								
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other								
3. Solvent and Other Product Use	**530**	**382**	**352**	**336**	**347**	**336**	**335**	**317**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Enteric Fermentation								
B. Manure Management								
C. Rice Cultivation								
D. Agricultural Soils								
E. Prescribed Burning of Savannas								
F. Field Burning of Agricultural Residues								
G. Other								
5. Land-Use Change and Forestry	**-2 128**	**-4 681**	**-4 486**	**-4 639**	**-3 757**	**-3 401**	**-4 016**	**-4 363**
A. Changes in Forest and Other Woody Biomass Stocks	-2 128	-4 681	-4 486	-4 639	-3 757	-3 401	-4 016	-4 363
B. Forest and Grassland Conversion								
C. Abandonment of Managed Lands								
D. CO_2 Emissions and Removals from Soil								
E. Other								
6. Waste	**0**	**357**	**357**	**357**	**357**	**357**	**357**	**357**
A. Solid Waste Disposal on Land								
B. Waste-water Handling								
C. Waste Incineration		357	357	357	357	357	357	357
D. Other								
7. Other (please specify)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Emissions/Removals with LUCF	**161 862**	**125 945**	**128 294**	**132 718**	**124 511**	**117 692**	**123 886**	**123 633**
Total Emissions without LUCF	**163 990**	**130 626**	**132 780**	**137 357**	**128 268**	**121 093**	**127 902**	**127 996**
Memo Items:								
International Bunkers	**617**	**283**	**459**	**407**	**225**	**539**	**343**	**439**
Aviation	617	283	459	407	225	539	343	439
Marine								
Multilateral Operations								
CO_2 Emissions from Biomass								

[30] Sinks in greenhouse gas emissions are denoted as (-) and emissions as (+).

[31] In subsequent surveys, only information for years recalculated to date are given in CRF format.

Tab. 5.6 Trends in CH_4 emissions

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1994	1996	1997	1998	1999	2000	2001
	(thous. t)							
Total Emissions	**798.26**	**619.44**	**599.72**	**575.50**	**543.83**	**509.10**	**510.21**	**499.30**
1. Energy	**453.38**	**354.48**	**334.63**	**329.72**	**303.75**	**278.68**	**287.18**	**282.07**
A. Fuel Combustion (Sectoral Approach)	59.31	34.92	33.95	31.27	22.51	20.95	19.41	14.06
1. Energy Industries	7.10	6.72	2.57	2.26	2.24	1.66	1.27	0.68
2. Manufacturing Industries and Construction	1.23	1.50	1.03	1.51	1.21	1.28	1.16	0.89
3. Transport	3.07	1.02	3.51	4.29	1.86	1.90	1.92	2.04
4. Other Sectors	47.91	25.69	26.83	23.22	17.19	16.12	15.06	10.46
5. Other								
B. Fugitive Emissions from Fuels	394.07	319.56	300.68	298.45	281.23	257.73	267.77	268.00
1. Solid Fuels	361.90	281.99	268.42	263.47	253.05	228.96	239.00	244.74
2. Oil and Natural Gas	32.17	37.56	32.26	34.98	28.18	28.77	28.77	23.27
2. Industrial Processes	**5.60**	**3.93**	**4.90**	**3.91**	**4.02**	**3.92**	**3.40**	**3.40**
A. Mineral Products		0.01	0.16	0.01	0.00	0.00	0.01	0.01
B. Chemical Industry	0.40	0.39	0.39	0.39	0.39	0.40	0.39	0.39
C. Metal Production	5.20	3.53	4.34	3.51	3.63	3.52	3.00	3.00
D. Other Production	5.60	3.93	4.90	3.91	4.02	3.92	3.40	3.40
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other								
3. Solvent and Other Product Use								
4. Agriculture	**204.19**	**133.97**	**133.83**	**129.11**	**121.13**	**120.50**	**113.76**	**112.92**
A. Enteric Fermentation	155.78	99.09	97.83	92.86	85.83	85.16	81.01	80.89
B. Manure Management	48.41	34.88	35.99	36.25	35.30	35.34	32.75	32.04
C. Rice Cultivation								
D. Agricultural Soils								
E. Prescribed Burning of Savannas								
F. Field Burning of Agricultural Residues								
G. Other								
5. Land-Use Change and Forestry	**2.58**	**1.91**	**2.31**	**2.25**	**2.25**	**2.58**	**2.36**	**2.59**
A. Changes in Forest and Other Woody Biomass Stocks								
B. Forest and Grassland Conversion								
C. Abandonment of Managed Lands								
D. CO_2 Emissions and Removals from Soil								
E. Other	2.58	1.91	2.31	2.25	2.25	2.58	2.36	2.59
6. Waste	**132.51**	**125.15**	**124.06**	**110.51**	**112.70**	**103.42**	**103.51**	**98.32**
A. Solid Waste Disposal on Land	93.20	92.67	95.04	80.87	81.93	75.98	75.98	73.48
B. Waste-water Handling	39.31	32.48	29.02	29.64	30.77	27.43	27.52	24.84
C. Waste Incineration								
D. Other								
7. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo Items:								
International Bunkers	**0.18**	**0.08**	**0.16**	**0.12**	**0.07**	**0.16**	**0.10**	**0.13**
Aviation	0.18	0.08	0.16	0.12	0.07	0.16	0.10	0.13
Marine								
Multilateral Operations								
CO_2 Emissions from Biomass								

Tab. 5.7 Trends in N_2O emissions

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1994	1996	1997	1998	1999	2000	2001
	(tis. t)							
Total Emissions	**36.34**	**26.69**	**29.71**	**28.42**	**27.07**	**26.17**	**26.37**	**26.75**
1. Energy	**4.57**	**3.93**	**4.16**	**4.31**	**4.47**	**4.46**	**4.78**	**4.98**
A. Fuel Combustion (Sectoral Approach)	4.57	3.93	4.16	4.31	4.47	4.46	4.78	4.98
1. Energy Industries	2.08	2.00	1.34	1.29	2.06	1.95	2.16	2.21
2. Manufacturing Industries and Construction	1.27	0.90	0.44	0.43	0.63	0.60	0.65	0.77
3. Transport	0.26	0.56	1.77	1.94	1.41	1.58	1.66	1.75
4. Other Sectors	0.96	0.47	0.61	0.65	0.38	0.33	0.31	0.25
5. Other								
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels								
2. Oil and Natural Gas								
2. Industrial Processes	**3.90**	**3.21**	**3.33**	**3.60**	**3.86**	**3.22**	**3.63**	**3.59**
A. Mineral Products								
B. Chemical Industry	3.90	3.21	3.33	3.60	3.86	3.22	3.63	3.59
C. Metal Production								
D. Other Production								
E. Production of Halocarbons and SF_6								
F. Consumption of Halocarbons and SF_6								
G. Other								
3. Solvent and Other Product Use	**0.66**	**0.69**	**1.00**	**0.60**	**0.71**	**0.69**	**0.69**	**0.69**
4. Agriculture	**26.56**	**18.21**	**20.57**	**19.26**	**17.39**	**17.14**	**16.62**	**16.84**
A. Enteric Fermentation								
B. Manure Management	2.14	1.53	1.55	1.52	1.44	1.44	1.36	1.35
C. Rice Cultivation								
D. Agricultural Soils	24.41	16.68	19.02	17.73	15.95	15.70	15.26	15.49
E. Prescribed Burning of Savannas								
F. Field Burning of Agricultural Residues								
G. Other								
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks								
B. Forest and Grassland Conversion								
C. Abandonment of Managed Lands								
D. CO_2 Emissions and Removals from Soil								
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.65**	**0.65**	**0.65**	**0.65**	**0.65**	**0.65**	**0.65**	**0.64**
A. Solid Waste Disposal on Land								
B. Waste-water Handling	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.64
C. Waste Incineration								
D. Other								
7. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo Items:								
International Bunkers	**0.02**	**0.01**	**0.00**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**
Aviation	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Marine								
Multilateral Operations								
CO_2 Emissions from Biomass								

Tab. 5.8 Trends in emissions of HFCs, PFCs and SF_6

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1995	1996	1997	1998	1999	2000	2001	GWP
Emissions of HFCs CO_2 equivalent (Gg) [32]	**2.21**	**134.51**	**295.62**	**381.78**	**411.87**	**674.32**	**1 045.17**	
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11700
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	650
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1300
HFC-125	0.00	0.00	0.00	0.00	0.03	0.05	0.06	2800
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1000
HFC-134a	0.00	0.10	0.23	0.29	0.14	0.26	0.44	1300
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	140
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	300
HFC-143a	0.00	0.00	0.00	0.00	0.03	0.05	0.07	3800
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2900
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6300
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	560
Emissions of PFCs CO_2 equivalent (Gg) [32]	**0.35**	**4.21**	**7.00**	**9.10**	**2.70**	**9.42**	**14.49**	
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6500
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9200
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7000
C_4F_{10}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7000
c-C_4F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8700
C_5F_{12}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7500
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7400
Emissions of SF_6 CO_2 equivalent (Gg) [32]	**166.82**	**183.07**	**323.13**	**131.69**	**110.85**	**205.90**	**223.20**	23900
SF_6	0.01	0.01	0.01	0.01	0.00	0.01	0.01	

[32] The table contains information on potential emissions; only in the row so designated are data given in thous. t $CO_{2\ eq.}$, the date in the rows for the individual gases are given in thous. t for the actual value of the given gas.

Tab. 5.9 Trends in aggregate GHGs emissions

CATEGORY OF SOURCE	1990	1994	1996	1997	1998	1999	2000	2001
	CO_2 equivalent (Gg)							
Net CO_2 emissions/removals	161 862	125 945	128 294	132 718	124 511	117 692	123 886	123 633
CO_2 emissions (without LUCF)	163 990	130 626	132 780	137 357	128 268	121 093	127 902	127 996
CH_4	16 763	13 008	12 594	12 085	11 421	10 691	10 714	10 485
N_2O	11 266	8 275	9 211	8 811	8 390	8 111	8 175	8 291
HFCs	0	0	135	296	382	412	674	1 045
PFCs	0	0	4	7	9	3	9	14
SF_6	0	0	183	323	132	111	206	223
Total Emissions/Removals with LUCF	**189 891**	**147 228**	**150 421**	**154 240**	**144 844**	**137 020**	**143 665**	**143 692**
Total Emissions without LUCF	**192 019**	**151 909**	**154 907**	**158 879**	**148 602**	**140 421**	**147 681**	**148 056**

CATEGORY OF SOURCES AND SINKS	1990	1994	1996	1997	1998	1999	2000	2001
	CO_2 equivalent (Gg)							
1. Energy	171 018	135 779	137 909	142 428	132 666	125 274	132 472	130 265
2. Industrial Processes	4 708	3 849	3 936	4 323	4 465	3 968	4 336	6 991
3. Solvent and Other Product Use	734	596	662	522	566	551	549	531
4. Agriculture	12 521	8 459	9 188	8 681	7 933	7 844	7 542	7 592
5. Land-Use Change and Forestry	-2 073	-4 641	-4 437	-4 591	-3 710	-3 346	-3 967	-4 308
6. Waste	2 983	3 186	3 163	2 878	2 924	2 729	2 731	2 621
7. Other	0	0	0	0	0	0	0	0

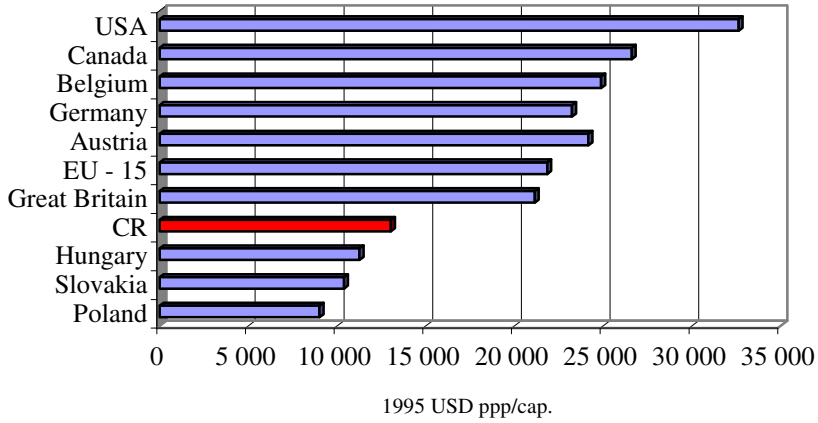
5.4. Comparison of selected indicators

The indicators that provide information on economic performance, production of electrical energy and GHGs emissions include in particular:

- the gross domestic product calculated per inhabitant (GDP/cap.) expressed in USD (1995 ppp[33]),
- the shares of the primary energy sources (%)
- the volume of primary energy sources calculated per inhabitant (PJ/cap.)
- the consumption of primary energy sources per unit GDP (PJ/bil. 1995 USD ppp)
- the amount of greenhouse gases calculated per inhabitant (t CO_2 eq. /cap.)
- the amount of GHGs emissions calculated per unit GDP (kg CO_2 eq. /1995 USD ppp), etc.

The graphs in Figs. 5.2 to 5.9 document the values of some indicators for CR and compare them with selected Annex I Parties.

Fig. 5.2 Magnitude of GDP per cap.in 2000

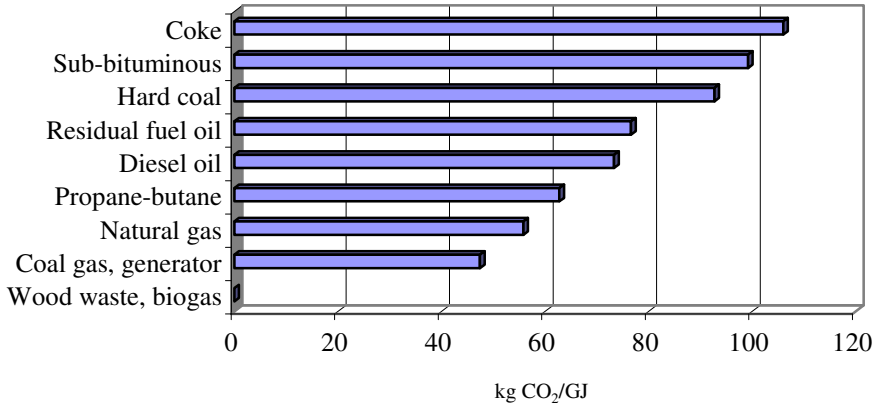


Source: IEA

GDP expresses the sum of total final production of goods and services produced in the particular country during one year and a certain energy and material dependence can be derived from its definition. Its value is dependent on the consumption of raw materials and energy and thus, as a consequence, affects the overall GHGs production. It follows from Fig. 5.2. that, compared with developed countries, the economy of CR has low performance but is nonetheless the highest of the states with transition economies; consequently, CR will be faced with objective reality when emission indicators are calculated per unit GDP production.

[33] ppp - parity purchasing power (an economic indicator that illustrates the relationship between two currencies through comparison of the prices of two consumer baskets in the different currencies). .

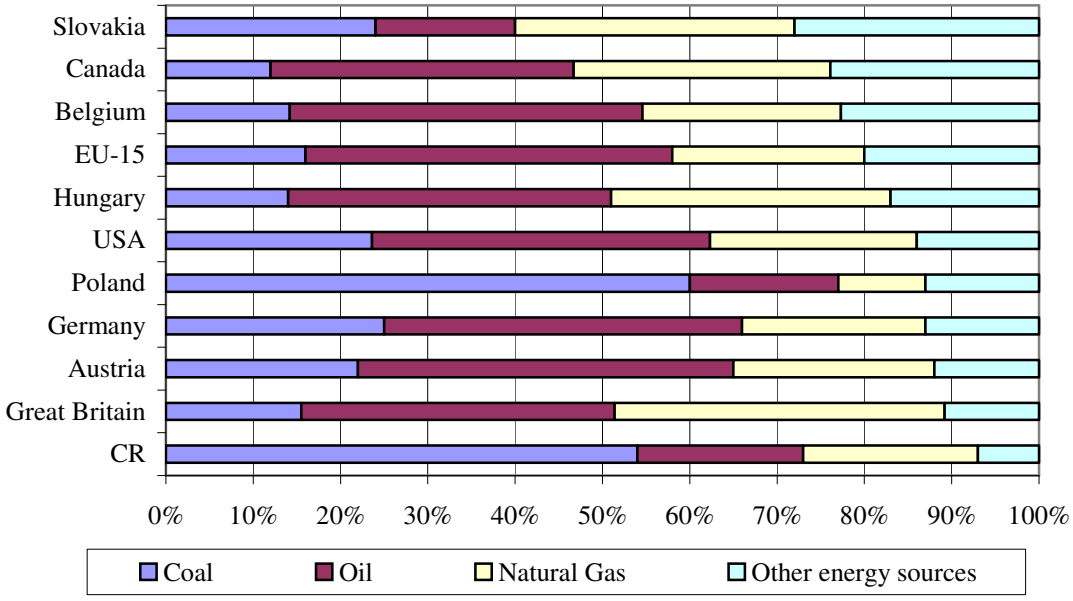
Fig. 5.3 Emission factors



Source: IPCC

GHGs emissions derived from the use of various energy sources differ. The combustion of solid fuels yields more carbon dioxide per unit energy than the combustion of liquid and gaseous fuels. Fig. 5.3 depicts the dependence of the kinds of fuel and emissions per unit of energy produced. The operation of a large group of energy sources does not produce any GHGs emissions (nuclear energy, water energy, combustion of biomass, solar energy, geothermal energy, wind energy and tidal energy, etc.).

Fig. 5.4 Use of primary energy sources in 2000 [34]



Source: IEA

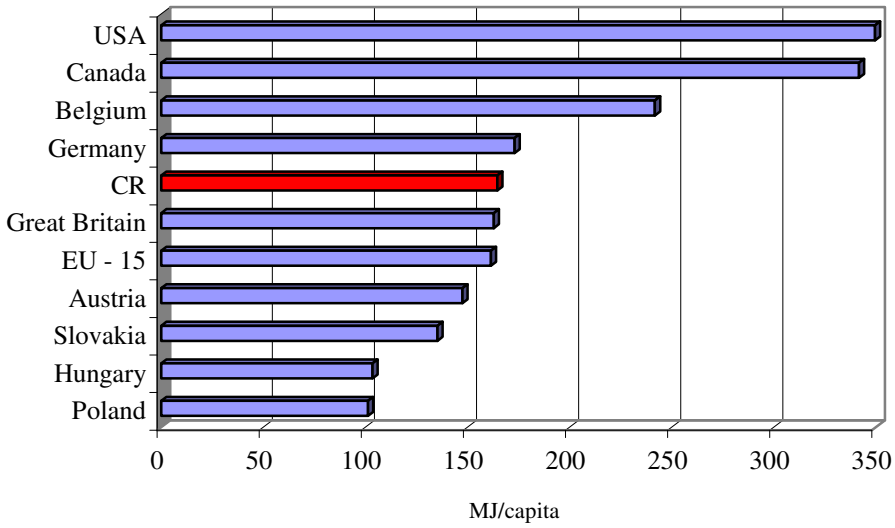
Fig. 5.4 indicates that energy sources in CR are oriented primarily towards coal and other carbonaceous fuels. Conditions are similar, e.g., in Poland, which, however, has a higher fraction of use of black coal (50 %) compared to poorer-quality brown coal (10 %). Consequently, these countries have higher specific CO_2 emissions. It can be estimated on the basis of differences in the structure of primary energy sources in the EU states and in CR and

[34] The category of "other sources" includes nuclear and water energy, use of biomass and other renewable energy sources

taking into account the emission factors for the individual fuels that emissions per unit of energy produced in CR should be approximately 1.3 times higher than in the EU member states. As the amount of primary energy sources per inhabitant is practically identical in EU and CR (Fig. 5.5) CO_2 emissions in CR from combustion processes should also be approximately 1.3 times higher than in the EU states. As combustion processes predominate in total CO_2 emissions on this country (almost 96 %), the average specific emissions of 8.8 t CO_2/cap. for the EU member states should correspond to a value of about 11.4 t CO_2/cap. in CR. However, at the present time, the value in this country is approximately one ton higher. It would be necessary to reduce CO_2 emissions in CR by a further 10 mil. tons to achieve similar specific emissions as those in the average EU state at the present time.

