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Second National Communication in the context of the Kyoto Protocol

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Preface

The fight against climate change has become the front line of a broader battle: the pursuit of global sustainability. In fact, the changes caused to the atmosphere and climate by anthropogenic emissions are the single global environmental problem that most strongly highlights the unsustainable nature of our current development patterns. In this sense, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol are essential tools for moving towards global environmental governance. That is why, following the recent Copenhagen Summit, it is so important to reach a global and effective agreement that can continue and further develop international climate policy.

This Fifth National Communication to the UNFCCC contains important information with regard to Portugal's implementation of its commitments and represents a reference guide for the outcome of national policy on climate change.

National commitments, and particularly the emissions reduction targets established in the Kyoto Protocol, have become Portugal's key drivers for efficiency, innovation, modernity and clean development.

In this respect, I must highlight the involvement of different sectors of public and private policy, the growing replacement of fossil fuels through the introduction of renewable energy sources, the policies for energy efficiency at different levels, the environmental taxation policy applied to cars, which began with the revision of the car tax to include an environmental component related to CO2 emissions, and the green public procurement policy, which issued environmental criteria to be applied to new state vehicle purchases, including limits on CO2 emissions and inhalable particles.

Apart from all the other associated environmental and social benefits, these measures (among many others) have been essential in reversing the continuing upward trend in greenhouse gases emissions prior to 2005. In fact, verified emissions decreased from 21% above the Kyoto target in 2005 to 14% in 2006 and 9% in 2007. The most recent projections for 2008 and the forecasts for the 2012 compliance period illustrate the trend for a consolidated decline in emissions towards the Kyoto Protocol targets and through the additional use of the Protocol's flexible mechanisms.

We are both proud and committed to the path of modernity and sustainability the UNFCCC has set for us. Today, Portugal is known as a developed country with one of the most ambitious policies on climate and energy - by 2010, 45% of our electricity will come from renewable sources. We need to broaden and deepen these policies to all sectors, particularly those that depend on the practices and daily options of

numerous actors. The information provided in this 5th Statement and the information available on the website www.cumprirquioto.pt, are, in this regard, an important contribution.

Dulce Álvaro Pássaro

December 2009

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Executive Summary

The Fifth National Communication to the United Nations Framework Convention on Climate Change (Second National Communication in the context of the Kyoto Protocol) hereby presented is organised in eight chapters describing the national circumstances, the national greenhouse gas (GHG) inventory, the impacts, vulnerability and adaptation, financial commitments and technology transfer, systematic research and observation, and education, training and awareness raising activities in accordance with articles 4 and 12 of the Convention, as well as the guidelines adopted in its 5th session (Decision 4/CP.5). Following the entry into force of the Kyoto Protocol in 2005, further information is also hereby submitted, under article 7(2) of the Kyoto Protocol.

The objective is to have a document containing information covering the 1990-2009 period[1], coherent with the National Inventory Emissions by Sources and Removals by Sinks of GHG hereby presented, and previously submitted to the Convention (2009).

Portugal is bound by GHG limitation commitments, agreed in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement[2], to a 27% increase in GHG emissions by 2008-2012, relative to 1990. The main instruments geared towards compliance with the national GHG emissions target and, more broadly, the implementation of the Kyoto Protocol include the National Climate Change Programme[3] (PNAC), the System to Monitor it – *CumprirQuitoto*, the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants [4] (SNIERPA), the participation in the EU-ETS as defined by the National Allocation Plan[5] (PNALE) and the Portuguese Carbon Fund[6].

National Circumstances

The Portuguese Republic is a democratic State that is based upon the rule of law, the sovereignty of the people, the pluralism of democratic expression and democratic political organisation, and respect and effective guarantees for fundamental rights and freedoms and the separation and inter-dependence of powers. The State is a unitary State that is structured and functions under the rule of the self-governing system of the islands and the principles of the subsidiarity, the autonomy of local authorities and the democratic decentralisation of the public service. The archipelagos of the Azores and Madeira shall constitute autonomous regions with their own political and administrative statutes and their own institutions of self-government.

[1] However, some of the data series were not available until 2009. Therefore, some indicators and data cover more limited time series, acoording to its availability.

[2] Decision 2002/358/CE of the Council, of 25 April 2002, on the approval, on behalf of the European Community, the Kyoto Protocol to the United Nations Framework Convention on Climate Change, and the joint compliance of their commitments. OJ L 130, May the 15th,
pp. 1–20. Under this decision, the Member-States are jointly responsible for European Union's compliance with its quantified reduction objective. In this context, Portugal should not exceed, in the 5 year compliance period, its Assigned Amount (AA) of 385 970.45 kt CO_2e.

[3] Council of Ministers Resolution 104/2006, August the 23rd and Council of Ministers Resolution 1/2008, January the 4th.

[4] Council of Ministers Resolution 68/2005, March the 17th.

[5] Council of Ministers Resolution 1/2008, January the 4th and Decree- Law 154/2009, July the 6th.

[6] Decree-Law 71/2006, of March the 24th and Law 64-A/2008, December the 31st.

In relation to climate change, the Government holds the full responsibility of assuring the fulfilment of internationally commitments undertaken in the frame of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

In 2001, the Government approved the National Strategy on Climate Change[7], which entrusts the Ministry for Environment and Spatial Planning (MAOT) the responsibility for spearheading and co-ordinating at Government level the development of programmes and actions to limit GHG emissions growth.

Given the transversal nature of issues related to climate change, the Government established in 1998 the Climate Change Commission[8] (CAC). The CAC is co-ordinated by the MAOT and includes representatives from the Ministry of Internal Administration (MAI), Ministry for Foreign Affairs (MNE), Ministry of Finance and Public Administration (MFAP), Ministry of Economy, Innovation and Development (including energy and industry) (MEID), Ministry of Agriculture, Rural Development and Fisheries (including forests) (MADRP), Ministry of Public Works, Transports and Communications (MOPTC), Ministry of Education (ME), Ministry of Science, Technology and Higher Education (MCTES), as well as representatives from the Autonomous Regions of Azores and Madeira.

Technical options and adequate policies are discussed within the remit of the CAC. Programmes, plans and legal instruments pertinent to the national policy framework on climate change are proposed for adoption by the Council of Ministers with the objective of complying with Portugal's commitments under the Kyoto Protocol and the European Union Burden Sharing Agreement.

In 2006, the CAC was appointed[9] as the Portuguese Designated National Authority (DNA) for the Kyoto Protocol flexibility mechanisms, responsible for, among other functions, promoting Portuguese investments in these mechanisms.

The Executive Committee of the CAC (CECAC) was created[10] in 2006 to support CAC in its role of Portuguese DNA and in the coordination of Climate Change Policies. CECAC is also the technical manager of Portuguese Carbon Fund. The CECAC is coordinated by a representative of the MAOT and its board includes representatives of MFAP, MEID, as sub-coordinators, of the MNE, MADRP, MOPTC.

The main instruments geared towards compliance with the national GHG emissions target and, more broadly, the implementation of the Kyoto Protocol include the National Climate Change Programme[11] (PNAC), the System to Monitor it – *CumprirQuitoto.pt*[12], the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants [13] (SNIERPA), the participation in the EU-ETS as defined by the National Allocation Plan[14] (PNALE) and the Portuguese Carbon Fund[15].

[7] Council of Ministers Resolution 59/2001, May the 30th.

[8] Council of Ministers Resolution 72/1998, of 29 June, altered by Council of Ministers Resolution 59/2001, May the 30th.

[9] Council of Ministers Resolution 33/2006, March the 24th.

[10] Council of Ministers Resolution 33/2006, March the 24th.

[11] Council of Ministers Resolution 104/2006, August the 23rd and Council of Ministers Resolution 1/2008 January the 4th.

[12] www.cumprirquioto.pt

[13] Council of Ministers Resolution 68/2005, March the 17th.

[14] Council of Ministers Resolution 1/2008, March the 3rd and Decree- Law 154/2009, July the 6th.

[15] Decree-Law 71/2006, of March the 24th and Law 64-A/2008, December the 31st.

Since 2007 competences on climate change policy – the Portuguese Carbon fund, PNAC, international negotiations - are incumbent upon CECAC, and both SNIERPA and the participation in the EU-ETS are coordinated by Portuguese Environment Agency (APA).

Portugal comprises three territorial areas: the mainland, within the European continent, and the archipelagos of the Azores and Madeira (92 151.8 km^2). In 2008, there were 10 627 250 inhabitants in Portugal, which corresponds to an average population density of 184 inhabitants per km^2.

The factors that most influence the weather conditions in mainland Portugal are latitude, topographic relief, the influence of the Atlantic Ocean and its continentality. Although these factors show limited variation, there is still a significant differences in the meteorological parameters, namely in air temperature and precipitation. The mean temperature has risen in all of Portugal's regions since the 1970s, at a rate of approximately 0.36 ºC/decade, with 1997 being the warmest of the last 78 years. A similar trend was observed with temperature maximums and minimums and the frequency of heat waves. The last 30 years have been particularly dry in Mainland Portugal when compared to the 1971-2000 time series: only nine years have registered values higher than the average. 2005 was the driest of the last 78 years, followed by 2007 and 2004.

With respect to the main economic indicators, Portugal experienced an increase of the Gross Domestic Product (GDP) of 15.3% from 2004 to 2008, due the country's economic performance. From 2004 to 2007, the contribution of industrial sectors to the national Gross Value Added (GVA) decreased slightly, from about 15.5% to 14.8%. This reflects the continuation of the deindustrialization process and a transformation to a services-based economy, demonstrated by the sectoral distribution numbers of the GVA.

The primary energy consumption increased 2.2% between 1990 and 2007. Between 2004 and 2007 Portugal had an annual average decline in the consumption of 1.3% and registered a per capita consumption of 2.39 toe in 2007, which evolved from 1.78 toe per capita in 1990. The final energy consumption increased in average 2.7% per year between 1990 and 2007: 2.3% in oil and 4.5% in electricity. The natural gas, has verified an annual average increase of 40.3% between 1997 and 2007. With an opposite trend, between 2005 and 2007, oil had an annual average decrease in use of 3.7%. Oil products' consumption represented 55.7% of the total in 1990, decreasing to 52.4% in 2007. The evolution of the sectoral energy consumption shows that the structure of the demand has been changing. The industrial sector, which represented 35.4% of the overall final energy consumption in 1990, represented 29.4% in 2007. On the other hand, the transport sector shows an opposite trend, representing 37.2% of the final energy consumption in 2007, while in 1990 represented 30.7%. In 2007, the residential and services sector represented 30.2% of consumption of total final energy, showing an increment of 192% in the services subsector when compared to 1990. In 2007, the energy intensity, relative to primary energy consumption, was 192 toe /GDP and was 137 toe/GDP in 2000.

In Portugal the contribution of Renewable Energy Sources (RES) for the total primary energy demand has its origin in hydro and biomass (from forestry). Despite the fact that biomass and solar energy have good potential to produce heat, the electricity production is the form of energy that has been showing a larger development and deployment of technologies to generate it from renewable sources. Therefore, between 2004 and 2007 Portugal had a boosted growth in the installation of infrastructures to produce energy from renewable sources when comparing to past years being the wind power the major responsible for this development.

Hydro has contributed significantly to electricity generation, being responsible for 22.1% of its total in 2007. However the contribution of hydro power is highly dependent on the annual amount of rainfall.
Wind power has reached, in the same year, 2 201MW of installed capacity, which represents a growth of 2 172MW compared to 1997, being now responsible for 28.8% of the Portuguese renewable matrix. The total installed capacity in renewables grew 60.5% between 1997 and 2007. However it is important to refer that this increase in the renewable installed capacity (without the large hydro) for the same period was 386% (635MW in 1997 and 3 085MW in 2007), as a result from the wind power development

Portugal has been gradually integrating environmental concerns in its energy policy, and adopting measures to reach the established goals, concerning its European community and international commitments. Since 2001, to further develop the connection between energy and environmental sectors, the National Energy Strategy has been giving priority to the following areas:

- diversification of energy sources, with a major use of endogenous resources;
- increase Energy efficiency within economic activity sectors;
- major use of clean technologies, taking into account the new environmental requirements.

In order to implement policies and measures defined in the National Climate Change Programme (PNAC), in 2003, several new targets for 2010 were established for almost all measures, highlighting:

- regarding energy efficiency measures, several projects were developed based on a set of financial incentives from MAPE, interconnected with the economic activities modernization incentive Programme (PRIME), within the community framework, in particular obtaining a co-financial support to promote cogeneration.

As for passenger transport, the annual average variation in road transport from 1990 to 2003 is approximately 10%; the same variation from 1990 to 2007 to air transport was 6.7% as opposed to -1.2% for railway transport. Over the last decade, air travel has shown the strongest growth with variations of 5.1% and 16% in 2006 and 2007, respectively. It is important to refer that in the last year the railway showed an inversion in the growth trend, recovering 3.6% from 2006 to 2007.

The Portuguese policy for the transport sector has been progressively oriented towards achieving a more sustainable transport system regarding the environmental, social and financial and economic levels. In order to increase sustainability in these three areas several objectives for the sector were defined, particularly the one to improve the efficiency in the transport system and contribute to the economic development and the social and territorial cohesion of our country.

The Portuguese agriculture has shown in last years a positive performance regarding sustainability, which is evidenced by several agro-environmental indicators. This is also the case of the positive trend in terms of GHG emissions, which makes agriculture sector the only one that reduced emissions since 1990. In the period under review, the composition of the UAA according to major surface types has radically changed indicating the extensification of agricultural systems in Portugal. In 2007, the "arable land" lost the lead, representing only 31% of the UAA and more than half (51%) came to be occupied by "permanent pasture. Between 1989 and 2007, the major types of surface suffered significant changes. There was a reduction in the area of "arable land" for less than half, losing 1 267 953 ha, and an increase of 276% in the "permanent pasture" area which gained 1 307 075 ha during the period.

In 2003, only 706 farms in the Mainland reported the adoption of practices of soil improvement and erosion control. The agricultural area covered by such measures amounted to 9 501 hectares, representing only 0.3% of the UAA. This situation had a strong and rapid development, since in 2005 this figure increased to 8.7%, covering some 293 000 ha of UAA in 4 973 farms**.**

Between 2004/2005 and 2007/2008, the agro-environmental measure "no-tillage" has received a decreasing number of farmers (from 225 to 153) and covered successively smaller areas (from 12.4 to 8.4 thousand ha).

In 2006, 38.9% of the Portuguese mainland was covered by forested areas, 32.5% by agriculture and 14.7% by mixed areas of agriculture and natural areas. According to the results of the project CORINE Land Cover 2006 for Continental Portugal (Caetano *et al*. 2009), these were the three major land cover types extending over the Portuguese territory by that time. In addition, looking at the land cover map produced within the framework of that project for the year of 2006, one perceives that the natural areas covered 9.4% of the mainland surface, whereas the artificial areas and water bodies occupied only 3.5% and 1.1% of the territory, respectively.

Portuguese forests have undergone significant changes in the past decade, both as a result of the abandonment of agriculture and the consequent transfer of land use to forestry, as well as due to forest fires that have reached huge proportions. Nevertheless, forestry resources play an important role in the national economy. Forestry is mainly an export sector, with a net commercial balance exceeding 1 thousand million Euros in 2003. Forest products (timber, cork, pulp, paper and wooden furniture) represent approximately 10% of the total Portuguese exports and worth over 2.7 thousand million Euros with 5 million tonnes of product in 2004.

Forest fires are one of the major threats to forests in the country, especially in Mainland. After two very severe years (2003 and 2005) when the area burnt was very significant the situation improved and the last three years were considerable better. The number of forest fires also decreased in the last two years, but one has to notice that 70% to 80% of the fires are less than one hectare.

The production of Municipal Solid Waste (MSW) in mainland Portugal increased, in 2008, to 4.8 million tonnes comparing with the 4.4 million tonnes in 2004. The production per inhabitant rose from 1.20 kg/inh.day to 1.29 kg/inh.day. Most of the production of MSW occurs in Lisbon and Tagus Valley and in the North, due to the higher population densities and the concentration of economic activities. The production of MSW has generally been increasing since 1990, apart from the decrease that occurred in 2004, the increase continued in 2006, 2007 and 2008.

The National Greenhouse Gas Emission Inventory

The SNIERPA (Portuguese National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants) compiles a number of institutional and legal definitions as well as procedures that aim to guarantee an estimate of the emissions, by sources and removals by sinks of air pollutants, the communication and the recording of relevant data to permit a timely formulation of the assessment of air pollutants according to defined international and community guidelines in order to enforce planning of tasks and management of the inventory taking into account cost-efficiency aspects. SNIERPA is made up of three technical bodies: the PDM (Methodological Development Programme), QA/QC (Quality Assurance and Control System) and SIGA (Integrated IT management system of SNIERPA). PDM and SCGQ guarantee precision, completeness and reliability in the inventory in terms of technical expertise and methodology.

In 2007, total GHG emissions estimates, without Land Use, Land Use Change and Forestry (LULUCF), accounted for 81.8 Mt CO_2e, an increase of approximately 36% relative to 1990 levels. In accordance

with the EU Burden Sharing Agreement[16], Portugal has committed to limit its emissions growth to 27% relative to 1990 levels. Comparing the growth observed between 1990 and 2007 with the linear trend for the period 1990-2010, GHG emissions in Portugal were, by 2007, about 13.1% above target (Figure 1). Emissions increased at 2% per annum throughout the period 1990-2007.

The most significant source of GHG in Portugal is associated to the Energy sector and is directly related to the burning of fossil fuels. With 77% of the total 2007 emissions weighed by GWP[17], CO_2 is the most abundantly emitted GHG, 90% of which accrues in energy-related activities.

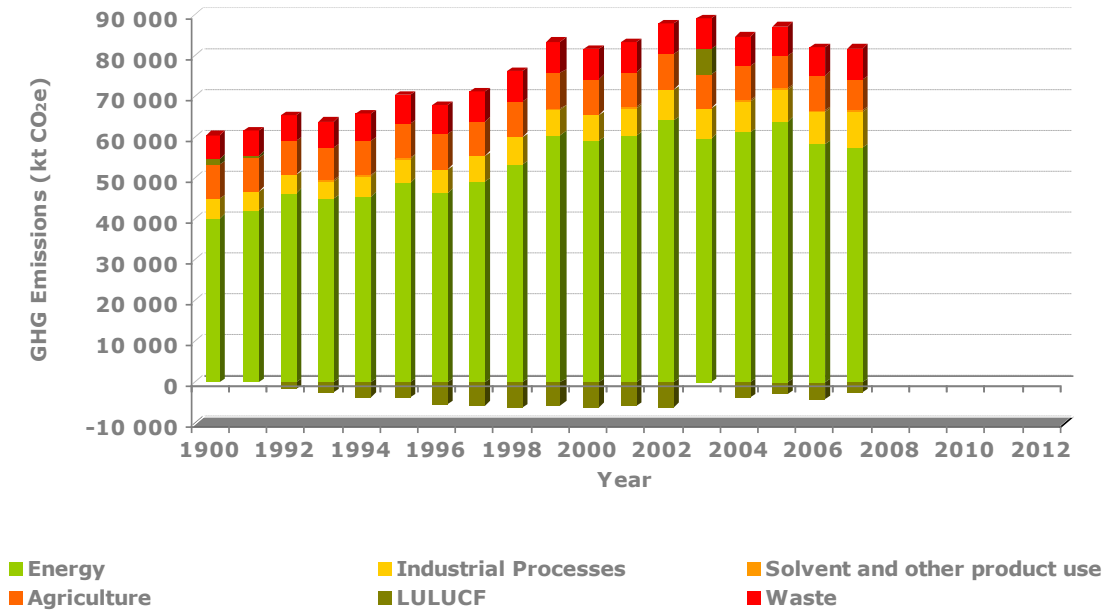


Figure 1. GHG emissions without LUULUCF (1990-2007)

Source: APA, 2009

The key drivers explaining the increase in national emissions for this period are, among others, economic growth and increase in energy demand, traffic volume and distances covered by road transport. Weather parameters, such as precipitation, which have a high inter-annual variability, also have a significant influence on hydroelectric power production, thus influencing in a very significant manner the fluctuations in emissions. Portugal registered rapid economic growth in the 1990s, with GDP increasing by 41% between 1990 and 2007, an annual variation of 2.6%. The most significant growth was observed between 1993 and 2000, with an average annual growth of 4.1% during the period. This economic growth was followed by a 2% annual average increase in primary energy consumption; in 2004, energy consumption was about 1.4 times higher than that recorded in 1990 (Figure 48).

Only in the last years Portugal manages to decouple GHG emissions and economic growth. There was a slight decrease in carbon intensity of the economy (emissions per unit of GDP) in recent years, a fact that may be explained by the implementation of some policies and measures with positive effects on GHG emissions such as the introduction of natural gas, increase of renewal energy production, the

[16] Council Decision 2002/358/EC of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder

[17] Global Warming Potential.

introduction of combined cycle gas thermal electric plants, the progressive installation of co-generation units, energy and technology efficiency improvements in industrial processes and improvements in fuel quality.

Policies and Measures

The National Climate Change Programme (PNAC) is the main strategic instrument for compliance with GHG limitation commitments in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement. The proposed policies and measures are broken down into those included in the Reference Scenario (MR) (implemented or adopted by the 1st January 2005), and the additional measures (MA), defined at a later stage for ensuring that the GHG reduction targets are duly met.

The PNAC 2006 contains a set of measures defined for the sectors of the economy with an impact on GHG emissions: Energy (demand and supply, including the sub-sectors Transport, Residential and Services, and Industry), Agriculture and Livestock, Forestry and Waste, and thereby developed a framework of policies and measures. Here, GHG emissions are estimated and projected up to 2010, are systematised considering a reference scenario and a with additional measures scenario for the period 1990-2010,assumed as the average year of the period 2008-2012.

More recently the PNAC 2006 has been complemented with a new set of policies and measures, through Council of Ministers' Resolution No. 1/2008 (January the 4th) (CMR 1/2008) in order to further strengthen Portugal's commitments on key emission sources such as energy (supply and demand) and transport, and include: an increase to 45% of the share of electricity production from renewable sources (previously 39%); the operational start of new natural gas combined cycle power plants (2160 MW in 2006 will now be 5360 MW in 2010); and the increase of the 5.75% biofuels goal to 10% in 2010, among others. The GHG emissions reduction potential from new 2007 measures is about 1 556 kt CO_2e (adopted by CME 1/2008).

National projections show that Portugal will meet its Kyoto target: according to PNAC projections for the reference scenario, it is estimated that, by 2010, Portugal's GHG emissions will total 84.61 Mt CO_2e. The GHG emissions reduction potential from additional measures is 3.69 Mt CO_2e/year, resulting in total emissions of 80.9 Mt CO_2e by 2010, under the "with additional measures scenario" of PNAC2006. Considering the emissions reduction potential of the New 2007 Measures evaluated in 1.56 Mt CO_2e/year the emissions will be 79.36 Mt CO_2e. This value is 2.97 Kt CO_2e emissions higher than the assigned amount under the Kyoto target 76.39 Kt CO_2e, as referred above. With the emissions reduction effort of 0,09 Mt CO_2e/year coming from PNALE II the emissions deficit will be compensated by the Portuguese Carbon Fund that has been created to address the participation in the Kyoto mechanisms and ensure Kyoto's compliance. Accordingly with the current investment planning, the fund will acquire 22.2Mt CO_2e.

Since the beginning of 2008, and for the first time, reflecting the great effort put by the Portuguese Government to assess its path towards compliance, it has been put in place a monitoring system for the current policies and measures of PNAC. Accordingly to the periodic monitoring of PNAC (every semester), the internal measures are not fully complying with the expected reduction. This decrease in the effectiveness has been acknowledged by the responsible entities that meanwhile have started working in contingency plans to evaluate the existing measures and other in a cost-effective way.

The cross-cutting P&M adopted by Portugal include the European Union Emissions Trading System (EU-ETS), the Fluorinated Gases Directive and the Green Public Procurement System.

The total amount of emissions allowances awarded to Portugal in the 2005-2007 period is of 38.16 Mt CO_2 (representing approximately 47% of national emissions), of which 36.90 Mt CO_2 corresponds to the 244 installations listed in PNALE, and the remainder 1.26 Mt CO_2 is set aside as a reserve for new entrants. This reserve amount will be cancelled in case it is not used.

PNALE II[18] stipulates a limit value of 33.93 Mt CO_2/year to existing installations covered under the EU ETS, corresponding to a total of 169.65 Mt CO_2 for the period 2008-2012.

Portugal has participated regularly and systematically in the discussions on emissions from the international air and maritime transport sub-sectors, both at UNFCCC and Community levels (namely with regard to aviation), as well as in following developments by the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO).

The National Civil Aviation Institute (INAC) is the responsible body for following issues relating to GHG emissions from the international civil aviation sector, ensuring the country's participation at the various international fora, both at the level of the ECCA[19] at the meetings of Director-Generals, and the ICAO, at the plenary sessions of the Assembly.

The Port and Sea Transport Institute (IPTM) has been directly involved in the International Maritime Organisation through meetings of the Marine Environment Protection Committee. Portugal is preparing for the ratification of Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL).

Portugal's contribution to the minimisation of the adverse effects of climate change in other Parties, particularly developing countries, is carried out through a strong commitment to implementing the Convention and the Kyoto Protocol.

As such, the policies and measures implemented, adopted or foreseen in PNAC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

Portugal's National Registry System is operational since November 2005. Such infrastructure meets the needs of the registry system and is capable of expanding to meet future requirements. An external team of Information Technology and Environment experts was hired to assist in the management of the registry system.

GHG Emissions Projections

In the beginning of 2009, Portugal has finalised the study *Clima2020* which evaluates the GHG emissions' scenarios until 2020 in order to determine the impacts of the European "climate and energy package". The effects of the PNAC measures are included in the Business as Usual (BAU) scenario being

[18] June 2006 version, presently under public consultation.

[19] European Conference on Civil Aviation

considered in this report as the "With Existing Measures (WEM), and the additional measures are considered in the Kyoto Trend (QUIT) scenario, which corresponds to the "With Additional Measures (WAM)".

The considered scenarios are summarized as follows:

- WEM – BAU
  - Trend in demand of goods and services
  - P&M implemented and approved until the 31st of December 2007 (assuming its total effectiveness)
- WAM – QUIT
  - Trend in demand
  - P&M implemented and approved until the 31st of December 2007 (assuming its total effectiveness) and those approved but not yet implemented.

In WEM and WAM scenarios inertia factors were introduced relating to the use of efficient equipments and the use of different types of final energy. These factors try to reflect that and are accordingly with what is forecasted in the National Plan for Energy Efficiency (PNAEE).

According to the projections[20] made in the scope of the study *Clima 2020*, for WEM, it is estimated that, by 2020, Portugal's GHG emissions will total 94 Mt CO_2e (without LULUCF). It is expected that the GHG emissions evolution differs according to the different scenarios considered: +8% in WEM and +4% in WAM (without LULUCF). This is explained by the different policy set that influences GHG emissions and reductions.

It is expected that energy industries, transport and industrial processes remain as the main emitter activities (28 Mt CO_2e, 23 Mt CO_2e and 11 Mt CO_2e and 29 Mt CO_2e, 22 Mt CO_2e and 10 Mt CO_2e, respectively in WEM and WAM) in 2020. Despite the increase in the demand of energy services a reduction of the emissions is also expected in the commercial and services' sectors, due to the replacement of heating gasoil by electricity and the use of more efficient technologies. Regarding smaller CHP and industries, the emissions are also to rise like the emissions from F-gases associated to a higher intensity in the use of cooling equipments. In WAM the reductions are noted in the Energy sector, namely towards the promotion of the use of Renewable Energy Sources (RES) and the use of biofuels. Therefore, the total expected emissions for 2020 are 91 Mt CO_2e, with Reductions is the Transports (21 Mt CO_2e) and other sectors.

[20] It is important to refer that these projections do not include the reductions that will be achievable through the application of the European Union Emissions Trading Scheme (EU-ETS) in the period 2013-2020.

Considering the emissions by gas, the Energy sector has the largest contribution to CO_2 emissions, with a maximum of 64 Mt CO_2 by 2010 in the WEM. The Waste and Agriculture sectors are the main sources of CH_4. From its maximum value in 2000 (304 kt CH_4), Waste sector emissions will decrease to a minimum of 213 kt CH_4 in 2020 under both scenarios. The Agriculture sector is the principal source of N_2O.

Impacts, Vulnerability and Adaptation

The Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures (SIAM) project is the most comprehensive study on the impacts and vulnerability associated with climate change in Portugal. This study was based on future climate scenarios derived from atmosphere general circulation models, analysing its effects on a number of socio-economic sectors and biophysical systems including hydrological resources, coastal areas, energy sector, forests and biodiversity, fishing, agriculture and health. The first phase of this project examined mainland Portugal; a second phase extended the study to the autonomous regions of the Azores and Madeira.

Building on this, the Portuguese Government is about to approve the National Adaptation Strategy. This is mainly programmatic, defining the guidelines for action for the next years, being periodically updated and defined within the various sectors by the public administration and the remaining stakeholders. This strategy is intended to be the first step in preparing Portugal for the challenges of adapting to a changing climate.

Financial commitments and Technology Transfer

The policy is defined in the frame of the International Development Agenda and in accordance with successive commitments undertaken in various international fora. It also aims at implementing, in a coherent, effective and up-to-date manner, a strategic cooperation framework whereby the fight against poverty, inequity and social exclusion in developing countries are high priorities. Furthermore, such policy will also reflect an enhanced inter-connection between bilateral and multilateral cooperation, so as facilitate a better integration of Portuguese cooperation and Official Development Assistance (ODA) in global strategies. In this backdrop, environmental issues, particularly those pertaining to climate change, are included in cooperation and ODA in an integrated way and mainstreamed in other intervention sectors like agriculture, fisheries, industry and tourism.

Despite having reaffirmed its commitment to the pledges undertaken in the context of global efforts to achieve the MDGs, Portugal has faced serious difficulties in increasing its ODA. It is impossible to ignore the fact that most Portuguese ODA is still derived from the State Budget. In a phase of strict budgetary restrictions imposed in order to reduce the national deficit, this fact makes it difficult to increase sums allocated to ODA without having a serious impact on Portugal's public finances. Future international financial commitments will require Portugal to achieve a ratio of 0.51% ODA/GNI in 2010 and 0.7% ODA/GNI in 2015. For this to be possible, the proposal for the Main Planning Options for 2009 has established an intermediary target of 0.45%, which, upon being approved by Parliament, will entail a greater financial effort on the part of the entire central administration.

Most aid is channeled bilaterally - an average of 61% of total ODA, from 2002 to 2007. However, the relative importance of Bilateral ODA, as compared to Multilateral ODA, has reduced progressively during this period, although it still exceeds 50% of total ODA annually.

Portuguese multilateral contributions represented between 38% and 51% of total external assistance in the period 2001-2003, with a sharp drop to 20% in 2004. This reduction is not due to a decrease in multilateral contributions, which in fact increased as an individual item by 17% relative to the previous year, but rather to the marked increase in total assistance resulting from the expansion of the bilateral component.

Systematic Research and Observation

To reach the targets defined in the Lisbon Strategy and the Barcelona European Council Conclusions adopted in Barcelona, which encompasses the Bologna Declaration, Portugal has reformed the structure of public expenditure and the incentives system to encourage growth and to boost scientific and technological development and innovation. This task involves doubling the scientific and technological research capacity of the country, which in turn reinforces the social and economic potential of Portugal. In 2003 the total expenditure on R&D activities was 1020 million Euros, corresponding to 0.78% of the Portuguese GDP.

Of the Public Budgetary Appropriations for R&D in 2000-2004, 0.07% was allocated to climate change research. 2004, with an allocation of 0.14%, was the peak year for climate change research funding.

Activities relating to systematic observation follow policies determined by international organisations in which Portugal participates, including the World Meteorological Organisation (WMO) and the EU. Portugal is mainly involved through the World Climate Programme (WCP), its research component (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

At the international level, Portugal contributes to the maintenance and improvement of the global observation system by taking part in Earth observation programmes, particularly satellite programmes of the Organisation for the Exploitation of Meteorological Satellite programmes (EUMETSAT) and the Global Climate Observing Systems (GCOS).

With regard to Portuguese Official Development Assistance ODA, it is worth noting the ongoing scientific and technical collaboration with institutions of the Portuguese Speaking Countries, namely in several operational and Research and Development projects, in particular with Sao Tome and Principe and Cape Verde, in the fields of Systematic Observation and models for weather, climate and ocean turbulence.

Public Education, Training and Awareness Raising

Climate change and other environmental issues are cross sectoral themes which are present in different forms in school curricula. In the current reorganisation of the curriculum for primary education and the revision of that for secondary education, this theme is specifically covered in some subjects.

Since the late 1970s, environmental themes have been introduced in school programmes. Since 1997, within the scope of the ME and the MAOT Cooperation Project (signed in 1996), teachers have been appointed to coordinate school projects for environmental education.

Due to their scope, Environmental NGOs play a very active role in public participation processes, while also having an equally important role raising awareness on environmental problems.

APA has financed, under PAAADS, the participation of ENGOs at various national and international events which contribute to the increase in the capacity of work done by the benefiting entities, mainly by supporting the participation at the Conferences of the Parties (COPs). Such supported has amounted to a total of about € 9956 in the 2000-2006 period.

1 National Circumstances

1.1 Government Structures and Decision-making Process

The Portuguese Republic is a democratic State that is based upon the rule of law, the sovereignty of the people, the pluralism of democratic expression and democratic political organisation, and respect and effective guarantees for fundamental rights and freedoms and the separation and inter-dependence of powers. The State is a unitary State that is structured and functions under the rule of the self-governing system of the islands and the principles of the subsidiarity, the autonomy of local authorities and the democratic decentralisation of the public service. The archipelagos of the Azores and Madeira shall constitute autonomous regions with their own political and administrative statutes and their own institutions of self-government.

Portugal's constitutional system foresees four sovereign organs: the President, who represents the Portuguese Republic; the Government, which leads the country's general policies and is the supreme organ of the Public Administration; the Assembly of the Republic (Parliament), which represents the Portuguese citizens; and the Courts of Law, which administer justice and which rulings are mandatory for all public and private entities. These entities are independent but obliged to cooperate among each other. The people through direct, secret and periodical suffrage elect both the President and the Parliament.

The Parliament is elected every four years and consists of a maximum of two hundred and thirty Members. It takes on several political and legislative functions as well as that of inspection of governmental and administrative acts.

The President of the Republic appoints the Prime Minister, after consultation with the parties represented at the Parliament and according to the electoral results. The President also appoints the other members of the Government, after having been proposed by the Prime Minister. The number, designation and appointments of the Ministries and the Secretariats of State, as well as their respective coordination, are defined by the nomination Decrees of the corresponding position holders or by Decree-Laws.

The Government takes on competencies in political, legislative and administrative functions, specifically, to negotiate and to agree international Conventions, to approve international agreements which approval is not within the powers of the Parliament or which have not been tabled before the Assembly, and to table bills and draft resolutions before the Parliament. The Government is responsible for its actions to the President of the Republic and to the Parliament.

In relation to climate change, the Government holds the full responsibility of assuring the fulfilment of internationally commitments undertaken in the frame of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

In 2001, the Government approved the National Strategy on Climate Change[21], which entrusts the MAOT the responsibility for spearheading and co-ordinating at Government level the development of programmes and actions to limit GHG emissions growth.

[21] Council of Ministers Resolution 59/2001, May the 30th.

Given the transversal nature of issues related to climate change, the Government established in 1998 the Climate Change Commission[22] (CAC). The CAC is tasked with promoting and facilitating climate change policy across the range of Government bodies with relevant competencies, as well as to ensure that such issues are duly considered in the full range of sectoral policies.

The CAC is co-ordinated by the MAOT and includes representatives from the Ministry of Internal Administration (MAI), Ministry for Foreign Affairs (MNE), Ministry of Finance and Public Administration (MFAP), Ministry of Economy, Innovation and Development (including energy and industry) (MEID), Ministry of Agriculture, Rural Development and Fisheries (including forests) (MADRP), Ministry of Public Works, Transports and Communications (MOPTC), Ministry of Education (ME), Ministry of Science, Technology and Higher Education (MCTES), as well as representatives from the Autonomous Regions of Azores and Madeira.

Technical options and adequate policies are discussed within the remit of the CAC. Programmes, plans and legal instruments pertinent to the national policy framework on climate change are proposed for adoption by the Council of Ministers with the objective of complying with Portugal's commitments under the Kyoto Protocol and the European Union Burden Sharing Agreement.

In 2006, the CAC was appointed[23] as the Portuguese Designated National Authority (DNA) for the Kyoto Protocol flexibility mechanisms, responsible for, among other functions, promoting Portuguese investments in these mechanisms.

The Executive Committee of the CAC (CECAC) was created[24] in 2006 to support CAC in its role of Portuguese DNA and in the coordination of Climate Change Policies. CECAC is also the technical manager of Portuguese Carbon Fund. The CECAC is coordinated by a representative of the MAOT and its board includes representatives of MFAP, MEID, as sub-coordinators, of the MNE, MADRP, MOPTC.

The main instruments geared towards compliance with the national GHG emissions target and, more broadly, the implementation of the Kyoto Protocol include the National Climate Change Programme[25] (PNAC), the System to Monitor it – *CumprirQuitoto.pt*[26], the National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants [27] (SNIERPA), the participation in the EU-ETS as defined by the National Allocation Plan[28] (PNALE) and the Portuguese Carbon Fund[29].

Since 2007 competences on climate change policy – the Portuguese Carbon fund, PNAC, international negotiations - are incumbent upon CECAC, and both SNIERPA and the participation in the EU-ETS are coordinated by Portuguese Environment Agency (APA).

[22] Council of Ministers Resolution 72/1998, Junne the 30th altered by Council of Ministers Resolution 59/2001, May the 30th .

[23] Council of Ministers Resolution 33/2006, March the 24th.

[24] Council of Ministers Resolution 33/2006, March the 24th.

[25] Council of Ministers Resolution 104/2006, August the 23rd and Council of Ministers Resolution 1/2008 January the 4th.

[26] www.cumprirquioto.pt

[27] Council of Ministers Resolution 68/2005, March the 17th.

[28] Council of Ministers Resolution 1/2008, March the 3rd and Decree- Law 154/2009, July the 6th.

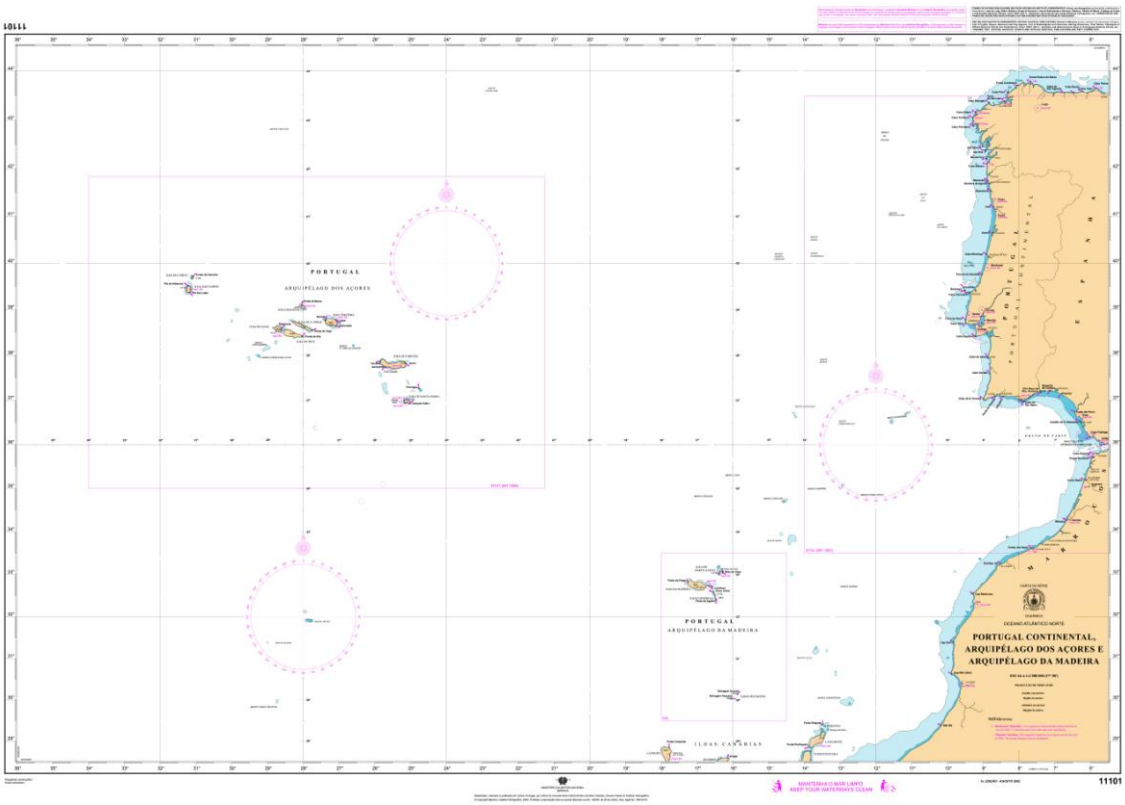
[29] Decree-Law 71/2006, of March the 24th and Law 64-A/2008, December the 31st.

Policies and measures included in the PNAC are pursuant to European Community (EC) Directives transposed into national legislation and the application of other types of EU instruments, namely in the context of the European Climate Change Programme (ECCP), as well as measures specifically developed by Portugal. Both the framework programmes and the specific instruments for the limitation of national GHG emissions have been approved by Government and duly published in the *Diário da República*[30].
At the local level, and within the spirit of Local Agenda 21, Local Authorities have a very important role in implementing policies and measures, as well as promoting awareness on issues relating to climate change, as these are the governmental bodies closest to the citizens and also the ones that can drive significant changes, especially in the behaviour of individuals and small and medium enterprises.

1.2 Geographic and Climate Profile

Portugal comprises three territorial areas: the mainland, within the European continent, and the archipelagos of the Azores and Madeira (92 151.8 km^2).

Mainland Portugal is located in the Southwest corner of Europe, between the latitudes of 37°N and 42°N and the longitudes of 9.5ºW and 6.5ºW. With a total surface area of 89 045.1 km^2, mainland Portugal is divided into eighteen Districts grouped into five Regions (North, Centre, Lisbon and the Tagus Valley, Alentejo and the Algarve), has roughly 1 450 km of coastline and shares a 1 200 km boarder with Spain. The archipelago of the Azores has a total surface area of 2 321.9 km^2, and is located approximately 1 200 km West of the mainland. The archipelago of Madeira has a total surface area of 784.8 km^2, and is located approximately 900 km Southwest of mainland Portugal (Figure 2).



[30] Official Gazette.

Figure 2. Portugal's geographic location
Source: http://www.portugal.gov.pt

The major rivers in Portugal are the Tagus, the Douro, the Guadiana and the Minho, which hydrological basins are shared with Spain, as is that of the river Lima. These shared basins occupy 264 560 km^2: 56 930 km^2 located in Portugal and 207 630 km^2 in Spain. The exclusively national rivers are smaller and more irregular, the most important of which are the Vouga, the Mondego and the Sado.

In the Northern region of Portugal (North of the Tagus) the terrain is mountainous, with altitudes between 400 m and a maximum of 1991 m, with the exception of the plains of the Tagus and Vouga rivers. The soils are predominantly acidic, though neutral soils can be found in the Centre region. South from the Tagus, in the Alentejo region, the altitude varies from 50 m to 400 m, with a variety of predominantly acidic and neutral soils. The far South, the Algarve, presents a continuous coastal strip of plains (with an altitude range from 0 m to 50 m), with acidic soils in the plateaus and predominantly alkaline and neutral soils in the plains.

1.2.1 Mainland Portugal

Portugal is located in the transition region between the subtropical anticyclone of the Azores and the sub polar depression region. The most conditioning climate factors in Mainland Portugal are, in addition to latitude, its orography and the effect of the Atlantic Ocean. In spite of the fact that the variation in climate factors is rather small, it is still sufficient to justify significant variations in air temperature and, most of all, in precipitation.

In fact, the Northwest region of the country (Minho) is one of European's rainiest regions (with an average of total annual precipitation of about 2500 mm) whilst in the Southeast region the annual average is of about 500 mm. Precipitation shows high interanual variability, with well known vulnerability to climate variability, namely to droughts in the Southern sector and floods in the North.

Temperature

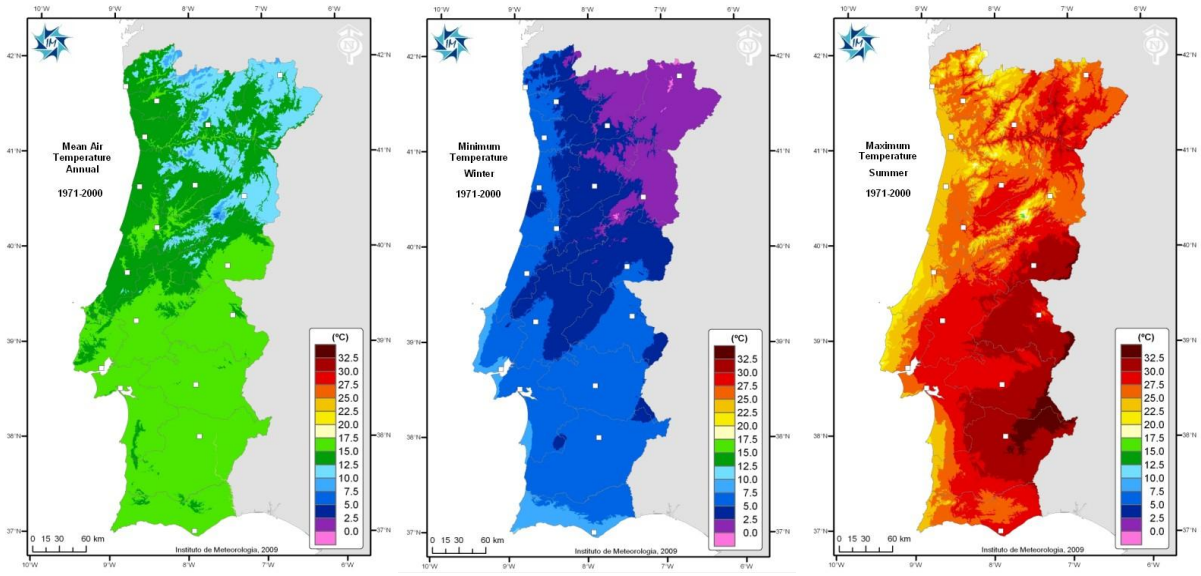


Figure 3. Mean annual air temperature, mean minimum temperature in winter and mean maximum temperature in summer (1971-2000)

Source: IM, 2009

The mean annual air temperature values vary from a minimum of 6 ºC in the Central interior highlands (Serra da Estrela) to a maximum of 17 ºC along the Southern coastline. The mean monthly air temperature values vary regularly throughout the year, with the maximum values being registered in August and minimum in January. In the summer, the mean values of maximum temperature vary between 20 ºC and 25 ºC in the Western littoral and is above 30 ºC in the interior Central region and Alentejo. The mean values of minimum temperature vary between below 0 ºC in Serra da Estrela and in the interior mountainous regions and 9 ºC to 10 ºC for the Southern coastline (Figure 3).

The annual number of days with a minimum temperature below 0 °C (frost days) can be higher than 50 in Northern Centre. The number of days with minimum temperature above 20 ºC (tropical nights) is more than 20 in some interior regions in the South and Centre. On the other hand, the spatial distribution of the average number of days with temperature values above 30 ºC (hot days) is maximum in the interior of Alentejo (South) with more than 90 days (Figure 3).

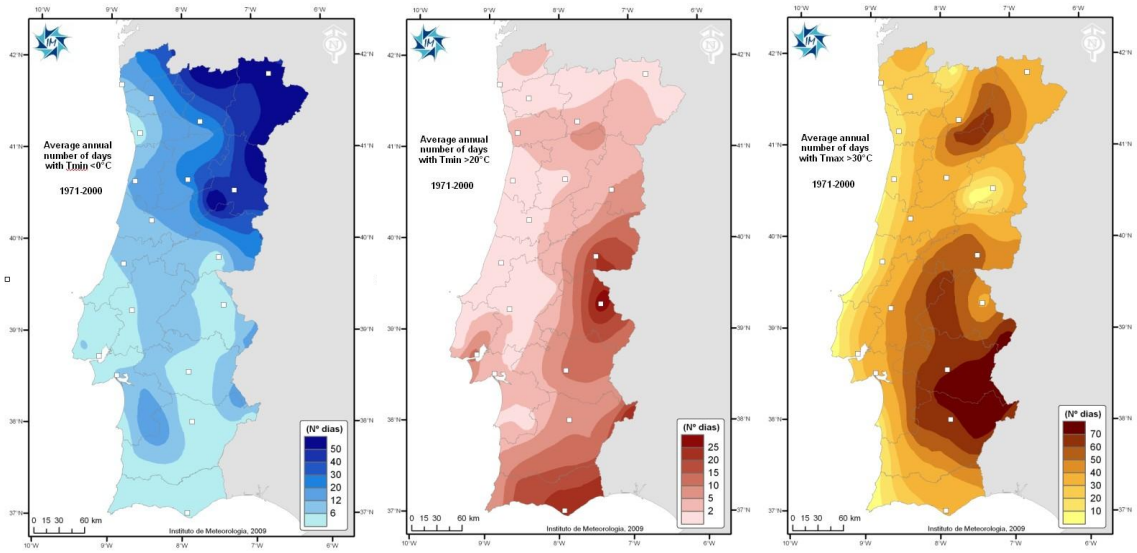


Figure 4. Average annual number of frost days (left), tropical nights and hot days (1971-2000)

Source: IM, 2009

Figure 4 shows the evolution of the average temperature in Portugal between 1931 and 2008: since the 70's the temperature has been raising at 0.36 ºC/decade, doubling the world rate. 1997 has been the hottest year of the last 78 years and seven of the ten hottest years occurred after 1990 (1997, 1995, 1996, 2006, 1990, 1998 and 2003).

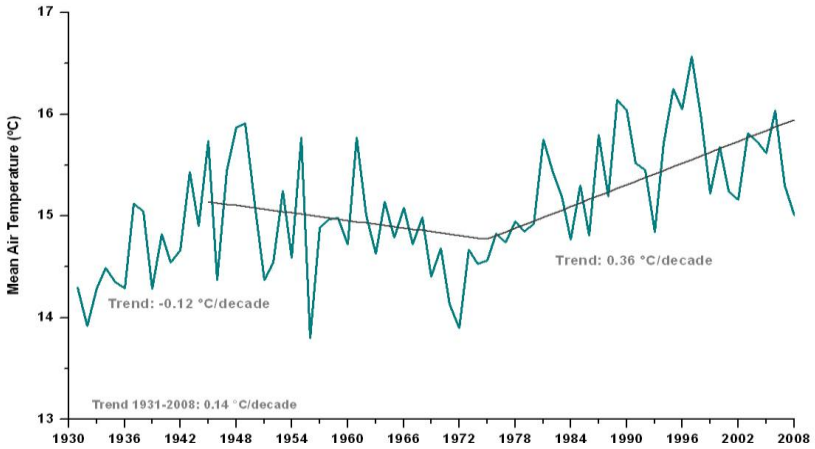


Figure 5. Annual variability of the mean air temperature in Mainland Portugal.[31]

Source: IM, 2009

As can be observed in Figure 5 in the last 33 years the maximum temperature is raising by 0.41 ºC/decade and the minimum by 0.30 ºC/decade.

[31] Superimposed are the piecewise trends calculated for the cooling and warming periods proposed by Karl *et al.* (2000)

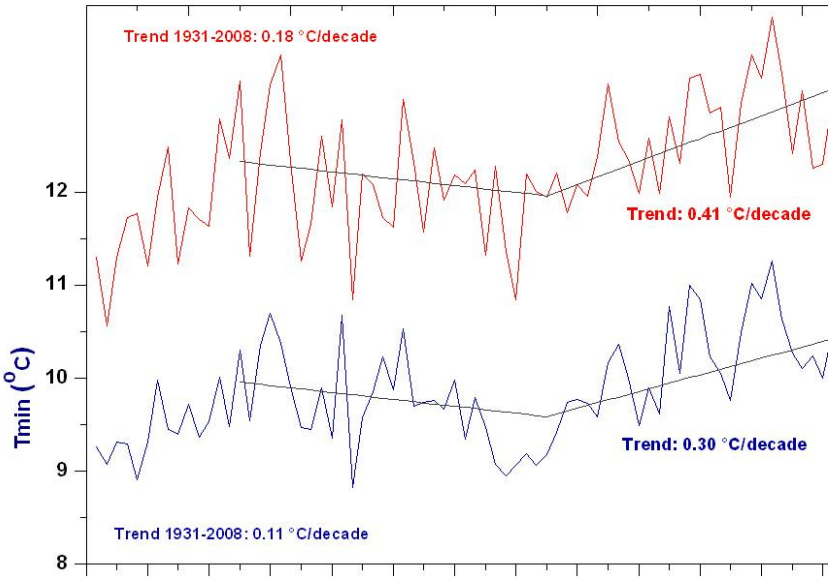


Figure 6. Annual variability of the maximum and minimum temperatures in Mainland Portugal.[31]

Source: IM, 2009

Changes in temperature related indices

The heat wave duration index has also been increasing. Heat waves occur when, in a period of at least 6 consecutive days, the daily maximum temperature is 5 ºC higher than the daily mean value of the reference period, between 1961 and 1990. Although they can occur at any time of the year, heat waves have a more significant impact in the summer months. Heat waves were more frequent in the 1990s. The heat waves of 1981, 1991, 2003 and, more recently, the two registered in June 2005 were of particular significance due to their duration and spatial extension.

The cold spell duration index has been significantly decreasing over the last 20 years. Cold spells occur when, during a period of at least 6 consecutive days, the daily minimum temperature is 5 ºC lower than the mean daily value of the reference period, between 1961 and 1990. The February 1983 cold spell was the longest and most widespread in the last 25 years.

One of the temperature indices with a larger variation from 1976 (the start of the warming period) onwards is the number of tropical nights per year shown in Figure 6 for Lisbon. At this station this number is clearly increasing to average values around 20 by the end of the 20th century, whereas before the 1970s it averaged about 7. This sharp increase is clearly related to the positive trend of minimum temperatures registered from 1976.

An index related to the maximum temperature is the number of summer days per year, shown in Figure 6 for Lisbon. There is a positive trend in this index since the 1970s (5.4 days/decade), although by the end of the century it has not recovered the larger values registered in the 1940s.

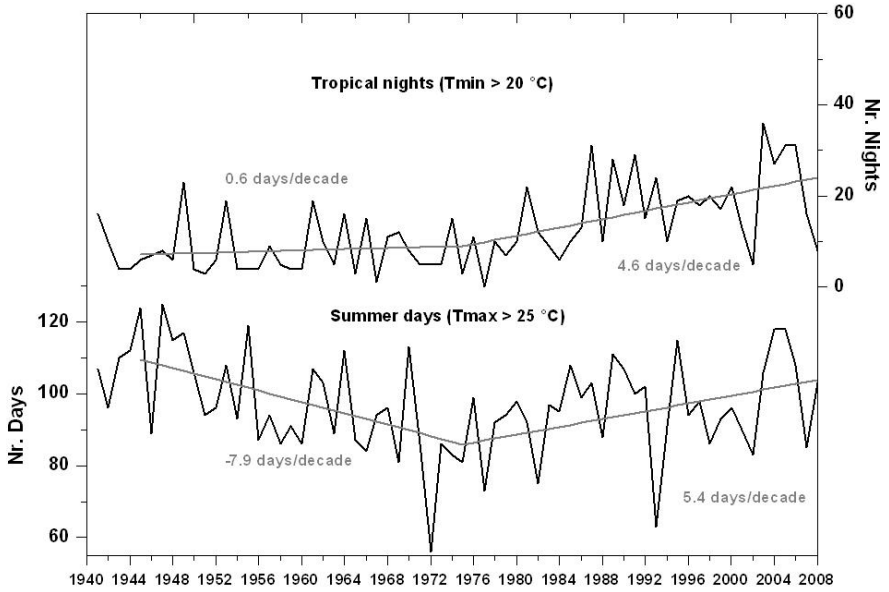


Figure 7. Lisbon's time series of number of tropical nights per year and number of summer days per year.

Source: IM, 2009

Precipitation

Mean annual precipitation over mainland Portugal is of about 900 mm, though with considerable spatial variability; the coastal North has the highest precipitation levels (>2500 mm) while the lowest (< 500 mm/year) are observed in the southern coast and in the eastern part of the territory.

On average, about 42% of the annual precipitation falls during the 3 month winter season (December to February), and the lowest precipitation values, corresponding to only 7% of the annual total precipitation, occur during the summer (June to August). During the transition seasons Spring (March to May) and Autumn (September to November) the amount of precipitation is highly variable (Figure 8).

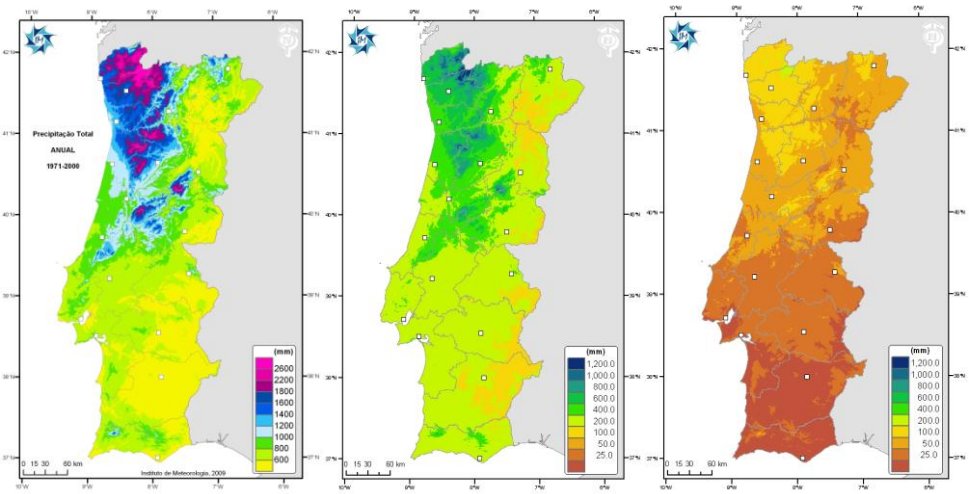


Figure 8. Mean annual precipitation in mainland Portugal (left), winter precipitation (centre) and summer precipitation (right) (1971-2000)

Source: IM, 2009

Figure 9 shows the number of days with precipitation values equal or above 1mm, 10 mm and 30 mm.

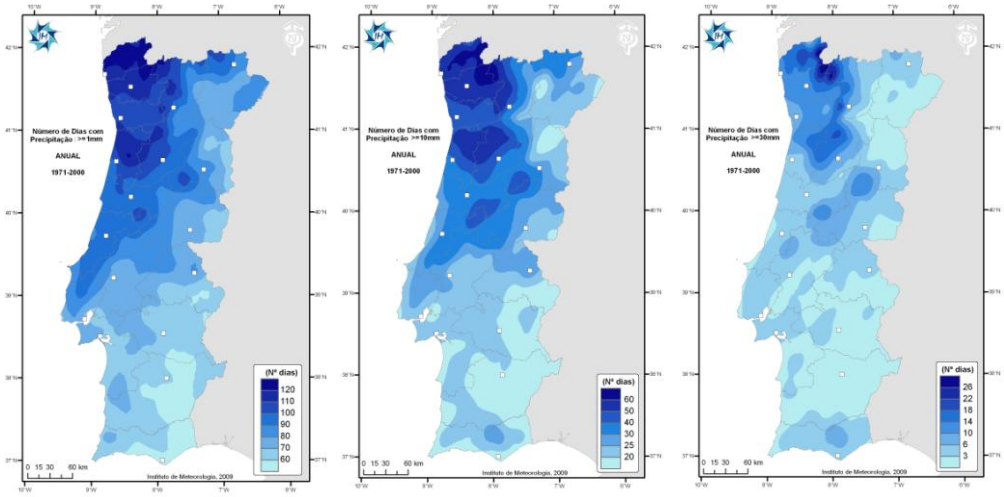


Figure 9. Average annual number of days with precipitation ≥1mm, 10 mm and 30 mm (1971 – 2010).

Source: IM, 2009

The average annual number of days with precipitation equal or above 1 mm reaches a peak in the highlands of the northern region (Alto Minho) with more than 120 days/year and the lowest values, below 60 days/year, can be found in southern (Alentejo and Algarve).

The annual average number of days with precipitation equal or above 10 mm varies between 15 to 25 days in the southern half of country and the northeast and up to 50 days in the north and the highlands.

The annual average number of days with precipitation equal or above 30 mm is higher in the northwest region (Alto Minho), with more than 30 days/year.

The last 30 years have been particularly dry in Mainland Portugal when compared to the 1971-2000 time series (Figure 10): only nine years have registered values higher than the average. 2005 was the driest of the last 78 years, followed by 2007 and 2004.

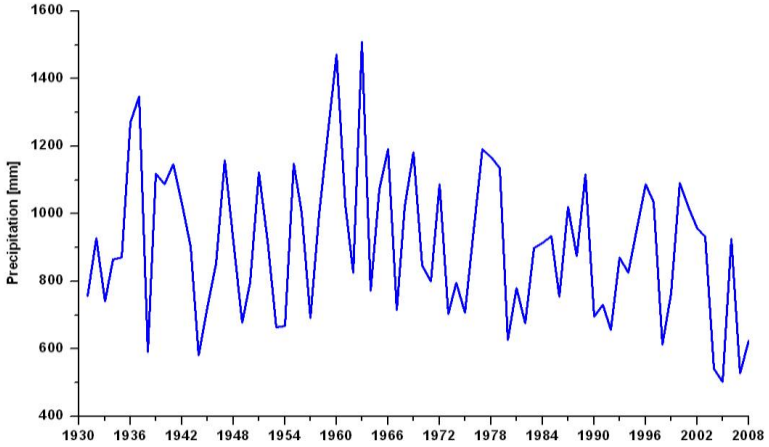


Figure 10. Annual variability of the precipitation – average in Mainland Portugal.
Source: IM, 2009

The seasonal evolution of the average precipitation since 1931 presents a significant reduction during spring in the last 4 decades. During winter the interanual variability has increased in the last 30 years.

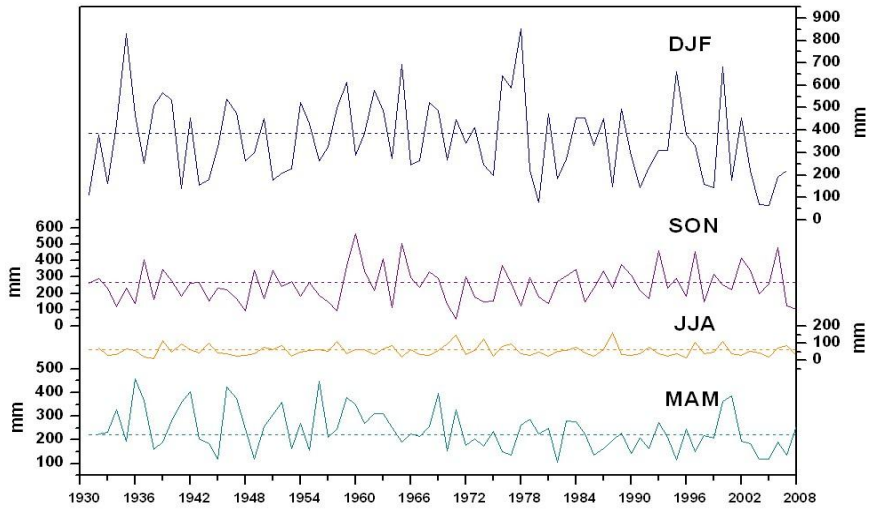


Figure 11. Mean annual variability of the precipitation in Mainland Portugal.
Source: IM, 2009

1.2.2 Archipelago of the Azores

The archipelago of the Azores is situated between the latitudes of 36º45' N and 39º43' N and the longitudes of 24º45' O and 31º17' O, with the Eastern most point at a distance of about 1400 km off the Western coast of mainland Portugal. The Azores comprises nine islands which are divided into three groups: the Eastern (Sao Miguel and Santa Maria islands), Central (Terceira, Graciosa, Sao Jorge, Pico and Faial islands) and Eastern Isles (Flores and Corvo islands). The lowest island (Graciosa) has a

maximum elevation of 402 m, whereas Pico has the highest point of the Azores and of Portugal (2351 m).

The Azores archipelago is located in the subtropical area of the Northern hemisphere anticyclones. The most determining factor that influences the weather conditions is the Azores antyclone.

The climate in this archipelago is temperate and humid. Given the altitudinal temperature variation, the climate is rainy and cool in high altitude regions. The season between September and March is predominantly rainy, characterized by the frequent passage of depression disturbances related to the polar front. In the remaining months the anticyclone's influence reduces precipitation.

In S. Miguel the annual mean temperature varies between 9 ºC and 17 ºC and the average annual precipitation can vary between 3 000 mm and 4 000 mm (Figure 12).

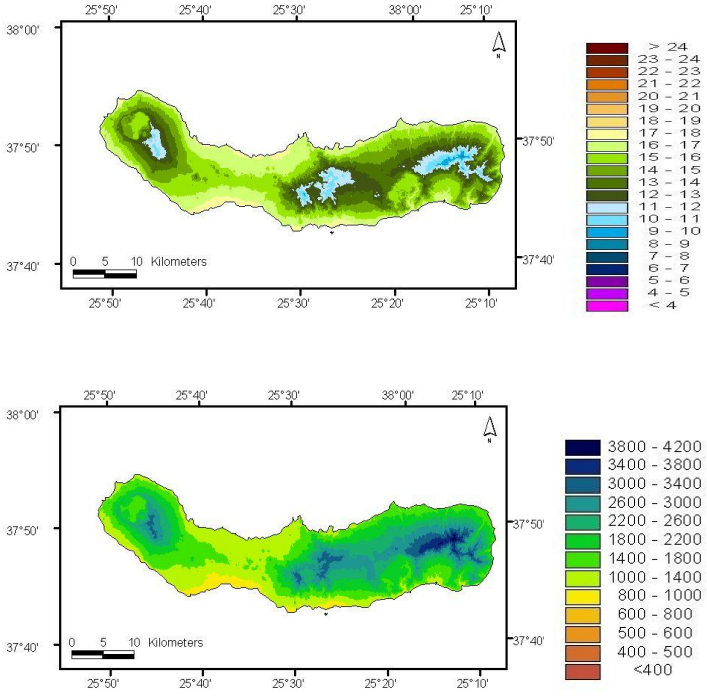


Figure 12. Distribution of the mean annual temperature and mean annual precipitation in S. Miguel (1961-1990).

Source: IM, 2009

In Terceira island the annual mean temperature varies between 10 ºC and 17 ºC and the average annual precipitation can vary between 1000 mm and 3 400 mm (Figure 13).

