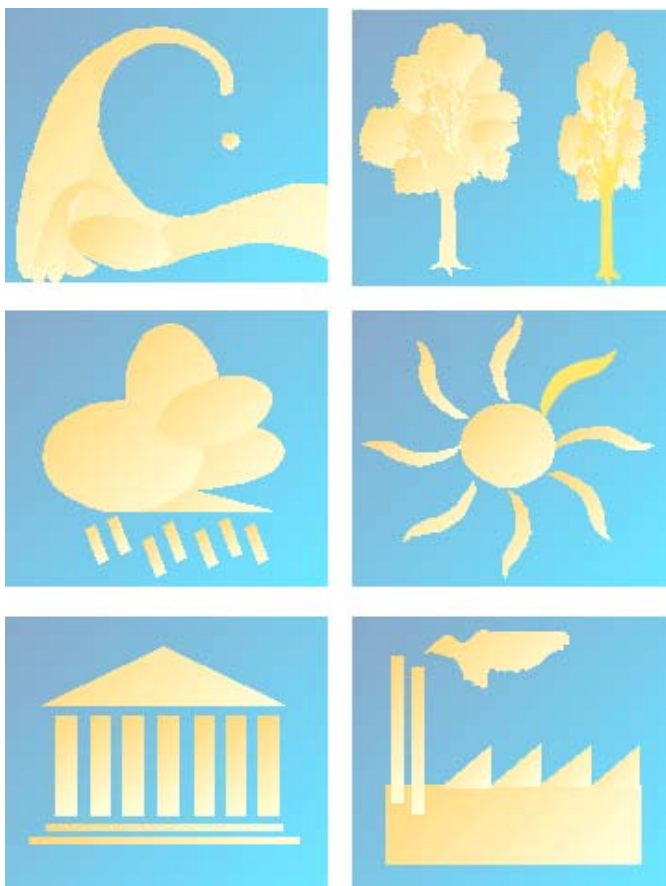


# HELLENIC REPUBLIC

MINISTRY FOR THE ENVIRONMENT, PHYSICAL PLANNING  
AND PUBLIC WORKS

## REPORT ON DEMONSTRABLE PROGRESS UNDER THE KYOTO PROTOCOL



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## 1 INTRODUCTION

In response to the emerging evidence that climate change could have a major global impact, Greece formulated and implemented policies to restrict its greenhouse gas (GHG) emissions since early 1990s. Greece adopted the 1<sup>st</sup> National Programme for Climate Change in 1995, in the context of which a realistic target for Greece that called for the restriction of the overall increase of three GHG (CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>) to 15% ± 3% by 2000 compared to 1990 levels was adopted. In 2002, the 2<sup>nd</sup> National Programme for Climate Change (2000-2010) was formulated and approved and included additional policies and measures necessary for Greece to meet its Kyoto target, i.e., restricting the increase of six GHG (CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, HFC, PFC and SF<sub>6</sub>) emissions to 25% over the time period 2008–2012, compared to base year emissions

In the 2<sup>nd</sup> National Programme for Climate Change, the development of the appropriate infrastructure for *enhancing the penetration of natural gas* into the Greek energy balance as well as the formulation of supportive policies for the further *exploitation of Renewable Energy Sources* (RES) constituted the major strategic themes of the national energy policy. To this end, significant economic resources were made available to support these policies in the context of the 2<sup>nd</sup> and 3<sup>rd</sup> Community Support Frameworks as well as through the National Public Investment Programme.

Apart from these two basic policy actions, the 2<sup>nd</sup> National Programme for Climate Change (as was also the case for the 1<sup>st</sup>) comprises a number of measures aiming at reducing GHG emissions in all sectors of the economic activity, the implementation of which is associated with the introduction of the appropriate legislative framework and/or the establishment of other supportive policies. Specifically, these actions are mainly concentrated on:

- ❑ The *reduction of GHG emissions from the power generation sector*. Basic tools are the development of the appropriate legislative framework for the liberalization of the electricity market, the operation of an emissions trading system since 2005, and the Directive 2001/77/EC for the promotion of electricity produced from RES in the internal electricity market.
- ❑ The *promotion of energy conservation measures in industry*. Key actions for the implementation of these measures are the operation of the emissions trading system for selected industrial sectors and units as well as the adoption of the Directive 2004/8/EC on promotion of cogeneration.
- ❑ The *implementation of measures for reducing GHG emissions in the transport sector*. The adoption of the Directive 2003/30/EC for the promotion of the use of biofuels, the voluntary agreement between the European Commission and motor manufacturers (ACEA, KAMA, JAMA) for the introduction of low emissions vehicles in the market, as well as the enhancement of public means of transport are the basic policies to this direction.

- ❑ The *promotion of energy conservation measures in the residential and tertiary sector*. Crucial action for the implementation of these measures is the adoption of the Regulation for Energy Performance of Buildings, which will also incorporate into the national legislative framework the corresponding EC Directive (2002/91/EC).
- ❑ The *implementation of measures for reducing GHG emissions from industrial processes*. In this context the Regulation (EC) 2037/2000 of the European Parliament and of the Council on the substances that destroy the ozone layer was already adopted. This Regulation adopts a time schedule for the reduction of HCFC-22 production (which results in the restriction of HFC-23 production), with specific quantitative targets for the periods 2000 – 2007, 2008 – 2013, 2014 – 2020 and 2021 – 2025 compared to 1997 production. Production of HCFC -22 is not allowed after 31 December 2025.
- ❑ The *implementation of measures for reducing GHG emissions from the waste sector*. The Council Directive 1999/31/EC on the landfill of waste, using the 4-year grace period to reach the targets set by the Directive for biodegradable waste has been adopted in the national legislative framework and is already being implemented.
- ❑ The *adoption of measures reducing GHG emissions from agriculture sector*.

In the following of chapters of this Report, details of the various policies and measures implemented, adopted or planned in Greece for reducing GHG emissions are presented. The effectiveness of the various policies and measures is also examined as is the extent to which their implementation can result in the achievement of the Kyoto Protocol target for Greece. Finally, the overall progress that has been made to-date with regard to the rest of its obligations under the Kyoto Protocol is described.

## 2 DESCRIPTION OF POLICIES AND MEASURES

### 2.1 Policy Making Process

The Ministry for the Environment, Physical Planning and Public Works (MEPPPW) is the main governmental body entrusted with the development and implementation of environmental policy in Greece. MEPPPW is responsible, among others, for the formulation of policies concerning environmental protection, for the coordination of implementation efforts and to ensure compliance with the current legislative framework. For this purpose, MEPPPW cooperates both with other competent ministries and with regional, prefectural and local authorities. Other ministries are responsible for integrating environmental policy targets within their respective fields (see **Table 2.1**).

**Table 2.1 Responsibilities of other Ministries (except MEPPPW) concerning issues of environmental policy in Greece**

Ministries	Responsibilities
Ministry of Rural Development and Food	Protection of forests – Management of water resources for agricultural use – Implementation of agricultural/environmental measures – Information of farmers on environmental issues
Ministry for the Aegean & Island policy	Environmental management and sustainable development of the Aegean islands
Ministry for Development	Control of fuel quality - Management of water resources – Industrial development and prevention of pollution – Energy policy – Severe Industrial accidents
Ministry of Mercantile Marine	Protection of marine environment
Ministry of Foreign Affairs	International environmental obligations
Ministry of Employment and Social Protection	Safety in the environment of work – Risk management in professional places
Ministry of the Interior, Public Administration and Decentralisation	Natural and technological disasters
Ministry of Macedonia and Thrace	Pollution control of in North Greece
Ministry of Transport and Communications	Control of vehicles
Ministry of Economy and Finance	Support of environmental investments – Energy and Environmental taxation - System of products distribution
Ministry of Culture	Conservation of historical and cultural monuments
Ministry of Health and Social Solidarity	Management of environmental risk and hygiene
Ministry of Tourism	Touristic policy and environment

The responsibilities on environmental issues at regional level concern the approval of environmental impact studies and the issuance of decisions on environmental terms. The responsibilities of prefectural authorities concern, among others, (a) the development and application of environmental policies and strategies at local level, (b) the adoption of Prefectural or Common Prefectural Decisions on local environmental issues, and (c) the implementation of

the physical planning projects which have been approved by the Ministry. Finally, the municipal and community authorities are responsible for licensing procedures for installations in urban areas, including specific industrial installations, as well as for issues related to solid waste disposal on land.

Climate change mitigation is one of the main targets identified in the Greek policy for sustainable development launched by MEPPPW in 2002. The objective of the strategy is the development of a set of principles for the formulation of an action plan in line with international challenges, and in accordance with EU policy directions and adjusted to the specific national circumstances. The key environmental issues examined in this framework are:

- Climate change mitigation
- Reduction of air pollutants
- Reduction and rational waste management
- Rational management of water resources
- Prevention of desertification
- Protection of biodiversity and ecosystems

Policies and measures, as well as all other issues and actions regarding mitigation are discussed within the framework of an inter-ministerial committee, comprising representatives from the following ministries/organisations:

- Ministry for the Environment, Physical Planning and Public Works
- Ministry of Foreign Affairs
- Ministry of the Interior, Public Administration and Decentralization
- Ministry of Economy and Finance
- Ministry for Development
- Ministry of Mercantile Marine
- Ministry of Transport and Communications
- Ministry of Rural Development and Food
- Public Power Corporation

Greece ratified the Kyoto Protocol in 2002 (Law 3017/2002) and adopted a National Programme (MEPPPW / NOA 2002) for achieving its commitment by a decision of the Council of Ministers (DCM5/2003). By Law 3017/2002 the MEPPPW is designated as the governmental body responsible for the coordination, within its responsibilities, of all other competent ministries and possibly any other public and / or private entities involved, for:

1. the implementation of the provisions of the Kyoto Protocol and
2. the formulation and monitoring of the National Programme for achieving the national targets set under the Kyoto Protocol.

Moreover, with this law it is defined that all issues related to the implementation of the provisions of the Kyoto Protocol, including among others, the establishment of the necessary administrative structures and procedures, enforcement rules, etc. are to be resolved and adopted by Common Ministerial Decisions of the Minister for the Environment, Physical Planning and Public Works and other, as appropriate, competent Ministers. The same procedure is to be followed in order to introduce into the national legislation any decisions of the COP and/or COP/MOP or any necessary modifications to the National Programme.

With the Common Ministerial Decision 54409/2632 (2005), the Directive 2003/87/EC «establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC» has been transcribed into the Greek legislation. With this Decision, the Ministry for the Environment, Physical Planning and Public Works is designated as the responsible authority for the implementation of the relative provisions. The co-ordination of all competent authorities is assigned to a seven-member inter-ministerial committee (3 members from the MEPPPW, 2 members from the Ministry for Development and 2 members from the Ministry of Economy and Finance). The competent authority for the monitoring of the implementation of the provisions of the Directive 2003/87/EC is assigned to Office for Emissions Trading, established in the framework of the above-mentioned Decision, and operating within the Directorate General for the Environment. Finally, with the same Decision the National Centre of Environment and Sustainable Development, an institute supervised by MEPPPW, is responsible for operating the National Registry.