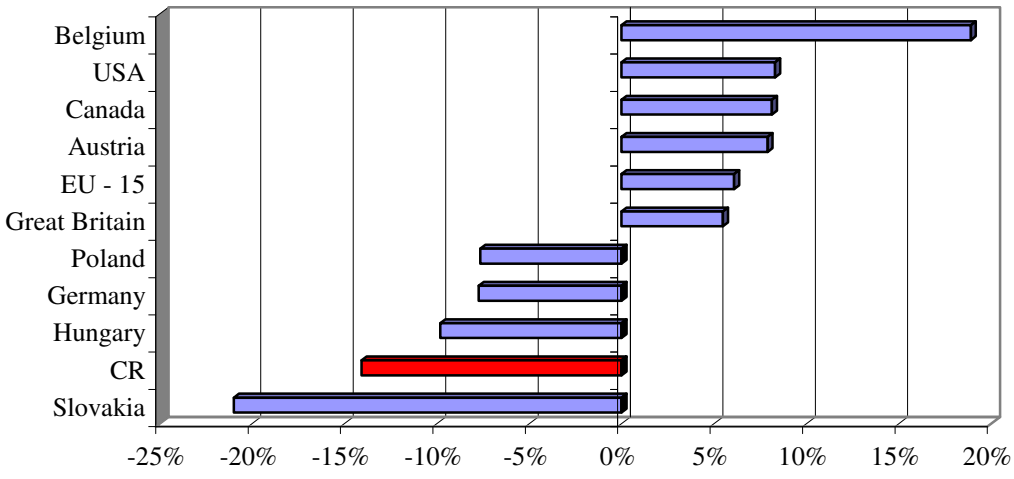
Figs. 5.5 and 5.6 depict energy consumption per inhabitant and the change between 1990 and 2000. In 2000, energy consumption per inhabitant in CR attained the average value in the EU member states as a result of a reduction on consumption by 14 % since 1990.

Fig. 5.5 Consumption of primary energy sources per capita in 2000



Source: IEA

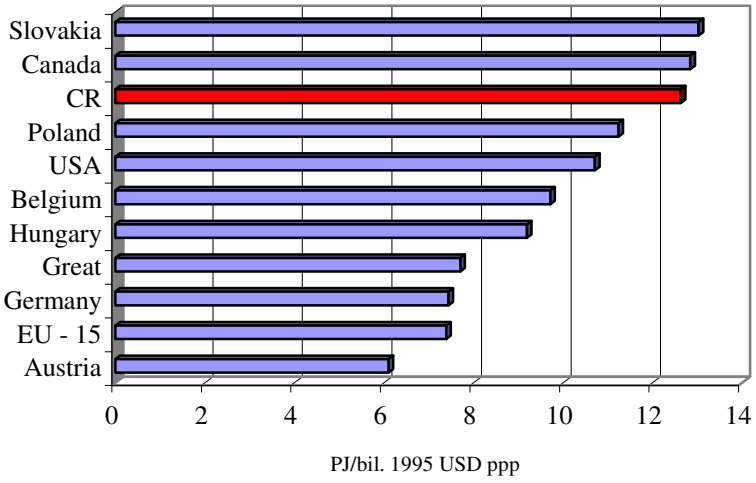
Fig. 5.6 Change in consumption of primary energy sources per capita in the 1990 - 2000 period



Source: IEA

It can be seen from Fig. 5.7 that the energy intensity of creation of GDP is similar in CR and the other countries with a transition economy (and also in USA and Canada); however, the EU member states utilise energy sources more effectively. However, there has been a significant decrease in the values of this indicator in recent years in countries with transition economies.

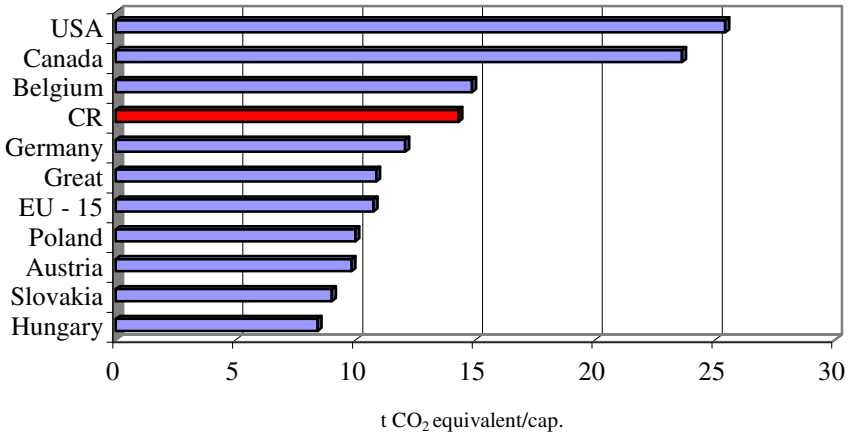
Fig. 5.7 Consumption of primary energy sources per GDP



Source: IEA

Figs. 5.8 a 5.9 document the amounts of total GHGs emissions recalculated per cap. and GDP in 2000. The values of the basic indicators for CR and the EU member states attained in 1990 and 2000 are given in Tab. 5.10.

Fig. 5.8 Amounts of total GHGs emissions calculated per cap. in 2000



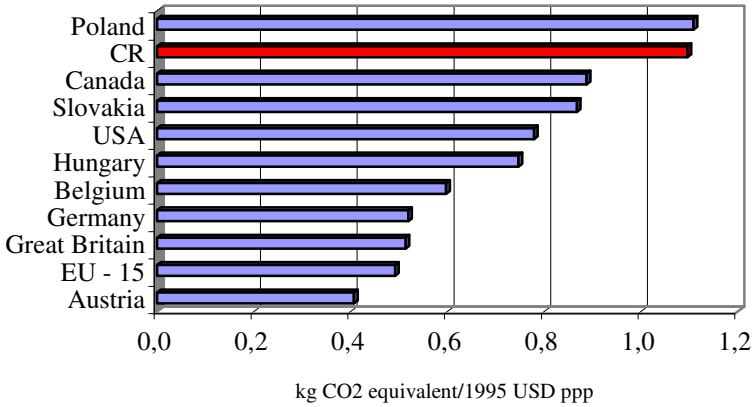
Source: UNFCCC

Tab. 5.10 Comparison of the values of basic indicators in CR and EU in 1990 and 2000[35]

Indicator	ČR		EU	
	1990	**2000**	**1990**	**2000**
t CO_2/cap.	15.83	12.45	9.14	8.78
t CO_2 eq./cap.	18.53	14.29	11.52	10.75
kg CO_2/GDP	1.22	0.96	0.49	0.40
kg CO_2 eq./GDP	1.43	1.10	0.62	0.49

Source: IEA, UNFCCC, CHMI

Fig. 5.9 Greenhouse gas emissions [kg CO_2 eq. / 1995 USD ppp]



Source: UNFCCC

The high GHGs emissions per unit GDP in CR are caused by the high proportion of use of fuels with high carbon contents as primary energy sources and, compared with developed countries, the low GDP per cap. value also plays a role. At the present time, total GHGs emissions calculated per cap. are approximately 1/3 higher than in EU member states and more than twice as high when calculated per GDP.

[35] CO_2 - total carbon dioxide emissions without sinks in the LUCF sector, $CO_{2eq.}$ - total GHGs as emissions, GDP - expressed in 1995 USD ppp

6. GHGs Emission Projections in CR to 2030

This chapter contains information on how GHGs emissions will probably evolve in 2005, 2010, 2015 and 2020. Trends are based on projections prepared in July 2003.

6.1. Construction of projection scenarios and their options

Projections of trends in GHGs emissions were prepared for three conceptually different scenarios of economic and technical developments - high, reference and low - and in accordance with the recommendations of the international methodology[36] in the options "without the effect of measures", "with measures" and "with additional measures". The projection was prepared in three scenarios because, with the still rather unstable and transforming national economies, it is difficult to prepare a sufficiently reliable, unambiguous projection up to the year 2020. The three scenarios provide better potential for orientation in the space delimited by the macroeconomic trends.

The methodology consists of a set of gradual steps from analysis of the emission inventory, through choice of a methodology and model instruments, to carrying out of sensitivity analysis on selected assumptions and their presentation. The results are based on analysis of trends in the economy in 1990 - 2000, scenarios of expected demographic and macroeconomic trends, expectations of the most probable economic growth, estimates of domestic primary energy sources, analysis of estimations of production of electricity and heat and also estimations of expected trends in the sectoral structure of creation of GDP, electrical energy and total energy intensity of creation of GDP, global fuel and energy prices, domestic fuel and energy prices, etc. Estimates of the benefits of the individual implemented and prepared measures were prepared for all three scenarios. In relation to the need to calibrate the EFOM/ENV[37] model, the year 2000 was selected as the initial year for calculation of CO_2, NO_X, SO_2 and CO emissions from combustion processes and partly also from industrial processes. Emissions of N_2O, CH_4, HFCs, PFCs and SF_6 were determined using a simplified model in the table processor with the same base year.

Three macroeconomic scenarios, differing in the rate of growth of GDP and contribution of the individual scenarios to creation of GDP, can be characterised as follows:

- high scenario - assumes a relatively high rate of growth of GDP by more than 4 % annually in the 2000 - 2030 period,
- reference scenario - assumes a rate of growth slightly above a level of 3.5 %, which is a value above the long-term trend in the economy of CR since 1993,
- low scenario - assumes a rate of growth slightly below a level of 3.5 %, which is a value slightly higher than the expected trend in the economies of the EU member states.

Tab. 6.1 gives data on the expected average rates of growth of GDP in five-year cross-sections. As most of the long-term projections for EU as a whole employ a rate of growth of

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[36] *Guidelines for Preparation of National Communications by Parties Included in Annex I to the Convention* (FCCC/CP/1997/7), http://www.unfccc.int

[37] The EFOM/ENV model is linear optimisation model of energy management with special emphasis on modelling energy savings and emissions of substances into the air. It was developed with the assistance of the European Commission and is used in a number of EU member states.

GDP of about 2.5 %, the rates of growth in all three proposed scenarios are above this value. However, only the high and reference scenarios would enable approximation to the economic level in the EU countries at an acceptable rate.

Tab. 6.1 Average inter-annual rate of GDP growth (%) in the individual macroeconomic scenarios

	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030
low scenario	3.11	3.24	3.03	2.93	2.70	2.54
reference scenario	3.55	3.99	3.73	3.65	3.22	3.33
high scenario	3.99	4.76	4.45	4.40	4.20	3.97

Source: EGÚ Brno, a.s., ENVIROS s.r.o.

A similar course is expected for the sectoral structures of GDP to that recorded in the past in the developed countries of Europe - a decrease in the contribution of industry and agriculture and an increase in the sector of services. The scenario with faster rate of growth of GDP assumes a higher rate of restructuring of industry, greater inflow of foreign investments, connected with developmental trends in the construction industry, and faster developments in the sector of services. The target consists in achieving the structure of the economy currently normal in the EU countries in the reference scenario to 2030. A further increase in the contribution of the services sector is expected for the high scenario in accordance with trends in EU, while restructuring of the economy will occur at a slower rate in the low scenario; the contribution of industry in 2030 will be higher than is common in EU member states. The resultant structure of GDP in 2030 is apparent from Tab. 6.2.

Tab. 6.2 Structure of GDP according to the individual macroeconomic scenarios in 2030 (in %)

	Agriculture	Industry and construction	Transport	Services
low scenario	3.7	32.8	7.5	56.0
reference scenario	3.3	29.9	7.3	59.5
high scenario	2.9	26.8	7.8	62.5

Source: EGÚ Brno, a.s., ENVIROS s.r.o.

The structure of GDP in industry sector is characterised by a reduction in energy-intense sectors, especially metallurgy. Machinery production is expected to make a growing contribution, with increasing importance of products with higher added value. Projections of changes in creation of GDP are based, among others, on the analysis of the transformations and structural changes occurring after unification of Germany, where the structure of the economy was similar to that in CR. A greater degree of restructuring of industry is expected in the scenarios with greater growth of GDP.

The creation of scenarios of trends in world fuel and energy prices is based on the assumptions that, at least to the year 2020, there will be no limitation on deposits of sources of fossil fuel production and that, after 2020, there will be partial limitations on sources of petroleum, leading to a gradual increase in prices and replacement by alternative fuels, especially in transport. No prolonged political or military conflicts are expected, that would lead to an increase in the prices of energy over a period of longer than a few months. There will be increased demand for natural gas and its prices will increase faster; there could be reduced demand for coal, leading to a slower increase in its prices. Current trends in cheap electrical energy are mostly based on old stocks of coal, which will be taken out of use in 2010 and where the price is based only on variable costs. New energy sources will have to meet strict environmental limits and thus the price of energy will be much higher.

The prices of domestic energy sources are based on the costs of their acquisition and will be affected by the position of the particular fuel in the market compared to competitive energy sources. Solid fuel, especially brown coal, will continue to be a decisive domestic primary energy source. These sources will depend on the binding nature of territorial environmental limits on brown coal mining. The scenarios do not include any increase in these limits. Substantial developments are expected in the development of technology for obtaining, converting, transport and use of energy sources. The use of solid fuels for the production of electrical energy will emphasise sources with supercritical steam parameters and fluid-bed technologies with much higher efficiency. For combined production of electrical energy and heat, an improvement in technology will permit the construction of sources much closer to the heat consumer, including small sources based on micro-turbines and fuel cells. As concerns nuclear energy use, it can be expected that a new generation of flexible reactors based on fission reactions will be available after 2010, which would be suitable for effective use in the energy-production systems of smaller countries; it is not expected that a reactor employing fusion would be available in CR before 2030. For motor fuels, in addition to a further reduction in specific consumption, it is expected that the use of alternative fuels will be gradually introduced, which will, amongst other things, be facilitated by the use of fuel cells in driving systems. In the area of renewable energy sources, the main trend will consist in a further reduction in specific investment costs for all sources, which will further improve their competitiveness compared with classical sources.

The following assumptions have been used for all the scenarios:

- the Temelín nuclear power plant will remain in normal operation for the whole monitored period,
- the Dukovany nuclear power plant will be reconstructed to prolong its lifetime and will be in normal operation for the whole monitored period,
- from 2004, there will be no limits on imports of petroleum, gas and black coal,
- imports of electricity will be a maximum of 10 TWh annually to 2010 to ensure stability and the ability to regulate the electrification system and, in the subsequent years, the balance of imports and exports of electricity will not exceed 5 TWh (attempts will be made to not increase dependence on energy imports through imports and not to increase local emissions of pollutants and GHGs through production of electricity for export),
- the environmental limits for brown-coal mining will remain valid.

For all the scenarios as in par. 6.1 to 6.4 holds that the construction of new nuclear plants is not expected.

The option "without measures" is considered to be the situation without the impact of the legislation on air protection and without intensive conversion to gas in 1995 - 1999.

After 1995, work was commenced on implementation of a number of measures and programs, which contributed to reducing GHGs emissions (e.g. the State Program of the Czech Energy Agency and the State Environmental Fund, the effective lighting program, programs in the area of transport, the use of alternative automotive fuels and programs to promote afforestation, etc.). This option also includes the Act on protection of the air, No. 86/2002 Coll., on wastes, No. 185/2001 Coll., and on packaging No. 477/2001, which came into force in 2002, and on integrated pollution prevention and control, No. 76/2002 Coll., which came into force in 2003. The set of these legislative measures was included in the "with measures" options.

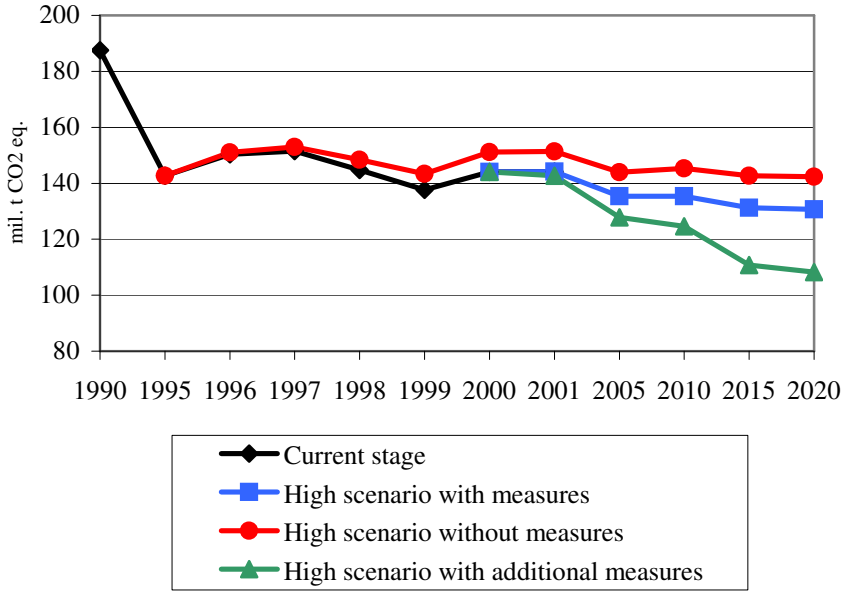
The option "with additional measures", which should most contribute to reducing GHGs emissions, entails the National Program for sound energy management and use of renewable

and secondary energy sources, which follows from implementation of the Act on energy management, No. 406/2000 Coll., the introduction of environmental tax reform and increased promotion of economically effective renewable energy sources.

6.2. Projections of GHGs emissions to 2020

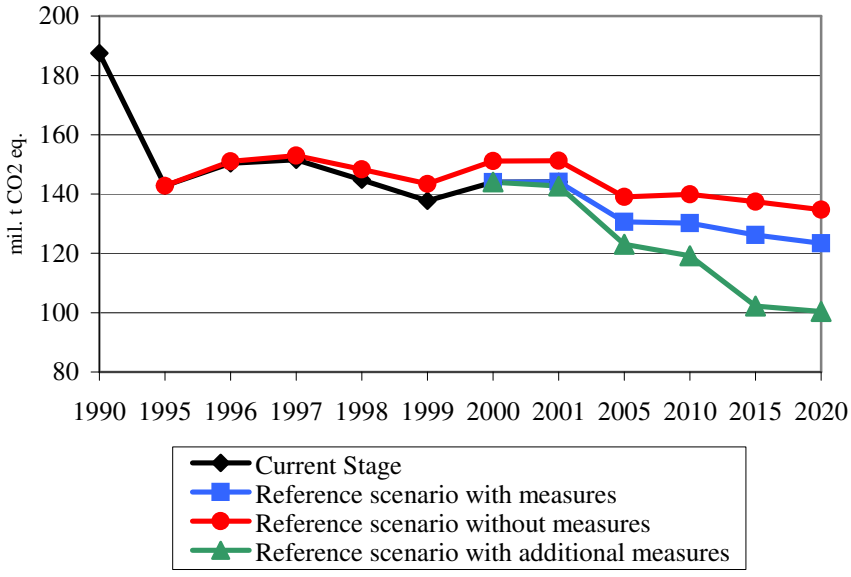
Figs. 6.1 to 6.3 depict projections of GHGs emissions for three scenarios and three options of inclusion of measures. It follows from comparison that, for the 2005 - 2020 period, the low scenario of economic development yields values of total GHGs emissions that are 2-5 % lower and the high scenario yields values that are 3.5 – 6 % higher than the reference scenario.

Fig. 6.1 Projections of GHGs emissions to 2020 (high scenario)



Source: CHMI, ENVIROS s.r.o.

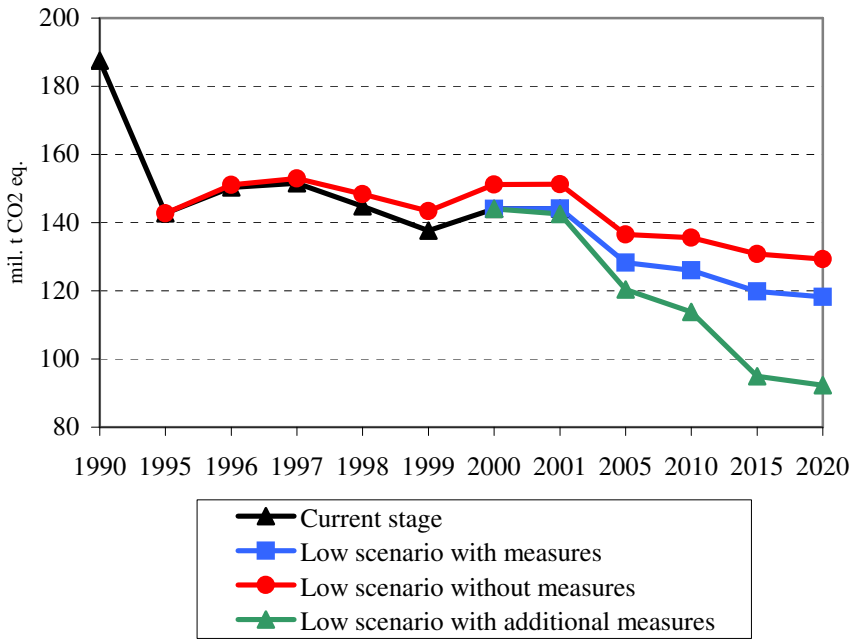
Fig. 6.2 Projections of GHGs emissions to 2020 (reference scenario)



Source: CHMI, ENVIROS s.r.o.