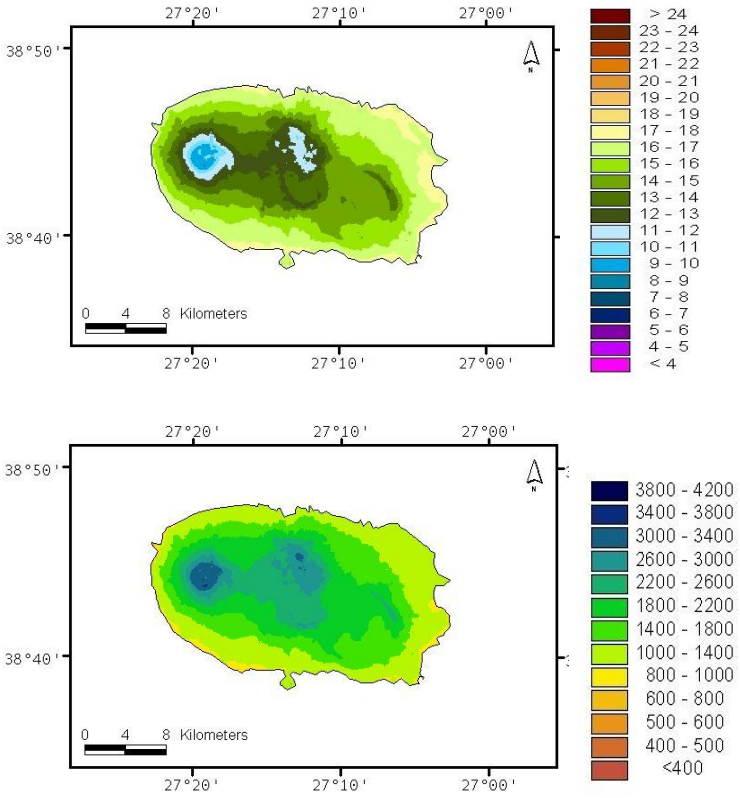


Figure 13. Distribution of the mean annual temperature and mean annual precipitation in Terceira (1961-1990).

Source: IM, 2009

Figure 14 shows that since the 70's the temperature has been raising in Angra do Heroísmo, Terceira Island, Azores.

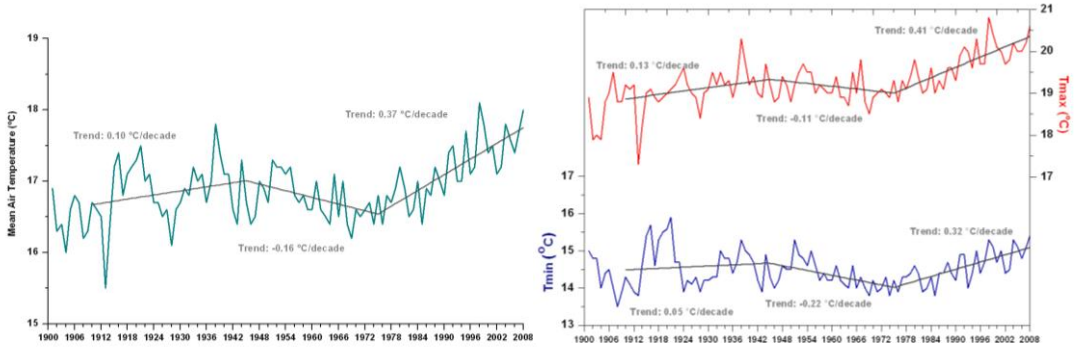


Figure 14. Mean annual variability of the mean, minimum and maximum temperature in Angra do Heroísmo (Terceira island).

Source: IM, 2009

In Figure 15 the seasonal precipitation is shown: with a high oscillation in winter.

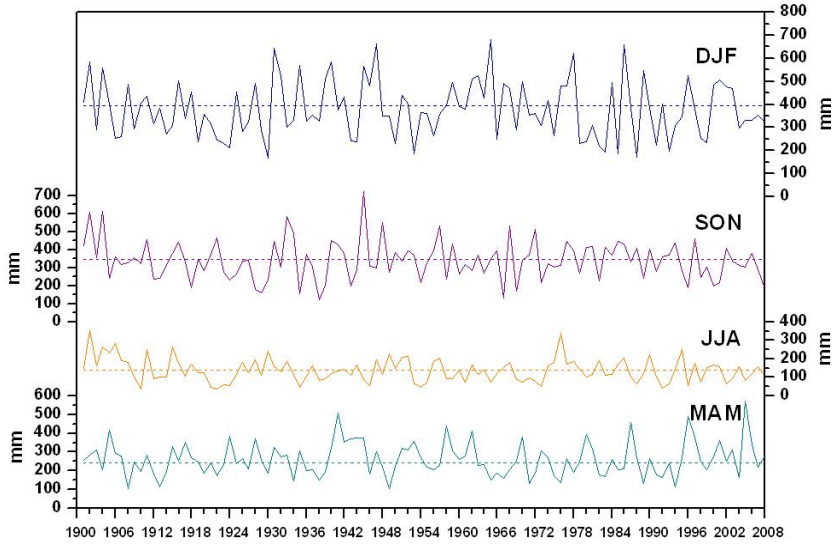


Figure 15. Evolution of the seasonal precipitation in Angra do Heroísmo (Terceira Island).
Source: IM, 2009

1.2.3 Archipelago of Madeira

The archipelago of Madeira is located in the North Atlantic, 1 300 km from the Azores and 900 km from the European continent. It comprises Madeira and the Porto Santo islands and two groups of deserted islets, the Desertas and the Selvagens.

Madeira island has a total surface area of 728 km^2 and is located at 32º45' N and 17º00' W. Madeira has an uneven orography; the highest points of the island, Pico Ruivo (1 862 m) and Pico do Areeiro (1 818 m), can be found on the Eastern side of the higher altitude formations, while to the West, the Paul Plateau rises to over 1 400 m. Porto Santo Island is located roughly 40 km Northwest of Madeira and has a maximum altitude of 517 m (Pico do Facho).

The climatic conditions are moderate, both during the winter and the summer, except in the highlands where there are lower temperatures. The island's complex relief creates many micro-climates.

Mean annual temperature can vary between 8 ºC in higher altitude and 18 ºC to 19 ºC in the coastal areas. From among the weather parameters, precipitation registers the broadest variability. Annual precipitation in Madeira varies between 3 400 mm (highest points) and 600 mm (Funchal basin). There is a significant contrast between the Northern bank and the highest spots, where abundant precipitation occurs, and the Southern bank.

The North/South asymmetry in the annual number of days with precipitation is very clear; in the Funchal area and in other parts of the Southern coast, there are less than 80 days with precipitation per year, whereas in the Northern coast over 120 days/year are registered. In the highlands there are over 200 days with precipitation per year, 70 of which have high values of precipitation (more than 10 mm). The minimum number of days with precipitation occurs on the Southern coast (in the Funchal area) and also on the Eastern coast (Machico area).

In Madeira the annual average temperature varies between 8 ºC and 19 ºC and the mean annual precipitation among 600 mm and 3 400 mm.

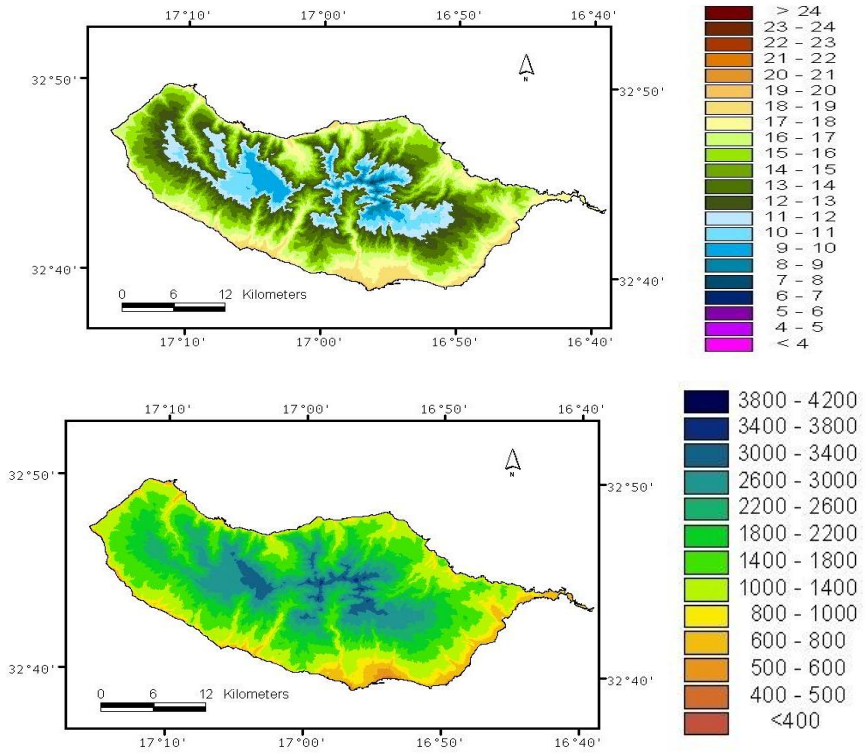


Figure 16. Distribution of the mean annual temperature and mean annual precipitation in Madeira (1991-1990).

Source: IM, 2009

Since the 70's the mean temperature has raised in Funchal and Porto Santo at rates of about 0.6 ºC/decade and 0.34 ºC/decade, respectively (Figure 17).

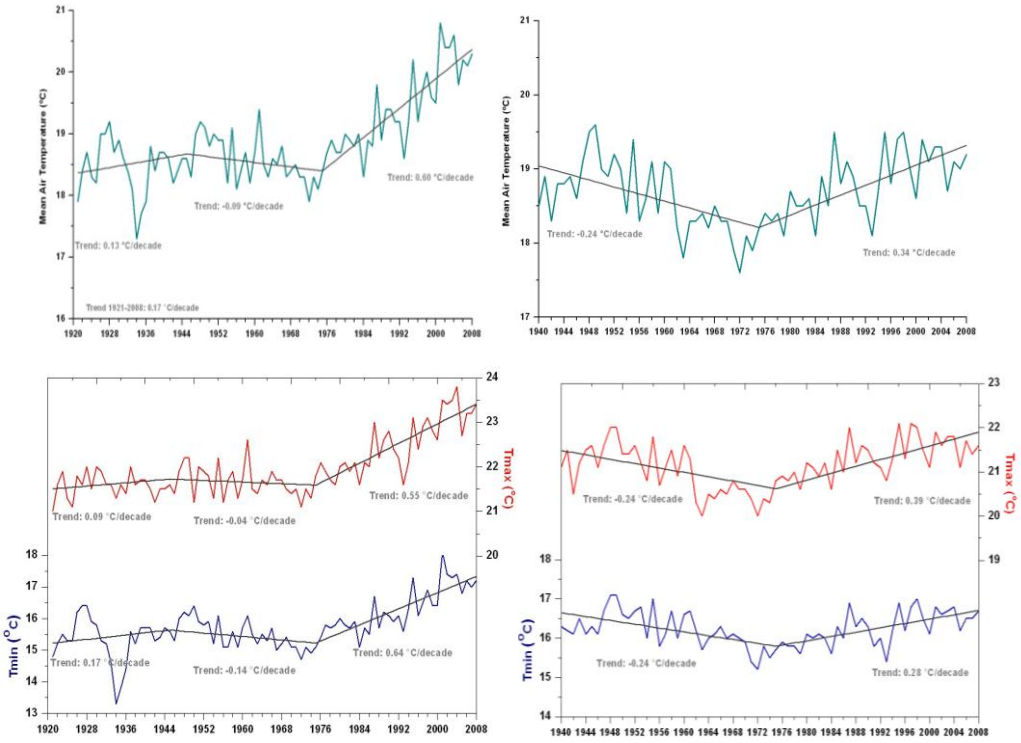


Figure 17. Mean annual variability of the average, minimum and maximum temperature in Funchal (left) and Porto Santo (right).

Source: IM, 2009

In what concerns the precipitation, only 11 years have shown values higher than the average.

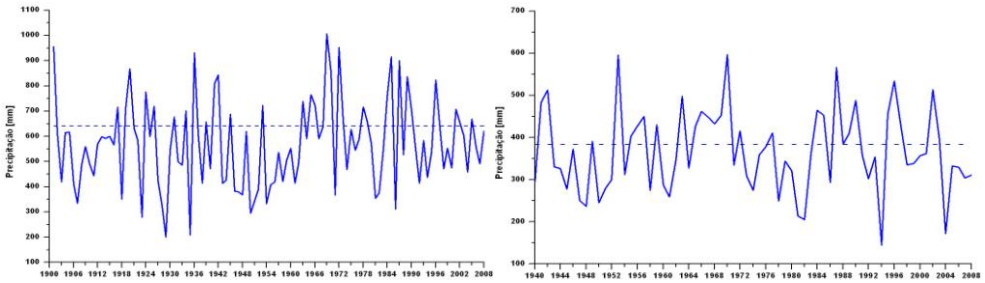


Figure 18. Mean annual variability of the precipitation in Funchal (left) and Porto Santo (right).

Source: IM, 2009

1.3 Population Profile

The resident population in Portugal on the 31st December 2008 was estimated at 10 627 250 individuals, which represented an increase of 6.6% over the 9 970 441 individuals estimated for the 31st December 1990.

Population figures have been rising slightly since 1992, and the year 2002 registered the highest variation (approximately 80 thousand), as showed in Table 1).

The slight rise in the population in 2008 occurred mainly due to the annual net migratory balance. The migration growth rate was 0.09% (immigration prevailed). The natural balance was slightly positive when, in the previous year, it was for the first time negative since 1918 (-1 020 people).

Table 1. Population in Portugal by age group, natural change and migration rate (1990–2008)

Year	Resident population	Population 0 - 14 years	Population 15 -64 years	Population >65 years	Natural change	Migration rate (%)
1990	9 970 441	1 993 079	6 620 653	1 356 709	13 526	-0.39
1991	9 965 315	1 928 457	6 648 818	1 388 040	12 404	-0.18
1992	9 974 591	1 875 558	6 682 689	1 416 344	14 276	-0.05
1993	9 990 590	1 836 005	6 710 461	1 444 124	7 999	0.08
1994	10 017 571	1 795 798	6 746 534	1 475 239	9 981	0.17
1995	10 043 180	1 756 829	6 778 260	1 508 091	3 609	0.22
1996	10 072 542	1 725 384	6 808 563	1 538 595	3 362	0.26
1997	10 109 697	1 696 681	6 840 153	1 572 863	8 155	0.29
1998	10 148 883	1 673 072	6 871 182	1 604 629	7 186	0.32
1999	10 195 014	1 654 678	6 905 459	1 634 877	8 131	0.37
2000	10 256 658	1 640 675	6 938 696	1 677 287	14 644	0.46
2001	10 329 340	1 640 160	6 980 609	1 708 571	7 682	0.63
2002	10 407 465	1 645 753	7 026 170	1 735 542	8 125	0.68
2003	10 474 685	1 648 996	7 064 293	1 761 396	3 720	0.61
2004	10 529 255	1 647 437	7 091 279	1 790 539	7 330	0.45
2005	10 569 592	1 644 231	7 115 261	1 810 100	1 937	0.36
2006	10 599 095	1 637 637	7 132 841	1 828 617	3 403	0.25
2007	10 617 575	1 628 852	7 138 892	1 849 831	- 1 020	0.18
2008	10 627 250	1 622 991	7 130 050	1 874 209	314	0.09

Source: Statistics Portugal, 2009.

Simultaneously, Portugal has seen its population aging, whether through the reduction of the younger population (younger than 15 years old) resulting from low birth rates or due to the increase of the elder population (65 years and older), a consequence of the increased average life expectancy at birth and of a higher number of individuals attaining older age. In 1990, 20.0% of the resident population was younger than 15 years old and 13.6% was 65 years old or older; in 2000 the proportion of the elderly (16.4%) exceeded that of youth (16.0%), a tendency observed also in 2008 (17.6% elderly and 15.3% youth).

From 1991 to 2001 the tendency to concentrate the population along the mainland's coast remained evident (namely in the Central and Northern regions). Population growth in some interior counties, especially District Capitals and their bordering counties contributed to reinforcing a network of medium-sized cities (Figure 19).

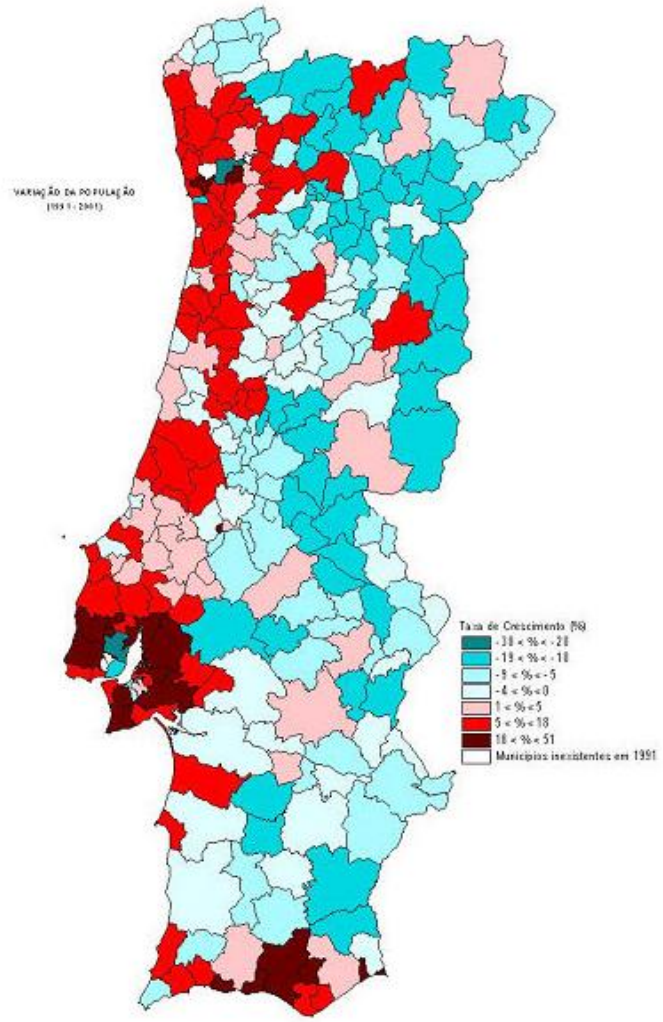


Figure 19. Variation in population (1991–2001)

Source: APA, 2005

In the same period, there the population decreased in the Alentejo region, the inner North and Centre regions and in some areas of the Tagus Valley, as opposed to the strong growth observed in the Metropolitan Areas of Lisbon and Oporto, along the coast North of the Tagus and in the Algarve. Nevertheless, the central core of the metropolitan areas, Lisbon and Oporto, underwent a considerable population decrease, which aggravated the abandonment of the historical town centres. As a consequence, there was a rise in mobility needs, especially in relation to commuters from urban peripheries.

1.4 Main Economic Indicators

The Gross Domestic Product (GDP) as increased 15.3% from 2004 to 2008, due the country's economic performance.

Table 2. GDP, GDP per capita and GDP deflator in Portugal

Millions of Euros			
	GDP (Volume Chain-linked series)	**GDP per capita**	**GDP deflator (2000 based)**
1995	100 093.8	8 488.0	-
1996	103 715.7	8 998.7	102.6
1997	108 057.3	9 701.4	103.8
1998	113 300.2	10 513.8	103.8
1999	117 652.5	11 226.2	103.3
2000	122 270.0	11 957.0	103.0
2001	124 735.4	12 562.8	103.7
2002	125 682.4	13 062.1	103.9
2003	124 670.2	13 272.8	103.2
2004	126 559.6	13 723.9	102.4
2005	127 711.1	14 135.7	102.5
2006	129 458.2	14 686.4	102.8
2007[32]	131 882.0	15 370.1	103.0
2008	131 833.9	15 668.1	102.1

n.s. – non specified

Source: Statistics Portugal, 2009

Erro! A origem da referência não foi encontrada. shows the trend in some national economic indicators for the period 1996 to 2008. The GDP has risen, but less than the last years, and the imports continue to be higher than the exports.

[32] 2007 and 2008 values refer to September the 8th, 2009.

Table 3. Gross Domestic Product and related indicators (1996-2008)

Year	PIB GDP (Millions of Euros)	GDP variation	Final Consumption Expenditure	Internal demand	Exports	% Exports on GDP	Imports	% Inports on GDP
1995	85 138.0	n.s.	70 781.3	90 579.5	24 356.5	29%	29 798.0	35%
1996	90 508.0	6%	75 488.0	96 799.7	25 505.9	28%	31 797.6	35%
1997	97 898.2	8%	80 686.0	105 751.3	27 981.2	29%	35 834.4	37%
1998	106 497.7	8%	87 085.2	115 997.7	30 843.2	29%	40 343.2	38%
1999	114 192.2	7%	94 077.1	125 819.7	31 872.6	28%	43 500.0	38%
2000	122 270.2	7%	101 723.9	135 584.7	36 386.7	30%	49 701.2	41%
2001	129 308.4	5%	107 235.6	142 267.0	37 360.4	29%	50 318.9	39%
2002	135 433.6	5%	112 528.7	146 689.0	37 879.3	28%	49 134.8	36%
2003	138 582.1	2%	115 950.7	147 666.1	38 789.8	28%	47 873.8	35%
2004	144 128.0	4%	122 069.8	155 388.6	40 952.7	28%	52 213.3	36%
2005	149 123.4	3%	128 680.9	162 330.3	42 567.1	29%	55 774.0	37%
2006	155 446.2	4%	133 731.9	168 213.0	48 204.4	31%	60 971.1	39%
2007	163 051.5	5%	139 109.9	175 307.5	53 430.6	33%	65 686.7	40%
2008	166 433.1	2%	145 205.1	182 325.0	54 877.9	33%	70 769.7	43%

Table 4 summarizes Portuguese international economic transactions.

Table 4. Current and capital and financial accounts and international investment position

	Current account and Capital account	Financial account	International investment position
		Millions Euros	
1996	-3 782.4	2 926.4	-9 624.9
1997	-5 767.8	3 729.0	-18 081.4
1998	-7 475.0	4 639.6	-27 280.4
1999	-9 665.7	8 327.9	-37 835.5
2000	-12 521.2	10 881.0	-50 279.0
2001	-12 801.2	10 835.1	-63 133.1
2002	-10 960.9	8 332.3	-77 623.0
2003	-8 457.0	5 084.0	-82 017.9
2004	-10 922.6	9 340.7	-92 205.3
2005	-14 138.8	13 062.1	-104 681.4
2006	-15 589.2	14 116.1	-125 833.5
2007	-15 374.3	13 135.7	-148 974.5
2008	-20 163.4	18 050.0	-161 531.1

Source: Statistics Portugal, 2009

The total active population has increased 2.5% since 2004 and the employment has also increased since 2004 (1.5%). In this period, the unemployment rate has increased by 0.9 percentage points (Table 5).

Table 5. Trend in employment and unemployment

Year	Active Population (individuals)	Total employment (individuals)	Total unemployment (%)	Employment rate (%)
1990	4 948.6	4 717.5	4.7	53.2
1991	5 064.9	4 857.4	4.1	54.8
1992	4 737.2	4 543.1	4.1	55.7
1993	4 715.1	4 457.7	5.5	54.1
1994	4 773.0	4 449.2	6.8	53.3
1995	4 754.3	4 415.9	7.1	52.7
1996	4 788.8	4 444.9	7.2	52.3
1997	4 854.5	4 530.4	6.7	52.9
1998	5 095.7	4 843.8	4.9	57.4
1999	5 136.1	4 910.3	4.4	57.7
2000	5 226.4	5 020.9	3.9	58.5
2001	5 325.2	5 111.7	4.0	59.1
2002	5 407.8	5 137.3	5.0	58.9
2003	5 460.3	5 118.0	6.3	58.2
2004	5 487.8	5 122.8	6.7	57.8
2005	5 544.9	5 122.6	7.6	57.5
2006	5 587.3	5 159.5	7.7	57.7
2007	5 618.3	5 169.7	8.0	57.6
2008	5 624.9	5 197.8	7.6	57.8

Source: Statistics Portugal, 2009

The distribution of the employed by sector is presented in Table 6. Both primary and secondary sectors have been employing less people since 2004, by -3.6% and -4.7%, respectively. The tertiary sector was the only sector that increased employment since 2004, by 5.9%.

Table 6. Sectoral distribution of the employment (1000 individuals)

	Total employment	Primary	Secondary	Tertiary	undefined
1990	4 717.5	845.6	1 624.6	2 245.2	2.0
1991	4 857.4	847.9	1 629.5	2 378.6	1.4
1992	4 543.1	522.3	1 499.5	2 521.3	-
1993	4 457.7	515.6	1 459.7	2 482.3	-
1994	4 449.2	523.1	1 451.6	2 474.4	-
1995	4 415.9	508.9	1 415.3	2 491.7	-
1996	4 444.9	545.9	1 385.5	2 513.5	-
1997	4 530.4	617.0	1 419.2	2 494.2	-
1998	4 843.8	651.8	1 701.1	2 490.9	-
1999	4 910.3	621.9	1 689.1	2 598.5	0.9
2000	5 020.9	635.4	1 733.7	2 651.7	0.1
2001	5 111.7	652.6	1 728.8	2 730.3	-
2002	5 137.3	636.9	1 727.7	2 772.7	-
2003	5 118.0	642.1	1 652.8	2 823.1	-
2004	5 122.8	618.1	1 596.0	2 908.6	-
2005	5 122.6	606.2	1 566.6	2 949.8	-
2006	5 159.5	603.8	1 577.2	2 978.4	-
2007	5 169.7	601.4	1 577.8	2 990.5	-
2008	5 197.8	595.6	1 520.8	3 081.4	-

Source: Statistics Portugal, 2009

From 2004 to 2007, the contribution of industrial sectors to the national Gross Value Added (GVA) decreased slightly, from about 15.5% to 14.8%. This reflects the continuation of the deindustrialization process and a transformation to a services-based economy, demonstrated by the sectoral distribution numbers of the GVA (Table 7).

Table 7. Contribution of the sectors activities to the total GVA at constant prices (1995–2006, base 2000)

Sub-sectors (Millions of Euros)												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Agriculture, animal husbandry, hunting and activity of related services	5.41	5.16	4.28	3.95	3.66	3.44	3.27	2.99	2.91	2.86	2.55	2.55
Fisheries	0.39	0.38	0.36	0.35	0.33	0.33	0.33	0.34	0.33	0.31	0.29	0.28
Extraction of energy products												
Extraction industries except the extraction of energy products	0.54	0.45	0.48	0.46	0.44	0.44	0.42	0.35	0.32	0.35	0.35	0.43
Food, drinks and tobacco industries	2.40	2.52	2.43	2.48	2.64	2.36	2.43	2.48	2.51	2.45	2.40	2.35
Textile industry	3.37	3.41	3.18	2.99	2.95	2.71	2.61	2.63	2.49	2.32	2.08	1.93
Leather industry	1.02	1.02	0.99	0.88	0.84	0.76	0.75	0.74	0.69	0.62	0.58	0.53
Wood and cork industries, and respective works	0.64	0.69	0.68	0.73	0.74	0.68	0.66	0.65	0.63	0.63	0.62	0.60
Pulp and paper industries and respective products; publication and printing	1.91	1.69	1.68	1.63	1.57	1.79	1.62	1.54	1.48	1.40	1.42	1.45
Manufacture of coke, refined oil products and nuclear fuel	0.01	0.06	0.08	0.17	0.07	0.06	0.07	0.04	0.05	0.13	0.28	0.29
Manufacture of chemical products and synthetic or artificial fibres	1.34	1.28	1.26	1.04	0.92	0.89	0.86	0.85	0.84	0.84	0.81	0.75
Manufacture of rubber products and plastic substances	0.56	0.62	0.59	0.60	0.56	0.52	0.53	0.53	0.54	0.53	0.52	0.52
Manufacture of other non-metallic mineral products	1.91	1.89	1.92	1.90	1.89	1.69	1.61	1.57	1.41	1.36	1.30	1.24
Metallurgical and metallic products industries	1.78	1.70	1.73	1.75	1.69	1.66	1.59	1.53	1.49	1.50	1.47	1.53
Manufacture of machines and equipments	0.82	0.85	0.87	0.85	0.94	0.93	0.90	0.92	0.87	0.82	0.80	0.81
Manufacture of electrical and optical equipment	1.22	1.37	1.42	1.33	1.28	1.20	1.20	1.04	1.00	0.91	0.89	0.82
Manufacture of transport material	0.57	1.14	1.18	1.16	1.09	1.08	1.08	1.02	0.91	0.86	0.83	0.82
Processing industries n.s.	0.89	0.81	0.83	0.79	0.81	0.76	0.79	0.81	0.80	0.80	0.74	0.69
Generation and distribution of electricity, gas and water	2.92	2.92	2.70	2.78	2.65	2.44	2.41	2.48	2.74	2.79	2.60	2.89
Construction	6.36	6.47	7.04	7.29	7.31	7.60	7.75	7.60	7.06	7.07	6.85	6.61

Sub-sectors (Millions of Euros)												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Gross and retail commerce, repair of vehicles, motorcycles and goods of personal and domestic use	14.10	13.69	13.86	13.76	13.38	13.37	13.58	13.45	13.25	13.32	13.04	12.85
Accommodation and restaurants	3.66	3.63	3.76	3.98	4.01	4.10	4.04	4.19	4.18	4.35	4.40	4.48
Transports, storage and communications	6.49	6.55	6.53	6.39	6.57	6.60	6.85	6.82	6.83	6.92	6.89	7.02
Financial activities	6.27	5.83	6.23	6.17	5.97	6.14	6.51	6.32	6.53	6.59	6.61	7.45
Real estate activities, leases and provision of services to enterprise	13.55	13.44	13.44	13.83	14.56	14.45	13.98	14.13	14.53	14.36	14.86	14.59
Public administration, defense and compulsory social security	8.24	8.33	8.27	8.52	8.52	8.90	8.66	8.87	9.30	9.17	9.54	9.20
Education	6.20	6.34	6.42	6.42	6.51	6.58	6.67	6.97	6.94	7.03	7.22	7.05
Health and social services	4.87	4.98	4.91	5.03	5.22	5.42	5.81	6.00	6.06	6.31	6.65	6.78
Other activities of collective, social and personal services	1.87	2.04	2.07	2.01	2.15	2.35	2.31	2.38	2.54	2.64	2.64	2.70
Families with household employees	0.71	0.77	0.79	0.75	0.73	0.73	0.73	0.76	0.78	0.76	0.77	0.77

Source: Statistics Portugal, 2009

1.5 Energy

Portugal is a country with scarce indigenous energy resources, such as oil, coal and gas, being dependent of external sources to supply its demand. In Portugal, the extraction of coal ended in 1995, when the Pejão mines were closed.

However the potential to use renewable energy sources (RES) is notable, exceeding, in theory, the Portuguese demand. Evidence is put in energy produced from hydro, wind, sun, biomass and geothermal. A larger use of the potential of RES constitutes an essential aspect to attain sustainable development.

In Portugal the contribution of RES for the total primary energy demand has its origin in hydro and biomass (from forestry). Despite the fact that biomass and solar energy have good potential to produce heat, the electricity production is the form of energy that has been showing a larger development and deployment of technologies to generate it from renewable sources. Therefore, between 2004 and 2007 Portugal had a boosted growth in the installation of infrastructures to produce energy from renewable sources when comparing to past years being the wind power the major responsible for this development.

Hydro has contributed significantly to electricity generation, being responsible for 22.1% of its total in 2007. However the contribution of hydro power is highly dependent on the annual amount of rainfall (Table 8).

Wind power has reached, in the same year, 2 201MW of installed capacity, which represents a growth of 2 172MW compared to 1997, being now responsible for 28.8% of the Portuguese renewable matrix.

The total installed capacity in renewables grew 60.5% between 1997 and 2007. However it is important to refer that this increase in the renewable installed capacity (without the large hydro) for the same period was 386% (635MW in 1997 and 3 085MW in 2007), as a result from the wind power development, not yet reflecting the new hydroelectric projects – "Programa Nacional de Barragens" (Table 9).

Table 8. Energy production from renewable sources (GWh)

	Hydro > 10MW	Hydro < 10MW	Biomass	Wind	Geothermal	Photovoltaic	Total Renewables	Total Electricity	% Renewables
1995	7 962	492	988	16	42	1	9 501	33 264	28.6%
1996	14 207	658	959	21	49	1	15 895	34 520	46.0%
1997	12 537	638	1 036	38	51	1	14 301	34 207	41.8%
1998	12 488	566	1 022	89	58	1	14 223	38 984	36.5%
1999	7 042	589	1 237	122	80	1	9 071	43 287	21.0%
2000	11 040	675	1 553	168	80	1	13 515	43 764	30.9%
2001	13 605	770	1 600	256	105	2	16 338	46 509	35.1%
2002	7 551	706	1 734	362	96	2	10 451	46 107	22.7%
2003	15 163	891	1 669	496	90	3	18 312	46 852	39.1%
2004	9 570	577	1 809	816	84	3	12 859	45 105	28.5%
2005	4 737	381	1 987	1 773	71	3	8 952	46 575	19.2%
2006	10 697	770	2 011	2 925	85	5	16 493	49 041	33.6%
2007	9 926	523	2 140	4 037	201	24	16 851	47 253	35.7%

Source: DGEG, 2009

Table 9. Installed capacity from renewable power plants (MW)

Year	Hydro > 10MW	Hydro ≤ 10MW	Biomass	Wind	Geothermal	Photovoltaic	Total Renewables	Total Electricity
1995	4 032.42	246.38	359.00	8.28	8.80	0.34	4 655	9 689
1996	4 036.00	248.00	345.00	18.41	8.80	0.43	4 657	9 810
1997	4 130.00	245.00	351.00	29.16	8.80	0.53	4 764	9 865
1998	4 051.00	247.00	351.00	53.00	18.00	0.65	4 721	10 989
1999	4 035.00	257.00	441.00	57.00	18.00	0.93	4 809	11 167
2000	4 036.00	267.00	441.00	83.00	18.00	1.17	4 846	11 280
2001	4 049.00	281.00	441.00	125.00	18.00	1.34	4 915	11 405
2002	4 061.00	293.00	478.00	190.00	18.00	1.51	5 042	11 620
2003	4 062.00	297.00	458.00	268.00	18.00	2.07	5 105	12 018
2004	4 321.00	306.00	473.00	553.00	18.00	2.70	5 674	13 114
2005	4 512.00	306.00	474.00	1 063.00	18.00	2.99	6 376	13 899
2006	4 550.00	318.00	487.00	1 699.00	30.00	3.40	7 087	14 962
2007	4 560.00	323.00	507.00	2 201.00	30.00	24.00	7 645	15 531

Source: DGEG, 2009

In Portugal, the geothermal energy is only used in Azores, and it is currently in expansion.

According to solar radiation data, Portugal receives annually the equivalent to 140 million of GWh, representing a great potential for its utilization through solar thermal and photovoltaic technologies. The implementation of the Directive on the Energy Performance of Buildings was a decisive factor for the development and larger use of these technologies.

Similarly, the potential of wave energy in Portugal is considerable, and is being explored though a project in experimental stage.

1.5.1 Primary Energy Production

Since Portugal has scarce indigenous fossil energy resources and after closing the activity of coal extraction in Pejão mines, the primary energy production in Portugal totally relays on renewable energy resources.

In terms of electricity generation from renewable sources 1995, 1999, 2002 and 2005 had the lowest level of production since these were dry years and the production from large hydro was reduced. Thus production of electricity from renewable sources is highly dependent on variations in the production from large hydro, which represented in 2007 about 58.9% of the total production from renewable sources. To accomplish the goal of producing at least 39% of gross electricity consumption from renewable sources in 2010, Portugal is strongly dependent of large hydro production (Table 8).

However it is important to refer the increase of wind in the energy production share, which represented 4 037 GWh in the electricity production in 2007 (38 GWh in 1997 and 816 GWh in 2004). Comparing to 2004 the increment was approximately 394.7%. In Azores, geothermal energy has contributed with 201 GWh in 2007 (51 GWh in 1997) (Table 8). With the instability of hydro power, the contribution of renewable energy to primary energy demand is irregular. The annual average contribution in electricity generation between 1997 and 2007 was 31.3%.

Considering the correction of values for hydro production, according to the Index of Hydro Production (IPH, *Índice de Produtibilidade Hidroeléctrica*) for each year, the result of annual average contribution of renewable sources in electricity production was 36.7%, between 1997 and 2007, with a medium hydrologic scenario (Table 10).

Table 10. Share of renewables corrected by IPH

Year	Total Hydro	IPH (Directive reference year - 1997)	Total Hydro corrected	Total corrected	Gross Production + Import balance (GWh)	% Renewable (Directive)
1997	13 037	1.000	13 037	14 099	36 183	39.0%
1998	12 953	0.852	15 203	16 304	38 262	42.6%
1999	7 514	0.557	13 490	14 836	41 358	35.9%
2000	11 606	0.885	13 114	14 822	43 535	34.0%
2001	14 240	0.975	14 605	16 445	45 484	36.2%
2002	8 096	0.623	12 995	15 066	46 652	32.3%
2003	15 894	1.090	14 582	16 690	48 220	34.6%
2004	10 053	0.664	15 140	17 678	50 017	35.3%
2005	5 000	0.336	14 881	18 552	51 729	35.9%
2006	11 323	0.800	14 154	18 996	52 749	36.0%
2007	10 219	0.627	16 298	22 392	52 952	42.3%

Source: DGEG, 2009

1.5.2 Primary Energy Consumption

The primary energy consumption increased 2.2% between 1990 and 2007. Between 2004 and 2007 Portugal had an annual average decline in the consumption of 1.3% and registered a per capita consumption of 2.39 toe in 2007, which evolved from 1.78 toe per capita in 1990.

In relative terms, the oil is still essential to satisfy the Portuguese energy demand, representing in 2007 53.8% of the total primary energy consumption, being 12.8% lower than in 1990 (66.6%).

The introduction of natural gas in 1997 contributed for this relative decrease, which enabled the diversification of the structure of the energy supply and reduced the external dependence on oil. The use of natural gas has registered a positive evolution, representing 15.1% of the total primary energy demand in 2007 (Table 11).

In 2007 about 82.8% of the primary energy consumed in Portugal was imported. The energy represented in 2007 about 11.9% of the total of imported Free on Board Products [33].

Energy's GHG emissions depend on the type of fuel used to produce it and its carbon intensity. In 2007, 80.3% of the primary energy consumed was produced from fossil fuels (coal, oil and natural gas), the renewable sources represented 17.2%, referring the domestic sources, the remaining 2.5% were provided from imported electricity.

1.5.3 Final energy consumption

Final energy consumption is important an important parameter in order to understand the evolution of the demand, aiming the definition and application of an energy policy focused on rationalization of its use and sustainability.

The final energy consumption increased in average 2.7% per year between 1990 and 2007: 2.3% in oil and 4.5% in electricity. The natural gas, has verified an annual average increase of 40.3% between 1997 and 2007.

With an opposite trend, between 2005 and 2007, oil had an annual average decrease in use of 3.7%. Oil products' consumption represented 55.7% of the total in 1990, decreasing to 52.4% in 2007.

The transports, residential and services sectors are the major contributors to this trend (Table 12 and

Table 13). Between 2005 and 2007, the annual average of final energy consumption decreased 1%, being this trend highlighted between 2006 and 2007 to 1.7%.

The evolution of the sectoral energy consumption shows that the structure of the demand has been changing. The industrial sector, which represented 35.4% of the overall final energy consumption in 1990, represented 29.4% in 2007. On the other hand, the transport sector shows an opposite trend, representing 37.2% of the final energy consumption in 2007, while in 1990 represented 30.7%. In 2007, the residential and services sector represented 30.2% of consumption of total final energy, showing an increment of 192% in the services subsector when compared to 1990 (Table 11).

[33] FOB – the price is charged in the origin

Table 11. Primary energy consumption by fuel type (ktoe)

Year	PEC[34]	Coal	Coal (%)	Oil	Oil (%)	Electricity[35]	Electricity (%)	Natural Gas	Natural Gas (%)	Others[36]	Others[37]	Population (millions)	PEC per capita
1990	17 625	2 760	15.7%	11 731	66.6%	804	4.6%	0	0.0%	2 331	13.2%	9 877	1.78
1991	17 881	2 906	16.3%	11 767	65.8%	798	4.5%	0	0.0%	2 410	13.5%	9 961	1.80
1992	19 033	2 950	15.5%	13 148	69.1%	552	2.9%	0	0.0%	2 383	12.5%	9 965	1.91
1993	18 743	3 142	16.8%	12 479	66.6%	768	4.1%	0	0.0%	2 354	12.6%	9 983	1.88
1994	19 308	3 328	17.2%	12 637	65.4%	1 001	5.2%	0	0.0%	2 342	12.1%	10 013	1.93
1995	20 474	3 604	17.6%	13 649	66.7%	811	4.0%	0	0.0%	2 410	11.8%	10 043	2.04
1996	20 363	3 430	16.8%	13 147	64.6%	1 379	6.8%	0	0.0%	2 406	11.8%	10 072	2.02
1997	21 935	3 513	16.0%	14 444	65.9%	1 390	6.3%	87	0.4%	2 502	11.4%	10 110	2.17
1998	23 209	3 232	13.9%	15 634	67.4%	1 159	5.0%	700	3.0%	2 484	10.7%	10 149	2.29
1999	24 880	3 747	15.1%	15 993	64.3%	600	2.4%	1 956	7.9%	2 584	10.4%	10 195	2.44
2000	25 325	3 813	15.1%	15 568	61.5%	1 109	4.4%	2 135	8.4%	2 699	10.7%	10 257	2.47
2001	25 244	3 201	12.7%	15 799	62.6%	1 288	5.1%	2 267	9.0%	2 689	10.7%	10 329	2.44
2002	26 334	3500	13.3%	16417	62.3%	913	3.5%	2743	10.4%	2761	10.5%	10 407	2.53
2003	25 737	3 355	13.0%	15 257	59.3%	1 672	6.5%	2 649	10.3%	2 805	10.9%	10 475	2.46
2004	26 445	3 375	12.8%	15 411	58.3%	1 508	5.7%	3 316	12.5%	2 835	10.7%	10 529	2.51
2005	27 047	3 349	12.4%	15 877	58.7%	1 186	4.4%	3 761	13.9%	2 874	10.6%	10 570	2.56
2006	25 906	3 310	12.8%	14 305	55.2%	1 713	6.6%	3 595	13.9%	2 982	11.5%	10 599	2.44
2007	25 375	2 883	11.4%	13 659	53.8%	1 909	7.5%	3 826	15.1%	3 096	12.2%	10 618	2.39

Source: DGEG and INE, 2009

[34] Primary Energy Consumption

[35] 1GWh = 86 tep

[36] Considers wood and biomass wastes, urban solid wastes, sulphite liquors, biogas and biodiesel.

[37] Considers wood and biomass wastes, urban solid wastes, sulphite liquors, biogas and biodiesel.

Table 12. Final Energy Consumption by fuel type

Year	FEC[38] (ktoe)	Coal	Oil	Electricity [39]	Natural gas	Others [40]	From wich renewable
1990	11 664	658	6 497	2 011	0	2 498	1 759
1991	12 237	656	6 903	2 145	0	2 534	1 699
1992	12 649	663	7 237	2 245	0	2 504	1 647
1993	12 776	647	7 366	2 267	0	2 497	1 611
1994	13 171	657	7 641	2 344	0	2 529	1 593
1995	13 554	600	7 894	2 469	0	2 591	1 597
1996	14 278	632	8 392	2 607	0	2 646	1 629
1997	14 919	526	8 909	2 747	44	2 693	1 635
1998	15 789	448	9 513	2 911	246	2 671	1 630
1999	16 542	401	9 750	3 109	503	2 779	1 635
2000	17 386	506	10 112	3 300	719	2 749	1 633
2001	17 812	227	10 421	3 436	1 054	2 675	1 668
2002	18 197	177	10 624	3 567	1 180	2 651	1 638
2003	18 352	140	10 494	3 712	1 267	2 739	1 688
2004	18 739	88	10 650	3 842	1 369	2 791	1 703
2005	18 641	16	10 558	3 932	1 257	2 878	1 720
2006	18 450	26	10 172	4 083	1 225	2 944	1 727
2007	18 131	168	9 494	4 216	1 297	2 956	1 744

Source: DGEG, 2009

[38] Final Energy Consumption

[39] 1GWh = 86 toe

[40] Considers wood and biomass waste, urban solid waste, sulphite liquors, biogas, coque gas, oven gas, condensable gases and asphalt.

Table 13. Final energy consumption by sector

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total Industry[41]	**4 130**	**4 291**	**4 343**	**4 224**	**4 326**	**4 415**	**4 646**	**4 958**	**5 058**	**5 217**	**5 299**	**5 339**	**5 388**	**5 353**	**5 484**	**5 375**	**5 434**	**5 331**
Coal	658	656	663	647	657	600	632	526	448	401	506	227	177	140	88	16	26	168
Oil	1 382	1 468	1 452	1 363	1 371	1 410	1 530	1 803	1 776	1 609	1 366	1 465	1 509	1 363	1 417	1 462	1 436	1 065
Electricity	935	920	969	942	979	1 029	1 056	1 115	1 160	1 201	1 266	1 275	1 293	1 321	1 340	1 312	1 362	1 427
Natural gas	0	0	0	0	0	0	0	43	223	435	592	842	909	963	1 026	899	849	896
Others[42]	1 155	1 247	1 258	1 272	1 319	1 376	1 428	1 471	1 451	1 572	1 569	1 530	1 500	1 566	1 613	1 687	1 761	1 775
% in F.E.C	35.4%	35.1%	34.3%	33.1%	32.8%	32.6%	32.5%	33.2%	32.0%	31.5%	30.5%	30.0%	29.6%	29.2%	29.3%	28.8%	29.5%	29.4%
Total Transports	**3 579**	**3 794**	**4 091**	**4 228**	**4 402**	**4 644**	**4 879**	**5 122**	**5 717**	**6 054**	**6 617**	**6 690**	**6 841**	**6 878**	**6 869**	**6 839**	**6 933**	**6 738**
Gasoline	1 448	1 592	1 778	1 873	1 923	1 984	2 035	2 023	2 093	2 118	2 159	2 034	2 135	2 070	1 988	1 885	1 756	1 645
%	40	42	43	44	44	43	42	40	37	35	33	30	31	30	29	28	25	24
% in F.E.C	30.7%	31.0%	32.3%	33.1%	33.4%	34.3%	34.2%	34.3%	36.2%	36.6%	38.1%	37.6%	37.6%	37.5%	36.7%	36.7%	37.6%	37.2%
Total Residential	**2 428**	**2 453**	**2 486**	**2 515**	**2 525**	**2 547**	**2 655**	**2 666**	**2 737**	**2 854**	**2 924**	**2 926**	**3 017**	**3 068**	**3 146**	**3 220**	**3 199**	**3 196**
Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil	585	615	653	687	697	700	755	738	777	820	831	761	761	742	736	716	682	622
Electricity	512	564	600	619	634	653	702	724	755	819	865	914	979	1 018	1 069	1 139	1 153	1 192
Natural Gas	0	0	0	0	0	0	0	1	10	36	74	118	147	159	182	200	203	221
Others[43]	1 331	1 274	1 233	1 209	1 195	1 194	1 199	1 203	1 195	1 179	1 154	1 134	1 130	1 150	1 159	1 165	1 161	1 161
% in F.E.C	20.8%	20.0%	19.7%	19.7%	19.2%	18.8%	18.6%	17.9%	17.3%	17.3%	16.8%	16.4%	16.6%	16.7%	16.8%	17.3%	17.3%	17.6%
Total	**779**	**898**	**938**	**976**	**1 041**	**1 076**	**1 175**	**1 340**	**1 566**	**1 721**	**1 790**	**1 998**	**2 095**	**2 301**	**2 451**	**2 487**	**2 231**	**2 273**

[41] Includes Extractive and Manufactoring Industries.

[42] Includes wood and wastes, coque gas, oven gas, incondensable gases, heat and asphalt.

[43] Includes wood, wastes and city gas.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Services																		
Coal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil	268	300	326	338	391	376	418	533	668	716	700	826	862	977	1 065	1 045	688	696
Electricity	499	585	599	622	634	682	738	789	863	948	1 020	1 086	1 124	1 196	1 246	1 297	1 379	1 408
Natural Gas	0	0	0	0	0	0	0	0	13	32	52	86	110	128	141	138	157	161
Others[44]	12	13	13	15	15	18	19	19	22	25	18	2	0	0	0	7	7	7
% in F.E.C	6.7%	7.3%	7.4%	7.6%	7.9%	7.9%	8.2%	9.0%	9.9%	10.4%	10.3%	11.2%	11.5%	12.5%	13.1%	13.3%	12.1%	12.5%
Total FEC	11 664	12 237	12 649	12 776	13 171	13 554	14 278	14 919	15 789	16 542	17 386	17 812	18 197	18 352	18 739	18 641	18 450	18131

Source: DGEG, 2009

[44] Includes city gas and heat.

1.5.4 Energy intensity

Energy intensity is an indicator of efficiency and sustainability of the economic system. This indicator is generally expressed by energy consumption (primary energy or final energy) per unit of GDP.

In 2007, the energy intensity, relative to primary energy consumption, was 192 toe /GDP (2000). The final energy consumption was 137 toe/GDP in 2000 (Table 14).

Table 14. Energy intensity of GDP

Year	Primary Energy Intensity (toe/10^6 Euros 2000)[45]	Final Energy Intensity (toe/10^6 Euros 2000)[46]
1990	198	131
1991	195	133
1992	203	135
1993	203	138
1994	204	139
1995	205	135
1996	196	138
1997	203	138
1998	205	139
1999	211	141
2000	207	142
2001	202	143
2002	210	145
2003	206	147
2004	209	148
2005	212	146
2006	200	143
2007	192	137

Source: DGEG, 2009

1.5.5 Evolution of Energy Policies and Measures

Portugal has been gradually integrating environmental concerns in its energy policy, and adopting measures to reach the established goals, concerning its European community and international commitments.

Since 2001, to further develop the connection between energy and environmental sectors, the National Energy Strategy has been giving priority to the following areas:

- Diversification of energy sources, with a major use of endogenous resources;
- Increase Energy efficiency within economic activity sectors;
- Major use of clean technologies, taking into account the new environmental requirements.

[45] Primary energy consumption per GDP money unit, adjusted to 2000 price level (oil equivalent tonne per thousand million Euros)

[46] Final energy consumption per GDP money unit, adjusted to 2000 price level (oil equivalent tonne per thousand million Euros)

In order to implement policies and measures defined in the National Climate Change Programme (PNAC), in 2003, several new targets for 2010 were established for almost all measures, highlighting:

- regarding energy efficiency measures, several projects were developed based on a set of financial incentives from MAPE, interconnected with the economic activities modernization incentive Programme (PRIME), within the community framework, in particular obtaining a co-financial support to promote cogeneration.

With the regulation for energy consumption management (RGCE – from Portuguese: *Regulamento de Gestão dos Consumos de Energia*), the industrial sector has been implementing energy efficiency measures, having DGEG received the submission, of 595 energy audits reports, between August 2003 and late 2008, corresponding to energy savings of 372 328.5 toe/year (7.3% of the industrial sector energy consumption). Through RGCE, 148 projects were financially supported between 2003 and 2006, corresponding to a total of €14 millions.

In the light of the community energy policy approach to promote renewable energy sources, Portugal has assumed, in the year 2003, an indicative goal target of 39% of the electricity production generated from renewable energy sources to achieve in 2010. Several adjustments have been made since then which will be briefly described next.

In 2005, the Council of Ministers' Cabinet Resolution nr. 169/2005 (of October the 25th), approving the National Energy Strategy, has revised some of the targets, mainly regarding renewable energy and energy efficiency, in order to be more demanding and also to correct some of the measures, due to the need to focus on market competition and consumers' protection issues.

Without making a sudden rupture with the past, the former framework was subject to a revision, being the new National Energy Strategy approved with the following objectives:

- Ensure security in the energy supply;
- Stimulate and promote competition, competitiveness and efficiency in the Portuguese companies;
- Promote the concurrency, the competitive and the energy efficiency of companies;
- Ensure environmental suitability of the processes involving energy cycle.

Regarding "security in the energy supply" it was necessary to include actions in order to:

- Reduce our external energy dependence;
- Constitute adequate levels of strategic storage;
- Increase the investment in renewable energy;
- Improve and promote energy efficiency.

Simultaneously, in order to ensure "environmental suitability" of the processes involving energy, priority was given to the goals measures that aim promoting the reduction of environmental impacts, namely in what concerns to the carbon intensity of GDP.

In order to further promote the use of renewables energy in electricity generation, new policies and measures were developed, through the creation of a new regime of differentiated tariffs for renewable energy sources and incentives to renewable energy generation, highlighting:

- Financial incentives to support investments on renewable energy projects;
- Fiscal incentives in renewable energy equipments and respective tax deduction;
- Attractive remuneration system to the installation of renewable energy generation facilities.

Additionally, through Cabinet Resolution 1/2008 (of 4 January the 4th), the government approved new objectives to electricity generation from renewable energy sources until 2010. The new objectives are:

- 45% of total electricity consumption will come from renewable energy sources;
- 10% of biofuels should be added in conventional road fuels;
- 5% to 10% substitution of the coal in Sines and Pego thermoelectric power plants by biomass or Waste Derived Fuel.

The National Action Plan of Action for Energy Efficiency (from Portuguese: "*Plano Nacional de Acção para a Eficiência Energética*" (PNAEE), called "*Portugal Eficiência 2015*" was approved in 2008, and constitutes a set of measures aiming at the improvement of energy efficiency in 10% relative to the final energy consumption and energy services in 2015.

The Plan is oriented to the energy demand's management and is articulated with PNAC and PNALE covering four specific areas: Transport, Residential and Services, Industry and Public Sector. Additionally, it establishes three cross cutting areas – Behaviors, Taxes, Financing and Incentives. For these areas, 12 programmes of action were created to address several branches of energy efficiency:

- Vehicle renewal (*Renove carro*)
- Urban mobility (*Mobilidade Urbana*)
- Transport Efficiency System (*sistema de eficiência energética nos transportes*)
- Home and Office Renewal (*Renove casa e escritório*)
- Building Efficiency System (*Eficiência energética nos edifícios*)
- "Renewables just in time" and Solar Programme (*Renováveis na hora e programa solar*)
- Industry Efficiency System (*Eficiência energética na indústria*)
- State Energy Efficiency
- Plus Programme (*Programa mais*)
- Operation E – Programme for youngsters and schools (*Operação E, escolas e jovens*)
- Green Taxes (*Fiscalidade verde*)
- Incentives and Financing, Eenergy Efficiency Fund (*Incentivos e financiamento, fundo de eficiência energética*).

A set of new measures, aiming complementing the PNAEE, are still being implemented:

- Revision of the vehicle tax,
- Establishment of a tax on inefficient light bulbs
- "Renewables just in time"
- Energy Certification of buildings.

For these new measures, it stands out:

- Setting an award to the best practices in energy efficiency;
- A reduction of 2.5% in the electricity tariff to those with lower energy consumption, and creating pricing schemes in favor of energy efficiency;
- The efficiency cheque, providing an "efficiency cheque" for two years, worth 10% or 20% of annual electricity costs to consumers with verified energy reductions of, respectively, 10% or 20% following investments in energy efficiency;
- The creation of a subsidized low-interest personal line of credit, worth EUR 250 million per year, for investments in energy efficiency measures, with an emphasis on urban renewal. Interest rate reduction of 4% provided for credit, up to 8% without guarantees;
- Programme to replace one million large electric appliances (white goods) – provision of a EUR 50 bonus for the replacement of an existing low efficiency good with an A+ appliance and EUR 100 for an A++ appliance; old appliances must be handed over for recycling;
- Creation of the Agreement for Rationalization of Energy Consumption (ARCE) , related to the Management System of Intensive Energy Consumption (SGCIE);
- Energy certification of all state buildings and launch of a programme to improve public illumination;

- Creation of "Green Taxis" fleet with low emissions level;
- Development of a platform for traffic management in Lisbon and Oporto with national technology.

For the three cross-cutting areas, Behaviors, Taxes, Financing and Incentives:

- Information and communication measures
  - The launch of an "Energy Plus Bonus" programme to reward excellence in energy efficiency in companies, buildings, schools and others;
  - The "Energy Efficiency Plus" programme will include an energy efficiency "seal of approval" to identify best practices for homes, public buildings, companies, schools and equipment;
  - The development of information and communication campaigns to increase awareness and knowledge of energy efficiency and actions that can be taken, including training schemes, with a budget of up to EUR 2 million per year.

- Fiscal measures
  - Creation of a new taxation regime for vehicles and industrial fuels; Creation of an accelerated depreciation regime for investments in energy efficient equipment and vehicles in the industry and service sectors; Providing fiscal incentives for micro-electricity production and progressively aligning the tax system with that of the energy certificates for buildings (for example fiscal benefits for class A/A+ level homes).

- Financial measures and incentives
  - Encouraging the reduction of the electricity consumption by providing an incentive for major consumers to reduce consumption by providing bonuses to those who consume less, and establishing an Energy Efficiency Fund; The "Efficiency Cheque", provided for two years, worth 10% or 20% of annual electricity costs, to consumers with verified energy reductions of, respectively, 10% or 20% following investments in energy efficiency; A reduction of 2.5% in the electricity tariff to those with lower energy consumption, and creating pricing schemes in favor of energy efficiency.
  - The creation of a subsidized low-interest personal line of credit, worth EUR 250 million per year, for investments in energy efficiency measures, with an emphasis on urban renewal. Interest rate reduction of 4% provided for credit, up to 8% without guarantees; Stimulate Energy Service Companies (ESCOs), by providing incentives for their establishment (QREN), calls for tender for public-sector audits, and establishing regulations for an "efficiency contract".

Building Sector

The System for Energy and Indoor Air Quality Certification of Buildings (from Portuguese: *Sistema de Certificação Energética e Qualidade do Ar Interior de Edifícios* (SCE)) was created and according to this system, since July of 2007, every new building will have an energy consumption certificate with information regarding the building energy consumption and a set of measures for its reduction. New related regulations were approved, namely:

- Regulation on heating, ventilation and air-conditioning systems in buildings (from Portuguese Regulamento dos Sistemas Energéticos e de Climatização dos Edifícios (RSECE)); and

- Regulation on the thermal behaviour of buildings (from Portuguese: Regulamento das Características de Comportamento Térmico dos Edifícios (RCCTE)).

This legislation package is an important step to improve energy efficiency in buildings, bringing new challenges to construction, like the obligation to install solar panels in every new building.

The PNAEE covers four specific areas: Residential and Services, Public Sector, Industry and Transport.

Residential and services sectors targets and measures from PNAEE

- Sustainable urban rehabilitation programme: one in every 15 households meets an optimal energy class (greater or equal to B-);
- Programme to replace one million large electric appliances (white goods): provision of a EUR 50 bonus for the replacement of an existing low efficiency good with an A+ appliance and EUR 100 for an A++ appliance; old appliances must be handed over for recycling; Phase-out of incandescent light bulbs: large-scale substitution of incandescent light bulbs with compact fluorescent light bulbs (CFLs);
- Simplified permitting of energy-efficient construction projects; Stimulating small-scale electricity production: turn 75 000 homes into electricity producers (installed capacity of 165 MW) by 2015;
- One in every 15 buildings equipped with solar hot water heaters.

Public sector targets and measures from PNAEE

- Energy certification of all state buildings to be completed;
- 20% of state buildings to fall within energy performance class greater than or equal to B;
- 20% of the state vehicle fleet to produce CO2 emissions less than 110g/km;
- Phase-out of inefficient street lighting;
- 20% of traffic lights to use efficient light-emitting diodes (LEDs).

Industrial Sector

It was created the Management System of Intensive Energy Consumption (from Portuguese: *Sistema de Gestão dos Consumos Intensivos de Energia* (SGCIE). The main objective of this regulation is to promote the energy efficiency and to monitor the energy consumption of energy-intensive consumption facilities (CIE). The typology of intensive consumption facilities is defined and there is a diversified regime and simplified administrative procedures to companies already bound to reduce CO_2 emissions covered in PNALE (from Portuguese: *Plano Nacional de Atribuição de Licenças de Emissão*).

This system imposes the conduction of energy audits on the conditions of energy consumption and use, the conception and conditions of facilities to all facilities with an annual energy consumption above 1 000 toe/year, each 6 years, and the facilities with an annual energy consumption superior to 500 toe/year, but above below to 1 000 toe/year, each 8 years.

Operators in this regime are obliged to develop Energy Consumption Rationalization Plans (PREn), where they establish targets regarding energy and carbon intensity indicators about their specific energy consumption, and after DGEG approval (competent entity to supervise and inspect the implementation of SGCIE) they are called an Agreement for Rationalization of Energy Consumption (from Portuguese: Acordos de Racionalização dos Consumos de Energia – ARCE).

Industry targets and measures from PANEE

- Agreements with manufacturing industry to reduce energy consumption by 8%;
- Creation and implementation of a Management System of Intensive Energy Consumption, extended to medium-sized enterprises (with consumption over 500 toe), with fiscal incentives provided for energy management measures.

Transport sector

In 2007, the government has begun to change its car tax approach: 10% of the imposed tax depends of GHG emissions. This measure which the government wants intents to further develop progressively, establishes an economic incentive to buy more energy efficient vehicles.

Transport sector targets and measures from PNAEE

Private motor car renewal.

Target : to reduce the percentage of vehicles aged more than ten years from the current 37% of total fleet to 35% in 2010 and to 30% in 2015; also to reduce the average CO_2 emission of new cars sold from 143 g/km to 120 g/km in 2010 and 110 g/km in 2015.

Measures: Tax incentive for the abatement of vehicles when buying lowemission new ones and a new motor vehicle tax calculation formula that incorporates a CO_2 emissions factor.

Tyre pressure control and fuel efficiency.

Target: to reduce from 30% to 15% by 2015 the percentage of vehicles running with incorrect tyre pressure and to increase from 10% to 20% in 2015 the volume of efficient fuels sold.

Measures: Information campaigns and fuel certification.

More efficient vehicles.

Target: to ensure that 20% of the 2015 vehicle fleet will be equipped with monitoring equipment (on-board computer, GPS, cruise control, automatic verification of tyre pressure).

Measures: Voluntary agreements with car importers.

Urban mobility

Increase urban mobility and spatial planning in district capitals.

Target: 5% modal shift by 2015.

Measures: To put in place metropolitan transport authorities in Lisbon and Oporto, establish the Mondego light rail system and develop regional and urban mobility plans. Develop urban mobility plans for corporate centres and industrial parks with over 500 workers.

Improve public transport efficiency. Target: 10% of low-emission vehicles in fleet by 2015; 5% of mini-bus on public vehicle fleets by 2010 and 15% by 2015.

Measures: Incentives to replace vehicles and mini-buses in the public transport fleets.

Establish a GPS-based innovative platform for traffic route management.

Target: 5% of GPS equipment with traffic optimisation.

Measures: Create a traffic optimisation system in large cities using GPS platforms.

Transport efficiency system

Create a national logistical system. Target: decrease road transport from 80% to 75% by 2015 and increase inter-modality in goods transport.

Measures: Construction of a national logistical platform network.

Implementation of the Motorways of the Sea network.

Target: shift 15% of international goods currently transported by road to maritime transport by 2010 and 20% by 2015.

Measures: Transfer of goods transportation from road to maritime mode. To increase passenger rail transport with absolute targets set in passenger.km.

Establish an energy-efficient goods transport system.

Target: decrease energy intensity of goods transport.

Measures: Voluntary agreements with industry.

Energy efficiency in the government-owned vehicle fleet.

Target: 10% decrease in fuel consumption by 2015.

Measures: Phasing out vehicles with CO_2 emissions above a certain level and guaranteeing a 20% quota of low-emission vehicles. Despacho 7382/2009 sets quotas for the maximum emissions of CO_2 of these vehicles from 2009 to 2012.

1.5.6 Legal Framework for special regime production

1.5.6.1 Electricity Generation from renewable energy sources

Main Legislation in place covering electricity generation from RES includes: Decree-Law 189/88 (May the 27th), Decree-Law 313/95 (November the 24th), Decree-Law 56/97 (March the 14th), Decree-Law 168/99 (May the 18th), 538/99 (December the 13th), Decree-Law 312/2001 (December the 10th), Decree-Law 313/2001 (December the 10th), Decree-Law 339-C/2001 (December the 29th), Decree-Law 68/2002 (March the 25th), Decree-Law 33–A/2005, (February the 16th), Decree-Law 225/2007 (May the 31st), Decree-Law 288/2007 (August the 17th) and Decree-Law 363/2007 (November the 2nd).

From the Decree-Laws above, the last three should be highlighted:

- Decree-Law 225/2007 – includes other technologies based on the production of electricity from biogas, supports micro generation, restores the tariff established in the Decree-Law 339-C/2001 regarding wave energy, introduces solar thermal, increases the established target for forest biomass, extend the remuneration time of hydro power plants, allows the over equipment of wind power plants, simplifies the procedures to the licensing permits and creates Renewable Energy Observatory (ObsER).

- Decree-Law 288/2007 – promotes faster procedures in order to obtain a license and administrative authorization and improves the articulation between the actual regime and others linked, namely the ones in the environmental legislation, simplifying the decision process.

- Decree-Law 363/2007 – the main purpose is to stimulate micro generation. The existing licensing regime is simplified and replaced by a simple registration, dependant on the inspection of technical aspects. The delivery and analysis of the project are replaced by a database of preexisting typified elements which the producer must respect, shortening a long procedure to a simple electronic registration.

1.5.6.2 Cogeneration

The main legislation to refer is: Decree-Law 538/99 (December the 13th), Decree-Law 312/2001 (December the 10th), Decree-Law 313/2001 (December the 10th), Decree-Law 68/2002 (March the 25th), Decree-Law 288/2007 (August the 17th) and Decree-Law 363/2007 (November the 2nd); Order of Council 57/2002, Order of Council 58/2002, Order of Council 59/2002 and Order of Council 60/2002, all of 15 January, Order of Council 399/2002 (April the 18th) and Order of Council 764/2002 (June the 1st).

The cogeneration is also included in Decree-Law 288/2007 (August the 17th).

1.5.6.3 Network Tariffs

The tariff to sell electricity to the grid produced by electricity manufacturer is based on the sum of the following:

- The avoided costs by the Public Electricity System with the operation of the energy power facility that includes:
  - The avoided investment in new power generation facilities;
  - The transport , operation and maintenance costs, including the acquisition of raw-material;
- The environmental benefits given by the use of endogenous resources in the power generation facilities or by the high energy efficiency in the use of primary energy in the cogeneration facilities.

The application of all these principles enabled favorable tariffs for energy generation which has given a major contribution to the increase of the special regime in Portugal.

1.6 Transport

In Portugal, the fleet of vehicles has increased quickly since 1990. Last year it has been created an incentive to renew the fleet of old vehicles to more efficient and with lower emissions ones. The main purpose was to reduce the increase of emissions in this sector.

1.6.1 Evolution of individual transport and collective transport

Passenger transport, measured in passenger-kilometers (pkm) transported by the different modes available, shows a variety of trends, as a reflection of both supply and demand tendencies, but also of the public politics implemented throughout the period from 1990 to 2007, favoring or damaging the traffic in each mode.

Table 15. Evolution of individual transport and collective transport (Millions of Passenger per kilometer transported)

Year	Road transport	Railway	Air transport
1990	3 139	6 149	7 605
1991	4 062	6 189	7 301
1992	14 173	6 176	7 724
1993	12 150	5 922	8 461
1994	11 711	5 650	8 092
1995	11 246	5 315	8 767

Year	Road transport	Railway	Air transport
1996	11 142	4 975	9 295
1997	10 442	4 995	10 067
1998	11 409	5 061	10 456
1999	11 474	4 881	10 165
2000	11 821	4 363	11 313
2001	11 159	4 444	12 857
2002	9 936	4 475	14 244
2003	10 537	4 351	16 421
2004	n.a.	4 540	18 591
2005	n.a.	4 690	18 927
2006	n.a.	4 864	19 885
2007	n.a.	5 037	23 072

Source: Statistics Portugal, 2009

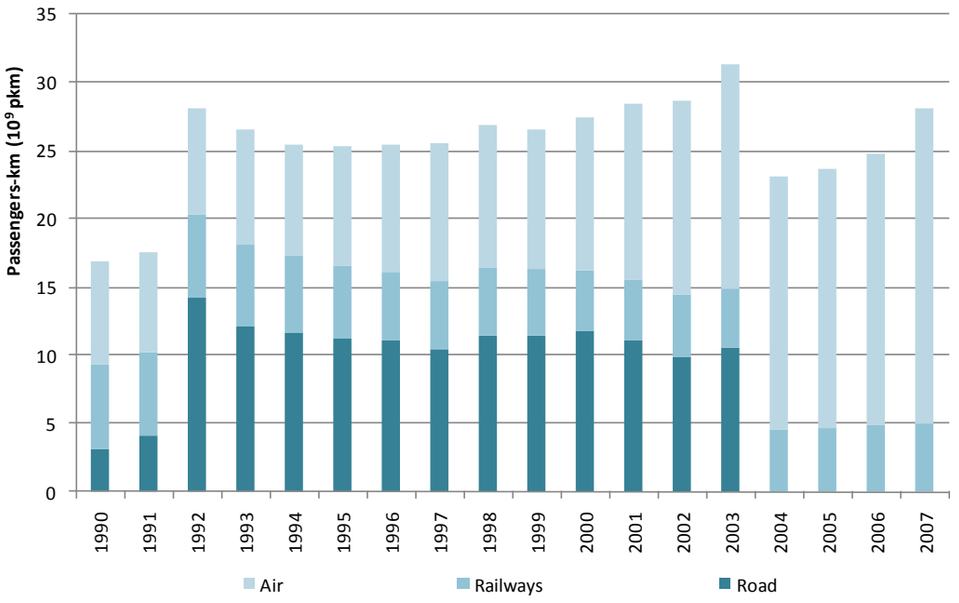


Figure 20. Trend in passenger transport, by mode (1990-2007)[47]

Source: Statistics Portugal, 2009

Over the last decade, collective road transport oscillated between 10 and 12 thousand million passenger transported per kilometer (pkm). Since 2001, air transport has outgrown road transport[48]. Railway transport, however, has had just over 4 thousand million pkm per year, considerably lower than other means and especially in comparison with air travel, which is also indicated for long-range transport.