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## **2.2 Policies and Measures per Sector**

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### ***2.2.1 A brief history***

In response to the emerging evidence that climate change could have a major global impact, the United Nations Framework Convention on Climate Change (henceforth the Convention) was adopted on 9 May 1992 and was opened for signature in Rio de Janeiro in June 1992. Greece signed the Convention in Rio and ratified it in 1994 (Law 2205/94) and adopted the 1<sup>st</sup> National Programme for Climate Change. In the context of this Programme the Greek government, after taking into consideration both economic and social parameters, agreed that a realistic target for Greece was the restriction of the overall increase of three greenhouse gases (CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>) to 15% ± 3% by 2000 compared to 1990 levels. The measures to be taken in order to achieve this restriction in the CO<sub>2</sub> emissions were stated in the 1<sup>st</sup> Greek National Action Plan for the

abatement of CO<sub>2</sub> and other gases emissions which were described in the 1<sup>st</sup> and 2<sup>nd</sup> National Communications submitted to the UNFCCC in 1995 and 1997 respectively.

Recognizing early on the need for an effective instrument to provide confidence in addressing the climate change challenge, the parties at the 3rd meeting of the Conference of the Parties (COP) to the Convention, held in Kyoto (1-11 December 1997), finalised negotiations related to the establishment of such a legal instrument, the Kyoto Protocol on Climate Change (henceforth the Protocol). The Protocol provides a foundation upon which future action can be intensified. It establishes, for the first time, legally binding targets for the reduction of greenhouse gas emissions and it confirms the capacity of the international community to cooperate in action to deal with a major global environmental problem. The Protocol calls for legally binding commitments of the developed countries to reduce, individually or jointly, emissions of 6 greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFC, PFC and SF<sub>6</sub>) by more than 5% in the period 2008 to 2012, below their 1990 level. The EU and its Associated Counties agreed to a -8% reduction, US to -7%, Japan to -6% while other countries such as Russia and Australia had to stabilize their emissions at 1990 levels.

With respect to the EU target under the Kyoto Protocol (i.e. reduction of emissions at 8% for the period 2008-2012), EU has stated that this will be achieved jointly by EU Member-States under the provisions of Article 4 of the Protocol. The Burden-Sharing agreement between all Member States was finalised during the Environment Council in June 1998 and entered into force with Decision 2002/358/EC concerning the approval, on behalf of the European Community, of the Kyoto Protocol. According to this agreement, Greece is committed to limit its GHG emissions increase for the period 2008 – 2012 to +25% compared to base year emissions (1990 for CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions, and 1995 for the f-gases). Greece ratified the Protocol in 2002 (Law 3017/2002) and adopted the 2<sup>nd</sup> National Programme for Climate Change (2000-2010) for achieving the above-mentioned commitment by a decision of the Council of Ministers (DCM5/2003).

## ***2.2.2 Supporting policies for the restriction of GHG emissions***

### ***2.2.2.1 The 2nd National Climate Change Program of GHG emissions reduction for the period 2000-2010***

The 2<sup>nd</sup> National Climate Change Programme, that was elaborated and adopted in 2002 (Act of the Ministerial Council 5/27.02.2003, Official Journal of the Hellenic Republic A' 58 – 05.03.2003) defines the additional policies and measures necessary for Greece to meet its Kyoto target, i.e., restricting the increase of GHG emissions to 25% over the time period 2008–2012, compared to base year emissions. The 2<sup>nd</sup> National Program has been presented in detail in the 3<sup>rd</sup> National Communication on Climate Change. The main actions foreseen include:



- Further penetration of natural gas in all final demand energy sectors as well as in power generation, including co-generation.
- Promotion of renewable energy sources (RES) for electricity and heat production.
- Promotion of energy saving measures in industry and in the residential – tertiary sectors.
- Promotion of energy efficient appliances and energy equipment in the residential – tertiary sectors.
- Structural changes in agriculture and in chemical industry.
- Emission reduction actions in transport and waste management sectors.

The implementation of policies and measures included in the 2<sup>nd</sup> National Program is at its initial phase. Some major parts of the program, as for example the penetration of natural gas into the energy system as well as the further development of RES, have made considerable progress, while additional supporting actions for the continuation and enforcement of these actions (e.g. completion of the legislative framework for the liberalization of electricity and energy markets that will allow the installation of new power generation units using natural gas as fuel, extension of the natural gas networks in the cities, enforcement of electricity transmission networks that will allow the exploitation of the rich wind potential of some remote areas, etc.) have been adopted. Actions to introduce energy conservation measures in the residential/tertiary sectors on the other hand, have encountered major delays due mainly to administrative problems in the adoption of the Regulation for Rationale Use and Conservation of Energy, which is also to incorporate the Community Directive 2002/91/EC for energy efficiency of buildings.

#### *2.2.2.2 Emissions trading system*

In 2005 the European CO<sub>2</sub> emissions trading system (EU-ETS) started operating. It covers a number of industrial and energy sector installations which exceed specific capacity limits set by Community Directive 2003/87/EC. The major objective of EU-ETS is to help the EU Member States to achieve their obligations in the frame of the Kyoto Protocol in terms of economic efficiency.

In brief, the basic functional characteristics of the emissions trading system include: (a) the determination of a number of emissions allowances which are allocated a priori in the liable installations based on specific rules, while the above mentioned installations are obliged to hand over emissions allowances in annual base equal to the CO<sub>2</sub> emissions that emitted in the year in question, (b) the total number of allowances for distribution is lower than the emissions that the indebted installations would emit if the trading system did not exist, so that the created closeness of allowances constitutes an incentive for emissions reductions, (c) in the first implementation period (2005-2007) the trading of allowances is limited to CO<sub>2</sub> and in installations of specific industrial sectors which exceed the predetermined capacity limits (in the future the Directive can be modified and include also other gases and/or sectors), (d) the distribution of emissions

allowances is made on the basis of an allocation plan which is formulated, placed on consultation and is completed before the beginning of the trading period, (e) a strict framework for monitoring and compliance enforcement of the liable installations is put in place which provides for substantial fines in case on non-compliance, and (f) all the transactions of emissions allowances are recorded in national and interconnected community-wide Registries.

In Greece, the trading system comprises 141 existing industrial installations and 27 new installations that are expected to start their operation during the period 2005-2007 (new entrants). An allowance reserve is also created which is intended to cover possible unknown new entrants in the period. According to the data presented in the National Allocation Plan (NAP), total CO<sub>2</sub> emissions from installations included in the EU-ETS are estimated at 228.1 Mt CO<sub>2</sub>, for the three-year period 2005-2007, while the allowances that will be allocated during the same period were fixed at 223.3 Mt CO<sub>2</sub> (namely a decrease of emissions by 2.1% is required by the enterprises that participate in the system).

### *2.2.2.3 Operational Programme Competitiveness (OPC)*

The Operational Programme Competitiveness of the Ministry of Development, which comes under the 3rd Community Support Framework (3rd CSF) for the period 2000-2006, constitutes one of the major tools for the promotion of interventions that may lead to GHG emissions reduction. The total budget OPC amounts to €6.6 billion, of which the community contribution is 2.06 billion €, the Greek public spending €1.29 billion and the private funding €3.32 billion.

The OPC includes 9 priority sectors with 41 measures, which in turn comprise a total of 134 actions. These actions are designed to implement the corresponding policies in the Programme's areas of intervention. A central feature of the Operational Programme is to support entrepreneurship in such areas as new technologies, the liberalized energy markets, environment, tourism but also to fund actions for business modernization, especially addressed to small and medium-sized enterprises engaged in manufacturing-processing, tourism and the service sectors. Under the OPC, projects are promoted projects to upgrade industrial regions, the national quality assurance system, energy infrastructures and regional structures providing information, consultation, education and management support to businesses.

As reported analytically below, the OPC aims to finance or co-finance the further development of infrastructure for the penetration of natural gas (through interconnections with networks of natural gas of neighbouring countries, further development of local networks, etc.) and RES into the electricity system (through the development of special energy infrastructures, interconnection of island grids, upgrading of electric transmission networks, etc.). It also finances specific investments for energy savings, installation of co-generation systems, installation of RES systems, etc. The total cost of measures in the OPC that aim at the further penetration of natural gas and RES as well as in the implementation of measures for energy saving amounts to €2.27 billion (34% of the total budget of the program), of which the public expenditure is €0.54 billion.

#### *2.2.2.4 Operational Programme Environment (OPE)*

The Operational Programme Environment, which also comes under the 3rd Community Support Framework, promotes inter alia special actions for the reduction of atmospheric pollution, particularly for the regions of Athens and Thessalonica. It also finances or co-finances actions for the reinforcement of infrastructure for monitoring the quality of atmospheric environment and developing information management systems that support measures for the reduction of atmospheric pollution, as specified in relevant European Legislation.

Specifically, it includes measures, actions and interventions aiming at:

- Fulfilling the country's commitments that arise from the relative Directives of the EU and international conventions.
- Interventions in the sources of atmospheric pollution.
- Actions for the fulfilment of obligations which arise from international Treaties and Conventions concerning climate change issues and protection of the ozone layer.
- Traffic management in the big urban centres of the country.
- Reducing noise in urban and tourist developed regions.

The total budget for OPE is €21.47 million and the implementation of its actions is expected to also contribute to the restriction of GHG emissions.

### *2.2.3 Key policies and measures*

#### *2.2.3.1 Promotion of natural gas*

The introduction of natural gas into the national energy system is one of the largest investments ever carried out in Greece. An important part of the infrastructure that is mainly related to the high-pressure transmission system and the medium-pressure network, which are necessary to transport of natural gas to the main consumption regions, has been completed. The development of low-pressure networks in the cities is ongoing and is also financed in the framework of OPC.

The penetration of natural gas into the Greek energy system constitutes a high priority of the Greek energy policy. This is also reflected in the pricing policy that has been adopted for natural gas. The Value Added Tax (VAT) is fixed at 9%, while the consumption of natural gas is exempted from any excise tax up to 1 Jan 2014. With the incorporation into the national legislative framework of Directives 1998/30/EC and 2003/55/EC, the liberalization of the gas market has started, while a number of issues concerning natural gas supply and transmission, the role of Regulatory Authority for Energy, the enhancement of gas security of supply etc. are also addressed.

In the context of OPC, funding of €800 million has been provided to the Public Gas Corporation investment programme for the period 2000-2006 for a number of projects that (a) enhance access to alternative sources of gas supply through the connection of the Greek system with Italy and Turkey - Actions 6.1.1 and 6.1.2 of the OPC -, (b) upgrade of the terminal station of Liquefied Natural Gas of Revithousa - Action 6.2.1 of the OPC -, (c) further increase penetration of natural gas in big industrial consumers as well as in the sector of transports - Actions 7.1.2 and 7.1.3 of the OPC -. Also, with the Action 7.1.1 of the OPC the extension of the cities networks aiming at a further penetration of natural gas in the residential - tertiary sectors is financed.

According to the most recent energy balance (2003), the penetration of natural gas seems to be at satisfactory levels in the power generation sector (1462 ktoe) where the installed capacity of power units that use natural gas has reached 1581MW as well as in the industrial sector (504 ktoe), but less so in the residential and tertiary sectors (a total consumption of approximately 46 ktoe has been recorded) mainly due to delays in the development of the low-pressure networks in cities. Small quantities of natural gas (approximately 12 ktoe) were also consumed in the transport sector where CNG buses were introduced into the Athens public transport network in 2000.