Approximation to the economic level of the EU member states at a reasonable rate is ensured by only the high and reference scenarios and thus further discussion will be based only on the reference scenario and forecasted emission trends will be termed expected trends in GHGs emissions. This scenario assumes a rate of growth of GDP slightly above a level of 3.5 %, which is a value above the long-term trend in the economy of CR since its founding. Tabs. 6.1 and 6.2 give the values for probable trends in GHGs emissions to 2020 assuming that there will be / will not be implementation of additional measures to reduce emissions. Fig. 6.4 gives a graphical depiction.

Fig. 6.3 Projections of GHGs emissions to 2020 (low scenario)



Source: CHMI, ENVIROS s.r.o.

Tab. 6.3 Expected trends in GHGs emissions to 2020, if additional measures are not implemented

	1990	***2000***	**2005**	**2010**	**2015**	**2020**
CO_2 [mil. t]	*162.5*	*124.2*	112.5	112.2	109.4	106.8
CH_4 [mil. t]	*16.8*	*10.7*	9.9	9.5	8.4	8.0
N_2O [mil. t]	*11.3*	*8.2*	7.9	8.0	7.9	7.8
HFCs, PFCs, SF_6 [mil. t]	*0.2*[38]	*0.9*	0.7	0.8	1.0	1.1
Total CO_2 eq. [mil. t]	*190.5*	*144.0*	131.0	130.5	126.6	123.8

Source: CHMI, ENVIROS s.r.o.

Tab. 6.4 Expected trends in GHGs emissions to 2020, if additional measures are implemented

	1990	***2000***	**2005**	**2010**	**2015**	**2020**
CO_2 [mil. t]	*162.5*	*124.2*	104.9	101.2	85.4	83.9
CH_4 [mil. t]	*16.8*	*10.7*	9.9	9.5	8.4	8.0
N_2O [mil. t]	*11.3*	*8.2*	7.9	8.0	7.9	7.8
HFCs, PFCs, SF_6 [mil. t]	*0.2*[39]	*0.9*	0.7	0.8	1.0	1.1
Total CO_2 eq. [mil. t]	*190.5*	*144.0*	123.5	119.5	102.6	100.9

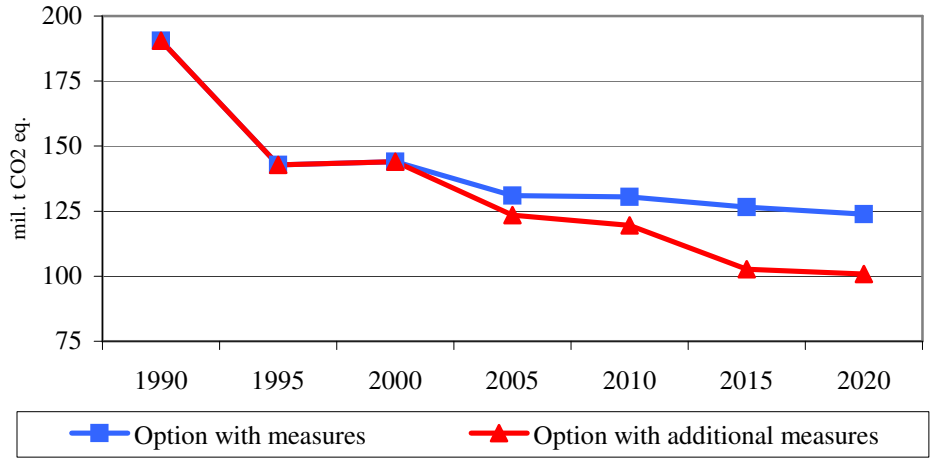
Source: CHMI, ENVIROS s.r.o.

[38] Data for 1995

[39] Data for 1995

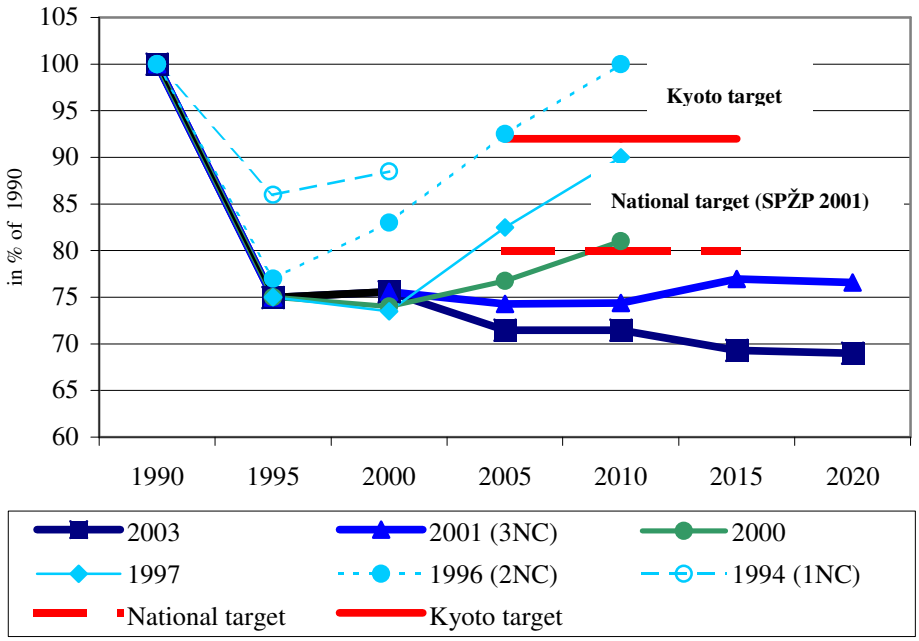
Fig. 6.5 describes uncertainties connected with preparation of the projections, and compares the individual projectionsregularly prepared in 1994 to 2003 using comparable methodologies. It follows from comparison of the high scenarios with measures, amongst other things, that projections of macroeconomic developments in the past tended to be optimistically over-evaluated, similarly as expected demand for energy was also over-evaluated. This was always reflected in over-estimation of the amount of maximum projected GHGs emissions.

Fig. 6.4 Expected trends in GHGs emissions to 2020



Source: CHMI,, ENVIROS s.r.o.

Fig. 6.5 Differences in projections of GHGs emissions prepared in 1994 to 2003[40]



Source: CHMI

[40] Results of the projections for the "high scenario"; the definition of the "high scenario" differed for the individual projections.

6.3. Sectoral Emission Projections for the Individual Gases

6.3.1. Emission Projections for the Individual GHGs

Expected trends in emissions of the individual GHGs to 2020 for the options "with measures" and "with additional measures" are apparent from Tab. 6.3 and Tab. 6.4; expected changes relative to the base year of the Protocol (1990 for basic gases, 1995 for F-gases) can be seen from Tab. 6.5.

Tab. 6.5 Expected changes in GHGs emissions to 2020 relative to the base year of the Protocol (1990)

	2005	2010	2015	2020
with measures				
CO_2 eq. (%)	***-31***	***-31***	***-33***	***-35***
CO_2 (%)	-31	-31	-32	-34
CH_4 (%)	-41	-43	-50	-52
N_2O (%)	-30	-30	-30	-31
HFCs, PFCs, SF_6 (%)	252	319	385	472
with additional measures				
CO_2 eq. (%)	***-35***	***-37***	***-46***	***-47***
CO_2 (%)	-35	-37	-47	-48
CH_4 (%)	-41	-43	-50	-52
N_2O (%)	-30	-30	-30	-31
HFCs, PFCs, SF_6 (%)	252	319	385	472

Source: ENVIROS s.r.o.

Tab. 6.6 Expected trends in the contributions of the individual GHGs to the overall balance

	2005	2010	2015	2020
with measures				
CO_2 (%)	85.9	86.0	86.4	86.3
CH_4 (%)	7.5	7.3	6.6	6.5
N_2O (%)	6.1	6.1	6.2	6.3
HFCs, PFCs, SF_6 (%)	0.5	0.6	0.8	0.9
with additional measures				
CO_2 (%)	85.0	84.7	83.2	83.2
CH_4 (%)	8.0	8.0	8.2	7.9
N_2O (%)	6.4	6.7	7.7	7.8
HFCs, PFCs, SF_6 (%)	0.6	0.7	0.9	1.1

Source: ENVIROS s.r.o.

6.3.2. GHGs Emission Projections for the individual sectors

A reduction in total GHGs emissions can be expected, corresponding especially to the degree of reduction of emissions of carbon dioxide; methane emissions will decrease faster and emissions of nitrous oxide will remain more or less constant.

Tab. 6.7 Trends in total GHGs emissions to 2020 (change in % compared to 1990)[41]

	2005	2010	2015	2020
Energy industries	-13	-13	-19	-18
Manufacturing Industries and Construction	-48	-50	-46	-48
Transport	+60	+62	+55	+54
Commercial/Institutional/Residential	-47	-47	-49	-56
Fugitive emissions from solid fuels	-35	-41	-50	-56
Fugitive emissions from liquid and gaseous fuels	-40	-40	-40	-6
Industrial processes	-24	-19	-17	-14
Solvent Use	-25	-25	-25	-25
Agriculture, Forestry	-66	-66	-67	-68
Waste	-6	-3	-11	-12

Source: ENVIROS s.r.o.

Emissions of HFCs, PFCs and SF_6 will increase slightly; nonetheless, the contribution of these substances to the overall balance of emissions in 2020 should not exceed 1.1 - 1.2 % of total emissions. For the option with additional measures, there will be a reduction of the contribution of CO_2 to the overall balance and an increase in the contributions of CH_4, N_2O and F-gases, in accordance with expected changes in EU member states. Tab. 6.7 gives the changes in total GHGs emissions to 2020 in percentage compared with the 1990 level for the reference scenario without measures.

6.4. Comparison of Expected Trends in Emissions Compared to 2000

Tab. 6.8 gives a comparison of GHGs emission projections with situation in 2000 for the reference scenario and the options "with measures" and "with additional measures". The values indicate that in case of the option "with additional measures", a reduction in total aggregate GHGs emissions in CR of up to 30 % can be expected in the 2000 - 2020 period and of "net" CO_2 by up to 32 %; as a consequence of existing measures, CH_4 emissions may decrease by up to one third of the 2000 value, while N_2O emissions will remain practically at the present value (reduction by a maximum of 4 %) and emissions of F-gases will increase by almost one third.

Tab. 6.8 Expected changes in GHGs emissions to 2020 relative to 2000

	2005	2010	2015	2020
with measures				
CO_2 eq. (%)	***-9***	***-9***	***-12***	***-14***
CO_2 (%)	-9	-10	-12	-14
CH_4 (%)	-8	-11	-22	-25
N_2O (%)	-3	-3	-4	-4
HFCs, PFCs, SF_6 (%)	-21	-6	9	29
with additional measures				
CO_2 eq. (%)	***-14***	***-17***	***-29***	***-30***
CO_2 (%)	-16	-19	-31	-32
CH_4 (%)	-8	-11	-22	-25
N_2O (%)	-3	-3	-4	-4
HFCs, PFCs, SF_6 (%)	-21	-6	9	29

Source: ENVIROS s.r.o.

[41] without F-gases

6.5. Impact of the nuclear scenario on future trends in GHGs emissions

Projections for the nuclear scenario were prepared as a simulation example. In addition to the assumptions set forth in par. 6.1, this scenario also simulates the effect of the construction of new nuclear power plants after 2015. Tab. 6.9 indicates expected trends in emissions (reference scenario) assuming implementation of additional measures and the nuclear energy scenario. If these results are compared with Tab. 6.4, it can be seen that the impact of the nuclear scenario on reducing GHGs emissions will be manifested at the earliest in 2020 in a minimum reduction in total aggregate emissions by 0.3 mil. t CO_2 eq., but will have a favourable trend in 2025 and 2030 in accordance with the gradual bringing of nuclear power plants into operation and with shutting down of end-of-life coal-burning power plants.

Tab. 6.9 Comparison of the impact of the nuclear and non-nuclear scenarios on estimation of the expected trends in GHGs emissions to 2030, if additional measures are implemented (in mil. t CO_2 eq.)

	2000	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
non-nuclear scenario	*144.0*	123.5	119.5	102.6	100.9	99.1	90.8
nuclear scenario	*144.0*	123.5	119.5	102.6	100.6	90.7	83.8

Source: CHMI, ENVIROS s.r.o.

The values for 2025 and 2030 in Tab. 6.7 can be taken only as a very rough estimate; nonetheless, they document that, in 2030, the nuclear scenario could contribute to reduction of GHGs emissions by approx. 7 to 8 mil. t CO_2 eq., which would mean a reduction in total GHGs emissions by more than 55 % compared to the 1990 level.

6.6. Overview of GHGs emission projections to 2020[42] [43]

Tab. 6.10 CO_2 emission projections - high scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(thous. t CO_2)			
Total Emissions	**116 212**	**116 744**	**113 255**	**112 842**
1. Energy	**117 255**	**117 578**	**113 758**	**113 039**
A. Fuel Combustion				
- (Sectoral Approach)	***116 701***	***117 045***	***113 306***	***112 666***
1. Energy Industries	52 884	54 449	47 016	45 556
2. Manufacturing Industries and Construction	33 626	31 077	35 131	35 931
3. Transport	11 685	12 155	11 849	11 884
4. Other Sectors	18 506	19 364	19 309	19 295
B. Fugitive Emissions from Fuels	***554***	***533***	***453***	***373***
1. Solid Fuels	554	533	453	373
2. Oil and Natural Gas	0	0	0	0
2. Industrial Processes	**2 659**	**2 904**	**3 065**	**3 208**
A. Mineral Products	2 659	2 904	3 065	3 208
B. Chemical Industry				
C. Metal Production				
D. Other Production				
3. Solvent and Other Product Use	**335**	**335**	**335**	**335**
4. Agriculture				
A. Enteric Fermentation				
B. Manure Management				
D. Agricultural Soils				
5. Land-Use Change and Forestry	**-4 529**	**-4 702**	**-4 881**	**-5 066**
6. Waste	**493**	**628**	**977**	**1 326**
A. Solid Waste Disposal on Land				
B. Waste-water Handling				
C. Waste Incineration	493	628	977	1 326
International Bunkers	**523**	**549**	**576**	**605**
Aviation	523	549	576	605

[42] scenario with measures

[43] CO_2 emissions from production and processing of iron and steel are included in sector 1A2; CO_2 emissions from fuel combustion are based on the sectoral approach.

Tab. 6.11 CO_2 emission projections - reference scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(thous. t CO_2)			
Total Emissions	**111 576**	**111 259**	**108 357**	**105 763**
1. Energy	**112 974**	**112 445**	**109 296**	**106 455**
A. Fuel Combustion				
- (Sectoral Approach)	*112 419*	*111 912*	*108 843*	*106 079*
1. Energy Industries	51 322	51 770	47 767	48 447
2. Manufacturing Industries and Construction	31 232	30 022	32 235	31 088
3. Transport	11 436	11 565	11 084	11 015
4. Other Sectors	18 430	18 555	17 757	15 529
B. Fugitive Emissions from Fuels	*555*	*533*	*453*	*376*
1. Solid Fuels	555	533	453	376
2. Oil and Natural Gas	0	0	0	0
2. Industrial Processes	**2 373**	**2 633**	**2 730**	**2 831**
A. Mineral Products	2 373	2 633	2 730	2 831
B. Chemical Industry				
C. Metal Production				
D. Other Production				
3. Solvent and Other Product Use	**335**	**335**	**335**	**335**
4. Agriculture				
A. Enteric Fermentation				
B. Manure Management				
D. Agricultural Soils				
5. Land-Use Change and Forestry	**-4 529**	**-4 643**	**-4 761**	**-4 881**
6. Waste	**424**	**490**	**757**	**1 024**
A. Solid Waste Disposal on Land				
B. Waste-water Handling				
C. Waste Incineration	**424**	**490**	**757**	**1 024**
International Bunkers	**523**	**549**	**576**	**605**
Aviation	523	549	576	605

Tab. 6.12 CO_2 emission projections - low scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(thous. t CO_2)			
Total Emissions	**109 256**	**107 262**	**102 276**	**100 928**
1. Energy	**110 722**	**108 533**	**103 310**	**101 725**
A. Fuel Combustion				
- (Sectoral Approach)	*110 184*	*107 999*	*102 858*	*101 321*
1. Energy Industries	49 829	52 029	47 106	50 245
2. Manufacturing Industries and Construction	31 094	27 930	30 250	27 609
3. Transport	11 093	10 874	10 232	10 041
4. Other Sectors	18 169	17 167	15 269	13 427
B. Fugitive Emissions from Fuels	*538*	*534*	*453*	*404*
1. Solid Fuels	538	534	453	404
2. Oil and Natural Gas	0	0	0	0
2. Industrial Processes	**2 333**	**2 545**	**2 615**	**2 687**
A. Mineral Products	2 333	2 545	2 615	2 687
B. Chemical Industry				
C. Metal Production				
D. Other Production				
3. Solvent and Other Product Use	**335**	**335**	**335**	**335**
4. Agriculture				
A. Enteric Fermentation				
B. Manure Management				
D. Agricultural Soils				
5. Land-Use Change and Forestry	**-4 529**	**-4 586**	**-4 644**	**-4 702**
6. Waste	**396**	**436**	**660**	**884**
A. Solid Waste Disposal on Land				
B. Waste-water Handling				
C. Waste Incineration	396	436	660	884
International Bunkers	**523**	**549**	**576**	**605**
Aviation	523	549	576	605

Tab. 6.13 CH_4 emission projections - high scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(thous. t CO_2)			
Total Emissions	**472.204**	**435.343**	**400.902**	**385.122**
1. Energy	**245.979**	**203.671**	**191.204**	**187.127**
A. Fuel Combustion				
- (Sectoral Approach)	***16.574***	***16.556***	***15.164***	***14.984***
1. Energy Industries	1.096	1.157	0.978	0.953
2. Manufacturing Industries and Construction	1.042	1.019	1.163	1.198
3. Transport	1.637	1.653	1.600	1.508
4. Other Sectors	12.800	12.727	11.422	11.324
B. Fugitive Emissions from Fuels	***229.405***	***187.114***	***176.040***	***172.143***
1. Solid Fuels	210.181	167.890	156.786	141.994
2. Oil and Natural Gas	19.224	19.224	19.254	30.149
2. Industrial Processes	**3.400**	**3.400**	**3.400**	**3.400**
A. Mineral Products	0.010	0.010	0.010	0.010
B. Chemical Industry	0.390	0.390	0.390	0.390
C. Metal Production	3.000	3.000	3.000	3.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use				
4. Agriculture	**115.417**	**119.264**	**121.408**	**123.521**
A. Enteric Fermentation	82.190	84.929	86.457	87.961
B. Manure Management	33.227	34.335	34.952	35.560
D. Agricultural Soils				
5. Land-Use Change and Forestry	**2.360**	**2.360**	**2.360**	**2.360**
6. Waste	**105.049**	**106.648**	**82.529**	**68.714**
A. Solid Waste Disposal on Land	76.242	76.499	50.975	35.690
B. Waste-water Handling	28.807	30.149	31.554	33.024
C. Waste Incineration				
International Bunkers	**0.154**	**0.162**	**0.170**	**0.179**
Aviation	0.154	0.162	0.170	0.179

Tab. 6.14 CH_4 emission projections - reference scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(tis. t CO_2)			
Total Emissions	**471.112**	**454.528**	**401.288**	**377.290**
1. Energy	**245.378**	**223.877**	**193.179**	**181.493**
A. Fuel Combustion				
- (Sectoral Approach)	***16.413***	***16.300***	***14.851***	***9.350***
1. Energy Industries	1.061	1.094	0.984	1.014
2. Manufacturing Industries and Construction	0.970	1.017	1.073	1.029
3. Transport	1.601	1.567	1.488	1.388
4. Other Sectors	12.781	12.622	11.305	5.918
B. Fugitive Emissions from Fuels	***228.966***	***207.576***	***178.329***	***172.143***
1. Solid Fuels	209.742	188.352	159.074	141.994
2. Oil and Natural Gas	19.224	19.224	19.254	30.149
2. Industrial Processes	**3.400**	**3.400**	**3.400**	**3.400**
A. Mineral Products	0.010	0.010	0.010	0.010
B. Chemical Industry	0.390	0.390	0.390	0.390
C. Metal Production	3.000	3.000	3.000	3.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use				
4. Agriculture	**115.417**	**119.264**	**121.408**	**123.521**
A. Enteric Fermentation	82.190	84.929	86.457	87.961
B. Manure Management	33.227	34.335	34.952	35.560
D. Agricultural Soils				
5. Land-Use Change and Forestry	**2.360**	**2.360**	**2.360**	**2.360**
6. Waste	**104.557**	**105.628**	**80.940**	**66.516**
A. Solid Waste Disposal on Land	76.242	76.499	50.975	35.690
B. Waste-water Handling	28.315	29.129	29.965	30.826
C. Waste Incineration				
International Bunkers	**0.154**	**0.162**	**0.170**	**0.179**
Aviation	0.154	0.162	0.170	0.179