[47] Data forpPassengers.km for road were not available for the period 2004-2007.

[48] Passenger-kilomenters for air transport refer exclusively to those recorded by TAP, SATA, Portugalia and Aerocondor.

The annual average variation in road transport from 1990 to 2003 is approximately 10%; the same variation from 1990 to 2007 to air transport was 6.7% as opposed to -1.2% for railway transport. Over the last decade, air travel has shown the strongest growth with variations of 5.1% and 16% in 2006 and 2007, respectively. It is important to refer that in the last year the railway showed an inversion in the growth trend, recovering 3.6% from 2006 to 2007 (Figure 20).

One of the reasons for railway transport hasn't managed to impose itself on the capture of new passengers could be the remarkable grown of road alternatives, as well as the increased use of the individual transport - car, because of the low interest rates and credit facilities enabled by the banks and other financial entities.

In comparison with the rest of Europe, Portugal has low railway/inhabitant and railway/area ratios (0.27 against 0.49 in Europe and 30 against 52 in Europe, respectively). The investment in the railway mode has been applied, in a significant way, on the maintenance and improvement of existent infrastructure, in opposition to what has happened in the road mode. Despite the investment effort in the modernization of the railway infrastructure, the percentage of double lines and of electrified network in Portugal is still above the correspondent results in Europe, what could negatively influence the competition of this transport mode in the country.

Figure 21 shows that Comboios de Portugal (CP) (Portuguese Railway Company) and Fertagus registered, over the past 5 years, 3.5 thousand million pkm annually. International transport (only by CP) decreased significantly, from around 90 million pkm in 2002 to almost 55 million pkm in 2004."

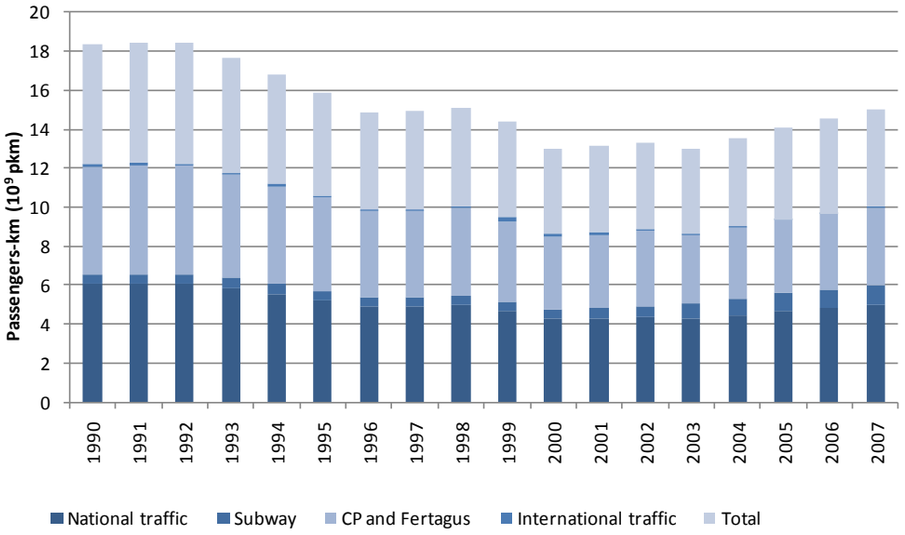


Figure 21. Trends in national and international rail transport

Source: Statistics Portugal, 2009

As for the subway network, the total length in Lisbon was of 37.7 km in 2007 (in 1990 there were only 15.8 km) and 94.2 km in Oporto, with a notable growth in the Oporto subway length, since the this mean of transport was available since 2003 with a line of only 11.8 km.

Figure 22 illustrates the trend in national and international passenger transport by air, registered in airports in the Mainland, Madeira and the Azores.

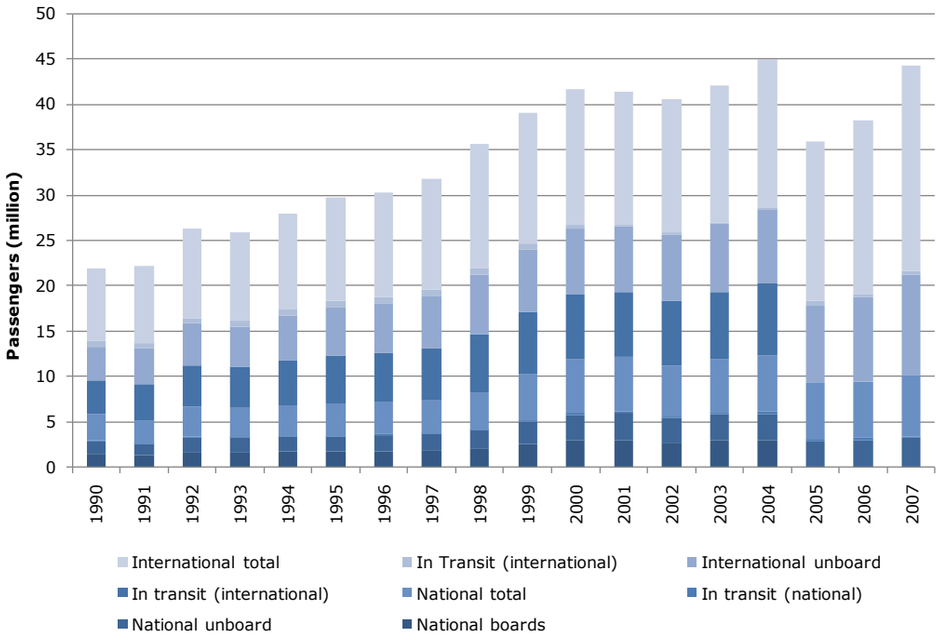


Figure 22. Trend in passenger transport by air (1990 – 2007)

Source: Statistics Portugal, 2009

Passenger transport by air has grown consistently, doubling national and international air travels from 1990 to 2007: the total annual average variation was of 4.9% and 6.3%, respectively, for national and international movements during this period. In the last years, specifically in 2006 and 2007, there were increases of 5.1% and 16.0% respectively.

The transport of passengers by sea and river has decreased annually since 1998, the first by -0.5% (Figure 23) and second by -3.0% (Figure 24).

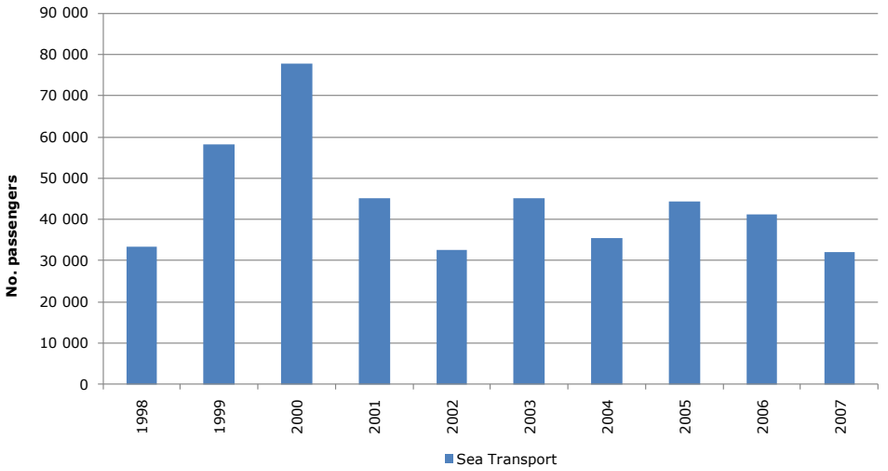


Figure 23. Trend in sea transport

Source: Statistics Portugal, 2009

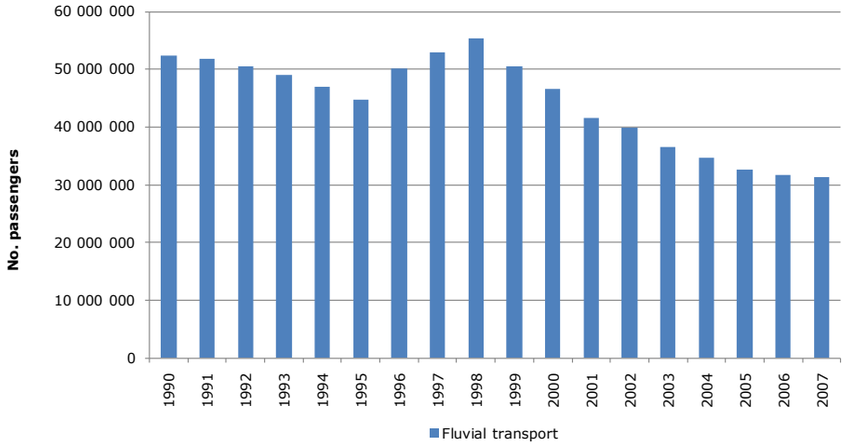


Figure 24. Trend in fluvial transport

Source: Statistics Portugal, 2009

1.6.2 Evolution of freight transport

The figures below show that road transport is the most significant mean of freight transport (tonnes/kilometre) when compared to air and railways. The road transport is more useful in short distances because it has more mobility than rail or air transports and had the annual average growth of 6.4% between 1990 and 2007.

The freight transport by air has smaller importance when compared to road and rail, despite been showing an annual average growth of 4.3% between 1990 and 2007.

The transport by rail is more useful in long distances, when is not necessary flexibility in destination and showed, between 1990 and 2007, an annual average growth of 2.9% in the freight transported.

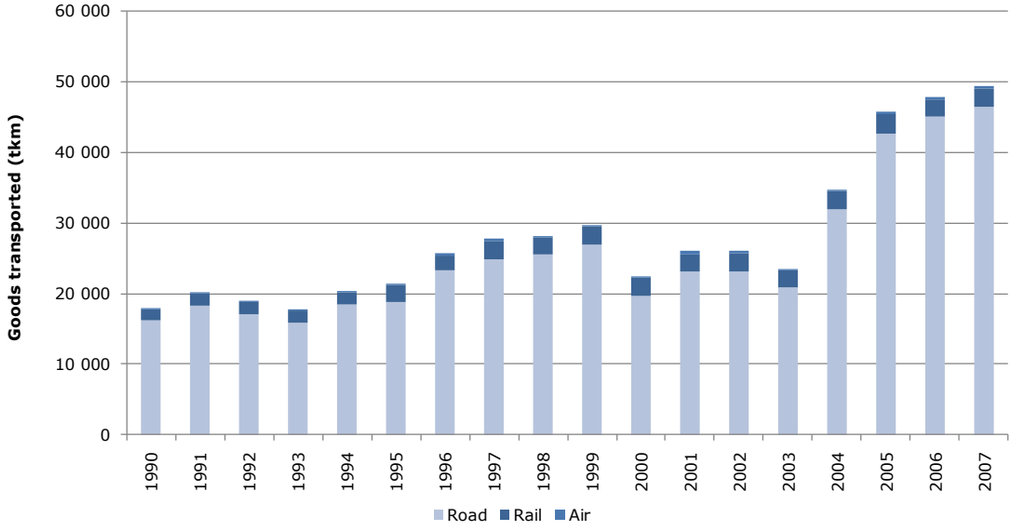


Figure 25. Trend of freight transport by road, rail and air.

Source: Statistics Portugal, 2009

Figure 26 shows that international traffic of sea transported freight has grown from 37 to 52 millions of tonnes between 1991 and 2007, having an annual average growth of 2,1%. In the last year the tendency has decreased when compared with previous: -1.5%. The domestic freight transportation recovered from the annual average growth of -0.5% between 1991 and 2007, but in last year the growth was positive reaching 9.0%.

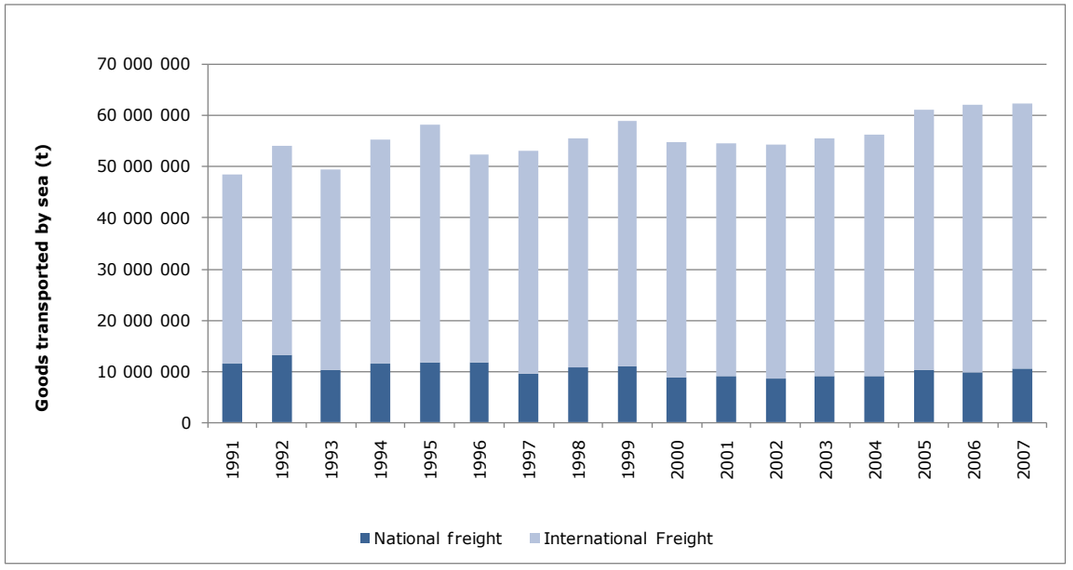


Figure 26. Trend of freight transport by sea

Source: Statistics Portugal, 2009

1.6.3 Strategy in the transport sector

The Portuguese policy for the transport sector has been progressively oriented towards achieving a more sustainable transport system regarding the environmental, social and financial and economic levels. In order to increase sustainability in these three areas several objectives for the sector were defined, particularly the one to improve the efficiency in the transport system and contribute to the economic development and the social and territorial cohesion of our country.

The environmental objectives and the fulfillment of commitments under the Kyoto Protocol, as well as sustainable mobility issues, modal split and balanced integration into international transport networks, have assumed particular importance in recent years and are reflected in several documents which constitute a reference for the sector, both globally, as the Great Options Plan 2005-2009, both on the sectoral level, with strategic guidelines specifically established to each subsector of transport.

In the Major Planning Options for 2005-2009 there were defined three main objectives for the transport sector. The first one focused on increasing the quality of life through the establishment of both the infrastructure and transport services, which should ensure accessibility and mobility standards that amongst other, integrate environmental concerns, and in particular, the compliance with the targets set in the Kyoto Protocol. The second objective was linked to the efficient integration with the Iberian, European and transatlantic transport networks, and the third was the redevelopment of urban mobility through sustainable transport policies integrated into new policies for cities.

The ambition to achieve a model for sustainable development is reflected on each of the specific strategic guidelines. As such, the strategic guidelines for the national airport system had the main objective to provide an airport infrastructure that would allow an efficient and competitive air transport performance. Also, they supported the promotion of mobility as the basis for urban planning processes and national cohesion, the complementarities of the airport and other transport infrastructures and finally for the inclusion of the Portuguese territory in the worldwide transportation network.

Following the strategic Guidelines, the maritime and port sector has developed a Strategic Vision which aims to strengthen the Portuguese Euro-Atlantic centrality, a strong increase in the competitiveness of the port system and shipping transport and to provide competitive and sustainable transport chains. With this vision in mind the objectives are to make Portuguese ports as a reference to the Iberian logistics chains and set European level standards in the areas of environment, safety and security in the maritime and port sectors, by promoting good environmental practices.

For the railway sector, one of the strategic objectives is the provision of adequate standards for security, interoperability and sustainability of the network, trying thereby to reflect society's concerns with mobility, especially regarding its impacts on the environment and the welfare of the population. The intention is the integration of environmental issues in the planning and modernization of the railway network system and introducing the energy-environmental performance of the railway as a key factor in its management.

Regarding the road sector both the strategic guidance and a framework for the entire transport sector are being defined. The Strategic Transport Plan has been recently submitted to public consultation and it is on the final stage. All the policy instruments in this sector have in mind the adoption of new mobility models which are more environmentally sustainable, like the Program for Electric Mobility, which falls under the National Action Plan for Energy Efficiency. The Program for Electric Mobility was approved by the Council Ministers' Resolution nº 20/2009 (February the 20th) and aims to create the conditions for the generalization of the electric car, ensuring an adequate infrastructure for its development and establishes a service model that will allow the widespread access to any electric mobility solution, constituting a pioneering and innovative example in the international arena.

1.7 Residential

In 2008, the number of building permits issued in Portugal decreased by 15.4% when compared to the previous year, meaning that 38 551 building permits were approved, following the trend displayed since 2000.

As in previous years, the majority of buildings aimed at new constructions represented around 72.3% of the total permits. In 2007 the new constructions represented 74.9% of total permits, what leads to a high relevance of buildings requalification in the construction sector.

The new residential dwelling permits issued decreased by 30.3% over 2007, corresponding to 45 366 dwelling permits in 2008. The characteristics of the new dwellings remained unchanged regarding the number of rooms (5 rooms and T3 typology), except for the regions of Algarve and Azores, where typology T2 dominates. The inhabitable area decreased in all regions of the country.

The number of works completed (based on the estimates for works completed, for 2007 and 2008) follow a different trend, with an increase of 5.5% over the previous year, corresponding to 53 600 works completed, which in the majority corresponded to residential buildings (about 81.3%), of which 82.0% referred to new constructions.
The number of dwellings completed (about 91.5 thousands) has also increased in 2008 (+3.9%). However, they have, in general, kept their characteristics both in terms of typology (typologies T2 and T3 continued to be the most common) and inhabitable area.

The analysis of the stock house estimates suggests that in Portugal and in 2008 there were about 3.4 million classic residential buildings, representing an increase rate of 1.0% over the previous year. Comparing with the 2001 Census, the increase was 7.6%, which represents about 244 thousands additional buildings; this evolution is represented in Figure 27.

As for the number of classic residential dwellings and according to the estimates, there were about 5.7 million dwellings in Portugal in 2008, representing an annual increase rate of 1.6% (Figure 27). According to the 2001 Census operation which accounted for 3 650 757 classic families in Portugal, the 2008 estimates suggest an average of 1.6 dwellings per family, corresponding to a residential surplus in Portugal.

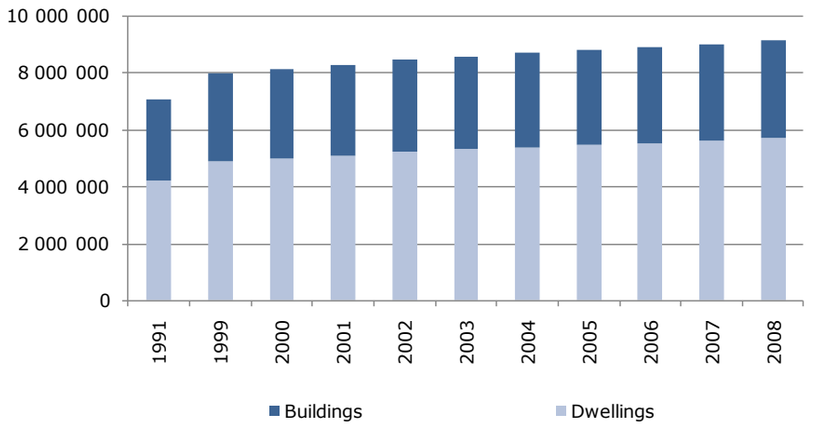


Figure 27. Stock house estimates in Portugal

Source: Statistics Portugal, 2009

In agree with the figure above, is important refer that the number of traditional classic dwellings dived by the number of residential buildings was incremented of 1 in 1991 to 2 in 1999, maintaining the trend until 2008, it means that there was a lot of buildings constructions between 1991 and 1999.

The number of dwellings per km^2 in 1991 was 45.8 and 62.8 in 2008, in other way the number of buildings per km^2 was 31.3 in 1991 and 36.6 in 2008, through these data is evident that had a big evolution in Portuguese construction.

1.8 Agriculture and Livestock

Portuguese agriculture has shown in last years a positive performance regarding sustainability, which is evidenced by several agro-environmental indicators. This is also the case of the positive trend in terms of GHG emissions, which makes agriculture sector the only one that reduced emissions since 1990.

According to IRENA indicator "Vegetal and Animal Production Systems", the analysis of the distribution of the Usable Arable Area (UAA) by farm type reveals that in 1989 the holdings of Class "crop – fallow" dominated (19%), followed by "permanent crops "(14%) and "mixed cultures" (12%). In 1999, the class that was previously predominant lost expression accounting only for 10% of the UAA while the farms classified as "livestock - permanent pasture" gained more importance (16% of UAA). According to figures available for the EU 15 countries (2005), in Portugal the proportion of the area of "permanent pasture" in the UAA was above the average, which was around 36% (Table 16). Looking further into the EU 15 the headers in terms of Livestock Units (LU) per hectare of UAA, Portugal was located in the percentile 20 alongside with Spain, Sweden and Finland.

Table 16. UAA Area per class typology, IRENA

	1989	1999
	ha	ha
Breeding - permanent pasture	379 511	610 915
Breeding - Temporary grass	12 825	9 931
Breeding - fodder	314 588	370 731
Poultry and swine	25 369	32 695
Crop - fallow	766 013	369 100
Crops - cereals	221 377	168 304
Crops - crops specific	158 918	107 957
Cultures - mixed	467 617	421 486
Horticulture	33 373	28 385
Permanent crops	558 798	621 218
Mixed	1 067 267	990 050

Source: Statistics Portugal, 2009

In the period under review, the composition of the UAA according to major surface types has radically changed indicating the extensification of agricultural systems in Portugal. In 2007, the "arable land" lost the lead, representing only 31% of the UAA and more than half (51%) came to be occupied by "permanent pasture. Between 1989 and 2007, the major types of surface suffered significant changes. There was a reduction in the area of "arable land" for less than half, losing 1 267 953 ha, and an increase of 276% in the "permanent pasture" area which gained 1 307 075 ha during the period (Table 17).

Alentejo (South) was the region with major changes, where the "arable land" lost more than 768 hectares (-60%) and the area of "permanent pasture" has increased 721% (+924 thousand hectares).

Table 17. Evolution of arable land occupied by successive crops

Region	1989			1999			2007		
	Permanent crops (ha)	Permanent pastures (ha)	Arable land (ha)	Permanent crops (ha)	Permanent pastures (ha)	Arable land (ha)	Permanent crops (ha)	Permanent pastures (ha)	Arable land (ha)
Total	789 415	473 503	2 346 656	711 648	1 389 875	1 761 672	596 245	1 789 578	1 077 703

Source: Statistics Portugal, 2009

Between 1999 and 2007, the rate of coverage of the surface of arable land by successive crops has remained relatively stable, increasing only 1% in national terms. However, some regions observed changes with loss of 10% in Beira Litoral and 8% in Entre Douro e Minho and Madeira. The Alentejo and Ribatejo e Oeste grew by 1%, value that influenced the national average due to the weight of these regions in total agricultural area of the country, as showed in Table 18.

Table 18. Evolution of arable land occupied by successive crops

Region	1999			2005			2007		
	Successive crops (ha)	Arable land (ha)	%	Successive crops (ha)	Arable land (ha)	%	Successive crops (ha)	Arable land (ha)	%
Entre Douro e Minho	79 879	109 407	73	62 004	95 590	65	57 718	89 320	65
Trás os Montes	10 604	158 133	7	6 919	126 215	5	5 664	112 565	5
Beira Litoral	40 381	103 637	39	29 297	84 714	35	22 702	78 861	29
Beira Interior	20 469	155 974	13	11 467	108 106	11	6 771	96 584	7
Ribatejo Oeste	4 894	207 719	2	2 931	154 707	2	4 227	138 286	3
Alentejo	3 185	977 104	0	1 257	617 237	0	5 382	510 243	1
Algarve	123	34 878	0	88	42 370	0	194	40 745	0
Açores	5 418	12 373	44	3 787	9 679	39	3 917	9 406	42
Madeira	870	2 396	36	483	2 082	23	490	1 715	29
Total	165 823	1 761 621	9	118 233	1 240 700	10	107 065	1 077 725	10

Source: Statistics Portugal, 2009

The management practices encompass a very diverse set of policies, procedures and operations carried out by farmers. These practices can exert a strong influence on the local environmental conditions. The conservation of the structure and fertility of soils depends largely on its cover and the type of practice to which they are subjected. Moreover, the use of fertilizers and pesticides, the conditions of production and the storage of manure or slurry directly influence the emission of pollutants to the soil, water and atmosphere. The sustainable management of the soil is a major concern of the agricultural policies, since this resource has low renewal capacity, and shows high degradation rates, with very slow regeneration processes. The area of successive crops gives an indication of the degree of coverage of arable land during the year, assuming that an increase in ground cover reduces erosion risks. The conservation tillage aims to substantially reduce the effects of soil erosion by water and wind, minimizing the formation of crust. Some specific practices present in Portugal for conserving tillage include direct seeding, reduced mobilization, mobilization on the line, incorporation of surface crop residues and cover crops. These are methods of mobilization leaving most of the crop residues (plant material that remains after harvest) on the surface. The mulch with weeds or planting of appropriate species for green manure are also considered good agricultural practices. The direct seeding, also called no-tillage, is a cultivation method that leaves the ground unchanged between the harvest of one crop and planting the next.

In 2003, only 706 farms reported Continent adopt practices of soil improvement and erosion control. The agricultural area covered by such measures amounted to 9 501 hectares, representing only 0.3% of the UAA. This situation had a strong and rapid development, since in 2005 this figure increased to 8.7%, covering some 293 000 ha of UAA in 4 973 farms**.** The adoption of such practices became widespread in all regions of the continent, but was particularly evident in the Alentejo, Ribatejo and Oeste.

Between 2004/2005 and 2007/2008, the agro-environmental measure "no-tillage" has received a decreasing number of farmers (from 225 to 153) and covered successively smaller areas (from 12.4 to 8.4 thousand ha).

Although the structure of livestock has not changed significantly, there was a general fall in the number of LU of the major species (less 321 thousands of livestock LU), especially for pigs (less 150 thousand LU). At the same time, only the Alentejo and the Azores have increased their LU, particularly cattle which has increased significantly (over 154 thousand and 20 thousand LU, respectively). On the other hand, the total number of the species considered has declined markedly in Ribatejo and Oeste (less than 143 thousand LU) and Beira Litoral (least 129 thousand LU). In the first case, that evolution was mainly driven by the variation of effective pig (less than 92 thousand LU), and the second was the number of bovine cattle that most influenced the fall-off (less than 87 thousand LU). Most affected were the Ribatejo e Oeste (less 143 one thousand LU) and Beira Litoral (less 129 one thousand LU). Moreover, the Alentejo and the Azores have seen grow their livestock, particularly cattle numbers (Table 19).

Table 19. Number major animal species, by region (1 000 LU)

Region	1989			1999			2007		
	Bovine	Sheep and Goats	Suine	Bovine	Sheep and Goats	Suine	Bovine	Sheep and Goats	Suine
Entre Douro e Minho	278	21	37	240	21	30	188	16	20
Trás os Montes	66	41	17	57	40	16	45	38	9
Beira Litoral	162	31	122	113	27	120	75	20	91
Beira Interior	49	51	19	41	56	18	38	47	10
Ribatejo Oeste	118	43	275	109	31	265	89	20	183
Alentejo	181	165	79	278	160	114	335	124	92
Algarve	16	10	16	8	9	16	7	7	9
Açores	145	1	10	181	1	15	165	1	11
Madeira	7	2	4	3	2	6	2	1	4
Total	1 022	365	579	1 029	347	601	943	273	429

Source: Statistics Portugal, 2009

The apparent consumption of inorganic fertilizers in agriculture reached about 248 154 t in 2007, what represented an increase of 11% facing 2006. This trend is opposite to the one observed among 2004 and 2006. In this period the annual apparent use of fertilizers average has been decreasing by 6%/year. The apparent use of mineral fertilizers is shown in Figure 28.

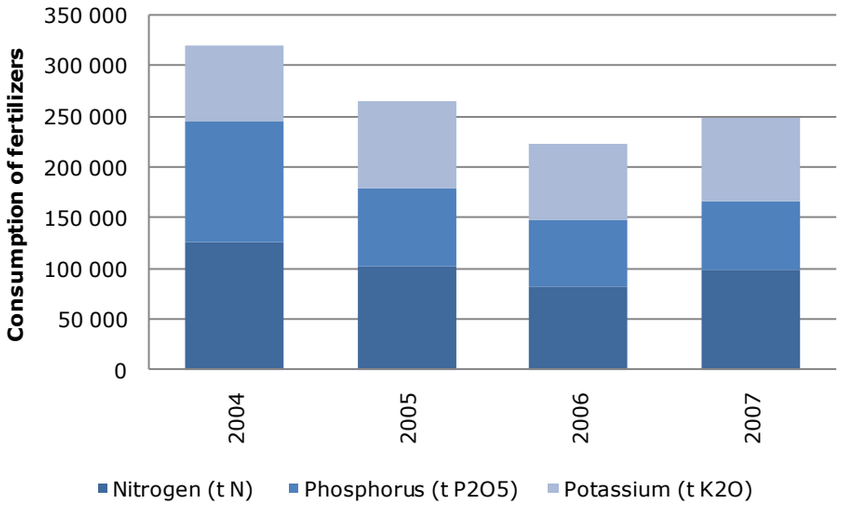


Figure 28. Apparent consumption of nitrogen, phosphorus and potassium (2004-2007)
Source: Statistics Portugal, 2009

In the period from 2004 to 2007 both the apparent consumption of Nitrogen and Phosphorus decreased by 22% and 44%, respectively. The apparent consumption was 68 kg/ha, decreasing about 5%/year. In 2006, Portugal had the lowest consumption of N/ha from the EU15 . Besides strategical conditionings, also the weather adverse conditions that characterized 2005 influenced the cereals cultivation, with a minor use of fertilizers.

For decades European agriculture walked towards intensification, a process characterized by increased incorporation of inputs and the consequent growth of income levels. However, the intensification usually produces negative effects on the environment. For example, increasing the stocking of cattle will cause an increase in emissions of methane and ammonia to the atmosphere.

At the national level, most of the UAA (always over 60%) has been managed with low levels of inputs. Rather, the UAA occupied by farms with high incorporation of inputs was always a minority between 1995 and 2007 and reached 14% in the last year observed. On the other hand, farms specialized in horticulture accounted for the highest values of the UAA with high levels of inputs, which increased 25 percentage points over the period observed.

The specialized production of grain appeared in the 2nd position in terms of the UAA occupied by farms with high inputs, but there was a trend of intensification, and experienced a decline in the percentage of UAA occupied by about 11%. The stocking rate was reduced significantly between 1999 (0.66 LU/ ha) and 2005 (0.56 LU/ha) and started to rise slightly in 2007 (0.58 LU/ha). The behavior of this index throughout the period examined was different depending on the animal categories considered: stability demonstrated for cattle (0.27 LU/ha in 1999 and 2007) fell 0.03 LU/ha in pigs and increased 0.03 LU/ha in sheep/goat. The remaining categories are grouped into "others" had the biggest impact with a total loss of 0.08 LU/ha.

The nitrogen balance represents a quantification of the imbalances between supply and uptake of nitrogen from agricultural soils and their effective use by crops, which result from excess or deficiencies of that nutrient. This is a rough balance of nitrogen, this is, including all emissions of waste nitrogen components harmful to the environment, used in agriculture (soil, water and air), the net balance exclude emissions into the air.

The nitrogen balance accounted for the year 2007, approximately 88 tons expressed in nutrient nitrogen. Changes from the previous year were more 30%. The increase in nitrogen balance compared to 2006 was mainly due to the increase in apparent consumption of nitrogenous fertilizers (19%) and increased manure production (2%), especially

due to the increased number of cattle and pigs, respectively 2% and 5%. The annual nitrogen average balance in the reporting period (2004 to 2007) decreased by 9%, due on the one hand, the reduction of nutrient inputs (less 22% of apparent consumption of nitrogenous fertilizers, 30% the area cultivated with legumes, less 4% of UAA) and, secondly, an increase of 5% for the nitrogen removed from the soil. In 2007, the balance of nitrogen achieved about 24 kg/ha of UAA, which corresponded to an increase of 33% over the previous year. However, in the period 2004 to 2007, this indicator fell to an average growth rate of 8%.

Table 20. Balance of nitrogen in the soil surface

	2004	2005	2006	2007
Inputs (inorganic fertilizers, manure, atmospheric deposition, fixation) (t N)	359 235	334 706	312 427	331 865
Outputs (Crops) (t N)	232 885	234 984	244 763	243 847
Balance (Inputs - Outputs) (t N)	126 350	99 772	67 664	88 018
Balance (Inputs - Outputs)/UAA (kg N/ha)	33	26	18	24

Source: Statistics Portugal, 2009

According to information available at this geographic level, it was found that the balance per hectare of UAA, between the deposition and removal of nitrogen concentrated the highest values in the municipalities located in the North and Central Coast and the Autonomous Region of Madeira.

In what concerns the production of energy from renewable sources, the domestic production of biofuels is relatively recent and incipient, and there are only DGEG official data since 2006, referring to a production of about 70 312 toe of biodiesel. For 2007, there was a production increase of 131% rising to about 162 152 toe. Despite the consumption of agricultural biogas evolved positively between 2000 and 2007, electricity production from biogas strictly from agricultural origin achieved an average annual growth of 10%. In 2007, comparing to 2000, the thermoelectrical showed an increase of 10%, while the production of heat decreased significantly by about 80%. The average annual growth of electricity and total heat of the agricultural sector were respectively more 1% and less 18%. Internationally, Portugal was placed in the 5th position among the countries of the EU15 biodiesel producers, accounting for 3.2% of 5 426 tones produced in 2007.

Organic farming can be defined as a method of agricultural production that is sustainable, based on soil biological activity, using incorporation of organic matter, which forms the basis of fertilization, avoiding the use of synthetic chemicals and fertilizers readily soluble, while the appropriate preventive strategies focus on plant and animal health. The aim is, thus, to obtain quality food, preserve environmental sustainability and develop local resources. The area under organic farming in Portugal has grown exponentially since the early 90's, as well as the number of operators involved in converting their land to this mode of production. Between 1993 and 2007, this area has increased from 2 799 ha to 233 475 ha, representing about 6.3% of the UAA, the maximum in the period considered. In 2007, 1 949 farmers reported the activity in organic production, while at first there were only 73 producers. The pastures were the dominant cultural occupation in organic farming (64%), followed by arable crops (16%). The leading areas were in the Alentejo region, with 60% of the national total area and 569 producers, representing 29% of the total national production. Portugal was, according to Eurostat figures for 2005, above the EU average in terms of the importance of area under organic farming facing its UAA, alongside countries such as Finland, Sweden and Greece.

1.9 Land Use and Land Use Change

In 2006, 38.9% of the Portuguese mainland was covered by forested areas, 32.5% by agriculture and 14.7% by mixed areas of agriculture and natural areas. According to the results of the project CORINE Land Cover 2006 for Continental Portugal (Caetano *et al*. 2009), these were the three major land cover types extending over the Portuguese territory by that time. In addition, looking at the land cover map produced within the framework of that

project for the year of 2006 (Figure 29), one perceives that the natural areas covered 9.4% of the mainland surface, whereas the artificial areas and water bodies occupied only 3.5% and 1.1% of the territory, respectively.

These results are quite similar to those derived from the CORINE Land Cover map for the year of 2000, thus suggesting stability on the landscape structure of the country. Indeed, from 2000 to 2006, the land cover changes, measured as a percentage of the Portuguese mainland territory that transited between six major classes – i.e. Artificial areas, Agriculture, Agriculture with natural areas, Forest, Natural areas and Water bodies – represented approximately 1% of the area of the territory and were mainly classified as a transition from Natural areas to Forest. The remaining land cover changes between major classes were minimal and can be disregarded. However, and reporting to the third level of the CORINE Land Cover map nomenclature (44 classes – Figure 1), the land cover changes in Portugal Continental during the period 2000-2006 occurred in 8.6% of the territory (Caetano *et al*. 2009). This means that the land cover transitions within those major classes constitute around 90% of the land cover changes that occurred in the territory. As examples, internal forests management activities were responsible for 6.0% of changes in the area of the Portuguese territory, agriculture internal conversions for 0.2% and urban land management for 0.1%.

The statistical analysis of the Portuguese landscape dynamics based on the six main land cover classes, indicates that the Water bodies presented the highest net formation as a percentage of the respective area in 2000. The net formation of that cover type was of 22% and the largest contribution to this value was from the artificial Alqueva dam infrastructure that was constructed in the south of Portugal during that period. The net formation of artificial areas between 2000 and 2006 has a similar trend, but an increasing value of only 10%. The urban residential sprawl and the sprawl of economic sites and road and rail networks in the North of Portugal were some of the processes that contributed to the positive urban net formation. On the other hand, there was a negative net formation of 4% on the Natural areas class that was mainly due to its transition to Forest. Similarly, there was a reduction of the Agriculture with natural areas in the Portuguese mainland territory. This was mainly due to a withdrawal of farming and creation of new forests, and to the construction of new artificial lakes and dams in the South of the country.

Looking at Figure 30 we observe the land cover changes' trajectories between the major land cover classes that are relative to the period 1985-2000-2006. Several observations can be made about the landscape dynamics and sustainability in the Portuguese territory for that period:

- Artificial areas and water bodies are the only classes with no significant transitions into others within the assessment period;
- Forest, artificial areas and water bodies classes present positive trends from 1985 to 2006;
- Between the periods 1985-2000 and 2000-2006 there was a positive acceleration on the forest and water bodies annual area increase and a reduction on the speed of annual growth for artificial areas;
- Water bodies presented the highest positive acceleration, four times superior to forests; this exuberant positive acceleration on its expansion was responsible for the consumption of areas previously occupied by all land cover classes, except by artificial areas;
- There was a decrease in the areas occupied by agriculture, agriculture with natural areas and on natural areas within the assessment period;
- Between 1985 and 2000 the agricultural areas were converted by human activities in artificial areas, forested areas and water bodies, and also abandoned and naturally converted into natural areas;
- The agricultural abandonment between 2000 and 2006 and the subsequent conversion of agriculture into natural areas was not significant;
- There was an extremely high acceleration on farming withdrawal between the periods of 1985-2000 and 2000-2006 that was essentially due to human induced processes, namely the construction of Alqueva dam;

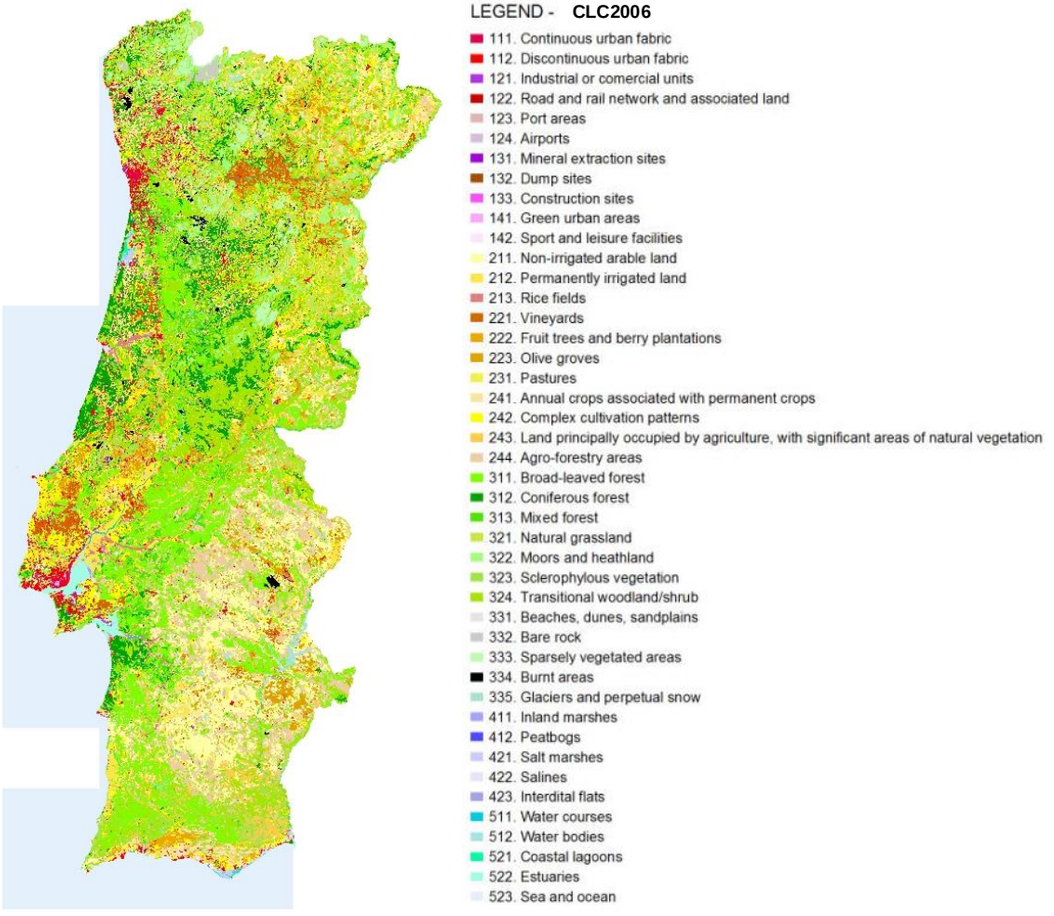


Figure 29. Geographical distribution of the main land use classes in the year 2006
Source: Caetano *et al.*, 2009

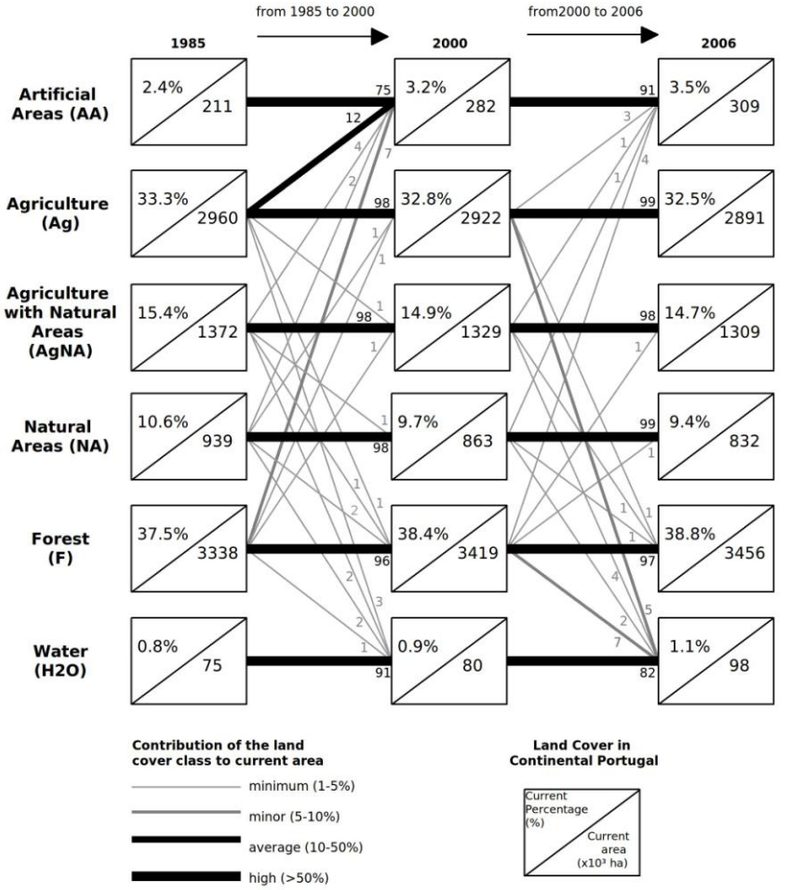


Figure 30. Land cover transitions between classes from 1985 to 2006
Source: Carrão and Caetano, to be published

1.10 Forestry

Portuguese forests have undergone significant changes in the past decade, both as a result of the abandonment of agriculture and the consequent transfer of land use to forestry, as well as due to forest fires that have reached huge proportions. Nevertheless, forestry resources play an important role in the national economy. Forestry is mainly an export sector, with a net commercial balance exceeding 1 thousand million Euros in 2003. Forest products (timber, cork, pulp, paper and wooden furniture) represent approximately 10% of the total Portuguese exports and worth over 2.7 thousand million Euros with 5 million tonnes of product in 2004.

Table 21. Distribution of forest stands for Portugal (including Azores and Madeira)

Region	Area (1000 ha)		
	1990	2000	2005
Forest	3 327	3 420	3 437
Other wooded land	45	101	155

Source: AFN, 2009
Portuguese reply to FAO FRA 2010 questionnaire

Table 22. Species distribution, in Mainland Portugal

	1982	1990	1995	2005
Specie	**IFN2ºrev**	**Interp.**	**IFN3ªrev**	**IFN5**
Pinus	1.217	1.069	976	711
Hoalm oak	662	693	713	737
Eucaliptus	366	554	672	647
Azinheira	464	462	462	388
Other soft wood	229	256	276	243
Other hard wood	104	104	105	98
New plantations				315
TOTAL	3.042	3.140	3.201	3.137
Burnt áreas			79	213
Clear cuts			28	41
OWL			41	21
Total	3.042	3.140	**3.349**	**3.412**

Source: AFN, 2009

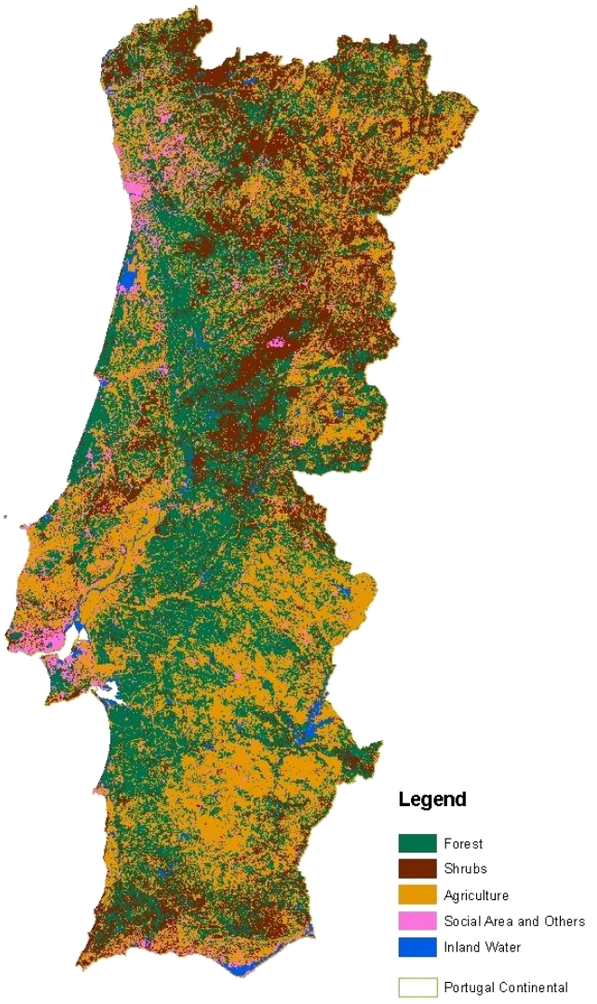


Figure 31. Main land uses according to the Portuguese National Forest Inventory 2005.
Source: AFN, 2009

Growing stock has been decreasing since 1990, reflecting the severity of forest fires.

Table 23. Growing stock.

	Volume (million cubic meters over bark)					
FRA 2010 Category	**Forest**			**Other wooded land**		
Total growing stock	203	198	185	n.a.	n.a.	1.79
... of which coniferous	118	107	92.5	n.a.	n.a.	n.a.
... of which broadleaved	84.6	90.0	92.1	n.a.	n.a.	n.a.
Growing stock of commercial species	166.0	163.0	152.0	n.a.	n.a.	n.a.

Source: AFN, 2009
Portuguese reply to FAO FRA 2010 questionnaire

Annual removals are around 13 million m^3 of wood over bark, with 4.8 million m^3 of softwoods and 8.5 million m^3 of hardwoods (mainly eucalyptus). Cork oak stands produce an average of 120 000 tonnes of cork per year.

Portugal imports raw forest materials for processing in the country, both for domestic consumption and for export.

Table 24. Removals over bark (m^3).

	Softwood	Hardwood	Total
1990	8 716	5 423	14 139
1991	7 467	6 098	13 565
1992	6 925	5 959	12 884
1993	6 889	5 907	12 796
1994	6 659	5 653	12 312
1995	6 672	5 078	11 750
1996	6 207	5 060	11 267
1997	6 207	5 060	11 267
1998	5 717	4 995	10 712
1999	5 711	5 516	11 227
2000	5 182	5 649	10 831
2001	5 161	5 984	11 145
2002	4 284	6 546	10 830
2003	4 606	7 367	11 973
2004	5 447	8 028	13 475
2005	4 523	8 731	13 254

Source: AFN, 2009

Forest fires are one of the major threats to forests in the country, especially in Mainland. After two very severe years (2003 and 2005) when the area burnt was very significant the situation improved and the last three years were considerable better. The number of forest fires also decreased in the last two years, but one has to notice that 70% to 80% of the fires are less than one hectare.

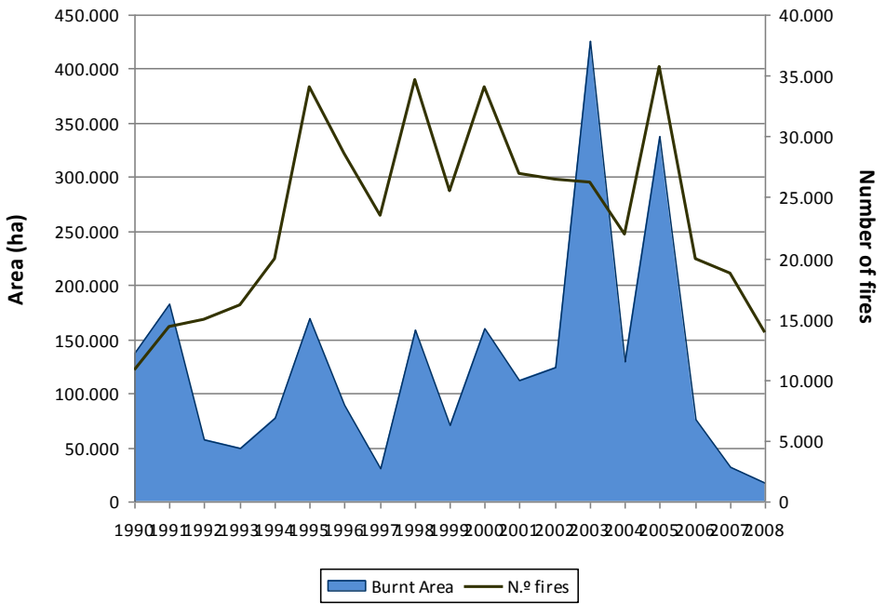


Figure 32. Fires affecting forests and other land: burnt area and number of fire events in Mainland.
Source: AFN, 2009

1.11 Waste

The Portuguese Environment Agency (APA) launched an integrated information system (SIRAPA) part of the overarching national program for simplification of administrative procedures. SIRAPA consists of a web-based platform in which entities, whether on a compulsory or voluntary basis, according to the applicable legislation, register information regarding their activities and environmental data. These data include annual information on generation, collection, transport and management of waste, which is crucial for the compliance of the Portuguese reporting obligations at national, EU and international levels, namely, within the Waste Statistics Regulation and the Waste Framework Directive.

SIRAPA will also incorporate an electronic waste tracking information system (eGAR) which will enable to monitor and update, on a day-by-day basis, data on collection, transport and management of waste and replace the paper forms that presently go along with waste movements inside Portugal.

The revised Portuguese Strategic Plan for Municipal Solid Waste Management (PERSU II) was adopted in 2007 and represents the policy instrument for the management of this type of waste until 2016. Priority has been given to the accomplishment of the targets for diversion of biodegradable waste from landfill and for recovery/recycling of packaging waste, as established in Directives 1999/31/EC ("Landfill Directive") and 2004/12/EC ("Packaging Directive"), respectively. In this context, indirect GHG emission reductions are achieved through material recycling, incineration with energy recovery and substitution of fertilizers, as compost is produced. Waste prevention, awareness-raising of the stakeholders and general optimization of systems and resources use are also key objectives of this plan.

In the sequence of PERSU II, the Strategy for Refuse-Derived Fuel was approved by the ministers responsible for the environment and for the economy and published in September 2009. The Strategy establishes the framework, actions and stakeholders involved in the promotion of the hierarchy of waste management considering the recovery of refuse produced in sorting and mechanic/mechanic-biological treatment units; synergies with industrial non-hazardous waste

and special waste streams are also envisaged. This Strategy thus represents a relevant environment and energy policy instrument and a contribution towards the sustainable management of waste and resources.

Furthermore, a National Waste Management Plan is currently under development, aiming at defining the vision, and the strategic and operational targets that will guide waste management in Portugal for the period 2009-2016. A Healthcare Waste Management Plan, which implements the National Plan in the specific field of healthcare waste, is also being developed and its operational objectives and actions were defined under the scope of five strategic axes – Prevention; Knowledge and Innovation; Awareness-raising, Training and Education; Operationalisation of Management; and Monitoring and Control. Both initiatives comply with the Waste Framework Directive and in this context a Prevention Programme on Urban Waste was also developed.

The Strategic Environmental Assessment of both Plans, pursuant to Law 232/2007, of the 15th of June, is expected to be concluded by the end of 2009.

The production of Municipal Solid Waste (MSW) in mainland Portugal increased, in 2008, to 4.8 million tonnes comparing with the 4.4 million tonnes in 2004. The production per inhabitant rose from 1.20 kg/inh.day to 1.29 kg/inh.day. Most of the production of MSW occurs in Lisbon and Tagus Valley and in the North, due to the higher population densities and the concentration of economic activities. The production of MSW has generally been increasing since 1990, apart from the decrease that occurred in 2004, the increase continued in 2006, 2007 and 2008, as showed in Figure 33.

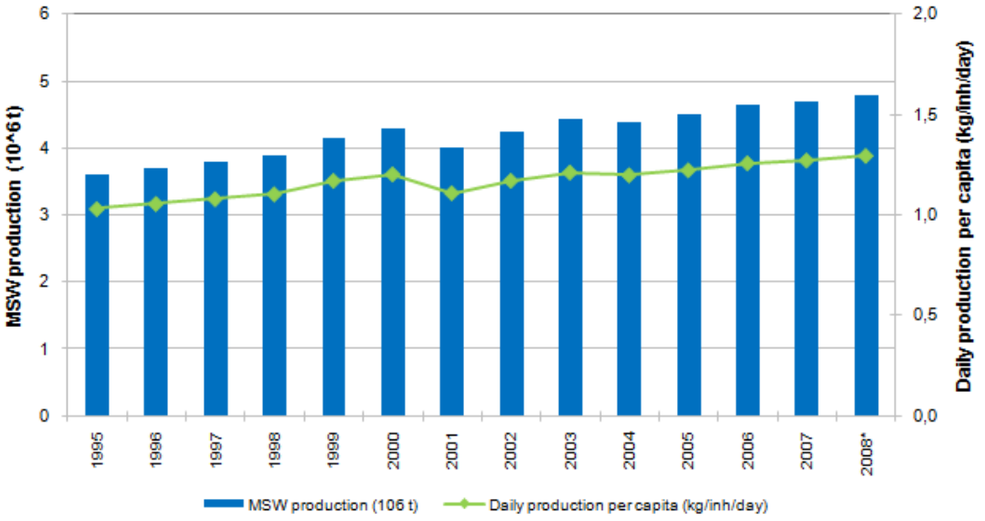


Figure 33. MSW total production and MSW production per capita/day (1990–2007)
Source: APA, 2009

All of the population is served by waste collection and environmentally sound waste management. The municipalities are grouped into waste management systems for the collection and treatment of waste. Although the Landfill Directive target for the reduction of biodegradable waste to landfill was accomplished in 2006, it was necessary to re-schedule the targets for 2009 and 2016, considering the 4-year derogation allowed by the Directive, as difficulties in operationalization of additional treatment capacity arose. Thus, MSW management will continue to be a priority area; the operation at full capacity and the reinforcement of existing infrastructure for mechanic/mechanic-biological treatment and energy recovery is required, so as to reduce the amount of waste that is conducted to landfills. The enhancement of selective collection of recyclables and biowaste is also envisaged.

Since 2001 there is no deposition of MSW in open dump sites, the majority of the MSW is deposited in managed landfills, 65% in 2008. From the rest of the MSW 18% is incinerated, 9% is recycled and 8% is composted, as showed in Figure 34.

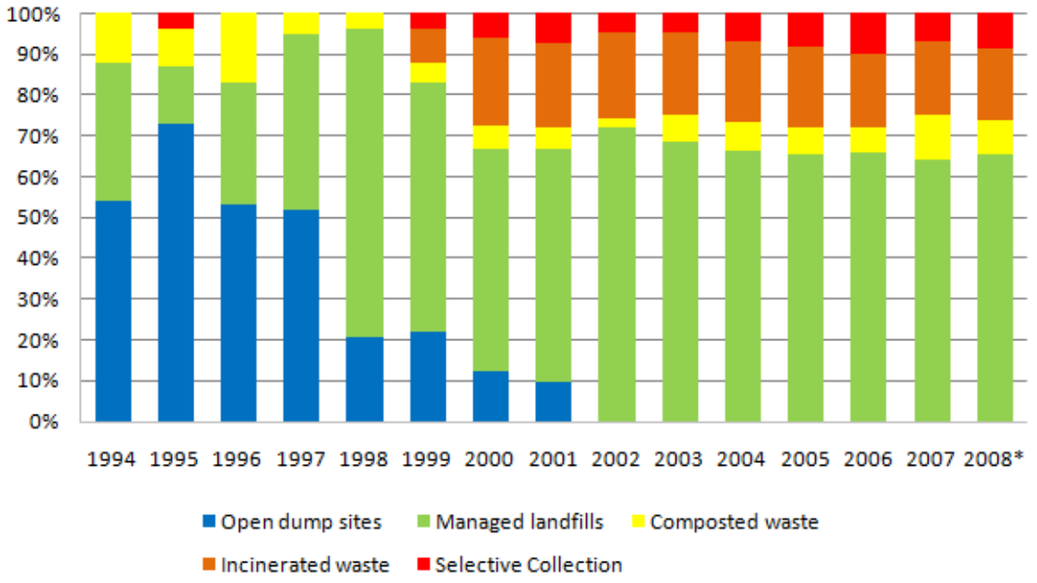


Figure 34. Share of MSW by final destination in mainland Portugal (1994-2007)

Source: APA, 2009

From the amount of methane produced in unmanaged disposal sites and landfill sites there was some that was burned before going to the atmosphere. That amount has increased in the last years, as it possible to see in Figure 35.

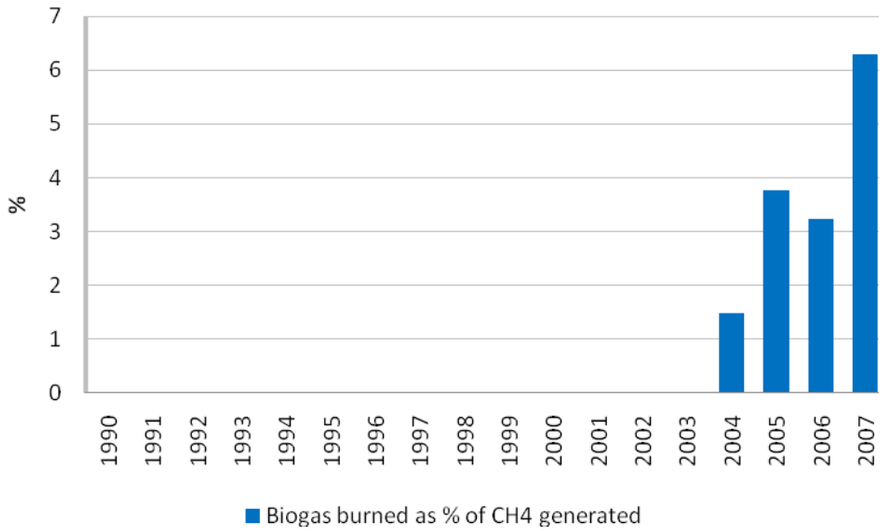


Figure 35. Percentage of biogas burned as CH_4 generated (1990-2007)

Source: APA, 2009

From the total quantity of incinerated waste, the majority where Municipal solid waste, as showed in Figure 36.

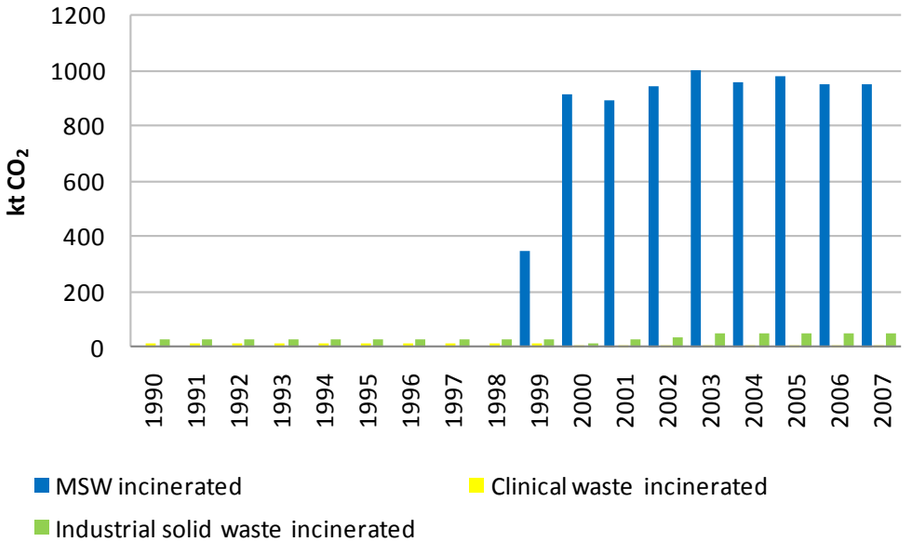


Figure 36. Sources of the incinerated waste (1990-2007)

Source: APA, 2009

The physical characteristics of the MSW produced in Portugal show that most of the MSW are organic (36%) and the least are wood residues. Figure 37 shows the distribution of MSW produced in Portugal.

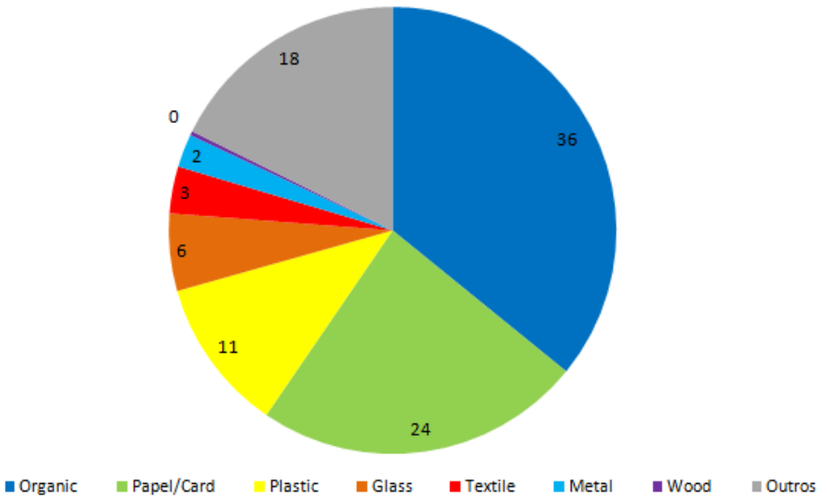


Figure 37. Typical physical characteristics of the MSW produced in Portugal (%), 2008

Source: APA, 2009

The concern with selective separation is demonstrated with the number of Ecopoints, which has risen every year, as possible to see in Figure 38. In 2008 there were 30 276 Ecopoints.

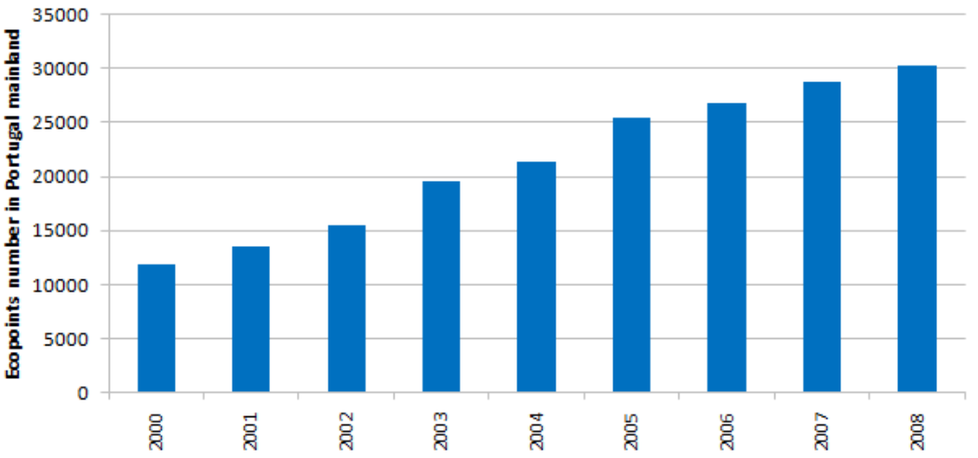


Figure 38. Ecopoints number in Portugal mainland

Source: APA, 2009

The industrial and hazardous wastes are matter of specific legislation and specific procedures. The amount of hazardous wastes has risen in the last 3 years, thought the Industrial wastes has decreased in 2006. No data was available for more recent years.