### *2.2.3.2 Improvements in the conventional power generation system*

PPC, the basic player up to now in the domestic electricity market, has been actively involved in the field of energy conservation both in its internal activities as well as in implementing demand side management projects. The main actions of PPC include: (a) efficiency improvements in the existing lignite-fired power stations through the technical enhancement of boilers, turbines, lignite mills, cooling towers and remaining equipment, (b) reduction of distribution losses through the replacement of normal loss distribution transformers and (c) implementation of a cogeneration programme in the lignite-fired power plants by setting up district heating networks in northern Greece.

### *2.2.3.3 Promotion of renewable energy sources*

The Ministry for Development considers the exploitation of renewable energy sources among its energy policy priorities. The OPE (Operational Programme Energy within the 2<sup>nd</sup> Community Support Framework, 1994-1999) and the provisions of the National Development Assistance Act providing investment cost subsidies in combination with Law 2244/93, which specifies favourable buy-back tariffs for electricity generated from renewable energies, were the main policy instruments for the promotion of RES until 2001. In the frame of the OPC both infrastructure projects to assist the further exploitation of RES (Action 2.1.2 "Extension of infrastructure of technical support in co-production, RES and energy conservation") as well as RES investments in the private and public sector (Measures 2.1, 6.3, 6.5) are supported. It should be also noted that Directive 2001/77/EC for the promotion of electricity produced from renewable

energy sources in the internal electricity market (Greece has an indicative target for the electricity production by RES to reach 20.1% by 2010) as well as Directive 2003/30/EC for the promotion of the use of biofuels or other renewable fuels for transport (in Greece consumption of biodiesel and ethanol should reach a percentage of 5.75% of the total consumption of diesel and gasoline in road transport by 2010) have been already incorporated into the national legislative framework.

As regards **wind energy**, the total installed capacity of wind systems in Greece reached 371MW in 2003, generating 1021 GWh of electricity, while in 2005 the installed capacity exceeded 470MW. Through the Operational Programme Energy (2<sup>nd</sup> Community Support Framework) 14 wind farms (~116 MW) were financed, while additional financing in wind parks was provided through the Development Assistance Acts 1892/1990 and 2601/1998. Support for wind energy is continued in the frame of the OPC through subsidies that amount to 30% of the eligible cost of the investments (in case of generation units) and reach 50% of the investment cost in the case of transmission networks for connecting the installations under development with the electricity grid. The interest of the investors for installation of wind systems is very high, and it is characteristic that the Regulatory Authority for Energy up to now (9/2005) has issued initial installation permits for 363 units reaching 4200MW total capacity. Nevertheless, delays are present in the implementation of the above investments due to bureaucratic problems and the complex institutional framework regarding issuance of installation permits. At the same time, it should be pointed out that areas of high wind potential (island regions, Evia, Lakonia, Thrace) have already attracted a large number of investors so much so that enhancement of the existing transmission lines is now required in order to connect additional planned wind parks. In the framework of OPC, the funding for transmission network enhancement is foreseen both stand-alone island grids (Action 6.3.1 and 6.3.3) and the main the interconnected system (Action 6.3.4). According to the “with measures” scenario, which incorporates the existing and adopted policies and measures for reducing GHG emissions, it is estimated that the installed capacity of the wind parks will reach 1281MW in 2010 and 1670MW in 2015. Also, with the implementation of additional supporting policies the installation of another 600MW is expected in the time horizon of 2010, which can reach 750MW in 2015.

The installed capacity of the **small hydro units** (< 10 MW) in Greece has reached 69MW in 2003. The Development Assistance Act financed 12 investments of small hydro of total capacity 35 MW during the period 1998 – 2001, while the Operational Programme Energy financed 9 investments of a total capacity of 11.5 MW (they concern units with a capacity smaller than 1 MW) during the same time period. The OPC continues to support the realization of small hydro projects under the Action 2.1.3. Support for small hydro projects is also foreseen through the latest Development Assistance Act. As regards **large hydro systems** (including pumped-storage units) their installed capacity reached 3043MW in 2003. Based on implemented and adopted policies and planning, it is estimated that the total installed capacity of hydro units in Greece will amount to 3560MW in 2010 and 3732MW in 2015. Despite already high exploitation of the hydro potential, it is estimated that possibilities for further exploitation of hydro resources is

feasible and based on this, interventions are planned for the additional installation of another 150 MW in 2010 that could reach 350MW in 2015.

The penetration of *photovoltaic units* in the Greek energy system is still limited and the installed capacity barely amounted to 1 MW in 2003. In the framework of OPC (Action 2.1.3), investments of photovoltaic systems are to be supported, while the Regulatory Authority for Energy has issued permits for additional 12 units of total capacity 2MW. According to the “with measures” scenario, a substantial penetration of photovoltaic units in the energy system for the time horizon 2010 and 2015 is not expected. At the same time the installation of photovoltaic units is also promoted in the tertiary sector (approximately 5 MW up to 2010). It should be pointed out that even though the implementation of this measure does not aim at the reduction of large quantities of GHG emissions, acquisition of know-how for future application, when the available technologies will be also more mature in commercial terms, is a very worthwhile gain.

No new substantial investments in *geothermal units* for electricity generation are expected now. Nevertheless, in the framework of the OPC (Actions 6.3.2 and 6.3.5), finance is provided for the preparation, development of infrastructures and installation of geothermal unit in Lesvos island. This installation of a geothermal unit with a capacity of 8MW by 2010 (for which the Regulatory Authority for Energy has already issued a permit) is feasible, while additional units with a total capacity of 12 MW are planned for the next decade.

Exploitation of *biomass* for steam production in industry as well as in power generation, have been financed in the framework of the Operational Programme Energy and supportive policies continue through OPC (Action 2.1.3). Up today, the Regulatory Authority for Energy has issued permits for 17 power units with a total capacity of 57MW that use biomass, while in the interconnected power generation system, small power units that use biomass with an installed capacity of about 22MW are already in operation. The implemented and adopted measures which are incorporated in the “with measures” scenario are expected to lead to an increase of the installed capacity of biomass units of 52MW in 2010, while with the application of additional policies, the further installation of 70MW up to 2010 reaching 100 MW in 2015 is possible. In the industrial sector the use of biomass for steam production constitutes a widespread practice in various industrial sectors. The application of additional measures aims at the further penetration of biomass in the industrial energy balance, increasing its exploitation by 5% in the time horizon of 2010 and by 10% in 2015.

The promotion of *solar collectors* constitutes one of the most important measures of both the 1<sup>st</sup> and the 2<sup>nd</sup> National Programme for GHG emissions reduction. The total surface of installed solar collectors amounted to 3.140.000 m<sup>2</sup> in 2003, the majority of which is used for the production of hot water in the residential sector. The implementation of the measure proceeds satisfactorily. Given however that in the last years the installation rate of new solar collectors has been decreased (to approximately 50.000 – 90.000 m<sup>2</sup> per year), the objective of the 2<sup>nd</sup> National Program for Climate Change for 2010 (i.e. the surface of installed solar collectors to reach 4.5 millions m<sup>2</sup>) for solar panels is difficult to reach and thus suitable additional initiatives should be



undertaken (e.g. enhancement of incentives with the form of tax exemptions, etc). The penetration of solar systems for combined space and water heating in the residential sector as well as the exploitation of solar energy in the industrial sector are currently exceptionally low, and additional supporting promotion policies are required.

Finally, the penetration of *biofuels* in the energy balance of the transport sector began in 2005. According to the 1<sup>st</sup> National report on the Promotion of Biofuels and other Renewable Energy Resources Use in the Sector of Transports in Greece, the consumption of biodiesel and bioethanol in 2010 is expected to reach 5.75% of total diesel and gasoline quantity that is consumed in road transport. In the frame of OPC, the installation of two biodiesel production units (with a total generating capacity of 80.000 t) in Kilkis and in Volos was financed, while according to the L. 3340/2005 the excise tax for these fuels is null for the years 2005 to 2007.

#### *2.2.3.4 Measures in the transport sector*

The main axes of intervention and implemented policies and measures in the sector, beyond the introduction of biofuels for road transports and natural gas in the public system of transport that were already described previously, are shortly presented below:

##### *Interventions in the transport system*

Public works to enhance the existing infrastructure described in the previous National Communications (road-grid improvements in the large urban centres, reconstruction of major highways, improvements in the traffic-light system) are in progress.

##### *Interventions in public transport*

Important interventions have already been implemented or are under development aiming at the enforcement of public transport. Two new metro lines were completed and started operation in 2000 and extended in 2004. An additional 12.8 km of new underground lines of urban railway are now under development and will be completed up to 2009. The operation of suburban railway in the wider area of Athens already started the connection to Corinthos was completed, while the connections with Livadia and Chalcida are expected to operate in 2006. Also in 2004, a new tram started operating in Athens with 2 lines reaching from the centre of the city to the southern waterfront suburbs. Also, an extended network of bus lanes of approximately 48 km length has already been created, resulting in the increase of the average speed of buses in Athens from 16 km/h to 21 km/h. The fleet of buses has been renewed to a large extent, while approximately 416 buses use natural gas as fuel. Moreover the renewal of the fleet of electrically driven buses (trolleys) began in 1998 with the supply of 224 vehicles and was extended with the supply of additional 142 vehicles by the end of 2004. In addition, by Law 2963/2001 (A 268), an age limit of 23 years has been instituted for all urban, semi-urban and long distance buses. Also the limit of 11 years was set as the higher permissible age for buses in public transport. Under the provisions

of the same law, economic incentives were given in the owners for the replacement of vehicles with new or used vehicles of small age. Of the 5.500 buses licensed in Greece, 3.100 buses have been replaced since 2000, of which 2.400 new and 700 used.

Finally, the public transport system in Athens has been reorganized on the basis of the new metro and tram lines, with buses and trolleys also playing a complementary role of connecting the metro and tram stations with other areas of the city.

#### *Interventions in vehicles*

The main regulation that aims at the restriction of GHG emissions from vehicles is the one requiring regular technical checks of vehicles, which has been mandatory since 1983 and takes place at the Centres for Technical Control of Vehicles (CTCV). The law provides for the establishment of private Centres for Technical Control, the improvement of public ones and the development of a special organization to supervise the operation of the above-mentioned Centres. Currently, 58 public and 20 private centres operate in Greece, with 19 new private centres expected to start operation in the coming period. The percentage of vehicles that is checked is still relatively low, as the number of existing CTCVs is not sufficient to cover the needs. If one takes into account that the average annual rate of increase of vehicles the last decade is in the order of 5% the problem becomes even more intense. With the increase of the CTCV number during the next period, the essential conditions and infrastructures for an important increase of the number of checked vehicles per year are created, in accordance with the objectives of the National Program.

An equally important intervention for GHG emissions reduction from vehicles is the exhaust-control card, which is required for all vehicles and should be renewed on an annual basis by private passenger cars and trucks up to 3.5 t. Certified auto-repair shops expressly certified to carry out this task and issue the control card.

The establishment of a renewal program of the fleet of motorcycles, with incentives for the final withdrawal of two-wheeled motorcycles over 50 c.c. and aged ten years and more (categorized until 1994) is another important intervention in the sector of vehicles. The program was put in force with Law 3245/2004 – article 2 (A 110) and its force was extended by Law 3333/2005 (A 91).