Tab. 6.15 CH_4 emission projections - low scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(tis. t CO_2)			
Total Emissions	**470.118**	**452.369**	**393.996**	**372.588**
1. Energy	**244.641**	**222.243**	**186.695**	**177.893**
A. Fuel Combustion				
- (Sectoral Approach)	***16.267***	***15.741***	***11.372***	***6.251***
1. Energy Industries	1.031	1.106	0.986	1.041
2. Manufacturing Industries and Construction	0.950	0.912	0.989	0.898
3. Transport	1.547	1.463	1.360	1.250
4. Other Sectors	12.739	12.261	8.036	3.063
B. Fugitive Emissions from Fuels	***228.374***	***206.502***	***175.323***	***171.642***
1. Solid Fuels	209.180	187.278	156.069	141.493
2. Oil and Natural Gas	19.194	19.224	19.254	30.149
2. Industrial Processes	**3.400**	**3.400**	**3.400**	**3.400**
A. Mineral Products	0.010	0.010	0.010	0.010
B. Chemical Industry	0.390	0.390	0.390	0.390
C. Metal Production	3.000	3.000	3.000	3.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use				
4. Agriculture	**115.417**	**119.264**	**121.408**	**123.521**
A. Enteric Fermentation	82.190	84.929	86.457	87.961
B. Manure Management	33.227	34.335	34.952	35.560
D. Agricultural Soils				
5. Land-Use Change and Forestry	**2.360**	**2.360**	**2.360**	**2.360**
6. Waste	**104.300**	**105.102**	**80.133**	**65.413**
A. Solid Waste Disposal on Land	76.242	76.499	50.975	35.690
B. Waste-water Handling	28.058	28.603	29.158	29.723
C. Waste Incineration				
International Bunkers	**0.154**	**0.162**	**0.170**	**0.179**
Aviation	0.154	0.162	0.170	0.179

Tab. 6.16 N_2O emission projections - high scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(tis. t CO_2)			
Total Emissions	**27.111**	**27.243**	**26.951**	**26.879**
1. Energy	**4.135**	**4.224**	**3.911**	**3.817**
A. Fuel Combustion				
- (Sectoral Approach)	***4.135***	***4.224***	***3.911***	***3.817***
1. Energy Industries	1.854	1.975	1.615	1.566
2. Manufacturing Industries and Construction	0.594	0.551	0.666	0.701
3. Transport	1.415	1.429	1.383	1.304
4. Other Sectors	0.272	0.270	0.247	0.247
B. Fugitive Emissions from Fuels	***0.000***	***0.000***	***0.000***	***0.000***
1. Solid Fuels				
2. Oil and Natural Gas	0.000	0.000	0.000	0.000
2. Industrial Processes	**3.630**	**3.630**	**3.630**	**3.630**
A. Mineral Products	0.000	0.000	0.000	0.000
B. Chemical Industry	3.630	3.630	3.630	3.630
C. Metal Production	0.000	0.000	0.000	0.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use	**0.692**	**0.692**	**0.692**	**0.692**
4. Agriculture	**18.005**	**18.047**	**18.069**	**18.091**
A. Enteric Fermentation				
B. Manure Management				
D. Agricultural Soils	18.005	18.047	18.069	18.091
5. Land-Use Change and Forestry	**0.002**	**0.002**	**0.002**	**0.002**
6. Waste	0.647	0.647	0.647	0.647
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.647	0.647	0.647	0.647
C. Waste Incineration				
International Bunkers	**0.015**	**0.016**	**0.017**	**0.017**
Aviation	0.015	0.016	0.017	0.017

Tab. 6.17 N_2O emission projections - reference scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(tis. t CO_2)			
Total Emissions	**26.970**	**27.063**	**26.816**	**26.681**
1. Energy	**3.994**	**4.045**	**3.776**	**3.619**
A. Fuel Combustion				
- (Sectoral Approach)	***3.994***	***4.045***	***3.776***	***3.619***
1. Energy Industries	1.784	1.849	1.628	1.687
2. Manufacturing Industries and Construction	0.555	0.574	0.619	0.585
3. Transport	1.384	1.355	1.286	1.200
4. Other Sectors	0.271	0.267	0.243	0.146
B. Fugitive Emissions from Fuels	***0.000***	***0.000***	***0.000***	***0.000***
1. Solid Fuels				
2. Oil and Natural Gas	0.000	0.000	0.000	0.000
2. Industrial Processes	**3.630**	**3.630**	**3.630**	**3.630**
A. Mineral Products	0.000	0.000	0.000	0.000
B. Chemical Industry	3.630	3.630	3.630	3.630
C. Metal Production	0.000	0.000	0.000	0.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use	**0.692**	**0.692**	**0.692**	**0.692**
4. Agriculture	**18.005**	**18.047**	**18.069**	**18.091**
A. Enteric Fermentation				
B. Manure Management	1.379	1.425	1.450	1.476
D. Agricultural Soils	16.627	16.623	16.619	16.615
5. Land-Use Change and Forestry	**0.002**	**0.002**	**0.002**	**0.002**
6. Waste	**0.647**	**0.647**	**0.647**	**0.647**
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.647	0.647	0.647	0.647
C. Waste Incineration				
International Bunkers	**0.015**	**0.016**	**0.017**	**0.017**
Aviation	0.015	0.016	0.017	0.017

Tab. 6.18 N_2O emission projections missions - low scenario

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2010	2015	2020
	(tis. t CO_2)			
Total Emissions	**26.848**	**26.906**	**26.589**	**26.465**
1. Energy	**3.872**	**3.887**	**3.548**	**3.403**
A. Fuel Combustion				
- (Sectoral Approach)	***3.872***	***3.887***	***3.548***	***3.403***
1. Energy Industries	1.725	1.874	1.634	1.741
2. Manufacturing Industries and Construction	0.539	0.492	0.556	0.489
3. Transport	1.338	1.264	1.176	1.080
4. Other Sectors	0.271	0.257	0.182	0.093
B. Fugitive Emissions from Fuels	***0.000***	***0.000***	***0.000***	***0.000***
1. Solid Fuels				
2. Oil and Natural Gas	0.000	0.000	0.000	0.000
2. Industrial Processes	**3.630**	**3.630**	**3.630**	**3.630**
A. Mineral Products	0.000	0.000	0.000	0.000
B. Chemical Industry	3.630	3.630	3.630	3.630
C. Metal Production	0.000	0.000	0.000	0.000
D. Other Production	0.000	0.000	0.000	0.000
3. Solvent and Other Product Use	**0.692**	**0.692**	**0.692**	**0.692**
4. Agriculture	**18.005**	**18.047**	**18.069**	**18.091**
A. Enteric Fermentation				
B. Manure Management	1.379	1.425	1.450	1.476
D. Agricultural Soils	16.627	16.623	16.619	16.615
5. Land-Use Change and Forestry	**0.002**	**0.002**	**0.002**	**0.002**
6. Waste	**0.647**	**0.647**	**0.647**	**0.647**
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.647	0.647	0.647	0.647
C. Waste Incineration				
International Bunkers	**0.015**	**0.016**	**0.017**	**0.017**
Aviation	0.015	0.016	0.017	0.017

Tab. 6.19 HFCs, PFCs and SF_6 emission projections - high scenario

Emissions (thous. t CO_2 eq.)	2005	2010	2015	2020
HFCs	553	650	780	910
PFCs	11	18	21	26
SF_6	170	215	240	287
Total	**734**	**883**	**1 041**	**1 223**

Tab. 6.20 HFCs, PFCs and SF_6 emission projections - reference scenario

Emissions (thous. t CO_2 eq.)	2 005	2 010	2 015	2 020
HFCs	537	618	715	845
PFCs	9	16	20	24
SF_6	158	205	234	276
Total	**703**	**838**	**969**	**1 144**

Tab. 6.21 HFCs, PFCs and SF_6 emission projections - low scenario

Emissions (thous. t CO_2 eq.)	2 005	2 010	2 015	2 020
HFCs	520	585	650	780
PFCs	7	14	18	21
SF_6	145	194	228	264
Total	**672**	**793**	**896**	**1 065**

Tab. 6.22 GHGs emission projections - high scenario

Emissions (thous. t CO_2)	2005	2010	2015	2020
CO_2	116 735	117 293	113 832	113 447
CH_4	472.359	435.505	401.072	385.301
N_2O	27.126	27.259	26.967	26.896
Emissions (thous. t CO_2 eq.)				
CO_2	116 735	117 293	113 832	113 447
CH_4	9 920	9 146	8 423	8 091
N_2O	8 409	8 450	8 360	8 338
HFCs, PFCs, SF_6	734	883	1 041	1 223
Total	**135 797**	**135 771**	**131 655**	**131 100**

Tab. 6.23 GHGs emission projections - reference scenario

Emissions (thous. t CO_2)	2005	2010	2015	2020
CO_2	112 099	111 809	108 933	106 369
CH_4	471.266	454.690	401.458	377.469
N_2O	26.985	27.079	26.833	26.698
Emissions (thous. t CO_2 eq.)				
CO_2	112 099	111 809	108 933	106 369
CH_4	9 897	9 548	8 431	7 927
N_2O	8 365	8 395	8 318	8 276
HFCs, PFCs, SF_6	703	838	969	1 144
Total	**131 064**	**130 589**	**126 650**	**123 716**

Tab. 6.24 GHGs emission projections - low scenario

Emissions (thous. t CO_2)	2005	2010	2015	2020
CO_2	109 779	107 811	102 852	101 534
CH_4	470,272	452,531	394,166	372,766
N_2O	26,863	26,921	26,605	26,482
Emissions (thous. t CO_2 eq.)				
CO_2	109 779	107 811	102 852	101 534
CH_4	9 876	9 503	8 277	7 828
N_2O	8 328	8 346	8 248	8 210
HFCs, PFCs, SF_6	672	793	896	1 065
Total	**128 655**	**126 453**	**120 273**	**118 636**

7. Policies and Measures to Reduce Greenhouse Gas Emissions

A number of policies and measures are being implemented in CR to reduce GHGs emissions. These consist in both framework measures and measures concentrating on a certain aspect or sector. However, the targets and impacts of most measures are usually broader, as it is necessary to reduce the negative impacts on the environment as a whole. The key measures with the greatest expected benefit consist primarily in framework measures related to several sectors:

- Yadopting of a Strategy for Protection of the Climate System of the Earth in CR in 1999 (Government Resolution No. 480/99),
- inclusion of the aspect of climate protection and of the National Program to Abate Climate Change in the Act on the air, No. 86/2002 Coll.,
- adopting of the Energy Act No. 458/2000 Coll. and the Act on energy management, No. 406/2000 Coll.,
- adopting of Act No. 76/2002 Coll., on integrated prevention.

and specific measures:

- implementation of the National Program for Clean Energy Management and Use of Renewable and Secondary Energy Sources,
- introduction of environmental tax reform and
- introduction of advantageous purchase prices for electricity produced from renewable sources.

Measures are classified as measures implemented and prepared, legislative and program, framework (the effect is reflected in several sectors) and specific (effect only in selected sectors). A summary is given in Tab. 7.8.

7.1. Legislative Policies and Measures

7.1.1. Act on Protection of the Air, No. 86/2002 Coll.

The main reason for amendment of the Act on the Air, No. 86/2002 Coll., consisted in harmonisation and transposition of the relevant EU regulations. The existing framework legislation also includes the aspect of protection of the climate system of the Earth, where this phase takes into account especially the requirements of Council Decision 99/296/EC. Even though this consists in authorisation for preparation of binding legislation, CR is amongst the states that are also aware of the need for preparation of legislation for the future.

7.1.2. The Energy Act No. 458/2000 Coll. and the Act on Energy Management No. 406/2000 Coll.

The adopting of the new energy legislation, prepared in the framework of harmonisation of the national legislation with the EU legislation, brought about a fundamental change in the area of production and consumption of energy, and contributes significantly to reduction of GHGs emissions from energy sources. It replaced and extended Act No. 222/1994 Coll., on conditions for operating a business and execution of the state administration in energy sectors (the Energy Act). The Energy Act No. 458/2000 Coll. and the Act on Energy Management

No. 406/2000 Coll. came into force in January 2001. The Acts contain some provisions that are directly connected with the structure and requirements on energy sources and consumption, and thus with related reduction in GHGs production.

The Energy Act No. 458/2000 Coll. establishes the right to preferential access to distribution networks for the operators of installations to utilise renewable energy sources and waste combustion and installations for combined electricity and heat production. Provided that basic technical conditions are met, the operators of distribution networks are obliged to purchase electricity and thermal energy derived from renewable sources and from combined electricity and heat production.

The Act on Energy Management No. 406/2000 Coll. includes the obligation for each region to prepare a territorial energy conception within five years, which will create conditions for sound energy management. The legislation defines and includes the National Program of Clean Energy Management and Use of Renewable and Secondary Sources of Energy. It introduces compulsory measures for increasing the economy of use of energy (e.g. requirements on minimal efficiency of production of electricity and heat for newly constructed sources, maximum losses for newly constructed installations for energy transfer and distribution, minimum technical requirements on specific consumption of heat for heating buildings and energy-consuming appliances), measures to support combined production of heat and electricity, the obligation to affix energy labels on selected energy-consuming appliances and the obligation of subjecting buildings and energy management to energy audits for entities in the public and private commercial sector of the tertiary and production sphere with energy consumption above a set value.

7.1.3. The Act on Integrated Prevention No. 76/2002 Coll.

In connection with preparation for membership in EU, this Act could be considered to constitute a fundamental measure in introduction of EU legislative regulations in the sector of industry and agricultural production, connected with transition to an integrated system of environmental protection. It is intended to ensure maximum possible prevention of industrial pollution of all the components of the environment and thus to ensure full compatibility with Directive 96/61/EC, the related Council Decisions and also the OECD C(96) recommendation. The IPPC regime applies to approximately 850 important enterprises and 1400 installations (energy production 14 %, metal production and processing 20 %, mineral processing 7 %, chemical industry 15 %, waste management 7 % and other installations 37 %). Through this law, enterprises are motivated to introduce the best available techniques (BAT) and issuing of an integrated permit is also based on assessment of energy intensity and the energy-saving characteristics of the installation.

7.1.4. Act on Wastes No. 185/2001 and Act on Packaging No. 477/2001 Coll.

GHGs emissions from the waste management sector (escapes of methane from landfills, waste incineration) can be affected through the manner of waste disposal. Waste separation at the level of the producer can bring considerable benefits, which also affect energy consumption in processing materials from recycled wastes and expands business opportunities. Both laws conform to the requirements of Council Directive 99/31/EC on waste landfills and the requirements of EU regulations on management of packaging wastes. According to the law, the manner of reducing the amount of biodegradable municipal wastes will be established in the binding part of the new waste management plan, where the necessary investment costs and a proposal for their coverage will also be given.

7.2. Systemic Policies and Measures

7.2.1. National Program to Promote Energy Savings and the Use of Renewable Sources of Energy

The newly conceived National Program to Promote Energy Savings and the Use of Renewable Sources of Energy, which was coordinated amongst the sectors, has been repeatedly promulgated in new form since 1999. The program covers all the sectors of the national economy and is related to programs in previous years. Especially the programs of the Ministry of Industry and Trade (MoIT) implemented by the Czech Energy Agency (CEA) (Part A) and programs of the Ministry of the Environment (MoE) implemented by the State Environmental Fund (SEF) (Part B) play a key role here. Further parts of the program are implemented by the Ministry of Agriculture (MoA) and the Ministry for Regional Development (MRD) and other sectors.

The programs of MoIT (CEA) are concerned with introduction of energy-saving measures in the area of production, distribution and consumption of energy, extended use of renewable and secondary energy sources and development of cogeneration production of heat and electricity. Emphasis is placed on introduction of greater efficiency in the use of energy, especially in industry, dissemination of modern technologies and procedures, support for projects with high efficiency of use of financial means, support for consulting, education, enlightenment and promotion of sound use of energy for the general public. The programs of MoIT (CEA) provide support especially in the form of nonreturnable financial subsidies for individual projects. Each year, subprograms are announced to support implementation of energy-saving projects in apartment buildings and family homes, educational facilities, health care, and in buildings of state and public institutions and projects for the use of renewable and secondary energy sources, development of combined production of heat and electricity, preparation of energy audits, financing of energy-saving projects from energy savings, development and use of modern technologies and materials for measures to increase the efficiency of energy use, modernisation of energy production and distribution installations, preparation of energy conceptions for cities and municipalities and optimisation of supply of energy to residential units, energy savings in industry, transport and agriculture and also consulting, education and promotion of sound use of energy.

The programs of MoE (SEF) concentrate mainly on investment projects and projects for the use of economically effective renewable energy sources and also on enlightenment, education and consulting in the area of use of renewable energy sources. Support is based particularly on the environmental effect primarily in areas that do not create sufficient internal sources of funds for implementation of the supported projects (e.g. local governments, budgetary organisations and the general population) through subsidies and soft loans. The amount of assistance provided also corresponds to this specific emphasis and corresponds to two- to three-times the amounts of subsidies provided by CEA.

7.2.2. Programs of the State Environmental Fund of CR

SEF supports measures related to energy savings and protection of the air also outside of the framework of the National Program to Promote Energy Savings and the Use of Renewable Sources of Energy. These consist especially of programs supporting the conversion from solid fuels to cleaner fuel (natural gas) for small and medium sources and support for the use of cogeneration units and development of energy infrastructure in small municipalities.

7.2.3. National Program to Reduce Emissions

7.2.3.1. The Integrated National Program to Reduce Emissions

The Integrated National Program to reduce emissions of particulate matter, sulphur dioxide, nitrogen oxides, volatile organic compounds, ammonia, carbon dioxide, benzene, lead, cadmium. nickel, arsenic, mercury and polycyclic aromatic hydrocarbons is concerned with all pollutants that are regulated in the Czech legislation at a higher level than at the individual air pollution sources, i.e. substances for which emission ceilings or pollution limit levels have been declared. The program is concerned, not only with substances for which the limit values (pollution limit values and emission ceilings) are exceeded but, in accordance with the prevention and precautionary principles, also substances that do not currently exceed the limit values but in an attempt to maintain this favourable state. The program is prepared as an integrated program, both in that it applies to a greater number of pollutants and especially in that practically all the proposed instruments and measures lead to reduction of the emissions of more than one pollutant substance. It is conceived as part of the air protection system, which also includes the National Program to reduce emissions of particulate matter, sulphur dioxide and nitrogen oxides from existing especially large combustion sources, regional and local programs to reduce emissions and regional and local programs to improve air quality. In the framework of this system, it will carry out the following tasks:

- establish priorities at a national level
- at a national level, supplement and modify the framework for formulation and implementation of the other individual programs
- define tasks for bodies of the public administration at a central (national) level and for institutions supporting execution of the public administration.

7.2.3.2. National Program to Reduce Emissions of Particulate Matter, Sulphur Dioxide and Nitrogen Oxides

The National Program to reduce emissions of particulate matter, sulphur dioxide and nitrogen oxides from existing very large combustion sources of air pollution is concerned with reducing emissions of particulate matter, sulphur dioxide and nitrogen oxides from existing very large combustion sources. It is intended to meet the requirements of Directive 2001/80/EC on reducing emissions of some pollutants into the air from large combustion installations, which contains two equivalent regulation mechanisms for existing sources, i.e.

- by January 1, 2008 at the latest, for each existing source, to attain the value of the emission limits for particulate matter, sulphur dioxide and nitrogen oxides laid down for new sources,
- to include existing sources in a national program whose implementation would lead to the same overall reduction of emissions of these substances from the entire group of existing sources, as would be achieved through extensive application of the emission limits for "new" sources, by the given date. The program has been prepared for the time period to 2010, as both the national emission ceilings and all the promulgated pollution limits values must be met by that year (some pollution limit values for protection of health must be met by 2005; pollution limit values for protection of ecosystems and vegetation for sulphur dioxide and nitrogen oxides must already be met at the present time).

In order to ensure interconnection with the National Program to reduce emissions, it is necessary to also take into consideration a number of different characteristics of GHGs (they can be active in the atmosphere for tens to thousands of years and thus have global effect) and

the pollutants that are the subject of National Programs to reduce emissions (they are active for several hours, days, or maximally weeks and thus have local or regional effect). Nonetheless, National Programs to reduce emissions undoubtedly also contribute to reducing GHGs emissions, as both programs overlap in a number of proposed measures (especially in the area of energy savings, combustion processes and transport). National Programs to reduce emissions should come into force at the latest on the date of accession of CR to EU.