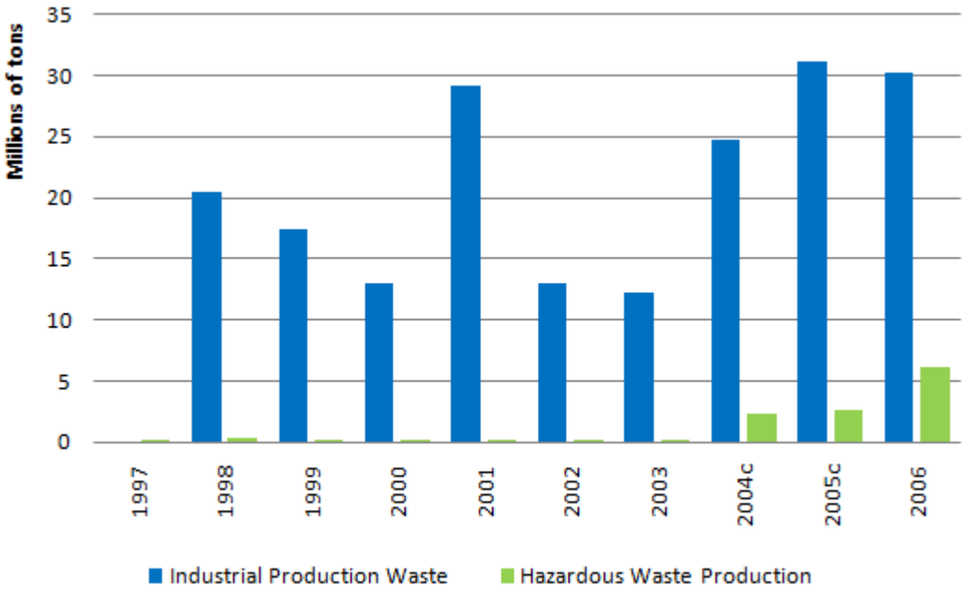


Figure 39. Production of Industrial Waste and Hazardous Waste

Source: APA, 2009

The Package Waste (PW) is monitored due the high amount of this type of waste. The trend shows an increase every year. Thought, in 2008 there were less PW that in 2007, but the recycled amount and the energy recovered was higher than in 2007. The package waste type that is more collected is the paper/cardboard and this type is also the most recycled.

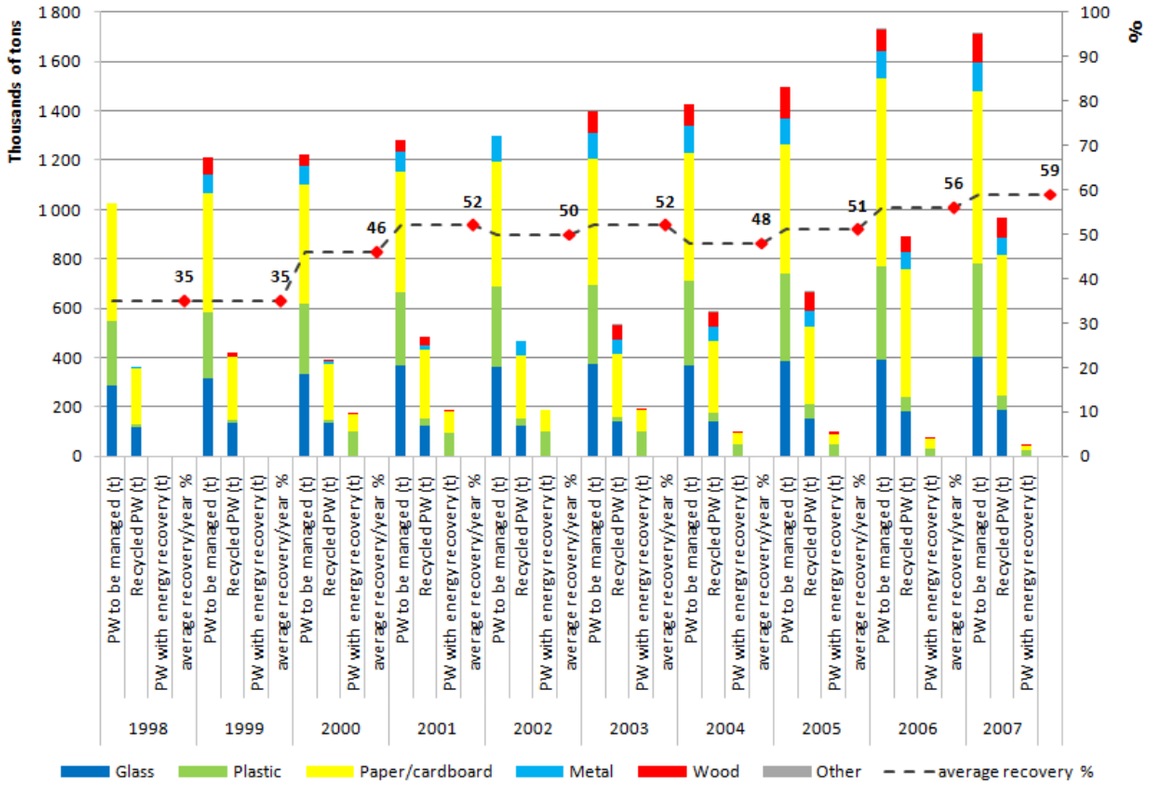


Figure 40. Packaging Waste Recycling and recovery rates (1998-2007)

Source: APA, 2009

The tires are aim of a legal tax added in the selling price in order to guaranty the recovery, recycling and energy use in the end of lifecycle. There is no direct connection between sold tires and collected tires, but the Table 25 shows that the collected tires have risen during the years.

Table 25. Sold tires, collected tires and afterlife tires destination.

	2003[49]	2004	2005	2006	2007	2008
Sold tires	61 037 995	73 667 533	72 613 993	79 738 849	83 722 000	83 139 373
Tires collected	59 069 160	76 681 777	77 828 110	88 582 278	92 322 000	96 209 760
Recycled used tires	30 632 570	33 470 334	38 641 480	42 496 340	43 603 000	48 332 004
Tires used to energy production	9 287 216	16 554 065	16 165 509	21 792 984	22 897 000	23 504 353
Tires sent to managed landfilled	720 140	4 531 340	1 591 000	0	0	0
Tires sent to other uses	0	1 588 471	1 622 524	989 020	400 000	2 056 720

Source: VALORPNEU, 2009

[49] Data Only 11 months (February to December)

2 Information on the National Greenhouse Gases Inventory System

2.1 National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants

The National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants - (SNIERPA) contains a set of legal, institutional and procedural arrangements that aim at ensuring the accurate estimation of emissions by sources and removals by sinks of GHG, as well as the documentation and archiving procedures for all relevant information.

The implementation of the SNIERPA is an answer to two commitments made at the international and EC levels:

- in the context of the Convention and of the Kyoto Protocol, the Decision 20/CP.7 - Guidelines for national systems for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks - under Article 5(1) of the Kyoto Protocol[50], which mandates the implementation of a national system until the 1st January 2007;
- at the EC level, Decision 280/2004/EC of the European Parliament and of the Council, of 11 February, on the creation of a mechanism for monitoring EC greenhouse gases (GHG) emissions and for implementing the Kyoto Protocol, which anticipates the implementation of a national system by 31st December 2005.

For the sake of efficiency, the Portuguese national system, which obligations include only emissions of GHG not covered by the Montreal Protocol, is broadened over a wider group of air pollutants, allowing for improvements in information quality, as well as an optimisation of human and material resources applied to the preparation of the inventory. At a first stage, it includes the acidifying and eutrophication gases, with the inclusion of particulates, heavy metals and persistent organic pollutants expected at a later stage.

The SNIERPA is composed of three technical instruments:

- a Methodological Development Programme (PDM);
- a Quality Assurance and Control System (QA/QC); and
- an automatic information system for SNIERPA's management (SIGA).

2.1.1 General Description on the National System

The main goal of the national system is to prepare in a timely fashion the inventory of air pollutants (INERPA), in accordance with the guidelines defined at international and EC levels, in order to fasten and facilitate in more cost-effective way the tasks of GHG inventory planning, implementation and management.

The system was established through Council of Ministers Resolution 68/2005, of the 17th of March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. This clear allocation of responsibilities is essential to ensure the inventory takes place within the defined deadlines. This year this Resolution is being updated in order to accommodate the new institutional arrangements, as well as the new responsibilities arising from the need for the identification of the areas and calculation of the emissions associated with the activities of the Articles 3.3 and 3.4 of the Kyoto Protocol that Portugal elected. These are Forestation, Reforestation and Deforestation and Forest, Grazing Land and Cropland Management, respectively.

[50] FCCC/CP/2001/13/Add.3

Three bodies are established with differentiated responsibilities. These are:

- Responsible Body[51] which is the Portuguese Agency for the Environment (APA), being responsible for: INERPA's overall coordination and updating; the inventory's approval, after consulting the Focal Points and the Involved Entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives;
- Focal Points (FP) work with APA in the preparation of INERPA, and are responsible for fostering intra and inter-sectoral cooperation to ensure a more efficient use of resources; and
- Involved Entities that may be public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body.

Table 26 lists the main focal points and involved entities, by sector of activity.

Table 26. Bodies that contribute information relevant to the preparation of the INIERPA (as in RCM. 68/2005)[52]

Sector of Activity	Focal Point	Involved Entities
National Statistics[53]	National Statistics Institute	
Environment Statistics[54]	Institute for the Environment	
Energy Statistics	Directorate-General for Energy and Geology	
Energy:		
Industry and civil construction.....	Directorate-General for the Enterprise	
Transport.....	Environmental Auditor of the Ministry of Public Works, Transport and Communications	
Road.....	Directorate-General for Driver Licensing	Studies and Planning Office of the Institute of Portugal's Roads, Directorate-General of Land and Water Transport
Rail.....	.....	Studies and Planning Office, National Institute of Rail Transport, "*Comboios de Portugal*", National Railway Network
Aviation.....	.....	Studies and Planning Office, National Civil Aviation Institute
Sea.....	.....	Studies and Planning Office, Port and Sea Transport Institute, Port Administration

[51] Portuguese Agency for the Environment, Rua da Murgueira, 9/9A, 2610-124 Amadora; Teresa Costa Pereira, teresa.costa-pereira@iambiente.pt

[52] RCM 68/2005 is being revised in order to accommodate recent institutional rearrangements.

[53] Transversal to all sectors of activity.

[54] Relevant data obtained from the implementation of the Directives on Large Combustion Plants and on Integrated Pollution Prevention and Control.

Sector of Activity	Focal Point	Involved Entities
Fugitive Emissions from Fossil Fuels.....	Directorate General Energy and for Geology	
Industrial Processes	Directorate-General for Enterprise	
Solvent Use and Other Products.....	Directorate-General for Enterprise	
Agriculture.....	Environmental Auditor of the Ministry for Agriculture, Fisheries and Forestry	Zootechnical Station Rebelo da Silva Agro-Chemical Laboratory
Forestry and Land Use Change		
Forestry.....	Directorate-General of Forestry	
Land Use Change.....	Portuguese Geographical Institute	
Waste		
Disposal/incineration of waste	Portuguese Environmentl Agency	
Wastewater.....	Water Institute.....	Directorate-General for Health

2.1.2 Planning and Quality

Two instruments of the SNIERPA ensure technical and methodological accuracy, completeness and reliability of the inventory: the Methodological Development Programme (PDM) and the Quality Assurance and Control System (QA/QC).

The PDM aims at identifying and defining a calendar for the application of methodological developments to the emissions estimates from the different categories of sources and sinks defined in the INERPA, by engaging experts in the inventory preparation process. It is a fundamental instrument in the planning of activities with all relevant entities.

The objective of the QA/QC System is to provide a set of verification (basic and technical) procedures to ensure the accuracy, completeness, transparency, reliability and representativeness of the emissions inventory. The system includes an application programme and a Manual of Procedures for QA/QC.

The results achieved with the application of the QA/QC system provide the main input in the preparation of the PDM. QA/QC procedures identify the areas of the INERPA with the most significant problems. The PDM allocates priorities to the resolution of problems identified through the QA/QC.

The complete implementation of these two instruments is important in ensuring that the national system is effectively implemented in the context of the Kyoto Protocol.

2.1.3 Management

SNIERPA's management includes tasks aimed at ensuring the application of these instruments, both in terms of annual time planning and achievement of medium and long term objectives.

An Integrated IT System for the Management of SNIERPA (SIGA) is currently being developed, with the view of endowing the national system with the capacity to archive and manage all the information necessary for the preparation of INERPA, including activity data, intermediate calculation parameters and emission factors, justification for the use of a given methodology, deadlines for submission of data and the identification of contacts for each body and Focal Point.

SIGA will be the reference for all involved in the preparation of INERPA, further to its role in information dissemination to the wider public. It will also perform simple functions such as sending reminders to the Focal Points and to the involved entities on upcoming deadlines for information's submission. Figure 41 represents the relation amongst the various components of SNIERPA.

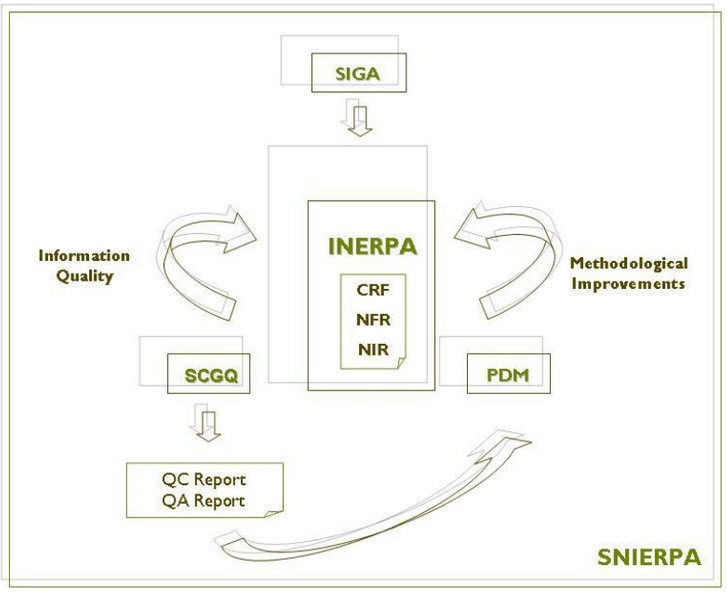


Figure 41. Linkages amongst the various elements of SNIERPA

Source: APA, 2005

2.2 Methodologies, Quality and Uncertainties

The inventory was calculated in accordance with internationally accepted recommendations and guidelines[55]. Key categories analysis of the 2009 inventory (period from 1990 to 2007) was based on a tier 1 methodology. This consists of a "level analysis" for each source (based on the emissions values) and a "trend analysis" (based on the time series trend for the period 1990-2007), enhanced by a set of qualitative criteria to identify additional uncertain or incomplete sources.

The QA/QC System consists of the Programme of Quality Control and Assurance and the Manual of Quality Control and Assurance. The first defines the calendar for the application of general procedures (QC1), the specific procedures for each source sub-category (QC2) and the quality assurance procedures (QA) listed in the manual. The various procedures listed on the manual have been drawn on the basis of the IPCC Good Practice Guide (GPG) guidelines and adapted to the specific characteristics of the Portuguese INERPA preparation.

QC1 procedures are organized by checklists which include: basic checks on the accuracy of data acquisition processes (e.g. transcription errors); checks on calculation procedures, data and parameters; cross-checking for consistency of

[55] UNFCCC Reporting Guidelines on Annual Inventories, Intergovernmental Panel on Climate Change; The Revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas (IPCC, 1997); Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000); Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2003).

data which is common across categories; verification of the National Inventory Report (NIR) and the Common Report Format (CRF) tables. Documentation and archiving procedures enable data handling for inventory recalculation.

QC2 procedures include technical verifications of the emissions factors and the activity data, and comparisons of the results obtained from different sources.

Finally, QA consists of a system of procedures to review parameters, activity data and emissions factors, as well as to validate the methodologies applied; this system is run by agents not directly involved in the development and compilation of INERPA.

Formal reports are produced following QC and QA procedures and made available for consultation.

The 2009 INERPA's submission, in the context of SNIERPA's implementation, was submitted to QC1, including the CRF tables and the NIR, and QC2 procedures (which results are referred in the NIR and in the dedicated report). The QA procedures were carried out in the frame of the PDM.

The main objective of the uncertainty assessment is to aid the prioritisation of efforts towards improving the accuracy of future inventories and methodologies. The level of uncertainty in the emissions estimates are due to the natural variability of some emissions processes, incomplete knowledge of emissions sources and their identification, the errors and gaps in data collection and statistical information, incorrect choice and calculation of emissions factors and parameters due to monitoring data errors, and expert studies and assessments.

A Tier 1 methodology was used to estimate total inventory uncertainty for each year, as well as the uncertainty in the emissions trends. This method of analysis attaches uncertainty values to the activity data and the emissions factors, for each pollutant, and uses error propagation rules to combine the uncertainty estimates of each of the individual sources in the overall value. According to the IPCC's GPG, uncertainty considerations for the Global Warming Potential are not considered.

The uncertainty analysis was applied CO_2, CH_4, N_2O, HFC and SF_6 emissions, and considers emissions in terms of CO_2 equivalents. The uncertainty of total emissions sources has been determined, except for the Land Use, Land Use Change and Forestry (LULUCF) sector.

The uncertainty values are defined within a 95% confidence interval; values for activity data, emissions factors and emissions estimate have a 95% probability of confinement within confidence limits.

2.2.1.1 Application of Tier 2: Quality control procedures to INERPA 2009

According to Portuguese National Inventory System (SNIERPA) Quality Assurance and Quality Control System (QAQCS), the National Inventory key sources shall be subjected to Quality Control (QC) in an annual basis. The application of the source categories' specific procedures (QC2) should be performed after the QC general verifications (QC1). The main objective of the QAQCS is to provide the National Inventory (INERPA) a set of verifications (basic and technical) that assure the exhaustiveness, transparency and representativeness of the national estimates.

Recommendations from previous revisions by the United Nations Framework Convention on Climate Change (UNFCCC) Expert Teams proposed the inclusion of the main results by each sector in the chapter of the National Inventory Report (NIR). Therefore, both the estimations for the time series 1990 – 2007 contained in the Common Reporting Format (CRF) and the data, emission factors and parameters explained in NIR for the sectors and GHG have been analysed. For the first time, QC2 was applied to every sources/sinks and GHG included in the Portuguese INERPA. This even exceeded the scope proposed by the IPCC guidelines, which imposed its application only to key sources.

Generally, the comparison of the GHG emissions obtained by different approaches revealed some differences, which can be related to the different emissions factors (EFs), Low Heating Values (LHV) and/or differences in fuels' classification and aggregation among the data provider and producer entities.

When country-specific Emission Factors (EF) and parameters were used, these are well documented and have been generally evaluated in previous UN Expert Reviews and peer reviewed. Adding to this, they have been compared with IPCC defaults and are pretty similar or within the range proposed.

As stated in NIR (APA, 2009) the Energy sector is the biggest emitter, accounting for 70% of total emissions in 2007, and presenting an increase of about 43% over the 1990-2007 period. Energy industries and transport are the two most important sources representing about 24% of total emissions. Transports, which are largely dominated by road traffic, are one of the sectors that have risen faster. In the period 1990-2007 these emissions increased 92%, due to the steady growth of vehicle fleets and road travel. Indirectly the increase in road traffic activity also augmented the emissions from fossil fuel storage, handling and distribution.

Industrial processes were, in the period analysed, the second most significant sources of GHG emissions, with 10.5% of the Portuguese emissions in 2007.

The Waste and Agriculture sectors represented each approximately 9% of Portuguese emissions in 2007, recording an increase of approximately 30% since 1990 and a decline of 5.6% in the case of agriculture. Solvent use represents less than 1% of total emissions.

Estimates of emissions and sinks from Land Use, Land Use Change and Forestry (LULUCF) category, show that this category has changed from being a net emitter in 1990 (1.5 Mt CO_2e) to becoming a carbon sink in 1992 and the following years until 2002. The situation was again reverted in 2003, and, from this year onwards, this category is again estimated as a net emitter. This pattern of time variation is explained by the exceptional occurrences and extension of forest fires in specific years, and the use of the burnt materials as inputs to the industry.

Future improvements in Portuguese INERPA are defined under the PDM which is settled each year in the context of the SNIERPA and is developed under the responsibility of the APA in cooperation with the sectoral Focal Points. The PDM pretends to reflect the results of the various review processes, in particular the UNFCCC reviews, the annual inventory compilation process (all experts and entities involved can make proposals for methodological development), and the results of the QAQC procedures (APA, 2009).

As stated before, the inventory team as part of their regular procedures associated with the GHG emissions/removals' estimations has been applying some CQ2 and proposing further developments.

After this summary, and as a general conclusion, the application of CQ2 procedures allowed affirming that the Portuguese GHG Inventory is consistent, transparent and exhaustive. The parameters, EFs, activity data and methodologies are well described and are solid as well as referenced and justified. Sectoral main conclusions and future developments are as follows.

In the energy sector, mainly in stationary combustion, when comparing sectoral and reference approaches, some differences are noticed. As stated in NIR, discrepancies in the emissions estimates are mostly explained by:

- Differences in the energy balance and the activity data collected directly from LPS and a different approach to account for emission from carbon stored in products
- Specific LHV values for LPS are not always considered in the Energy Balances
- The proportion of carbon stored in feedstock are default values and not specific of the national conditions reflected in the inventory
- The allocation of fuel sales to domestic or international in the energy balances is made according to the flag of the air-ship or the vessel. This is not consistent with the IPCC guidelines.

In the Energy sector, the existing differences between the several entities responsible in terms of reporting energy balances (such as DGEG, Eurostat and IEA) may be linked to several factors, such as difficulties and differences in the aggregation of the activities in each sector (since there is no standard between the several entities for the selection and aggregating), as well as the utilization of different LHV values.

The main development expected in the next submission will be a more widespread use of plant specific EFs, covering more pollutants and more plant units. Further incorporation of time evolution of these EFs is also necessary. Efforts to increase the percentage of units treated as LPS is also considered an objective. These efforts are in accordance with the goals that the team has set to streamline data collection for the inventories and for the EU-ETS. In the same sense on-going efforts should be maintained for the coherence of data acquisition by APA and DGEG in order to get a higher degree of consistency among the data that is used for the Energy Balance and the LPS data used in the inventory. During the last year several meetings have been held with this institution to further develop the streamlining of the inventory data.

On the other hand, data used in NIR, mainly due to confidentiality obligations, are aggregated by sector. Other sources of data, such as the EU-ETS, EPER, LPS' and Environmental Licensing are reported by installation. Once these obligations are not exhaustive, not covering all the installations, the direct comparison in each installation is not possible. However, the inventory team is involved in a project that intends to compare the values reported in EU-ETS and the DGEG's energy balance.

During this exercise, the access to monitoring data from the LPS was not possible. When applying CQ2 to 2010 submission it is expected that these data are available for comparison with DGEG's data.

Considering that the energy sector is the most prevalent emission source, special efforts must always be made to improve emission estimates, even if they affect smaller energy sub-sectors. Future improvements to the inventory will depend on the conclusions of the Methodological Development Plan (PDM) for the implementation of the National System, which is being made with direct contact with the main intervenients of the energy sector, and in close collaboration of the inventory team. Although the main conclusions from this report are still not set in a final report and plan, the following preliminary actions may be here identified:

- Better integration between activity data in the air emissions inventory and other surveys such as LCP directive, Autocontrolo program, EPER/E-PRTR, the EU-ETS Carbon Market and the energy surveys (co-generation) made annually by DGEG. Contacts are being made to implement it. Particular work is being done to streamline the collection of data and emission estimates between the inventory and the EU-ETS, following the promotion efforts that are being made by the European Commission
- Determination of country-specific EFs (SOx and NOx) from monitoring data collected from the Autocontrolo program and CO_2 EFs for information collected under carbon market
- Better characterization of the use of Biodiesel in co-generation and non-cogeneration equipment
- In Geothermal production, in the scope of the PDM, efforts are being done together with the regional government of Azores islands, to improve the knowledge of this activity and resulting emissions.

In Road Transports, it is expected that the first draft results from COPERT 4 emission model will be available during the year of 2009. Therefore, COPERT 4 could be used for the next 1990-2008 inventory years.

Concerning Fugitive Emissions, efforts are being done with DGEG and the major Portuguese company responsible for gross transport of natural gas, in order to increase the tier level of the methodology used. Results and changes in estimates are expected in the coming years.

In Industrial processes the major issue concerns the time series of the activity data. To ameliorate it some actions are predicted in the scope of next year submission, namely the consideration, by the Permanent Body for Statistical Secret from the National Statistics Institute, of the options to end with the confidentiality constrains, that do not allow the

access to production data in some years of the period, enabling the use of a complete time series for most of the sources in the industrial sector. As a consequence, one major development foreseen for next year's submission will be the update of industrial production and external commerce data from Statistics Portugal from 2001 onwards. Following the problem raised in the 2008 UNFCCC process review concerning the regular update of industrial production data from IAPI (Survey on Industrial Activity) and external commerce database, the APA contacted Statistics Portugal in order to establish an arrangement under the national system to facilitate annual provision of the necessary activity data. After a meeting of the Statistical Council (coordination of the overall National Statistical System), there was a positive deliberation about the use of confidential information for inventory purposes, and from now on, the required data will be annually provided to APA.

In terms of specific processes:

- Cement production: the information that was received is not sufficient to derive country-specific CaO contents since its fractions are not available for all industrial plants. So, efforts are also under way in order to improve the knowledge of carbon content of products, or CaO and MgO content, for all plants with the possible outcome of a country-specific emission factor.
- Lime: there is still the possibility that the inventory is doubling some of the estimate of CO_2 emissions, if part of the quick-lime that is produced in an industrial unit is sold and used again to produce slacked lime or hydraulic lime in a different industrial plant. To correct this effect, emissions estimated from lime production should be cross checked with emission estimates from limestone and dolomite consumption also in the paper pulp industry. Since some units producing lime are included in the European Union's Emission Trading System (EU-ETS), the comparison of National Statistical information with the reports made annually by industrial plants may improve the inventory. The comparison and use of EU-ETS data is envisaged under the efforts that are being made to streamline both inventories.
- Limestone, dolomite and carbonate: an intensified effort to obtain the necessary statistical information or alternative methodologies will be envisaged to estimate emissions from carbonate use in the production of synthetic fertilizers (nitrates of calcium and magnesium and ammonium nitrate with calcium and magnesium).
- Iron and steel: lack of information concerning activity data and possible double counting in steel production activities may be a problem to emission estimates for this source sector.
- Ferro-alloys: although this is a less important emission source, improvement of emissions estimates will have to be made in future, concerning the update of time series since 1990 and the individualization of each ferro-alloys by alloy, and application of specific emission sources.

In what concerns F-gases, it is expected that emission estimates will improve as a consequence of the inclusion of non quantified sources and the upgrade of methodologies and parameters for the already quantified sources. The main aspects that will be subjected to future improvements include:

- The knowledge of the SF_6 that was used in Portugal as a tracer in scientific studies, even in the development of air emission methodologies
- The consideration of refilling of refrigeration equipments
- To reduce uncertainty on activity data and parameters: emissions from certain source sectors rely in less accurate activity data, which was estimated from surrogate data and assumptions
- Better PFC actual emission estimates should be addressed.

In Agriculture, the main findings are related to some parameters and emissions factors. The Nex (T) values were provided by Ministry of Agriculture expert judgement based in monitoring results, complemented international sources and data submitted by other countries. The values are also under revision and are expected to be included in the 2010 submission. The same is happening with the distribution of the animal waste management systems through Statistics Portugal that will perform an extensive agriculture survey, which will monitor the present situation and the future expected developments.

Other developments expected for the sector are the improvement of de data concerning the share of use of each nitrogen fertilizer, particularly the importance of urea use, which is under consideration by Statistics Portugal and will be used to improve the preliminary estimate that was made by APA and that is temporarily being used in this year report. Despite the lack of suitable statistical information, efforts will continue in order to quantify the nitrogen in sewage sludge that is used as soil fertilizer.

The importance of the Manure Management Systems in ammonia emissions needs also to be included in the methodology, but that depends on the existence of appropriate emission factors. Efforts will continue in order to ameliorate the volatilisation rates from the application of synthetic fertilizers, following a future better knowledge of the nitrogen fertilizer types used in Portuguese agricultural soils.

In LULUCF, efforts are still going on to improve the methodology that will be used to report emissions under the Kyoto Protocol. At present, the results of a pilot study (implemented to define Portugal's reporting methodology under the UNFCCC and the Kyoto Protocol (KP)) are being applied to the all country issuing the Protocol's activities included in Article 3.3 (Forestation, Reforestation and Deforestation) and Article 3.4 (Forest Management, Grassland Management and Agricultural Management). Despite these efforts aim mainly the Kyoto Protocol, the methodology that will be used under the Convention will be revised accordingly, as much as possible, in order to maintain consistency between the two reports. The main actions that are under way and that could affect the estimates under the Convention are:

- Revision of the carbon content of soils, with the inclusion of country specific studies and monitoring
- Development of yield tables per age and per Forest Planning Regions (PROF) using models of biomass production for main species (*P. pinaster*, Eucalyptus, *Q. suber*); and tables at national level for other species (*Q. rotundifolia*, Quercus, *C. sativa*, etc); this will in principle revise the use of the BEF methodology
- Revision of the methodology used to estimate emission from forest fires, considering the per cents that remain alive after the fire, and avoiding the double counting of harvest and biomass loss during fires. The main questions of concern are:
  - some trees are used in industry or fuel
  - avoid double counting of harvesting
  - not all biomass is lost
  - some forest became unproductive
  - differences by specie.

Also, the production of a new Land Cover Cartography (*Carta de Ocupação do Solo* – COS) is presently under way, based on the aerial images of 2007. The technical specifications of this cartography (COS2007) and nomenclature were approved by the cartography's Advisory Committee, which included representatives of SNIERPA, in order to ensure that the cartography would match Portugal's reporting requisites under the UNFCCC and the KP. COS2007 will be used to assess the forest, agriculture and grazing land area in the beginning of the first commitment period (2008), and to identify the afforested/reforested and deforested areas between 1990 (COS1990) and the beginning of the CP. The country also envisages to complement this coverage with forest change monitoring data (forest fires, harvest and replanting) based on satellite imagery, and other available land cover/use databases (e.g. Agro-Environmental subsidies).

As a Party to the Kyoto Protocol, Portugal is committed to submit information under Article 7, paragraph 1 of the Kyoto Protocol, following the provisions of Decision 15/CP.10 (FCCC/KP/CMP/2005/8/Add.2). According to this Decision, each Party shall start reporting this information with the inventory submission due under the Convention for the first year of the commitment period after the protocol has entered into force for that Party, but may start reporting from the year following the submission of the information on the Assigned Amount Report.
This report aimed to fulfil the commitments related to Activities under Article 3 paragraphs 3 and 4 of the Protocol on a voluntary basis.

Accordingly, the main goal of that voluntary submission was to validate the Portuguese proposed methodology to identify land areas and to account for the associated emissions/removals, made through the development of a pilot study.

The submission resulted from the work of a Group settled in the framework of the National Inventory System (SNIERPA) with the aim of defining a methodological approach to tackle the reporting needs of article 3, paragraphs 3 and 4 of the Kyoto Protocol (WG 3.3&3.4).

The entities involved, in this process, in the context of SNIERPA, have agreed that the methods were the appropriate for the fulfilment of the additional information reporting obligations under Article 7.1 of the Kyoto Protocol dictated by the Article 3.3 (deforestation, afforestation, reforestation and forest management) and Article 3.4 (cropland management and grassland management), considering the existing information and the cost/benefit ratio in terms of Kyoto's obligations fulfilment. The methodology defined to identify the areas and account for the emission/removals during the first commitment period is different for Afforestation (A), Deforestation (D) and Reforestation (R) (Art. 3.3) and Forest management (FM) and the remaining Grassland Management (GM) and Cropland Management (Art. 3.4) activities and encompasses:

2.2.2 Afforestation, Reforestation, Deforestation and Forest Management

- In Portugal the 1990 Land Use Map (COS'90), based on aerophoto obtained in August 1990, is available with 1 ha resolution; This cartography will be improved and used to determine land use/cover in that year;

- Portugal will produce COS2007, based on aerophoto from 2007, which will be used to assess the forest area in the beginning of the first commitment period (2008) and to identify the afforested/reforested and deforested areas between 1990 and the beginning of the commitment period; the later areas will be classified within the scope of Article 3.3[56];

- Considering the need to warrant that the time period is appropriate to gather, interpret and handle the base data (aerial photography), to minimize costs and to guarantee the consistency with the National Forestry Inventory (NFI) I, the collection of land use/cover data during the commitment period must be anticipated. Therefore, a new COS will be produced with reference to 2010 or 2011, which will allow the results to be available in 2013. The comparison of COS2010/2011 with COS2007 will permit the determination of the land use changes occurred in the commitment period;

- The AFN annual cartography on forest fires which is annually produced t through satellite images will be used to identify the burnt areas during the commitment period.

- The tree fellings assessment can be done using data from NFI 2005, through growth models and subsequent NFIs or, eventually and if necessary, using data from an IGP project also based on satellite imagery; in the later case the methodology still has to be developed.

- Biomass in forest areas and annual increments will be assessed in detail using regional simulators that use the NFI 2005 data, subsequent exercises to predict the evolution, and biomass models per species. Simulators are being developed by the Technical University of Lisbon/Agronomic Institute for the AFN.

2.2.3 Cropland Management and Grassland Management

The assessment of carbon change will cover all cropland and grazing land areas in Portugal, but using differentiated methodological detail.

[56] . In the case that COS2007 is not available in a timely manner (end of 2009), the data to be used to report 2008 will be the photo-points from NFI, referring to 2005

Areas with specific cropland management or grassland management practices (no-tillage or sown biodiverse pastures)

- The identification of the areas with cropland or grassland management, activities that are expected to improve carbon storage significantly, will use the data base from the IFAP the paying agency for CAP. These areas are georeferenced;

- The determination of the changes on land use and practices in these areas will be done with the information from IFAP;

- The soil carbon sequestration of both management practices will be determined using results of scientific studies published in the literature, using a country-specific Tier 2 approach.

Other cropland or grassland Areas hereafter referred as "non-managed" areas

- These areas will be identified using COS (1990, 2007 and in subsequent year during the first commitment period). The cropland and grassland areas with specific management activities (based on IFAP's database) will be subtracted from the national total identified on COS, to avoid double-counting;

- The soil carbon content will be determined through parameterization, using data from Rebelo da Silva's Laboratory regarding sampling soil analysis for agricultural management

To test the proposed methodology, the WG 3.3&3.4 decided to implement a study for testing and validating the proposed approach. Since some of the data sources that will be used in the future, as was the case of COS2007, is still under production, the WG decided to use an available cartography with similar characteristics referring to the District of Évora (AMDE), in the South of Mainland Portugal (Figure 42). Furthermore, this submission considers forest activities exclusively for Eucalyptus, as the work on regional simulators for the other main forest species is still ongoing.

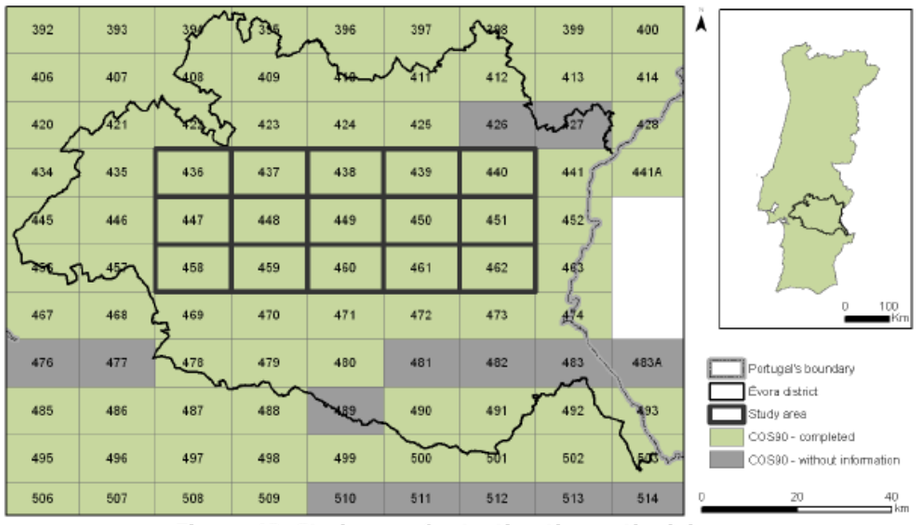


Figure 42. Study area for testing the methodology.

The proposed methodological approach, which was based on the overlay of the 1990 Land Use Map (COS'90) with the AMDE cartography for the year 2004 and the NFI plots for this pilot area, revealed however difficult to apply in the case of forest land activities (D/AF/FM). This was due essentially to the small number of existing plots for each combination of KP activity and forest land use type, and also, to the unavailability of regional statistics of wood harvested to apply the forest simulators in the pilot area only.

As a consequence, the application of this methodology to the pilot area was abandoned, and the estimates of C sequestration/removals in forest land in this experimental submission refer to the whole country and only to Eucalyptus forest species. This approach differs from the one used for CM and GM activities which concerns the pilot area – AMDE.

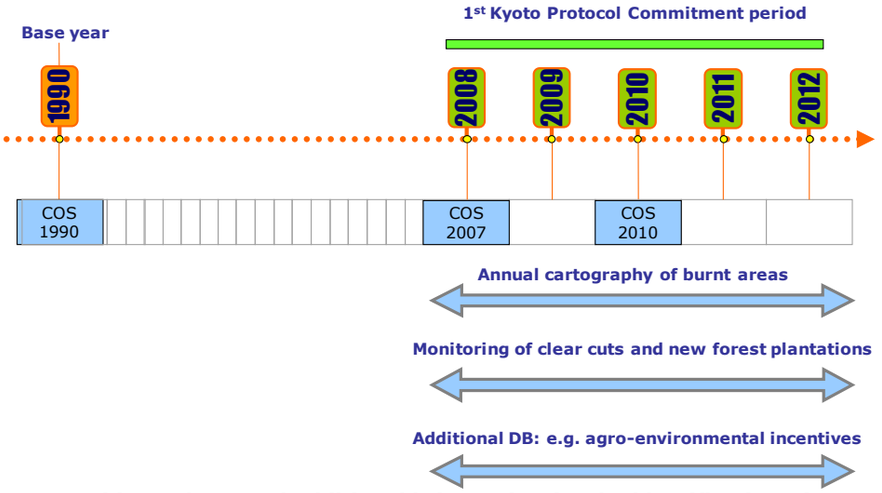


Figure 43. Cartographic products and additional information for the identification of areas to be used in future submissions

In the Waste sector, mainly in Wastewater and considering the limitations in the time trend in load and the share of each treatment system, efforts will continue in order to improve the knowledge of the situation of industrial wastewater. It is expected that the situation will improve soon, after the implementation of a new survey system and data base by the National Water Institute. Namely, only for some industrial sectors, specific characterization of the share of Wastewater treatment schemes was available. Despite the efforts made to better characterize the situation for the remaining sectors, in particular for the six major emission contributors, in the end it was not possible to improve the methodology on this issue, mainly because there are no reliable records of the situation existing in 1990 concerning the treatment systems. The situation after 2000 can be better known for some plants, mainly from Environmental Licensing (European Union's IPPC directive). Nevertheless, the implementation of this directive, and other previous environmental programmes (Covenants of Environmental Adaptation) caused the improvement in the situation of wastewater treatment and the situation in 2000 should not be considered representative of the situation in 1990. More efforts are expected in this area.

The emission estimates for this sector needs to be improved by the calculation of the total load of nitrogen in industrial effluents, which would allow the use of the methodology proposed by IPCC for domestic wastewater (IPCC, 2000; IPCC, 2006). Nevertheless, the lack of pollution coefficients of comprehensive data on wastewater characteristics may postpone improvements in this sector for the near future.

2.3 Emissions Trends: 1990-2007

In 2007, total GHG emissions estimates, without Land Use, Land Use Change and Forestry (LULUCF), accounted for 81.8 Mt CO_2e, an increase of approximately 36% relative to 1990 levels. In accordance with the EU Burden Sharing

Agreement[57], Portugal has committed to limit its emissions growth to 27% relative to 1990 levels. Comparing the growth observed between 1990 and 2007 with the linear trend for the period 1990-2010, GHG emissions in Portugal were, by 2007, about 13.1% above target (Figure 44). Emissions increased at 2% per annum throughout the period 1990-2007.

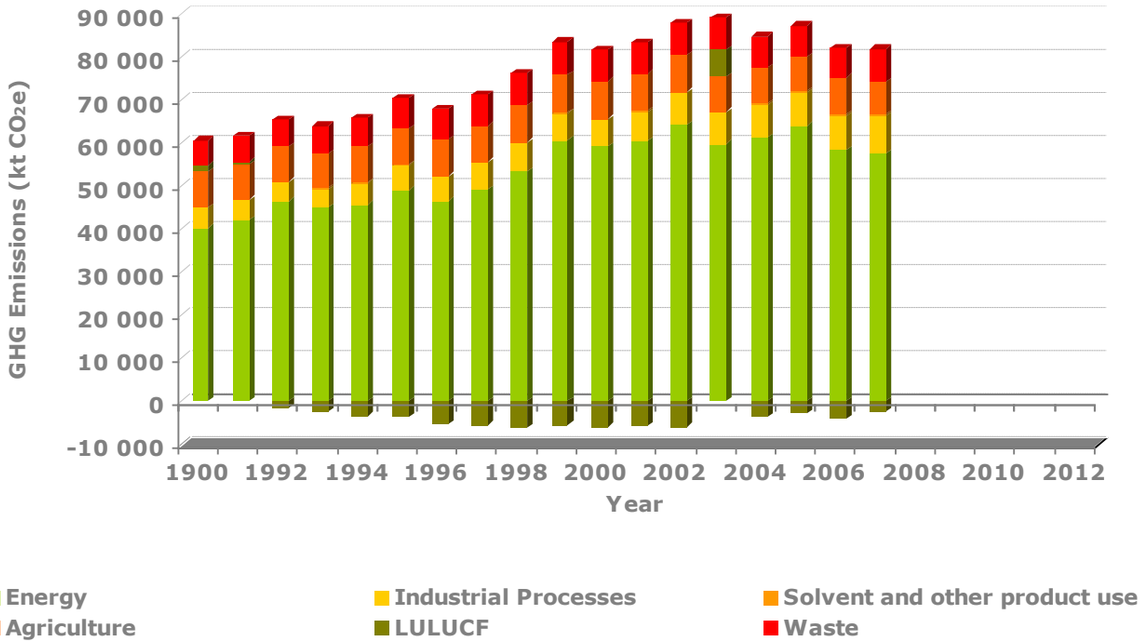


Figure 44. GHG emissions with LUULUCF (1990-2007)

Source: APA, 2009

The most significant source of GHG in Portugal is associated to the Energy sector and is directly related to the burning of fossil fuels. With 77% of the total 2007 emissions weighed by GWP[58], CO_2 is the most abundantly emitted GHG, 90% of which accrues in energy-related activities.

2.4 Analysis by Gas

As showed in Figure 45, the trend is that greenhouse gas emissions continue to rise. The gas that rise most was the F-Gases, but because it represents only 1.2% of the total emissions, it is considered that the carbon dioxide rise is more significant, it raised 44.1% and it emissions represent 77% of the emissions, as showed in Figure 46.

[57] Council Decision 2002/358/EC of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder

[58] Global Warming Potential.

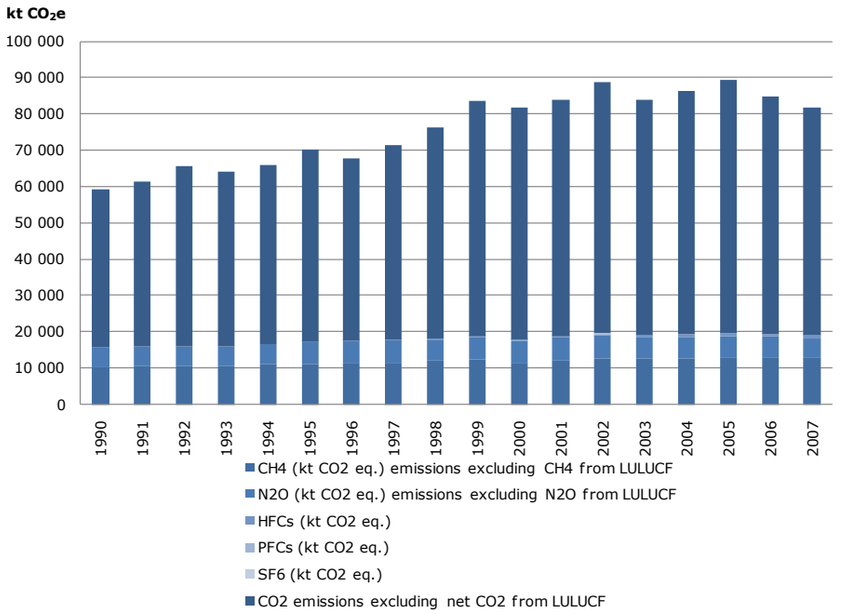


Figure 45. GHG emissions trend between 1990 and 2007.

Source: APA, 2009

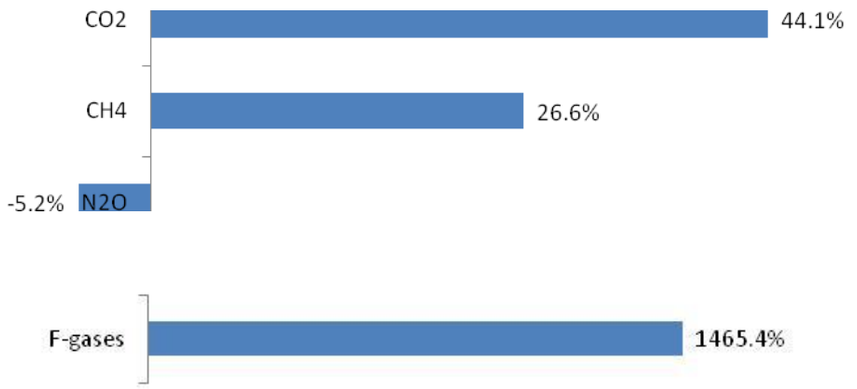


Figure 46. GHG emissions increase by gas, between 1990 and 2007

Figure 47 shows the relative contribution of each of the GHG to the emissions total for the base year (1990 for all GHG, except 1995 for fluorinated gases) and 2007.

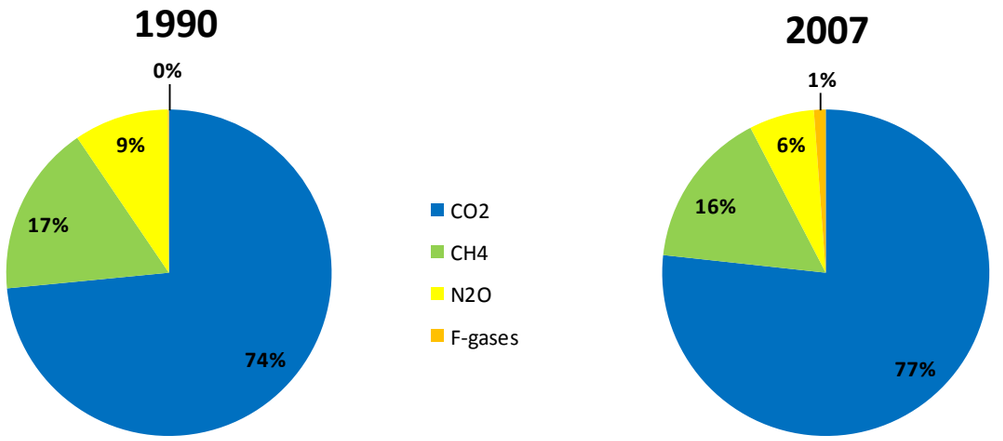


Figure 47. GHG emissions by gas in the base year and in 2007[59]

Source: APA, 2009

The burning of fossil fuels in energy related activities (IPCC sector 1) is the primary source of CO_2. Other non-energy related production processes, such as cement production (category 2A), are also significant contributors.

CH_4 is mainly produced from anaerobic decomposition of organic matter in biological systems, such as urban waste and livestock waste, wastewater treatment systems or enteric fermentation in animals. Other sources that are equally responsible for CH_4 emissions include the burning of biomass, natural gas and oil distribution and the incomplete burning of fossil fuels.

N_2O is associated to direct and indirect emissions from agricultural soils, mostly related to the use of synthetic fertilisers and manure from cattle, nitrogen fixing by leguminous crops and the incorporation of agricultural residues in the soil. Other significant sources include the chemical industry (nitric acid production), wastewater treatment, burning of fossil fuels (mainly in the transport sector) and burning of biomass (forest fires, agricultural residues, biomass combustion in the residential sector and waste incineration).

The fluorinated gases encompass hydrofluorocarbons (HFC) and sulphur hexafluoride (SF_6). The first are the result of leaks in the production, operation and decommissioning of cooling and air conditioning equipments, foams, fire protection equipment and inhalators. The latter results from losses in electricity distribution systems, circuit breakers and metal-clad substations.

2.5 Analysis of Key Drivers

The key drivers explaining the increase in national emissions for this period are, among others, economic growth and increase in energy demand, traffic volume and distances covered by road transport (supported by the development of road infra-structures and the increase in the number of private vehicles). Meteorological parameters, such as precipitation, which have a high inter-annual variability, also have a significant influence on hydroelectric power production, thus influencing in a very significant manner the fluctuations in emissions.

[59] Portugal chose 1995 as the base year for fluorinated gases.

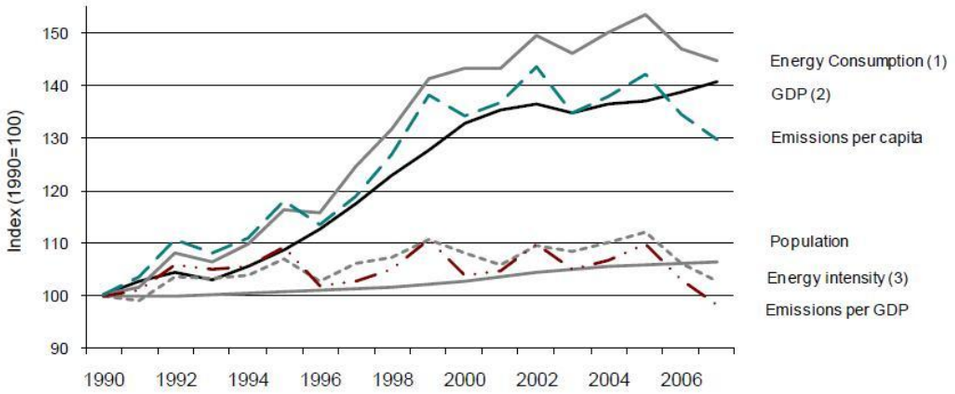


Figure 48. GHG emissions per capita, per unit GDP and relative to energy consumption[60]
Source: APA, 2009

Portugal registered rapid economic growth in the 1990s, with GDP increasing by 41% between 1990 and 2007, an annual variation of 2.6%. The most significant growth was observed between 1993 and 2000, with an average annual growth of 4.1% during the period. This economic growth was followed by a 2% annual average increase in primary energy consumption; in 2004, energy consumption was about 1.4 times higher than that recorded in 1990 (Figure 48).

Only in the last years Portugal manages to decouple GHG emissions and economic growth. There was a slight decrease in carbon intensity of the economy (emissions per unit of GDP) in recent years, a fact that may be explained by the implementation of some policies and measures with positive effects on GHG emissions such as the introduction of natural gas, increase of renewal energy production, the introduction of combined cycle gas thermal electric plants, the progressive installation of co-generation units, energy and technology efficiency improvements in industrial processes and improvements in fuel quality.

The slowing of economic growth since 2001 has also contributed to stabilize the emissions in recent years. However, recent emissions levels reveal significant fluctuations related to the high variability in hydroelectricity generation, which is strongly dependent on the current levels of precipitation, technically known as the hydraulic index (IPH). 2005 was a dry year (IPH of 0.42), resulting in a reduction in hydroelectricity production and a consequent increase in GHG emissions. In contrast, 2003 was a year with a high IPH (rainfall figures 33% above those of the average hydrological year) thus increasing hydroelectric production and decreasing CO_2 emissions from thermal power plants.

The influence of hydroelectric production on emissions is evident: the higher IPH values are matched by the lowest emissions values from electricity and heat production (1996 and 2003, for instance). The inverse can be observed in the years 1992, 1999 and 2002, whereby low IPH is matched by highest emissions values for those categories.

2.6 Analysis by Sector

In accordance with Convention reporting guidelines, emissions estimates are grouped in six main sectors: Energy, Industrial Processes, Solvent Use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF) and Waste.

All sectors (excluding LULUCF and Agriculture sectors) have registered emissions increase in the period 1990-2007. The Industrial Processes sector registered the higher increase from 1990 to 2007, about 86%, as showed in Figure 49.
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[60] Primary Energy Consumption; GDP at 1995 prices and energy intensity as the ratio between energy consumption and GDP.

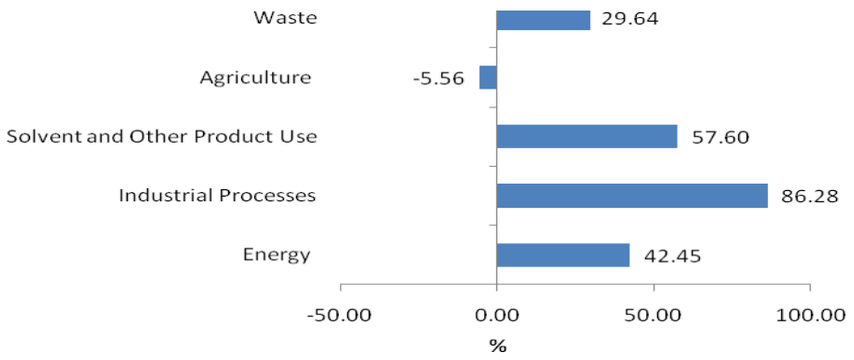

Figure 49. GHG emissions and removals in percentage, by sector (1990–2007)
Source: APA, 2009

In 2007 GHG emissions from Industrial Processes sectors, Agriculture and Waste represented about 11%, 9% and 9%, respectively. The Energy sector is responsible for the most significant share of emissions, representing about 70% of the emissions total in 2007, a 42.5% increase since 1990. This demonstrates the extent of Portugal's dependency on fossil fuels for power generation and, in particular, for transport, although, the situation seems to have changed in the most recent years, has it is possible to observe by the stagnation and decrease of these trends. The Solvent and Other Product Use sector represents only 1% of total emissions.

The sectors that increased emissions in last years were the Industrial Processes sector and the Solvent and Other Product Use sector. The Energy, Agriculture and Waste sectors registered a decrease in their emission. The LULUCF has been generally acting as a sink.

3 Policies and Measures and the Use of Kyoto Protocol's Mechanisms

The National Climate Change Programme (PNAC) is the main Portuguese strategic instrument for the compliance with GHG limitation commitments in the context of the Kyoto Protocol and the European Union Burden Sharing Agreement (that allows a 27% increase in GHG emissions by 2008-2012, relative to 1990).

Preparatory work for PNAC started in 2000 and since then that has been developed in close cooperation with stakeholders, in particular, economic agents of the relevant sectors and competent sectoral public administration departments. The first version - PNAC 2004 was approved by Council of Ministers Resolution no. 119/2004 of 31st July.

Afterwards, a new version - PNAC 2006, was approved by Council of Ministers' Resolution no. 104/2006 (August 23rd), containing a set of measures defined for the sectors of the economy with an impact on GHG emissions: Energy (demand and supply, including the sub-sectors Transport, Residential and Services, and Industry), Agriculture and Livestock, Forestry and Waste. Here, GHG emissions estimated and projected up to 2010 (and, were feasible, up to 2020), are systematised considering a reference scenario and a with additional measures scenario for the period 1990-2010 (assumed as the average year of the period 2008-2012).

The reference scenario under PNAC 2006 integrates policies and measures (MR) with an impact on GHG emissions reduction implemented or adopted by 1st January 2005 (including the activities of afforestation, reforestation and deforestation under art. 3(3) of the Kyoto Protocol). Additional policies and measures (MA) adopted or at the planning stage after that date, were considered in PNAC 2006 as additional measures including forest management, cropland management and grazing land management activities, under art. 3(4) of the Kyoto Protocol.

In 2007, PNAC has been reviewed with a new set of policies and measures (New 2007 Measures), approved through Council of Ministers' Resolution no. 1/2008 (January the 4th). Those refer mainly to the energy supply and to the use of biofuels.

The overall package of policies and measures defined in PNAC 2006 are expected to have an impact of about 7.00 Mt CO_2e. Including the new 2007 additional measures it will add up an evaluated emissions reduction potential of 1.56 Mt CO_2e/year.

The following tables provide a description of the sectoral policies and measures under implementation, adopted and planned for all sectors of activity with relevant contribution to the GEE emissions balance - BAU measures, including the new 2007 additional measures.

3.1 Policies and Measures in the Energy Sector

3.1.1 Energy Supply, Industry, Construction, Public Works and Others (including Residential and Services)

Table 27. Policies and Measures for the energy supply, industry, construction and public works and other (including residential and services) sub-sectors

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020**
MRe1. "E4, E-RES" Programme (replaced by MA2007e1)	Reduction of GHG emissions from electricity production through the increase in generation from renewable energy sources (meeting a 39% target of gross electricity consumption by 2010 with RES)	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for E-RES generation)	Implemented	MEID	280	[High Scenario] 1273 [Low Scenario] 893
MRe2 – (New) Expansion Plan of the electricity production system (replaced by MA2007e2	Operational start of new natural gas combined cycle power plants (NGCCP) (2160 MW in 2006 will now be 5360 MW in 2010)	CO_2 CH_4	Regulatory	Planned	MEID		NA
MRe3. Energy Efficiency in Buildings	Increase energy efficiency in buildings by about 40% through the adoption of new regulation(s) on acclimatisation and thermal behaviour of buildings, in substitution of present regulations	CO_2 CH_4 N_2O	Regulatory	Implemented	MEID	90	[High Scenario] 500 [Low Scenario] 331
MRe4. Solar Hot Water for Portugal Programme (AQSpP)	Promotion of domestic water heating by solar energy. Initial target of 1 million m^2 of solar panels installed by 2010 (around 150 000 m^2 per year) altered to sustaining in 2005 and 2006 the growth rate of past few years. An installation rate of 100 000 m^2/year is considered for the following years (2007-2020), with the entry into force in 2006 of new legislation	CO_2 CH_4 N_2O	Economic (tax incentives)	Implemented	MEID	101	High Scenario] 322 [Low Scenario] 312

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020**
MRe5. IPPC Directive (Integrated Prevention and Pollution Control)	The IPPC Directive was transposed to internal legislation by Decree-Law 194/2000, of 21 August.	CO_2 CH_4	Regulatory	Implemented	MAOT	No evaluation	
MAe1. Energy efficiency improvement in the electricity generation sector	Reduction of the rate of loss in the energy transport and distribution network to 8.6%[61] by 2010	CO_2 CH_4 N_2O	Regulatory	Implemented	MEID	146	[High Scenario] 217 [Low Scenario] 113
MAe2. Energy efficiency improvement in the energy supply systems, considering electricity generation from co-generation	Increase in electricity generated from co-generation systems, up to a share of 18% of the gross national consumption of in 2010.	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for co-generation)	Implemented	MEID	200	[High Scenario] 185 [Low Scenario] 103
MAe3. Improvement in energy efficiency from the electricity demand-side	Reduction of electricity consumption by about 1000 GWh by 2010	CO_2 CH_4 N_2O	Regulatory	Implemented	MEID	795	[High Scenario] 420 [Low Scenario] 340
MAe4. Promotion of electricity produced from renewable energy sources	Increase installed capacity of units of electricity generation from RES to yield up to 5100 MW of wind power	CO_2 CH_4 N_2O	Economic (investment subsidies and specific tariffs for E-RES generation)	Implemented	MEID	370	[High Scenario] 0 [Low Scenario] 0
MAe5. Introduction of natural gas in the Autonomous Region of Madeira	Substitution of the most polluting fuels and diversification of energy sources in the Autonomous Region of Madeira	CO_2 CH_4 N_2O	Regulatory	Planned	Regional Government Autonomous Region of Madeira	5	[High Scenario] ND [Low Scenario] ND
MAr1. Realignment of the tax burden on diesel fuel for heating (residential sub-sector)	Tax harmonization between diesel fuel for heating and for transport by 2014[62]	CO_2 CH_4 N_2O	Economic/ Fiscal	Implemented	MEID	14	[High Scenario] 54 [Low Scenario] 53
MAs1 Realignment	Tax harmonization between diesel fuel	CO_2 CH_4	Economic/ Fiscal	Implemented	MEID	59	[High Scenario]

[61] This measure impacts electricity on EU-ETS facilities.

[62] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system.

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020**
of the tax burden on diesel fuel for heating (services sub-sector)	for heating and for transport by 2014[63]	N_2O					330 [Low Scenario] 323
MAi1. Increase in tax on industrial fuels	Changing the fuel tax (ISP) on industrial fuels, so as to create an incentive structure for GHG emissions reduction[64]	CO_2 CH_4 N_2O	Economic/ Fiscal	Implemented	MEID	78	[High Scenario] 102 [Low Scenario] 93
MAi2. Review of the Regulation on the Management of Energy Consumption (RGCE)	Defining of a new RGCE that promotes energy efficiency in the industrial sector through voluntary agreements[65]	CO_2 CH_4 N_2O	Voluntary Agreement Regulatory	Implemented	MEID	32	[High Scenario] 60 [Low Scenario] 54
MAi3. Incentives to the substitution of fuel oil co-generation by natural gas generation	Reduction or phasing-out of the tariff for co-generation using fuel oil[66]	CO_2 CH_4 N_2O	Economic	Implemented	MEID	189	[High Scenario] 196 [Low Scenario] 196
MA2007e1 – replacing MRe1	Renewable energy: increase to 45% the goal of electricity generation in 2010 by renewable sources (previously of 39%)[67]	CO_2	Economic (investment subsidies and specific tariffs for E-RES generation)	Planned	MEID	458*	NA
MA2007e2 – replacing MRe2	Operational start of new natural gas combined cycle power plants (NGCCP) (2160 MW in 2006 will now be 5360 MW in 2010)[68] MA2007e2/scenario 1 – use rate of an average 37% in the 2008-2012 period for all (existing and new) NGCCP plants MA2007e2/scenario 2 - use rate of an average 40% in 2008-2012 period for all (existing and	CO_2	Regulatory	Planned	MEID	[MA2007e2/ scenario 1] 114* [MA2007e2/ scenario 2] -155*	NA

[63] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system.

[64] This measure has impact on EU-ETS facilities

[65] The reduction potential includes the indirect effect of the increase in emissions in the electricity generation system

[66] This measure has impact on EU-ETS facilities.

[67] This measure has impact on EU-ETS facilities

[68] This measure has impact on EU-ETS facilities

Designation of P&M	Objective and/or affected activity	GHG	Type of Instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020**
	new) NGCCP plants						
MA2007e3 – (new)	Co-combustion of biomass: 5% to 10% substitution of the coal in Sines and Pego thermic power plants by biomass or Waste Derived Fuel.[69] MA2007e3/scenario 5% MA2007e3/scenario 10%	CO_2	Regulatory	Planned	MEID	[MA2007e3/ scenario 5%] 380* [MA2007e3/ scenario 10%] 761*	NA

NA – Not available
* - this amount is additional to the replaced measure
** Expected annual emission reductions for 2020 values correspond to a high and a low economic growth scenario evaluated in PNAC 2006

[69] This measure has impact on EU-ETS facilities

3.1.2 Transport sector

Table 28. Policies and measures for the transport sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
MRt1. Auto-Oil Program: Monitoring of the Agreement with Atomobile Manufacturers Associations	Reduction of the carbon intensity of light passenger vehicles transport, with increasingly restrictive consumption (and CO_2 emissions) standards, to reach the 120 g CO_2e/km target by 2010	CO_2 CH_4 N_2O	Voluntary Agreement	Implemented	MFAP MAI	175	NA
MRt2. Expansion of the Lisbon Metro (ML)- extension of the Blue Line; extension of the Yellow Line; Red Line	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, through the expansion of the Lisbon Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Implemented	MOPTC	14.8	NA
MRt3. Construction of the Metro Sul do Tejo	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, by the construction of a new light metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Implemented	MOPTC	13	NA
MRt4. Construction of the Oporto Metro (MP)	Promotion of modal transfer, and consequent reduction in carbon intensity of the entire transport sector, through the construction of the Oporto Metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Implemented	MOPTC	30.4	NA
MRt5. Construction of the Metro Ligeiro do Mondego (MLM)	Promotion of modal transfer, and consequent reduction in carbon intensity of the global transport activity through the construction of a light metro network	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Planned	MOPTC	NA	NA
MRt6. Improve services provided by CP (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco; Lisbon-Algarve	Promotion of modal transfer, and consequent reduction in carbon intensity of the global transport activity through supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco and Lisbon-Algarve, and consequent increase in the competitiveness of the railway system	CO_2 CH_4 N_2O	Economic (increase in the supply of public transport)	Planned	MOPTC	78	NA
MRt7.	Reduction of carbon	CO_2	Economic	Implemented	MOPTC	1.2	NA

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
Enlargement of the fleet of vehicles powered by natural gas of CARRIS and of the STCP	intensity of heavy passenger vehicle transport, through the enlargement of the fleet of public vehicles powered by natural gas (of CARRIS and of the STCP), and the substitution of diesel-powered vehicles	CH_4 N_2O	(promotion of the investment in vehicles powered by natural gas)				
MRt8. Incentive Programme for the dismantling of End-of-Life Vehicles	Promotion of the renovation of the car stock, in order to reduce carbon intensity of light passenger vehicles, through the provision of monetary incentives for the substitution of end-of-life vehicles. 4200 vehicles over 10 years old are expected to be decommissioned annually from 2005	CO_2 CH_4 N_2O	Economic (monetary incentives for the acquisition of new vehicles)	Implemented	MAI	2.9	NA
MRt9. Reduction of interurban motorway speeds	Promotion of the reduction of speeds and consequent reduction of the carbon intensity of road transport by lowering the average motorway speed by about 6 km/h, comparatively to year 2000 in the frame of an accident prevention programme	CO_2 CH_4 N_2O	Regulatory/ Information	Implemented	MAI	0.6	NA
MRt10. Biofuels Directive **(Replaced by MA2007t1)**	Reduction in the consumption of fuels responsible for the emission of GHG through the promotion of the use of biofuels in the transport sub-sector (2%-2005; 5.75%-2010)	CO_2 CH_4 N_2O	Regulatory and Economic (concession of subsidies to investment and proper tariffs for biofuels)	Adopted	MEID	1149	NA
MAt1. Reduction of Taxis´ service days	Reducing the number of service days to a maximum of 6 days per week	CO_2 CH_4 N_2O	Regulatory	Planned	MOPTC	3.9	NA
MAt2. Enlargement of the fleet of taxi vehicles powered by natural gas	Promotes the shift to natural gas in 200 vehicles	CO_2 CH_4 N_2O	Economic (promotion of investment in natural gas-powered vehicles)	Planned	MOPTC	0.2	NA
MAt3. Review of	Energy efficiency	CO_2	Economic	Implemented	MOPTC	7.7	NA

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
the current tax regime on private vehicles	improvements of the car stock through the revision of the present taxation regime on private vehicles, so that CO_2 emissions are factored in the calculation of the tax (representing at least 60% of the total value of the tax from 2008)[70]	CH_4 N_2O	and Tax		MFAP		
MAt4. Metropolitan Authority of Lisbon Transports	Modal transfer of 5% (pkm/pkm) by 2010	CO_2 CH_4 N_2O	Regulatory and Economic (change in the supply of public transport)	Planned	MOPTC	245.4	NA
MAt5. Metropolitan Authority of Oporto Transports	Modal transfer of 5% (pkm/pkm) by 2010	CO_2 CH_4 N_2O	Regulatory and Economic (change in the supply of public transport)	Planned	MOPTC	101.5	NA
MAt6. Incentive Programme for the dismantling of End-of-Life Vehicles (further objectives)	Extra 500 vehicles decommissioned annually relative to the 4200 considered in measure MRt8	CO_2 CH_4 N_2O	Economic (monetary incentive for the acquisition of new vehicles)	Implemented	MAI	0.4	NA
MAt7. Regulation on Energy Management in the Transport Sector	5% reduction of the consumption factor of freight transport	CO_2 CH_4 N_2O	Regulatory	Planned	MOPTC	18.1	NA
MAt8. Railway connection to Aveiro Sea Port	Transfer of 1553 kt of freight to maritime transport, yearly, from 2007	CO_2 CH_4 N_2O	Economic (change in the supply of freight transport)	Implemented	MOPTC	40	NA
MAt9. Motorways of the Sea	Transfer of 20% of international road freight traffic to maritime transport	CO_2 CH_4 N_2O	Economic (change in the supply of freight transport)	Implemented	MOPTC	150	NA
MAt10. Logistical Platforms	Development of the National Logistics System	ND	Economic	Planned	MOPTC	Under evaluation	NA
MAt11. Restructuring of supply of CP (national railway) service	Renovation of trains and changes at the supply level (schedules and frequency of services, new connections/services,	CO_2 CH_4 N_2O	Economic	Implemented	MOPTC	44.4	NA

[70] The impact of this instrument is considered under the full compliance with the Auto-Oil Programme.