Also, by Law 3109/2003 (A 38), the age limits for the withdraw of public use cars (taxi) were revised and scaled from 10 to 21 years, depending on the vehicle's engine displacement, the region and its population. In the framework of the same law, economic incentives were given to the owners of taxis for the replacement of their vehicles with new ones. The result of the measure was the replacement of approximately 9,300 cars out of a total of 35,000 taxis active in the country overall.

Finally, the voluntary agreement between the European Commission and the European, Japanese and Korean car-manufacturers associations to improve the fuel efficiency of new cars is



considered as an adopted measure aiming at the reduction of GHG emissions. The agreement foresees the improvement of the fuel efficiency of new cars, so as the CO<sub>2</sub> emission factor to reach down to 140gr/km in 2008. The measure is expected to have an important long-term output through the penetration of low emissions vehicles in the total fleet.

*Planned interventions* that will contribute in additional GHG emissions reductions, concern the improvement of road signalling which can lead to reductions in the consumption of fuel in the order of 0.8% - 3.5%, as well as the further reinforcement of public transport means aiming at the important increase of their share in transportation work they cover in the large urban centres.

### *2.2.3.5 Measures in the industrial sector*

Energy-efficiency improvements in various areas of the industry sector have been promoted since the 1<sup>st</sup> National Climate Change Program through the provisions of the Development Assistance Acts, Law 2244/93 (for CHP plants) and the OPE (Measures 2.2 and 2.3). The support of energy conservation interventions in industry is also continued through the OPC. Selective projects of energy conservation are being financed (Action 2.1.3) as well as supporting policies for energy conservation in industry (Actions 2.1.1 and 2.1.2).

Concerning *planned interventions*, apart from the further promotion of natural gas and RES (biomass, solar energy) in industry, further implementation of energy conservation programs in various industrial units is pursued to be supported by OPC, the Development Assistance Act and also the operation of the EU-ETS.

### *2.2.3.6 Measures in residential and tertiary sector*

The Community Directive on the "Energy Performance of Buildings" (2002/91/EC) which constitutes an addition to Directive 1993/76/EEC and approaches the subject in the light of new challenges resulted from the Kyoto Protocol implementation has been incorporated to the existing national framework for energy conservation in buildings. The directive proposes specific actions, such as a common methodology of calculation of the integrated energy performance of buildings, energy certification of new and existing buildings, inspection of boilers and minimum requirements on the energy performance. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with the Directive at the latest on January 2006.

The 2<sup>nd</sup> National Climate Change Program includes actions that aim at the conservation and rational use of energy in the buildings of the residential and tertiary sector. Beyond the penetration of natural gas and RES, specific quantitative intervention objectives are set which mainly concern improvement of the thermal behaviour of residential sector buildings, promotion of energy efficient appliances and heating equipment, etc.

It is clear that at a certain degree the interventions identified will be realized because of the expected development of the buildings sector, nevertheless their mass implementation, which will allow approaching the objectives and the penetration rates set by the National Programme requires the systematic construction of supporting policies and monitoring mechanisms. Currently the application of the above measures is in the stage of planning. The adoption and application of the Regulation of Energy Performance of Buildings (REPB) specifying energy inspections, as well as energy and environmental certification of buildings, constitutes a crucial step for the realization of these interventions. The REPB is foreseen to be completed at the end of 2005 incorporating and the above mentioned EC Directive on "Energy Performance of Buildings".

### *2.2.3.7 Measures in the sector of industrial processes*

The policies and measures in the sector of industrial processes concern the restriction of f-gases emissions from chemical industries and their consumption in a number of appliances and applications. The remaining activities which are included in the sector of industrial processes were not examined, as the most important of them (cement and steel production) have already proceeded in implementing investments for modernization, while the contribution of the rest to the total GHG emissions of Greece is low.

Regarding HCFC-22 production, which constitutes a source of HFC-23 emissions, Regulation (EC) 2037/2000 of the European Parliament and of the Council adopts a time schedule for the reduction of HCFC-22 production, with specific quantitative targets for the periods 2000 – 2007, 2008 – 2013, 2014 – 2020 and 2021 – 2025 compared to 1997 production. Production of HCFC - 22 is not allowed after 31 December 2025.

Concerning the planned measures, recovery of f-gases from discarded air-conditioning units (both stationary and mobile) and refrigeration equipment was examined according to the Directive 2003/108/EC.

### *2.2.3.8 Measures in the sector of waste*

National policies and measures for the waste sector are related to the operation of managed solid-waste disposal sites and the construction of municipal wastewater plants.

Regarding solid waste disposal on land, with Decision 50910/2727 (December 2003), the measures, the terms and the processes for the rational management of waste in national and regional level have been specified. Fundamental objectives are the elimination of unmanaged solid waste disposal sites, the coverage of all urban and rural areas of the country with modern installations for final disposal and the promotion of measures for the prevention and reduction of produced waste, as well as the exploitation of materials with maximization of recycling and recovery of products and energy.

In addition the necessity to reduce the quantities of biodegradable wastes landfilled through the installation of treatment facilities in agreement with Directive 1999/31/EC is acknowledged. According to this Directive the targets set for the reduction of biodegradable wastes landfilled are at 75%, 50% and 35% for the years 2010, 2013 and 2020 respectively compared to their production in 1995.

As regards wastewater, a collection network with its corresponding wastewater treatment plants has already been developed during the last five-years, covering the needs of 70% of the population in 2001. The new objective is to increase the percentage of the population served by 95% by 2006.

#### *2.2.3.9 Measures in agricultural sector*

The restriction of nitrogen fertilizers use in combination with the promotion of organic farming constitutes a main policy initiative of the Ministry of Rural Development and Food to reduce pollution caused from agriculture. According to the Ministry of Rural Development and Food records, the total land with organic farming in 2002 was 29,500 ha, representing 0.8% of the total cultivated land of the country, while in 2003 this percentage increased to 1.01%. Based on projections for measures already implemented, it is expected that up to 2010, the cultivations without use of synthetic fertilizers will represent approximately 2.5% of total agricultural land (approximately 100,000 ha). Further promotion of organic farming, already planned, might raise that to 200,000ha by 2010.

The introduction of wet systems for manure management for cattle and pigs constitutes a basic measure of N<sub>2</sub>O emissions reduction. Today, most cattle breeding activity and over 10% of pig raising farms utilize dry treatment of manure. Further penetration of this practice in the sector in order to decrease N<sub>2</sub>O emissions is pursued. The N<sub>2</sub>O emission factor per unit of nitrogen excreted from animals is much smaller in wet systems.

#### *2.2.3.10 Measures in Land Use Change and Forestry*

The 2<sup>nd</sup> National Climate Change Program (2000-2010) does not determine additional measures of removals through sinks (measures in the sector of Land Use, Land Use Change and Forestry). However, in recognition of the role of forests in addressing the greenhouse effect, the sustainable management of the Greek forests was strengthened through financing of forest management practices as well as measures for the prevention and control of forest fires.

Also, in the frame of the program Agricultural Land Forestation of the Ministry of Rural Development and Food, which targets the non-public sector, projects for agricultural lands forestation and improvement of existing forest lands have been financed. On the basis of the Regulation 2080/92, 35,840ha of agricultural lands were forested during the period 1994-2001 while 4,835ha were forested in the years 2002 and 2003 based on the Regulation 1257/99.

### 3 DESCRIPTION OF TRENDS IN, AND PROJECTIONS OF GREENHOUSE GAS EMISSIONS

#### 3.1 Greenhouse Gas Inventory for the Years 1990-2003

This chapter summarizes greenhouse gas (GHG) emissions of Greece for the time period 1990–2003 as reported in the National Inventory Report submitted in 2005.

An overview of GHG emissions for the time period 1990–2003 is presented in **Table 3.1**. Following the IPCC Guidelines, emissions from international air transport and marine bunkers are not included in the national totals and are presented separately in **Table 3.2**.

**Table 3.1 Total GHG emissions in Greece (in Mt CO<sub>2</sub> eq) for the period 1990-2003**

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A. GHG emissions per gas (without LULUCF)														
CO <sub>2</sub>	84.02	83.74	84.68	85.29	87.20	87.34	89.55	94.29	98.86	98.24	104.11	106.33	106.16	109.98
CH <sub>4</sub>	10.01	10.00	10.13	10.22	10.45	10.57	10.76	10.83	11.11	10.39	10.35	10.05	10.12	10.17
N <sub>2</sub> O	14.19	13.92	13.97	13.14	13.41	13.13	13.61	13.37	13.26	13.22	13.44	13.24	13.17	13.28
HFC	0.94	1.11	0.91	1.64	2.21	3.37	3.92	4.19	4.67	5.44	4.27	3.87	4.01	4.14
PFC	0.26	0.26	0.25	0.15	0.09	0.08	0.07	0.17	0.20	0.13	0.15	0.09	0.09	0.08
SF <sub>6</sub>	Not estimated <sup>1</sup>													
<b>Total</b>	<b>109.42</b>	<b>109.02</b>	<b>109.94</b>	<b>110.44</b>	<b>113.36</b>	<b>114.49</b>	<b>117.90</b>	<b>122.85</b>	<b>128.10</b>	<b>127.42</b>	<b>132.32</b>	<b>133.58</b>	<b>133.55</b>	<b>137.64</b>
<b>Index (B.Y.=100)</b>	<b>98.0</b>	<b>97.6</b>	<b>98.5</b>	<b>98.9</b>	<b>101.5</b>	<b>102.5</b>	<b>105.6</b>	<b>110.0</b>	<b>114.7</b>	<b>114.1</b>	<b>118.5</b>	<b>119.6</b>	<b>119.6</b>	<b>123.3</b>
B. Emissions / Removals of GHG from LULUCF														
CO <sub>2</sub>	-3.25	-3.60	-3.07	-3.88	-3.55	-4.41	-3.99	-3.96	-3.59	-4.44	-3.14	-5.32	-5.46	-5.53
CH <sub>4</sub>	0.05	0.03	0.08	0.07	0.06	0.03	0.02	0.05	0.13	0.01	0.17	0.02	0.00	0.00
N <sub>2</sub> O	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00
<b>Total</b>	<b>-3.19</b>	<b>-3.57</b>	<b>-2.99</b>	<b>-3.81</b>	<b>-3.48</b>	<b>-4.37</b>	<b>-3.97</b>	<b>-3.91</b>	<b>-3.45</b>	<b>-4.43</b>	<b>-2.96</b>	<b>-5.30</b>	<b>-5.46</b>	<b>-5.53</b>

Total uncertainty for 2003 is estimated at 11.5% (including LULUCF), while the uncertainty carried over into the GHG emissions trend is approximately 8%. The uncertainty estimates for GHG emissions per gas (including LULUCF), in 2003, were estimated at:

- ↪ 5.0% for CO<sub>2</sub> emissions,
- ↪ 34.4% for CH<sub>4</sub> emissions,
- ↪ 104.4% for N<sub>2</sub>O emissions

<sup>1</sup> SF<sub>6</sub> emissions are not estimated. According to information from the Public Power Corporation, fugitive emissions from the use of SF<sub>6</sub> were 0.23 kt CO<sub>2</sub>eq during the last 20 years. However, according to data presented by the Ministry for Development during the in-depth review of the 3rd National Communication (November 2004) SF<sub>6</sub> emissions, for the first semester of 2004, were estimated at 1.74 kt CO<sub>2</sub>eq. At the moment, this inconsistency has not been resolved and as a result no emission estimates are reported.