7.2.4. Initiative for Energy-Saving Lighting

The initiative for energy-saving lighting is a three-year program prepared by the International Financial Corporation and financed by the Global Environmental Facility for the 2000 - 2003 period. It is intended to reduce GHGs emissions through rapid introduction of energy-saving technologies on the newly formed markets; the overall budget for CR equals 1.25 bil. USD. It is directed mainly towards the public sector, households and public street lighting. The budget is employed to stimulate local private and public sources and the expected direct benefits are estimated as savings of about 390 kt CO_2 in 2002 - 2003 and as indirect benefits in subsequent years at the level of 425 kt CO_2 annually.

7.2.5. Program to Support Reconstruction and Restoration of Panel Buildings

In the framework of its programs, MRD provides support for repair of defects in panel structures, where subsidies are also provided for repair of structural components and their contacts and joints, leading to an improvement in their thermal insulation properties. Support is provided for measures leading to a reduction in consumption of heat for heating buildings through the State Fund for Development of Housing (SFDH), established by MRD. Financial subsidies, contributions towards payment of interest and guarantees for activities connected with repairs and reconstruction of panel apartment buildings are provided in the framework of the program. Economically weaker areas with a worsened environment are preferred in this respect. Assistance is also provided for insulating buildings, improving heating systems, distribution lines and sources of heat and hot utility water and the use of renewable energy sources in buildings, which will have a favourable impact on energy efficiency and thus on GHGs emissions.

7.2.6. Measures in the Transport Sector

The vast majority of measures to reduce GHGs emissions in the transport sector are applied and implemented at regular intervals and were included in the Strategy for Protection of the Climate System of the Earth in CR and in the transport policy of the Ministry of Transport (MoT). Compared to previous years, there has been an increase in the input of financial means for implementation of these measures as the newly established State Fund of Transport Infrastructure has participated significantly in financing measures since 2000. Key measures in the area of transport consist in application of international standards for means of transport in the area of the environment and safety, support for gradual transfer of part of the volume of passenger and freight transport in highway and air transport to rail transport, ROLA and combined transport, support for creation of the relevant infrastructure for development of unmotorised kinds of transport, support for public mass transport, development of its infrastructure and introduction of integrated transport systems, support for improved organisation and regulation of highway transport and support for research, development and use of alternative kinds of vehicle drives and conversion of transport to natural gas. The construction of a dense network of separate cyclist routes as a basis for alternative emission-free daily transport can be considered significant. The vast majority of measures to reduce GHGs emissions in the transport sector are applied and implemented at regular intervals and

were included in the Strategy for Protection of the Climate System of the Earth in CR and in the transport policy of MoT. Compared to previous years, there has been an increase in the input of financial means for implementation of these measures as the newly established State Fund for Transport Infrastructure has participated significantly in financing measures since 2000. Key measures in the area of transport consist in application of international standards for means of transport in the area of the environment and safety, support for gradual transfer of part of the volume of passenger and freight transport in highway and air transport to rail transport, ROLA and combined transport, support for creation of the relevant infrastructure for development of unmotorised kinds of transport, support for public mass transport, development of its infrastructure and introduction of integrated transport systems, support for improved organisation and regulation of highway transport and support for research, development and use of alternative kinds of vehicle drives and conversion of transport to natural gas. The construction of a dense network of separate cyclist routes as a basis for alternative emission-free daily transport can be considered significant.

7.2.7. Support for Afforestation of Unused Agricultural Areas

The measures have an effect in reduction of emissions of CO_2, CH_4 and N_2O (in agriculture) and in increasing the level of sinks for CO_2 through absorption (in forest management). The Strategy of Protection of the Climate System of the Earth in the Czech Republic requires that MoA implement measures related to afforestation of unused agricultural areas, support for maintenance of permanent grasslands, use and production of alternative motor fuels, introduction of new technologies of farming and cultivation methods. MoA provides nonreturnable financial assistance for afforestation of unused agricultural properties, including protection of established forest cultures. Although this is the result of two contradictory processes (afforestation of agricultural land and withdrawal of forest properties for investment construction and extraction of raw materials) the area of forests has increased favourably over the past decade by approx. 5000 ha.

7.2.8. Support for the Production of Alternative Motor Fuels

In the framework of its assistance programs, MA provides assistance for the production of biodiesel fuel and bioethanol through noninvestment, direct nonreturnable subsidies. Support is provided for the production of alternative motor fuels based on processing of crops from domestic agricultural production. The programs will continue in the future through relief from consumer taxes and taking costs into consideration.

7.2.9. Use of Landfill Gas and Biogas from Waste Water Treatment Plants

In recent years, a number of projects have been implemented for removal of gas from waste landfills, not only for new landfills but, in a number of cases, also for old landfills. Of approximately 250 landfills, gas was collected from 12 in 2001 and the biogas was used for energy production in six cases. The technology of utilisation of waste biogas has been implemented for a number of municipal and industrial waste water treatment plants in recent years.

7.3. Prepared Policies and Measures

7.3.1. The National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources

The National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources is included in Act No. 406/2000 Coll., on energy management in Chapter III. In accordance with this wording, the National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources is considered to be a document expressing targets related to reducing energy consumption, the use of renewable and secondary energy sources in accordance with economic and social requirements according to the principles of sustainable development and protection of the environment and is an expression of the commitment of the state to support and co-finance activities contributing to meeting the targets of sustainable development in CR. The program is prepared by MoIT in cooperation with MoE.

Tab. 7.1 Estimation of the maximum reduction of CO_2 emissions on the basis of implementation of the National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources as of 2005 (thous. t)

Reduction in emissions through implementation of			**Total reduction in emissions between 2005 and 2000**
Noninvestment / organisational measures	technical measures implemented without assistance	supported technical measures	
3 560	2 752	2 080	8 392

Source: ENVIROS s.r.o.

The summary analytical material[44] on this program contains enumeration of potential benefits in reducing emissions, including GHGs emissions. As the program is connected with a number of measures that have already been implemented, it is necessary to reduce its benefits by benefits from these measures, with the exception of transport. When it was being prepared, it was assumed that 0.2 % GDP would be available annually for implementation. Because of other priorities and limited financial resources, financing is not provided at the expected level, and thus benefits are substantially lower. Consequently, for preparation of the option "with additional measures", full financing of the National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources is assumed.

Tab. 7.2 Net effect of the National Program for Clean Energy Management and Use of Renewable and Secondary Energy Sources (thous. t)

	2005	**2010**	**2015**	**2020**
Benefit of measures adopted in 1995 (without transport)	1 939	1 978	1 978	1 978
Expected total benefit from the National Program	8 392	8 392	8 392	8 392
Additional expected benefit from the National Program	**6 453**	**6 414**	**6 414**	**6 414**

Source: ENVIROS s.r.o.

[44] *Analysis of the draft for the structure of the National Program for Sound Energy Management and Use of Renewable and Secondary Energy Sources* - collected analytical material forming the basis for work on the National Program for Clean Energy Management and Use of Renewable and Secondary Energy Sources, *SRC International CS, SEVEn, March Consulting, EkoWatt*, June 2001 (report for CEA)

Estimation of the maximum reduction of CO_2 emissions through implementation of the National Program of Clean Energy Management and Use of Renewable and Secondary Energy Sources as of 2005 to the original extent to 2005 is given in Tab. 7.1 and the estimate of the net total effect is given in Tab. 7.2. The benefit of additional measures to the total reduction in emissions is thus estimated for all the scenarios at 6.4 mil. tons of CO_2 over the entire forecast period.

7.3.2. Environmental Tax Reform

Although a Draft EU Directive on environmental taxes was prepared in 1997, this draft has not yet been adopted and the individual member states have chosen their own approaches. In recent years, application has been motivated primarily by the need to meet obligations following from the Protocol. The prepared environmental tax reform has not yet been implemented in CR.

Tab. 7.3 Expected progress of environmental taxes

Product	2003/96/EC (non-bus./bus.)	Rates in CR - per 1000 l		Amendment of the Act on consumer taxes, per 1000 l		
		CZK/ 1000 l	€/ 1000 l	change in rate CZK	new rate CZK	new rate €
Motor fuels						
Unleaded petrol per 1000 l	359	10 840	340	**1 000**	11 840	372
Leaded petrol per 1000 l	421	10 840	340	**2 870**	13 710	431
Diesel fuel per 1000 l (330 € from 2010)	1	8 150	256	**1 800**	9 950	313
Biodiesel fuel	0-302	5 624	177	**1 242**	6 866	216
LPG per 1000 kg	125	2 850	90	**1 083**	3 933	124
- special use	41	2 850	94	**-1 560**	1 290	45
Kerosene per 1000 l (330 € from 2010)	302	10 840	340	**-890**	9 950	313
Compressed gases per 1000 kg	125	0	0	**3 355**	3355	105
- special use	14.4	0	0	**387**	387	12
Heating fuel						
Light heating oil per 1000 l	21	0	0	**660**	660	21
Heavy heating oil, 1 % sulphur/1000 kg	15	0	0	**472**	472	15
Kerosene per 1000 l	0	0	0	**0**	0	0
LPG per 1000 kg	0	0	0	**0**	0	0
Compressed gases per 1000 kg	14.42 / 7.21	0	0	**0**	0	0
Solid energy products (coal) per GJ	0.30 / 0.15	-	-	**-**	-	-
Electricity per MWh	1.0 / 0.5	-	-	**-**	-	-
Waste oils		8 150	256	**0**	0	0

Note: Comparison of rates - CNB exchange rate on Sept. 30, 2003 - 1 EUR = 31.84 CZK

Source: MoE

Tab. 7.4 Expected rate of progress of environmental taxes, in %

Emissions	First 10 years	Remaining period
Natural gas	1.25	2
Black Coal	2.0	3
Brown coal	2.75	4
Electricity from nuclear sources	0.5	1
Petroleum (liquid fuels)	2.0	3

Source: MoE

The target of the draft included in the legislative program of the Government consists in reducing emissions and support for more favourable energy sources and its principle consists in imposing a tax on the prices of fuel and energy, whose amount will be proportional to the amount of CO_2 emitted in production of the energy or combustion of the given fuel. This instrument has similar effects to fees for discharge of emissions into the air. Consequently, the introduction of environmental tax reform should also be connected with at least partial internalisation of external costs. Tabs. 7.3 and 7.4 give the expected progress of environmental taxes. The progress curve is based on implementation of the minimum rate valid in EU in 2004 and an annual increase in taxes by the proposed inter-annual increase in rates in 2005 - 2030.

7.3.3. Advantageous Purchase Prices for Electricity Produced from Renewable Sources

Advantageous purchase prices for electricity produced from renewable sources are a decisive instrument used in CR to support renewable energy sources. The prepared measure introduces a further advantage in these prices compared to current situation and is intended to stimulate purchases of electricity produced from renewable sources and increased use of renewable sources. The impacts of increased purchase prices according to Tab. 7.5. are analysed in the scenario with additional measures.

Tab. 7.5 Expected purchase tariffs for electricity produced from renewable energy sources (CZK/kWh)

	2001	**2004**	**2020**
Wind power plants	3.00	3.00	3.00
Small water power plants	1.50	2.00	2.50
Production of electricity by combustion of residual biomass	2.50	3.50	3.00
Production of electricity by combustion of energy-production plants	2.50	3.50	3.50
Production of electricity by combustion of biogas	2.50	3.50	3.00
Production of electricity using geothermal energy	3.00	6.00	4.00
Production of electricity using solar radiation	6.00	15.00	6.00

Source: ERA price assessment (2001), MoE (2004 and 2020)

The latter two measures are very closely related, as the benefit from environmental taxes should be a source of subsidies for preferential purchase prices. Three model calculations were prepared for each of the scenarios (Chap. 6.1) (implementation of only environmental tax reform, implementation of only increased purchase prices and implementation of both measures simultaneously[45]. As an example of the impact of the synergic effect, Tab. 7.6 gives estimates of savings in CO_2 for the reference scenario and Tab. 7.7 gives the total estimated

[45] The third calculation is necessary because the benefits from the two measures cannot be simply added together because of synergic effects.

savings in CO_2 emissions for simultaneous implementation of environmental tax reform and increased purchase prices for electricity produced from renewable energy sources for each of the three scenarios.

Tab. 7.6 Annual savings in CO_2 emissions in the reference scenario (mil. t)

	2005	2010	2015	2020
Environmental taxes	0	3	8	4
Increased purchase prices	0	4	11	13
Environmental taxes + increased purchase prices	1	5	18	16

Source: ENVIROS s.r.o.

Tab. 7.7 Annual savings in CO_2 emissions for simultaneous implementation of environmental tax reform and increased purchase prices for electricity produced from renewable energy sources (thous. t)

	2005	2010	2015	2020
Low scenario	1 417	5 794	18 480	19 480
Reference scenario	1 111	4 607	17 549	16 518
High scenario	1 057	4 293	14 013	15 994

Source: ENVIROS s.r.o.

Tab. 7.8 gives the values of the fraction of renewable energy sources in domestic consumption of primary energy sources in the reference scenario without introduction of both measures and in the reference scenario with introduction of environmental tax reform and increased purchase prices for electricity produced from renewable energy sources in the period to 2020.

Tab. 7.8 Fraction of renewable sources in domestic consumption of primary energy sources (%)

	2000	2005	2010	2015	2020
Without introduction of both measures	2.6	5.0	7.0	8.0	8.6
With implementation of environmental tax reform	2.6	5.2	8.1	10.7	10.8
With introduction of increased purchase prices	2.6	5.7	9.4	14.0	16.5
With introduction of both measures simultaneously	2.6	5.7	9.5	15.3	17.2

Source: ENVIROS s.r.o.

Overall, it can be stated that:

- Environmental taxes promote the replacement of solid fuels by cleaner fuels, especially renewable energy sources.
- Preferential purchase prices unambiguously lead to an increase in the fraction of renewables both in domestic consumption of primary energy sources and in the production of electricity.
- Application of both measures simultaneously leads to a further reduction in CO_2 emissions, but the effect achieved is less than the sum of the benefits of the two measures implemented independently.
- The two measures should be implemented simultaneously, not only for economic reasons, where revenue from taxes will subsidise preferential purchase prices, but also from the standpoint of the overall reduction in CO_2 emissions achieved.
- Simultaneously, it will be necessary to solve the serious aspect of combustion of coal in local heating units that do not have dust removal and sulphur removal equipment and significantly lower the quality of the lives of individuals in municipalities an in cities. The price of coal for such combustion will have to include at least part of the external costs and it will be necessary to terminate use of this fuel in local heating units as soon as possible.

Tab. 7.9 Survey of measures in the individual sectors

Name of measure	Target and/or affected activity	Affected GHGs	Type of measure	State of affairs	Implementation	Benefit in reducing GHGs emissions (p.a. in CO_2 eq.)			
						1995	2000	2005	2010
Framework (multisectoral) measures									
Strategy of Protection of the Climate System of the Earth in the Czech Republic	provision for meeting obligations following for CR from the Protocol	all GHGs	policy, framework	implemented	Government of CR and designated Ministries	0	n/a	n/a	n/a
Act on Protection of the Air No. 86/2002 Coll.	harmonisation of CR legislation with EU legislation	CO_2	legislative	implemented	MoE and other state administrative bodies in the area of air protection	0	n/a	n/a	n/a
Energy Act No. 458/2000 Coll.	harmonisation of CR legislation with EU legislation	CO_2	legislative	implemented	MoIT and the Energy Regulation Authority	0	n/a	n/a	n/a
Act on Energy Management No. 406/2000 Coll.	harmonisation of CR legislation with EU legislation	CO_2	legislative	implemented	MoIT	0	n/a	n/a	n/a
Sector of energy production and consumption									
National Program to Promote Energy Savings and the Use of Renewable Sources of Energy - Part A (CEA Programs)	reduction of the energy intensity of the economy, savings in energy materials and minimisation of the environmental impact from pollutant emissions and reduction of GHGs emissions	CO_2	economic, information, educational, research	implemented	CEA	150	222	297	336
National Program to Promote Energy Savings and the Use of Renewable Sources of Energy - Party A (CEA Programs) - Part B (SEF Programs)	reduction of the energy intensity of the economy, savings in energy materials and minimisation of the environmental impact from pollutant emissions and reduction of GHGs emissions	CO_2	economic, information, educational, research	implemented	SEF	n/a	73	n/a	n/a
SEF support in the area of air protection	reduction of emissions of pollutants into the air	CO_2	economic	implemented	SEF	n/a	1 160	n/a	n/a
GEF Efficient lighting initiative	reduction of GHGs emissions through accelerated introduction of energy-saving lighting technologies	CO_2	economic, information, educational, research	implemented	GEF, SEVEn (local coordinator)	0	0	425	425
Program to Support Reconstruction and Restoration of Panel Buildings	repairs and reconstruction of panel apartment buildings	CO_2	economic	implemented	MRD (SFDH)	0	n/a	50	100
Preferential purchase tariffs for electricity produced from renewable sources	replacement of fuel in production of electricity	CO_2	regulation, legislative, economic	prepared	MoE, MoIT, Energy Regulation Authority		0		
Environmental tax reform	replacement of fuel in consumption of energy	CO_2	regulation, legislative, economic	prepared	MoF, MoE				
Transport									
Set of measures in the transport sector (e.g. construction of cyclist routes as alternative emission-free transport)	reduction of emissions of pollutants	CO_2, CH_4, N_2O	regulation, legislative, economic, fiscal, information	implemented National strategy for development of bicycle transport in CR prepared	MoT in cooperation with other sectors (SFTI, MRD, municipalities, regions, MoE)	1 334	1 843	2 797	3 917

Name of measure	Target and/or affected activity	Affected GHGs	Type of measure	State of affairs	Implementation	Benefit in reducing GHGs emissions (p.a. in CO_2 eq.)			
						1995	2000	2005	2010
Industry									
Act on Integrated Prevention No. 76/2002 Coll.	Introduction of BAT and increasing energy efficiency	CO_2, CH_4, N_2O	legislative information voluntary	being implemented	MoE, MoIT, MoA, regions, enterprises, Integrated Prevention Agency	0	0	n/a	n/a
Agriculture and forestry									
Support for afforestation of unused agricultural areas	more rational use of agricultural land	CO_2	economic	implemented	MoA	84	84	84	84
Support for the production of alternative motor fuels	nonfoodstuff use of domestic agricultural production	CO_2	economic	implemented	MoA	n/a	60	n/a	n/a
Waste Management									
Act on Wastes No. 185/2001 and Act on Packaging No. 477/2001 Coll.	harmonisation of CR legislation with EU legislation	CO_2, CH_4, N_2O	legislative	implemented / prepared	MoE, MoIT	0	0	n/a	n/a
Use of landfill gas and biogas from waste water treatment plants	reduction of methane emissions from landfills and waste water treatment plants	CH_4	technical	implemented	operators of landfills and waste water treatment plants	n/a	n/a	n/a	n/a

n/a - data not available and/or estimate cannot be made

Source: ENVIROS s.r.o., MoE, MOT, MT, MA, SEF, CEA, CHMI

8. Adaptation Measures

Adaptation measures consist of a set of potential adaptations of a natural or anthropogenic system to an actual or expected climate change and its impact. Adaptations that encompass the expected changes sufficiently far in advance or measures that are capable of immediately reacting following the occurrence of a natural or other catastrophe can be elaborated and subsequently introduced. Measures can be adopted at the level of individuals, private companies, groups of inhabitants, municipalities or cities, or can be adopted at the level of the state. However, such measures usually require mutual cooperation of a number of sectors.

In the vast majority of cases, adaptation measures are connected with financial requirements, to cover the costs of their preparation and introduction. However, implementation costs are usually balanced by the reduction in the amount of damage that the unfavourable impacts of climate change cause or could cause. Consequently, prior to their implementation, it is necessary to analyse their efficiency, benefits, costs, effectiveness and feasibility in relation to the ability of the whole system or its individual components to adapt to the climate change.

At the present time, the importance of implementation of adaptation measures to abate the impacts of climate change is considered to be of similar importance to measures connected with reducing the levels of GHGs concentrations in the atmosphere. It is very difficult to compare the economic costs and benefits of the two types of measures. Compared with the global action of measures to reduce GHGs emissions, the benefits of adaptation measures are mostly only of local or regional character; nonetheless, on the scale of individual countries, they are an important instrument for reducing the impacts of climate change, that should not be neglected in CR.

Outputs from the climate change scenarios of and the expected impacts (see Chapter 2) can be employed to propose suitable adaptation measures. Primarily, activities should be carried out that do not require high expenditures and are desirable to abate the negative effects of observed and projected climate changes. These include a number of nonstructural measures for improvement, e.g. information systems and promoting enlightenment of the lay and professional public, including restoration of the landscape, which is fundamental.