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
	etc.) so as to capture $261x10^6$ tkm of the road transport mode.						
MA2007t1 replacing MRt10. Biofuels Directive	Biofuels Directive– increase of the 5.75% goal to 10% in 2010 regarding biofuels incorporation tax in the road fuels	CO_2	Economic (concession of subsidies to investment and proper tariffs for biofuels)	Adopted	MEID	655*	NA

NA – Not available
* - this amount is additional to the replaced measure

3.2 Policies and Measures for the Agriculture and Livestock Sector

Table 29. Policies and measures for the agriculture and livestock sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
MRg1. IPPC Directive (Integrated Prevention and Pollution Control)	Implementation of the IPPC Directive	-	Regulatory	Implemented	-	No Evaluation	NA
MAg1. Evaluation and promotion of carbon sequestration in agricultural soil	Adoption of cropland management and grazing land management activities, under the Art. 3(4) of the Kyoto Protocol	CO_2	Economic	Implemented	MADRP	500	NA
MAg2. Treatment and energy recovery of livestock waste	Reduction in methane emissions resulting from manure management through the conversion of medium and large manure management systems (headcount over 1000) to anaerobic biodigestors with energy recovery 945 000 heads associated to the Liz, Oeste, Algarve, Setubal e Rio Maior systems	CH_4 N_2O	Economic (Promotion of investment in waste-to-energy recovery systems)	Planned	MADRP MAOT	429	507

3.3 Policies and Measures for the Forestry Sector

Table 30. Policies and measures for the forestry sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
MRf1. Programme for the Sustainable Development of Portuguese Forests (in the context of IIIFSP)	Promote the sustained increase in forested area, through financial support and incentives to new tree plantations	CO_2	Economic (financial support and incentives to the establishment of new tree plantations)	Implemented	MADRP	3743	4300
MAf1. Promotion of carbon sink capacity of forests	Increase in the carbon sink capacity of Portuguese forests, through the improvement of forestry management (forest stands in place on the 1st of January 1990).	CO_2	Economic	Adopted	MADRP	800	NA

3.4 Policies and Measures for the Waste Management Sector

Table 31. Policies and measures for the waste management sector

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
MRr1. Directive on Packaging and Packaging Waste	Decree-Law 366-A/97, of 20 December, transposed the EC Directives that manage the flow of packaging and related waste (Directive 94/62/CE of the European Parliament and Council, of 20 December, altered by Directive 2004/12/CE of the European Parliament and Council, of 11 February) imposing recovery and recycling objectives for packaging waste. The following targets, to be met by the 31st December 2011, were defined: - recovery: of at least 60% of waste - Recycling: Overall: 55-80% Glass: 60% Paper: 60% Metals: 50% Plastics: 22,5% Wood: 15%	CO_2 CH_4 N_2O	Economic	Implemented	MAOT	900	NA
MRr2. Landfill Directive	Decree-Law n.º 183/2009, of 10 August, which replaced the Decree-Law 152/2002, of 23 May, transposed Directive 1999/31/CE of the Council, of 26 April, on the disposal of waste to landfills, establishes the need to define a national strategy to reduce biodegradable municipal waste (BMW) destined to landfills. Maximum percentage of BMW disposed in landfills in relation to the BMW production in 1995 (targets): 2006 (75%) 2013 (50%) 2020 (35%)	CH_4	Economic	Implemented	MAOT	363	NA
MRr3. IPPC Directive (Integrated Prevention and Pollution Control)	The IPPC Directive was transposed to internal legislation by Decree-Law 194/2000, of 21 August. Waste Management (Category 5) includes a set of activities of Annex I of DL 194/2000. Improvement of environmental performance of facilities covered with regard to: discharges to the atmosphere, water and soil; waste production; use of raw materials, energy efficiency, noise, risk prevention and management, among others (Time Horizon: 2007-2010)	CO_2 CH_4	Regulatory	Implemented	MAOT	The Environmental Licences for waste management facilities (Category 5) already issued in the context of IPPC, in particular for atmospheric emissions control, do not specify any level of environmental	

Designation of P&M	Objective and/or affected activity	GHG	Type of instrument	Implementation Status	Implementing Bodies	Expected annual average GHG reduction (kt CO_2e/year)	
						2010	2020
						performance to be fulfilled, but rather impose the periodic monitoring of emissions As such, the IPPC Licensing, as defined to date, is a rather ineffective instrument for GHG reduction. However, the information collected (quantities and composition of waste, atmospheric emissions, etc.) will allow for future monitoring of the reference scenario defined for the waste sector	

Greenhouse emissions estimated and projected up to 2010 (and, were feasible, up to 2020), are systematised in PNAC 2006 considering a reference scenario and a with additional measures scenario for the period 1990-2010 (assumed as the average year of the period 2008-2012). The underlining parameters of the projections are indicated in the Portuguese Report under Article 3(2) of Decision no. 280/2004/EC Concerning a Mechanism for Monitoring Community Greenhouse Gas Emissions and for Implementing the Kyoto Protocol (APA, 2009).

3.5 The New 2007 Measures

As referred earlier, PNAC 2006 has been reviewed with a new set of policies and measures, through Council of Ministers' Resolution no. 1/2008 (January the 4th). Those refer mainly to the energy supply and to the use of biofuels, including an additional package of climate measures that have been adopted in order to further strengthen Portugal's commitments on key areas such as energy (supply and demand) and transport. These measures are better described here.

1 MA2007e1: Renewable Energies – increase to 45% the goal of electricity generation in 2010 by renewable sources (previously 39%)

1.1 Wind Energy

Increase of the installed capacity goal in 1.950 MW, in 2012. New total of 5 100 MW with a 600 MW increase by equipment upgrading.

1.2 Hydro Energy

Increase of the hydro potential through the reinforcement of the Picote, Bemposta and Alqueva dams production capacity: 575 MW increase in order to totalize 5575 MW of installed capacity in 2010 (National Dam Plan).

1.3 Biomass

Increase in 100MW the installed capacity goal (67% higher). Decentralized biomass power plant grid with 250MW of capacity.

1.4 Solar Energy

Ensure good articulation with micro generation goals and politics.

1.5 Wave Energy

Increase of the installed capacity in 200 MW: exploring potential up to 250 MW in experimental projects in pilot area of S. Pedro de Moel.

1.6 Biogas

Establish a goal of 100 MW of installed capacity in anaerobic waste treatment units (currently of 20 MW in 15 units).

1.7 Micro generation

Program to install 50.000 systems until 2010, with incentives to hot solar water in already built houses.

2 MA2007e2: Operational start of new natural gas combined cycle power plants (2160 MW in 2006 will now be 5360 MW in 2010)

2.1 Decommissioning

2008 – 400 MW (about) 2 groups of old Carregado power plant, and of groups 3 and 4 of Tunes Power Plant

2010: Shut down of the fuel Barreiro power plant, and zero operational labour of the remaining fuel power plants.

After 2010 – Shutdown of all remaining fuel oil power plants

2.2 MA2007e3: 5% to 10% substitution of the coal in Sines and Pego thermic power plants by biomass or Waste Resultant Fuel.

3 MA2007t1: Biofuels – increase of the 5.75% goal to 10% in 2010

Source: Council of Ministers' Resolution no. 1/2008 (January the 4th)

Three of the referred measures (MA2007e1 to MA2007e3 and MA2007t1) will modify the additional measures MRe1, MRe2 andMRt10 of the PNAC2006.

The expected avoided GHG emissions of these four new additional measures taken as a whole that are now supplementary to "PNAC 2006 with additional measures" are:

Table 32. New additional avoided emissions with measures MA2007e1 – MA2007e3 and MA2007t1

Expected Avoided Emissions to PNAC 2006 WMA	2008	2009	2010	2011	2012	Annual Average
MA2007e1, MA2007e2 and MA2007e3 (kt CO_2e)	1417	658	199	724	1507	901
MA2007t1 (kt CO_2e)	314	160	919	934	948	655
Total	**1731**	**818**	**1118**	**1658**	**2455**	**1556**

Source: Council of Ministers' Resolution No. 1/2008 (January the 4th).

Regarding the impact in the fulfilment of the Kyoto Protocol the New 2007 Measures, Council of Ministers' Resolution no. 1/2008 (January the 4th), states that it will be expected to induce another 4% of emissions reduction in the energy supply sector when comparing to the PNAC 2006 with additional measures, and 3% more in the transports sector.

According to this Resolution, globally the additional 2007 Measures reduce the GHG emissions in 2% of the total net emissions, when comparing to the reductions achieved in the PNAC2006 with additional measures.

So, given that the estimated net emissions in the PNAC 2006, including additional measures, placed Portugal 5% above its assigned amount, the emissions reduction potential of the New 2007 Measures, evaluated in 1.556 Mt CO_2e/year, will contribute to the convergence, although it remains 4% above it. The emissions deficit will now amount to 2.977 Mt CO_2e/year.

3.6 Cross-Cutting and Community Policies and Measures

Cross-cutting P&M adopted by Portugal include the European Union Emissions Trading System (EU-ETS), the Green Public Procurement System already approved by Council of Ministers and the Fluorinated Gases Regulation.

The EU-ETS was established by Directive 2003/87/EC of the European Parliament and of the Council, of 13th October, and transposed to national legislation by Decree-Law 233/2004, of 14th December, which was later changed by Decrees-law no. 243-A/2004, December the 31st, 230/2005, 29th of December and no. 72/2006, 24th of March.

The Council of Ministers Resolution no. 53/2005, March the 3rd, approved the National Allocation Plan (PNALE I) for the period from 2005 to 2007 and also allows EU-ETS operators to use emission credits generated through eligible project activities under the Kyoto Protocol according to the Linking Directive[71]. The total amount of emissions allowances awarded to Portugal in the 2005-2007 period[72] was of 114.48 Mt CO_2 or 38.16 Mt CO_2/year (representing

[71] Directive 2004/101/EC of the European Parliament and of the Council, of 27th of October.

[72] Considering the Comission Decision on the 2nd of March of 2007 regarding to the corrections to PNALE I notified by Portugal in the 16th of January of 2007

approximately 47% of national emissions), of which 36.91 Mt CO_2/year corresponds to the 244 installations listed in PNALE I, and the remainder 1.25 Mt CO_2/year was set aside as a reserve for new entrants. However at the end of this period the allowances awarded were in fact 113.58 Mt CO_2, from which 2.90 Mt CO_2 corresponded to the reserve for new entrants. The verified emissions represented 88.7 % of the total above mentioned allowances awarded.

The Council of Ministers' Resolution No. 1/2008 of 14th of January approved the National Allocation Plan for the period 2008-2012 (PNALE II) and provides an update on GHG allocation information on a sectoral basis which activities are established in Annex I of the Directive 2003/87/EC, namely: electricity generating sector, refineries, co-generation, cement and lime, ceramics, glass, pulp & paper, ferrous metal and combustion installations.

The total amount awarded has a cap of 34.81 Mt CO_2/year, 9% below the previous period. From the total amount, 30.50 Mt CO_2/year corresponds to existing installations listed in PNALE II, and the remainder 4.30 Mt CO_2/year is set aside as a reserve for new entrants. The unused amount of the reserve will be cancelled. In 2008 the verified emissions were 29.91 Mt CO_2 representing 98.5%of the total of allowances awarded in this year

The EC Regulation no. 842/2006 on the 17th of May, regarding certain fluorinated GHG has the purpose to contain, prevent and thereby reduce emissions of the fluorinated greenhouse gases covered by the Kyoto Protocol. The national legislation is being elaborated.

The National Green Public Procurement Strategy was established by Council of Ministers' Resolution no. 65/2007 following Product Integrated Policy Communication COM (2003) 302 final of the European Parliament. This Strategy defines priority products and services, on which, public entities shall begin to address a green public policy. For that APA has developed ecological criteria to be taken into account. This strategy for 2008-2012 shall be implemented and monitored by the National Agency for public Procurement (ANCP) in close articulation with APA.

Next, there's a list of the current Common and Coordinated Policies and Measures and its relation with Portugal's Policies and Measures.

Table 33. Common and Coordinated Policies and Measures (CCPM) and corresponding Policies and measures

Sector	Common and Coordinated Policies and Measures (CCPM)	Policies and Measures
Cross Cutting	Integrated pollution prevention and control (IPCC) (Dir 96/61/EC)	▪ MRe5. IPPC Directive (Integrated Prevention and Pollution Control) ▪ MRg1. IPPC Directive (Integrated Prevention and Pollution Control) ▪ MRr3. IPPC Directive (Integrated Prevention and Pollution Control)
	Emissions trading scheme (Dir 2003/87/EC)	▪ 0.09 Mt CO_2e/y
	Kyoto Protocol project mechanisms (Dir 2004/101/EC)	▪ 24.1 Mt CO_2e
Energy (supply side)	Electricity production from renewable energy sources (Dir 2001/77/EC)	▪ MRe1. "E4, E-RES" Programme ▪ MRe4. Solar Hot Water for Portugal Programme (AQSpP) ▪ MAe1. Energy efficiency improvement in the electricity generation sector ▪ MAe4. Promotion of electricity produced from renewable energy sources ▪ MA2007e1 – Renewable energy: increase to 45% the goal of electricity generation in 2010 by renewable sources (previously of 39%)
	Promotion of cogeneration (Dir 2004/8/EC)	▪ MAe2. Energy efficiency improvement in the energy supply systems, considering electricity generation from co-generation
	Internal market in natural gas (Dir 98/30/EC)	▪ MAe5. Introduction of natural gas in the Autonomous Region of Madeira ▪ MAi3. Incentives to the substitution of fuel oil co-generation by natural gas generation ▪ MRe2 – (New) Expansion Plan of the electricity production system (without changes from MA2007e2)

Sector	Common and Coordinated Policies and Measures (CCPM)	Policies and Measures
		▪ MA2007e2 – Operational start of new natural gas combined cycle power plants (NGCCP) (2160 MW in 2006 will now be 5360 MW in 2010)
	Taxation of energy products and electricity (Dir 2003/96/EC)	▪ MAr1. Realignment of the tax burden on diesel fuel for heating (residential sub-sector) ▪ MAs1 Realignment of the tax burden on diesel fuel for heating (services sub-sector) ▪ MAi1. Increase in the tax on industrial fuels
	Internal electricity market (Dir 2003/54/EC)	▪ No estimation available for this CCPM
	emissions from large combustion plants (Dir 88/609/EEC)	▪ No estimation available for this CCPM
Energy (Consumption side)	Energy performance of buildings (Dir 2002/91/EC)	▪ MRe3. Energy Efficiency in Buildings
	End-use efficiency and energy services (Dir 2006/32/EC)	▪ MAe3. Improvement in energy efficiency from the electricity demand-side
	Ecodesign requirements for energy-using products (Dir 2005/32/EC)	▪ No estimation available for this CCPM
	Efficiency requirements for new hot-water boilers (Dir 92/42/EEC)	▪ No estimation available for this CCPM
	Motor challenge programme	▪ No estimation available for this CCPM
	Eco-management and audit scheme (EMAS) (Reg No 761/2001)	▪ No estimation available for this CCPM
	Energy labelling of household appliances (Dir 2003/66/EC (refrigerators - freezers), 2002/40/EC (electric ovens), 2002/31/EC (air-conditioners), 99/9/EC (dishwashers), 98/11/EC (lamps), 96/89/EC (washing machines), 96/60/EC (washer-driers) and 92/75/EC	▪ No estimation available for this CCPM
	energy-efficiency labelling for office equipment (Reg no. 2422/2001)	▪ No estimation available for this CCPM
	Efficiency fluorescent lighting (Dir 2000/55/EC)	▪ No estimation available for this CCPM
Transports	Voluntary agreement with car manufacturers to reduce specific CO_2 emissions (ACEA, KAMA, JAMA)	▪ MRt1. Auto-Oil Program: Monitoring of the Agreement with Atomobile Manufacturers Associations
	Towards a rail network giving priority to freight" COM(2007)608	▪ MAt8. Railway connection to Aveiro Sea Port ▪ MAt11. Restructuring of CP (national railway) supply service
	TEN-T Guidelines" COM(2004)0884	▪ MAt9. Motorways of the Sea
	Freight Transport Logistics Action Plan COM(2007)607	▪ MAt10. Logistical Platforms
	Internal market in natural gas (Dir 98/30/EC)	▪ MRt7. Amplification of the fleet of vehicles powered by natural gas of CARRIS and of the STCP ▪ MAt2. Amplification of the fleet of taxi vehicles powered by natural gas
	Shifting the balance between modes of TRA:, in particular towards rail (2001/12/EC, 2001/13/EC, 2001/14/EC of 15/03/01 Regulation 881/2004 of 29/04/2004, 2001/49/EC, 2001/50/EC, 2001/51/EC of 29/04/2004)	▪ MRt2. Expansion of the Lisbon Metro (ML)- extension of the Blue Line; extension of the Yellow Line; Red Line ▪ MRt3. Construction of the Metro Sul do Tejo (MST) ▪ MRt4. Construction of the Oporto Metro (MP) ▪ MRt5. Construction of the Mondego Light Metro (MLM) ▪ MRt6. Supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco; Lisbon-Algarve ▪ MAt11. Restructuring of CP (national railway) supply service
	Biofuels Directive (Dir 2003/30/EC)	▪ MRt10. Biofuels Directive (applied to the transport sector) ▪ MA2007t1 - Biofuels Directive– increase of the 5.75% goal to 10% in 2010 regarding biofuels incorporation tax in the road fuels
	Labelling of new passenger cars (Dir 1999/94/EC)	▪ No estimation available for this CCPM
	Integrated European railway area (2nd + 3rd Railway package) (COM(2002)18 final)	▪ MRt6. Supply changes (reduction in travel time) between Lisbon-Oporto; Lisbon-Castelo Branco; Lisbon-Algarve ▪ MAt8. Railway connection to Aveiro Sea Port ▪ MAt11. Restructuring of CP (national railway) supply service

Sector	Common and Coordinated Policies and Measures (CCPM)	Policies and Measures
	Environmental performance freight transport (Marco Polo Programme)	▪ MAt9. Motorways of the Sea
Industrial Processes	**HFC emissions from air conditioning in motor vehicles (Dir 2006/40/EC)**	▪ No estimation available for this CCPM
Agriculture	Support for rural development (Reg (EC) No 1783/2003 amending a number of other Regulations)	▪ MAg1. Evaluation and promotion of carbon sequestration in agricultural soil ▪ MAg2. Treatment and energy recovery of livestock waste ▪ MAf1. Promotion of forests carbon sink capacity
	Nitrates Directive (Dir 91/676/EEC)	▪ No estimation available for this CCPM
	Common rules for direct support schemes under CAP (Regulation (EC) No 1782/2003)	▪ No estimation available for this CCPM
	Transition to rural development support (Reg (EC) No 2603/1999)	▪ No estimation available for this CCPM
	Agricultural production methods compatible with environment (Reg (EEC) No 2078/92)	▪ No estimation available for this CCPM
	Aid scheme for forestry measures in agriculture (Reg (EEC) No 2080/92)	▪ No estimation available for this CCPM
	Emission by engines to power agricultural or forestry (Dir 2000/25/EC)	▪ No estimation available for this CCPM
	Pre-accession measures for agriculture and rural development (Reg (EC) No 1268/1999)	▪ No estimation available for this CCPM
Waste	Packaging and packaging waste (Dir 94/62/EC, 2004/12/EC, 2005/20/EC)	▪ MRr1. Packaging and Packaging Waste Directive
	Landfill Directive (Dir 1999/31/EC)	▪ MRr2. Landfill Directive

Next, there's a list of the current Policies and Measures which aren't related to the Common and Coordinated Policies and Measures.

Table 34. Policies and measures which aren't related to the Common and Coordinated Policies and Measures (CCPM)

Policies and Measures
MAi2. Review of the Regulation on the Management of Energy Consumption (RGCE)
MRt8. Dismantling of End-of-Life Vehicles Incentive Programme
MRt9. Reduction of motorway speeds
MAt1. Reduction of Taxis´ service days
MAt3. Review of the current tax regime on private vehicles to improve energy efficiency on the new automobile national fleet
MAt6. Incentive Programme for the dismantling of End-of-Life Vehicles (further objectives)
MAt7. Regulation on Energy Management in the Transport Sector
MRf1. Programme for the Sustainable Development of Portuguese Forests (in the context of IIIFSP)
MA2007e3 – Co-combustion of biomass: 5% to 10% substitution of the coal in Sines and Pego thermic power plants by biomass or Waste Derived Fuel.

3.7 Domestic Action and the Use of the Kyoto Mechanisms

In order to meet the emissions' target defined in the context of the Kyoto Protocol and the EU Burden Sharing Agreement Portugal has been focused on implementing policies and measures in GHG sources and in sinks, domestically making use of the Kyoto Protocol market mechanisms in a supplementary way.

This demonstrates Portugal's effort in fully exploring the potential of emissions reduction, through a broad range of policies and measures, and by using market mechanisms as a tool to ensure an overall benefit in the most cost-effective manner, as foreseen under the Kyoto Protocol.

Portugal intends to use all of the Kyoto Mechanisms. To that effect Government entrusted the Climate Change Commission to act as the Designated National Authority (DNA) for the flexibility mechanisms, and created the Portuguese Carbon Fund to acquire credits from those mechanisms. All relevant legal provisions are already in place and the Fund is fully operational.

Following the analysis of the National Climate Change Programme 2006, the new 2007 targets and the NAP 2008-2012, the final Kyoto deficit to be offset by the Portuguese Carbon Fund was estimated at 2.88 Mt CO2e/year, according to the Council Ministers Resolution n.º 1/2008. However, taking into account a conservative estimate of Portugal's emissions until 2012, in result of the implementation of Cumprirquioto.pt system the estimated deficit is set at 19.1 Mt CO2e for the compliance period. Therefore the current planned investment target of PCF is set at 22.2 Mt CO2e, in order to address the higher deficit estimate and the risks associated to this estimate. The PCF has committed 125 M € worth of investments namely 29 M€ fully disbursed in Luso Carbon Fund (Banif Asset Management), 11.70 M€ in Carbon Fund for Europe (World Bank/European Investment Bank), 10.23 M€ in Asia Pacific Carbon Fund (Asian Development Bank) and 22.80 M€ in NatCAP (Natsource). With the investments in funds, FPC expects to acquire 6.50 Mt of emission reductions (CER, ERU and AAUs). This investment also includes the purchased 4.00 Mt of AAUs and 0.28 Mt CER in the secondary market.

More information on the use of mechanisms under articles 6, 12 and 17 of the Kyoto Protocol in chapter 6.

3.8 Monitoring of Policies and Measures

Since the beginning of 2008, and for the first time, reflecting the great effort put by the Portuguese Government to assess its path towards compliance, it has been put in place a monitoring system for the current policies and measures of PNAC.

Accordingly to the periodic monitoring of PNAC (every semester), the internal measures are not fully complying with the expected reduction. This decrease in the effectiveness has been acknowledged by the responsible entities that meanwhile have started working in contingency plans to evaluate the existing measures and other in a cost-effective way.

Council of Minister's Resolution no. 104/2006 – PNAC 2006, determines the elaboration of Action Plans for the policies and measures considered to be performed by the Ministries that have proposed them. It also imposes monitoring of those every semester.

This monitoring has been performed based on the progress reports submitted by the Ministerial focal points but some ameliorations were put in place and currently an online information system for the assessment of Kyoto's Compliance is available. This system – CumprirQuioto.pt - includes the monitoring of PNAC's policies and measures.

This allows inferring automatically possible deviations from the expected effectiveness of PNAC's policies and measures (Figure 50).

Figure 50. Example of of of the results of the Cumprirquioto.pt.

The system integrates one tool linked to a database to calculate national performance indicators to determine the trend towards Kyoto's compliance and assess potential deviations from the achievement of the national targets.

The estimations provided by the system shall be interpreted as indicators to support planning and decision making allowing the adjustment of the national Policies and Measures in a timely manner.

The system considers the following instruments:

- Policies and Measures (P&M): PNAC monitoring and the evaluation of its execution
- Portuguese Carbon Fund (PCF): financial execution and its participation in the Carbon market through the acquisition of reduction units
- Kyoto's compliance: national GHG emissions, including those arising from installations included in EU-ETS (with performance indicators)

- National indicators: PNAC, PFC and Kyoto's compliance.

3.8.1 P&M

This component includes the monitoring of the effectiveness of the PNAC and has been developed with the various focal points responsible by the implementation of the P&M, which proposed entry data and validated the algorithms.

The sectoral focal points are responsible for the upload of the performance data, its timeliness, quality and accuracy. The focal points can also upload any reference documentations found pertinent for the effect.

The outputs of this component are the degree of execution (%) and the environmental effectiveness (Mt CO_2e) concerning any P&M.

3.8.2 PCF

This component integrates the degree of financial execution and its participation in the Carbon market through the acquisition of reduction units, namely Certified Emission Reductions (CERs), Emission Reduction Units (ERUs) and Assigned Amount Units (AAUs), as Mt CO_2e.

The information concerning the acquisition of reduction units are reported though the compromises assumed by the PCF, namely its participation in Carbon Funds and GHG emission reduction projects.

3.8.3 Kyoto's compliance

This component integrates the relevant variables to assess the compliance status:

Indication of the Assigned Amount (76.39 Mt CO_2e/year)

Estimation of the national GHG emissions

The contribution arising from PCF.

The GHG emissions estimates to 2008-2012 includes the effects of PNAC and PNALE and is based on the most recent assessment made by the National Greenhouse Gas Inventory (APA, 2009), considering the time series from 1990 to 2007. From this data, GHG emissions' trends are inferred and applied to the next time period. This information is complemented by 2008 energy's and transports' statistics as well as the EU-ETS verifications results.

To calculate GHG emission estimates the following was considered:

EU-ETS emission for 2008-2012: represented by the 2008-2012 NAP II allocation, including the new entrants reserves (34.8 Mt CO_2e/year)

Non EU-ETS industry, energy and other processes: the same trend observed in EU-ETS for 2007/2008 is applied to 2008, applied to the 2007 GHG emissions obtained from INERPA. In what concerns 2009, a small contraction of the economic activity was assumed, similar to the one registered in 2008. For 2010-2012, the forecast is based on the trend for the period 2005 -2007.

Transport: according to the national inventory data, this sector has been slightly decreasing since 2002, which is assumed as the trend for the next years. 2008 forecast is based on data on fuel consumption available from DGEG and for 2009 – 2012 the rate is the same as the one observed in 2000 – 2012 period, adjusted by the degree of biofuels incorporation.

Other activities (e.g. agriculture and waste): GHG emissions from these sectors have been stable since 2000, slightly decreasing since 2005. The forecasts are based on the 2000 – 2007 verified trends.

Cropland Management: the data was obtained by input of the Ministry of Agriculture related to the MAg1 – Promotion of Carbon Sequestration in Cropland Soils.

New Forest and Forest Management: the data was obtained by input of the Ministry of Agriculture related to the MRf1 – Sustainable Development of the Portuguese Forest and MAf1 – Promotion of Carbon Sequestration in Forest Land.

Finally, the national GHG estimates are compared with the Assigned Amount and the differential is obtained. This result allows inferring the indicator Kyoto compliance.

3.8.4 Monitored effectiveness of PNAC 2006 Policies and Measures

In the energy sector, the measures concerning the production of electricity from RES have being performing satisfactorily (MA2007e1 – production of 45%). Also to refer is the publication of the regulatory document concerning the Intensive Energy Consumers that materializes the MAi2 – revision of the Regulatory Framework for Energy Consumption (RGCE).

Also, with the publication of the National Action Plan for Energy Efficiency (Council of Minister's Resolution no. 80/2008, the 20th of May) promotes the effectiveness of MAe3 – Efficiency in the Consumption.

However, some measures are not performing as initially expected and other are not being closely monitored, namely:

MRe4: not performing as expected
MRe5: not implemented yet and no effect during the first commitment period whatsoever is expected
MAi3: significantly late in implementation.

In the transport sector, some measures are having higher performances, such has the MAt3 (rate on the CO2 from vehicles in the Tax on Vehicles) and MAt6 – Incentive Programme for the dismantling of End-of-Life Vehicles. This also applies to MRt1 – the voluntary agreement with the manufacturers (ACEAC; JAMA; KAMA) and to the acquisition of buses using natural gas by CARRIS and STCP. On the other hand, measures that are not performing as expected or with no information (ni), include MRt3 and MRt5 (construction of the South Tagus' and Mondego's Metro), MAt2 (taxis using natural gas), MAt4 and MAt5 (Lisbon's and Oporto's Metropolitan Authorities for the Transports), MAt7 (regulatory framework for energy management in transports; MAt9 (Motorways of the Sea), MAt10 (logistics platforms) and MRt10 (biofuels in transports).

Considering agriculture, the promotion of the sink capacity of the soils has been performing as expected (MAg1) and the valorisation of agricultural wastes is not (MAg2).

In forestry, the information made available is being assessed to evaluate the status of implementation of the policies and measures for the sector.

3.9 Portugal's performance towards Kyoto

The main instruments to fulfil Portugal obligations under Climate Change are the National Climate Change Programme (PNAC 2006 and New 2007 Measures), the ETS - National Allocation Plan 2008-2012 (PNALE II) and the Portuguese Carbon Fund.

Greenhouse gases emission inventories are essential to control national emissions. In 2007 (Portugal's GHG inventory, 2009) the total emissions of GHG were estimated to be 81.80 Mt CO_2e (without LULUCF), 7% above Kyoto target.

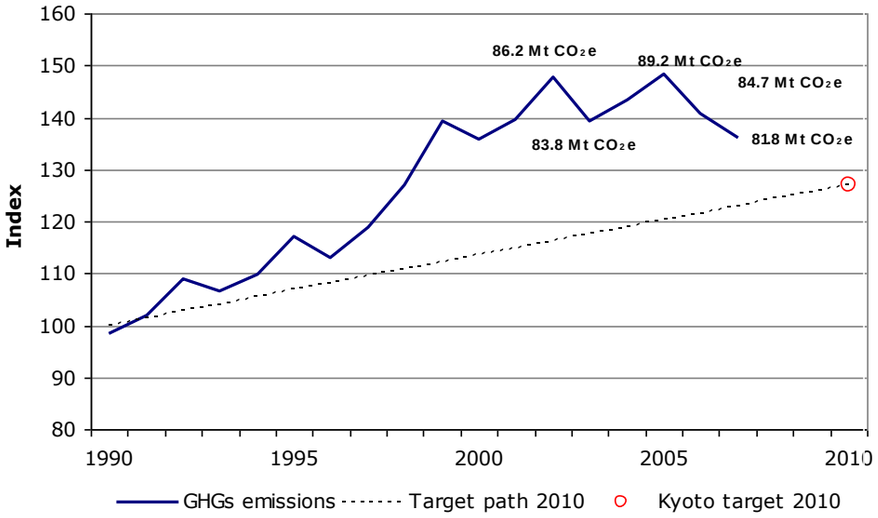

Figure 51. Historic GHG emissions and target path to Kyoto.

National projections point out that Portugal will meet its Kyoto target: according to PNAC projections for the reference scenario, it is estimated that, by 2010, Portugal's GHG emissions will total 84.61 Mt CO_2e. The GHG emissions reduction potential from additional measures is 3.69 Mt CO_2e/year, resulting in total emissions of 80.9 Mt CO_2e by 2010, under the "with additional measures scenario" of PNAC2006. Considering the emissions reduction potential of the New 2007 Measures evaluated in 1.56 Mt CO_2e/year the emissions will be 79.36 Mt CO_2e. This value is 2.97 Kt CO_2e higher than the assigned amount under the Kyoto target 76.39 Kt CO_2e, as referred above. With the emissions reduction effort of 0,09 Mt CO_2e/year coming from PNALE II the emissions deficit will amount to 2.88 Mt CO_2e/year, to be compensated by the Portuguese Carbon Fund. This is illustrated in the next figure.

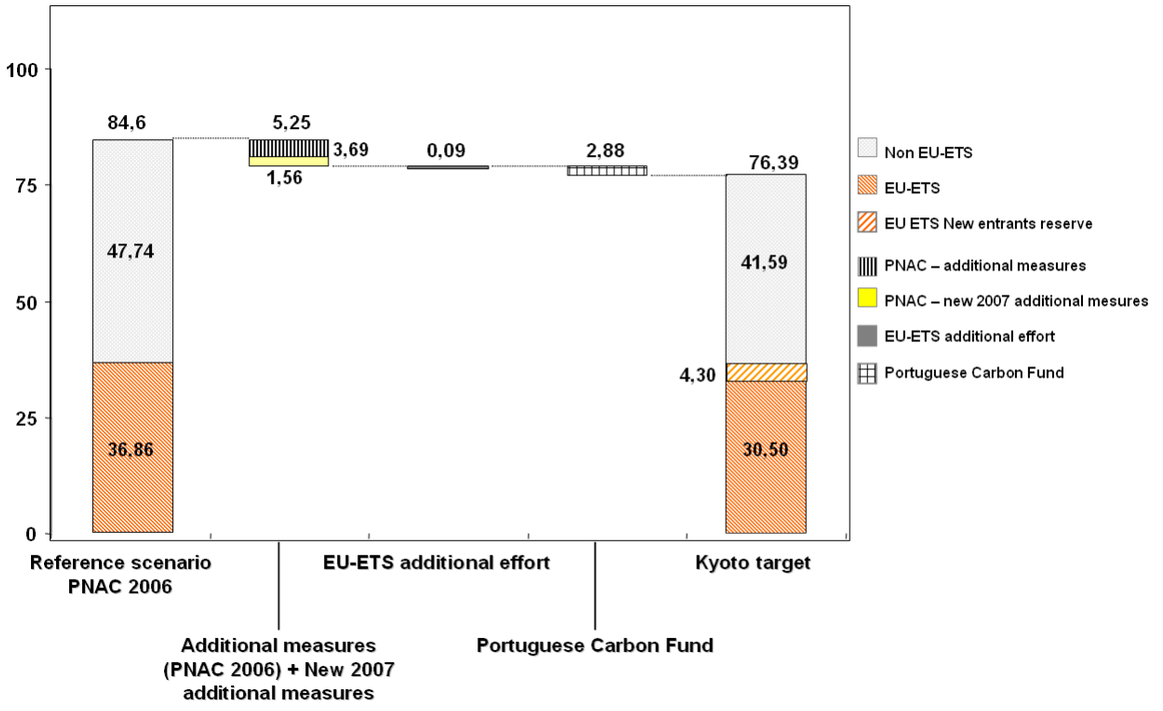

Figure 52. Use of the different mechanisms to comply with Kyoto

Following the analysis of the National Climate Change Programme 2006, the new 2007 additional measures and the NAP 2008-2012, the final Kyoto deficit to be offset by the Portuguese Carbon Fund was estimated at 2,88 Mt CO_2e/year, according to the Council Ministers Resolution n.º 1/2008. However, taking into account a conservative estimate of Portugal's emissions until 2012, in result of the implementation of Cumprirquioto.pt system, the estimated deficit is set at 19,1 Mt for the compliance period, and the Portuguese Carbon Fund's current planned investment target addresses this.

The Portuguese Carbon Fund also supports domestic projects which are additional to PNAC. Emission reductions are expected to amount to around 1.5 Mt in the compliance period.

3.10 Information on National and Regional Programmes and/or Legislation Initiatives, and Coercive Administrative Procedures

Environmental protection is regulated by the Framework Law on the Environment (Law 11/87 of 7 April)[73]. This law postulates a general protection principle which is that all citizens have the right to an ecologically balanced human environment and the duty of protecting it, while the State is entrusted with improving the quality of life, both individual and collective, through the activities of its institutions, as well as through grassroots and community initiatives.

This Framework Law contains a series of clauses on preventive and repressive interventions, concerning the environment, which can be carried out by the Public Administration, such as: articles 33 and 36, on licensing and emergency situations; article 42, on administrative embargos; and article 47, on environmental infractions. In short, the Law defines the institutions responsible for environmental policy and their main types of intervention.

Such law, in coordination with the other sectoral policies, sets the frame for Portugal's climate change policy, namely through national and Community legislation for the implementation of the UNFCCC and the Kyoto Protocol.

As an EU Member State, Portugal is subject to compliance with Community rules, and in particular the extensive body of legislation with relevance to climate change policy, namely the Burden Sharing Agreement (Council Decision 2002/358/EC of 25 April), which determines the GHG emissions limitation objective (following from article 4 of the Protocol), and Decision 280/2004/EC, of the European Parliament and Council, of 11 February 2004, on the creation of a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol.

3.11 Participation at ICAO and IMO Decision-making Process

Portugal has participated regularly and systematically in the discussions on emissions from the international air and maritime transport sub-sectors, both at UNFCCC and Community levels (namely with regard to aviation), as well as in following developments by the International Civil Aviation Organisation (ICAO) and the International Maritime Organisation (IMO).

The National Civil Aviation Institute (INAC) is the responsible body for following issues relating to GHG emissions from the international civil aviation sector, ensuring the country's participation at the various international fora, both at the level of the ECCA[74] at the meetings of Director-Generals, and the ICAO, at the plenary sessions of the Assembly.

The Port and Sea Transport Institute (IPTM) has been directly involved in the International Maritime Organisation through meetings of the Marine Environment Protection Committee. Portugal has ratified the Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL) approving the Decree Law 1/2008 (January the 9th).

[73] The analysis of the Framework Law on the Environment hereby presented was authored by Professor Dr. Diogo Freitas do Amaral and can be read at http://www.diramb.gov.pt/data/basedoc/TXT_D_9134_1_0001.htm

[74] European Conference on Civil Aviation.

3.12 Efforts for the Minimization of Adverse Effects

Portugal's contribution to the minimisation of the adverse effects of climate change in other Parties, particularly developing countries, is carried out through a strong commitment to implementing the Convention and the Kyoto Protocol.

As such, the policies and measures implemented, adopted or foreseen in PNAC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

In some cases, such as measures pertaining to the diversification of primary energy sources (namely shifting to natural gas), there can simultaneously be positive effects on Portugal's emissions reduction and in the economy of some fossil fuel exporting countries.

3.13 Information on the Use of Mechanisms Foreseen in Articles 6, 12 and 17 of the Kyoto Protocol

Further to the emissions reductions achieved domestically, Portugal will resort to the flexibility mechanisms foreseen in the Kyoto Protocol in order to meet the emissions target defined in the context of the Protocol and the EU Burden Sharing Agreement, with a view to acquiring emissions credits of up to 1.86 $MtCO_2e$/year.

As such, Government entrusted the Climate Change Commission to act as the Designated National Authority (DNA) for the flexibility mechanisms, and created the Portuguese Carbon Fund to acquire credits for those mechanisms. An Executive Committee was created to manage the Portuguese Carbon Fund including:

- acquisition of GHG emissions credits, at competitive prices, through direct investments in the flexibility mechanisms of the Kyoto Protocol (Emissions Trading, Joint Implementation and Clean Development Mechanism projects);
- acquisition of GHG emissions credits, at competitive prices, through direct investments in funds managed by third parties or in other carbon market instruments;
- support to projects, in Portugal, which lead to a GHG emissions reduction, namely in the areas of energy efficiency, renewable energy, carbon sinks, CO2 capture and geological sequestration, and adoption of new technologies, as justified by the return in avoided emissions; and
- promoting the participation of public and private bodies in the flexibility mechanisms of the Kyoto Protocol.

Finally, a series of memoranda of understanding on climate change and flexibility mechanisms with several parties have either been signed or are currently under negotiation. These memoranda will form a platform for dialogue, particularly through the sharing of experience among the private sector.

3.14 Information on the National Registry System (SNR)

3.14.1 Current infrastructure of the Portuguese National Registry

Since October 2007, the Portuguese Registry of GHG emissions and assigned amounts are supported by CR software, developed by Trasys for the European Commission and in use in several European countries. The CR software substituted the SERINGAS software which was in use since the start of the Portuguese Registry operation, in

November 2005. On November 2008, the Portuguese registry was linked to ITL in a coordinated action of all ETS registries. Currently, the Portuguese registry is in full operation with CR v1.2.2 software, which has been subject to validation, minor adaptation and bug correction from eChiron.

The current infra-structure includes two independent set of servers installed at different locations, both dedicated to support the Portuguese registry. Each location is supported by a different telecommunication operator (PT and Colt) and both are linked through a redundant Layer 2 Gigabit connection.

Each infra-structure set is composed by an application server, with Weblogic and the CR application, and a database server with Oracle 10g. The secondary set of servers serves as hot standby and a disaster recovery infrastructure.
The database servers are SUN V20z/1xCPU@2,2/4.0GB and run Oracle 10g over Linux. The applications servers are SUN V20Z 1xCPU@2,2/4.0GB and run Weblogic v8.1 SP6 over Windows 2003 Enterprise Edition.

eChiron, an IT company with a large experience in the environment domain, is responsible for the full operation of the registry, since its implementation. It hosts and manages the entire registry infrastructure, monitors its operation, evaluates and tests all software and provides support to the registry users and as well as to APA, as the registry administrator. In addition to several IT experts, a team of 4 people with special training on the registry regulation and protocols is responsible for the registry operation.

3.14.2 Procedures to minimize discrepancies

The Portuguese technical team maintains a fully operational test environment to test operational procedures or to test software upgrades and patches of CR, CITL and ITL. The registry operation supported by the CR software has been tested by the EC and by Logica on behalf of the UNFCCC review team, who both evaluated how it conformed to technical standards for transactions between registries. The tests performed by the EC evaluated the performance of the registry regarding ETS operations, while the tests performed by Logica evaluated the performance of the registry when connected to the ITL. In the framework of the ETS go-live, Portugal participated in the major testing effort of the whole registry system, which was an opportunity to test, once again, the registry software.

A close cooperation between parties using CR (Portugal, Spain, Belgium, Luxembourg, Germany, Denmark and the EC) is maintained and any information regarding the software, namely possible bugs or performance issues, is quickly distributed and shared, as well as any available patch. The Portuguese Registry also benefits from the larger cooperation between all European national registries.

CR software includes a number of validations to minimize the discrepancies in the registry transactions and rules to terminate them whenever a discrepancy is identified. The operation of the registry is permanently monitored by the registry service team, in addition to the overall and continuous monitoring of the shared infrastructure and services managed by eChiron. Terminated transactions (uncompleted transactions) are swiftly investigated by the registry support team to identify the reason of the termination. The registry service team also routinely performs random checks of the database consistency and compares its results with information on the ETS, independent maintained by APA, namely regarding allowance allocation and surrendering and verified emission values.

All transactions performed on the Portuguese Registry are currently verified by ITL and the ITL. Moreover, daily reconciliations are performed with these ITL and CITL.

It should be stressed that during the two and a half years period of operation of the registry no discrepancies have been found between the registry and the CITL. No complaint has also been reported by the registry users regarding a hypothetical discrepancy in their accounts.

3.14.3 Security measures

A strict access control to the registry is maintained. The internet data centers, where the Portuguese Registry is housed enforce a strict control of physical access. All aspects of physical security are duly covered. The access to the datacenters is controlled by dedicated security staff.

The number of persons with administration privileges to the registry is kept to a minimum and all are under a strict confidentiality agreement. Written procedures are in place to ensure a common and tested way of dealing with all issues regarding the registry maintenance.

The Portuguese Registry interface is made available through https protocol. An SSL digital certificates provides authentication and encryption power for secure online transactions. The access to the Portuguese Registry is controlled by username and password. An account holder needs to sign an agreement with the Portuguese Registry to be granted access to the registry. By signing this contract, the account holder becomes aware of its obligations towards the registry, including the ones regarding security issues, and assumes the responsibility for fair use of the registry.

3.14.4 Disaster management

The current infra-structure includes two independent set of servers installed at different locations, both dedicated to support the Portuguese registry. Each location is supported by a different telecommunication operator (PT and Colt) and both are linked through a redundant Layer 2 Gigabit connection.

Each infra-structure set is composed by an application server, with Weblogic and the CR application, and a database server with Oracle. The secondary set of servers serves as hot standby and a disaster recovery infrastructure.
In the event of failure in the primary infrastructure, the secondary infra-structure can provide the service if the internet connection of the main datacenter is maintained. If this internet connection becomes not operational for a long period (an extreme event given its redundancy and the fact that it is directly connected to the backbone of Portugal Telecom), a secondary a connection from the secondary datacenter can be implemented in a short period of time (this redundancy will only become available later in the year).

Routine daily backups are performed on the application servers and database servers (see description of this procedure in previous documents). In addition, the any data change in the primary database server is shipped to the secondary database server, making use of Oracle's DataGuard. A 5 minutes time interval is used in this procedure.
The backup procedure to an LTO3 tape library is run automatically and managed by a Veritas NetBackup Solution. Every morning a ticket in the eChiron service desk application is automatically opened and assigned to the Applications Group of eChiron Technology Management Department. The ticket is handled as any other ticket opened in the Service Desk application. A member of the Applications Group assumes the responsibility of this ticket and checks if the backup procedure has run without problems, before closing the ticket. The supervisor of the Applications Group makes

sure that no ticket is left opened beyond a defined period. The service desk supervisor monitors all tickets opened in the application and is alerted is any unjustified delay occurs.

Security copies from the Portuguese registry are handled through the standard procedures of the company. Every month, each client service manager routinely selects a set of files and a database from its clients to be recovered. A ticket is opened in the Service Desk application to request such recovery. The Applications Group of eChiron Technology Management answers the requests and the ticket is closed when the client service manager verifies that the recovery was successful.

In addition to this internal verification, one must refer that eChiron clients often request the recovery of sets of files or the replication of databases. Since the backup procedures are the same for all clients, this provides an extra layer of confidence that the security copies are usable.

3.14.5 Registry administrator

The registry administration is performed by the Agência Portuguesa do Ambiente (APA).

Organization: Agência Portuguesa do Ambiente (APA)

Contact persons: Filomena Boavida / Ana Teresa Perez

Email: admin@rple.pt

Address: Rua da Murgueira 9/9ª, Apartado 7585, 2611 – 865 Amadora, PORTUGAL

3.14.6 Registry Manager

APA has contracted eChiron to host and maintain the registry operation as well as to provide support to its users.

Organization: eChiron, Gestão de Aplicações de Software, S.A.

Contact persons: Rodrigo Proença de Oliveira

Email: suporte@rple.pt

Address: Edifício Premium, Alameda Fernão Lopes, nº16–10º, 1495-190 Algés PORTUGAL

3.14.7 Internet address

Registry url: https://rple.pt/

3.14.8 Cooperation arrangement

The Portuguese registry is operated independently, i.e., in a non-consolidated way.

4 National Greenhouse Gas Emissions Projections

In the beginning of 2009, Portugal finalised the study *Clima2020* which evaluates the GHG emissions' scenarios until 2020 in order to determine the impacts of the European "climate and energy package". The package has two major aims:

- Reduce, until 2020, the GHG emissions in 20% (or 30% in the case of the comparable effort by other developed countries and of those developing with emerging economies)
- Increase, by 2020, in 20% the use of renewable energy sources (RES).

Under the adopted climate and energy package Portugal will:

- Contribute to the overall linear annual reduction in the emissions until the target of -21% relating to 2005 target of the third phase of the European Union's Emissions Treading System (EU-ETS), from 2013-2020;
- Limit the emissions of the sectors not covered by the ETS (non EU-ETS), like housing, services, transports and waste, to +1% compared to 2005;
- Be bound to a +31% target of RES in the final energy consumption, including an incorporation of 10% of biofuels in transports;

The tables of Annex II present the underlining parameters of the projections for 2010, 2015 and 2020.

4.1 GHG emissions Projections Summary

GHG projections consider those emissions related to the energy sector (both production and use), directly accounted towards TIMES75_PT model and for each scenario, and the remaining sectors, concerning agriculture and livestock, waste and the production and use of F-gases (estimated outside of the TIMES_PT model). These projections are coherent with the methodology used in the Portuguese National Inventory (APA, 2007) and, therefore, with the IPCC guidelines.

It is expected that the GHG emissions evolution until 2020 differs according to the different scenarios considered: +8% in WEM and +4% in WAM (without LULUCF). This is explained by the different policy set that influences GHG emissions and reductions.

To simplify, two sets of activities are considered: those included in EU-ETS and the remaining. Also to consider is the base year for comparison, 2005.

It is expected that energy industries, transport and industrial processes remain as the main emitter activities (28 Mt CO_2e, 23 Mt CO_2e and 11 Mt CO_2e and 29 Mt CO_2e, 22 Mt CO_2e and 10 Mt CO_2e, respectively in WEM and WAM) in 2020. Despite the increase in the demand of energy services a reduction of the emissions is also expected in the commercial and services' sectors, due to the replacement of heating gasoil by electricity and the use of more efficient technologies. In an opposite way, in housing the emissions are expected to grow in the WEM scenario, where a more intensive use of electricity is not so evident. Regarding smaller CHP and industries, the emissions are also to rise as the emissions form F-gases associated to a higher intensity in the use of cooling equipments.

[75] TIMES – The Integrated Markal-EFOM System.:both Markal - MARKet Allocation as EFOM - Energy Flow Optimisation Model are energy models developed by the International Energy Agency (IEA).

In those activities included in EU-ETS the increase in GHG emissions is similar in both scenarios facing 2005 baseline: +15% to +16%. The activity that has the greater representativeness continues to be the electricity production, accounting for from 51% to 52% of the total GHG emissions.

Table 35. GHG historic emissions and projections.

Sectors	1990	2005	2007	2010 (Gg CO_2e)		2020 (Gg CO_2e)		Var 2020/2005 (%)	
				WEM	WAM	WEM	WAM	WEM	WAM
Energy Industries	16 010	24 952	19 914	23 233	23 953	28 422	29 487	12	15
Industries and Construction	9 267	10 370	10 860	9 066	8 817	10 893	9 217	5	-13
Transport	10 149	19 861	19 500	22 132	21 184	22 617	21 570	12	8
Other sectors[76]	4 610	7 067	5 645	7 173	7 182	6 970	6 442	-1	-1
Other	104	73	73	0	0	0	0	-100	-100
Fugitive emissions	281	1 541	1 590	280	291	457	387	-237	-298
Industry	4 611	7 802	8 589	8 714	8 646	11 103	9 646	30	19
Solvent	220	332	346	328	328	338	338	2	2
Agriculture	8 088	8 081	7 638	8 715	8 715	7 984	7 984	-1	-1
LULUCF	1 543	-1 994	-2 324	-3355	-4655	NA	NA	NA	NA
Waste	5 928	7 151	7 685	6 154	6 154	5 679	5 679	-26	-26
Total (with LULUCF)	60 812	87 230	79 517	82 441	80 615	94 463	90 750	8	4
Total (Without LULUCF)	59 269	87 230	81 841	85 796	85 270	94 463	90 750	8	4

Source: CECAC, 2009

According to the projections for the WEM scenario, it is estimated that, by 2020, Portugal's GHG emissions will be 94 463 kt CO_2e and 90 750 in WEM and WAM, respectively (without LULUCF). The sector with most significant representation is Energy, with 69 360 kt CO_2e and 67 103 kt CO_2e. Energy industries and Transport sub-sectors have the largest contributions, corresponding to approximately 53% of the national total.

The trend of the "diffuse" sectors is noteworthy: the Transport sub-sector is expected to grow about 8% to 12%, and the Residential and Services sub-sector, to decrease in -1% compared to 2005. The Waste sector contribution is expected to reduce in -26% compared to 2005.

GHG emissions reduction potential from additional measures totals 526 kt CO_2e/year, resulting in total emissions (without LULUCF) of 85 270 kt CO_2e by 2010, under WAM (or QUIT scenario).

Figure 53 shows the trend in GHG emissions (2005-2020) estimated for the WEM and WAM scenarios.

[76] Residential, Commercial, Services

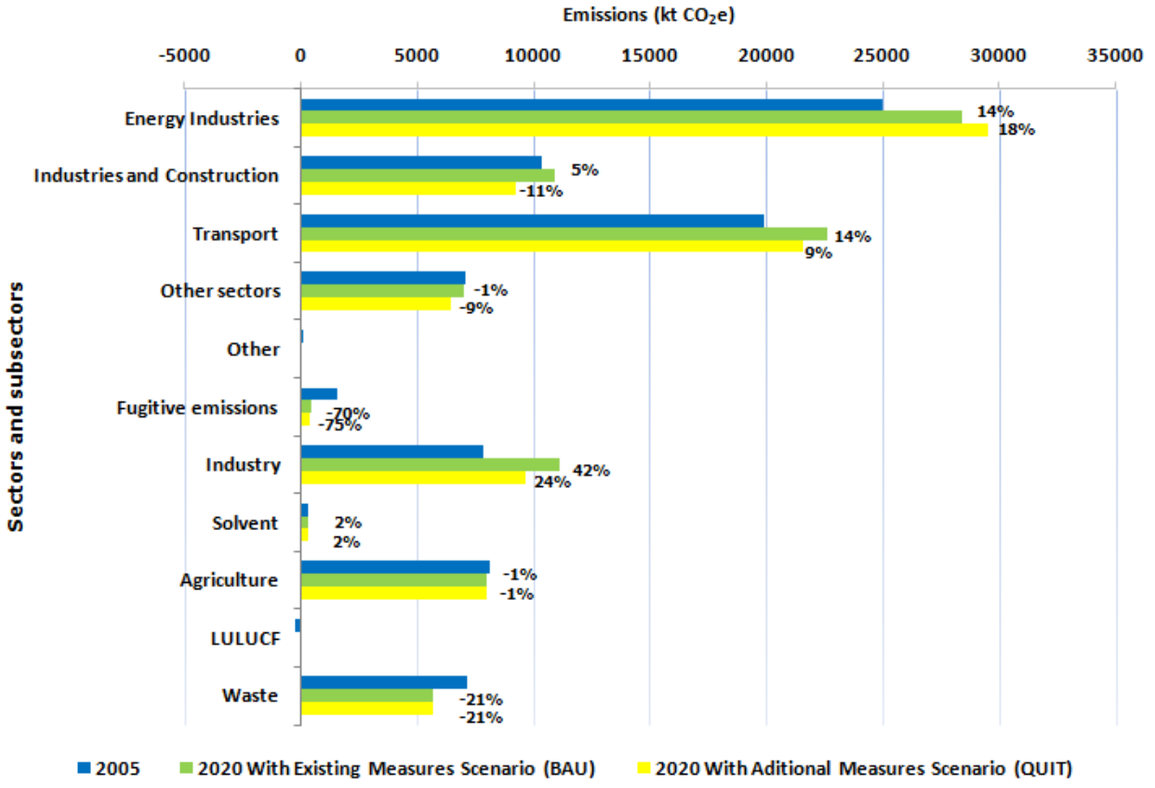

Figure 53. Trend in GHG emissions (2005-2020) estimated for the WEM and WAM scenarios.
Source: CECAC, 2009

Below a more detailed analysis of the GHG emissions projection by sector in presented (Figure 54).

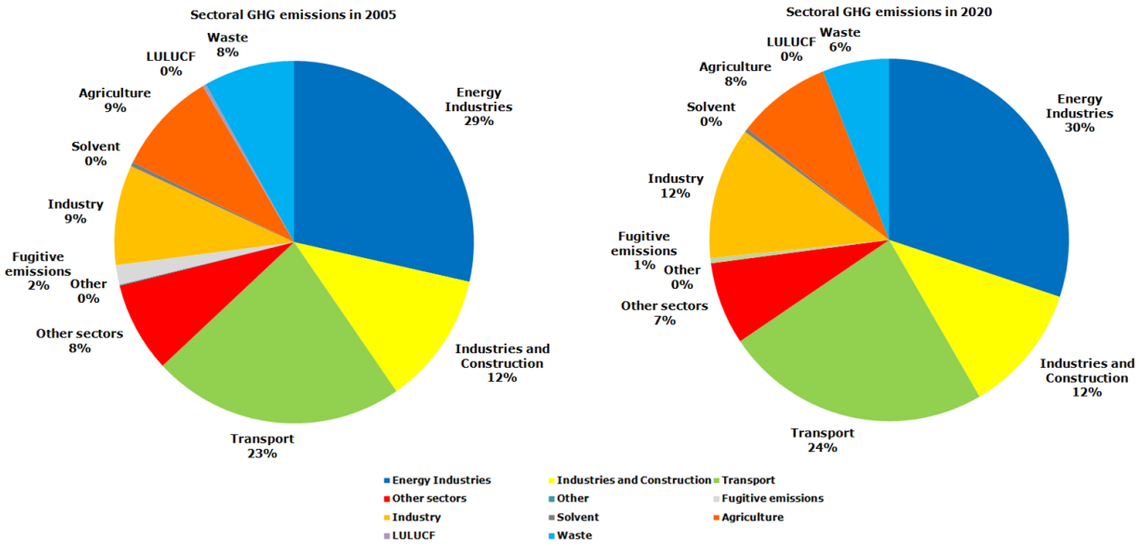

Figure 54. Sectoral structure of GHG emissions in 2005 and in 2020 (WEM and WAM), disaggregated by sector[77]

Source: CECAC, 2009

4.1.1 Energy Production and Consumption and Industry

Globally, the emissions from energy and industry have been seeing their contribution to the GHG emissions rise: in 1990 they accounted with 75% and in 2005 they totalized 82%, with a light increase expected by 2020. As previously said, despite the increase in the demand for energy services, some decrease in the emissions are explained by the use of renewable and more efficient technologies. With an opposite trend, GHG emissions from industry are almost the double, due to a higher demand for materials and a lower capacity from the sector to reduce emissions.

Table 36. GHG emissions from energy production and consumption and industry[78]

(Gg CO_2e)	1990	2000	2005	2020	
				WEM	WAM
FUEL COMBUSTION ACTIVITIES	**40169**	**59016**	**63916**	**69319**	**67064**
Var (2020/2005)				**+8%**	**+4%**
1. Energy Industries	**16010**	**20714**	**24952**	**30256**	**31332**
Electricity (EU-ETS)		19151*	21912	21243	21976
CHP		3773*	3945*	3093	3057
EU-ETS |Non EU-ETS		*na*	*1972|1972**	*1226|1867*	*1185|1872*
Refining (EU-ETS)	1920	2307	2596	5920	6300
2. Industry and Construction	**9263**	**11884**	**10370**	**9019**	**7332**
Chemistry		753*	641*	1525	525
EU-ETS |Non EU-ETS		*Na*	*206/ 435**	*1296| 229*	*446| 79*
Pulp and Paper		201*	344*	185	265
EU-ETS |Non EU-ETS		*Na*	*315|29**	*142|43*	*221|43*
Ceramic		1179*	1097*	1525	1397
EU-ETS |Non EU-ETS		*Na*	*866|231**	*1403|22*	*1286|112*

[77] No changes are observed in the sectoral structure of GHG emissions under the with additional measures scenario, relative to the reference scenario

[78] For the years 1990, 2000 and 2005 the source are the national submissions and EU-ETS in 2005
* Values were obtained from TIMES_PT model not including cogeneration, because in this study those emissions are evaluated in separate.

(Gg CO_2e)	1990	2000	2005	2020	
				WEM	WAM
Glass		744	693	549	549
EU-ETS |Non EU-ETS		*Na*	*640|53[a]*	*522|26*	*522|26*
Cement (EU-ETS)		2270	2287	2397	2397
Lime		81*	67*	27	27
EU-ETS |Non EU-ETS		*Na*	*61*|6**	*24|3*	*24|3*
Iron and steel (EU-ETS)*		769	181	448	448
Other construction industries		2813*	2424*	2283	1653
EU-ETS |Non EU-ETS		*Na*	*571|1853**	*342|1941*	*248|1405*
3. Transport	**10052**	**19412**	**19861**	**22617**	**21570**
Civil Aviation	167	367	420	**665**	**665**
Road	9459	18699	19162	**21547**	**20500**
Railway	185	141	86	**60**	**60**
Maritime	242	204	193	**344**	**344**
4. Other sectors	**4619**	**6329**	**7067**	**6970**	**6442**
Commercial and Services	755	2208	3437	**2891**	**2841**
Residential	2050	2745	2652	**2989**	**2512**
Agriculture/Forestry/Fisheries	1814	1376	978	1090	1090
FUGITIVE EMISSIONS FROM FUELS	**225**	**677**	**1593**	**457**	**387**
INDUSTRY	**4626**	**6021**	**7725**	**11101**	**9619**
Var (2020/2005)				**44%**	**25%**
A. Mineral products	**3385**	**4360**	**4392**	**5042**	**5042**
C. Metal	**29**	**28**	**15**	**17**	**17**
B. Chemistry	**1209**	**1486**	**2560**	**1952**	**1952**
Prod. NH_4+ (EU-ETS > 2015)		935	1809	269	269
Prod. N_2O (EU-ETS > 2005)		435	612	1683	1683
D. Other (Non EU-ETS CELE)		**105***	**90***	**92**	**92**

Source: CECAC, 2009

4.1.2 Agriculture

The methodology used for this sector follow the National Inventory Report (NIR). Agriculture represents various sources of GHG emissions, namely:

- CH_4 from enteric fermentation
- CH_4 and N_2O from manure management systems
- N_2O direct and indirect emissions for agriculture soils
  - Direct:
    - N_2O applied to the soil as manure or synthetic fertilizers (minus the NH_3 volatile fraction)
    - Direct deposition of organic matter by the animals
    - N fixed by legumina
    - N from agricultural waste applied to the soil
  - Indirect:
    - N_2O emissions that do not occur at the time of the application of N to the soil
      - N volatilization
      - N from manure management systems
      - N from manure applied as fertilizer
      - N from animal excretion
      - N form synthetic fertilizers or manure
- CH_4 from rice cultivation

- CH_4 and N_2O from the open field burning of agricultural waste.

According to the estimations based on the WEM and WAM scenarios, in the year 2020 the GHG emissions from this sector are expected to decline by -1%, comparing to 2005, in both scenarios.

4.1.3 Projection Model for Land Use, Land Use Change and Forestry[79]

The areas occupied by each type of forest settlement in 2010 and 2020 were estimated by interpolation, considering the targets for 2025 and the Regional Plans of Forestry Planning (PROF) (under the responsibility of Directorate-General for Forestry – DGRF). New forested areas were calculated by species, to 2010 and 2020, based on estimates of total forested area, and assuming consistent deforestation rates and annual harvested or burnt areas.

4.1.4 Waste

Considering both the WAM and WEM scenarios, the expected GHG emissions reduction can be of about 21% in 2020 facing 2005. The sector that contributes the most is the deposition of solid waste in the soil, with estimated reductions of -89% and the increase in the incineration emissions of about 74% in both scenarios. Also wastewater treatment sees its emissions increasing by 4%.

4.1.5 F-gases

The basis for this projection is the National Inventory, with some changes induced by the study performed by the Department for Prospective, Planning and International Relations (Ribeiro *et al.*, 2008a). Therefore, for the sectors considered, the projection of the number of equipments had as basis the expected evolution of Net Added Value (in a yearly basis), in PNAC or by the expert guesses from sector's representatives.

The scenarios evaluated consider the control of leakages in the production, operation and disposal of the equipments, accordingly with EC proposal for regulation (2003/0189A). To evaluate these effects, the STEK[80] model was used, considering that the reduction during operation the leakages are reduced from 15.0% to 5.5%. During production and disposal, IPCC values were used (k=0.2; z=70.0 and z=50.0, for individual air conditioning and mobile, respectively).

Table 37. Units considered in the production of equipments using F-gases.

		2005 (NIR)	2015	2020
Domestic (1000 units)	Refrigerators	310.2	408.4	429.2
	Freezers/Coolers	224.6	295.8	310.9
Commercial (1000 units)		99,7	131.3	137.9
Domestic air conditioning (1000 units)		99,5	220.0	446.9
Industrial air conditioning (1000 units)	Little and medium	5.3	10.3	9.8
	Big	5.7	7.1	10.3
Mobile air conditioning (1000 units)	Light vehicles	150.5	150.5	150.5
	Heavy vehicles	1.8	1.8	1.8

[79] These projections were not calculated in the frame of the study Clima 2020, but correspond to the previous submission once changes in the P&M and in the sector model were not expected.

[80] www.stek.nl

		2005 (NIR)	2015	2020
Cooled vehicles (1000 units)		1,0	0.6	0.4
MDI – Inhalers (1000 units)		378,9	250.9	207.5
Foams (t)	PES – HFC 152a	556.2	734.5	904.5
	PUR – HFC 152a	56.0	72.0	91.1
	PUR – HFC 134a	11.5	14.8	18.7
Extinguishers (t)	HFC-23	4	5	5
	HFC-227ea	14	15	15

Source: CECAC, 2009

Table 38. Units considered in the operation of equipments using F-gases.

		2005	2015	2020
Domestic (1000 units)	Refrigerators	5462.4	6596.7	7174.7
	Freezers/Coolers	3004.3	3628.2	3946.1
Commercial (1000 units)	Freezer boxes	100.4	125.2	142.4
	Exposers	997.4	1207.8	1345.3
	Coolers	55.1	56.8	58.3
	Freezers	29.2	30.4	31.5
	Mini-freezers	60.7	77.7	87.9
	Big commercial surfaces1	246.0	282.6	282.6
Domestic air conditioning (1000 units)		563,9	1367.3	2304.9
Industrial air conditioning (1000 units)	Little	13.5	25.9	29.6
	Medium	19.3	37.0	42.2
Mobile air conditioning (1000 units)	Big	8.1	16.5	22.3
	Light vehicles	101.9	284.8	374.7
	Light commercial vehicles	72.7	127.5	152.4
	Heavy commercial	84.1	192.4	230.3
	Heavy passengers	6.3	11.4	13.0
Cooled vehicles (1000 units)		15,0	23.2	25.7
Foams (t)	PES – HFC 152a	4.5	8.4	10.7
Electric equipment (t SF_6)	Without technological innovation	46.1	145.7	403.3
	With technological innovation	46.1	138.2	378.3

Source: CECAC, 2009

4.1.6 Projections by Gas

From Table 39 through to Table 42 the trend in emissions are systematised for each of the GHG in WEM and WAM, as well as historical data.

The Energy sector has the largest contribution to CO_2 emissions, with a maximum of 67 211 kt CO_2 and 64 900 kt CO_2 by 2020 in the WEM and WAM scenarios, respectively. The Waste and Agriculture sectors are the main sources of CH_4. From its maximum value in 2005 (341 kt CH_4), Waste sector emissions will decrease to a minimum of about 206 kt CH_4 in 2020 under both scenarios. This trend is expected to continue and intensify beyond 2010 to 2020 due to reductions from the Agriculture and Waste sectors and in spite of an expected increase from the Energy sector.

The Agriculture sector is expected to be the principal source of N_2O (13 kt N_2O for WEM and WAM in 2020). No significant variation is expected between the reference scenario and with additional measures scenario for this gas, which emissions show a growth trend in particular due to the Energy and Waste sectors.

Additional information can be obtained from PNAC 2006.

4.1.7 Sensitivity analysis

In order to consider the main sources of uncertainty associated with the modelling the sensitivity analysis was focused on the factors that have more impact in the energy sector: hydro potential for the production of electricity (measured through the Producible Hydroelectric Index – PHI, having 0.885 as the baseline) and primary energy prices.

In the first, two scenarios were considered:

1. wet year (high PHI = 1.090)
2. dry year (low PHI = 0.336).

In the case of the primary energy prices, for the sensitivity analysis, the high scenario was based on the work of the International and of the USA Energy Agencies, which was validated by national experts. The prices for natural gas and coal assuming the relation among crude oil and other fossil fuels' prices equivalent to the scenario Hugh Growth defines in World Energy Outlook 2007 from International Energy Agency.