↪ 69.9% for F-gases

**Table 3.2** GHG gas emissions from international transport for the period 1990 – 2003 (Mt CO<sub>2</sub>eq)

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO <sub>2</sub>	10.48	10.48	9.48	10.67	12.21	13.25	13.86	12.40	12.34	13.60	12.69	13.86	13.35	12.21
CH <sub>4</sub>	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
N <sub>2</sub> O	0.09	0.09	0.08	0.09	0.10	0.11	0.12	0.11	0.11	0.12	0.11	0.12	0.11	0.11
<b>Total</b>	<b>10.58</b>	<b>10.58</b>	<b>9.58</b>	<b>10.77</b>	<b>12.34</b>	<b>13.39</b>	<b>14.00</b>	<b>12.53</b>	<b>12.47</b>	<b>13.73</b>	<b>12.82</b>	<b>14.00</b>	<b>13.49</b>	<b>12.34</b>

Base year GHG emissions for Greece (1990 for CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O and 1995 for f-gases) were estimated at 111.67 Mt CO<sub>2</sub> eq. Given that LULUCF was a net sink of GHG emissions in 1990 (and for the rest of the reporting period) the relevant emissions / removals are not considered in estimating base year emissions for Greece.

In 2003, GHG emissions (without LULUCF) amounted to 137.64 Mt CO<sub>2</sub> eq showing an increase of 23% compared to base year emissions and of 26% compared to 1990 levels. If emissions / removals from LULUCF were included then the increase would be 24% (from 106.22 Mt CO<sub>2</sub>eq in 1990 to 132.11 Mt CO<sub>2</sub>eq in 2003).

Carbon dioxide emissions accounted for 80% of total GHG emissions in 2003 (without LULUCF) and increased by approximately 31% from 1990. Nitrous oxide emissions accounted for 10% of total GHG emissions in 2003 and decreased by 6% from 1990, while methane emissions accounted for 7% of the total GHG emissions in 2003 and increased by 2% from 1990. Finally, F-gases emissions that accounted for 3% of total GHG emissions, increased by 23% from 1995 (base year for F-gases) or by more than four times compared to 1990 levels.

GHG emissions by sector for the period 1990 - 2003 are presented in **Table 3.3**.

**Table 3.3** Total GHG emissions by sector for the years 1990-2003 (in Mt CO<sub>2</sub>eq)

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Energy	81.70	81.52	82.66	82.91	84.93	84.63	87.04	91.62	96.60	95.71	101.61	103.87	103.85	107.72
Industrial processes	8.67	8.65	8.53	9.31	9.79	11.40	12.01	12.59	12.80	13.64	12.81	12.36	12.40	12.58
Solvents	0.17	0.18	0.17	0.17	0.16	0.15	0.15	0.15	0.15	0.16	0.15	0.15	0.16	0.16
Agriculture	13.51	13.31	13.10	12.50	12.74	12.49	12.78	12.48	12.34	12.36	12.33	12.12	12.06	12.00
Waste	5.36	5.36	5.48	5.55	5.74	5.81	5.93	6.01	6.20	5.55	5.43	5.09	5.08	5.18
<b>Total</b>	<b>109.42</b>	<b>109.02</b>	<b>109.94</b>	<b>110.44</b>	<b>113.36</b>	<b>114.49</b>	<b>117.90</b>	<b>122.85</b>	<b>128.10</b>	<b>127.42</b>	<b>132.32</b>	<b>133.58</b>	<b>133.55</b>	<b>137.64</b>
Change (1990=100)	100.0	99.6	100.5	100.9	103.6	104.6	107.8	112.3	117.1	116.5	120.9	122.1	122.1	125.8
<b>LULUCF</b>	<b>-3.19</b>	<b>-3.57</b>	<b>-2.99</b>	<b>-3.81</b>	<b>-3.48</b>	<b>-4.37</b>	<b>-3.97</b>	<b>-3.91</b>	<b>-3.45</b>	<b>-4.43</b>	<b>-2.96</b>	<b>-5.30</b>	<b>-5.46</b>	<b>-5.53</b>

Emissions from *energy sector* in 2003 accounted for 78.3% of total GHG emissions (without LULUCF) and increased by 32% compared to 1990 levels. The majority of GHG emissions (54.2%) in 2003 derived from energy industries, while the contribution of transport, manufacturing industries and construction and other sectors is estimated at 20.3%, 9.7% and 14.3% respectively. The rest 1.5% of GHG emissions from the energy sector derived from fugitive emissions from fuels. The sector with the greatest increase of emissions since 1990 is "Other sectors" (i.e. residential, tertiary and agriculture sectors), showing an average rate of increase of 4.3%. GHG emissions from transport and energy industries increased with an average annual rate of 2.6% and 2% respectively, for the period 1990 - 2003. Emissions from manufacturing industries and construction decreased with an average annual rate of 0.4%, while fugitive emissions from fuels increased with an average annual rate of 2.9%

The living standards improvement, due to the economic growth of the period 1990 – 2003, the important growth of the services sector and the introduction of natural gas in the Greek energy system constitute the basic factors affecting emissions trends from energy.

The living standards improvement resulted in an increase of energy consumption and particularly electricity consumption (mainly in the residential – tertiary sector), of passenger cars ownership and transportation activity. The increase of electricity consumption led not only to the increase of direct emissions (due to combustion for electricity generation) but also of fugitive methane emissions from lignite mining. At the same time total CO<sub>2</sub> emissions per electricity produced (**Table 3.4**) have decreased by 22% (from 1150 kg CO<sub>2</sub> / MWh in 1990 to 900 kg CO<sub>2</sub> / MWh in 2003) mainly as a result of the introduction of the natural into the electricity system. It should be mentioned that the availability of hydropower has a significant effect to emissions trends. For instance, the significant increase of electricity demand in 1999 was not followed by a similar increase of emissions because of the penetration of natural gas and the high availability of hydropower (the highest of the period 1990 – 2003).

The increase of energy consumption in the domestic and tertiary sector in combination with the delays in the construction of natural gas distribution networks (restricting the penetration of natural gas) as well as with the limited penetration of energy conservation measures and RES technologies (with the exception of the use solar energy for water heating) resulted in a continuous increase of GHG emissions. This situation is also depicted in the indicators presented in Table 3.4 as CO<sub>2</sub> emissions per inhabitant from the residential sector have almost doubled from 1990 until 2003, while the intensity of CO<sub>2</sub> emissions from the tertiary sector has increased by approximately 45% during the period 1990 – 2003. On the contrary, the intensity of CO<sub>2</sub> emissions from industry has decreased by 23% due to the modernization investments realised in energy intensive sectors with significant exporting activity (e.g. cement, steel production etc) and the use of natural gas.

The substantial increase of GHG emissions from road transport is directly linked to the increase of vehicles fleet but also to the increase of transportation activity. The renewal of the passenger car fleet (cars of new technology constitute 60% of total passenger cars in 2003) and the implied

improvement of energy efficiency (Table 3.4) limit the increase of GHG emissions. However, the positive results from the improvement of the vehicles performance are reduced by the high use of passenger cars in transportation activity.

Emissions from *industrial processes* accounted for 9.1% of the total emissions (without LULUCF) and increased by 45% compared to 1990 levels. Emissions from *Industrial processes* are characterized by intense fluctuations during the period 1990 – 2003, reaching a minimum value of 8.53 Mt CO<sub>2</sub>eq in 1992 and a maximum value of 13.64 Mt CO<sub>2</sub>eq in 1999, that are mainly attributed to changes in industrial production. In total, the increase of emissions from *Industrial processes* is mainly due to the increase of cement production and HCFC-22. The sector of solvents and other products use, with minimum contribution to total GHG emissions (0.1%), presents a small decrease.

Emissions from *agriculture* that accounted for 8.7% of total emissions in 2003 (without LULUCF), decreased by approximately 11% compared to 1990 levels. Emissions reduction is mainly due to the reduction of N<sub>2</sub>O emissions from agricultural soils, because of the reduction in the use of synthetic nitrogen fertilizers. The changes of the rest determining parameters of GHG emissions from the sector (e.g. animal population, crops production etc.) have a minor effect on GHG emissions trend.

**Table 3.4 Basic indicators for the assessment of GHG emissions trends for the period 1990 – 2003**

Sector	Index	1990	1995	2000	2001	2002	2003
Total	Emissions intensity, (t CO <sub>2</sub> / M€)	860	840	845	828	797	789
Energy - Total	Emissions intensity, (t CO <sub>2</sub> / M€)	789	767	779	763	735	728
Electricity generation	CO <sub>2</sub> emissions from electricity generation (kg CO <sub>2</sub> / MWh)	1161	1014	957	978	944	905
Industry	Emissions intensity, (t CO <sub>2</sub> / M€)	640	583	558	539	517	473
Tertiary sector	Emissions intensity, (t CO <sub>2</sub> / M€)	8.6	10.1	10.0	12.1	12.0	12.4
Residential sector	Emissions per capita, (kg / capita)	459	460	696	745	775	908
Road transport	CO <sub>2</sub> emissions from passenger transport, (t CO <sub>2</sub> / Mp-km)	84.8	78.5	73.0	73.2	73.0	72.5
Road transport	CO <sub>2</sub> emissions from goods transport, (t CO <sub>2</sub> / Mt-km)	508.1	442.7	392.6	368.6	359.0	357.8
Waste	CH <sub>4</sub> emissions from solid waste disposal on land, (kt CH <sub>4</sub> / kt waste)	45.1	47.3	40.1	40.5	40.2	41.0

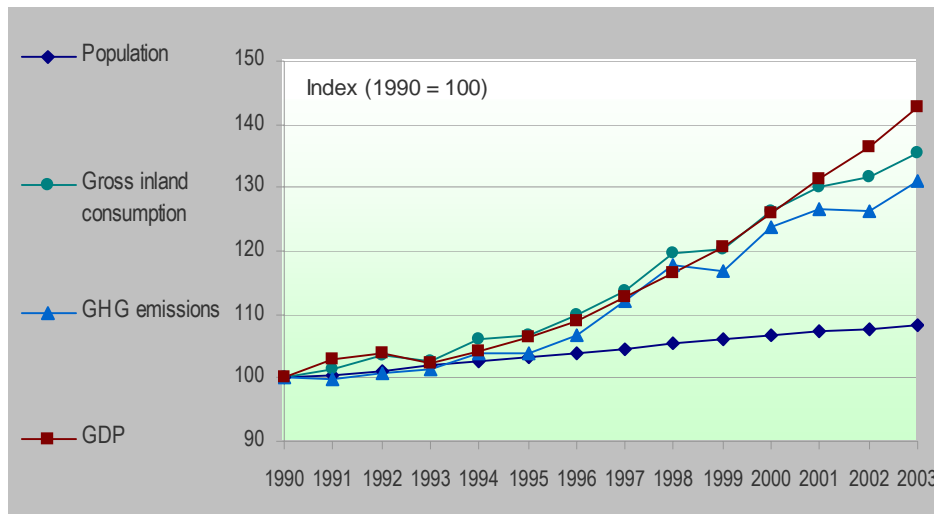


Emissions from the **waste sector** (3.8% of the total emissions, without LULUCF), decreased by approximately 3% from 1990. Solid waste disposal on land constitutes the main source of emissions from the sector.