8.1. Water Management

The water management sector is clearly most sensitive to climate change under the national circumstances in CR and Central Europe. Adaptation measures for this sector should consists especially of implementation of measures leading to an increase in the water retention properties of the landscape, restoration of partial systems, reduction of affecting of water quality by contamination, the security of water-powered structures against overflowing, a change in the controllable retention space, an increase in the capacity of safety overflows, an increase in the effectiveness of management of water-powered structures under nonstationary conditions and of the decision-making process in dangerous and uncertain situations. Suitably selected measures, respecting the technical and natural conditions in the individual water-powered structures, can reduce the risk following from flood situations.

Further measures can be directed towards achieving greater flexibility and effectiveness of water management systems and comprehensive and integrated use of water sources, which will be favourably manifested especially under extreme weather events, i.e. in long periods without precipitation, similar to prolonged precipitation with potential subsequent floods. The

regular provision for safe passage of major floods through the affected territory and continuous increasing of the water retention ability of the landscape are also important adaptation measures. Reduction of losses in water distribution lines, reduction of requirements on water consumption and minimising of pollution of water courses can be considered key measures that will assist in water management and in improving water quality.

8.2. Agriculture

Agricultural activities will undoubtedly be affected by climate change; nonetheless, in contrast to other sectors, the impacts can be relatively easily affected by changing the species composition and management methods. From the perspective of impacts, this sector is unusual in that, in addition to detrimental effects, a number of favourable effects may occur (prolonging of the frost-free period by 20 - 30 days, prolonging of the vegetation period, favourable changes in other phenophases and earlier ripening or harvesting by 10 - 14 days, increased rate of photosynthesis as a direct result of an increase in CO_2 concentrations, etc.).

Adaptation measures suitable for further elaboration must be focused on modification of cultivated varieties of agricultural crops and farm animals (introduction, improvement), the use of new agrotechnical methods to reduce losses of soil moistures, provision for reproduction of soil fertility, increasing the stability of the land concerning the harm erosion and improvement and expansion of the use of irrigation for growing special crops. The most complex task will apparently consist in finding suitable ways of resisting the increased pressure from infectious diseases, caused by fungi and insects, and the increased competitive pressure from growth of weeds.

8.3. Forestry

The impacts on forest ecosystems will differ considerably by regions and thus adaptation measures must be the results of long-term planning, taking into consideration the specific features of the individual forest areas and local predictions of potential danger.

In general, the most important measure consists in increasing the adaptation potential of forests through species, genetic and age diversification of tree stands. The most severe adaptation measure consists in an enforced change of the species composition of stands (premature felling of stands of narrow-leaved species, especially spruce, and replacement of single-species stands by mixtures of tree species) and a change in the clear-cutting method of management for undergrowth methods. Similarly as in the agricultural sector, it will be necessary to implement measures to eliminate the risk of increased populations of insect pests, vascular mycosis and especially root rot.

8.4. Health

The health sector should be relatively least affected by the impacts of climate change. If global transboundary migration were to occur as a consequence of climate change and population growth in developing countries, there would be an increased need to combat infectious diseases and diseases from tropical areas. In the future, adaptation should be concentrated on modification of the legislation (modification of construction rules and consideration of new urban requirements), technical aspects (use of air conditioning, expansion and use of urban green areas and recreation zones, provision for the case of occurrence of extreme weather episodes, reduction of the occurrence of disease transfer agents), improvement of warning systems for the population to include potential dangers and an increase in provision of information, leading to a change in the behaviour of the population during extreme weather episodes.

9. Costs of Greenhouse Gas Emission Reduction

9.1. Cost Curves for Reducing CO_2 Emissions

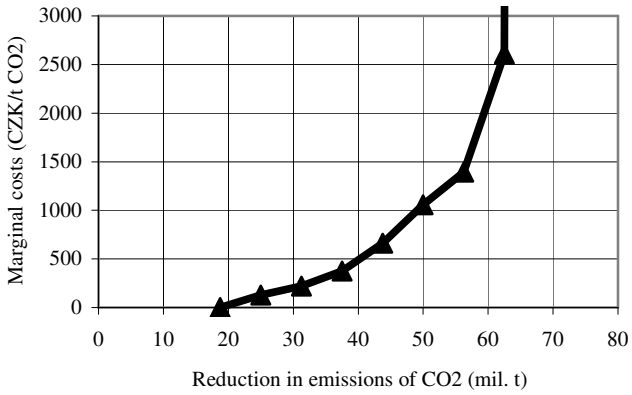
Scenarios with measures (see Chap. 6.1) were subjected to analysis from the standpoint of achievable reduction of CO_2 emissions and marginal costs. The EFOM/ENV model was used to calculate the theoretically achievable reduction in emissions in 2035 irregardless of costs. Tab. 9.1 gives the "start-up" in calculated values in the individual periods (e.g. absolute reduction by 60 % of the maximum values of reduction calculated for 2035 must be attained in 2020, etc.). All the data in this part are related only to reductions in emissions of CO_2 alone, compared to 2000.

Tab. 9.1 The relevant start-up curve for reduction of CO_2 emissions

	2005	2010	2015	2020	2025	2030	2035
Reduction in the given year	10 %	20 %	40 %	60 %	80 %	100 %	100 %

Source: ENVIROS s.r.o.

Fig. 9.1 Marginal costs for reducing CO_2 emissions for the reference scenario with measures



Source: ENVIROS s.r.o.

The curve in Fig. 9.1 gives the values of the resultant marginal costs for CO_2 emission reduction. Where zero values are given, all the measures that must be implemented to attain the given reduction in emissions over the economic lifetime of the measure are economically recoverable from energy savings and it is not necessary to expend additional sums for their implementation. Where the graph gives a nonzero value for the required reduction in emissions, this can be interpreted as meaning that achieving of the total required reduction in emissions in the target year of 2035 (because of the requirements of the EFOM/ENV model, this is practically 2030), e.g. by 20 % (i.e. reduction in emissions by approx. 25 mil. t), would require investment into the required measures of between 0 and 130 CZK/t CO_2 (for the most expensive measures) and, for a required reduction by 30 % (i.e. reduction in emissions by approx. 37.5 mil. t), it would be necessary to invest up to 370 CZK/t CO_2, etc. The overall costs of reduction of the given volume of emissions are given by the area defined by the y-axis and the cost curve for the given value. Thus, cost curves can be employed to read off both the value of marginal costs and total costs for achieving the required reduction in CO_2 emissions in the given year.

The following order of reduction measures (from the least to the most expensive) was derived from the model simulations:

- least cost saving measures on the part of consumers,
- replacement of solid fuels by natural gas,
- combustion of biomass,
- nuclear power plants,
- wind power plants,
- expensive savings measures on the part of consumers.

More effective technologies for use of solid fuels (furnaces with supercritical parameters, integrated gasification steam-gas cycles, etc.) are more or less evenly distributed over the whole spectrum. Reduction of CO2 has only a small impact on transport; there has only been a slight increase in the fraction of use of natural gas and alternative fuels (biodiesel fuel, bioethanol) for driving vehicles. This is mainly because transport is faced by emission limits for NO_X and other pollutants and thus fundamental changes in the structure of transport must occur for other reasons than only to reduce CO2 emissions.

More detailed examination of some technologies reveals that:

- Even with the higher price of natural gas, replacement of coal by natural gas is a relatively cheap way to reduce CO_2 emissions (including microturbines and fuel cells), with marginal costs of about 200 CZK/t CO_2.
- A new nuclear block was added at marginal costs for reducing emissions of about 500 CZK/t CO_2.
- Renewable energy sources would be used as follows:
    - combustion of biomass to produce heat at marginal costs of about 0 CZK/t CO_2; thus the measure is economically recoverable,
    - combustion of biomass to produce electricity in cogeneration units at costs of about 250 CZK/t CO_2 using waste biomass and 350 CZK/t CO_2 using specially grown biomass,
    - wind power plants at marginal costs of about 1200 CZK/t CO_2,
    - photovoltaic power plants at marginal costs of over 1200 CZK/t CO_2.

Savings measures on the part of consumption are considered to have 50 % economic recoverability even without forced reduction of emissions. These consist primarily of all the no-cost measures, measures to improve heating systems by introducing measuring and regulation technologies, replacement of electricity by more effective and properly dimensioned power, use of waste heat from most industrial operations, introduction of efficient light sources, etc. The remaining 50 % of savings measures would, in contrast, be employed for higher potential reductions and marginal costs of over 1200 CZK/t CO_2.

9.2. Estimation of Total Costs of GHGs Emission Reduction

The cost curves according to par. 9.1 can be used for a model estimate of the total costs of reducing GHGs emissions for the reference scenario and various options of percentage reduction of emissions to 2020 compared to 2000. The simulated values are given in Tab. 9.2.

Tab. 9.2 Estimation of total costs of GHGs emission reduction for the 2000 - 2020 period

Emission reduction in 2020 (%)	Emission reduction in 2020 (mil. t)	Marginal costs (CZK/t $CO_{2)}$	Sum of reductions to 2020 (mil. t CO_2)	total costs (mil.) CZK)
15	19	0	188	0
20	25	128	250	400
25	31	221	313	1 491
30	38	374	375	3 350
35	44	662	438	6 588
40	50	1 056	500	11 956
45	56	1 392	563	19 606
50	63	2 608	625	32 106

Source: ENVIROS s.r.o.

10. Targets and Priorities of the Czech Republic in the area of Climate Change

It follows from the updated projections of GHGs emissions to the year 2020 that CR will not have difficulties in meeting the reduction targets of the Protocol for the first commitment period, i.e. reduction of aggregate GHGs emissions by the 2008 - 2012 period by 8 % compared to 1990. These results also guarantee that CR will also meet the national reduction targets set forth in the State Environmental Policy of 2001, i.e. maintenance of production of GHGs in 2005 at a level 20 % lower than in 1990.

If the Protocol comes into force, negotiations will be commenced in 2005 on reduction targets for the subsequent commitment period after 2012. As was mentioned in Chapter 2, reduction of emissions by 5.2 % according to Art. 3 of the Protocol is, from the standpoint of stabilisation of global GHGs emissions, at a level that is completely negligible for minimising negative interactions with the global climate system of the Earth. It has been estimated that attaining of the required stabilisation would necessitate reduction of GHGs emissions by at least 50 %.

One of the alternatives that will certainly be considered in international negotiations after 2005 on reduction targets for the subsequent commitment period of the Protocol (after 2012) consists in differentiation of reduction targets according to the energy production, macroeconomic or social characteristics of the individual countries. This proposal will certainly be an important alternative to the approach to that taken to date, as it has at least two aspects in its favour:

- The USA, which currently produces more than 25 % of global GHGs emissions has withdrawn from the existing form of the Protocol with absolute reduction targets. They pointed out the "economic unacceptability" of limiting further development of the economy of USA, with detrimental impacts on the entire global economy. As an alternative approach, they propose reducing energy intensity and taking into account macroeconomic viewpoints.
- At the beginning of the negotiations on the Convention, industrially developed countries emitted almost 70 % of global emissions and thus the reduction commitments of the Protocol were limited to this group of states. However, in the past 10 - 15 years, the emissions of developing countries have increased rapidly and, as estimated by IPCC, the emission contributions of these two groups of states should become equal in about 2010. Thus, it is necessary to also direct further negotiations towards adopting of similar obligations for the developing countries, at least the economically more advanced ones, possibly on a voluntary principle. Participation of the developing countries in the process is also one of the conditions for further participation of USA in the negotiations.

If there continues to be interest in the constructive continuation of the process, then it is necessary that both states with the highest production of GHGs and the economically most advanced developing countries participate in this process. This can be realised only at the price of some concessions and a search for compromises. One of these must certainly be reducing the energy intensity of the economy and consideration of macroeconomic points of view, as proposed by USA, and which could also be acceptable for the developing countries. Such an approach would lead to greater pressure on CR for reasons of the continuing higher energy intensity of creation of GDP and the high specific GHGs emissions per capita in CR.

Consequently, in the creation of medium and long-term policy in the area of climate change, it is not possible to assume a static and lax approach consisting in problem-free compliance with obligations for the first commitment period of the Protocol and the consequent "lack of need" for further measures in this area. Conditions in the subsequent commitment periods can be diametrically different from the current position of this country.

An important factor will certainly consist in accession of CR to the EU, which considers the issue of climate change to be a basic priority, not only in the area of the environment, but also in the area of energy production and the economy and for a number of years has presented itself as an initiator of further reduction in GHGs emissions, although the results to date of EU attempts do not yet fully correspond to this[46]. Especially for this reason, EU currently greatly prefers emission trading, although it still had very serious objections to this mechanism at the time of negotiations on the Protocol. In spite of the not very optimistic beginning, EU is now very active and ambitious in relation to GHGs emissions reduction and related policies (e.g. support for renewable energy sources) and, unless there is a substantial change in the current policy course, increased pressure can be expected in the coming years on the new member states, who almost all have a certain emission cushion as a result of construction of the target for the first commitment period of the Protocol. As in the first commitment period, in the second commitment period an internal discussion or redistribution of the entire EU obligation (currently in the form of a Burden-Sharing Agreement) amongst the individual member states can be expected, where not only economic situation, but also reduction potential and the initial position for emission reduction will be taken into account. It should be emphasised that the national policies of the individual member states and the European Climate Change Programme now include measures that contribute particularly to reducing the energy intensity of creation of GDP and the values of specific GHGs emissions per inhabitant. Simultaneously, it should be emphasised that EU has clearly declared an attempt to continue the current active policy in the area of climate change even if the Protocol does not come into force.

Another factor that must seriously be taken into account is the absence of experience in regulation of GHGs emissions in CR. There is a lack of the necessary institutional structures, including a uniform framework for monitoring and reporting these emissions and there is no obligation for installations to report these data. Thus, the availability of data on the level of sources is complicated by a number of imprecisions and errors, which can have a negative impact in the preparation and application of instruments for reduction of GHGs emissions. Elimination of these inadequacies is, however, very demanding and tedious and tends to have a medium-term framework. However, it does not prevent introduction of measures that are decisive for actual reduction of GHGs emissions.

Simultaneously, it is necessary to be aware that measures that are implemented for reduction of GHGs emissions are usually long-term in nature (replacement of heating systems and technologies, reconstruction of sources or replacement of existing sources by new models, etc.) and consequently, decisions on their implementation are made in view of trends in conditions over a period of up to decades. From the standpoint of investors, it is thus desirable to know at least the framework of future policy, which can be one of the factors in making decisions on investments. The currently advantageous position of this country cannot be taken as a situation that will ensure a problem-free position in the long term. A sudden change, e.g.

[46] Total emissions were reduced by 3.5 % in the 1990 - 2000 period, while the joint EU target for the 2008 - 2012 period is 8 %. Only Finland, France, Germany, Luxembourg, Sweden and Great Britain are currently on the way to meeting their obligations, while Austria, Belgium, Denmark, Greece, Ireland, Italy, Holland, Portugal and Spain will encounter serious difficulties in this respect.

in the form of stricter or less advantageous targets, could be a shock for the economy or business sector with worse results than for a gradual, clearly declared, long-term target of policy in the area of climate change.

For these reasons, it is necessary that CR also seriously consider the aspect of a further reduction of emissions beyond the framework of the current reduction targets of the Protocol and prepare new, economically feasible measures to reduce emissions in an attempt to gradually reduce the currently unfavourable values of the individual indicators. In this sense the policy of CR can be called active.

10.1. Implementation of the Convention and Protocol in the Czech Republic

10.1.1. Survey of Activities

The Czech Republic signed the UN Convention on Climate Change on June 13, 1993 and acceded to it on October 7, 1993. CR signed the Protocol on November 23, 1998 on the basis of Government Resolution No. 669/1998 and completed the ratification process in the sense of Art. 25 of the Protocol on November 15, 2001.

On the basis of the requirements of the Secretariat of the Convention, the signatories of the Convention must regularly submit a document analysing current situation in the area of climate change and documenting the state of compliance with obligations following from the Convention and the Protocol, i.e. a National Communication. The First National Communication of CR[47] was submitted to the UNFCCC Secretariat in 1994 and the Second National Communication of CR[48] was sent in 1997. While, in the period of preparation of the First and Second National Communications, the issue of global climate change in CR was considered to be rather a narrow problem of interest only to professionals, manifestations and consequences of the "unusual" variations in the weather and the occurrence or more frequent extremes attracted increased attention from the lay public and subsequently also politicians. The greater frequency and consequences of dangerous anthropogenic interference in the climate system have led to the need to search for new, more efficient and economically more effective mechanisms for reducing unfavourable consequences both in an international context and at a national level. For adopting of the Protocol, work was commenced in 1998 on preparation of a national strategy for reducing GHGs emissions and, in Resolution 480/1999, the Government of CR approved the document "Strategy of Protection of the Climate System of the Earth in the Czech Republic", which included climate protection amongst top-priority environmental issues in CR and simultaneously established the main tasks that the individual affected sectors must carry out in the framework of achieving the quantitative targets of the Protocol. Simultaneously, the work of the Interministerial Commission on Climate Change was renewed; this body acts as a consulting body to the Minister of the Environment.

In 2001, the Third National Communication of CR was submitted, demonstrating that the long-term process of creating the preconditions for meeting the Protocol targets and attempts to achieve further reduction savings are continuing successfully in CR. The document, which simultaneously evaluated targets following from Government Resolution No. 480/1999, underwent the international audit procedure in 2002[49].

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[47] International audit in CR in 1995; document FCCC/IDR.1/CZE

[48] International audit in CR in 1999; document FCCC/IDR.2/CZE

[49] document FCCC/IDR.3/CZE

An important part of meeting national obligations following from the Convention consists in carrying out GHGs inventories (Chap. 5), which has regularly been entrusted to the Czech Hydrometeorological Institute since 1995. Information on expected trends in GHGs emissions is provided by projections (Chap. 6), which have been prepared for use in the individual National Communications (1994, 1997 and 2001) or for use in specific studies carried out in CR during 1996 - 2001 on the basis of financing from the World Bank and Phare Program.

The National Climate Program (NCP) is another key organisation; this is an association of legal persons founded in CR on January 1, 1994. At the present time, it carries out tasks following from the World Climate Program, coordinated by the World Meteorological Organisation in (i) obtaining climatological data and monitoring the climate, (ii) processing climatological data, (iii) estimating impacts of the climate on the lives and activities of human beings and estimating the effects of human activities on the climate and (iv) research on the connections between components of the climate system and estimations of climate change. It is also engaged in professional consulting in adopting and monitoring the obligations for CR following from its accession to the Conventions on protection of the ozone layer and on climate change, which are related to long-term environmental aspects. In 1991- 1992, it carried out work on the task "Strategy for Reducing the Risk of Climate Change" and, in 1993 - 1995, on the basis of support from US EPA (US Environmental Protection Agency), a territorial study of climate change for CR, concerned with all the important aspects of this change, and that was completed by issuing a number of publications documenting the impact of potential climate change on agriculture, forests and water sources in CR. The study continued in 1996 - 1997 in preparation of an action plan of measures intended to reduce the risk of the potential consequences of expected climate change.

In 2000, MoE renewed financial support for research concentrated on projects of the Program of Science and Research and concerned with study of regional impacts of climate change caused by an increase in the greenhouse effect, climate fluctuations, determination of the normal values of selected climatological features and refining the scenarios of climate change and long-term forecasting of climate anomalies. By 2003, NCP had issued 38 specialised publications related to research and systematic observation of climate change in the CHMI publishing house.

10.1.2. Flexible Mechanisms of the Protocol under the Conditions in the Czech Republic

A certain degree of flexibility in the form of three flexible mechanisms is permitted for meeting the Protocol commitments. This consists of two mechanisms based on implementation of projects (joint implementation projects according to Art. 6 of the Protocol and the clean development mechanism according to Art. 12 of the Protocol) and international trading of GHGs emissions according to Art. 17 of the Protocol.

The principle of the project mechanisms lies in the fact that a state, which is forced to meet a certain emission reduction target where, however, implementation of these measures is too expensive in relation to its national circumstances, has the potential for participation in implementation of a project in another country (host country), where achieving of the reduction is cheaper than under national circumstances. It subsequently obtains the emission reduction achieved in the project in return for these investments (i.e. these emission reductions do not remain in the host country, but are transferred to the investing country). The Protocol and related documents establish rules for the individual project mechanisms, which must be followed in order that the transfer of the achieved emission reduction be recognised. In relation to the position of CR in the area of GHGs emissions, amongst the project

mechanisms defined in the Protocol, only the use of joint implementation projects according to Art. 6 of the Protocol comes into consideration, where CR would be a host country. The clean development mechanism is not currently being considered under the national circumstances (CR could only be an investor).