Table 39. Historical and projected emissions of CO_2 in the WEM scenario and with additional measures WAM

CO_2	Historical data		Projections			
			WEM		WAM	
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2005**	**2007**	**2010**	**2020**	**2010**	**2020**
	(Gg CO_2e)					
1. Energy	61 909	55 452	59 886	67 211	59 392	64 900
2. Industrial Processes	6 668	6 994	5 674	5 411	5 674	5 411
3. Solvent and Other Product Use	332	346	328	338	328	338
4. Agriculture			0	0	0	0
5. Land Use, Land-Use Change and Forestry(2)	-543	-2 370	0	0	0	0
6. Waste	10	1	593	628	593	628
7. Other *(as specified in Summary 1.A)*	NA	NA	NA	NA	NA	NA
Total CO_2 emissions including net CO_2 from LULUCF	69 135	60 422	66 480	73 590	65 987	71 278
Total CO_2 emissions excluding net CO_2 from LULUCF	69 678	62 793	66 480	73 590	65 987	71 278

Source: CECAC, 2009

Table 40. Historical and projected emissions of CH_4 in the WEM and WAM scenarios

CH_4	Historical data		Projections			
			WEM		WAM	
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**2005**	**2007**	**2010**	**2020**	**2010**	**2020**
	(Gg CO_2e)					
1. Energy	63	54	32	38	33	35
2. Industrial Processes	0	1	0	1	0	1
3. Solvent and Other Product Use	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
4. Agriculture	215	217	219	198	219	198
5. Land Use, Land-Use Change and Forestry	10	1	0	0	0	0
6. Waste	341	338	234	206	234	206
7. Other *(as specified in Summary 1.A)*	NA	NA	NA	NA	NA	NA
Total CH_4 emissions including CH_4 from LULUCF	629	611	485	443	486	440
Total CH_4 emissions excluding CH_4 from LULUCF	619	610	485	443	486	440

Source: CECAC, 2009

Table 41. Historical and projected emissions of N_2O in the WEM and WAM scenarios

N_2O	Historical data		Projections			
			WEM		WAM	
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2005	2007	2010	2020	2010	2020
	(Gg CO_2e)					
1. Energy	3	3	4	4	4	5
2. Industrial Processes	2	2	5	7	5	7
3. Solvent and Other Product Use	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
4. Agriculture	11	10	13	12	13	12
5. Land Use, Land-Use Change and Forestry	0	0	0	0	0	0
6. Waste	2	2	2	2	2	2
7. Other *(as specified in Summary 1.A)*	NA	NA	NA	NA	NA	NA
Total N_2O emissions including N_2O from LULUCF	18	17	25	26	25	26
Total N_2O emissions excluding N_2O from LULUCF	18	17	25	26	25	26

Source: CECAC, 2009

Table 42. Historic and projected emissions for F-gases in the WEM and WAM scenarios

F-Gases	Historical data		Projections			
			WEM		WAM	
	2005	2007	2010	2020	2010	2020
			(Gg CO_2e)			
Consumption of F-gases (SF6, HFC, PFC)	787	955	1438	3618	1370	2162

Source: CECAC, 2009

4.2 General Description of Projection Model

4.2.1 Energy services' and other goods' demand 2020

The projections for energy consumption and other sources of GHG for 2005-2020 are built on national macroeconomic scenarios with the evolution of the global and sectoral growth, GDP and Gross Value Added (GVA) respectively, housing, services and the needs of passengers and products mobility expansion. These prospective scenarios, developed by the Department of Prospective, Planning and International Relations (DPP)[81], originate needs for goods and energy that will be supported towards the energy and industrial systems that simultaneously generate GHG emissions. In order to illustrate the assumptions made in the various scenarios a synthesis relating to major economic sectors is made:

4.2.1.1 Exportable goods and services – crucial for the growth of the open economy

It is expected that the tourism sector will grow, with some uncertainties related to the impacts of climate change in the activity. The traditional exporting sectors are expected to decrease in importance being replaced by products of higher added value and a stronger internationalization of the reference companies is also predicted. Also, there is the consideration of the growing of the production of the exportation of pulp and paper and chemical/petrochemical products and the investment in new equipment in Glass and Ceramic.

4.2.1.2 Construction and facilities – crucial for the endogenous growing dynamics and for the Portuguese role in Europe (passengers, load and communications)

High investments in transport infra-structures allowing a higher international connectivity (like the new airport in Lisbon and the high velocity connection Lisbon-Madrid, the expansion of Sines' harbour and also in the management of the water resources, waste and wastewater treatment and energy production are expected. Also, the civil construction related to residential tourism and rehabilitation of the park in Lisbon and Oporto is considered.

4.2.1.3 Transports and Intern Mobility – key in energy demand and GHG emissions

In this sector, what are expected are the transformation of the railway net with the high velocity and subways and the bigger penetration of fuels not dependent on oil (natural gas and biofuels). Also to consider is the investment in logistic platforms.

[81] From the Ministry for the Environment, Planning and Rural Development (MAOT)

4.2.1.4 Residential and Services – crucial for energy demand

Generalization of the housing and services' new buildings energy certification, with the investment in passive systems, intern air quality, thermic comfort and renewable energy source for eater heating. Also the installation of Micro generation systems in housing and services' buildings will be promoted.

4.2.1.5 Energy transformation – dependent on the remaining sectors, of fuels' price and of GHG emissions' reductions

What is expected is the construction and operation of the natural gas combined cycle plants (eight groups of 400 MW) and the investment in big hydroelectric facilities, as well as the investment in the use of RES (5800 MW from wind, 1500 MW from biomass, 150 MW from solar, 250 MW from waves, 100 MW from biogas). Also, a plant will be developed in Sines to produce biofuels form imported used oils and energy efficiency will be promoted.

The macro-economic scenarios defined the demand of energy services (like heating, cooling, lightning, cooking and others) to sector of residential and services, of mobility and of other goods and raw materials to industry (cement, iron and steel, ceramic, chemistry, pulp and paper and other), with two main scenarios. The global framing was called Trend that is a continuity scenario that allies the pattern of specialization observed in the 90's and a higher concern with energy supply security and environmental protection, in a context of moderate economic growth.

Table 43. Evolution of NAV, GDP, private consumption and population

	Yearly variation rates (%)			
	Trend			
	2001-2005	**2006-2010**	**2011-2015**	**2016-2020**
Indicators				
NAV at current prices				
Agriculture, Forestry and Fisheries	-0.7	2.0	0.5	1.0
Coal extraction and petroleum refining	17.7	-0.1	2.0	2.0
Electricity, gas and steam	2.3	3.7	3.4	3.5
Metallic minerals	0.1	3.3	1.0	1.0
Non-metallic minerals	-0.8	1.2	2.5	1.5
Chemistry	-0.7	2.3	4.0	4.0
Pulp and paper	0.2	1.3	3.5	2.5
Traditional exporting industries	-1.1	0.2	-0.5	-0.5
Equipments	1.4	4.1	1.3	1.0
Rubber, plastics and recycling	1.0	3.3	-4.6	1.5
Construction	-2.7	-0.5	4.0	3.0
Terrestrial transports	0.2	1.5	1.5	1.5
Air and maritime transports	4.3	1.5	2.0	2.5
Transport's services	3.2	2.4	3.5	4.0
Tourism's services	-0.6	2.5	3.5	4.0

	Yearly variation rates (%)			
	Trend			
	2001-2005	**2006-2010**	**2011-2015**	**2016-2020**
Commercial	0.5	2.1	1.9	2.0
Companies' services	3.1	2.4	2.4	2.5
Social and health services	2.3	1.2	1.5	2.0
Water and sanitation	1.9	2.6	2.5	2.5
Public administration, Education and other services	1.4	0.9	1.0	1.0
NAV total	**1.1**	**1.8**	**1.9**	**2.1**
Cement and lime	-3.5	1.2	2.5	1.5
Glass	1.3	1.2	2.5	1.5
Ceramics	-0.6	1.2	2.5	1.5
GDP at market prices	0.8	1.7	1.9	2.1
Private consumption	1.5	1.5	1.8	2.0
Population (year average) (1000 inhab)	0.6	0.1	-0.1	-0.2

Source: CECAC, 2009

The considered scenarios are summarized as follows:

- WEM – BAU
  - Trend in demand
  - P&M implemented and approved until the 31st of December 2007 (assuming its total effectiveness)
- WAM – QUIT
  - Trend in demand
  - P&M implemented and approved until the 31st of December 2007 (assuming its total effectiveness) and those approved but not yet implemented.

In WEM and WAM scenarios inertia factors were introduced relating to the use of efficient equipments and the use of different types of final energy. Naturally, consumers do not behave in a perfect way and these factors try to reflect that and are accordingly with what is forecasted in the National Plane for Energy Efficiency (PNAEE).

4.2.2 Description of the Model TIMES_PT

The TIMES_PT is a technological model of linear optimization of economy – energy – environment. TIMES was developed by ETSAP[82]. It was adapted to Portugal to simulate our energy's system in the scope of the European project NEEDS[83]. The ultimate goal of TIMES is to satisfy the demand for energy services at the minor cost. In order to do that, investment options and the operation of some technologies, as well as the primary energy sources and exportations are simultaneously considered according to (Loulou *et al.*, 2005a):

[82] ETSAP – Energy Technology Systems Analysis Programme from IEA. http://www.etsap.org/index.asp

[83] New Energy Externalities Developments for Sustainability - http://www.needs-project.org/nf2.asp

$$NPV = \sum_{r=1}^{R} \sum_{y \in YEARS} (1 + d_{r,y})^{REFYR-y} \bullet ANNCOST(r, y)$$

NPV: actualizes net value of total costs
ANNCOST: annual total cost
d: actualization rate
r: region
y: years
REFYR: reference year for the actualization
YEARS: years in which costs exist (every for the modelling period)[84]

In the case of TIMES_PT costs include investment, operation and maintenance (fixed and variable) of the production technologies and for energy consumption, as well as the tax on petrol products. Usually the gains include subsidies and material recovery. The model represents the Portuguese energy system from 2000 until 2030, including the following sectors:

- primary energy supply (refinery and production of synthetic fuels, importation and endogenous resources)
- electricity production
- industry (cement, glass, ceramic, steel, chemistry, pulp and paper, lime and other)
- residential
- commercial and services
- agriculture, forestry and fisheries (only energy consumption)
- transport.

In each sector the monetary, energy and materials fluxes are modelled according to the various technologies for the energy production and consumption. The implementation of TIMES_PT requires a set of inputs, namely:

- demand for energy services (e. g. lightening)
- technologies' technical and economic characteristics for the base year and the future (e.g. efficiency, input/output rate, availability, investment, operation and maintenance costs and actualization rate)
- availability of primary energy sources
- policy restrictions.

These kinds of models do not incorporate economic interactions out of the energy sector. The model also assumes that the agents have perfect knowledge of the market, present and future.

[84] For every year in the modeling period and also past years and the years after the use of the equipment (in the case of disassembling.

4.2.2.1 Modelling assumptions

The model TIMES_PT was calibrated for the year 2000 and validated to 2005, having as basis the national energy balances. The assumptions made were:

- The electricity exchanges with Spain were not modelled in detail. The maximum limits were established according to REN[85] and the increase of the net capacity.
- A maximum limit for CHP in industry was defined based on the past trend. In 2001 32% of the electricity consumption of the industry was obtained from CHP and the estimate for 2020 is 45%.
- The trend in the consumption of final energy in housing is assumed to remain constant.
- The inertia factors introduced consider:
  - The values verified for 2000, as in the national energy balance and comfort parameters
  - The maximum life time of the equipments in 2000: 15 years for gas and electricity stoves; 9 years for LPG stoves and 17 for water heaters:
  - The fact that the electrical heating is viable in Portugal.
- The inertia factors were also applied to electricity's, natural gas' and fuel oil's consumption in other industries and ceramic.
- Only 85% of the housing, commercial and services can be satisfied towards natural gas due to technical and geographic barriers.
- All the heat produced is done towards CHP.

According to the proposal of the European Commission for the changes in the EU-ETS the new definition of installation was considered as well as the consideration of N_2O from combustion activities. A conservative approach was adopted, not considering the opt-out option for installations below the 25 MW and emissions lower than 10 000 t CO_2e in previous years. Until 2020 the total GHG emissions (exception made to CHP) from the centralized production of electricity, refining, cement, pulp, steel and plain glass are included. In the case of CHP the different technologies are highly desegregated in the model so the thermic power is determined towards the investment option.

To sectors such as the packing glass and crystal, paper, ceramic and other combustion installations the percentage of EU-ETS incidence was estimated based on the ration among the 2005 verified emissions and the total emissions of the sector for the same year, such as in the national GHG emissions inventory. This approach assumes that the structure of the industry is constant until 2020, although the new projected installations were considered.

Projection estimates for national anthropogenic GHG emissions are organised according to Intergovernmental Panel on Climate Change (IPCC)[86] sectors, with fugitive emissions presented together with emissions of the Energy Supply sub-sector. These estimates are supported by the following:

- expected emissions in the reference scenario, estimated on the basis of energy demand forecasts derived from macro-economic indicators, as well as from the implementation of sectoral policies and measures, adopted or in force on the 1st January 2005 (thus excluding the EU Emissions Trading Scheme) which bear an impact on GHG emissions reduction (including afforestation, reforestation and deforestation under art. 3(3) of the Kyoto Protocol); and
- GHG emissions reductions expected from the adoption of additional policies and measures undertaken with the objective of reducing GHG emissions (including forest management, cropland management and grazing land management activities under art. 3(4) of the Kyoto Protocol).

[85] National Electricity Network (REN). Is the regulatory body for electricity in Portugal.

[86] In the Energy sector, Transport sub-sector is presented separately.

The review of macro-economic and sectoral scenarios was supported by updated information, namely (i) new data on the national accounts for the period 2000-2005 (INE, 2006) (ii) GDP growth rate forecasts for the period 2005 to 2010 (Stability and Growth Programme 2005-2009, December 2005 version).

The integration of these new macro-economic and sectoral variables revises downward the GDP growth rates for the period 2005 to 2010 and also changes the structure of intra and intersectorial Gross Value Added (GVA) considered for the purpose of simulating energy demand in the various final consumption sectors.

Relative to the national GHG projections, the following should be noted:

- figures for the period 2000-2005 are based on historical data, namely the preliminary annual national accounts (Base year 2000) (INE 2006);
- projections for the period 2005-2010 are based on the annual GDP growth rates provided in the Stability and Growth Programme 2005-2009 (December 2005 version). The growth rate for 2010 was maintained at the same level of 2009 (the last year covered in the Programme); and
- Projections for the period 2010-2020 are based on the annual GDP growth rates considered in the PNAC 2004 scenarios, which, in turn, are based on CISEP (CISEP, 2001) estimates, for two economic scenarios (high and low)
- The reductions to be achievable by the EU-ETS are not considered. It is not clear how much will the Portuguese installations reduce once the -21% is defined for all the Member-States and different sectors.

The modelling of the trend in energy consumption in the energy demand sectors, apart from residential, is based on GVA variation hypotheses (Annex II) for the respective sectors and sub-sectors (Agriculture; Forestry and Fisheries; Industry; Construction and Public Works; Services). A reduction in GDP growth rates and sectoral GVA will induce a reduction in energy consumption and associated GHG emissions. Also, a reduction in energy consumption in the final sectors will induce a slower growth of the energy supply sub-sectors, namely in terms of electricity production. Reduction in GDP growth also impacts on transport demand variables, namely freight transport and acquisition of new passenger vehicle fleet, with negative consequences in terms of technology efficiency and lower GHG emissions.

4.2.3 Projection Model for the Energy Sector – production and consumption

For the purpose of emissions projections, the Energy sector has been organised in energy demand sub-sectors (including Industry, Construction and Public Works; Agriculture, Forestry and Fisheries; Residential and Services) and energy supply sub-sectors.

The energy system was analysed with the TIMES_PT tool, with results including primary and final energy balances and the technological profile for the production and consumption.

4.2.3.1 Primary Energy

This definition is the one adopted in the national balance, considering the importation of oil refined products. The evolution of the consumption is about -2% to -8%, justified a higher demand of energy services. However, in all the scenarios, the consumption of primary energy is lower than the increase in the demand, due to a higher efficiency.

Also, for both scenarios, the crude demand is decreasing (60% in 2005 and 35% to 38% in 2020). This reduction is accompanied by a higher use of RES, from 13% to a range from 25% to 34% in 2020, namely hydro, biomass and wind, as well as natural gas. The use of coal remains approximately the same due to the new plant with CCS. Even so, the Portuguese external energy dependence decreases from 87% in 2005 to 66% a 75% in 2020. These variations are due to changes in the electroproductor system: closing of the fuel oil plants, the installation of new combined cycle plants using natural gas and the increase in the electricity production from RES.

4.2.3.2 Final energy

Although the demand is expected to increase, there is not a similar need in the final energy available for consumption, since there are efficiency gains. Both in BAU and QUIT the demand of final is 14% higher. All the scenarios consider the reduction, in relative terms, of the use of oil products and biomass, that are replaced by natural gas, electricity, thermic solar and heat produced towards CHP. In the different scenarios, the mains differences in 2020 are in the BAU the lower use of electricity in industry, residential and commercial and services, compensated by biomass and heat and natural gas, respectively,

The structure of the demand from the various sectors in 2020 is similar to 2005, noticing only the replacement of the energy sources.

4.2.3.2.1 Industry

The major changes in this sector are:

- Iron and steel: the update was done prior to 2005, so major changes are not expected. The heat is produced using new CHP using natural gas. The only difference is the use of turbines in BAU and the condensation in QUIT;
- Cement: higher use of oil coque in the clinker ovens, and the introduction of biomass in the BAU. The fuel switching and the ameliorations in the auxiliary processes allow for a lower consumption of about 5% in WEM and WAM;
- Ceramic: fuel switching in the ovens using biomass, LPG and fuel oil by natural gas, with gains representing 4% of the consumption. Replacement of the CHP by gas boilers;
- Pulp: higher production of recycled paper until a share of 9% is done in 2020;
- Paper: replacement of the production technologies by others more efficient, with 50% in 2020 representing a lower consumption of about 4%. Fuel switching in CHP from biomass and fuel oil to natural gas;
- Chemistry: new technologies are modest – 60% of chlorine is produced through a process that is more efficient in 20%;
- Lime: it is estimated that about 70% will be produced towards a more efficient process, using more gas and electricity instead of fuel oil, showing consumptions lower in 30% in 2020;
- Other industries: introduction of more efficient technologies to produce steam and heat (reducing the consumption in 18% and 4%). The process heat is generated through the use of natural gas, gasoil and electricity instead of fuel oil. The same is done in steam, but only with natural gas and solar in WAM. In this scenario, due to a lower demand, the heat production can be done entirely using solar.

4.2.3.2.2 Residential, Commercial and Services

In housing, the biomass and LPG use are expected to decrease, being switched by electricity, heat produced using solar and natural gas. In QUIT the consumption is expected to increase in about 24% in 2020 facing 2005. In the sectors of commercial and services, the consumption is expected to increase in 24% in the QUIT scenario, noticing the replacement of the use of gasoil for heating by electricity and solar.

4.2.3.2.3 Transports

The demand for this sector was estimated with a growth rate of 55% to 57% for passengers and 64% to 77% to goods in the period from 2005 until 2020. Even so, the consumption in the sector increases in 13% namely due to the use of new technologies:

- Hybrids representing 40% to 50% of the fleet
- Buses using natural gas representing 26% to 30%
- Biofuels use of about 10%
- Bigger share of diesel use to transport passengers and goods representing 75% to 80% of the energy consumption in the sector.

Besides this, it is considered that the light vehicles fleet is totally renewed in 2020, respecting the volunteer producers' agreement (ACEA).

4.2.3.2.4 Electricity production (including CHP)

This sector is characterized by a huge transformation, both in terms of installed capacity and consumption, to satisfy a higher demand for electricity as well as energetic profile towards the promotion of the use of RES. The installed capacity from RES rises from 48% in 2007 to 54% in 2020. According to the policy instruments available, between 2005 and 2020 the electricity production plants are to increase in 6% in WEM scenario and 76% in WAM. This growth is done towards:

- Technologies based in the use of gas, including the four CHP
- On-shore wind platforms, with higher installed capacity of about 4 to 8 times for 2020 facing 2005
- Higher hydro installed capacity in 17% for WAM and 44% in WEM.

Besides these major investments, also to note is the higher use of technologies to use RES such as biogas, forestry biomass CHPs, valorisation of waste, waves, geothermic and solar.

4.2.4 Sensitivity analysis

In order to consider the main sources of uncertainty associated with the modelling the sensitivity analysis was focused on the factors that have more impact in the energy sector: hydro potential for the production of electricity (measured through the Producible Hydroelectric Index – PHI, having 0.885 as the baseline) and primary energy prices.

In the first, two scenarios were considered:

3. wet year (high PHI = 1.090)
4. dry year (low PHI = 0.336).

In the case of the primary energy prices, for the sensitivity analysis, the high scenario was based on the work of the International and of the USA Energy Agencies that was validated by national experts. The prices for natural gas and coal assuming the relation among crude oil and other fossil fuels' prices equivalent to the scenario Hugh Growth defines in World Energy Outlook 2007 from International Energy Agency.

Table 44. Prices associated with the importation of primary energy for sensitivity analysis.

Year	Crude oil		Natural Gas		Coal	
	($ 2207/bbl)		($ 2007/m^3)		($ 2207/ton)	
	Base	High	Base	High	Base	High
2000	35.84	35.84	0.21	0.21	35.25	35.25
2005	57.15	57.15	0.27	0.27	65.82	65.82
2010	53.53	93.28	0.22	0.39	50.85	85.04
2015	56.08	97.13	0.24	0.41	55.68	86.02
2020	58.75	101.15	0.25	0.43	58.21	87.01

Source: CECAC, 2009

The main results are:

- Low PHI: the reduction of hydroelectricity production is compensated by wind, in WAM and especially in WEM (+40%) and also by solar in WAM (+6%). The total contribution of the RES in primary energy diminishes to 23% - 29% when in the base scenario was 25% - 34%.
- High PHI: in the WEM scenario, the contribution of the hydro production is higher in +9%. This implies a reduction in the consumption of natural gas of -2% and of -1% in solar. In WAM the higher PHI has no impact, once the cogeneration is prevalent. This way, the contribution of RES in WEM is only +1% higher, with negligent impact in the scenarios.
- High prices of primary energy: in all the scenarios, there is a reduction in the consumption of natural gas. This implies a reduction on the new cogenerations and in the consumption in industry's boilers and ovens. Alternatively, fuel oil and biomass use are promoted. Therefore, in WEM the higher prices of the primary energy induct a higher consumption of fossil fuels (+10% in WEM). Also to be noted is an increased consumption of biogas (+14%), biomass (+5%) and waste (+4%) for electricity production, what represents a slightly higher use of RES in WEM.

For all the scenarios considered (base and sensitivity analysis) the external dependency in 2020 never is below than 66%. Obviously, the increase in the prices of the primary energy and the hydro potential contribute to reduce external dependency: WEM is the "most dependent" scenario (74% to 77%). The analysis of the GHG emissions is presented in Table 45.

Table 45. Variation of GHG emissions in 2020 in the various sensitivity and scenarios (relative to Base).

2020 vs. 2005 (%)	Low PHI		High PHI		Crude oil $100/bbl	
	WEM	WAM	WEM	WAM	WEM	WAM
Non EU-ETS						

2020 vs. 2005 (%)	Low PHI		High PHI		Crude oil $100/bbl	
	WEM	WAM	WEM	WAM	WEM	WAM
Energy	-7	1	0	0	-20	0
Industry and solvent use	-5	23	-2	0	5	2
Transports	0	0	0	0	0	0
Tertiary	0	2	0	0	-2	0
Domestic	0	5	-11	0	-13	-11
F-gases	0	0	0	0	0	0
Agriculture	0	0	0	0	0	0
Waste	0	0	0	0	0	0
Non EU-ETS total	**-1**	**2**	**-1**	**0**	**-1**	**0**
			ETS			
Thermoelectric	4	0	0	0	0	0
Cogeneration	93	2	-1	0	18	0
Ceramics	0	1	-1	0	3	0
Cement	0	0	0	0	0	0
Chemistry	-7	27	0	0	10	-2
Combustion	-2	9	-1	0	2	1
Iron	0	0	0	0	0	0
Refining	0	0	0	0	1	0
Pulp and paper	0	-36	0	0	39	-11
Glass	0	0	0	0	0	0
EU-ETS total	**4**	**2**	**0**	**0**	**2**	**0**

Source: CECAC, 2009

In non EU-ETS sectors, the various sensitivity analyses do not imply any changes in the GHG emissions associated with transports and energy consumption in agriculture, once the energy alternatives are not competitive even with higher primary energy prices. In the remaining sectors:

- Low PHI: has different impacts in the cogeneration – high emissions in WAM and lower in WEM. This is due to the lower production by hydro, compensated in WEM by wind and in WAM by a bigger use of natural gas in cogeneration. In the residential sector, there significant increases of GHG emissions in WAM, due to the substitution of electricity by natural gas.
- High PHI: GHG emissions reductions in non EU-ETS sectors are observed only in WEM in energy supply, industry, tertiary and residential. These reductions are due to the substitution of natural gas by electricity and to a lower cogeneration activity.
- High prices of primary energy: this induces a significant reduction of the GHG emissions in non EU-ETS in WEM since cogeneration. In services and residential there are also reductions, induced by the witching of natural gas by electricity, insulation and solar. In industry, there are slight increases in both WEM and WAM, since no new investments are made and fuel oil. There is also an increase in the use of electricity and biomass, but the global effect is the increase in the emissions.

Considering the activities under EU-ETS, the emissions of cement, glass and iron production do not change since there are no technological alternatives. The emissions of the thermoelectric centrals are only altered facing a lower PHI in WEM (+4%), due to a higher activity in the combined cycle centrals. To the remaining EU-ETS sectors, the principal changes are:

- Low PHI: there is an increase of the GHG emissions in cogeneration (higher natural gas consumption) in ceramics, chemistry and combustion in WAM. WEM is less sensitive to PHI since there are more RES options. The GHG emissions reductions in pulp and paper are due to a higher use of the heat produced in the cogeneration using biomass instead of natural gas and electricity.
- High PHI: justifies keeping the existing fuel oil cogeneration facilities, instead of investing in new more efficient technologies.
- High prices of primary energy: leads to significant increases of cogeneration emissions in chemistry, ceramics and combustion facilities (only in WEM) and pulp and paper. This is due (as above) to a shorter investment in new equipments.

Globally, it is concluded that the Portuguese energy system in sensible to the hydroelectricity production potential: in EU-ETS activities there can be an increase from +4% to +11%.

In what concerns higher prices of primary energy, there is a lower increase in EU-ETS activities (+2% to +4%) and -2% to -1% in non EU-ETS emissions.

5 Impacts, Vulnerability and Adaptation

5.1 Climate Change Impacts

The "Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures" (SIAM) project was the most comprehensive and integrated assessment on the impacts and vulnerability associated to climate change in Portugal and was also the first one in the southern Europe. It was initiated in the middle of 1999 and was financed by two Foundations; Calouste de Gulbenkian and Science and Technology.

The aim of SIAM project was to become the most comprehensive and integrated assessment on the impacts and vulnerability associated with climate change in mainland Portugal in the 21st century. This study was based on future climate scenarios derived from atmosphere general circulation models, analysing its effects on a number of socio-economic sectors and biophysical systems including hydrological resources, coastal areas, energy, forests and biodiversity, fishing, agriculture and health. A sociological analysis on the climate change problem in Portugal was also performed.

The second phase of SIAM project (SIAM II) has begun in January 2002 and focused on the area of the Sado estuary and was widened to include to the autonomous regions of the Azores and Madeira. SIAM II also included the simultaneously dissemination of the results obtained in the previous phase among the various stakeholders while collecting inputs for the SIAM II, through consultation. The SIAM II was funded by APA.

5.1.1 Climate Scenarios and Main Impacts

The different climate scenarios show significant change to the Portuguese climate. A systematic increase in temperature in the order of 3 ºC to 7 ºC is estimated for the summer season in continental Portugal, affecting in particular inland Northern and Central regions. Increased frequency and intensity of heat waves is also foreseen. In the islands, the temperature increase is estimated to be more moderate, in the order of 1 ºC to 2 ºC in Azores and 2 ºC to 3 ºC in Madeira.

As a result of a reduction of the rainy season, different scenarios forecast a reduction in annual rainfall in the continent by 20% to 40% of current levels. The majority of the models predict a moderate increase in rainfall in the North in the winter season for the period 2070-2099 relative to the baseline period of 1961-1990. Model projections are more variable for the Centre and South in the winter season within this same period. A generalised reduction in rainfall is projected, particularly in the spring and autumn.

A significant reduction (about 30%) in annual precipitation is also projected for Madeira during this period. In the Azores, changes are predicted in the annual rainfall cycle but without substantial impact on total precipitation.

The main impacts identified in the SIAM project include:

- probable changes in flood and drought regimes, as well as changes in the quality and availability of water;
- significant increase in the risk of fire hazards;
- considerable increase in air pollution levels and ecological disturbances, which may lead to significant changes in the dynamics of infectious disease transmission as well as regional variations in agricultural productivity;
- increase of the erosion processes and consequently of the flooded areas;
- reduction in the yield of irrigated crops.

5.1.1.1 Climate Scenarios in Mainland Portugal

Climate scenarios for continental Portugal were obtained in this study by using versions 2 and 3 of the regional model from the Hadley Centre (HadRM). These models offered a better spatial definition compared to other global models. Both HadRM2 and HadRM3 models offer a horizontal grid spacing of approximately 50 km. HadRM3 covers eastern regions of the North Atlantic (excluding Azores and Madeira) and continental Europe. Daily and monthly data from several meteorological parameters simulated by HadRM2 and HadRM3 models served as a platform for the climate scenarios. Data for the HadRM2 and HadRM3 models were obtained from the scenario IS92a or SRES (Special Report Emission Scenarios) A2 and B2 scenarios, respectively. Data from two simulations were used in the IS92a scenario: a control simulation where the level of CO_2 was kept constant (323 ppm) and comparable to levels during 1961-1990, and a simulation with CO_2 concentrations increasing at a rate of 1% per year from 1990.

SIAM (first phase) applied the IS92a emissions scenario, which predicted a doubling of the concentration of CO_2 by the end of the 21st century relative to 1990. The new SRES scenarios consider a wider combination of factors than the IS92a scenarios in forecasting possible emissions trends. There are four SRES scenario families: A1 ("Global Economy" or "Comfort and Efficiency without Borders"), A2 ("Protectionism" or "Regional Self-sufficiency"), B1 ("Global Sustainability"), B2 ("Rural Sustainability" or "Back to Nature and the Community"), where A1 is subdivided in three groups, A1FI (Fossil Intensive), A1T (Predominantly non-fossil fuel) and A1B (Balanced).

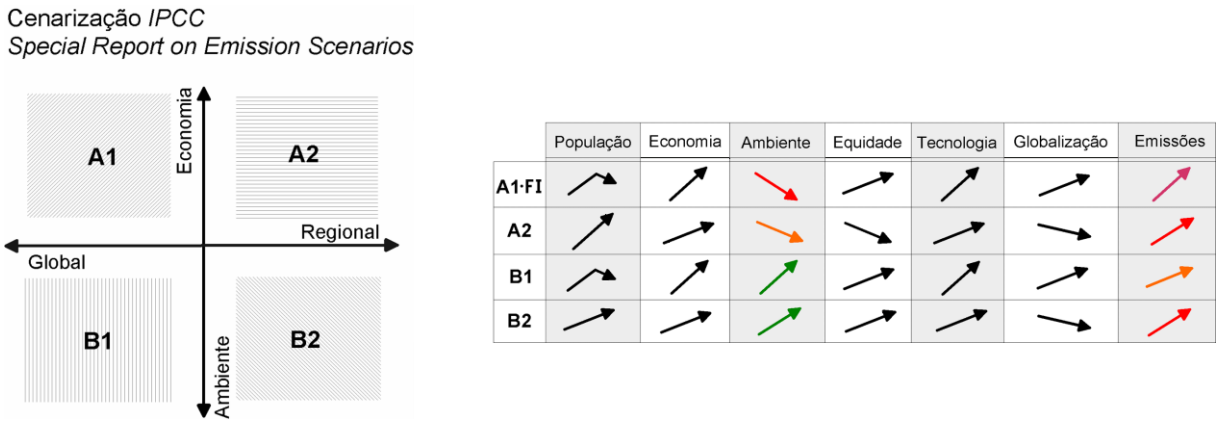

Figure 55. Long-term IPCC scenarios: SRES scenarios, dominated by governance type (horizontal axis) and predominant values (vertical axis) (left) and storylines of the SRES scenarios at a global level; FI is a variant of the A1 scenario (right)

Source: Santos *et al.*, 2006

Atmospheric concentrations of CO_2 generated by the IS92a and different SRES scenarios are shown in Figure 56. By 2100, atmospheric CO_2 concentrations are projected to vary between 540 ppm (B1) to 970 ppm (A1F1), 90% to 250% above the respective concentration in 1750 (280 ppm). The IS92a scenario is used as an intermediate scenario (compared to SRES scenarios) with atmospheric CO_2 concentrations reaching 705 ppm by 2100. Projections (using various models) for the period 2070-2090 include an increase in air temperature, accompanied by a decrease in annual rainfall, except in a case where aerosol effects are considered. In general these models show deviations in air temperature varying between 3ºC and 7ºC in the western parts of the Iberian Peninsula.

The results of all simulations show a positive trend in the mean air temperature for the Iberian Peninsula in the 21st century. In 2100, air temperature deviations vary between 1.7 ºC and 7.0 ºC compared to the control simulation. Throughout the 20th century the models predict a small increase in the mean air temperature; this is particularly the case in the last quarter of a century, coinciding approximately with the latest period of local and global warming.

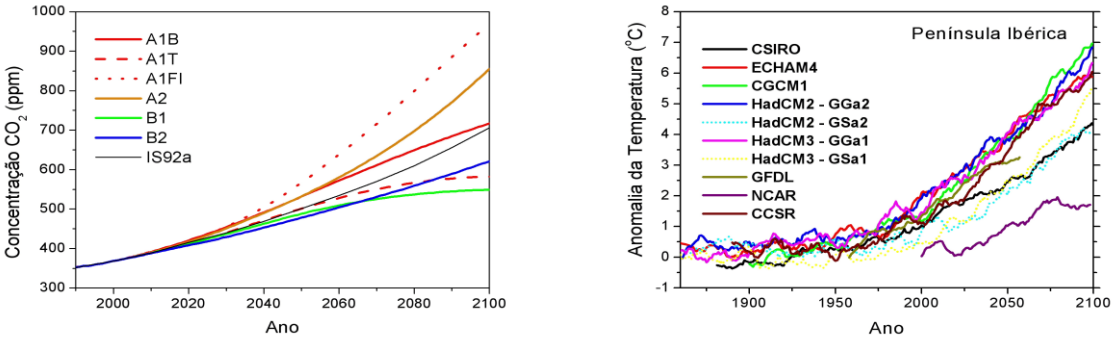

Figure 56. SRES scenarios for atmospheric CO_2 concentration (A1B, A1T, A1FI, A2, B1 and B2); and trends in mean air temperature deviations for the Iberian Peninsula using various atmosphere general circulation models (AGCMs), calculated from the difference in simulations of increased CO_2 concentration (scenario IS92a) and control simulations; moving average of 10 years applied to annual series

Source: Santos *et al.*, 2006

5.1.1.2 Climate scenarios for Azores and Madeira

The simple, stationary CIELO (*Clima Insular à Escala Local*) model was used for the Azores and Madeira. This model incorporates air temperature, pressure, rainfall and wind speed values observed in a reference station near sea level. Following altimetric correction, these values are used as a representation of the thermodynamic state of a nearly-saturated air particle over the ocean.

For the period 2070-2099, the A2 scenario predicts deviations in maximum temperature in the summer by +2.0ºC in Madeira, whilst in the Azores the deviation is predicted to be moderately lower, between +1.0 ºC and +2.0 ºC. In the less extreme scenario of B2, both Madeira and Azores experience an increase in the maximum temperature in the summer between 1 ºC and 2 ºC.

The A2 scenario shows an increase in the minimum temperature in winter of approximately 2.5 ºC in Madeira and varying between 1.5 ºC and 2.0 ºC in the Azores. In the B2 scenario the increase in temperature is moderately greater than 1.5 ºC in Madeira and in the order of 1. 0ºC in the Azores. The most significant winter temperature deviations are projected for the African continent, not for the Iberian Peninsula as happened in the case of Summer temperature. The A2 scenario forecasts, for 2070-2099, a slight increase of the winter's precipitation deviations in latitudes greater than 35 ºN, including the Azores, and a decrease in the precipitation observed below this latitude. Thus the model predicts a reduction of 20% in the winter precipitation for Madeira and an increase in the Azores precipitation of 10%. Still in the context of the A2 scenario, the summer precipitation deviation values are predominately negative in the Northeast Atlantic, with the exception of the Northern African coast and the Southern continental Portugal, where maximum precipitation levels increase significantly, by up to 90%. This exception also applies to the Western Mediterranean close to the Spanish coast. Madeira is located in a region where the summer precipitation deviation is positive, in the order of 40%. In contrast, the model predicts a loss in precipitation greater than 20% in the Azores summer.

In scenario B2, winter precipitation deviations for Madeira are negative and slightly more significant than those of scenario A2, whilst for the Azores they are comparable (positive). Madeira presents a more moderate increase in summer precipitation in scenario B2 (20%) compared to scenario A2, whilst the decrease in precipitation in the Azores region is between 10% and 20%, values lower than those projected under scenario A2.

5.2 National Strategy for Adaptation to Climate Change

Answering to the need of preparing the country for more intense and frequent impacts of climate change, the Portuguese government decided to start working on a National Strategy for Adaptation to Climate Change.

The proposal was presented with a set of tracks to guide to Portugal on the task of preparing itself for the more likely climate changes – and respond with appropriate adaptation measures to be implemented by several sectors. Indeed, the theme of climate change in general, and adaptation to its effects in particular, are highly cross-challenges that require the involvement of a wide range of sectors and an integrated approach. This is definitely the philosophy of the Portuguese Strategy.

Therefore, at present, the Strategy is mainly programmatic, defining the guidelines for action for the next years, being periodically updated and defined within the various sectors by the public administration and the remaining stakeholders. This strategy is intended to be the first step in preparing Portugal for the challenges of adapting to a changing climate.

Main steps of the Strategy preparation

- 25th of March – meeting of the Climate Change Comission (CCC)
  - Presentation and discussion of the Strategy's first version
  - Decision to create a working group to develop the proposal
- 27th of April – Adaptation Working group (WG) officially created
- April/July – Adaptation WG meetings
- 8th of July – CCC Meeting
  - Public discussion of the proposal presented
- 17th of July / 4th of September – Public discussion
- January 2010 – Expected adoption by the Government

5.2.1 Strategy's Main Objectives

The national strategy for adaptation to climate change is structured under four objectives, presented in the following table:

Objectives of the National Strategy for Adaptation to Climate Change	
Objective 1:	**Information and Knowledge** Understand, identify and anticipate the vulnerabilities and impacts from climate change across sectors, and methodologies for the identification of adaptation measures, analysis of its feasibility and assessment of costs and benefits
Objective 2:	**Reducing Vulnerability and Increasing Responsiveness** Identify measures, set priorities, implement actions that reduce the vulnerability of various sectors to more likely and more disturbing climate change, and implement actions to improve the efficiency of response to the impacts resulting from climate change, in particularly extreme weather events
Objective 3:	**Participation, raising awareness and dissemination** Generating a high level of involvement and public participation on the definition and implementation of the strategy, make clear to citizens, businesses and other social agents the main expected impacts, and disseminate best adaptation sectoral practices
Objective 4:	**International co-operation** Monitor international negotiations on adaptation to climate change and support the implementation of adaptation actions in the most vulnerable countries, particularly in the context of the CPLP

5.2.2 The Strategic Areas for Adaptation to Climate Change

In preparing the draft strategy, the Working Group considered that the most efficient approach to identify impacts and adaptation measures was a sectoral approach. A sector approach is justified if we consider two kinds of considerations:

- First, the fact that each sector will be affected differently by climate change, justifies an analysis and reflection very focused on the major threats (and opportunities eventually) affecting each sector in particular;

- On the other hand, stakeholders in each sector are also different between sectors and the involvement and commitment of public and private actors is perhaps higher in smaller groups, more thematically focused and with more homogeneous interests.

Despite the advantages of this model, the working group also identified the need not to overlook the functional interrelationships between some of the areas and sectors identified, so it's necessary to try to maximize possible synergies and avoid creating adverse effects between the measures adaptation identified for each area or sector.

Notwithstanding, during the work, other areas and sectors are identified, the strategy will focus initially on identifying and defining impacts of adaptation measures in the areas identified in Figure 57.

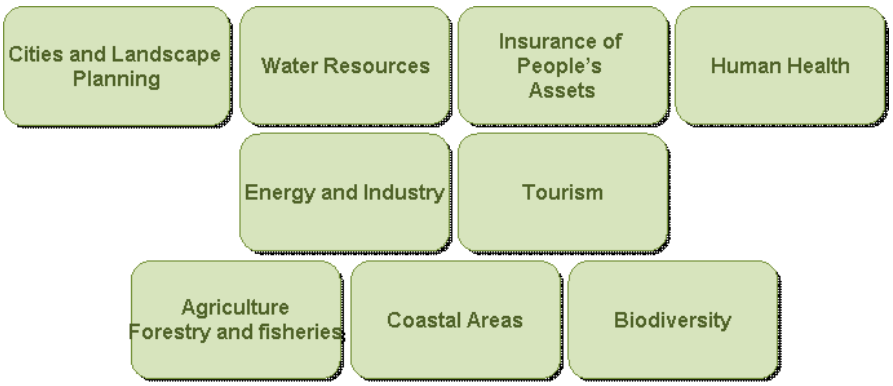

Figure 57. Sectors identified in the scope National Strategy for Adaptation to Climate Change

5.2.3 Methodology for Identification and Implementation of Adaptation Measures

The strategy defines the socio-economic and climate scenarios that will be used to anticipate a range of future impacts. These impacts are often seen as negative but there is also a set of opportunities.

The answer to climate change will involve, therefore, an iterative process of risk management including adaptation and mitigation and takes into account the benefits and damages caused by climate change, sustainability, equity and attitude towards risk.

Adaptation measures are an answer that the various decision makers and managers should take in consideration to address the risks and impacts of climate change that have been previously identified and mainstream in their planning. The aim of these measures are various, offsetting or substantially reducing the risk of harm, maximizing the expected benefits, reducing or mitigating the consequences impacts resulting from climate change.

From transition to practice these measures should be preceded by an analysis of the expected benefits (which depend on the impact and which mitigates the likelihood of it occurring), and the costs incurred in implementing this measure of adaptation.

Once implemented, the success of these adaptation measures shall be evaluated. In addition to the technical rectification, this assessment should be extended to the analysis of the benefits of the measure, the degree of the climate impact and the associated risk and the way how science has evolved, underpinning the development of climate scenarios and the identification of potential impacts.

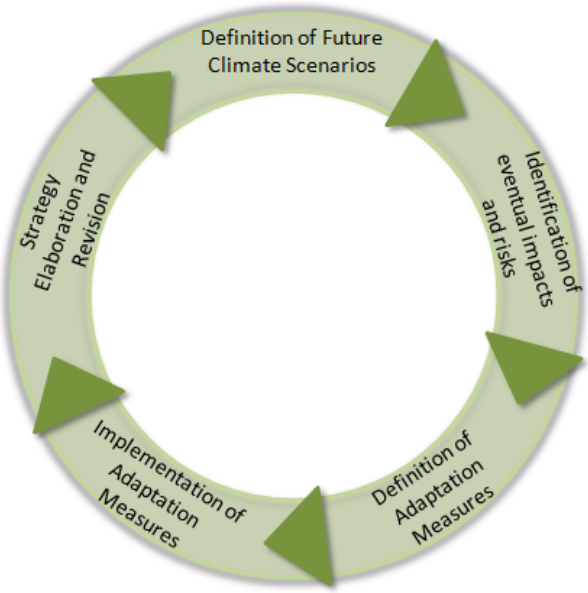

Figure 58. General Methodology for Identification and Implementation of Adaptation Measures

5.2.4 Development and implementation of a National Adaptation Strategy

The operationalization of such a strategy requires a flexible organizational structure and a set of dynamics to improve the maximization of the effectiveness in the application of efforts and resources, developing and strengthening partnerships. It is intended, therefore, the mobilization of the Portuguese society, the array of social partners and each individual citizen, aiming at the inclusion of specific actions to reduce climate change impacts vulnerability. To ensure the proper implementation of the strategy, it includes assessment, monitoring and evaluation' mechanisms.

The implementation of this strategy will be supported by a coordination group in sectoral working groups and a scientific panel (Figure 59).

Given its inter-sectoral coverage, the implementation of the strategy should be coordinated by the Interministerial Commission on Climate Change, supported by its Executive Committee (CECAC). In particular the group coordinator should be joined by all coordinators of the sectoral working groups, as well as representatives of the Autonomous Regions and the National Association of Portuguese Municipalities (ANMP).

The core competencies of the coordination group will be:

- The relationship between the various actors and partners
- Endorsement of the scheduled activities
- The monitoring of the implementation of the strategy and reporting its progress
- The development of specific actions in the area of information and knowledge, awareness and information and international cooperation[87]
- The overall coordination of the sectoral working groups' work and consolidation of the results achieved by them
- The preparation of proposals for the periodic strategy revision.

[87] Nevertheless the identification of actions in these three areas, they may be coordinated by other entities, such as the IPAD in the case of international cooperation, or the Meteorology's Institute in case is necessary to upgrade the climate scenarios for all sectors covered by the strategy.

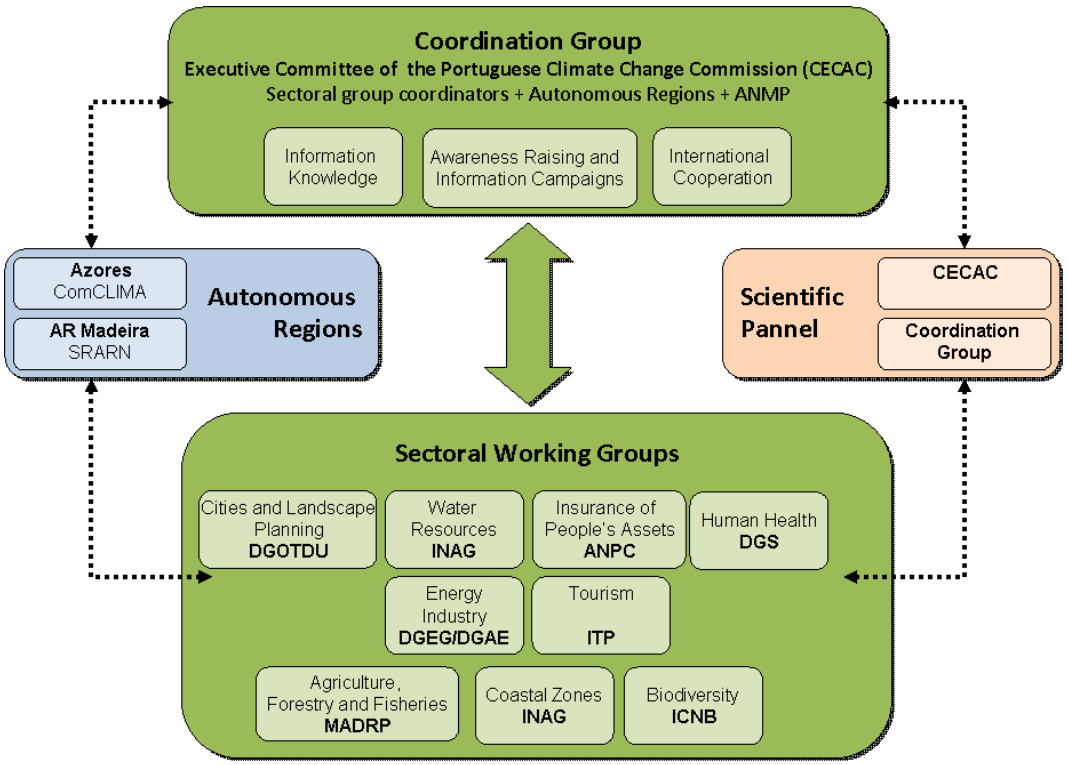

Figure 59. Proposed framework for the constitution of the Working Groups associated with the definition of the Adaptation Strategy.

The Scientific Panel will consist of permanent members, which should be nominated within the CECAC, and sectoral working groups according, created by the coordination group.

The structure of the Scientific Panel regarding the implementation of this strategy aims to support and advise the Steering Group and / or sectoral working groups to achieve their specific goals. For the purpose of supporting this strategy, this panel will meet twice a year, or extraordinary, by decision of the designated coordinator(s), or upon the request of its members.

The main goal of the working group of the Scientific Panel is to support the sectoral working groups and will involve researchers with expertise in the specific area of the respective sectoral working groups. This working group will be created by the steering group based on the proposals presented from the coordinators of the sectoral working groups.

5.3 Other adaptation projects

5.3.1 Madeira and Azores: CLIMAAT and CLIMAAT II

Given the geographical constraints (location), size and morphology, the Atlantic islands have specific relationship with the whole climate system that are not in line with the resolution scale of most of the weather information disclosed or with the methodologies of spatial generalization of the weather data used for the mainland regions or larger.

The CLIMAAT project "Climate and Meteorology of the Atlantic Archipelago", developed as part of the Community INTERREG_III B (for Azores, Madeira and the Canary Islands), aimed promote scientific cooperation with the main

purpose of developing specific methodologies for approaching the study of meteorology and climate regions of the Atlantic islands and its surroundings, particularly at a scale compatible with the generally applied purposes.

This project had the following objectives:

- The collection and compilation of relevant climate information and also its treatment and subsequent public disclosure for the possible applications
- The promotion of the geo-strategic position of the Atlantic islands as a basis for studies in the climatology and meteorology fields being ideal platforms for observation large areas of sparse monitoring points
- The implementation of scientific cooperation aimed at developing specific methodologies for approaching the study of the island climate and its surroundings, particularly at a scale compatible with most applied purposes.

In this context, the creation and operation of a monitoring cabinet to observe the Azores' atmosphere intends to make a decisive contribution to the monitoring and forecasting weather in the North Atlantic region and for the detection and understanding of changes on a global scale.

5.3.2 The Project "Impact of Climate Change on Biodiversity in Peninsular area Spain and Portugal"

Aware of the vulnerability of national biodiversity to climate change and the importance of deepening the knowledge on the subject, MAOT concluded in 2008 a Cooperation Protocol between the CECAC and ICNB, EDP[88] for the study of "Climate Change Impacts on Biodiversity in mainland Portugal".

This study is the national contribution to the project "Iberia-Change - Impacts of Climate Change on Biodiversity in Peninsular area of Spain and Portugal" resulting from the commitment made at the XXII Portugal Spain Summit held in 2006.

This project, which should be completed in late 2009, has the following main objectives:

- Prepare maps of the potential distributions, present and future, of a set rate of terrestrial vertebrate fauna of the Iberian Peninsula;
- Identify the 'winners' and 'losers'' species in terms of area of potential distribution in the context of climate change on the Iberian Peninsula;
- Identify the regions of 'winners' and 'losers'' species richness in the context of climate change on the Iberian Peninsula
- Identify mitigation and adaptation policies to the impacts of climate change and biodiversity conservation, common to the two Iberian states, for the conservation of vertebrate fauna in various climate change scenarios.

This project is the first initiative of this kind between neighbouring countries.

5.3.3 Project ENAAC-RH

The project sets itself to identify, discuss and build consensus on the main lines of action of a national strategy for climate change adaptation in the water resources' field. In particular, being the project funded by the Water's National Institute (INAG), seeks to identify concrete actions that INAG should develop or promote in the short or medium term.

[88] that, in its Biodiversity Policy and in its commitment to the Business and Biodiversity Initiative, has agreed to be a partner in this project

The actions to be included in the plan should be more concrete and linked to a priority level and a timeframe adequate for monitoring the implementation. Whenever possible the responsible agency should be identified for the development of each action.

Proposals should be based on existing studies regarding the evaluation of the climate change impacts, since the goal of the project is not the development of new studies in this field. While recognizing that our current knowledge about the vulnerability of water resources to climate change may still not be enough to justify the implementation of adaptation measures, it is likely that some of the proposed measures will improve our knowledge about the exposure, sensitivity and resilience the various components of the system of water resources to climate change. The project's main objective is to define the general principles relating to water resources and identification of adaptation measures, whose application may be initiated, with the current level of knowledge about the phenomenon of climate change and its impacts.

5.3.4 … in a Changing Climate

…in a Changing Climate – National Initiative of Adaptation to Climate Change launched a larger discussion on adaptation to climate change in Portugal, merging the public and private sectors and aiming at preparing the society and economy to an uncontainable reality.

This initiative included a International Conference, with participation of several experts, "Portugal in a Changing Climate", that occurred in June 2007. The initiative was planned to continue during 18 months, with a cycle of twelve workshops dedicated to several key socioeconomic sectors: Tourism, Banking and Insurance, Water, Energy, Agriculture and Forests, Biodiversity, Spatial Planning, Natural Disasters and Civil Protection, Coastal Zones, Human Health, and Cooperation and Foreign Investment.

Portugal In a Changing Climate
National Conference on Adaptation to Climate Change

The initiative, promoted by MAOT, the British Embassy in Lisbon and Ecoprogresso, accomplished the following main objectives:

- To promote the debate on adaptation to climate change and contribute to knowledge sharing with the poorest countries, in particular the Portuguese speaking ones
- To encourage the mainstreaming of impacts to climate change and adaptation on decision making processes.

… *in a Changing Climate* aimed at bringing together both the public and the private sector on the discussion about adaptation to climate change.

The target of the initiative ... *in a Changing Climate* included Businessman, Financial institutions (Banks and Insurers), Associations (Agriculture, Tourism, Forestry, and Industry, among others), Central Administration, Local governments, Non-Governmental Organizations (NGOs) for the Environment, Local Development and Cooperation, Project managers, Research institutions and the Scientific community.

6 Financial Commitments, Technology Transfer and International Cooperation

6.1 Background to the National Policy on Development Cooperation

Development cooperation policy is determined and coordinated by the Portuguese Government, with the direct participation of the parliament and the necessary involvement of all relevant stakeholders, namely public administration bodies, municipal authorities, non-governmental organisations, business associations, universities, foundations and other social institutions. The strategic guidelines for Portuguese Cooperation are defined in a document named *A Strategic Vision for Portuguese Cooperation*, approved by the Council of Ministers Resolution 196/2005, on the 24th of November.

The policy is defined in the frame of the International Development Agenda and in accordance with successive commitments undertaken in various international fora. It also aims at implementing, in a coherent, effective and up-to-date manner, a strategic cooperation framework whereby the fight against poverty, inequity and social exclusion in developing countries are high priorities. Furthermore, such policy will also reflect an enhanced inter-connection between bilateral and multilateral cooperation, so as facilitate a better integration of Portuguese cooperation and Official Development Assistance (ODA) in global strategies.

In this backdrop, environmental issues, particularly those pertaining to climate change, are included in cooperation and ODA in an integrated way and mainstreamed in other intervention sectors like agriculture, fisheries, industry and tourism.

In the Main Planning Options (GOP) 2005-2009[89] the policy aimed at reviving Portuguese Cooperation sought to achieve the following objective, "To correspond to international commitments with regard to the quantity and quality of Official Development Assistance, keeping in mind that the present international context, both in terms of the European Union as well as the commitments undertaken in multilateral terms, requires a great deal of dynamism and efficiency on the part of Portugal, namely, in attempting to fulfil the Millennium Development Goals"[90].

Likewise, the National Strategy for Sustainable Development (ENDS)[91] views global poverty and achieving sustainable development as a challenge to be overcome. The Sixth Objective of the ENDS frames international cooperation in a dimension of global sustainability, affirming that this should, "Contribute decisively towards global economic and social development, for the consolidation and reinforcement of peace, democracy, human rights and a Just State, towards reducing poverty and, in general, towards achieving the Millennium Development Goals, as well as a better and safer environment on a planetary scale and, especially, towards preserving the biodiversity and sustainability of eco-systems"[92] (IPAD, 2008).

[89] The **Main Planning Options** are outlined in a strategic document that was prepared by the Portuguese government and approved by the Portuguese parliament, which includes a definition of the main lines of action for the Executive branch of the government, based on the contents of its Programme.

[90] *Law 52/2005*, dated 31 August, which approves the *Main Planning Options for 2005-2009*, Chapter I, *5th Option – To Enhance Portugal's Foreign Positioning and Construct A Suitable Defence Policy to Enable A Better International Position for Portugal*, I. Foreign Policy. Available at: http://dre.pt/pdf1s/2005/08/167A00/51865284.pdf

[91] Approved by the Cabinet of the Portuguese Government, this Strategy seeks to delineate national actions in terms of contributing towards achieving sustainable development, in keeping with the European Strategy for Sustainable Development and the international commitments undertaken within the scope of the UN Conference on the Environment and Development (Rio de Janeiro, 1992), the Special Session of the United Nations General Assembly (1997), the World Summit on Sustainable Development (Johannesburg, 2002) and the World Summit of the United Nations (60th Plenary Session of the General Assembly, 2005).

[92] *Cabinet Resolution No. 109/2007*, dated 20 August, Part I, I. Introduction. Available at: http://dre.pt/pdf1s/2007/08/15900/0540405478.pdf

In the light of the various commitments undertaken by donors in recent years, development aid has become increasingly stringent, especially in structural terms. In order to achieve objectives, it is not enough to merely increase the volume of aid but it is essential to also improve the quality of aid so as to ensure a greater level of sustainability.

This need has been the subject of much debate in diverse international forums. The *Conference on Financing for Development* (Monterrey, 2002) was an emblematic event in this regard, having identified the challenges involved in seeking innovative sources of finance; a greater emphasis on the benefits to be derived from the relationship between the private sector/trade, financing and development; and greater leadership/responsibility on the part of partner countries in the overall process of development. Another fundamental aspect was the appeal made to donors to increase the amount of ODA they make available, as an essential tool to achieving the MDGs. In response to this appeal, the EU and its Member States have committed to specific goals to be achieved in terms of ODA/GNI (0.33% for each State in 2006, with a view towards achieving a collective EU target of 0.39% and an individual target of 0.51%, in 2010, and a collective target of 0.56%, so that, in 2015, the EU can achieve its objective of 0.7% ODA/GNI).

The *Paris Declaration on Aid Effectiveness* (2005) was decisive for the commitments of donors and partner countries in terms of changing practices with regard to the granting/management of aid, so as to ensure greater aid effectiveness. This document will be examined in greater detail in the chapter dedicated to the subject of Aid Effectiveness. However, it is essential to highlight this declaration as a fundamental input for the international strategy aimed at achieving the MDGs.

In keeping with these debates, the EU and its Member States have also been developing diverse reforms and new strategies concerning the delivery of aid. The *European Consensus on Development* (November 2005) is a paradigm of these new dynamics and the new realities in the world of development aid. It constitutes a matrix of principles and guidelines for EU Member States in this regard (IPAD, 2008).

In the light of this new scenario, Portugal, like many other donors, prepared a new strategy for its policy of cooperation, which was published in December 2005[93]. Via this new document, entitled *A Strategic Vision for Portuguese Development Cooperation*, an effort has been made to ensure greater clarity in terms of objectives and confer greater effectiveness to Portuguese Cooperation for Development, in harmony with international efforts to achieve the MDGs. Learning from international best practices and attempting to adapt them to its own situation, the Portuguese government has thus adopted a new policy for strategic management, which is aimed at implementing an integrated approach towards programming, monitoring, evaluation and a result oriented management that seeks to attain specific objectives.

An operational document was prepared to facilitate the implementation of this strategy, which encompasses the following dimensions: enacting terms, mechanisms and instruments and the multilateral framework of Portuguese Cooperation; support for the private sector; and the relationship between Portuguese Cooperation and civil society (IPAD, 2008).

The fundamental mission of Portuguese Cooperation, as defined in the *Strategic Vision*, is, "*To contribute towards achieving a better and more stable world, especially in Portuguese speaking countries, characterized by economic and social development and the consolidation and strengthening of peace, democracy, human rights and the rule of law*"[94].

[93] *Cabinet Resolution No. 196/2005*, dated 22 December 2005. Available at: http://dre.pt/pdf1sdip/2005/12/244B00/71807201.PDF

9 *Cabinet Resolution No. 196/2005*, dated 22 December

[94] *Cabinet Resolution No. 196/2005*, dated 22 December 2005, Part I, Point 3. *Guiding Principles*.

Five fundamental objectives were defined in order to achieve this mission, which today provide a framework for all the actions of Portuguese aid:

- To steadfastly pursue the MDGs
- To contribute towards reinforcing human security, especially in "Fragile States" or in post-conflict situations
- To support the diffusion and use of the Portuguese language, as an instrument for education and training
- To support economic development, with a view to ensuring social and environmental sustainability
- To participate more actively in international debates, to support the principle of international convergence around common goals.

With a view to ensuring greater rationality and effectiveness for its cooperation, Portugal has sought to follow the principle of concentrating its priorities, both at a geographical as well as a sectoral level, targeting them to achieve positive results in the quest to fulfill the MDGs.

In terms of geographical priorities, Portugal has always maintained a very close relationship with Portuguese speaking countries, owing to a common historical past. Angola, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome and Principe and Timor-Leste are thus the main partners of Portuguese Cooperation. However, since countries are not isolated units, it is necessary to view them in the regional context in which they are framed. Thus the new Strategic Vision for Portuguese Development Cooperation has also focused its attention on the regional areas in which its partner countries are located.

Sectoral priorities have also been defined, in association with these geographical priorities. Common historical and cultural ties have resulted in the creation of an institutional and juridical matrix in these Portuguese speaking partner countries that is similar to the existing matrix in Portugal. This has ensured that Portugal has comparative advantages as compared to other donors - especially in terms of historical and linguistic aspects - which have facilitated its support in certain sectors. In keeping with these factors, the following areas have been identified as priorities in terms of intervention:

- Good Governance, Participation and Democracy
- Sustainable Development and Poverty Reduction, with a special emphasis on the areas of Education, Health, Rural Development, Environment and Economic Growth/Generating Employment
- Education for Development.

The Portuguese Ministry for Foreign Affairs (MNE) is responsible for the Portuguese foreign policy namely for defining the policy guidelines, priorities and strategies of Portuguese Cooperation. In its turn, the Portuguese Institute for Development Assistance (IPAD) is responsible for implementation and coordinates Portuguese aid under the tutelage of the said Ministry.

Amongst other functions, IPAD has been entrusted with the following tasks[95]:

- To supervise, to orient and coordinate ODA
- To plan, programme, monitor and evaluate cooperation programmes and projects
- To provide a suitable framework for cooperation programmes and public development aid financed and implemented by other Portuguese state bodies and other public authorities
- To collect and compile information regarding actions developed by private entities
- To support initiatives undertaken by civil society with regard to development aid
- To ensure and coordinate Portuguese intervention in the area of humanitarian and urgent aid.

[95] For comprehensive information about the responsibilities and functions of IPAD, see Decree-Law No. 120/2007, published in the *Diário da República* gazette on 27 April 2007. Available at: http://www.ipad.mne.gov.pt/index.php?option=com_content&task=view&id=20&Itemid=51

In addition to these two coordinating entities, the Portuguese cooperation system also involves other public entities, such as institutions from the central and local administration, universities and public institutes, and is characterized by its broad based, high decentralized nature.

Along with public institutions, private entities such as Development NGOs or Foundations also assist the efforts of Portuguese Cooperation.

Given the multiplicity of these actors, it was necessary to create mechanisms that ensured greater rationality and efficiency for cooperation interventions, coordinating actions and making them more coherent. The new *Strategic Vision* document has sought to respond to this need through two essential measures.

On the one hand, the role of the Inter-Ministerial Commission for Cooperation (CIC) was revitalized. The CIC is a forum to concert sectoral efforts and an instrument for coordination between different state departments in the field of development cooperation, assisting in the tasks of planning, monitoring and implementing programmes and projects. The CIC holds meetings of its Permanent Secretariat96, in which the sectoral ministries are generally represented by their respective Departments of International Relations. These departments are responsible for circulating the strategic guidelines pertaining to the cooperation policy, as well as their coordination within the scope of intervention by their ministry.

On the other hand, the government sought to ensure a greater articulation between the public and private sectors, creating the Development Cooperation Forum (FCD). The purpose of this forum is the coordination among central state administration, civil society and local administration and to thus catalyze synergies and promote forms of complementarily between the actions being developed.

In order to carry out the coordination functions that have been attributed to it, IPAD has three fundamental instruments at its disposal: the coordination of the Budgetary Programme for Development Cooperation (PO05), the management of the Portuguese Cooperation Database and the preparation of the Indicative Cooperation Programmes.

Created in 2004, the Budgetary Programme for Development Cooperation (PO05) was developed as a budgetary programming instrument, which outlines the allocation of funds to commitments undertaken by Portugal in the context of Cooperation. It is coordinated by the Ministry for Foreign Affairs, through IPAD. The PO05 is one of the fundamental mechanisms in terms of aid predictability, since it provides a clearer idea of what each Ministry intends to spend; coordination, since it results in a lesser dispersion of funds, which frequently occurs when there are multiple agents/executors; and accountability, since during the process of allocating funds for cooperation in the State Budget, targets and indicators are associated with each action that is to be funded.

Ever since it was created, the structure and functioning of the PO05 has been improved, which reflects how important and necessary this mechanism is, not just for the granting of aid but also, mainly, for its effectiveness. In the wake of the Portuguese government's strategy to implement the Performance Budgeting system, to be concluded in 2010, the PO05 was selected as a Pilot Programme for this initiative since it met all the required criteria. A central element in terms of budgeting for programmes is a shift in focus, which is now aimed more at results instead of focusing on resources, with clearly defined and monitored goals and objectives. Another significant aspect is its pluriannual nature. This implies that it is essential to plan and define objectives and goals on a pluriannual basis and that supporting financial resources have to be attributed in a similar timeframe. These characteristics ensure that the PO05 initiative makes Portuguese aid more predictable, due to its pluriannual commitments, and will also improve the quality of aid, owing to a greater concentration on the results. This innovative PO05 initiative is scheduled to be introduced in the 2009 State Budget.

[96] The Permanent Secretariat comprises representatives from the sectoral ministries and is presided over by the president of IPAD.

The Portuguese Cooperation Database is another essential instrument for the centralization, coordination and management of official information about cooperation activities. Every year, IPAD collects information about the cooperation activities developed by different agents and compiles it in this Database, thus enabling a reliable monitoring of Portuguese aid flows and activities. This instrument was designed according OECD/DAC statistical system and is close linked to it.

As for the Indicative Cooperation Programmes, these are strategic documents that guide Portuguese Cooperation with Portugal's main partner countries. In 2006, Portugal adopted a new strategy for these Programmes, which is based on the Common EU Country Strategic Programme Framework. This strategy essentially seeks to institute a common format in keeping with the EU programming framework. The document entitled Guidelines for the PICs 2007-2009 establishes the following objectives for all Portuguese Cooperation Programmes:

Global:

To contribute towards reducing poverty, via a medium term approach that allows the promotion of sustainable economic and human development.

Specific:

To support the process of good governance and reinforce institutional capacities in a long and medium term perspective, so as to reinforce the capacity to provide services to the population, transparency, a democratic culture and human rights.

To promote decentralization, namely via social and community development actions, so as to contribute more directly towards improving living conditions for inhabitants.

These objectives must be implemented keeping in mind questions such as a concentration on geographical and priority areas; the incorporation of transversal questions, coordination and complementarily with other donors; greater integration of actions into multilateral projects; and greater participation by civil society and the private sector.