Living standards improvement resulted in an increase of the generated waste and thus of emissions. Moreover, the increase of the number of managed solid waste disposal sites (SWDS), without a systematic exploitation of the biogas produced, and the limited application of alternative management practices resulted in the increase of methane emissions. Emissions reduction which is observed in 1999 is mainly due to the extension of the network for collection and flaring of the biogas produced in the largest SWDS of the country (in Ano Liosia), which receives approximately 30% of municipal solid waste produced.

At the same time, emissions from wastewater handling have considerably decreased, due to the continuous increase of the population served aerobic wastewater handling facilities.

GHG emissions trends (excluding LULUCF) are mainly driven by economic development as presented in **Figure 3.1**. Moreover, and given the fact that energy is the main source of GHG emissions, emissions and energy consumption follow the same pattern. On the contrary, the impact of population increase to GHG emissions is minor. A basic conclusion resulting from Figure 3.1 is that since 2000 a decoupling of GHG emissions from economic development is observed as the growth rate of GHG emissions for the period 1990 – 2003 (approximately 2.1%) is lower than both the growth rate of gross inland energy consumption (approximately 2.4% for the same period) and the GDP growth rate (approximately 2.8%).



**Figure 3.1** Factors underlying GHG emissions trends.



## 3.2 Projection of GHG Emissions

This Paragraph describes firstly a baseline or “*with measures*” *scenario*, which estimates the evolution of GHG emissions in Greece up to the year 2020, **taking into consideration the policies and measures for reducing GHG emissions already implemented and adopted and assuming that no additional emission reduction actions are adopted.** In addition a “*with additional measures*” *scenario* is also presented, which incorporates into the “with measures” scenario, **the additional policies and measures adopted in the context of the 2<sup>nd</sup> National Programme on Climate Change (2000-2010).**

### 3.2.1 With Measures Scenario

According to the results of the analysis (**Tables 3.5 and 3.6**), the “with measures” scenario foresees that GHG emissions will be 34.7% and 49.4% above base year levels<sup>2</sup> (111.7 Mt CO<sub>2</sub>eq) by 2010 and 2020 respectively.

The energy sector constitutes the major source of GHG emissions in Greece and accounts for approximately 74-80% of total GHG emissions for the entire period under consideration. The rate of increase of GHG emissions from this sector is slowed down from approximately 2.2% in 1990-2000, to 1.7% in 2000-2010 and to 1.1% in the following decade, mainly because of the penetration of natural gas and of various renewable energy sources especially in the power generation sector. GHG emissions from the sector of industrial processes present the highest rates of growth, while the emissions from the agriculture sector approximately constant. Finally, GHG emissions from the wastes sector present a substantial decrease mainly after 2010, as a result of the implementation of the Directive 1999/31 for landfill of waste.

**Table 3.5 Projections of GHG emissions in the "with measures" scenario, disaggregated by sector, kt CO<sub>2</sub>eq**

Sources and Sink categories	1990	1995	2000	2005	2010	2015	2020
Energy	81704	84634	101611	112416	120326	127351	134674
<i>of which transport</i>	<i>15645</i>	<i>17317</i>	<i>19802</i>	<i>22587</i>	<i>24756</i>	<i>27398</i>	<i>29384</i>
Industrial processes	8670	11400	12810	12848	13910	15619	17188
Solvents	170	153	145	158	161	164	168
Agriculture	13514	12489	12330	12126	12265	12429	12606
Waste	5357	5811	5429	5328	3750	2608	2203
<b>Total</b>	<b>109415</b>	<b>114487</b>	<b>132324</b>	<b>142876</b>	<b>150413</b>	<b>158172</b>	<b>166839</b>
Land Use	-3193	-4369	-2959	-4702	-4773	-4509	-4264

<sup>2</sup> 1990 has been used as base year for CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O emissions and 1995 has been used for HFC, PFC and SF<sub>6</sub>.

**Table 3.6** Projections of GHG emissions in the "with measures" scenario, disaggregated by gas, kt CO<sub>2</sub>eq

Gas	Base year	1990	1995	2000	2005	2010	2015	2020
Carbon dioxide	84021	84021	87344	104112	115021	122913	130044	137440
Methane	10011	10011	10565	10354	10280	9015	8048	7811
Nitrous oxide	14190	14190	13127	13436	13720	14042	14369	14732
HFC	3369	935	3369	4273	3779	4366	5635	6779
PFC	83	258	83	148	76	76	76	76
SF <sub>6</sub>	Not estimated							
<b>Total</b>	<b>111675</b>	<b>109415</b>	<b>114487</b>	<b>132324</b>	<b>142876</b>	<b>150413</b>	<b>158172</b>	<b>166839</b>
<i>Change from base year levels</i>	<i>100.0</i>	<i>98.0</i>	<i>102.5</i>	<i>118.5</i>	<i>127.9</i>	<i>134.7</i>	<i>141.6</i>	<i>149.4</i>

Carbon dioxide emissions accounts for more than 75% of total emissions. F-gases emissions are estimated to increase with a mean annual rate of more than 4 times higher compared with that of total emissions for the period 1990-2020 (6% for the f-gases compared to 1.4% for total emissions).

**Table 3.7** presents the evolution of specific sectoral indicators, which evaluate the effectiveness of the implemented and adopted policies and measures aiming at reducing GHG emissions in Greece. These indicators were estimated on the basis of the background information and the results obtained by the "with measures" scenario. The main findings of this analysis are summarized below:

- ❑ Despite the substantial increase of **total CO<sub>2</sub> emissions** in the country, emissions intensity per GDP unit is projected to show a significant decrease during the period 2000-2020 (from 845 t CO<sub>2</sub>/M€ in 2000 to 686 t CO<sub>2</sub>/M€ in 2010 and to 563 t CO<sub>2</sub>/M€ in 2020) as a result of the implemented and adopted policies and measures, and particularly because of the penetration of natural gas and various renewable energy sources into the energy system.
- ❑ In the **transport** sector emissions per passenger-kilometre covered are projected to decrease during the period, particularly after 2005, mainly because of the penetration of biofuels as well as the modernization of the fleet and the increased use of vehicles with lower specific consumption. Similarly emissions per ton-kilometre covered are estimated to decrease mainly due to the modernization of the fleet.
- ❑ In the **industrial** sector, the intensity of CO<sub>2</sub> emissions decreases during the entire period examined (from 640 t CO<sub>2</sub>/M€ in 1990 to 558 t CO<sub>2</sub>/M€ in 2000 and below 500 t CO<sub>2</sub>/M€ in the decade 2010-2020) as a result of the implementation of energy conservation policies in the sector and the penetration of natural gas.
- ❑ In the **residential sector**, CO<sub>2</sub> emissions per household have substantially increased during the last decade and this trend is expected to continue until the end of the 2000-2010 decade

as a result of the improved standards of living. This increasing trend though is projected to slow down during the next decade because of the penetration of natural gas into the sector and the promotion of policies that aim at the improvement of energy efficiency of buildings as well as the stabilization of the population live in the country.

- ❑ In the *tertiary sector*, an increase of CO<sub>2</sub> emissions intensity is projected until 2010, which is reserved during the decade 2010-2020. These trends are primarily attributed to the improved working conditions and the high growth rates of the sector, as well as to the natural gas penetration, which is expected to substitute oil and electricity in some energy uses (e.g. heating, air-conditioning, etc.).
- ❑ In the *power generation* sector, CO<sub>2</sub> emissions per unit of energy produced from conventional fossil-fuelled power plans shows a remarkable decrease during the entire period under examination, primarily as a result of natural gas penetration into the electric system, and secondarily due to the refurbishment of some old lignite-fired power units.
- ❑ In the *agricultural* sector, N<sub>2</sub>O emissions per nitrogen unit from the use of fertilizers and animal manure, remain at the same level during the entire period examined. This is mainly attributed to the fact that the management practices in the sector will remain unchanged. Per animal CH<sub>4</sub> emissions from cattle show a slight decrease especially after 2010.
- ❑ Finally in the *waste* sector, CH<sub>4</sub> emissions per kt of landfill waste presents a substantial decrease mainly after 2010, as a result of the implementation of the Directive 1999/31 for landfill of waste.

**Table 3.7** Projection of basic indices for the evaluation of policies and measures implementation to reduce GHG emissions.

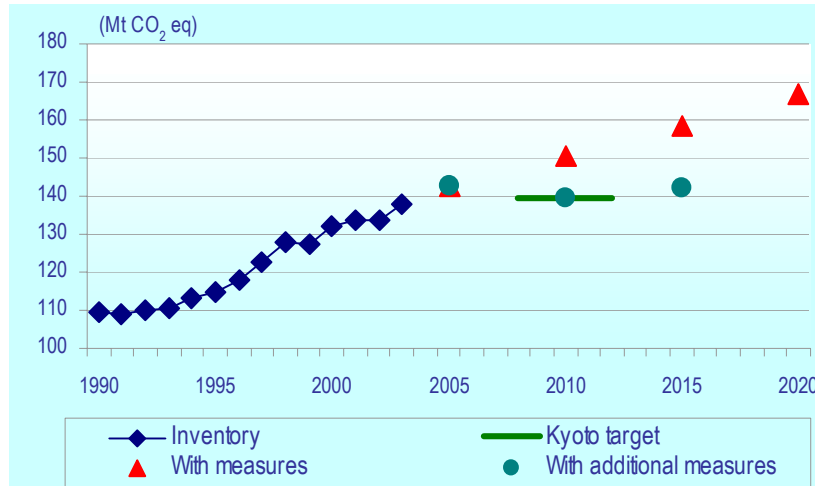
Sector	Index	1990	1995	2000	2005	2010	2015	2020
Total	Emissions intensity (t CO <sub>2</sub> / M€)	860	840	845	769	686	612	563
Transport	Specific CO <sub>2</sub> emissions of passenger cars (t CO <sub>2</sub> /p-km)	0.085	0.079	0.073	0.072	0.063	0.060	0.058
Transport	Specific CO <sub>2</sub> emissions of freight transport (t CO <sub>2</sub> /t-km)	0.51	0.44	0.39	0.35	0.32	0.31	0.29
Industry	Emissions intensity (t CO <sub>2</sub> / M€)	640	583	558	532	496	460	429
Residential	Specific CO <sub>2</sub> emissions of households (t CO <sub>2</sub> / household)	1.38	1.33	1.96	2.39	2.60	2.70	2.79
Tertiary	CO <sub>2</sub> emissions intensity (t CO <sub>2</sub> / M€)	8.63	10.13	10.03	13.27	14.08	13.72	13.44
Electricity generation	CO <sub>2</sub> emissions of large power plants (t CO <sub>2</sub> / TJe)	378	343	320	304	274	260	248
Agriculture	Specific N <sub>2</sub> O emissions of fertilizer and manure use (kt N <sub>2</sub> O / kt N)	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Agriculture	Specific CH <sub>4</sub> emissions of cattle production (t CH <sub>4</sub> / head)	81.20	81.32	80.49	80.20	79.86	79.52	79.19
Waste	Specific CH <sub>4</sub> emissions from landfills (kt CH <sub>4</sub> /kt waste)	0.05	0.05	0.04	0.04	0.04	0.03	0.02

### 3.2.2 With Additional Measures Scenario

With the realization of the additional policies and measures adopted in the context of the 2<sup>nd</sup> National Programme on Climate Change, Greece will be able to reach its Kyoto Protocol target for the 1st Commitment Period with policies and measures almost exclusively domestic. As a result of these additional policies and measures GHG emissions in Greece will increase by 24.9% in 2010 and by 27.4% in 2015 compared to base year levels (**Table 3.8**). **Figure 3.2** presents a comparison between the results of the “with measures” scenario and the “with additional measures” scenario. However, considering the fact that at least some of the planned interventions have a significant cost, the use of credits from the exploitation of the Protocol Flexible Mechanisms should not be excluded. It is worth mentioning that the Ministry of Environment, Physical Planning and Public Works is funding studies to examine the overall attractiveness of various JI and CDM projects, which will allow the fulfilment of the Kyoto Protocol commitments with higher economic efficiency.