So far, trading in GHGs emissions according to Art. 17 of the Protocol has not yet been exactly defined at an international level; emphasis is rather placed on verification and submission of reports and definition of responsibility (following from the text of Art. 17 of the Protocol. The modalities of trading as such (or especially how the revenues from sales of GHGs emissions will be used) will most probably not be regulated and this will remain entirely up to the will and responsibility of each country.

In this connection, it should be pointed out that all flexible mechanisms are mechanisms between signatories of the Protocol, i.e. between states (as follows from the logic of the Protocol as such) and thus this is not a mechanism of trading in which private entities are directly engaged. This does not *a priori* mean that they cannot participate in trading; however, as the state (central authority) is unambiguously responsible for meeting the obligations of the Protocol, it is necessary that unambiguous control exist over this trading, i.e. interstate agreements on trading. In cases of problems, it will clearly be the state that will have to accept responsibility for meeting obligations, including all the consequences thereof, and the role of the state in this process is irreplaceable.

10.1.2.1. Joint Implementation Projects According to Art. 6 of the Protocol

CR has rather broad experience in implementing projects in the area of protection of the environment, especially in connection with projects supported by the State Environmental Fund and Czech Energy Agency. In case of implementation of JI projects it is assumed that these two institutions would participate in the process of their preparation, assessment and implementation right from the beginning.

The pilot phase of joint implementation projects (phase AIJ - activities implemented jointly)

In the framework of participation of CR in the pilot phase of joint implementation projects as the testing phase of joint implementation projects, in which there will not be a shift of the achieved emission reduction to the investor, the National Reference Centre for AIJ was established at MoE in 1996 and published the basic rules for their implementation. The rules had a rather general character (e.g. reduction of GHGs emissions by at least 10 %, submission of an application to MoE, the requirement of additionality, etc.), where the assessment process and the technical aspects of the solution have not been specified or approved (e.g. determination of a methodology for calculating the basic or reference developmental emission baseline - emissions under the condition that the project would not have been implemented).

A total of five projects have been implemented, which were approved more or less on an individual basis. These are various types of projects: two projects for a change in the kind of fuel employed, two projects to increase energy efficiency in a given company and one project related to afforestation.

The first project consisted in switching the heating medium for central heating in Děčín. This project was approved in 1996 and the investor country was the USA. The project was concerned with switching from coal to gas, the use of cogeneration and increasing energy efficiency. The total costs of the project were approx. 8 mil. USD, where the AIJ component consisted of approx. 7.5 % of investment costs in the form of soft loans from a private company in the USA (600 000 USD). The installation was brought into operation in 1996 and the annual reduction in GHGs emissions equals 24 kt CO_2.

The second project was a project to renew forests the Šumava and Krkonoše National Parks. This project was approved in 1997 and the investor country was The Netherlands. It involved afforestation of 14 000 ha of land (9000 ha in Krkonoše and 5000 ha in Šumava), with total costs of 60.5 mil. USD; the AIJ component corresponded to 80 % (48 mil. USD) and the costs were covered by the FACE project. The annual reduction in GHGs emissions equals 734 kt CO_2. The project is expected to have a lifetime of 99 years.

The third project consisted in modernisation of the Čížkovice cement plant. This project was also approved in 1997, the investor country was France and the measures were concerned with aspects of energy efficiency. This project was carried out in the foreign branch in the framework of a single company, with total investments of about 6 mil. USD and achieved annual reduction in GHGs emissions of about 33.6 kt CO_2.

The fourth project was a biomass heating plant in Hostětín. The project was approved in 1999 and the investor country was Holland. This was a comprehensive demonstration project for central heating using biomass together with the use of solar energy for heating hot utility water, supplemented by the construction of an information centre on renewable resources. Total costs were about 860 000 USD, of which the AIJ component was about 470 000 USD. The total annual reduction in GHGs emissions equalled about 3350 t CO_2, which, with a lifetime of 15 years, corresponds to a total reduction of 50.25 kt CO_2

The fifth project consisted in installation of a new cogeneration unit in Škoda Mladá Boleslav. Once again this was a project implemented in the foreign branch of a single company (Germany was the investing country). The project involved modernisation and renovation of the cogeneration units where, together with an increase in energy efficiency, there was a change in heating medium from coal to gas. The total costs of the project equalled approx. 110 mil. USD, mostly covered by a commercial loan. The annual reduction in emissions equals 272 kt CO_2, corresponding to a total of 5.4 mil. t CO_2 for a lifetime of twenty years.

In evaluation of the pilot phase of AIJ, it was pointed out that there is a lack of a systematic procedure for accepting and evaluating AIJ projects, which were accepted and subsequently evaluated on an individual basis, the basic rules were fundamentally very general (for example the methodology for calculating the baseline was not defined). Simultaneously, the work encountered a lack of human resources for preparation of a more detailed analysis of the entire area. Pressure of foreign investors for certification was an expected phenomenon (i.e. although the project was submitted as AIJ, foreign investors subsequently exerted pressure for transfer of at least part of the saved emission credits). In this connection, it was found that one of the key moments in implementation of similar projects is preparation of a suitable agreement, which requires careful examination of all the aspects of the project; because of the lack of experience in both the investing and host countries and unresolved international rules for these projects at the time of their implementation, this was a rather problematic aspect.

In December 1999, a working group for AIJ was established at MoE, whose main goal was coordination of AIJ activities, preparation for transition from the pilot phase of AIJ to the phase of joint implementation projects and especially preparation of new more detailed rules for preparation, submission and approval of projects. These new rules for AIJ (which, however, were intended to serve as a starting point for JI projects) were approved by MoE in June 2002. The following priorities were established, based primarily on the targets of the State Environmental Policy and other individual documents:

- use of renewable energy sources,
- energy savings in heating buildings (insulation, regulation, low-energy buildings) in the public sector,

- energy savings in heating buildings (insulation, regulation, low-energy buildings) in residential buildings,
- use of waste industrial heat in existing installations,
- construction of collection systems for landfill gases for old landfills and their energy-production use,
- greening of public transport,
- afforestation, and
- other measures leading to a significant reduction in GHGs emissions.

The parties submitting projects were obliged to provide more detailed information on the technical parameters (transparent calculation of the baseline and emission reductions, the economic effectiveness of the proposed approach, other environmental effects, etc.). Transparent identification of financial sources participating in financing the project was also required. A professional commission was to be employed to assess pilot projects and its services would be used by the AIJ National Reference Centre. The aspect of human resources for comprehensive provision for the entire area has not yet been resolved.

As foreign investors have not expressed interest in implementing projects without transfer of emission reductions (e.g. no pilot project has been implemented since 1999), the activities of this group are basically limited to preparation of a more detailed methodology. Because of the unclear international situation in the area of implementation of flexible mechanisms, no progress had been made to the phase of joint implementation projects by the end of 2001.

Phase of joint implementation projects (JI phase)

Because of the long-expected progress in international negotiations and clarification of the position of CR (ratification of the Protocol), work was commenced towards the end of 2001 on transferring joint implementation projects to the JI phase, i.e. projects with expected subsequent transfer of emission reduction units to the foreign investor. Decision 16/CP.7 from COP 7 formed the basis for the work.

10.1.2.1.1.1. MoE working group

The first step consisted in preparing institutional provision for this subject area at MoE. The MoE working group on the subject of climate change, which thus replaced the National Reference Centre for AIJ and the professional commission for AIJ assessment. At the present time, this working group has 11 members consisting in representatives of MoE (Climate Change Unit, Department of Environmental Economics, Department of Global Relations, Air Protection Department, Strategy Department, Internal Financing Department), of organisations established by MoE (Czech Environmental Institute, State Environmental Fund, Czech Environment Inspection) and of the national contact person for the Convention (UNCCC National Focal Point). The Head of the Climate Change Unit is the chair of the working group. It is the task of this group especially to prepare documents for ministerial decisions in subjects related to climate change for adoption of measures by MoE, related to reducing GHGs emissions, and also to propose measures to the Minister for reducing GHGs emissions, to propose methodologies for choice of JI projects, to assess submitted proposals for projects and to recommend their implementation.

10.1.2.1.1.2. Methodical instruction for submitting and evaluating joint implementation projects

The initial documentary basis for preparation of the methodology was the framework method for projects in the AIJ phase, which was further specified and supplemented to include other documents describing the technical and economic aspects of the submitted draft projects and the relevant applicants. The transfer of CR from phase AIJ to phase JI was officially announced in January 2002. Simultaneously, information was published on the approach of MoE to the subject of JI projects (http://www.env.cz). The following have been named as top-priority areas for inclusion in JI projects:

- use of renewable energy sources,
- energy savings in heating buildings (insulation, regulation) in the public sector,
- energy savings in heating buildings (insulation, regulation, low-energy buildings) in residential buildings,
- use of waste industrial heat in existing installations,
- construction of collection systems for landfill gases for old landfills and their energy-production use, and
- greening of public transport.

However, in principle, projects outside of these priority areas can also be submitted as joint implementation projects. Compared with the original priorities for AIJ projects, the area of afforestation was excluded, primarily for methodological reasons (the difficulty in calculating emission sinks). However, this does not mean that this area cannot be included amongst priority areas at a later date.

Independent projects or groups of projects can be proposed as JI projects if they (a) are of an investment character, (b) are in accordance with the generally binding regulations of CR, (c) do not lead to transfer of pollution between the individual components of the environment (e.g. air - water - soil) and (d) are prepared for implementation. Activities of a non-investment character (technical assistance, consulting, expertise, education and enlightenment, etc.) and also projects that have already been implemented or commenced cannot be recognised as projects in this sense.

The submitted draft projects are assessed particularly according to the following criteria:

- total and annual reduction of GHGs emissions,
- requested number of emission credits,
- price offered per emission reduction unit, where the price will be evaluated in the context of trends in prices for reduction on an international level,
- the condition of "additionality", i.e. a reduction in GHGs emissions from the given technology that could not have occurred without implementation of the project; proposals that will be directed towards compliance with the conditions laid down by the relevant generally binding regulations of CR in the area of the environment will be automatically excluded from further procedures,
- accordance with the priorities of the State Environmental Policy and with the priorities of the State Program for Energy Savings and Use of Renewable Energy Sources,
- the condition of the "best available techniques" in accordance with the adopted legislation of the European Communities,
- the benefit for dissemination of know-how and new technologies in CR,

- environmental aspects of the project (e.g. economic use of natural resources, waste recycling)
- economic aspects of the project (e.g. the cost effectiveness of the approach, accordance with macroeconomic policy at a national and regional level - increase in employment, regional development, etc.).

Detailed methodical instructions were published on May 17, 2002 on the MoE web site in Czech and English (http://www.env.cz) and the current updated version is available there in the section on climate change.

10.1.2.1.1.3. Administrative structure for assessing and evaluating draft joint implementation projects

In assessing joint implementation projects, it is necessary to assess the project in a comprehensive manner from both the technical and economic viewpoints (analysis from the standpoint of energy, benefit for the environment, financing, benefit for technology, etc.). The existing capacities of SEF and CEA will be used for this purpose, as both institutions have long-term experience in assessing projects for saving energy and use of renewable energy sources amongst selected priorities; the capacity and professional base for these activities is also an important factor.

The Climate Change Unit at MoE is the official contact site for methodology and for submitting applications for projects. Here, the project is registered and the proposal is submitted for expert assessment at SEF and CEA. A new non-investment program has been established for comprehensive assessment of applications at SEF. Both these agencies may request further documents from the applicant within a certain period of time. This comprehensive assessment will subsequently be prepared in the form of a proposal for a ministerial decision and, after approval, will be submitted to the Minister of the Environment for a decision. If approved, an agreement will be prepared dealing with further details and conditions under which the saved emission units will be transferred after 2008.

The commencement of transition from phase AIJ to phase JI in JI projects was received favourably by both domestic entities and potential implementors, as well as foreign entities and potential investors. The adopted methodological instruction for submitting and assessing proposals for joint implementation projects constituted a favourable move forward in specifying the requirements of MoE for these projects; nonetheless, a number of problem areas appeared in its practical application and there is space for improvement here. The methodical instruction itself and assessment of the individual projects and their administration are thus not fixed and modifications of these documents or procedures may be submitted on the basis of experience or requirements, so that they correspond best to national circumstances and domestic needs.

10.1.2.1.1.4. Experience in implementation of projects in the framework of joint implementation

The Netherlands, which is, in a sense, a pioneer in the use of flexible mechanisms, and also Austria, Denmark, Germany and Japan have expressed active interest in cooperation in the framework of the joint implementation mechanism (as investor countries). A number of other countries are also interested in closer specification of existing general cooperation in the future. Cooperation is usually based on the experience of both the host and the investor countries and, as this is a new subject area, experience is gained gradually through practical implementation and in the individual steps. In a number of cases, there is potential for use of assistance from the investor countries, which is concentrated on dealing with certain specific and technical aspects.

Cooperation with the World Bank (IBRD) and the Prototype Carbon Fund (PCF), which was commenced in 2001, is also based on the JI principle. PCF cooperates in the long term with the UNFCCC Secretariat on preparation and development of rules for implementation of projects according to Article 6 of the Protocol and monitors compliance with these rules in implementing pilot projects. PCF has available the amount of approx. 180 million USD for the purposes of preparation and implementation of JI projects (some countries, e.g. Sweden and Finland, and also supranational companies, such as Gas de France, and international banking houses contribute to this fund). In accordance with the MoE methodology for JI projects, PCF will support projects concerned with energy savings through increasing energy efficiency in the following sectors: public buildings (hospitals, schools, etc.), central heating systems, renewable energy sources and, to a limited degree, suitable industrial sites. Participation of PCF in JI projects in CR is implemented on the basis of agreements concluded on the basis of Government Resolution No. 648 of June 30, 2003. The expected degree of participation of IBRD in JI projects corresponds to 5-7 million USD in dependence on the amount of reduction of emissions through implementation of specific projects. In preparing these projects, PCF cooperates closely with the State Environmental Fund and Czech Energy Agency. The Czech Republic will obtain a grant from the Japanese Trust Fond to promote PCF activities in CR. The funds will be earmarked for technical assistance, especially for the State Environmental Fund and Czech Energy Agency.

However, practical experience in preparation and assessment of JI projects has also revealed some problematic areas in application of this procedure in CR. A general problem consists in the fact that preparation of projects in a form complying with international rules according to the Convention, which is a condition for approval of transfer of emission reductions, is demanding as to time and finances (of course, under conditions were the country does not comply with the Track I requirements, which permits a much simpler procedure in calculation of emission reduction achieved in the project). For example, considerable expenses are involved in the calculation of the baseline, which often requires the collection of a large amount of data and complex calculations of hypothetical situations "without implementation of the project" and which must undergo independent "validation", which must be carried out by a person authorised by the UNFCCC Secretariat. The costs of validation also constitute a considerable fraction of the total administrative costs of the project. Subsequently, a monitoring plan must be established, which will monitor the actual GHGs emissions and these data must again undergo independent "verification". These costs also mean considerable expenditures for the project as such. As a result, the benefit for financing the project from the standpoint of sale of the emission reduction achieved is reduced by these costs, which are, to a substantial degree, independent of the size of the project and thus substantially decrease the attractiveness of small projects, where the costs associated with preparation of the project may even be higher than the revenue from sale of the emission reduction.

One of the potential approaches consists in grouping of small projects (where support for these projects is one of the priorities of MoE) of a single type into portfolios, where at least part of the administrative costs would be distributed amongst the individual projects. Administration of the portfolio also entails further complications; nonetheless, it is one of the ways in which these projects can be promoted in the framework of the JI mechanism and MoE supports it in this sense. It has been found that it is necessary to resolve any difficulties individually based on practical experience.

Another limiting factor consists in calculation of the basic or reference emission level (baseline). These calculations are frequently complicated and must encompass especially the requirement of additionality. This requirement of the Convention means that a project that is implemented as a consequence of the requirements, e.g., of the domestic legislation, cannot be

recognised as a JI project (in other words, a project that would be implemented even without JI). Thus, the scope for emission reductions that can be traded in the framework of this mechanism is reduced in relation to the accession of CR to EU and the necessity of implementing the relevant legislation and the overall developed state of the economy (i.e. this affects the shape of the baseline). As a consequence, it follows that the scope for JI is much smaller in the acceding countries that for countries that will not become EU members in the foreseeable future. A further complication lies in the mutual interaction between JI and the system of trading in the framework of EU; this will be described in detail below.

One of the difficulties lies in difficult identification of potential projects suitable for JI, where, in the framework of improving current conditions, consideration is given to more active participation of the regions in this area, where connections to regional conceptions in the area of energy and emissions can be utilised. Cooperation at this level has already been commenced but development will require some time.

The aspect of responsibility for international transfers of emission reductions in the framework of the flexible mechanisms of the Protocol was found to be a fundamental and, in a certain sense, general problem. It was found that a responsible person, who would represent CR in these relations, must be designated for approving the transfer of emission units to another country. As MoE is responsible for compliance with the Convention and Protocol in CR, it is recommended that the Minister of the Environment be authorised in this sense. The authorisation would encompass not only authorisation for transfer of emission reductions in the form of units defined by the Protocol, but also the conclusion of the necessary international agreements related to this area.

Practical experience in implementing JI projects will be employed in methodical elaboration of the use of project mechanisms in CR, on which intense work is currently being carried out (see also Chapter 10.2.2).

10.1.2.2. Trading in Greenhouse Gas Emissions According to Art. 17 of the Protocol

So far, trading in GHGs emissions based on this principle has not yet been exactly defined at an international level; emphasis is placed rather on verification and submission of reports and definition of responsibility (following from the text of Article 17 of the Protocol). The modalities of trading as such (or especially how the revenues from sales of emissions will be used) will most probably not be regulated and it will remain entirely up to the will and responsibility of each country how this is defined.

Trading in GHGs emissions according to Art. 17 of the Protocol is basically simple. An agreement will be concluded between two entities (states), which are mutually in the relationship of seller and buyer. Following meeting all the requirements of the Protocol (general requirements related to access to the instrument of trading as such, requirements in the area of inventories, used for calculation of the number of emission units, etc.), this trading is implemented and the relevant transfer of the units is carried out in the GHGs registers of the two entities (with control of the transaction by the UNFCCC Secretariat).

The possibility of trading on the basis of this principle has not been the subject of detailed examination in CR yet; however, possibilities have been indicated that will be elaborated in the future. It is proposed that the pilot phase of use of this mechanism be employed, in which a limited number of emission units would be sold, and the revenue from these sales would be recycled back to support projects leading to a further reduction in GHGs emissions, with similar emphasis as for JI projects. As these measures usually also resolve related problems (support for renewable energy sources, energy savings, etc.), which are amongst top priorities

of environmental policy or other policies (e.g. employment, support for use of the landscape or agriculture for targeted cultivation of biomass), it can be stated that this is an optimal approach. If the results are favourable, consideration can be given to expansion of the use of this method in the form of sales of a further amount of emission units. Recycling of the benefit from the sale of emission units would be based on existing mechanisms of the State Environmental Fund, where a separate investment program would be created for this purpose, to distribute the revenues from the sale of emissions, which would be bound to this purpose.

It has been found that this approach could be an alternative to JI projects to eliminate some of their inadequacies. A number of states have expressed interest in participation in this mechanism (these are usually states that are also interested in JI projects). The specific procedure for this mechanism is currently well prepared and it is expected that its specific form will be decided at the beginning of 2004 (in the framework of comprehensive undertaking of project mechanisms - see the text of the conclusion of Chap. 10.2.2).

10.2. Cooperation with the European Union Under the National Circumstances

The Czech Republic, which is in the position of a country acceding to the European Union, is obliged to ensure transposition of the relevant EU legislation to the Czech legislation. Another important document consists in Council Decision No. 1999/296/EC, amending Decision 93/389/EEC for a monitoring mechanism for CO_2 and other GHGs emissions (Chap. 3). The regulation as a whole is transposed by § 34 and § 35 of Act No. 86/2002 Coll., on protection of the air, which came into force on June 1, 2002. At the present time, CR already complies with the majority of the requirements in this decision. One of these is the obligation to draw up, publish, implement and regularly update national programs directed towards controlling and reducing anthropogenic total GHGs emissions and increase their sinks so that, by 2000, this contributes to stabilisation of CO_2 emissions at their 1990 level and contributes to meeting the EU obligations to reduce all GHGs emissions in the sense of the Convention and the Protocol.

After accession to EU, CR will also be subject to the requirements of the new Council Decision for mechanisms for GHGs monitoring at the level of the Communities and implementation of the Protocol, to supplement and extend the original Council Decision 1999/296/EC. This new Decision was to be approved in November 2003.