In the two Forums for Aid Effectiveness, Portugal pledged to change its development aid practices. In order to implement this commitment, Portuguese Cooperation prepared two Action Plans: *Portugal's Action Plan for Harmonization*[97], prepared by Portuguese Cooperation in 2005, as a manifestation of the commitments undertaken within the Rome Declaration; and *Portugal's Action Plan for Aid Effectiveness*[98], prepared in the wake of the II High Level Forum for Aid Effectiveness.

Portugal's Action Plan for Aid Effectiveness incorporates the measures defined in the *Action Plan for Harmonization* and adds other measures that, in their turn, translate into goals with timeframes. These measures and goals are structured towards each of the dimensions of the partnership commitments: Appropriation, Alignment, Harmonization, Result Oriented Management and Mutual Accountability. The implementation of this Plan is currently being evaluated internally by the IPAD.

Portuguese Cooperation likewise seeks to integrate the commitments undertaken within the framework of the European Union with regard to Aid Effectiveness. In addition to incorporating the recommendations contained in the Paris Declaration, Portugal also follows EU guidelines outlined, amongst other documents, in the *Aid Effectiveness Package* (2006), which includes three essential communiqués aimed at improving the quantity and quality of aid: "*Joint Programming Framework*"[99], "*Delivering Aid: More, Faster and Better*"[100] and "*Financing for Development and Aid*

[97] Available at: http://www.ipad.mne.gov.pt/images/stories/APD/ha_planodeaccao.pdf

[98] Available at: http://www.ipad.mne.gov.pt/images/stories/APD/PlanoEficaciaAjudaEn.pdf (English version)

[99] COM(2006)88

[100] COM(2006)87

Effectiveness – Scaling Up Aid 2006-2010"[101] . These three communications seek to establish a concrete strategy to be adopted by EU Member States in order to achieve the MDGs.

In 2008, the European Commission issued the Communication entitled "*The EU – A Global Partner for Development - Speeding Up Progress Towards the Millennium Development Goals"*[102], which analyzed the EU's contribution towards achieving the MDGs and suggested ways of overcoming the obstacles that had been identified in the process. This Communication is an important EU manual in terms of aid effectiveness and serves as an input not just for the next High Level Forum on Aid Effectiveness (Accra, September 2008), but also for the subsequent period. As an EU Member State Portugal follows this document.

Financial Planning and Budgeting mechanisms for Portuguese Cooperation were reinforced and improved in order to comply with the international commitments, such as the earmarking of 0.33% of Gross National Income[103] (GNI) to ODA by 2006. In this context, the creation of the Budgetary Programme for Portuguese Cooperation (P5), under the State Budget, was of special relevance, as it aims to concentrate and budget all cooperation activities developed by Portuguese Public Administration bodies. This programme constitutes an important instrument for compliance with guidelines, priorities and objectives in the context of policy for development cooperation, conferring more predictability, coherence and transparency to cooperation and ODA.

Other commitments were agreed in the context of the European Union (EU) in important areas for sustainable development, namely the untying of aid[104], technical assistance related to trade, new forms of partnerships for the management and financing of global commons, and environmental conservation, policy coordination and harmonisation of procedures.

Despite having reaffirmed its commitment to the pledges undertaken in the context of global efforts to achieve the MDGs, Portugal has faced serious difficulties in increasing its ODA. It is impossible to ignore the fact that most Portuguese ODA is still derived from the State Budget. In a phase of strict budgetary restrictions imposed in order to reduce the national deficit, this fact makes it difficult to increase sums allocated to ODA without having a serious impact on Portugal's public finances. Future international financial commitments will require Portugal to achieve a ratio of 0.51% ODA/GNI in 2010 and 0.7% ODA/GNI in 2015. For this to be possible, the proposal for the Main Planning Options for 2009 has established an intermediary target of 0.45%, which, upon being approved by Parliament, will entail a greater financial effort on the part of the entire central administration.

Between 2003 and 2006, the volume of Portuguese ODA recorded a slight tendency to grow, with the exception of 2004, a year in which the restructuring of Angola's debt (562 M€) caused an exponential rise in aid figures. In 2006, European donors were put to the test before the goal established by the EU to achieve an ODA/GNI ratio of 0.33%.

The ratio of Portuguese aid was about 0.21%, below the EU target. The difficulties in honoring this commitment had, in large measure, to do with the Portuguese government's efforts to control Portugal's public deficit and budgetary consolidation, in order to fulfill the rules established by the EU Stability and Growth Pact. In 2007, this ratio grew slightly and was 0.22% ODA/GNI.

Table 46, below, shows ODA net figures from 2004 to 2007.

[101] COM(2006)85

[102] COM(2008)177

[103] Gross National Income (adopted as an indicator by DAC/OECD in 2000, with data revised until 1995).

[104] Tied aid refers to loans and grants whose concession to the beneficiary country is linked to the acquisition of goods and services from the donor country.

Table 46. Portuguese ODA disbursed between 2004 and 2007

	2004	2006	2007
Net ODA (MEuros)	1.031	396	344
ODA/GNI (%)	0.63	0.21	0.22

Source: IPAD, 2008

Most aid is channeled bilaterally - an average of 61% of total ODA, from 2002 to 2007. However, the relative importance of Bilateral ODA, as compared to Multilateral ODA, has reduced progressively during this period, although it still exceeds 50% of total ODA annually.

Table 47. Evolution of Portuguese Multilateral ODA in terms of Total ODA 2004-2007

	2004	2006	2007
Multilateral ODA (% net ODA)	15.4	46.7	43.6

Source: IPAD, 2008

Portugal has traditionally had a high percentage of untied aid. Between 1995 and 2007, untied aid represented an average of 84% of total ODA. In terms of international practices, Portuguese Cooperation has implemented the *DAC Recommendation on Untying Bilateral Development Assistance to Least Developed Countries* (LDCs). It has also joined the international consensus to eliminate minimum untying limits for the activities covered by the Recommendation and approved the option of extending the Recommendation's coverage to include *Heavily Indebted Poor Countries* (HIPCs) that are not LDCs.

With regard to the procedures of *procurement (processes to acquire goods and services), Portuguese Cooperation has clearly given priority to local and regional procurement*, thus seeking to stimulate local/regional economies. Procurement from Portugal is used only when local procurement proves to be impossible.

The main modality of Portuguese ODA is Technical Assistance, with an annual average that is generally above 50%, owing to the emphasis on the sector of Education and programmes for technical assistance and training. This is also facilitated by the very similar institutional and juridical matrix that exists between Portugal, PALOP and Timor-Leste. Investment projects, debt reorganization, debt forgiveness and direct budget support are modalities that are likewise used by Portuguese Cooperation.

Portuguese ODA is traditionally highly concessional. Most aid is distributed in the form of grants.

Portugal delivers its ODA mainly through Technical Assistance and debt relief activities, and to a lesser degree but still noteworthy, direct government budget support of some partner countries and emergency and reconstruction aid. Tied aid has essentially occurred through the financing of small projects and the support to import programmes of consumer goods and equipment.

Technical Cooperation (TC) is the most important item of bilateral assistance, facilitated by the historical and cultural ties and the institutional and legal frameworks common to Portugal and its partner countries. Technical cooperation is developed mainly through sectoral programmes or projects covering, among other activities, teacher training, placement of aid workers, scholarship awards (not only for studies in Portugal but also in schools within the beneficiary country) and technical assistance for capacity-building of third country institutions.

6.2 Financial Commitments and Multilateral Cooperation

Multilateral development cooperation policy is seen as an essential complement to bilateral cooperation, as well as a means of reinforcing Portugal's integration in the international system of development support. Portugal is in compliance with the commitments that the international donor community has made at multilateral fora, namely in terms of resource allocation and improved effectiveness of ODA.

While the main beneficiaries of bilateral ODA are PALOP and Timor-Leste, the major share of multilateral Portuguese aid goes to the European Union, as a result of contributions to the European Development Fund (EDF), which finances EU aid to ACP (Africa, Caribbean, Pacific) countries, and to the European Commission Budget for External Aid, which finances aid to developing countries that are not covered by the EDF.

At a multilateral level, Portugal has contributed financially towards the main conventions, protocols and funds dedicated to environmental protection, namely the *Global Environment Facility* (GEF), the *Multilateral Fund for the Montreal Protocol*, the *UN Framework-Convention on Climate Change*, the *Convention on International Trade in Endangered Species* or the *International Union Convention for Conservation of Nature,* amongst others. Portugal has been paying attention to the work developed by the EU-ACP *Water Facility*.

In the context of the United Nations, Portugal contributes towards diverse UN agencies, namely to the UNDP, FAO, UNFPA, UNHCR, UNICEF and the WHO. Contributions to the United Nations received an average aid of approximately 8.7 M€ between 2002 and 2007.

The group of Financial Institutions constituted by the International Monetary Fund (IMF), World Bank and the World Trade Organization (WTO) received an average of about 10.7 M€ during the same period. Portugal has simultaneously sought to maintain an active role in diverse regional *fora* in Africa, Latin America and Asia. The Community of Portuguese Speaking Countries (CPLP) is particularly relevant in this regard, since it is the forum that brings together the main beneficiaries of Portuguese Cooperation, along with Brazil.

Portugal has been engaging ever more actively in the activities developed by the various international bodies and specialised agencies in the context of assistance to developing countries. It has been particularly active in its participation in a variety of international fora in Africa, Latin America and Asia, although its interventions still have a special focus on the Community of Portuguese Speaking Countries[105] (CPLP).

Portuguese multilateral contributions (Table 48) represented between 38% and 51% of total external assistance in the period 2001-2003, with a sharp drop to 20% in 2004. This reduction is not due to a decrease in multilateral contributions, which in fact increased as an individual item by 17% relative to the previous year, but rather to the marked increase in total assistance resulting from the expansion of the bilateral component.

The largest share of multilateral contributions is channelled through the EU, via instalments to the European Development Fund (EDF) which finances EU assistance to African, Caribbean and Pacific (ACP) countries, and contributions to the European Commission Budget for External Assistance which finances the assistance to developing countries not covered by the EDF.

Portuguese multilateral cooperation with the ACP countries is defined in the context of the EU and its various mechanisms, with the Cotonou Agreement playing an important role in EU's development cooperation policy and external relations. Its unique characteristics make it a true symbol of EU policy.

[105] The Community of Portuguese Speaking Countries (CPLP) was created on the 17th July 1996 and is a privileged multilateral forum for deepening friendship and cooperation among its member-states: Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe and East Timor.

The Portuguese Presidency of the EU in the first semester of 2000 presented a special opportunity for fostering an enhanced partnerships between Europe and Africa, with the realization of the first Europe-Africa Summit, in Cairo, on the 3-4 April 2000, and the resulting follow-up mechanism that marked the beginning of a new era in the relationship between the EU and the African continent and with to the conclusion of EU/ACP negotiations, which in turn led to the signing of the Cotonou Agreement[106].

Strengthening the relationship between the EU and Africa was also a major priority of the third Portuguese Presidency of the EU, in the second semester of 2007. The Second EU-Africa Summit held in Lisbon, on the 4-5 December 2007, was a landmark in the relationship between the two continents, by reviving and deepening the political dialogue at the highest level and laying the ground for the future relationship, taking into account the developments that have taken place in the African continent (launch of the African Union and New Partnership for Africa's Development), in the EU (enlargement of the EU), as well as new global challenges (e.g. climate change). This Summit has resulted in the adoption of a Joint Africa-EU Strategy and its first Action Plan (2008-2010) that established enhanced partnerships in eight key areas, including climate change.

Within the framework of the United Nations, Portugal has implemented co-financing mechanisms for projects in the PALOP countries and East Timor through trust funds, in the context of agreements with the United Nations Development Programme (UNDP) and United Nations Education, Science and Culture Organisation (UNESCO). Portugal also makes voluntary contributions to a wide number of United Nations (UN) agencies and funds, namely the World Food Programme (WFP), the HABITAT Programme (UN-HABITAT), the World Health Organisation (WHO), the United Nations High Commission for Refugees (UNHCR), the United Nations Population Fund (UNFPA), and the United Nations Children's Funds (UNICEF), among others (Table 48).

[106] Signed in Cotonou, Benin, in June 2000, the new partnership agreement, in force since April 2003, remains a unique model in North-South relations, based on cooperation for development, economic and trade relations and political dialogue. It reiterates the fight against poverty, the progressive integration of ACP countries in the world economy and sustainable development as EU-ACP cooperation objectives, adapting the relationship to a new world order (namely, in the trade front) and improving the effectiveness of assistance through a rationalisation of existing instruments.

Table 48. Portugal's multilateral contributions 2001-2007 (millions of USD)[107]

Institution or Programme	Contribution						
	2001	2002	2003	2004	2005	2006	2007
1. World Bank	0.30	6.88	10.83	12.41	11.92	14.38	14.28
2. International Finance Corporation	-	-	-	-	0.00	0.00	0.00
3. African Development Bank	5.26	0.17	16.71	9.30	0.23	19.76	11.50
4. Asian Development Bank	-	43.19	7.46	7.87	2.46	10.40	5.67
5. European Bank for Reconstruction and Development	1.06	1.12	1.33	1.47			
6. Inter-American Development Bank	-	0.72	0.22	0.22	0.22	0.22	0.22
7. United Nations Development Programme – specific programmes	1.47	3.70	1.68	2.49	2.84	2.35	1.84
8. United Nations Environment Programme – specific programmes	-	0.06	0.02	0.04	0.02	0.02	0.02
9. UNFCCC – Supplementary Fund	0.04	0.07	0.07	0.05	0.07	0.28	0.00
10.Other	102.97	112.94	146.37	183.84	1.37	0.00	3.76
10.1 UNICEF - The United Nations Children's Fund	0.20	0.17	0.17	0.16	0.17	0.21	0.17
10.2 UNRWA – United Nations Relief and Works Agency	-	0.12	0.10	0.09	0.10	0.10	0.00
10.3 WFP – World Food Programme	0.04	0.22	0.22	0.21	0.11	0.12	0.11
10.4 UNHCR - Office of the UN High Commissioner for Refugees	0.22	0.17	0.19	0.31	0.19	0.31	1.67
10.6 UNFPA – United Nations Population Fund	0.04	0.07	0.02	0.29	0.04	0.10	0.20
10.5 IFAD[108]						0.33	0.80
10.7 Other UN	5.56	6.02	5.60	6.34	6.19	6.39	7.61
10.8 EDF – European Development Fund	12.39	12.37	19.51	31.79	28.09	30.56	35.06
10.9 EC – European Commission	56.62	60.92	68.88	79.15	95.20	91.30	103.32
10.10 EIB - European Investment Bank	-	-	-	1.51	4.36	2.58	2.99
10.11 Regional Banks	0.35	-	-	-	0.60		

[107] Contributions to Part I organisations (ODA) and Part II (OA) of the DAC /OECD.

[108] Since 2006, IFAD is one of the UN Agencies

Institution or Programme	Contribution						
	2001	2002	2003	2004	2005	2006	2007
10.12 IFAD					0.65		
10.13 IMF – International Monetary Fund	-	-	-	-	0.00	0.00	0.00
10.14 Other Multilateral	1.61	1.43	3.05	4.44	3.99	5.66	11.15
10.15 EC for Part II of DAC	25.73	31.22	48.63	59.25			
10.16 Other Multilateral Institutions for Part II of DAC	-	-	-	-			
					159,82	**185,07**	**200,37**

Source: IPAD, 2009

In order to address global environmental problems, including those stemming from climate change, Portugal contributed to the Global Environment Facility with a total of USD 13,883,474 million, in the period 2001 to 2008. Of this amount, a total of USD 11,672,246 accounted for ODA. It is also worthnoting that, in 2009, commitments to the GEF amounted to EUR 1,432,500 (Table 49).

Table 49. Financial contributions to the Global Environment Facility (millions of USD)

	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
Commitments (EUR)[110]	1 225 497	0	2 865 180	1 432 590	1 432 590	0	2 865 000	1 432 500	11 253 357
Commitments (USD) Erro! Marcador não definido.	1 097 555	0	3 237 367	1 779 850	1 780 566	0	3 921 899	2 066 238	13 883 474
Disbursements (EUR)[111]	718 992	1 353 500	1 510 800	2 058 810	1 554 868	1 338 968	1 901 100	2 188 000	12 625 038
Disbursements (USD) Erro! Marcador não definido.	643 929	1 275 538	1 707 053	2 557 866	1 932 545	1 680 673	2 602 416	3 155 971	15 555 991
Annual average exchange rate	0,8956	0,9424	1,1299	1,2424	1,2429	1,2552	1,3689	1,4424	n/a

[109] The total amount includes financial contributions to the Global Environment Facility (GEF) (table 29).

[110] Commitments materialized through the issuance of promissory notes

[111] Budgetary expenses/disbursements, regarding the encashment of promissory notes previously issued

	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
USD/EUR									
Proportion ODA[112]	75%	75%	77%	77%	77%	77%	96%	96%	n/a
Amount ODA (EUR)	919 123	n/a	2 206 189	1 103 094	1 103 094	n/a	2 750 400	1 375 200	9 457 100
Amount ODA (USD)	689 342	n/a	2 492 772	1 370 484	1 371 036	n/a	3 765 023	1 983 588	11 672 246

Source: MFAP/GPEARI and MFAP/DGTF, 2009

[112] The proportion of ODA (Offical Development Assistance) only takes in consideration the amount of commitments, in accordance with OECD rules

6.3 Financial Commitments and Bilateral Cooperation

With regard to bilateral cooperation, political initiatives favour intervention in the Portuguese speaking countries – with which historical, linguistic and cultural ties exist – through public-private partnerships, the development of an appropriate financial support framework and the support to civil society organisations with relevant activities in this area. Portugal places specific interest in its participation in the context of the CPLP, aiming at reinforcing political and diplomatic relations with this group of countries, as well as contributing to their inclusion in international guidelines, so that they become active participants in the global economy and capable of overcoming poverty. The privileged relation of Portugal with these countries thus allows the development of capacities which enable the pursuit of sustainable development goals.

Table 50 shows the monetary values of Portuguese bilateral cooperation related to the implementation of the Convention, which amounts to a total of € 9 125 782 in the period from 2001 to 2007. This value has been on the increase, peaking in 2005 with a value of € 1 845 316 and then in 2007, with € 3 314 299.

Table 50. Bilateral and regional financial contributions related to the implementation of the Convention in the period 2001-2007 (Euros)

2001	2002	2003	2004	2005	2006	2007
958 250	1 042 991	662 158	1 788 735	1 845 316	1 359 349	3 314 299

Source: IPAD, 2009

In terms of cooperation for development, and at a bilateral level, Portugal has also been developing diverse projects in the sector of the environment, in PALOP countries and in Timor-Leste, which focus, above all, albeit not exclusively, on the areas of water and sanitation, combating climate change and institutional capacity building for this sector. Examples include the *Project to Quantify Stored Carbon and the Carbon Sink Capacity of Forests*, in Guinea-Bissau; or aid for the implementation of the *Climatic Information System and the State of the Sea to Support Sustainable Development*, in Cape Verde, Guinea-Bissau and S. Tome and Principe.

6.4 Technology Transfer

Several projects were supported by Portuguese Official Development Assistance between 2001 and 2005 involving technology transfer of various kinds. With the objective of mainstreaming environmental and climate change considerations, Portugal has been focusing its support on technologies that allow for a more rational use of resources, particularly water and also energy. Equally important is the Portuguese Carbon Fund (FPC), which is responsible for diverse activities to obtain carbon credits, through investments in flexibility mechanisms envisaged by the Kyoto Protocol (such as Joint Implementation Projects – IC and the Projects for Clean Development Mechanisms - CDM).

6.5 Institutional Capacity-Building

In terms of institutional capacity building, Portugal has supported CPLP countries in the areas of: environmental licensing; environmental impact evaluation; environmental inspections; environmental education; implementation of the main international agreements and conventions regarding the environment, territorial organization, cartography and records.

Following the commitment by the EU, Canada, New Zealand, Norway and Switzerland at the Second Part of the Sixth Conference of the Parties in Bonn in 2001, agreed to contribute annually with 410 million dollars to support non-Annex I countries in climate change related projects (Bonn Political Declaration), as well as the decisions

subsequently made within the EU, Portugal ensured that its own share of annual international obligations were duly met (Table 51). In the period from 2005-2007, Portugal's contributions in accordance with the Bonn Political declaration amounted to €3 910 669.

Table 51. Breakdown of Portugal's contributions in accordance with the Bonn Political Declaration (Euros)

	Year		
Expenditure on climate relevant development assistance	**2005**	**2006**	**2007**
UNFCCC special funds: SCCF and LDCF	€1 070 000	€50 000	€0
Contributions to climate change in the GEF Trust Fund	€367 698	€0	€916 858
Bilateral ODA: CC mitigation	€4 494	€37 277	€104 426
Bilateral ODA: CC adaptation	€133 652	€530 578	€128 305
Contribution through EC	€0	€0	€0
Contributions to other multilaterals eg UNDP, UNEP, WB, ADB etc	€114 438	€268 364	€311 700
Total	€1 690 282	€886 218	€1 461 289

Table 52. Breakdown of Portugal's bilateral contributions (Euros)

Type of Contribution	**Period: 2005-2009**	
	Description	**Amount (€)**
Contributions for activities related to climate change in the context of GEF		
Additional bilateral and multilateral contributions	Multilateral contribution: participation at the LDC workshop (Bonn, May)	5 000
	Multilateral funding: Trust Fund for Supplementary Activities to support adaptation work ("workshops"	50 000
	Multilateral funding:" workshop" Africano – Portuguese interpretation)	3 000
	RELAC - Participation COPs and SBs (Cape Verde, Guinea-Bissau, Mozambique, São Tome and Principe)	97 584
	Bilateral Contribution: SICLIMAD-CV[113] Project	330 948
	Bilateral Contribution: SICLIMAD-STP[114] Project	175 755
	Bilateral funding: Project SICLIMAD-Guine-Bissau (Systematic observation)	253 911
	Bilateral funding: Project CARBOVEG-Guine-Bissau	352 043
	Bilateral funding: Project Establishment of the Cape Verde's Designated National Authority for the Kyoto Mechanisms	30 000
	Bilateral funding: Project Establishment of the São	30 000

[113] Climate and Sea Information System for Sustainable Development – Cape Verde.

[114] Climate and Sea Information System for Sustainable Development – Sao Tome and Principe.

Type of Contribution	Period: 2005-2009	
	Description	Amount (€)
Contributions for activities related to climate change in the context of GEF	Tome and Prince's Designated National Authority for the Kyoto Mechanisms	
	Multilateral funding: support for the participation of the Focal Points from the Portuguese Speaking Countries on the Clima Workshop, Ilha do Sal, Cape Verde	5 850
	Multilateral funding: III Portuguese Speaking Countries Environmental Meeting/I Portuguese Speaking Countries' Designated National Authorities Meeting (CECAC+GRI)	11 000
	Capacity builders for Mozambique	33 142
	Agro-ecological planning and sustainable agrarian use of the land in the Province of South Kwanza (Angola)	54 993
	CRIA - Agency for Climate and Respective Environmental Implications in the Portuguese-speaking African Countries and Macao	17 278
	Fire in Amazonia: multi annual cartography and GHG emissions detection using remote sensing	74 553
	Cooperation among Portuguese and Mozambician Universities – curricula on CC mitigation	50 000
	Fire in the Brazilian Amazon: multi-year mapping of area burned and estimation of pyrogenic emissions using remotely sensed data	53 176
	CC expert in the Portuguese Embassy in Nairobi	11 400
Contributions for the Special Climate Change Fund (SCCF), the Adaptation Fund do Kyoto Protocol and the Least Developed Countries Fund (LDCF)	SCCF	1 070 000
	LDCF	50 000
Contributions resulting from the approval of CDM projects		-
Total (Euros)		**2 759 633**
Total (USD[115])		**3 859 623**

Source: IPAD, 2009

A substantial part of the funding available for compliance with the Bonn Declaration results from a new budget line of MAOT created specifically for this objective. Further to the integrated support already provided to other projects, the management of this specific funding line, under the responsibility of APA, will support both mitigation and adaptation projects conceived for the implementation of the Convention and the Kyoto Protocol.

[115] Dollar amount calculated using the exchange rate of the day of the transfer (1 Euro = 1.3986 USD)

Under the Bonn Declaration, Portugal contributed to the UNFCCC funds and provided support for activities under the supplementary fund of the Convention. Part of Portugal's contributions will continue to be channelled to provide support to developing countries through the Convention and its Kyoto Protocol, including the Adaptation Fund once it becomes fully operational.

Additionally, the referred funds have been managed in order to meet the objectives of the two regional networks established specifically to promote cooperation on the implementation of the Convention and Kyoto Protocol – the Portuguese Speaking Countries Climate Change Network (RELAC) and the Iberian-American Climate Change Network (RIOCC) – both promoted by Portugal between 2004 and 2005 in close collaboration with the involved countries. With similar goals and formats, these networks differ mainly by their geographical scope, being focused in Africa and Latin America respectively. Both these networks aim at promoting the exchange of knowledge and experiences between the regions, through specific mechanisms to be established.

RELAC includes Angola, Brazil, Cape Verde, Guinea-Bissau, Mozambique, Portugal, Sao Tome and Principe and East-Timor, and is a fundamental instrument for networking between CPLP countries. It will facilitate the exchange of perspectives and experiences, as well as the preparation of joint proposals on action against climate change.

RIOCC involves Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Equator, El Salvador, Spain, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Dominican Republic, Uruguay and Venezuela. The general objectives common to both networks are:

- Keeping an effective and permanent dialogue amongst participant countries.
- Promoting the exchange of information on mitigation and adaptation policies, by identifying priorities and barriers to tackle climate change and its impacts.
- Supporting and promoting the implementation of the Convention and the Kyoto Protocol.
- Promoting capacity building initiatives and exchange of knowledge in the context of the Convention and the Kyoto Protocol.
- Identifying opportunities and promoting initiatives in the domain of education, training and public awareness on climate change.
- Exchanging views on possible ways forward in international negotiation fora.
- Supporting the integration of climate change strategies into development policies and ODA strategies, as complements to existing programmes.
- Facilitating initiatives aimed at taking advantage of opportunities in the context of the Clean Development Mechanism (CDM).

Projects in the context of these networks will be developed within the following areas of intervention:

- Capacity building
  - Exchange of information and/or experiences on methodological aspects, particularly with regard to the preparation of National Adaptation Programmes of Action (NAPA), GHG inventories, projects to be submitted to GEF and Clean Development Mechanism (CDM) projects.
  - Exchange of information and/or experiences on research and systematic observation on climate change.
- Adaptation
  - Collaboration and/or exchange of information and/or experience on vulnerability and impacts of climate change.
  - Collaboration and/or exchange of information and/or experience on adaptation strategies.

- Development of NAPAs.
- Use of funding mechanisms foreseen in the context of the Convention and GEF.

- Clean Development Mechanism
  - Identification of the main obstacles to the development and implementation of CDM projects.
  - Identification of possible opportunities for projects in RIOCC and/or RELAC countries.
- Capacity Building, Education and Public Awareness
  - Identification of other institutional capacity building needs not covered in the previous points and identification of potential activities that can contribute towards this end.
  - Promotion of the exchange of experiences and/or collaboration in education and public awareness-raising.

In this scope, IM has also promoted with Cape Verde's meteor institute in March 2008 and with the support from CPLP, WMO and EUMETSAT the International Workshop on *Climate and Natural Resources in the Portuguese Speaking Countries* (WSCRA 2008) aiming at identifying priorities in climate change understanding and the adoption of adaptation measures and, also, to establish public-private partnerships in this scope.

7 Systematic Research and Observation

7.1 Scientific Research

7.1.1 General Policy on Scientific Research Funding

Scientific research in Portugal is generally undertaken in higher education institutions (universities, polytechnic universities and higher schools), state institutions (institutes, laboratories and scientific centres), private foundations and companies.

However, there has been a recent rise in the diversification of institutions involved in Research and Development (R&D) activities mostly as a result of a growing wish by the government to support the creation of new businesses and projects relating to technology and science, as well as to attract internationally renowned companies in these specific fields. There has also been a stronger commitment by private institutions, namely foundations and national and international companies, to support the development of a number of R&D projects in many areas. Despite these efforts, private-sector scientific knowledge creation is still far from playing a significant role in Portugal.

The Lisbon Strategy and European Council Conclusions adopted in Barcelona, which encompasses the Bologna Declaration, established strategic targets for 2010 associated to scientific, innovation and qualification of human resources indicators. In order be competitive, the Portuguese economy, in line with the Lisbon Strategy, requires a renewed and invigorated participation of both the public and private sectors, with investments in R&D representing 3% of GDP, of which 2% is to be derived from enterprise and 1% from the public sector. Currently, the public sector invests about 0.55% of GDP in R&D in Portugal.

To reach these targets, Portugal has reformed the structure of public expenditure and the incentives system to encourage growth and to boost scientific and technological development and innovation. This task involves doubling the scientific and technological research capacity of the country, which in turn reinforces the social and economic potential of Portugal.

The principal targets include:

- to encourage the private sector through incentives, tripling its entrepreneurial R&D efforts (which is currently no greater than 0.26% of the GDP);
- to triple the number of registered patents;
- to double public investment in R&D by up to 1% of the GDP;
- to promote the growth, by 50%, of human resources involved in R&D and the production of high quality scientific research of international calibre; to raise the number of Portuguese PhD doctorates to 1500 per year in Portugal and abroad;
- to encourage scientific employment in both public and private sectors. The State will support a progressive and competitive replenishment of staff, creating 1000 placements for R&D and reducing other less qualified placements in other administration sectors;
- to make experimental practice compulsory in scientific and technological subjects in primary and secondary schools; and
- to organise existing scientific and technological expertise with the aim of minimising and preventing public health hazards, increasing security as well as to strengthening regulatory and surveillance bodies in the country.

The Science and Technology Foundation (FCT), a subsidiary body of the Ministry of Science, Technology and Higher Education (MCTES), is directly responsible for coordinating and funding scientific research in Portugal.

In 2003 the total expenditure on R&D activities was 1020 million Euros, corresponding to 0.78% of the Portuguese GDP (Table 53).

Table 53. Total Expenditure in Research and Development (1999-2003)

	Year	1999	2001	2003
Total Expenditure in R&D	Current Prices (MEuros)	814.7	1038.4	1019.6
	Constant Prices[116] (MEuros)	842.6	995.9	911.5
	Annual average growth rate at constant prices	-	8.7	-4.3
	Expenditure R&D / GDP (%)	0.75	0.85	0.78

Sources: OCES/MCTES, 2005; OCDE, 2005 and INE, 2005

The Government, with co-finance by the European Union (EU) and private bodies, provide the funding for these R&D activities. According to the Science and Higher Education Observatory, R&D finance in 2003 was structured as follows: 60% by the state, 32% by companies, 5% by foreign investment and 3% by other national sources such as the higher education sector.

Public Budgetary Appropriations (DOP) between 2000 and 2004 are listed in Table 54. With 915 million Euros allocated to R&D, 2004 was the top year in the last two decades for R&D investment.

Table 54. Public Budgetary Appropriations (2000-2004)

	2000	2001	2002	2003	2004[117]
Current Prices (MEuros)	713	778	901	847	915
Constant Prices (MEuros)	603	629	693	636	672
Deflator[118]	1.183	1.237	1.299	1.333	1.363

Source: OCES, 2005

Research on climate change by means of scientific projects was financed exclusively by Government via FCT, with 2.7 million Euros invested between 2000 and 2004 (Table 55).

Table 55. Number or projects and funding granted in the area of climate change by the Foundation for Science and Technology (2001-2004)

	2000	2001	2002	2003	2004	Total
Number of projects	8	4	5	2	19	**38**
Funding granted (Euros)	538 701	420 096	435 395	110 000	1 307 500	**2 811 692**
Fraction of PBA in R&D (%)	0.08	0.05	0.05	0.01	0.14	**0.07**

Source: FCT, 2005

[116] Series of GDP implicit deflators (Base 2000 = 1), *Principaux Indicateurs de la Science e de la Technologie*. OCDE, 2005(1) – *Base de donnés.*

[117] Provisional values.

[118] The considered Deflators were the price indices implicit in the GDP, published by the OECD in April 2004 (Base 1995 = 1).

Of the Public Budgetary Appropriations for R&D in 2000-2004, 0.07% was allocated to climate change research. 2004, with an allocation of 0.14%, was the peak year for climate change research funding (Figure 60).

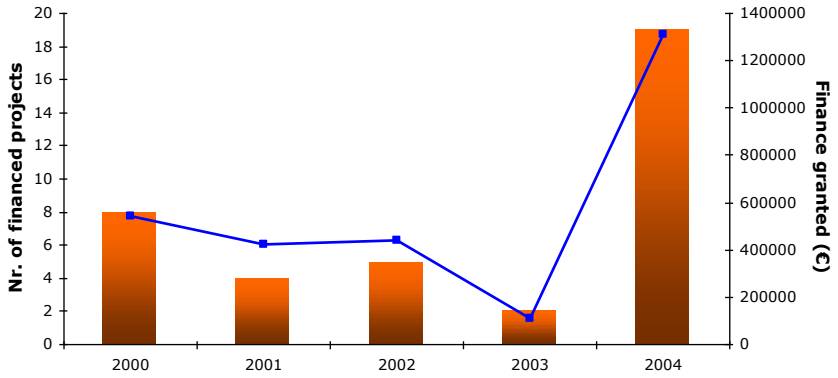

Figure 60. Investment by the Science and Technology Foundation on research projects relating to climate change (2000-2004)

Source: FCT, 2005

In 2004, a call for proposals by FCT for research projects included for the first time specific financing for climate change research, reflecting the greater attention that this theme is drawing within scientific community at both national and international levels. This shift demonstrates growing concern about energy and environmental issues (as well as related implications and impacts).

7.1.2 Climate Change Related Research Projects

Table 56 presents a list of research projects which have been sponsored by FCT between 2000 and 2004 and which, while covering various scientific fields, have particular relevance to climate change. For more detail, see Annex 4.

For more information on projects sponsored by FCT see: http://www.fct.mctes.pt/.

References are also made to two other projects financed by institutions other than FCT, one public and another private, considered to be projects relevant to this field.

Climate change in Portugal, scenarios, impacts and measures for adaptation (SIAM II).

The second phase of the SIAM project (Climate Change in Portugal: Scenarios, Impacts, and Adaptation Measures) involved research using updated climate models that featured two additional elements: public participation and a case study. The sessions in which there was public participation took place in Beja, Bragança, Covilha, Ílhavo, Olhao, Peniche and Oporto, where the impact of climate change and respective adaptation measures for local relevant sectors were discussed. This process involved the participation of 125 government, academic, environmental non-governmental organisations (NGOs) and industry representatives, as well as civil society representatives.

The case study of the hydrological basin of the Sado aimed to apply the general SIAM methodology at a more reduced scale, with a view to providing appropriately scaled information for public-sector decision-makers. (http://www.siam.fc.ul.pt/).

APA's Operational Environmental Programme financed the project (2004), proposed by the Faculty of Science and Technology (more information on Chapter 5).

Impact E – Impact of extreme events on health in Portugal: past, present and future.

A multidisciplinary team composed of researchers from several public national and international institutions in the fields of health, epidemiology, climatology, physics and environmental risk assessment was created to undertake this study. The aim is to provide an integrated study of the impact of meteorological and extreme climate events (cold spells, heat waves and drought) and related elements such as air pollution and forest fires on public health in Portugal. Past correlations and projections of future risks based on climate scenarios until the end of the century will be used.

The Calouste Gulbenkian Foundation financed this project, proposed by the Faculty of Science of the University of Lisbon.

7.1.3 National Participation in International Research Networks

Portugal has been represented in meetings of the International Panel on Climate Change – IPCC - since 2001 by a nominated focal point at the Meteorology Institute (IM).

The Focal Point's role includes the following functions:

- participation in the IPCC 18th plenary session in London, UK, 24th – 29th September, 2001;
- participation in the IPCC 19th plenary session in Geneva, Switzerland, 17th – 20th April, 2002;
- chairing informal coordination meetings on behalf of the President of the Regional Association VI (RA VI) for Europe and the Middle East;
- directing the appointment process of candidates from the RA VI (IPCC/World Meteorological Organisation) to placements in various groups of the IPCC Bureau during the IPCC 19th plenary session;
- chairing negotiation meetings in the scope of the RA VI at the 19th plenary session;
- organisation of three meetings with candidates to the IPCC Presidency, to get to know candidates´ profiles and their respective proposals, through open discussion.

Portugal has also participated, since 2005, in the European project CIRCLE (Climate Impact Research Coordination for a Larger Europe*).* It is represented by the FCT (MCTES) with € 3 000 000 in EU funding.

CIRCLE's prime objective is to contribute to scientific knowledge in the field of climate change by encouraging collaboration, complementarities and efficiency of the national programmes on climate change throughout the EU. This process will provide a strong support for the implementation of a European Research Area Network (ERA-NET) in the field of climate change.

The CIRCLE project was initiated in the summer of 2004 and its activities were extended in the form of a contract ERA-NET for the period of 2005-2009. To date, CIRCLE has compiled information on climate change impacts and adaptation measures from national research programmes.

In total, 27 institutions from 16 European countries have joined CIRCLE. These institutions (ministries of science and technology or research foundations) finance or manage national research programmes on climate change and, through CIRCLE, their methodologies, strategies and data may be shared in order to optimise, complement and develop

national programmes within an EU framework. Portugal contributes with information on impacts and adaptation measures from the SIAM Group, which is the Focal Point for this project.

Table 56. Research projects in the field of climate change funded by the Science and Technology Foundation (2000-2004)

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCTI/CTA/32649/2000	Black carbon levels in the atmosphere over the North Atlantic ocean	Institute of Marine Research	Earth and Atmospheric Sciences	59 855.75
POCTI/CTA/33582/2000	Reduction of uncertainties of estimates of atmospheric emissions from fires in Southern Africa	Technical University of Lisbon - Higher Institute of Agronomy	Earth and Atmospheric Sciences	74 819.68
POCTI/CTA/34346/2000	Climate change in Portugal: impact on the occurrence of forest wildfires and on the air quality	University of Aveiro	Earth and Atmospheric Sciences	79 807.66
POCTI/CTA/35598/2000	Portuguese wood industries: greenhouse gas fluxes and accounting methods for the evaluation of the global warming effect	University of Aveiro	Earth and Atmospheric Sciences	49 879.79
POCTI/CTA/35626/2000	Carbon balance of eucalypt plantations in Portugal – the Kyoto forest problem	Technical University of Lisbon – Higher Technical Institute	Earth and Atmospheric Sciences	99 759.58
POCTI/CTA/36258/2000	Aquifers as archives of palaeoclimate and indicators of future climatic scenarios - Sado-Sines system and Bairrada carsic aquifer	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	49 879.79
POCTI/MGS/33592/2000	OIKOMATRIX - Evaluation of the socio-economical impact of legal tools to control the emission of green house gases	University of Aveiro	Modelling and Management of Environmental Systems	49 879.79
POCTI/MGS/34883/2000	Built environment, urban climate and rational use of energy	National Institute of Engineering, Technology and Innovation	Modelling and Management of Environmental Systems	74 819.68
POCTI/CTA/11048/2001	Climate Change in Portugal: Scenarios, Impacts and Adaptation Measures (SIAM)	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	88 617.00
POCTI/CTA/38326/2001	Study of forcing mechanisms of low frequency atmospheric variability in the euro-Atlantic region	University of Aveiro	Earth and Atmospheric Sciences	47 000.00
POCTI/CTA/39607/2001	CLIVAR - Climate variability and change: patterns and impacts at the regional scale	Institute of Science of the Earth and Space	Earth and Atmospheric Sciences	85 000.00
POCTI/MGS/37970/2001	GENETICLAND: discovering future landscapes under climate change scenarios using genetic algorithms	Institute of Marine Research	Modelling and Management of Environmental Systems	99 475.00
POCTI/MGS/41874/2001	OIKOMATRIX II – evaluation of the socio-economical impact at regional level of legal tools to control the emission of greenhouse gases	University of Aveiro	Modelling and Management of Environmental Systems	100 000.00

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCTI/CTA/46573/2002	VAST - variability of Atlantic storms and their impact on land climate	University of Lisbon – Foundation of the Science Faculty	Earth and Atmospheric Sciences	55 000.00
POCTI/CTA/47803/2002	SIGN - signatures of environmental change in the observations of the geophysical institutes	Institute for Earth and Space Sciences	Earth and Atmospheric Sciences	80 000.00
POCTI/MGS/49210/2002	Assessment of climatic change impact on water resources and CO_2 fixation in fast growing forest stands in Portugal	University of Aveiro	Modelling and Management of Environmental Systems	150 392.00
POCTI/AGG/47275/2002	Adaptation of pine shoot beetle to host pine physiology under the influence of climate change	Technical University of Lisbon – Higher Institute of Agronomy	Agricultural Sciences	80 000.00
POCTI/AGG/47938/2002	Effects of elevated CO_2 and interacting environmental variables on grapevines grown under Mediterranean field conditions	University of Trás-os-Montes and Alto Douro	Agricultural Sciences	70 000.00
PDCTE/CTA/49826/2003	Cloud properties retrievals from ENVISAT in the presence of aerosol events over Portugal	University of Evora	Programme for the Promotion of Space Science and Technology	50 000.00
PDCTE/CTA/49985/2003	CARBERIAN - Terrestrial vegetation carbon trends in the Iberian peninsula exploratory analysis from Northern Atlantic oscillation related behaviour	Institute of Marine Research	Programme for the Promotion of Space Science and Technology	60 000.00
POCI/CLI/56269/2004	Climate Change and Tourism in Portugal: Potential Impacts and Adaptation Measures (CLITOP)	University of Lisbon – Foundation of the Science Faculty	Climate Change	75 000.00
POCI/CLI/56371/2004	BioAridRisk – Space-Time Evaluation of the Risks of Climate Changes based on an Aridity Index	Technical University of Lisbon – Higher Technical Institute	Climate Change	50 000.00
POCI/CLI/57597/2004	Climatic /environmental factors affecting the population dynamics of *Lymnaea truncatula* and transmission of *Fasciola hepatica* in Portugal.	Institute of Tropical Medicine and Hygiene	Climate Change	95 000.00
POCI/CLI/58348/2004	Present and Future Portuguese Coastal Climate and its impact on the biological communities (PORTCAST)	University of Lisbon – Foundation of the Science Faculty	Climate Change	90 000.00
POCI/CLI/58680/2004	Climate change inferences from tree rings in the Mediterranean area: a database for Portugal	Institute of Marine Research	Climate Change	50 000.00
POCI/CLI/58865/2004	CIDmeg – CIDmeg - Construction of a Desertification Susceptibility Index for the Left Margin of Guadiana	Technical University of Lisbon – Higher Technical Institute	Climate Change	85 000.00

Reference	Title	Proposing Institution	Scientific Area	Funding Granted (Euros)
POCI/CLI/60006/2004	Linking Water and Carbon Cycles in Eucalypt Plantations	National Institute for Agriculture and Fisheries Research	Climate Change	95 000.00
POCI/CLI/60110/2004	ALQUEVA XXII - Shooting at a moving target. Scenarios of agricultural land use of the Alqueva irrigation project in a changing environment. Climate change, crop options and water needs.	Technical University of Lisbon – Higher Agronomy Institute	Climate Change	70 000.00
POCI/CLI/60192/2004	Impact of climatic and anthropogenic variations on the Northern continental shelf, Gulf of Cadiz)	University of Algarve	Climate Change	95 000.00
POCI/CLI/60413/2004	Vulnerability of cork oak woodlands to climate change: a modelling approach	Technical University of Lisbon – Higher Agronomy Institute	Climate Change	95 000.00
POCI/CLI/60421/2004	Urban flood risk and pollutant relocation as a result of global change	Higher School of Agriculture of Coimbra	Climate Change	90 000.00
POCI/CLI/60784/2004	Use of traditional knowledge to attain water sustainable management under different climate change scenarios - TRADWATER	University of Aveiro	Climate Change	90 000.00
POCI/CLI/61605/2004	Latitudinal variation on the biology of estuarine key-species as a tool to predict climate change effects	Maritime and Environmental Research Centre	Climate Change	50 000.00
POCI/AGR/57279/2004	Simulation of the effect of different management and climate change strategies in the production of wood / cork and in the carbon sequestration for the main species of the Portuguese forest	Technical University of Lisbon – Higher Agronomy Institute	Agricultural Sciences	85 500.00
POCI/AGR/59152/2004	Mediterranean woody species of montados: surviving the drought	National Institute for Agriculture and Fisheries Research	Agricultural Sciences	85 500.00
POCI/COM/56973/2004	The politics of climate change: discourses and representations	University of Minho	Communication Sciences	30 000.00
POCI/MAR/56296/2004	Studying the impact of the climate change in the Portuguese coastal waters - the Aveiro costal ecosystem -SIMCLAVE	University of Aveiro	Science and technologies of the Sea	76 500.00

Source: FCT, 2005

7.2 Systematic observation

7.2.1 General Policy on Systematic Observation

Activities relating to systematic observation follow the policies determined by international organisations in which Portugal participates, including the World Meteorological Organisation (WMO) and the EU. Portugal is mainly involved through the World Climate Programme (WCP), its research component (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

The Institute for Meteorology (IM), governing body responsible for meteorology and climate commitments, has provided continuity of scientific and technical activities relating to climate change observations, which have been carried out in Portugal since 1856. These multi-parameter climate series support research pertaining to trends, variability and analysis of extreme climate events.

At the international level, Portugal contributes, through the IM, to the maintenance and improvement of the global observation system by taking part in Earth observation programmes, particularly satellite programmes of the Organisation for the Exploitation of Meteorological Satellite programmes (EUMETSAT) and the Global Climate Observing Systems (GCOS). Data obtained in the scope of GCOS are archived by and made available from the following international centres:

- World Data Centre for Greenhouse Gases (WDCGG) in Japan;
- World Radiation Data Centre (WRDC) in Russia;
- World Ozone and Ultraviolet Radiation Data Centre (WOUDC) in Canada;
- World Data Centre for Aerosols (WDCA) / Aerosols Optical Depth (AOD) in Italy;
- World Data Centre for Precipitation Chemistry (WDCPC) in the United States of America ;
- World Data Centre for Meteorology (WDCM) in the United States of America;
- Finnish Meteorological Institute (FMI) in Finland and
- The National Climatic Data Centre (NCDC) in the United States of America.

Data collected and sent to international centres by the IM network include global, diffuse and direct solar radiation, total ozone, surface ozone, ultra-violet radiation, precipitation chemistry, and chemistry of the atmosphere and of particles. Meteorological surface and upper air data is sent daily in real time. In addition to sharing of these databases and results analysis, the IM participates in prediction model work groups, and partakes in consortia for conception and distribution of products of scientific and economic applications. The time series of the various parameters, actually covering more than 150 years, allow the development of investigation activities in climate change, namely through the analysis of its trends, variability and climatic extremes.

For more information regarding Portugal's participation in projects for systematic observation please visit http://www.meteo.pt/.

Continued systematic observation through station networks is fundamental for both climate analysis and monitoring, as well as for long term planning of strategic resources, and thus involve regular investments in equipment, education and conservation, to ensure reliability of data.

IM has the responsibility of installing, exploring and maintaining the network of meteorological stations in the country and being also responsible for archive and quality control of the weather observations. There are currently 139

meteorological stations and 880 udometric stations. Comprising some 19 stations per 1000 km^2, climate network average density is comparable with the European average.

7.2.2 Atmospheric Climate and Composition Observing Systems

Portugal's participation, through the IM, in the Global Atmospheric Observation System has remained constant in recent years (Table 57).

Table 57. Participation in the Global Atmospheric Observation System

	GSN[119]	GUAN[120]	GAW[121]	CLIMAT[122]
Number of stations under Portugal's responsibility	4	1	8	10
Number of stations currently operational	4	1	7	10
Number of stations operating in accordance with the GCOS standards	4	1	7	10
Number of stations operating in 2005	4	1	7	10
Number of stations providing data to international data centres	4	1	7	10

Source: IM, 2009

In the scope of the WMO's Global Atmosphere Watch (GAW) programme IM operates 7 stations from atmospheric chemical composition's monitoring network, in which observations are also done for the UNECE's European Monitoring and Evaluation Programme (EMEP) and OSPAR's Comprehensive Atmospheric Monitoring Programme (CAMP).

The observing programmes from GAW/EMEP/CAMP include the monitoring of the total ozone and UV radiation and also the monitoring of: total ozone quantities using spectrophotometers; UV intensity using spectrophotometers; surface ozone concentration using photometric analysers; concentrations of suspended particulate matter using high volume samplers; concentrations of carbon dioxide and methane; pH, conductivity, concentration of ions and metals in rain water samples (wet deposition) and in dry depositions using automatic collectors.

7.2.3 Ocean Climate Observing Systems

IM participates in the Ocean Climate Observation Systems featured in Table 58.

Table 58. Participation in the Global Oceanographic Observation System

	VOS[123]	SOOP[124]	TIDE GAUGES	SFC[125] DRIFTERS	SUB-SFC[126] FLOATS	MOORED BUOYS	ASAP[127]
Number of platforms under Portuguese responsibility	75	0	13	0	0	0	0

Source: IM, 2009

[119] GCOS Surface Network.

[120] GCOS Upper Air Network.

[121] Global Atmosphere Watch.

[122] CLIMAT – International exchange of monthly mean data is realised through official notices in CLIMAT code form.

[123] Volunteer Observing Ship

[124] Ship of Opportunity Programme

[125] Surface Drifters

[126] Sub-Surface Drifters

[127] Automated Shipboard Aerological Programme

7.2.4 Global Terrestrial Observing Systems

Portugal does not participate in projects related to Global Terrestrial Observing Systems, namely GTN-P, GTN-G and FLUXNET. Some projects could be classified under this category but are described in the following section.

7.2.5 Programmes Based on Space Observations

7.2.5.1 Remote Sensing

Portugal is a founding member of the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and participates in several of its programmes.

Of particular importance is the project Satellite Application Facility on Land Surface Analysis (LSA SAF), which is coordinated at a national level by the IM. This project has both research and operational targets, the former dedicated to the development of algorithms that determine land parameters via satellite data, and the latter to the generation, archiving and dissemination of surface parameters. Both EUMETSAT and IM co-finance the long-term monitoring of the ground segment in this project (Resolution EUM/C/92/Res.V, contract EUM/LAD/CA/04/0489) divided into three stages: a first developmental phase lasting 5 years which was concluded in February 2005, a second, initial operational phase (current stage of the project) to be completed in February 2007, and a third operational stage predicted to take at least eighteen years to complete. The project is financed until 2024.

The scientific framework of this project is based on physical parameters and an integrated approach in order to maximise temporal, spatial and spectral resolutions provided by satellite sensors, Meteosat (MSG) and EUMETSAT Polar System (EPS). The scientific activities under development by the LSA SAF including observation and characterisation of surface biosphere processes have several applications including: weather and climate modelling; environmental management and land use; and management of natural disasters.

The strategy behind the structure and activities of LSA SAF was to explore synergies between the various institutions involved in the development of physical parameters in order to optimise the efficiency of the institutions for processing and an appropriate balance between innovative and robust parameters to support long periods of operation. This approach was taken with the aim of benefiting the majority of users. The following parameters were selected: albedo, aerosols, solar radiation flux, surface temperature, emissivity, thermal radiation flux, vegetation indices, soil moisture, evapotranspiration and snow cover. Operational activities include the processing, archiving and distribution of these parameters, in real or time or otherwise.

Geoland is an Integrated Project for research, technological development and demonstration, within the context of the European Commission's Sixth Framework Programme (FP-6 Priority AERO-2.2 - Aeronautics and Space). The project aims to provide and establish geo-information products and services to support the European Global Monitoring for Environment and Security (GMES) programme, generated by the European Commission in collaboration with the European Space Agency. The objective of the programme is to provide the EU, by 2008, with expertise for global monitoring to support European objectives for environment and security.

The project will integrate Earth Observation available resources and existing models with pre-operational end-user applications, namely those that enable a more efficient follow-up, monitoring and management of land and vegetation cover as well as those involved in the development of products and services to be implemented in European policies and Directives as well as by international Conventions. The project is a consortium of 56 partners, including the IM, comprising enterprise, authorities, end-user institutions and organisations, service providers and researchers.

The Geoland products and services aim at monitoring land and vegetation cover by addressing the GMES priorities, namely, "Land Cover Change in Europe", "Environmental Stress in Europe", and "Global Vegetation Monitoring".

The project Geoland-2 is the continuation of Geoland's activities in the period 2008-2012 at a global scale.

7.2.5.2 Meteorological Radars

The IM uses and develops a national meteorological radar network and aims to upgrade it through the acquisition, installation, application and integration of a new system - the Northern mainland meteorological radar. Through this network it is possible to monitor land cover for the whole of mainland Portugal. The exploitation of the operational potential of this sensor will also complement other meteorological radars to determine the global land cover of the Iberian Peninsula.

Some of these developments are within the framework of Action COST (European Co-operation in the field of Scientific and Technical Research), in particular COST731, Propagation of Uncertainty in Advanced Meteo-Hydrological Forecast Systems, where the aim is to encourage the exchange of scientific and technological information and address issues associated with quality and uncertainty of meteorological observations from remote sensing and other conventional instrumentation, along with their impacts and benefits on hydro-meteorological outputs from advanced forecasting systems.

7.2.6 Assistance to Developing Countries

Ongoing scientific and technical collaboration is maintained with developing countries, namely with institutions of the Portuguese Speaking Countries. The activities include, among others, the continued participation of the IM in several operational and R&D projects, in particular with Sao Tome and Principe and Cape Verde, in the fields of Systematic Observation and models for weather, climate and ocean turbulence.

Within the framework of the Portuguese Official Development Assistance and in the context of the Bonn Political Declaration, several cooperation protocols were celebrated with Cape Verde and Sao Tome and Principe in 2005, and a similar one with Guinea-Bissau is foreseen in 2006, for implementation of the Climate and Sea Information System for Sustainable Development (SICLIMAD) project in these countries.

The SICLIMAD project is characterised by the use of meso-scale numerical models, also known as regional scale models. Through climate modelling, regional scenarios for possible climate change have been established. The project thus provides a fundamental instrument to support political and economic decision-makers in determining policies for mitigating and adapting to the adverse effects of climate change. This yields invaluable positive impacts for society as a whole.

This aspect is of particular relevance since Cape Verde and Sao Tome e Principe are archipelagos, both with extensive Exclusive Economic Zones. Operations connected to the many socio-economic activities directly or indirectly related to the sea are strongly dependent upon the hydrodynamic conditions of the ocean.

The global objectives of SICLIMAD aim at:

- creating a climate information system that allows for comprehensive action against anthropogenic or natural climate change, in Cape Verde and Sao Tome and Principe, by establishing scenarios of climate system trends and evaluating climate change impacts. Furthermore, they also seek to identify adaptation measures that will make up a system to support political and economic decision-makers in actions against climate change, while also contributing to poverty eradication and, consequently, regional sustainable development;
- contributing to a better understanding of the climatic system, its interaction mechanisms and the way these influence local climates, and their expected impacts upon the various ecosystems, quality of life, economy and natural resources; and
- implementing a regional-scale Weather and Sea Forecasting System in Cape Verde, based on the Regional Atmospheric Modelling System *(*RAMS), developed by the University of Colorado by Cotton et al. (1989) and

on the Simulating Waves Nearshore (SWAN) sea model, adjusted for the oceanic area around Cape Verde and Sao Tome and Principe.

Also noteworthy is the scientific and technical cooperation with the Meteorological and Geophysical Services of the Special Administrative Region of Macau and the Meteorological Administration of the Popular Republic of China. Under the protocol established between the IM, the Meteorological Service of Macau and the Meteorological Administration of China, scientific and technical cooperation continues in the domain of Radar Meteorology and its applications, namely the development of precipitation measuring techniques using radar technology.

8 Education, Training and Awareness Raising

8.1 General policy guidelines on Education, Training and Public Awareness

According to the Education basis system law, nº 46/86 of 16 October, the education system comprises pre-school education, school education and extracurricular education. Public education is free.

The educational policies take in consideration the investment in education by raising the qualification of human capital. The education is a key role in improve productivity, competitiveness, employment and social cohesion. Portugal has ongoing a set of measures to meet the demands of the knowledge society, of which the highlights are:

- Extension of pre-school education;
- Full School time schedule in the first cycle, with Enrichment activities;
- Action Plan for Mathematics;
- Strategic Plan for the Teaching of Portuguese;
- National Reading Plan;
- National Training Programs for Mathematics, Experimental Sciences and Portuguese;
- Portuguese as non mother language;
- Provision of Education and Training courses for Basic Education;
- Diversification of training choices in public schools, with the Professional Courses
- Technological Plan for Education (PTE).

These measures have helped to create conditions for dropout rates and school failure has declined and enrollment in secondary education has increased the number of passing students from 263 000 to 282 000. It is worth noting the growth in the professional education, 28 000 students sign up in 1998/1999 ad 91 000 students sign up in 2008/2009, representing an increase of 225 percent.

The preschool is designed for children aged 3 years till mandatory school age; is optional and is provided in kindergartens, public or private. Public kindergartens are free.

Basic education corresponds to obligatory education, three cycles of education, as showed in Table 59. Recently obligatory education was extended until 18 years old, meaning the three cycles plus the secondary education.

Table 59. Level, years of schooling and ages of the basic students

Level	Years of Schooling	Age (years)
1st cycle	1º - 4º	6 - 10
2nd cycle	5º - 6º	10 – 12
3rd cycle	7º - 9º	12 – 15

Source: ME, 2009

In the first cycle, education is comprehensive and aims to develop basic skills in Portuguese Language, Mathematics, Environmental Studies and Expressions. With the implementation of full-time education by extending the opening hours for a minimum of eight hours a day, the schools offer curriculum enrichment activities, including the compulsory education of English, support for the study to all students, the activity fitness and sports in the teaching of music and other artistic expressions and other foreign languages.

The first cycle works on a single teacher, with the use of specialist teachers in certain areas. In the second cycle, education is organized by disciplines and multidisciplinary areas of study. In the third cycle, education is organized by

disciplines. The main objectives of this course are the development of knowledge and skills necessary for entry into employment or further study.

Cycles two and three operate under multi-specialist teachers in different subject areas or disciplines. The teaching of information technologies is introduced in eight grade curricular areas, preferably in the project area, and as a compulsory subject in the 9th grade.
In primary education is compulsory to learn two foreign languages, including English, French, German and Spanish.

Throughout the school pupils are subject of internal summative assessment, in addition, at the end of third cycle, students are subjected to external summative assessment by national exams in the disciplines of mathematics and Portuguese.

8.1.1 Secondary School

Table 60. Learning are, years of schooling and age of the Secondary school

Learning area	Years of Schooling	Age (years)
Scientific-humanistic, Technology, Artistic specialized, Professional Vocational	10º - 12º	15 - 18

Source: ME, 2009

To get access to any course of secondary school students must have completed compulsory education or possess an equivalent qualification.
Secondary education is organized according to different forms, both targeted for further study and for the world of work. The curriculum of secondary-level courses has a benchmark of three academic years and comprises four types of courses:

- Scientific-humanistic courses, are mainly aimed to further study at tertiary level;
- Technology courses, aimed at students wishing to enter the labor market, and also allowing for further study in specialized technology courses or higher education;
- Artistic specialized courses, to ensure artistic training in specialized areas of visual arts, media, dance and music, allowing entry into employment or further study in postgraduate courses;
- Professional Vocational courses are intended to provide entry into the world of work and offering further study in postgraduate courses - no more than secondary or higher education. They are organized by modules in different areas of training.

To complete any course of high school students are subject to an internal summative assessment. In addition to this assessment, students of the scientific-humanistic courses are also subjected to an external summative assessment by the national exams in certain disciplines provided by law.

Students who have completed this level are assigned a secondary education diploma. Technological, artistic and professional expertise curses also give a vocational qualification at level three.

8.1.2 Education Post-secondary non-Higher

The technological specialization courses provide specialized training courses in different areas of technology, allowing insertion into the world of work or further study at university level. Training held on technologic institutes is credited in the degree in which the student is admitted. Successful completion of a course of technological expertise provides a degree of technological specialization and qualification level 4; it may also provide access to a certificate of competence.

8.1.3 Education and Training for Youth and Adults

Education and training for young adults offers a second chance to individuals who left school early or who are at risk of leaving and those who were not able to attend when young, and also to those seeking a school for questions of a professional or personal development in a perspective of lifelong learning. In order to provide new ways to learn and progress emerged initiative like "Novas oportunidades" (New Opportunities) which are defined as a major objective of broadening the theoretical minimum of 12th grade and whose strategy rests on two pillars: Raise the basic training of the workforce and making vocational education a real option for young people.

The various methods of education and training of young people and adults allow acquiring a school certificate and/or professional qualifications, and further studies at post-secondary non higher education.

Education and training for young and adults includes the following procedures:

- System of Recognition, Validation and Certification of Competencies, acquired throughout life, through formal, informal and non-formal, allowing students to obtain dual certification professional and academic. The training received provides access to better jobs and better perspective of lifelong learning. This system takes place in "Novas Oportunidades" (New Opportunities) Centers, spread across the country;
- Education and Training courses, for students aged 15 years and more;
- Education and Training of Adults, and Modular Training for students over 18 years;
- Short actions "S@ber +" (Know More), for students over 18 years;
- Recurrent education, in primary and secondary education for pupils aged 15 or over 18 years for the primary and secondary, respectively;
- National System of Learning, a responsibility of the Employment Office and Vocational Training for young people aged 15 years.

8.2 Primary, Secondary and Higher Education

According to the Framework Law, the Education System includes kindergarten, school education and out of school education. In June 2009 the parliament approved a proposal of the executive government that extends the mandatory education period until the 12th year of education.

School education includes Primary, Secondary and Higher Education as well as special free-time activities.

Primary education aims to provide all individuals with a general preparation: it begins at around the age of six, lasts nine years and includes 3 sequential cycles, the first of which lasts four years, the second lasts two years and the third, three years. It is public, obligatory and free-of-charge.

Secondary education follows the obligatory primary education and is composed of a single three-year cycle (10th, 11th and 12th years).

In 2007 the education main statistical indicators of education continue to improve comparing to the previous years. The rate of pre-school attendance was 78.4%, the retention rate in primary education was 10.0%, the retention and dropout in secondary education was 24.6% and the number of students per computer with internet connection in public education was 12.8%. The number of teachers per student was 14.8 in pre-school education, 8.9 in primary education and 8.1 in secondary education. Enrollment rates in secondary education have increased, as showed in Table 61.

Table 61. Enrollment rates in secondary education

Grade/year	2005	2006	2007
10	81.7	91.1	94.3
11	72.8	80.5	82.9
12	67.4	65.4	65.4

Source: ME. 2009

Higher education is structured according to the Bologna principles and aims to ensure a solid scientific, cultural, artistic and technological research that qualifies students for the professional and cultural activities and the development of creative, innovative and critical analysis. In Portugal is organized in a binary system: the university and polytechnic education, administered by institutions of higher education public, private or cooperative.

To apply for access to higher education, students must meet the following requirements: have successfully completed a course of secondary education or equivalent qualification, have carried out the necessary entrance exams for the course you wish to attend with a classification least 95 points, meet the pre-requisites (if applicable) for the course for which they apply. Entrance to each institution of higher education is subject to *numerus clausus*. Students over 23 who have no qualifications for higher education can access through special examinations to prove their ability to attend the course for which they apply. These examinations are organized by their higher education.

In higher education the following academic qualifications are conferred: Bachelors Degree, Masters Degree, and a PhD Degree. The university and polytechnic institutions confer Bachelors degrees and Master's degrees. The PhD degree is conferred only by universities. In polytechnics, the studies leading to bachelor's degree involving 6 semesters that correspond to 180 credits. In the universities, the cycle of studies leading to bachelor's degree usually has a duration of 6 to 8 semesters, which corresponds to 180 or 240 credits. The course of study leading to Master's degree lasts 3 to 4 semesters, which corresponds to 90 or 120 credits. The doctoral degree is awarded to those who have passed courses in the PhD program, if any, and the public defence of the thesis. Institutions of higher education may also teach the post-secondary education not universitary, for purposes of specialized vocational training. Fees are set by the institutions of higher education, between a minimum and maximum value, according to the type of courses.

Since the late 1970s, environmental themes have been introduced in school programmes. From the 1980s, the possibility was established for a more formal involvement by schools in project methodologies of predominantly environmental themes, both in terms of studies and local activities.

In 2002 began the implementation of new curriculum for basic education, introducing new subjects, new curricular areas and new cross-cutting areas. Among them stand out "Citizenship Education", the "Project Area" and "Civic Education", for the significant contributions they bring to environmental education within an overall framework of Education for Sustainability.

In 2005 Portugal as a member of the EU and as a signatory to the European Strategy for Sustainable Development in Europe, *Vilnius*. Following this strategy our nation has developed in education a series of actions that are examples of cross-curricular integration of education for sustainability and the many environmental projects that are implemented in all schools to contribute to awareness of our children and young people on issues related to the environment.

The Ministry of Education is also a member of the National Commission for UNESCO and subscriber of the document "United Nations Decade of Education for Sustainable Development, 2005-2014 - Contributions to galvanize them to Portugal." Thus, about 60 groups within the network of UNESCO schools where issues related to sustainability are contained in the Educational Projects and Curriculum School.

Citizenship Education is a cross-sectional area that is expressed in all disciplines and in the organization and rules of life of the school community. The Project Area is a weekly space for all students, where using a project methodology to develop projects that take into accounts the interests of students, in which often address environmental issues. Civic Education is a compulsory weekly space for reflection on experiences and concerns expressed by students regarding their participation in the school and the local community and where the discussion also concerns the national and international events.

The curriculums of the disciplines of Geography, Natural Science and Physical Chemistry have been replaced with curriculum guidelines, strengthening the link between Science, Technology, Society and Environment in a critical approach to development/economic and technological growth. The issues related to proper management of natural resources - water, oceans, fisheries, air, biodiversity and forest are included in these curriculum guidelines, and could be across in all disciplines with a view to Citizenship Education, and even in the Project Area and Civic education.

In secondary education, in the process of creating/adjusting the curriculum, Education for Citizenship was adopted on a pervasive nature in all programs. In this sense, the programs of all disciplines are part of the development of skills in the various aspects of education for citizenship, including the Environmental Education, Mobility Education, the Consumer Education, and Health and to all the media.

In the case of science programmes the preferred approach to Science/Technology/Society-Environment, where the relationships established between Science, Technology, Society and Environment are the matrix integrating the theme of programs. These are all aimed at teaching integrated science in all its dimensions, from the sociological methodology, which emphasizes the analysis of the impact of socio/scientific and technological environment. It is an integrated and contextualized approach of Science, which supports the development of skills essential to the exercise of an enlightened citizenship and promotes a development that will be sustained.

It gives good value for contextualizing the development of concepts, as well as the interrelations between Science, Technology, Society and Environment. The programs emphasize an approach centered on major themes of current problems, as contexts for the development and deepening of concepts. For example, the program of Physics and Chemistry of 10º year, around the theme of Atmospheric Environment is developed, among others, the concepts of atoms, molecules and chemical bonding in a context of an integrated environmental issues are addressed such as: The scientific and social problem "of the ozone hole".

As an example, climate change is specifically covered in the following subjects:

Geography (3rd cycle of primary education) – Theme 9 "Environment and Society". Global Warming – Climate Change

Physical/Natural Sciences (3rd cycle of Primary education) – Theme 4 Sustainability on Earth: Global Change Forecast and description of atmospheric conditions; the impact of human activity on the earth's atmosphere and climate. The Activity suggested is to take into account the need to extract, transform and use natural resources and the advantages and disadvantages of doing so. Therefore students should reflect upon and suggest proposals for rational management of resources, later comparing them with current initiatives on this subject – for example the Kyoto Protocol, signed on December 11th, 1997. Debate the controversy around this Protocol.

Physics and Chemistry (Secondary Education, 10th year) – Physics Unit 1 From Sun to Warming: includes camp activities where students can see the impact of the greenhouse effect and the negative consequences of the changes caused to the atmosphere by human activity.