**Table 3.8** Projections of GHG emissions in the "with measures" and the "with additional measures" scenario, disaggregated by sector, kt CO<sub>2</sub>eq

Sources / Sinks	1990	1995	2000	2005	2010		2015	
					With measures	With additional measures	With measures	With additional measures
Energy	81704	84634	101611	112416	120326	110497	127351	113312
<i>of which Transport</i>	<i>15645</i>	<i>17317</i>	<i>19802</i>	<i>22587</i>	<i>24756</i>	<i>24147</i>	<i>27398</i>	<i>26329</i>
Industrial processes	8670	11400	12810	12848	13910	13192	15619	14083
Solvents	170	153	145	158	161	161	164	164
Agriculture	13514	12489	12330	12126	12265	12131	12429	12277
Waste	5357	5811	5429	5328	3750	3549	2608	2459
<b>Total</b>	<b>109415</b>	<b>114487</b>	<b>132324</b>	<b>142876</b>	<b>150413</b>	<b>139531</b>	<b>158172</b>	<b>142296</b>
Change from base-year levels								
	<i>98.0</i>	<i>102.5</i>	<i>118.5</i>	<i>127.9</i>	<i>134.7</i>	<i>124.9</i>	<i>141.6</i>	<i>127.4</i>



**Figure 3.2** Projections of GHG emissions in the "with measures" and the "with additional measures" scenarios.

## 4 ANALYSIS OF THE CONTRIBUTION OF POLICIES AND MEASURES AND USE OF KYOTO MECHANISMS

### 4.1 Detailed Results of Policies and Measures

In Chapter 2 the implemented, adopted and planned policies and measures for reducing GHG emissions in Greece in the light of reaching its Kyoto Protocol target for the 1st Commitment Period were presented. The total realistic GHG emissions reduction potential from the implemented and adopted policies and measures was calculated at 28.3 Mt CO<sub>2</sub>eq for 2010, and at 37.6 Mt CO<sub>2</sub>eq for 2015, if possible interferences between these implemented/adopted measures, which may restrict the estimated GHG emissions reduction potential, are excluded (**Table 4.1**). These reductions constitute, for 2010, 25% of the total GHG emissions of the base year, highlighting the effectiveness of the already implemented actions for reducing GHG emissions. Thus, it is obvious that the application of the already implemented and adopted measures for the restriction of GHG emissions contributes considerably in the restriction of the augmentative trend of emissions that characterizes the Greek economy which is developing with relatively high rates. The total GHG emissions reduction potential from the planned policies and measures was estimated at 11.1 Mt CO<sub>2</sub>eq for 2010 and at 16.4 Mt CO<sub>2</sub>eq for 2015, also without taking into account the possible interferences between them (Table 4.1). **Table 4.2** presents analytically the expected effects of these policies and measures in the time horizon of the year 2010, which is the midpoint of the 1st commitment period of the Kyoto Protocol.

**Table 4.1** Sectoral GHG emissions abatement potential of the implemented, adopted and planned policies and measures by 2010 (kt CO<sub>2</sub>eq).

Sector	Implemented / Adopted measures	Planned measures
Electricity generation	19415	5321
Industry	2009	945
Residential – tertiary sectors	2386	3217
Transport	1647	609
Industrial processes	Not estimated	718
Waste	2888	201
Agriculture	Not estimated	134
<i>Total</i>	<i>28345</i>	<i>11145</i>

**Table 4.2** Effects of implemented, adopted and planned policies and measures for reducing GHG emissions in Greece by 2010. (The numbers in parentheses present the emission reduction potential related to implemented and/or adopted measures).

Policies and Measures	Emissions reduction potential (kt CO <sub>2</sub> eq)	Degree of implementation / comments
<i>Horizontal policies</i>		
2 <sup>nd</sup> National Programme on Climate Change	-	In force
Emissions Trading System	Not estimated	In force
<i>Power generation</i>		
	24736 (19415)	
Natural gas in electricity generation	18463 (15630)	In force The completion of the legislative framework for the liberalization of electricity market, will accelerate the installation of new power generation units by private investors is expected
Improvements in the conventional power generation system	Not estimated	In force, there are no details available about the replacement programme of the old lignite-fired power units
Wind energy	4525 (2990)	In force The upgrading of the electric transmission networks is expected
Hydro units	1374 (793)	In force
Photovoltaics	23 (2)	Small-scale implementations
Biomass	353	In preparation
<i>Industry</i>		
	2954 (2009)	
Cogeneration	1051 (839)	In force, supportive actions for additional penetration are required
Natural gas in industry	1106 (904)	In force, supportive actions for additional penetration are required
Biomass	307 (266)	In force, supportive actions for additional penetration are required
Solar energy	208	In preparation
Various energy conservation measures	282	In preparation
<i>Residential – Tertiary sector</i>		
	5603 (2386)	
Natural gas in residential - tertiary sector	1383 (1215)	In force Supportive actions for further development of the gas network
Cogeneration	45	In force, additional supportive actions are required
Solar energy	2172 (1171)	In force, additional supportive actions are required
Photovoltaics	8	In force, additional supportive actions are required
Improvement of the thermal behaviour of existing buildings	103	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Systematic maintenance of central heating boilers	181	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Replacement of central heating boilers	63	In preparation, the adoption of the Regulation for

Policies and Measures	Emissions reduction potential (kt CO <sub>2</sub> eq)	Degree of implementation / comments
		Energy Performance of Buildings is expected
External shading of buildings, night ventilation and use of roof fans	53	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Energy efficient air conditioning units	227	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Energy efficient electric appliances	260	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Replacement of incandescent bulbs by high efficient ones	1085	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
Advanced lighting control systems	23	In preparation, the adoption of the Regulation for Energy Performance of Buildings is expected
<i>Transport</i>	<i>2256 (1647)</i>	
CNG busses	7	In force
Biofuels	1194	In force
ACEA agreement	446	In force
Improvements in road signalling	67	In force, additional supportive actions are required
Promotion of public means of transport	542	In force, additional supportive actions are required
<i>Industrial processes</i>	<i>718 (0)</i>	
Restructuring of chemical industries	Not estimated	In force
Recovery of F-gases from discarded equipment	718	In preparation
<i>Waste</i>	<i>3089 (2888)</i>	
Landfill Directive	2888	In force
Flaring of landfill gas	201	In force, additional supportive actions are required
<i>Agriculture</i>	<i>134 (0)</i>	
Manure management systems	67	In preparation
Organic farming	67	In force, additional supportive actions are required
<i>Total</i>	<i>39490 (28345)</i>	

## 4.2 Total Effect of Policies and Measures

As already mentioned, the estimation of total emissions reduction potential was arrived at without taking into account the secondary effects from the concurrent implementation of several policies and measures, which restrict to a certain percentage the estimated potential. The problem mainly concerns the measures that are related to electricity generation and consumption, given that the implementation of the planned interventions in the electricity generation sector will reduce the overall efficiency of those measures that aim at reduction of electricity use in the sectors of final consumption. The reduction potential of GHG emissions in the various sectors of economic activity, taking into account the consequences from the concurrent implementation of the various



measures, is presented in **Table 4.3**. This potential is estimated at 10.9 Mt CO<sub>2</sub>eq in 2010 and at 15.9 Mt CO<sub>2</sub>eq in 2015.

**Table 4.3** Sectoral GHG emissions abatement potential taking into account the interactions from the combined implementation of the planned policies and measures (kt CO<sub>2</sub>eq).

Sector	2010
Electricity generation	5321
Industry	928
Residential – tertiary sectors	2971
Transport	609
Industrial processes	718
Waste	201
Agriculture	134
<i>Total</i>	<i>10882</i>

### 4.3 Use of Flexible Mechanisms of the Kyoto Protocol

A set of domestic policies and measures (implemented, adopted and planned) aiming at the restriction of the increase of GHG emissions for Greece to fulfil the commitment under the Kyoto Protocol was presented in previous chapters. The 2<sup>nd</sup> National Climate Change Programme was developed in order to define the additional policies and measures necessary for Greece to meet its Kyoto target by means of domestic actions.

Nevertheless, given the fact that at least some of the planned interventions have a significant cost while the implementation of others is delayed, the use of the flexible mechanisms defined in the Kyoto Protocol should not be excluded. To this end, analyses examining the possibilities to use Joint Implementation and Clean Development Mechanisms in order to achieve the Kyoto target in terms of economic efficiency have been financed by the Ministry for the Environment, Physical Planning and Public Works. The preliminary analysis identified several projects, both in developing countries and in countries with economy in transition that could be used in order to acquire CERs and ERUs. At the moment and since it is not clear whether and at what extent, the exploitation of flexible mechanisms for the fulfilment of the commitment under the Kyoto Protocol will be required, the national administration has not committed any resources that could be used for the acquisition of emissions credits. However at the level of individual enterprises participating in the EU emissions trading scheme, agreements for the purchase of emissions allowances which will contribute in the fulfilment of their obligations, already exist.

## 5 PROGRESS ON OTHER COMMITMENTS IN THE CONTEXT OF THE KYOTO PROTOCOL

### 5.1 Improvement of GHG Emissions / Removals Inventory

Annual inventories of greenhouse and other gases emissions form an essential element of each national environmental policy-making process. They can be used to derive information on emissions trends, with reference to a pre-selected base year, and can assist in monitoring the progress of existing abatement measures for the reduction of greenhouse gases emissions. Also, they comprise an important tool for the monitoring of the implementation of the provisions of international conventions.

The planning, preparation and management of the national GHG emissions /removals inventory are accomplished according to the provisions of the relevant decisions of the Framework Convention, the Kyoto Protocol and the EU (Decision 280/2004/EC of the European Parliament and of the Council *concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol* and Decision 2005/166/EC of the European Committee on the establishment of implementation rules of the Decision 280/2004/EC).

The improvement of the national GHG emissions/removals inventory at a technical level (calculation methodologies, inventory completeness, data processing, documentation) is an on-going activity. The parameters determining the improvements to be made are related to: (a) the results of the various review stages of the national GHG inventory, at national and international level, (b) the results of the key categories analysis and (c) the internal (from the inventory team) evaluation of the inventory.

The main improvements of the Greek GHG inventory implemented since 2002 (submission of 3rd National Communication) are presented in brief, hereafter.

- ❑ Calculation of CO<sub>2</sub> emissions from cement production on the basis of the Tier 2 methodology described in the IPCC Good Practice Guidance.
- ❑ Calculation of indirect N<sub>2</sub>O emissions from Agricultural soils for the first time in the 2004 inventory submission.
- ❑ Calculation of CH<sub>4</sub> emissions from enteric fermentation of sheep (approximately 50% of emissions from enteric fermentation) on the basis of the Tier 2 methodology, as CH<sub>4</sub> emissions from enteric fermentation is a key category.
- ❑ Concerning the sector of *Waste* (a) CH<sub>4</sub> emissions from industrial waste water handling and (b) N<sub>2</sub>O emissions from protein consumption and their consequent treatment through waste water handling systems were calculated for the first time in the 2004 inventory submission.