CR is also capable of employing the EU funds through the Infrastructure Operational Program and the Cohesion Fund. The Infrastructure Operational Program is based on the requirements of the Framework Directive on air quality 96/62/EC and its daughter Directives and high CR GHGs production, whose specific values, related to inhabitant or unit GDP production, are almost twice the average in the EU member states. Air protection projects will be supported primarily in the framework of measure No. 2.3 (Support for introduction of alternative fuels) and No. 3.3 (Improvement of air protection infrastructure). In the framework of measure No. 2.4 (Study and research projects to provide for the aspect of improving the environment from the viewpoint of transport), support will also be provided for study and research projects concerned with internalisation of the external costs of transport infrastructure and thus also economic damage caused by GHGs emissions from transport. Support can be provided from the Cohesion Fund for major investment projects and associated projects in the area of the environment with costs exceeding 10 mil. EUR. The Cohesion Fund is based on experience with the ISPA preaccession fund and was corrected in the framework of the process of introduction of EDIS. The importance of resolving problems in the area of air protection was taken into consideration through including air quality amongst the priority areas of the Cohesion Fund. The Infrastructure Operational Program and Cohesion Fund will support a

number of projects in the area of air protection, which will significantly affect conditions in all of the Czech Republic.

10.2.1. Directive 2003/87/EC Establishing a Scheme for Greenhouse Gas Emission Allowance Trading at the Company Level

Soon after the official declaration of the Communities of their intention to ratify the Protocol and thus support its coming into effect, work was commenced at the level of the European Union on preparation of instruments that would be capable of meeting the agreed obligations most effectively at the Community level. Attention was devoted to the system of emission trading (although other instruments of environmental policy or their combinations are also considered) that would, in its extensive use, encompass the Communities as a whole and in which the individual polluters would participate (trading would occur at the level of enterprises).

The European Parliament approved the draft for this scheme in the form of a Directive on July 2, 2003 and Directive 2003/87/EC was published in the EU official bulletin on October 25, 2003. The Directive provides each member state with a certain degree of flexibility in implementation. The main principles of the proposed system can be summarised as follows:

- The system will be started up in 2005 (its starting-up phase will occur in 2005 - 2007 and from 2008 it will copy the commitment periods of the Protocol).
- Trading is concentrated in the basic sectors of the economy, in the framework of which there are also size limits for obligatory entrance of the source into the system.
- Initially, the only tradable commodity will be carbon dioxide (other GHGs later).
- Consistency with the EU rules on provision of state assistance and no interference in the competitive environment and functioning of the single market is required.

Practical application of the system will simultaneously employ experience gained in the already functioning systems (Great Britain, Denmark and possibly others). An important aspect consists in integration of the trading system with other instruments of environmental policy (especially IPPC, where the Directive in trading amends the Directives on IPPC, air protection, renewable energy sources, etc.). The aspects of sanctions for failure to meet commitments, connection to the need for monitoring, reporting and emission verification are also outlined.

The principle of the system consists in transfer of the obligations of the state to the individual enterprises in that a ceiling at a certain height is set for them, for which the enterprises obtain allowances. These allowances provide it with the right to emit a certain amount (1 ton) of CO_2 emissions in a certain period of time. The enterprise meets the given target in that it either reduces the amount of emissions discharged to the level corresponding to the number of allocated allowances or purchases further allowances to cover its remaining emissions. As the total number of allowances (environmental target) is fixed and cannot be further increased, this means that, when additional allowances are purchased from some other sources, then the selling source will have to reduce its emissions more than the amount corresponding to the number of allowances it received (and thus it can sell the extra allowances). The trading mechanism thus means that the required emission reduction is achieved where it is most cost-advantageous (determined by the mechanism of functioning of the market). The individual sources will compare their costs for reduction of CO_2 emissions with the price of allowances and implement the more advantageous (- cheaper) alternative. However, a necessary requirement consists in a certain degree of simplicity and fixed establishment of trading conditions so that trading is not too awkward.

A key element in the system is the National Allocation Plan, which is a document describing how (in what number) emission allowances will be allocated to the individual enterprises at the beginning of the trading period (at least at the beginning, it is assumed that allowances will be allocated free of charge; the Directive permits part of the allowances to be sold by the state through an auction). The European Commission will issue a certain scheme for preparation of this document, which will specify which information it should contain. It must contain not only a list of companies covered by the force of the Directive, together with the number of allocated emission allowances, but also a number of items of related information on implementation of policies in the area of reduction of emissions, relation to competitiveness and the single internal market, etc.

The allocating of allowances entails a number of problems (the need for a database for sources covered by the Directive, dealing with the aspect of restructuring of industry and thus the absence of historical data, entrance of new sources into the system, the potential for publication in relation to the fact that the National Allocation Plan is a public document, etc.). The Czech Republic is obliged to submit this plan for approval to the European Commission by May 1, 2004 and the assessment will also apply to consistency with the rules for state assistance (allocation of free allowances is a form of subsidy).

Further related areas must be resolved in parallel and involve a number of individual problems (monitoring, legislative provision for allowances, legislation related to the system as such, verification of emission data for the individual companies). A certain complication consists in the fact that the draft Directive was prepared without taking into account different national circumstances in the candidate countries, i.e. future new EU member states (problem-free meeting of the targets of the Protocol) and is thus based on a situation where the state must reduce its emissions (which are above the commitment), meaning in practice that enterprises would also obtain fewer allowances than correspond to their current emissions. There are several similar problems following from the different national circumstances in countries on which the system is based; nonetheless, the representatives of the European Commission point out a certain degree of flexibility of the Directive, which permits domestic adjustment of the system so as to best correspond to the national circumstances in each individual state.

In spite of certain difficulties, the participation of Czech enterprises in a trading system at the level of the Communities seems, in any case, to be beneficial, primarily because of the expected lower costs for reduction of pollution, Czech enterprises could exploit this advantage through sale of the emission units saved. Other advantages include participation in a supra-national trading system, which would force enterprises to think in a broader context and, in addition, also implementation of instruments, including the necessary institutional structures, which could be utilised in the future for reducing GHGs emissions at the level of CR (if this need is identified in the future).

As this is a subject area that is closely related to circumstances in industrial enterprises, the formation of a working group has been initiated for implementation of this Directive, which will consist mostly of representatives of federations of enterprises or key enterprises, which would participate in a potential trading system. It is the purpose of this group to discuss the basic principles of the system with representatives of companies, and also to prepare and propose those parameters of the system that can be adjusted to national circumstances. The composition of the working group is conceived so as to represent all the key sectors from the standpoint of the scope of effect of the prepared Directive and further professionals and experts may be invited to meetings.

In parallel with resolving specific problems in allocation of emission allowances, consideration will also be given to the aspect of incorporation of the Directive into the national legislation, which will be resolved with the relevant professional departments of the Ministry of the Environment. Because of the limited time available, the legislative process must be accelerated as much as possible so that trading can be commenced at the required time (January 1, 2005).

10.2.2. Interconnection of the System of Trading in Greenhouse Gas Emission Allowances with the Project Mechanisms of the Protocol

Very soon after preparing the proposal for trading at the company level (described above), work was commenced on preparation of a separate Directive to deal with mutual interaction of project flexible mechanisms of the Protocol (JI and CDM) and emission trading at the level of the Communities. It follows from the above text that, although in all cases reduction of GHGs emissions is entailed, and in fact the same target is concerned (the target defined in the Protocol), instruments at different levels and with different philosophies are involved. While flexible mechanisms are mechanisms between signatories of the Protocol (i.e. states), trading in the framework of the Communities will occur at the level of enterprises and trading in allowances as such is not in any way outlined in the framework of the Protocol (this is an EU internal instrument). On the other hand, the question arises of whether enterprises that obtain individual obligations for reduction in the framework of the trading system (a given number of allocated allowances) could, in meeting this obligation, employ the potential for investments into measures (projects) defined in the framework of the Protocol (stated simply, the investor would not be the state but an enterprise, which would employ the emission reduction obtained to meet its target). While the rules are more or less fixed for project mechanisms (all projects must conform to the requirements of the Convention and the Protocol), the sphere of entrance of these units into the EU system should be the subject of a separate regulation.

This is a result of the complexity of the whole area and also the need to cover certain problematic points, as the mutual interaction of two different systems is involved and there are justified fears, e.g., that some emission reductions could be calculated twice (once in the framework of the Protocol mechanisms and then in the framework of the EU system). It can be stated that the amount of emission reduction from flexible mechanisms will probably be quantitatively limited and certain limitations will be established for interconnection of the two systems. In connection with national circumstances in CR, it can be stated that the scope for implementation of JI projects is further reduced by this proposal and, although it depends on the final form of the proposal, which is not yet known, it is already certain that the approach of CR in the area of project mechanisms will have to be re-evaluated. For this purpose, comprehensive material is currently being prepared to newly define the methodical approach to the subject of projects and which will be based on experience in practical implementation of JI projects. The final form of this methodical approach was expected at the beginning of 2004.

10.3. Proposal of Targets and Measures in the area of Climate Change for the Czech Republic

The submitted National Program to Abate the Impacts of Climate Change in CR is a logical continuation of procedures that were commenced for adopting the Protocol and led in 1999 to the Strategy for Protection of the Climate System of the Earth in the Czech Republic and Government Resolution No. 480/1999. International negotiations have progressed

considerably since that time and a number of the general intentions of the Protocol have been elaborated in detail. Similarly, the position of CR changed considerably with the approaching date for accession to EU, and thus it is necessary to react to this situation in a suitable manner.

Total GHGs emissions controlled by the Protocol have decreased since 1990 by approximately 25 % and have remained stabilized at this level since at least 1994 (Chap. 5). Projections for further trends in GHGs emissions (Chap. 6) indicate a continuation in the stabilisation or reduction trend and the reduction in total GHGs emissions during the first commitment period of the Protocol (2008 - 2012) should be at the level of over one third less than the level in 1990. Consequently, there is a guarantee that CR will meet the existing quantitative commitment in relation to the Protocol and will also meet the internal national target laid down by the State Environmental Policy of 2001.

10.3.1. Reduction Targets

In spite of a considerable reduction in the nineties, the energy intensity of GDP creation remains high and there is still a high volume of GHGs emissions per capita. As these indicators, which are not very auspicious for CR (Chap. 5.4), may also be taken into account in international negotiations on prospective targets of the Protocol after 2012, CR must attempt to bring these values closer to the values for the EU member states in the near future. This is the main reason for setting the following targets and policies and measures for reduction of GHGs emissions:

- After the end of the first commitment period of the Protocol, reduce CO_2 emissions per capita to 2020 by 30 % compared to 2000,
- After the end of the first commitment period of the Protocol, reduce total aggregate CO_2 emissions to 2020 by 25 % compared to 2000,
- continue in the commenced trend to 2030,
- increase the share of renewables in primary energy sources consumption to 6 % by 2010 and to 20 % by 2030.

The following instruments should be employed to achieve these emission reduction targets:

- reduce energy intensity in the area of production, distribution and final consumption of energy to a level of 60 % to 70 % of current primary energy sources consumption of in 2030;
- introduce an environmental tax reform,
- increase the share of use of biofuels to 5.75 % in 2010 and attain a fraction of 20 % of use of all alternative fuels in transport in 2020.

10.3.2. Reduction and Adaptation Measures

As a new member state of EU, it is necessary to carry out work in CR parallel to the set of measures that is analysed in the European Climate Change Programme (Chap. 3) and, **as a priority for formulation of further policies and measures to reduce GHGs emissions, recommend** (key sectors directly affected by the given group of measures are identified in brackets; other sectors may be affected by the given measures indirectly or marginally):

In the area of energy production (MoIT, MoE):

- development of the internal market in electricity and gas taking into account environmental priorities,
- ensuring access to distribution networks for decentralised electricity production,
- an increase in the fraction of renewable sources in energy production,

- internalisation of external costs caused by all negative emissions,
- timely publication of environmental tax reform for investors,
- an increased fraction of combined production of heat and electrical energy,
- reduction in methane emissions in mining and extraction of coal,
- support for a change in technology using more effective and cleaner fossil fuels,
- an increase in energy efficiency in production of energy.

In the area of energy consumption:
amongst retail consumers (MoIT, MoE, MRD):

- increasing public awareness of energy-efficient end appliances,
- support for further development of energy audits, energy certification of buildings, introduction of regular controls of the efficiency of small and medium heating sources,
- improvement of thermal insulation of buildings, increased efficiency of lighting systems and ventilation systems and improvement of land-use planning and infrastructure construction,
- promotion of sustainable construction.

in the sector of industry and trade (MoIT):

- increasing the standards of energy efficiency of energy-production furnaces, energy distribution systems and electrical instruments,
- increasing the standards of efficiency in industrial processes,
- development of instruments to reduce emissions of partly and fully fluorinated hydrocarbons and emissions of sulphur hexafluoride.

in the transport sector (MT, MoE):

- extension of the conceptions of environmentally sound operation of passenger cars and light trucks and support for development of alternative fuels for motor vehicles (biofuels, natural gas),
- an information campaign to support environmentally sound means of propelling motor vehicles,
- revision of conceptual materials in the transport sector, support for combined transport and urban mass transport and modification of transport price policy,
- increasing the capacity of roadways,
- support for bicycle transport through construction of cyclist routes and accompanying infrastructure.

In the area of waste management (MoE, MoIT):

- improvement of the separation and processing of biodegradable waste,
- increased efficiency of waste water treatment in relation to optimal energy use of biogas in anaerobic processes,
- revision of packaging management and use of packaging technology,
- support for the use of landfill gases for production of heat and electricity.

From the standpoint of increasing sinks of GHGs, the following can be recommended (MA, MoE):

- restoration of river systems and planting of vegetation,
- planting of vegetation in territorial systems of ecological stability (TSES),
- greater utilisation of afforestation,
- part of the financial means of SEF obtained from pollution sources should be transferred to the forest fund specifically for use for liming, fertilising, adjustment of soil pH, etc.

The flexible mechanisms of the Protocol and their implementation in CR can also contribute to global reduction of emissions. Consequently, the following must also be considered to be further priorities:

- improvement of the conditions for smooth technical implementation of JI projects and meeting of Track I requirements in the shortest possible time,
- creation of requirements for introduction of GHGs emissions trading in according to Article 17 of the Protocol.

In this connection, the EU legislation in the area of trading in GHGs emissions at the company level should be mentioned, as this will have an important connection in implementation of measures in the affected sectoral economies and which, in the coming years, will become one of the key elements in policy in the area of reducing emissions. Its timely implementation of all provisions needed for smooth and timely operation of the trading system at the level of EU-25 must thus be a clear priority for both MoE and MoIT.

However, according to the Protocol, reduction of GHGs emissions is a necessary but not a sufficient condition for meeting the international obligations of CR. It is necessary to concentrate on:

- preparation of appropriate provision for completion of GHGs emission inventory recalculations for the period since 1990 according to the relevant methodologies and authorizing the national inventory expert team (MoE),
- preparation of information on parameters of calculations of emission sinks in the forestry sector and changes in the use of the landscape as compliance with obligations given by decisions 11/CP.7 and 19/CP.7 (MoE, MA),
- preparation and entering into operation of the national registry system (MoE),
- elaboration of specific adaptation measures to abate the impacts of climate change on the regional level (particularly MoA, MoRD, MoE, MoH),
- economic evaluation of proposed adaptation measures and their implementation in the sectors of hydrology, agriculture and forestry (particularly MoA, MoRD, MoE, MoH),
- promotion of scientific research on regional and local climate change impacts and improvement of systematic observation (MoE) and

- an increase in the level of education and public awareness (MoE, MoEYS).

Specific sectoral adaptation measures that can be recommended are as follows:

in the water management sector (MoE)

- implementation of policies and measures leading to an increase in the water retention properties of the landscape, restoration of individual systems, prevention of deterioration of water quality by contamination, increasing the safety of water-powered constructions against overflowing, a change in the controllable retention space, an increase in the capacity of safety overflows, increasing the effectiveness of management of water-powered structures under nonstationary conditions and of the decision-making process during extreme, hazardous and dangerous situations,
- achieving greater flexibility and effectiveness of the water management system and comprehensive and integrated use of water sources,
- preparation of appropriate provision for safe passage of major floods through the affected territory and continuous increasing of the water retention ability of the landscape,
- reduction of losses in water distribution systems, reduction of water consumption requirements and minimisation of river pollution.

in the agricultural sector (MoA)

- change in cultivated species of agricultural crops and farm animals (introduction, improvement),
- use of new agro technical management methods to reduce losses of soil moisture,
- implementation of provisions for reproduction of soil fertility, increasing the stability of soils to reduce soil erosion or improvement and extension of the irrigation systems to secure production of special crops,
- application of suitable methods to eliminate an increased pressure from infectious diseases, caused by fungi and insects, and the increased competitive pressure of growth of weeds.

in the forestry sector (MoA, MoE):

- increasing the adaptation potential of forests through species, genetic and age diversification of tree stands,
- change of the species composition of stands (premature felling of stands of narrow-leaved species, especially spruce, and replacement of single-species stands by mixtures of tree species) and a change in the clear-cutting method of management for undergrowth methods,
- elimination of the risk of an increase in the number of insect pests, vascular mycosis and especially root rot.

in the health sector (MoH)

- cooperate with the relevant sectors in improving the public warning systems on potential dangers and increase information levels, allowing a change in the behaviour of the population during the extreme weather events episodes.

Experience from abroad has indicated that adaptation measures are in many cases economically very acceptable, especially over the longer period. It also creates the need for support for scientific research on the climate change impacts at the national and regional level, an improvement of systematic observation and forecasting and integrated warning systems.

The set of targets, instruments and priorities set forth above must be incorporated in concrete form in the conceptual materials of all the sectors and local governments (regions, municipalities, cities) that can contribute in any way to reducing the risk of disturbance of the climate system of the Earth or could be affected by such a risk (i.e. especially the Ministry of the Environment, Ministry of Industry and Trade, Ministry of Transport, Ministry of Agriculture, Ministry of Finance, Ministry of Foreign Affairs, Ministry of Education, Youth and Sports, Ministry for Regional Development and Ministry of Health). This elaboration must also include estimates of the costs of achieving the recommended targets for reducing GHGs emissions by 2020 and 2030 (Chap. 9).

CR is aware that, in the spirit of current scientific knowledge, anthropogenic production of greenhouse gases actually does affect the climate system of the Earth (Chap. 2). Nonetheless, due to the complexity of the climate system, including all the mutual interferences, it is, however, not possible to quantify the anthropogenic contribution to overall climate change at the present time. Nonetheless, any further increase in temperature will destabilise the climate system even further, which will be manifested in different ways in various parts of the planet and the individual components of the natural environment will react differently to this.

In assessing global impacts of the increase in anthropogenic GHGs emissions and the search for suitable measures, it is necessary also to take the following factors into account in a broader context:

- The Protocol, targeted at reducing GHGs emissions by the 2008 - 2012 period by 5.2 % compared to 1990, has not yet come into force.
- According to the IPCC estimates, to reduce GHGs atmospheric concentrations to the preindustrial level of about 280 ppm, which could prevent negative interaction with the climate system, would entail the need for further GHGs emissions reduction by more than 50 %.
- The national contribution to global GHGs emissions equals approx. 0.5 %, while, e.g., the contribution of USA (which has refused to ratify the Protocol) is 25 % and the contribution of Russia (which has not yet decided about ratification) is 12 %.
- Costs of GHGs emissions reduction increase exponentially with increasing size of the reduction target and, in some sectors, could reach a level that will be economically, socially and politically unacceptable for some countries (for example, this was the reason why USA refused to ratify the Protocol, similar to fundamental changes in the position of EU towards emission trading in recent years).
- The climate change impacts , whether caused by natural fluctuations or anthropogenic influence, will be manifested differently in different parts of the world. Under the national circumstances it can be expected that the weather will change towards more frequent occurrence of extreme meteorological phenomena, towards longer very warm episodes accompanied by drought, alternating with more frequent occurrence of relatively short but very intense precipitation, during which local flooding or floods cannot be excluded, i.e. weather that has occurred with increasing frequency in recent years and which must be very seriously expected in the future.
- In the longer term, support for research and development of new technologies and energy sources with reduced environmental impacts will contribute to GHGs emissions reduction.
- For better use of renewable energy sources, it is necessary to emphasise a further reduction in specific investment costs, which can improve their competitiveness compared with classical energy sources.

- Emphasis should also be placed on reduction of emissions of precursors (NO_X, CO, NMVOC and SO_2).
- Policies and measures should be oriented towards emission reduction for fluorinated hydrocarbons (HFCs, PFCs, SF_6).
- Emphasis should be placed on reducing or abolishing of combustion of coal and coal sludges in local heating units, also because of other parallel detrimental impacts on the environment and the quality of the lives of individuals.

The National Program outlines the position of CR in relation to one of the most serious environmental issues of the contemporary world for the period to 2020, where this is an open document, which will be regularly evaluated and which can be amended at any time according to developments in international negotiations.