In addition a number of actions aiming at the improvement of completeness, the correction of errors and the improvement of documentation have also been implemented (for a detailed presentation of actions for the improvement of the national GHG emissions/removals inventory, see Inventory submissions of 2004 and 2005).

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## **5.2 National Programmes for Adaptation**

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As presented in more detail in the 4<sup>th</sup> National Communication to UNFCCC, the first systematic effort for the estimation of future climate change in Greece and in the broader Balkan region which was carried out recently (2004-2005) by the “Climate, Weather, Water & Sustainability” research group of the National Observatory of Athens (NOA) showed that climatic conditions in the Balkan regions are expected to change significantly during the next 70-100 years. In the case of Greece, the most important characteristics of climate change will be the increase of maximum and minimum temperature, as well as the reduction of precipitation.

It is clear that these changes will cause a number of impacts on different activities, and particularly agriculture, water resources, energy, natural ecosystems etc. Therefore, apart from implemented policies and measures for the reduction of greenhouse gases emissions, initiatives in the field of adaptation have also to be undertaken.

To date, the Ministry for the Environment, Physical Planning and Public Works (MEPPPW) has financed a number of activities with respect to the estimation climate change impacts in Greece. Within this framework, the “Climate, Weather, Water & Sustainability” research group of NOA established and calibrated the regional climate model PRECIS (developed at Hadley Centre, UK) in order to estimate the future changes of climatic conditions in the Balkans, while quantitative analyses of climate change impacts in different economic sectors (agriculture, energy etc.) are in progress.

Furthermore, in January 2003 a particularly important study concerning the management of water resources, namely the “Draft Programme for the Management of Water Resources in Greece” was completed. The study was carried out by the Ministry for Development, in collaboration with the National Technical University of Athens (NTUA), the Institute of Geology & Mineral Exploration (IGME) and the Centre for Planning and Economic Research (KEPE). In addition, under the support of the 1<sup>st</sup> and 2<sup>nd</sup> Community Support Framework, the National Observation Network for Water Quality in Greece was organized. The 3<sup>rd</sup> Community Support Framework – Operational Programme “Environment” includes actions related with the extension of the National Observation Network for the monitoring of quality of surface, underground, coastal and sea water resources.

The National Action Plan for Combating Desertification was completed in 2001. Necessary actions for dealing with this problem, as foreseen by the National Action Plan, together with the relevant Common Ministerial Decision for its implementation (Common Ministerial Decision

996005/31719) are integrated within the general national development programme and specifically the programme for endangered regions. The National Action Plan aims at combating desertification trends in areas covering 35% of the Greek territory that is under direct threat and to prevent desertification process in an additional 60% of the national territory.

Finally, within the framework of capacity building programmes financed by the Greek government, a number of actions related to the estimation of climate change impacts in developing countries and countries with economies in transition in the Balkan region have been carried out.

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### 5.3 Support for Developing Countries in the Field of Climate Change

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The Global Environment Facility (GEF) was established in 1991, as a pilot programme, within the framework of UN International Conventions for environmental protection, setting as its target the mitigation of global or regional environmental problems and the support of national activities on sustainable development. GEF seeks to link the local scale to global environmental and development problems, and by combining national and international resources aims at:

- protection of biodiversity
- reduction of climate change impacts
- mitigation of problems related to water resources
- protection of the ozone layer,
- mitigation of desertification and deforestation
- mitigation of soil degradation and permanent toxic pollutants

In 1995, it was decided that GEF will be a funding mechanism for programmes in sectors mentioned above, submitted by developing countries or countries with economies in transition, aiming at the fulfilment of relevant commitments resulting from International Conventions. In addition, a strategy for the operation of GEF was adopted, which has to be economically efficient and aim at maximization of environmental benefits.

Greece contributed 1,531,700,000 Greek drachmas to the second GEF Replenishment in 1997 which covered the period 1/7/1998 – 30/6/2002.

In the third GEF Replenishment in 2002, covering for the period 1/7/2002 – 30/6/2006, Greece committed to a total contribution of €5.73 million. The Greek contribution is submitted in four annual payments. **Table 5.1** presents the contribution of Greece to GEF to date. The last annual payment to the third GEF Replenishment amounts to €1,432,500 and is being processed.

**Table 5.1** Financial contributions of Greece to the Global Environmental Facility (GEF)

	Contribution (thousands €)					
	2001	2002	2003	2004	2005	2006
Global Environmental Facility	1123.8 <sup>1</sup>	0.0	2432.6 <sup>2</sup>	432.4 <sup>2</sup>	1432.5 <sup>2</sup>	1432.5 <sup>3</sup>

<sup>1</sup> Second GEF replenishment

<sup>2</sup> Third GEF replenishment

<sup>3</sup> Last annual payment to the third GEF replenishment (in progress)

In addition, Greece contributes financially to various international organizations which play an important role in the promotion of sustainable development. This contribution is given by means of regular payments for the support for specific projects or programmes. Funding supplied to these institutions totalled **€73 million (Table 5.2)** over the time period 2001 – 2005. Approximately 48.5% of this is contributions to World Bank and the European Bank for Reconstruction and Development. However, the exact amount out of this contribution which is related to activities on climate change is unknown.

Finally, the enhancement of democratic practices and the promotion of sustainable economic development in the neighbouring regions represent the main strategic orientation of the official Greek development aid programme. More than 80% of the Official Development Assistance (ODA) of Greece is provided to developing countries in Southern-Eastern Europe. In 2003, the total net expenses of the Official Development Assistance of Greece (bilateral and multilateral programs) amounted to **€320 million**. However, there are no detailed data on the share of these funds, which is related to climate change activities.

**Table 5.2** Financial contributions of Greece to international institutions and programmes

Institution or Programme	Contribution (thousands €)				
	2001	2002	2003	2004	2005
World Bank	6242.1	7200.0	3700.0	3561.8	3660.8
Organization for Economic Co-operation and Development (OECD)	1232.6	1406.9	1122.5	719.4	1808.7
European Bank for Reconstruction and Development (EBRD)	2184.2	2328.8	1828.8	1828.8	1828.8
United Nations Industrial Development Organization (UNIDO)	328.2	534.8	555.0	544.2	536.7
United Nations Development Programme UNDP)	205.4	293.5	293.5	293.5	293.5
UNFCCC <sup>1</sup>	48.7	95.8	95.8	95.8	109.9
Black Sea Trade and Development Bank (BSTDB)	6712.6	6423.5	5231.9	4850.5	4718.9

<sup>1</sup> These credits are reported in million \$, and for the year 2005 the national contribution within the framework of the Kyoto Protocol is included

**Table 5.3** presents information on the financial support provided by Greece to developing countries for the implementation of actions related to the mitigation and/or adaptation to climate change. The total support amounts to approximately **3 million \$**.

**Table 5.3 Financial support provided by Greece to developing countries related to the implementation of the UNFCCC and the Kyoto Protocol (thousands \$).**

Country		Mitigation actions					Adaptation actions			
		Energy	Transport	Forestry	Agriculture	Waste	Industry	Infrastructure development	Management of coastal areas	Other vulnerability analyses
Egypt	2003									7.9
Azerbaijan	2003							22.6		
Albania	2001							184.9		
	2003					265.7		17.3		
Armenia	2002							138.7		
	2003							188.4		
Bosnia-Herzeg.	2001							190.7		
	2003							17.3		
Georgia	2003							128.7		
Jordan	2003									7.9
Iran	2002	37.2								
Kenya	2002							7.1		
	2003							20.2		
Croatia	2003							17.3		
Lebanon	2003							112.9	282.4	7.9
Palestine	2002							71.5		
	2003							178.4		
FYROM	2001							176		
	2002							31.1		
	2003							56.9		
Serbia – Mont .	2001							190.7		
	2002	92.4						65.3		
	2003									
Syria	2002							28.6		
	2003							40.6		23.7
Turkey	2002				43.5	130.5				130.5
	2003							17.3		
Tunisia	2002			52						

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## **5.4 Cooperation in Scientific and Technological Research**

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Greece is a member of EUMETSAT (EUropean organisation for the exploitation of METeorological SATellites), the consortium which operates the meteorological monitoring satellite METEOSAT. It is also a member of ECMWF (EUropean Centre for Medium-range Weather Forecast) to which it contributes staff members. In both these international efforts, Greece is represented by the Hellenic National Meteorological Service.

The National Observatory of Athens operates a network of stations aimed at the detection of lightning strikes. The network consists of 6 recording stations located between Denmark and Romania in the north and Cyprus and Portugal in the south. The lightning-strike data provide real-time information regarding the location of thunder cells and severe rainstorm activity from the coast of Florida to the Persian Gulf. This information is crucial for predicting floods and for providing more accurate local forecasts. This information is supplied to the meteorological community via Internet. Recently (2003), in collaboration with the US National Oceanic and Atmospheric Agency (NOAA), the network was expanded with 2 new stations in Africa in order to cover the Northern Africa and India.

The University of Thessaloniki–Laboratory of Applied Physics operates the World Ozone Mapping Center, which utilizes measurements from the 90 stations of WMO Global Ozone System (part of GAW) and of TOMS to generate and archive global maps of total ozone density.

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## **5.5 Capacity Building – Assistance to Developing Countries in Implementing the Convention and the Protocol**

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National Communications are essential for the coordination of international climate policy. The Greek Ministry for Environment, Physical Planning and Public Works has financed a capacity-building project within the framework of DAC in order to support 6 Balkan countries to design and implement climate policies and to prepare their National Communications.

The purpose of this project was to enable Balkan countries to set up policies for limiting their GHG emissions, to effectively implement the objective of the Convention and to prepare for their participation in the Kyoto Protocol when it comes into effect. Seven different Balkan countries have participated in this framework: Greece, Albania, FYROM, Bosnia and Herzegovina, Yugoslavia, Bulgaria and Romania.

Bulgaria and Romania are Countries with Economies in Transition included in Annex I of the Convention, and therefore must adopt national policies and take corresponding measures to limit the emissions of GHG. As countries undergoing the process of transition to a market economy, they need to enhance their ability to address climate change issues. The establishment of an effective monitoring system for their GHG emissions, the improvement of energy efficiency in

various sectors, and the development of a framework in order to effectively host Joint Implementation projects are identified as the major priorities for these countries.

Albania, Bosnia and Herzegovina, FYROM and Yugoslavia are not included in Annex I of the Convention, however the UNFCCC creates a variety of obligations on these countries. The priority areas for action in the context of this capacity-building framework for these countries will be: (i) establishment of an effective monitoring system for their GHG emissions, (ii) elaboration of national action plans for limiting GHG emissions, (iii) improvement of energy efficiency in industrial, transportation and residential/commercial sectors, and (iv) exploitation of Kyoto mechanisms.

In addition, Greece has repeatedly provided the services of technical experts belonging to the “Energy Planning & Sustainable Development” research group of NOA, which have been trained and officially recognized as reviewers of the UN Framework Convention on Climate Change for the technical review of National Communications of Annex I Parties.