Geology (Secondary Education, 12th year) – Theme The Earth, Yesterday, Today and Tomorrow where Humans are seen as agents of climate change and global warming seen in geological terms

Geography (Secondary Education, 12th year) – Sub-theme the Greenhouse Effect and Global Warming where Debates are proposed on the resolutions of world conferences

Biology (Secondary Education, 12th year) – Unit 5 Preserve and Recover the Environment: the Greenhouse Effect

Chemistry (Secondary Education, 12th year) – Unit 2 Fuels, Energy and the Environment
Various environmental aspects are covered, such as the identification of environmental problems related to atmospheric pollution (particles, CO_2, SO_x, NO_x and CO_2 emissions and related chemical reactions), specifically climate change as provoked by the oil industry and by fuel combustion

- The Area Project / Technology Project (Year 12)
    - is also an ideal place for students, using methods of project work, develop concrete projects that lead to an integrated view of knowledge, allowing them to reflect on the social, economic, technological, and environmental science in an integrated way.

ME in partnership with MAOT, Municipalities, Universities and other governmental and non-governmental institutions, have developed various Environmental Education projects in schools including those described below.

Project **"O ambiente é de todos – vamos usar bem a energia" (Environment belongs to all – lets use energy well)**. This educational project addressed the topics of energy efficiency and climate change with the schools of the 2nd and 3rd cycles, it has been developed by EDP in conjunction with the Sustainable Energy Europe Campaign, the National Commission for UNESCO, the Portuguese Environment Agency, the General direction of Geology and Energy, ADENE (Energy Agency) and the Ministry of Education. This project aimed to sensitize the young to the problem of climate change and the issue of energy efficiency. Between 2006 and 2008 were involved in the project more than 325 000 students and 46 500 teachers.

The quality of the project has been recognized internationally: it was designated as one of the three best projects worldwide for the premium World Energy Globe Award in the category "Youth".

The competition **"Rock in Rio – Escola Solar" (Solar School)**, took place on schools across the country to submit projects combining the benefits of environmental and social to the applicability in their own communities. This included the participation of 197 schools on the mainland and islands. This competition was sponsored by the Better World and SIC Esperança, in partnership with the General Direction for Energy and Geology and Energy Agency and supported by the Directorate-General for Innovation and Curricular Development Ministry of Education. The initiative aimed to stimulate awareness of the issue of climate change and encourage the adoption of good practice in energy use by participating schools in the development of social projects in the communities in which they operate. This initiative won the first prize os the Energy Globe Awards, being the best project in the "Youth" category.

The **Project Escola – Electrão (Electron School)**, promoted by amb3e (Portuguese Association of Waste Management of Electronic Equipment), in collaboration with the Ministry of Education, intended to raise students and the school community for the correct routing of Waste Electrical and Electronic Equipment, the combined effect of dissemination and training and participation in a competition among schools. The project involved the students in the 2nd and 3rd cycle of basic education and secondary education. Participated in it 413 schools, 285 000 students, who in a competition among schools promoted the collection of 1 164 783 kg of Electrical and Electronic Waste.

"Eco Escolas" (Eco-Schools), is an international program that aims to encourage actions and recognize the work carried out by schools, under the Environmental Education and Sustainable Development subjects. It provides fundamental methodology, training, teaching materials, support and supervision to the work of the school, targeting schools of basic education. The Education Ministry is part of the National Committee of the Eco-Schools which is streamlined by the Blue Flag Association of Europe.

The contest **"A minha escola participa no combate à desertificação" (My school fights desertification)**, aimed young people to the issues concerning the "International Year of Deserts and Desertification", by organizing a contest in which the problems related to climate change have been addressed.

The project **"Escolas na Natureza" (School in Nature)**, aimed the goal of provide to all students in 8th grade the training on environment and sustainability. This action took place in the Protected Areas, where the students stay two days and one night, during which he held a series of activities. This project, which has involved around 1300 students and 150 teachers.

The Project **"Ideias que mudam o Mundo" (Ideas that change the world)** was sponsored by Bayer with the support of ME and UNESCO. It aims the development of science and technology in a sustainable development perspective.

The project **"Latitude 60"** involved more than 2 000 students from the mainland and islands and its main objectives are the development of science in the Polar Regions and public awareness of the importance of these regions in the regulation and dynamics of the planet.

The project **"ECO XXI"**, promoted by the Blue Flag Association of Europe seeks to recognize the best practices of sustainability developed by municipalities, considered as the privileged agents in promoting sustainable development.

The Tree Parade is an initiative of the AFN that aims at building awareness of the school population in the fight against desertification and forest fires.

8.3 Training

The ME's Directorate-General for Innovation and Curricular Development has been coordinating teacher training initiatives on the new programmes, in which Citizenship Education is considered a transversal approach which includes the environment, road safety, consumption, health, media and human rights. In relation to training for science projects, the focus was on the CTS/A approach as a framework for citizenship education through science. The following are examples of teacher training programmes:

- XV National Meeting on Environmental Education, promoted by the APA and Gaia Biological Park, 2-5 October 2004 in Castelo de Vide, under the Climate change and Eco-tourism theme, with 280 participants;
- Training sessions organised by Teacher Training Centres including information and pedagogic support on climate change.

During the 2004/2005 school year, the theme proposed to teachers for inclusion in projects, awareness raising actions, training and other activities was Sustainable Development and Climate Change.

Although these projects and activities did not specifically cover the climate change theme, most touched on the issue, linked to other areas such as biodiversity, water management, energy consumption and coastal protection.

In addition to the formal education process, the production of pedagogical materials, support and information for students and teachers is promoted by publishers and developed by NGOs. Hence, various Environmental Education projects in schools, coordinated by the ME in collaboration with MAOT, count on the support of Local Councils and Universities as well as other governmental institutions and NGOs.

Under the scope of MAOT, training actions are developed for the armed and security forces, aimed at teaching specific environment skills, including:

Courses on Environment – Concepts and factual information on climate change aimed at training agents for the Nature and Environment Protection Service/National Guard (7 courses developed between 2001 and 2005, with the participation of a total of 400 trainees);
Training Course for Trainers - Concepts and factual information on climate change for Police force trainers (held in 2005 with the participation of 30 trainees);
Environmental Training Courses for Portuguese Navy Trainers (2 courses per year since 2000, including approximately 30 trainees per course);
Santa Margarida Military Camp 2005 Environmental Week, aimed at trainers (approximately 100 participants including officers and other Army trainers);
Training Courses for the Portuguese Air Force Trainers (2 courses in 2004 and 2005).

8.4 Raising Public Awareness

The Environmental Awareness seeks to awaken the conscience of the people leading change ingrained habits and procedures. Along with the Government Ministries, the Municipal Energy Agencies and some companies several activities took place in order to increase public awareness about climatic change. Some of the initiatives, amongst many other, are further described below.

IM has been conducting actions directed at raising the **public awareness related to climate change**, in the scope of its scientific dissemination programme in areas such as meteo and climate. These actions have as target students, that have been participating at a rate of 2500/year. Also, this institution has been organizing seminar on climate change relates to its effects on public health and in the environment (2009), natural disasters and icebergs (2008) and global impacts (2007).

EcoCasa, launched in 2004 was an innovative project with the aim of promoting the reduction of energy consumption in homes and renewable energy use. This was a project that aimed, in addition to raising public awareness, providing practical solutions, change behavior, management, renovation or purchase of a home and/or its contents. This work continues today by the increase in recent years, energy consumption at household level in our country. Since its inception, were developed several tools to work and outreach efforts to raise the average citizen and persuade him to change behavior. With the maturing of the project, quickly concluded that sustainable habits extended to other areas of everyday life, thus the project also includes Water, Mobility and Sustainable Construction - which came to a more cross-efficiency concept. This project was carried out by the Directorate General for Energy and Portuguese Agency of Environment in collaboration with universities, nonprofit organizations and private foundations.

The **Plan for the Protection of the National Forest against Fire** defines a strategy and a coordinated set of actions to promote the active management of forests, creating advantageous conditions to the progressive reduction of forest fires. To achieve the objectives, actions and goals where defined three priority areas: structural prevention,

surveillance and combat. With this plan Portugal hopes to increase the resilience of the territory to forest fires, reduce the incidence of fires, improve the effectiveness of the attack and the management of fire, recover and rehabilitate ecosystems, adapt the organizational structure and develop the functioning effectively. This project is responsibility of the Ministry of agriculture, rural development and fisheries.

The **Guide to Fuel Economy** is part of an information system for consumers, particularly to buyers of new cars, allowing them to make informed choices and informed about the fuel consumption and CO_2 emissions. Elaborated by the Institute for Mobility and Land Transport, it also rouses the driver to a correct and regular maintenance of vehicles, as well as aware the driver of the benefits of efficient, ecological and sustainable driving mode (Eco-Driving).

Monitoring of emissions of greenhouse gases in Almada, promoted by the Municipal Energy Agency of Almada, this action provides for the continuation of work begun with the energy program and the establishment of the "Inventory of Greenhouse Gases in the municipality of Almada". This project calculates and monitors the energy consumption and emissions of greenhouse gases emissions by sector of economic activity in the municipality of Almada.

Sustainable Development Award: Heidrick & Struggles organized by the third consecutive year an initiative in the area of sustainability. After having launched a pioneering study in 2007, and to have continued and improved in 2008, the high level of organizations participation gave the motivation to a new step towards the establishment of a prize. This award which seeks to recognize entities moved from theory to practice and actually embraced the challenge of sustainable development.

Energy Efficiency in Public Lighting (Lisbon) is a project aiming at the improvement of the overall energy efficiency of the city's lighting. It will develop a set of actions in systems management and monitoring, replacement of components and the continuous monitoring to reach a more efficient energy use. The goal is the reduction of energy consumption, by 80%. Taking in account the criteria of comfort and security needed for the city, this project will give priority to energy efficiency measures in lighting, exploring the full potential of natural light and adjusting the characteristics of light intensity and colour to the function. This project is responsibility of the Municipal Energy and Environmental Agency of Lisbon.

"Pego Longo, Vila do Clima" – promoting Climate Responsibility: the objective of this project is to intervene in the neighbourhood of Pego Longo, both environmental and social. The neighbourhood consists of precarious housing construction and thus serious shortcomings in the energy and heat. With the renovation of the neighbourhood in a more climate responsible village, the purpose is to reclassify it and equip it with several basic infrastructures to increase the quality of life in this population. In addition to physical issues there's another priority of the project, which will proceed and provide education and environmental awareness to the people for energy efficiency and energy savings in households. It is planned to provide the population of means and tools to manage with changes taking the most environmentally correct options. This project intends Pego Longo Village to become an example for other districts with the same origins, in what concern to sustainability. This project was developed by Municipal Energy Agency of Sintra.

Hunting Watts is a project developed by the Cascais' Energy Agency that aims at helping householders to reduce energy waste in their homes and adopt best practices in energy efficiency. By request, householders can ask an energy technical auditing in order to identify equipments and habits that are more appropriate to reduce energy waste.

In a Changing Climate – National Initiative of Adaptation to Climate Change launched in Portugal a larger discussion on adaptation to climate change, merging the public and private sectors and preparing society and economy

to an uncontainable reality. The initiative, promoted by Ecoprogresso, the Ministry for the Environment, Spatial Planning and Regional Development and the British Embassy started in June 2009 and it will continue for 18 months with a cycle of twelve workshops dedicated to several key socioeconomic sectors: Tourism, Banking and Insurance, Water, Energy, Agriculture and Forests, Biodiversity, Spatial Planning, Natural Disasters and Civil Protection, Coastal Zones, Human Health, and Cooperation and Foreign Investment. This is an innovative initiative both at national and international level, because it is focused on the "other side" of climate change.

Efficient bulbs distribution: in 2008 the Portuguese Government started a campaign aiming the eradication of the incandescent lamps, with the distribution of efficient lamps on half million houses. This campaign is the result of the collaboration between public and private entities, where three million lamps were distributed in 2008. In 2009 this campaign is still active, continuing to distribute efficient lamps.

NGC Efficient house initiative was proposed by the National Geographic Channel and promoted by EDP. This innovative project promoted energy efficiency and other environmental measures which can transform the Portuguese houses. The project consisted in a common house with 2 rooms and 100 square meters of total area. This "real" house could be visited and people could see and analyze several options and suggestions to improve energy efficiency, the environment and at the same time, to save money on their own homes.

Energy's and Environment's Space, opened in Lisbon in 2009, this new space is the result of the joint collaboration between the Lisbon energy agency, the Portuguese Energy Agency, Portuguese Environmental Agency and the local authority of Lisbon. In this space, citizens can access relevant information regarding energy and environmental fields, and particularly information about building certification, measures to improve the energy efficiency in their homes and management of solid waste techniques.

Certified House is a website that offers direct access to energy services certification proposed by the qualified experts of Certification Building System and access to information about potential suppliers of solutions to improve energy and environmental performance to the residential sector. This website was created by ADENE (State Energy Agency).

To assess the awareness of the students concerning to climate change a survey was made, called " Análise da Percepção Ambiental de estudantes do ensino básico em Portugal" (**Analysis of Environmental Perception of elementary school students in Portugal**). This survey, conducted by the Centre for Research in Environmental Perception/Univix at the invitation of the Portuguese Association for Environmental Education, was administered to 1034 students from 10 schools spread across seven districts of Portugal. The research focused on aspects of environmental citizenship and rational use of water and involved students from the fifth to eight years since it was intended among other objectives to evaluate the environmental evolution of the students. The conclusions about the profile of Environmental Citizenship stand out with a good level of awareness the following aspects, among others:

> "The perception of the students was very good as regards the assessment of aspects of the frequency with which issues related to the environment are treated in the classroom (56.7%), importance of the environment in vocational training (61.6%)".
>
> "They emphasized the need to incorporate activities at the schools with the communities around it (68.2%), such as, the responsibility for caring for the environment (59.9%) and interest in issues related to the environment (48.1%)".
>
> "The knowledge of the process of final destination of batteries and fluorescent lamps used (59.7%), causes of global warming (excess greenhouse gas 59.8%, while 12.1% admit not knowing what is global warming),

global warming effects (hot flashes 66.3%, melting of the poles 32.4% and the temperature rise 22.8%), and for suggesting measures aimed to mitigate Global Warming (52.7% of students submitted proposals)".

8.4.1 Access to Information and Public Participation

In January 2005 APA published the 1st National Report on the Aarhus Convention, on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. This Report refers to measures adopted to assure that the MAOT bodies and their employees support and assist the general public. The MAOT bodies have Information and Documentation Centres with the skilled and experienced staff necessary to ensure that users receive all the support and help them need when researching information. These bodies also have websites where information is provided on the areas of their competencies, and procedures to respond to e-mail requests. Within this framework, MAOT has supported actions promoted by civil society, namely NGOs, aimed at providing citizens with access to information on the environment.

The Institute for the Environment website contains information on the national GHG inventory (inventory data as well as the annual report explaining the methodologies and information base), the National Climate Change Programme (PNAC) and Portugal's participation in the EU Emissions Trading Scheme (EU-ETS).

The National Climate Change Programme (PNAC) and the National Allocation Plan (PNALE) were both subject to consultation processes.

As a result of what is set out by the PNAC 2001, presented to the public on December 18th, was drawn up in accordance with the Council of Ministers Resolution 59/2001, of May 30th. APA promoted three public sessions during the months of January and February 2002; results were included in the PNAC 2001 after analysis by the Commission for Climate Change (CAC).

As a result of the work initiated in the PNAC 2001, sectoral Reference Scenarios were identified, from which GHG emissions reduction efforts would be determined for the various sectors of the economy. This group of sectoral documents was subject to public discussion in February 2003.

Additional policies and measures were considered to guarantee Portugal's fulfilment of the Kyoto Protocol, with a view to updating PNAC as well as its effective implementation. On December 18th, 2003 the Public Discussion period began with a presentation of these additional measures. The documents were disseminated and made available from APA website. Between December 18th 2003 and February 2004, comments and suggestions were received and summarised in the respective public discussion report.

The National Allocation Plan (PNALE) was determined in the frame of Directive 2003/87/CE of the European Parliament and of the Council of 13 October, creating a GHG emissions trading scheme within the EU. With the support of CAC, a working group was formed to develop the PNALE proposal for the period 2005-2007. This document was subject to public discussion and was publicly presented on March 17th, 2004. The public discussion on the document ran until March 2004.

Regarding Public Consultation, contributions were received from:

- 3 business associations
- 1 NGO
- 12 companies and other entities and
- 1 individual.

All received individual replies from the working group, explaining and justifying the options adopted.

According to RCM 1/2008 PNALE II was also subjected to process of public consultation between the 1st and the 15th of July 2006 previously to its publication and after consultations among associations of the various sectors. During this process comments were received from:

- 3 companies
- 9 business associations
- 2 NGOs
- the Portuguese Agency for the Investment
- the National Regulatory Entity for the Energy Services(ERSE) and
- the National Electric Network (REN).

In what concerns EU-ETS, most of the comments were related to particular situations, namely on the inclusion or exclusion for the PNALEII provisional list (mainly from ceramics). Other aspects included the application of Maximum Factors for the Emissions from Combustion (MFECs) in the installations that resulted in a moderate reduction rhythm easy adopted. It was also considered that a minimum MFEC should be established in biomass, once its scarcity could lead to the use of back-up equipments using other fuels.

Recently, the proposal for the Portuguese National Strategy on Adaptation has been subjected to Public Consultation between the 17th of July and the 4th of September. This process resulted in 31 comments from:

- the Portuguese Council on Sustainable Development and Water
- 7 individual citizens
- Port and Sea Transport Institute
- The Madeira's Harbour
- The Railway Network
- Faculty of Sciences of the University of Lisbon
- Council for Associated Laboratories
- National Agriculture's Confederation
- Regional Directorate for Agriculture and Rural Development, Madeira
- Regional Directorate for Forestry, Madeira
- Regional Directorate for Fisheries, Madeira
- Department of Prospective and Planning of the Ministry of the Agriculture, Regional development and Fisheries
- Environment, Spatial Planning and Regional Development
- Madeira's Natural Park
- Regional Directorate for Tourism, Madeira
- Regional Secretary for the Social Affairs, Madeira
- National Municipalities' Association
- Municipality of Aveiro
- Municipality of Ponte da Barca
- Municipality of Setúbal
- Municipality of Sintra
- Vice-Presidency of the Regional Government of Madeira
- Industry's National Confederation
- Ecoprogresso
- Group for the Study of Spatial Planning and the Environment
- Quercus.

Globally, the comments received were constructive and the report of the public consultation resumes its consideration. The actual version of the proposal for the Strategy has been sharpened to include the comments and suggestions received and it has been proposed for formal approval.

8.4.2 Involvement of Environmental Non-Governmental Organisations

Environmental NGOs in Portugal are legally defined according to Law 35/98, of June 18th. Article 14(2), establishes that the APA is responsible for providing financial support to the ENGOs and other equivalent organisations. Decree Orders 478/99, of June 29th and 71/2003, of January the 20th; regulate the National Registry of the ENGOs and Equivalent (RNOE). Steps needed for establishment, modification, suspension and annulment of NGOs, as well as financial support received, are published in the *Diário da República*. Information regarding registered and active NGOs is available on the internet (http://www.iambiente.pt/docs/5026/RNOE_1205). To date there are 135 registered organisations.

The MAOT currently has two means of financial support:

- Programme for the Support of Environmental and Sustainable Development Activities (PAAADS): it funds environmental and sustainable development actions. Registered organisations such as Environmental Protection Associations, their federations, NGOs, universities, Higher Education and Polytechnic Institutes can apply for funding; and
- ENGO Financial Support Programme (PAFOE): exclusively for ENGOs and Equivalents registered at the RNOE. It aims to reinforce the capacity for participation and the development of projects or actions, providing three different types of funding. In 2004, 2005 and 2006, the main funding priorities were policies and measures to respond to climate Change.

In 2003 these two funding programmes supported 145 projects, involving 50 organizations amounting to about € 257 621. In 2004, 111 projects were supported, amounting to about € 221 041; in 2005, 134 projects were supported to a sum of about € 237 156.

8.5 Participation in International Activities

The ME participates in the Education for Values programme, with the Ibero-American Organisation. Its main objective is to promote the values, attitudes, behaviour and concepts from an ethical perspective which unites the local and global dimensions of this theme. Within this context, the ME also collaborates in the European Council's and the EU's Education for Citizenship project.

The APA has financed, under PAAADS, the participation of ENGOs at various national and international events which contribute to the increase in the capacity of work done by the benefiting entities (Table 62).

Table 62. Support to the participation in national and international events that contribute to the building of capacity of the beneficiary organisations (2000-2006)

Association	Year	Action	Action's Description	Funding (Euros)
QUERCUS – National Association for Nature Conservation	2000	6th Conference of the Parties to the Climate Change Convention (COP6)	The Hague, Amsterdam, November 13th to 24th	987.98
QUERCUS – National Association for Nature Conservation	2001	Second part of the 6th Conference of the Parties to the Climate Change Convention (COP6bis)	Bonne, Germany, July 16th to the 27th	703.31
QUERCUS – National Association for Nature Conservation	2001	7th Conference of the Parties to the Climate Change Convention	Marrakech, Morocco, October 29th to November 9th	404.03
EURONATURA – Centre for Environmental Law and Sustainable Development	2001	7th Conference of the Parties on the Climate Change Convention	Marrakech, Morocco, October 29th to November 9th	1326.78
QUERCUS – National Association for Nature Conservation	2002	8th Conference of the Parties to the Climate Change Convention	New Delhi, India, October 23rd to November 1st	2500.00
QUERCUS – National Association for Nature Conservation	2003	9th Conference of the Parties to the Climate Change Convention	Milan, Italy, December 5th to the 12th	515.71
QUERCUS – National Association for Nature Conservation	2004	10th Conference of the Parties to the Climate Change Convention	Buenos Aires, Argentina, December 6th to the 17th	1580.20
QUERCUS – National Association for Nature Conservation	2005	11th Conference of the Parties to the Climate Change Convention / 1st Meeting of the Parties to the Kyoto Protocol	Montreal, Canada, November 28th to December 9th	1345.15
QUERCUS – National Association for Nature Conservation	2006	12th Conference of the Parties to the Climate Change Convention / 2nd Meeting of the Parties to the Kyoto Protocol	Nairobi, Kenya, November 10th to the 17thh	555.55

Source: APA, 2009

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Annex 1.
National Greenhouse Gas Emissions Inventory (1990-2009)

Table 63. Summary report for CO_2e emissions, in 1990 (2009 Submission)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**44 949,37**	**10 257,43**	**5 605,41**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**60 812,21**
1. Energy	**39 318,33**	**581,65**	**522,14**				**40 422,12**
A. Fuel Combustion (Sectoral Approach)	39 154,47	464,43	522,14				40 141,04
1. Energy Industries	15 944,40	4,33	61,04				16 009,77
2. Manufacturing Industries and Construction	9 162,02	38,03	67,21				9 267,26
3. Transport	9 919,64	73,60	156,12				10 149,36
4. Other Sectors	4 025,13	348,30	236,92				4 610,35
5. Other	103,28	0,17	0,85				104,29
B. Fugitive Emissions from Fuels	163,86	117,22	NE,NO				281,08
1. Solid Fuels	8,65	66,02	NO				74,66
2. Oil and Natural Gas	155,22	51,20	NE,NO				206,42
2. Industrial Processes	**4 035,28**	**9,08**	**566,68**	**NE,NO**	**NE,NO**	**NE,NO**	**4 611,04**
A. Mineral Products	3 384,40	0,76	NO				3 385,16
B. Chemical Industry	634,38	8,32	566,68	NE	NE	NE	1 209,38
C. Metal Production	16,06	IE,NO	NO	NE	NE	NE	16,06
D. Other Production	0,44						0,44
E. Production of Halocarbons and SF_6				NE,NO	NE	NE	NE,NO
F. Consumption of Halocarbons and SF_6 [2]				NE,NO	NE,NO	NE,NO	NE,NO
G. Other	NO	NO	NO	NE	NE	NE	NE,NO
3. Solvent and Other Product Use	**219,71**		**NE,NO**				**219,71**
4. Agriculture		**4 054,76**	**4 033,58**				**8 088,34**
A. Enteric Fermentation		2 621,88					2 621,88
B. Manure Management		1 175,66	575,15				1 750,81
C. Rice Cultivation		226,76					226,76
D. Agricultural Soils [3]		NE,NO	3 436,64				3 436,64
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		30,46	21,80				52,25
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry [1]	**1 365,93**	**137,08**	**40,23**				**1 543,23**
A. Forest Land	-50,43	137,08	13,91				100,56
B. Cropland	190,38	NO	24,24				214,62
C. Grassland	-24,74	NO	NO				-24,74
D. Wetlands	104,75	NO	NO				104,75
E. Settlements	1 113,65	NO	NO				1 113,65
F. Other Land	32,33	NO	NO				32,33
G. Other	NO	NO	2,07				2,07
6. Waste	**10,10**	**5 474,86**	**442,79**				**5 927,76**
A. Solid Waste Disposal on Land	NA	3 032,57	NO				3 032,57
B. Waste-water Handling		2 442,25	441,67				2 883,92
C. Waste Incineration	10,10	0,04	1,12				11,26
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [4]							
International Bunkers	2 836,74	3,05	23,83				2 863,63
Aviation	1 453,79	2,58	12,77				1 469,14
Marine	1 382,95	0,47	11,07				1 394,49
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**10 570,89**						**10 570,89**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	59 268,98
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	60 812,21

[1] For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

[2] Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

[3] Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

[4] See footnote 8 to table Summary 1.A.

Source: APA, 2009

Table 64. Summary report for CO_2e emissions, in 2007 (2009 Submission)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs [2]	PFCs [2]	SF_6 [2]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [1]	**60 422,15**	**12 833,86**	**5 306,19**	**941,12**	**5,72**	**8,04**	**79 517,08**
1. Energy	**55 452,22**	**1 137,21**	**993,03**				**57 582,46**
A. Fuel Combustion (Sectoral Approach)	54 563,77	435,41	993,03				55 992,21
1. Energy Industries	19 776,99	7,67	129,43				19 914,09
2. Manufacturing Industries and Construction	10 695,39	62,04	102,74				10 860,17
3. Transport	18 838,92	50,82	610,37				19 500,11
4. Other Sectors	5 179,85	314,87	149,85				5 644,57
5. Other	72,62	0,01	0,64				73,27
B. Fugitive Emissions from Fuels	888,46	701,80	NE,NO				1 590,26
1. Solid Fuels	IE,NO	IE,NO	NO				IE,NO
2. Oil and Natural Gas	888,46	701,80	NE,NO				1 590,26
2. Industrial Processes	**6 993,54**	**13,90**	**626,96**	**941,12**	**5,72**	**8,04**	**8 589,28**
A. Mineral Products	4 845,27	1,86	NO				4 847,13
B. Chemical Industry	2 132,12	12,04	626,96	NO	NO	NO	2 771,11
C. Metal Production	15,71	IE,NO	NO	NO	NO	NO	15,71
D. Other Production	0,44						0,44
E. Production of Halocarbons and SF_6				NA,NO	NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [2]				941,12	5,72	8,04	954,88
G. Other	NO	NO	NO	NA,NO	NO	NO	NA,NO
3. Solvent and Other Product Use	**346,26**		**NE,NO**				**346,26**
4. Agriculture		**4 560,48**	**3 077,82**				**7 638,29**
A. Enteric Fermentation		2 979,37					2 979,37
B. Manure Management		1 169,55	572,64				1 742,19
C. Rice Cultivation		391,88					391,88
D. Agricultural Soils [3]		NE,NO	2 488,53				2 488,53
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		19,67	16,64				36,32
G. Other		NO	NO				NO
5. Land Use, Land-Use Change and Forestry [1]	**-2 370,48**	**18,45**	**28,19**				**-2 323,84**
A. Forest Land	-3 786,84	18,45	1,87				-3 766,52
B. Cropland	190,38	NO	24,24				214,62
C. Grassland	-24,74	NO	NO				-24,74
D. Wetlands	104,75	NO	NO				104,75
E. Settlements	1 113,65	NO	NO				1 113,65
F. Other Land	32,33	NO	NO				32,33
G. Other	NO	NO	2,07				2,07
6. Waste	**0,60**	**7 103,82**	**580,20**				**7 684,63**
A. Solid Waste Disposal on Land	NA	4 945,39	NO				4 945,39
B. Waste-water Handling		2 158,38	578,65				2 737,03
C. Waste Incineration	0,60	0,05	1,55				2,21
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [4]							
International Bunkers	4 259,73	2,11	36,08				4 297,93
Aviation	2 499,66	1,51	21,95				2 523,12
Marine	1 760,08	0,60	14,13				1 774,81
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**13 093,56**						**13 093,56**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	81 840,92
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	79 517,08

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

Source: APA, 2009

Annex 2.
Research Projects on Climate Change (2000-2004)

Funded by FCT

2000

Title

BLACK CARBON LEVELS IN THE ATMOSPHERE OVER THE NORTH ATLANTIC OCEAN

Proposing Institution

Instituto do Mar - IMAR

Summary

The North Atlantic atmosphere is particularly susceptible to impacts from long-range transport of air pollutants. Two main reasons explain these negative impacts: the emission of large amounts of pollutants from populated and industrialised areas in the eastern coast of North America; and the dominant westerly wind regime in the area bounded by approximately 30 ºN and 60 ºN. Combustion-generated black carbon (BC) particles are a ubiquitous component of the atmospheric aerosol transported into the North Atlantic atmosphere and have been the focus of attention in recent years because of the role they can play in climate change. The chemical inertness of BC particles, coupled with their small sizes, prolong their atmospheric residence time, which is on the order of several days. Such long lifetime indicates that long-range transport becomes important and suggests that BC can serve as a tracer of anthropogenic activity in polluted air masses. It is also known that BC has a high specific absorption of solar radiation. Consequently, there is a strong suspect that aerosol transport from polluted areas in the United States and Canada can have important climatic effects over the North Atlantic region.

The Azores islands provide a unique natural laboratory to study the effects of anthropogenic emissions on the atmosphere over the North Atlantic Ocean, because the impact of local pollution sources is considered to be minimal. In addition, the islands are the only location in the central North Atlantic where ground-based measurements of the atmosphere are possible.

The objective of this project is the continuous measurement of atmospheric levels of BC at two remote sites in the Azores islands, in order to determine the frequency and magnitude of long-range transport events that disperse this air pollutant. Altitude differences in BC transport over the central North Atlantic Ocean will be investigated from measurements performed simultaneously in the boundary layer (Terceira Island) and the free troposphere (summit of Pico Island). The information gathered from this project will provide further insight into the spatial and temporal distribution of BC and add to the growing database of BC concentrations in the global atmosphere. In addition, these measurements will improve current understanding of human impacts on the North Atlantic atmosphere and will contribute to improved estimates of the influence of BC in climate change.

Title

REDUCTION OF UNCERTAINTIES OF ESTIMATES OF ATMOSPHERIC EMISSIONS FROM FIRES IN SOUTHERN AFRICA.

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior de Agronomia – ISA

Summary

The goal of this project is to contribute towards the reduction of uncertainties in the estimates of emissions of trace gases and aerosols resulting from biomass burning in southern Africa. The specific objectives are: to develop burned area detection algorithms using data from the newest generation of instruments of the NASA Earth Observing System; to improve estimates of combustion completeness in the Miombo ecosystems of southern Africa; to study the relationships between land use/land cover and fire.

The core of the project is the development and application of new methods of burned area detection and mapping using the new generation observation systems (TERRA sensors, and SPOT-4 Vegetation). Reliable quantification of burned area and combustion completeness have been pointed as a major limiting factor on the ability to reduce the high variability of the currently available emissions estimates. Collaboration with NASA's Goddard Space Flight Centre will facilitate the development of burned area detection algorithms for the new generation of satellites, and access to the knowledge gathered by this team during the SAFARI-92 campaign. All activities of the project are coordinated around a participation in the SAFARI 2000 campaign (Southern Africa Fire-Atmosphere Research Initiative), an international collaborative science initiative that takes place in southern Africa and comprises (1) a number of linked ground based short and long term field campaigns to measure biological, soil atmosphere and radiation processes, (2) aircraft measurements of vertical and horizontal properties of the atmosphere, (3) remote sensing observations from NASA's new generation of Earth observation systems.

The tasks proposed in this project are of two types:

- algorithm development, image processing, statistical analysis, geographical data processing and analysis, and generation of maps;
- fieldwork for ground validation of the image classification, fuel and combustion efficiency measurements, and spectro-radiometric measurements.

The fieldwork will be conducted mainly at a study site in Northern Mozambique (one of SAFARI's network of ground based study sites). The Portuguese team is responsible for the operations in this site, which will be coordinated through Universidade Eduardo Mondlane, Maputo.

The results expected are: an algorithm for burned area detection at 1 km spatial resolution adapted to the major ecosystems of southern Africa; a set of 1 Km resolution burned area maps for the same region; a high resolution burned area map-set for accuracy assessment; a field data base with ground data information; improved estimates of combustion completeness in Miombo ecosystems; a characterization of fire spatial and temporal patterns by land cover type; and an estimate of biomass burning and atmospheric emissions by land cover type, for the SAFARI 2000 study area.

Title

CLIMATE CHANGE IN PORTUGAL: IMPACT ON THE OCCURRENCE OF FOREST WILDFIRES AND ON THE AIR QUALITY

Proposing Institution

Universidade de Aveiro

Summary

Attending to the fact that climate change is regarded as one of the main threats to world-wide sustainable development, the principal purpose of this project is to provide a base of scientific information for national policy makers and public use by the assessment of the vulnerability of Portugal to climate change, namely in what concerns the occurrence of forest wildfires and the air quality. Human activity is responsible for an increase of the greenhouse gases (GHG) and aerosols concentration's in the atmosphere, contributing to an increase of the greenhouse effect. Several studies using climatic general circulation models (GCM), and assuming different scenarios of GHG concentration point to important global changes in temperature, precipitation and soil moisture content. At a regional level potential changes were identified, which concern ecosystems composition and their productivities, severe extreme high temperature events, floods, and drought (which are closely related to forest fires occurrence). However, the horizontal resolution of present coupled atmosphere-ocean models is still too coarse to capture the effects of local and regional forcing in areas of complex surface physiography and to provide information suitable for many impact assessment studies.

This project intends to evaluate climate change impacts on Portugal with a technique that consists of using outputs from a GCM (MUGCM) simulations, estimated for a present climate and for a climate submitted to an increase of carbon dioxide concentration in the atmosphere, to provide initial and driving lateral meteorological boundary conditions for a high resolution regional climate model (MM5). The vertical profiles resulting from MUGCM applications will be validated with historical radio soundings data sets, which will provide better initialisations of the regional model MM5. MM5 results will be validated with reanalysis data sets from the European Centre for Medium Range Forecast. Fire meteorological risk indexes for Portugal will be estimated using the regional meteorological results both for control and for perturbed global climate simulations. Different methodologies will be applied, namely: the Canadian Fire Weather Index, the Nesterov Index (modified by the Portuguese Meteorological Institute) and the Haines Index (calculated from radiosounding meteorological data). Aiming to compare and to evaluate the different estimated indexes a meteorological field campaign will be performed, in the centre of Portugal, during one fire season. On the other hand, the impact of climate change on photochemical production and on the air quality will be calculated using a numerical system of models to simulate the transport and photochemical production (MEMO/MARS) on Portugal, with a dynamical downscaling approach. The national emissions database of the University of Aveiro will be used to estimate present air pollutants emissions, both biogenic and anthropogenic one, in order to be included in the air quality system. Regarding simulations considering a future climate, several emission scenarios will be built. Different factors such as economic growth patterns, trends and characteristics of energy consumption and intensity, the influence of specific co-ordinated policies and measures at national and European Union level will be considered. Results from this project would be useful for future policy decisions regarding forest and air quality management.

Title

PORTUGUESE WOOD INDUSTRIES: GREENHOUSE GASES FLUXES AND ACCOUNTING METHODS FOR THE EVALUATION OF THE GLOBAL WARMING EFFECT

Proposing Institution
Universidade de Aveiro

Summary

The adoption of the Kyoto Protocol in December 1997 implies the development of a series of policies and measures at national level to ensure that the quantified targets for greenhouse gases (GHG) reduction are met in the period from 2008 to 2012. The wood industries are a very important industrial sector in Portugal and they are in a good position with regard to GHG emissions. In fact they use a renewable material as raw material, wood, that act as a carbon sink when is taken from sustainably managed forests, and also because the energy consumed in this industry is largely based on renewable fuels. In addition most of forest products contribute to the storage of carbon through the products storage.

The main goal of this project is to provide a decision-supporting tool for the establishment of strategic policies for the wood industries and Portuguese government in order to meet the Kyoto Protocol's target concerning the global warming effect. One objective of the project is the identification and quantification of GHG emissions and removals along the life cycle of the products from wood industries. The subsystems considered are, among others, the following: forest growth and management, wood products production, recycling, different final disposals (landfilling, incineration, etc.) and transportation.

The methodologies used to estimate GHG emissions and removals are those accepted by the IPCC (Intergovernmental Panel on Climate Change), according to the Kyoto Protocol recommendations.

Another objective is the comparison between different models for carbon accounting (such as, IPCC default method, atmospheric-flow approach, stock-change approach and production approach). When applied to the Portuguese forest, this comparison is based on sensitivity analysis and considers the following quality criteria: accuracy, simplicity and scale independence.

The main result of this project is to gain knowledge and understanding of the technical and political implications of choosing one carbon accounting method applied to the Portuguese forestry

Title

CARBON BALANCE OF EUCALYPT PLANTATIONS IN PORTUGAL – THE KYOTO FOREST PROBLEM

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior Técnico – IST

Summary

The main goals of the project are to study the magnitude, seasonal variation and distribution between ecosystem components of carbon stocks and fluxes in eucalypt plantations and their potential role as carbon sinks in the context of the Kyoto Protocol.

More specifically the project aims at:

(1) quantifying the net ecosystem carbon exchange through the continuous measurement of surface flux of CO_2using the eddy covariance method, on a flux tower installed on an 8 years-old eucalypt plantation, and the partition of this flux between plant CO_2 exchange with the atmosphere and soil respiration. This is the flux which, if summed annually, provides the estimate of Net Ecosystem Exchange (NEE), and thus provides a direct measurement of the annual ecosystem carbon source/sink strength, which shall be compared with the stock inventories for carbon accounting in the Kyoto protocol commitment period.
(2) The quantification of carbon stocks by the inventory of biomass components and changes in soil carbon storage along a chronosequence of eucalypt plantations in Herdade da Espirra.
(3) To extrapolate the results found for carbon sequestration in the main site, across a range of soil and climate conditions in Portugal using adequate models.

This study will be done using data collected by the group for more than two decades and the validation of the results in the Herdade da Espirra, a site has been extensively studied in terms of soils, hydrology and biomass production leaf physiology and leaf area index.

Title

AQUIFERS AS ARCHIVES OF PALAEOCLIMATE AND INDICATORS OF FUTURE CLIMATIC SCENARIOS - SADO - SINES SYSTEM AND BAIRRADA CARSIC AQUIFER

Proposing Institution

Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

The Sado-Sines System represents an important water resource for a vast region (Sines-Grândola-Setúbal-Alcochete). The highly populated urban and industrialised areas of Sines and Setúbal are mainly supplied by this system, which has been extensively exploited over the recent decades. In the remaining region the agricultural and cattle breeding activities are also depending of this resource. Concerning the Bairrada Carsic aquifer, this is mainly composed by carbonate formations (Liassic), and represents a vital water resource for public supply in that region (Anadia, Cantanhede, Mealhada, Montemor-o-Velho and Oliveira do Bairro).

This project will contribute to a better understanding of Sado-Sines System and Bairrada Carsic Aquifer, updating the knowledge of the dynamic evolution response in time of both systems, using chemical, physical and isotopic determinations. The comparison of Sado-Sines system characterised by a long residence time, with the Bairrada Carsic Aquifer (fast circulation) will allow determining the influence of the climatic variations in precipitation, along hydrological cycles since Pliocene to present and predict future climatic scenarios.

Isotope data enabled a reconstruction of the hydrodynamic response of the system to dramatic changes of climate. Stable isotopes will be used in the identification of the salts contamination sources in groundwater (salt dissolution and seawater intrusion). 14C determinations will be performed along the main flow path of the system. The apparent flow velocities gives information about the aquifer response to the sea level changes (Sado-Sines System), also reflected in the chemical evolution of the groundwater. The identification of pollution mechanisms (seawater intrusion actual/ancient and agricultural or cattle breeding activities (15N)) using traditional chemical tools associated with isotope techniques, delimitation of recharge areas and estimation of residence time and flow velocities are the first goals to be achieved in Sado-Sines basin; in parallel, the application of environmental isotope techniques (2H, 13C, 15N, 180 and 3H, 14C) together with chemical analysis and noble gases measurements will give information about palaeoclimatic and palaeohydrogeological evolution of the area and the response of the system to the sea level changes estimating the palaeoflow velocities. Concerning the Bairrada Carsic aquifer, the characterisation of its hydraulic behaviour and hydrochemical evolution along the flow path, will contribute to a correct water management and identification of its vulnerability to anthropogenic pollution.

Title

OIKOMATRIX - EVALUATION OF THE SOCIO-ECONOMICAL IMPACT OF LEGAL TOOLS TO CONTROL THE EMISSION OF GREEN HOUSE GASES

Proposing Institution
Universidade de Aveiro

Summary

Portugal has been experiencing a remarkable economic growth in the last years. This growth was reflected in an increasing use of resources, namely fossil fuels, with a significant contribution for the increase of greenhouse gases emission. With the Kyoto Protocol in 1997, and considering the state of relative development of the country in the frame of the European Union, Portugal obtained the right to increase its emissions of carbon dioxide up to 27% till 2010, comparing to 1990 levels. This 'right' will be depleted in 2000, according to more pessimistic scenarios: the emissions increased in these three years about 37%.

Using a 'business as usual' scenario, results show that Portugal is close to reaching or even surpassing the values agreed upon in Kyoto (Borrego et al., 1999a and b). Considering the assumed commitments, Portugal will be forced to acquire rights of emission with costs estimated in over 1 GEuro per year. In this context it is obvious the need to implement measures in order to oppose and invert these trends. In the frame of this project an evaluation of the economic impacts due to the introduction of policies to limit the use of energy with generation of carbon dioxide from non-renewable sources will be performed. This evaluation will be based on national, single-region and multi-regional input-output economic matrices.

The goals are, on the other hand, to follow and evaluate the evolution of the emissions of carbon dioxide in Portugal and to assess the impacts on the economy of the legal measures to adopt, both at national and regional levels. The evaluation of the effect of different alternatives will be done by the construction of scenarios that will include estimates of the effect of:

- the technological improvement;
- the introduction of new products or alternatives;
- the reduction of production and/or the consumption;
- the changes of fuel consumption patterns in industry, houses and transportation.

These scenarios will be translated, when adequate, in an update of the technical coefficients of the economic matrices. The evaluation of the direct effects of the different measures will be based on the existing experience in the team in this domain and the extrapolation of the effects of similar implementations in other countries. The final project goal is to establish both a methodology to estimate environmental impacts from changes on the economic activities and to apply the economic matrices for the evaluation of the impact of new legal measures in the domain of the environment, both at national and regional levels. These methodologies may be the basis of a decision support system, generating regional cost-benefit and multi-criteria analysis.

Title

BUILT ENVIRONMENT, URBAN CLIMATE AND RATIONAL USE OF ENERGY

Proposing Institution

Instituto Nacional de Engenharia, Tecnologia e Inovação – INETI

Summary

In the panorama of the Portuguese energy sector, the buildings are responsible for about 20% of the consumption. This value is prone to increase, in response to expectations of the citizens for higher comfort levels. The energy bill is usually a significant portion of the operation costs of buildings. Energy use is also closely related to environmental problems such as global and local climate change. Both are good reasons for having the energy use in the built environment as one of the main targets for policies of energy savings, rational use of energy and greenhouse gas emission reductions.

The use of energy in buildings is naturally related to the materials and components used - but also by factors such as occupancy patterns, location, shape, etc. In particular, factors such as the surrounding climate and microclimate are very important, as quite large variations in ambient temperature, humidity and wind speed and direction can often be found within a same location. A correct adaptation of the buildings to their environment is crucial for optimisation of both human comfort and energy use.

An on-going PRAXIS Project (SIAM) is currently examining the impact of climatic change in Portugal, including in the Energy sector. The impact of global climate change in the use of energy in buildings is one of the main issues surveyed.

The current Proposal (ACLURE) focuses on the local scale. The influence of urban climate variability and human induced climate changes on energy use in buildings (and comfort) will be analysed through measurements and simulations for a variety of typical cases. Subjects of study will be the influence of vegetation, large water bodies, average volumetry of the area, shading, street canyons; size of the urban aggregate (e.g. heat island effect); and type, shape and constructive details of buildings.

The outcome of this Project should be translated into models and methods for assisting in estimating the urban microclimate, its effects on the thermal performance and energy use in buildings and guidelines for building placement and design. Case studies will be analysed. A brochure will be published. Also a ready-to-use tool decision aid for professionals - such as architects, engineers, decision-makers - will also be implemented as a Geographical Information System coupled to an Expert System, however carefully designed to be "light" so as to run easily and fast in a common desktop computer.

2001

Title
CLIMATE CHANGE IN PORTUGAL – SCENARIOS, IMPACTS AND ADAPTATION MEASURES (SIAM)

Proposing Institution
Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

Climate change is one of the most serious environmental problems facing the earth today. The Intergovernmental Panel on Climate Change (IPCC) revised its conclusions of 1995, in which it stated "…the balance of evidence suggests that there is a discernible human influence on global climate…" to "…there has been a discernable human influence…" in its 2000 preliminary version. It is a fact that the systematic increase in anthropogenic emissions of greenhouse gases, among which CO2 is most prevalent, causes climate change. These changes are hardly reversible, and have negative impacts in many regions and countries.

The combustion of fossil fuels (coal, oil, etc.) and the changes in the use of land, namely forestry are contributing to the increase in the concentration of greenhouse gases in the atmosphere, changing the thermal balance, heating the atmosphere in some regions and cooling in others. As aerosols do not remain in the atmosphere for long periods of time and their concentration is not foreseen to substantially increase, these cannot compensate for the long-term effects of greenhouse gases (which have long atmospheric residence times).

The main goal of this proposal is to report on the potential effects of climate change in Portugal. This report will provide, on a regional basis, a compilation of the available information on the vulnerability of ecosystems, human health and socio-economic sectors to climate change. The vulnerability of social and natural systems to climate change will be evaluated according to a systematic and integrated process. Uncertainties regarding the characteristics, magnitude and future climatic variation indices create limitations on climate change impacts projections, especially at the scale of a country such as Portugal.

This study has four objectives:

1 – Creation and analysis of climate scenarios for different time intervals to 2100;
2 – Quantitative assessment of the impacts of climate change on different sectors and socio-economic activities;
3 – Identification of vulnerability to annual and seasonal meteorological variations by different sectors and activities;
4 – Study and identification of possible response and adaptation measures with regard to climate change impacts.

Title

STUDY OF FORCING MECHANISMS OF LOW FREQUENCY ATMOSPHERIC VARIABILITY IN THE EURO-ATLANTIC REGION

Proposing Institution

Universidade de Aveiro

Summary

Much of the energy that feeds the extra-tropical atmospheric systems originates in the excess of energy in the tropics, which is meridionally transported to the extra-tropics by the Hadley circulation. Superimposed on the Hadley Circulation, one observes throughout the equatorial region, a series of zonal direct thermal cells named the Walker Circulation, its ascending branches corresponding to regions of strong superficial convergence and intense precipitation located over Indonesia and west Pacific, Amazonia and Southern Africa.

Perturbations of these important general circulation mechanisms can have consequences on the climate and its variability (on an inter-annual and in longer temporal scales) in some regions of the planet. In particular, it is known the influence of the El Niño-Southern Oscillation phenomenon (ENSO) in the structure of the Walker Circulation. Less addressed has been the impact of these changes on the Hadley Circulation, particularly in the Euro-Atlantic region. Much of the research carried out so far on the influence of ENSO on European climate links the propagation of the ENSO signal through of a wave train which propagates across the Pacific, North America and North Atlantic. Recent concerns on the desertification of the Mediterranean and southern Europe regions, which may or may no be related to ENSO, resulted in a number of local climate studies of these regions seem to confirm this tendency. However, the physical mechanisms behind these changes remain obscure. Thus, it seems a reasonable scientific hypothesis the existence of physical mechanisms related to the variability of the meridional circulation, which force extra-tropical low-frequency variability.

In winter, when the westerly winds predominate in the extra-tropical stratosphere, the troposphere and stratosphere are dynamically coupled. Thus, the effect of the tropical/extra-tropical connection could be different, depending on the characteristics of the coupling between the two atmospheric layers.

In this project, one intends to perform a series of 20 simulations with the Melbourne University General Circulation Model, to study the atmospheric inter-annual climate variability of the Euro-Atlantic tropics/extratropics interface region. In these simulations the atmosphere is forced with lower boundary conditions (sea surface temperature and sea-ice) observed during the 1979-96 period. Each of these simulations differs in the initial conditions. With this approach one can separate the total variability into forced (due to the temporal evolution of the boundary conditions), and internal variability. This allows also the separate study of the anomalous energy excess (El Niño) and deficit (La Niña) in the tropics to which the extra-tropical circulation may not respond linearly.

The effect of the dynamical coupling between the troposphere and stratosphere will be studied. The analysis will be performed also on observed data and, if necessary, on simulations available from other models.

Title

CLIVAR - CLIMATE VARIABILITY AND CHANGE: PATTERNS AND IMPACTS AT THE REGIONAL SCALE

Proposing Institution

Instituto de Ciências da Terra e do Espaço – ICTE

Summary

Project CLIVAR proposes to clarify some aspects of the Iberian regional climate which are important both for downscaling of long-term and seasonal weather predictions and for climate change assessments. CLIVAR will study relationships between the large scale circulation and its variability, and the regional features which are due to the Iberian geometry, topography, soils and land use. The aim is not only to explore the regional aspects of climate variability and change, but also to assess the interactions between expected climate change, coming from increased greenhouse gases concentrations at the world level, and other climate change forcing associated with changes in land use at the regional and local levels.

The methodology to be used brings together some new methods from statistical climatology, which can be used to design highly efficient weather classification systems, and state-of-the-art mesoscale modelling techniques, allowing for a detailed simulation of case studies at the sub-regional scale.

At the same time, because agriculture is one of the main potential end users of improved seasonal forecasts, the project will also test the impact of seasonal forecasts and climate scenarios on the agriculture system, again by direct numerical modelling, allowing for the analysis of model sensitivities to the available parameters.

It is expected that Project CLIVAR will contribute to a better understanding of the regional aspects of climate variability, which are essential for the understanding of the most relevant issues of climate change and its impacts.

Title

GENETICLAND: DISCOVERING FUTURE LANDSCAPES UNDER CLIMATE CHANGE SCENARIOS USING GENETIC ALGORITHMS

Proposing Institution

Instituto do Mar - IMAR

Summary

Climate changes have repercussions in the landscape. Some of them may be good, but others may be disastrous for the world environment therefore, it is important to study how the landscape is going to evolve due to these changes. The purpose of this project is to shed some light into this topic. Specifically, we address the following question: given forecasted data on climate changes, is it possible to predict how the landscape will look like in the next 50 years? We believe it is possible to do so with the aid of computer simulation incorporating multi-scale processes and patterns, and utilizing genetic algorithms to simulate landscape evolution.

The simulation of future behaviours of physical systems under climate change scenarios raises the possibility of improving the state of knowledge of the physical systems' underlying processes.

Some examples include the relationships between hydrological processes at the land surface and processes within the atmosphere (see http://www.cais.com/gewex/projects.html). Although some progress has been made, the assessment of related impacts (e.g. soil erosion) have been constrained by three issues: (1) the limited understanding of processes relating climate forcing and hydrological responses, (2) the lack of methods to couple different multi-scale (space and time) processes and patterns, and (3) the lack of techniques to generate future system states according to forecasted variables.

The theoretical foundations for this work come from two major areas: methods to couple multi-scale processes designed by different simulation models, and methods to generate spatial states under known local constraints and global optimization goals. Practical motivation comes from the recent conclusions on the future climate for Southern Europe (IPCC, 2001), with increases of the frequency of intense precipitation events (very likely -90-99% chance- to occur), and summer drying and associated risk of droughts (likely - 66-90% chance - to occur). Lavee et al (1998) showed that relatively small changes in the climate may push many Mediterranean areas into a more arid and eroded landscape. That's precisely what is likely to happen in Southern Alentejo, a region that was identified as a changing landscape with decreasing carrying capacity (Seixas, 2000). It is our purpose to use Southern Alentejo as a case study to test our research methodology.

For simplicity and feasibility, the major driving force governing the carrying capacity of semi-arid landscapes is assumed to be hydrological soil erosion. Within this framework, the project has two novel research goals. The first one is the development of a method to integrate both large scale (Cornell ref, 2000) and small scale (Nunes et al, 2000) physical processes governing soil erosion. The second one is to design a genetic algorithm capable of generating landscapes according to global objectives (e.g., minimization of soil loss, maximization of net primary productivity), subject to local constraints (e.g., spatial coherence) and guiding requirements (e.g. policy land uses). Therefore, new contributions for genetic algorithms and multi-scale simulation methods are expected. Methods of scientific visualization of future synthetic landscapes will be worked with impact on the project final product. Moreover this project aims to give insights for the potential disruption of the Southern Alentejo landscapes under climate change scenarios.

Title

OIKOMATRIX II – EVALUATION OF THE SOCIO-ECONOMICAL IMPACT AT REGIONAL LEVEL OF LEGAL TOOLS TO CONTROL THE EMISSION OF GREENHOUSE GASES

Proposing Institution
Universidade de Aveiro

Summary

The relatively high growth rate of the Portuguese economy leads to a significant increase in the use of fossil fuels and, consequently, in the emission of greenhouse gases (GHG). This GHG emission growth is now clearly associated with the growth on the transportation sector - eventually reaching a 100% increase by 2010. Portugal is now near the limits assumed with the Kyoto Protocol for its CO_2 emissions and, at this rate, by 2010 it could be paying a GEuro/year on emission rights. The measures/ policies to invert this trend will have socio-economical impacts that may affect differently the various economic sectors and regions.

The team involved in Oikomatrix has been working in these domains. Major sources of CO_2 are being added and updated and input-output modelling have been used in this areas of interest; contacts with other European teams working in this field were reinforced. In the beginning of 2002 a technical basis will be produced to support the generation of legal measures in what concerns GHG emissions, together with an operational input-output model including environmental aspects.

The work described in this proposal will take this research further onto the evaluation of the socio-economical effects at the regional level (considering five mainland regions in Portugal) and the effects down into the enterprise scale - including the effect of necessary investments on product costs, enterprise profitability and competitiveness. The regional effect evaluation will be based on national, single-region and multi-regional input-output economic matrices.

The goals are to follow and evaluate the evolution of the emissions of CO_2 in Portugal and to assess the impacts on the economy of the legal measures to adopt, both at regional and enterprise levels. The evaluation of the effect of different alternatives will be done by the construction of scenarios that will include estimates of the effect of:

- the technological improvement;
- the introduction of new products or alternatives;
- the reduction of production and/or the consumption;
- the changes of fuel consumption patterns in industry, houses and transportation.

These scenarios will be translated, when adequate, in an update of the technical coefficients of the economic matrices. The evaluation of the direct effects of the different measures will be based on the existing experience in the team in this domain and the extrapolation of the effects of similar implementations in other countries.

The final project goal is to establish both a methodology to estimate environmental impacts from changes on the economic activities and to apply the economic matrices for the evaluation of the impact of new legal measures in the domain of the environment, both at national and regional levels. An enterprise level effect will also be assessed complementarily. These methodologies may be the basis of a decision support system, generating regional cost-benefit and multi-criteria analysis.

2002

Title

VAST - VARIABILITY OF ATLANTIC STORMS AND THEIR IMPACT ON LAND CLIMATE

Proposing Institution

Universidade de Lisboa - Fundação da Faculdade de Ciências

Summary

The new generation of climate databases, including the ERA-40 reanalysis results that will be soon released, and output from numerous GCM simulations of present climate and different climate change scenarios, allow the development of sophisticated interpretation techniques that help us to understand the physics of climate variability and change.
In mid-latitudes, significant weather in a given location is produced by the action of the active meteorological systems. Because most of our interest in weather is associated with either precipitation distribution or extreme events (e.g. strong winds) it is clear that changes in the atmospheric circulation are of great relevance when they are associated with changes in the mean storm intensity or in their trajectories.
Project VAST aims to develop algorithms for automatic storm detection and storm tracking, which are applicable to the North and South Atlantic storm tracks. The algorithms will identify individual storms from gridded meteorological data, classify its time varying intensity and will follow the storms along their tracks. Output from that analysis, that is the temporal evolution and position and intensity of each storm, will be used to compute monthly and seasonal statistics of storms in different areas of the Atlantic basin. The storm statistics will then be related with observed climate variability indices, namely low-frequency modes (NAO, ENSO, Antarctic Oscillation) and precipitation statistics in three key areas: Southwest Europe, South America and the Azores.

Project VAST will also try to extend the storm tracking algorithms to the analysis of tropical weather. Because of its smaller scale and signature, this is a difficult task, but the relative high resolution and parameter richness of the new reanalysis may provide just enough detail to get useful information.

Title

SIGN - SIGNATURES OF ENVIRONMENTAL CHANGE IN THE OBSERVATIONS OF THE GEOPHYSICAL INSTITUTES

Proposing Institution

Instituto de Ciências da Terra e do Espaço – ICTE

Summary

The three Portuguese Geophysical Institutes, in Lisbon, Oporto and Coimbra, were established in the 19th century and have since their foundation maintained continuous series of Meteorological and Geophysical Observations. These data constitute the richest Portuguese repository of Earth observations, including important Climate Change data, long-term geomagnetic measurements and many seismological records. However, most of that data is not accessible to researchers because it has never been converted to digital format.

Project SIGN joins, for the first time in many decades, the three Geophysical Institutes, in an integrated effort to recover the historical meteorological and geophysical records, make them available to a large community of users, and use them to investigate the changes that have taken place in our geophysical environment in the last 150 years.

In what concerns to meteorological records, SIGN will produce a complete dataset of daily observations, including raw data, derived quantities and homogenized monthly values of the main variables. The project will also focus on the analysis of data that has been generally overlooked in climate change assessments, like cloud cover, sunshine hours or soil temperatures, and will look at changes not only in the mean but also in the extremes.

The Coimbra Magnetic Observatory has been operating for over 140 years, providing valuable data for a wide range of studies in geomagnetism: calibration and control during aeromagnetic and satellite surveys; monitoring and forecasting of magnetic storm activity; monitoring of secular variation of the magnetic field for studies of the Earth's deep interior.
During this period, a large amount of magnetograms recorded on photographic paper has been produced. These magnetograms contain information, which cannot be found elsewhere, on the high frequency variations of the geomagnetic field produced by sources (currents) lying in the magnetosphere and ionosphere. As scientists gain new insight into geomagnetic and solar activities, they become aware of the main defining features of the short-term events such as geomagnetic storms and sudden commencements (SC). Old magnetograms need then to be checked in search of those features, not only for studies of historical geomagnetic activity but also as an important test for new theories and models.

In what concerns seismological data, the Project will digitize all available records corresponding to earthquakes generated in and around Portugal, estimated to be of the order of 1000 events in the past century (with magnitudes above 3).

Title

ASSESSMENT OF CLIMATIC CHANGE IMPACT ON WATER RESOURCES AND CO2 FIXATION IN FAST GROWING FOREST STANDS IN PORTUGAL

Proposing Institution
Universidade de Aveiro

Summary

Recent work witnesses the important impact that climate change will have upon evapotranspiration rate and therefore water resources availability for fast growing forest stands in Portugal. This will be particularly important under the foreseen scenarios of a decrease in annual rainfall for Southern Europe (Parry, 2000). In addition, water stress is predicted to occur for some forest species (Coelho et al., 2001), leading to changes in stand growth, litter layer dynamics, water consumption and atmospheric CO_2 fixation, which will affect the calculations to meet the Kyoto protocol assignments. On the other hand, the impacts of climate change on soil and slope/catchment hydrological processes are not well understood and require further research to facilitate improved management of water, an important natural resource. Soil moisture is critical in these processes since it plays an important role on plant growth rates, litter layer decomposition rates and on slope and catchment hydrological and hydrochemical processes.

This project uses a multiple scale approach comprising a series of unbounded plots where soil moisture pattern is measured through permanent TDR probes, bounded plots where slope hydrological processes will be assessed and small instrumented catchments with dominant land uses which will be used to characterize runoff and evapotranspiration. Tree growth and litter layer decay rates will be monitored on a monthly basis throughout the project, with more intensive sampling during key periods to assess the impact of various weather patterns. Analysis of the results will enable the mechanisms of interaction between climate change, plant growth, hydrological processes and water resources availability to be established.

The environmental impact of predicted climate scenarios (Parry, 2000) on water resources in terms of changes in vegetation interception rate, soil moisture patterns, slope and catchment hydrology, and on CO_2 fixation in terms of trees/shrub growth rates and litter layer dynamics will then be assessed for a range of eucalyptus forest stands. The data obtained will be used to calibrate the Globulus 2.0 growth model in order to estimate productivity of fast growing stands inside each watershed and the relationship with evapotranspiration rates, soil hydrological properties and processes and catchment runoff response. Using the national forest inventory data, results will be extrapolated on a national scale for different climate change scenarios.

Title

ADAPTATION OF PINE SHOOT BEETLE TO HOST PINE PHYSIOLOGY UNDER THE INFLUENCE OF CLIMATE CHANGE

Proposing Institution

Universidade Técnica de Lisboa - Instituto Superior de Agronomia – ISA

Summary

The sustainability of pine forest ecosystems, widely present in Portugal for wood production, soil protection as well as landscape quality, is a priority of forest policy.

Bark beetles are generally considered among the most important limiting biotic factors of pine forests. They affect the productivity of pine stands, either by directly killing living trees or as vectors of pathogenic organisms. A favourable influence of climate change on this insect guild is likely to occur in consequence of changes on their host tree physiology. Increased temperature and drought stress may favour bark beetles due to changes on the phloem nutritional quality as well as a depletion of secondary defensive components in host plants. In contrast plants growing in enriched CO_2 conditions could be more able to compensate water-stress. However results achieved so far are not conclusive and little knowledge is available of how these conditions will affect insect-plant interactions.

Other disturbances predicted, such as increasing fire risk and windstorms, may amplify bark beetle attacks by increasing available material for insect breeding. The pine shoot beetle (*Tomicus piniperda L.*) is one of the main pests in Portugal associated with pine stands and particularly promoted by forest fires. Its possible coexistence with the close species *T. destruens* raises further questions both of scientific and practical relevance which we aim to clarify through the following specific objectives:

1) To analyze the genetic diversity among populations of *T. piniperda* and *T. destruens*, and relate it to their bioecology, in particular assessing population dynamics parameters, as an indicator of possible adaptation to local conditions and host species;
2) To decode and identify differences in the main semiochemicals involved in the process of host selection and colonization by the two species and their populations;
3) To assess the effect of climate changes in tree physiology due to drought stress and CO_2 enrichment in the colonization and performance of the two species.

Genetic differentiation of local populations of *T. piniperda* and *T. destruens* will be analyzed by collecting individuals in several regions, seasons and on different pine species for DNA analysis. In parallel studies on the two bark beetles' populations related to host tree species will be conducted by using logs and young plants from different species in field and laboratory trials. Bark beetles attraction behaviour towards different pine species will be further related to the species monoterpenes emissions and/or contents, determined by gas chromatography analysis. The performance of these insects in relation to host tree physiology will be further analyzed by using trees watered and under drought stress, combined with elevated CO_2 atmosphere and at environmental conditions. Several tree physiological and insect performance parameters will be evaluated.

Title

EFFECTS OF ELEVATED CO_2 AND INTERACTING ENVIRONMENTAL VARIABLES ON GRAPEVINES GROWN UNDER MEDITERRANEAN FIELD CONDITIONS

Proposing Institution

Universidade de Trás-os-Montes e Alto Douro

Summary

Over the past 230 years since the beginning of the industrial revolution the amount of CO_2 in the atmosphere has been increasing as a result of the use we have been making of fossil fuels. The concentration has risen from 270 ppm to 365 ppm and is continuing to rise at an increasing rate which is at present about 1.5 ppm per year. This might cause major climatic changes. Global warming and shifts in amount, seasonality and distribution of precipitation will occur. It is, therefore, essential to understand the response of crops to the elevated levels of CO_2 by trial experiments in the field in order to obtain realistic data on crop responses for use in crop models. The impact of increasing atmospheric CO_2 on crop systems is of considerable importance to realize the crop productivity and food security in future. Thus, for impact assessment analysis of global increase in CO_2, it was considered important to generate a database on plant responses to locally elevated CO_2 concentration. Relatively little information is available on the interaction of the elevated CO_2 and interacting environmental variables on growth and physiology of grapevines, and none, of our knowledge, was performed in Portugal, where viticulture is the main agricultural activity.

A team of 11 researchers, with different academic formation, such as agronomy, biology, biochemistry and oenology, from 4 Departments of the University of Trás-os-Montes e Alto Douro will participate in several tasks including analysis of phenology, soil and plant elemental analyses, foliage characteristics (leaf area, main and lateral leaf number, degree of foliage exposure), vigour, canopy microclimate, vine physiology and anatomy (light use efficiency, water relations, sap flow, leaf gas exchange rates, photosynthetic proteins and lipids, chloroplast bioenergetics, metabolites, antioxidants activities, leaf and stem anatomies), yield, fruit composition (control of grape maturation), winemaking and analytical characterization of wines. All of the data will be assembled in a standard format for validation of grapevine growth models. To this end experimental facilities to study the response of grapevines to elevated CO_2 and the variation on the physiological, structural and biochemical processes of grapevines in response to the interaction of elevated CO_2 (550 ppm), moisture stress and temperature and their consequences on the yield and vine quality. In addition to these objectives, the project aims the academic formation of students, namely of master and graduation degrees.

2003

Title

LONG TERM REMOTE SENSING OF ATMOSPHERIC TRACE GASES OVER PORTUGAL BY COMBINED GROUND BASED UV-VIS SPECTROMETER AND SATELLITE REMOTE SENSING.

Proposing Institution
Universidade de Évora

Summary

Ozone and the atmospheric chemical related compounds are important regulating factors of the Earth's climate through the absorption and scattering of solar radiation. In addition, the columnar and vertical profiles of these gases may suffer variations due to anthropogenic and natural emissions of interfering compounds.

In this regard, the studies of chemical and dynamic processes involving the stratospheric trace gases, as well as the tropospheric ones are very important since they prompt remarkable contributions to the climate change process. The double aspect of the ozone effects is well known: it works as a filter for the UV-A and UV-B radiation in the stratosphere (the ozone bulk is located at 20-22 Km of altitude), but it is a very dangerous pollutant in the lower troposphere. The interactions between ozone and chemical related compounds (mainly NO_2, HCHO, BrO, IO) can produce significant variations in the ozone total content as well as in the location of the ozone bulk. The so-called "ozone hole", occurring in the stratosphere during the spring season for the Polar Regions, can also reach the mid-latitudes (as evidenced by the last Match campaigns).

Portugal is at the border of the European continent, but it can be reached by ozone-depleted air masses, depending on the meteorological conditions. On the other hand, during summer, the polluted air masses from Eastern Europe or from the coastal industrialized cities (Lisbon, Oporto and Sines), driven by the main circulation, can determine increases of the tropospheric ozone content as well as of the atmospheric pollutants, due to the high temperature of the continental Portuguese regions. Undoubtedly, satellite observations have determined a remarkable advance in the study of the atmospheric processes, but the ground-based measurements must equally be used in order to validate the satellite results. In addition, the ground-pixels of the satellite borne spectrometers, utilized in this study (SCIAMACHY and GOME), are too large (respectively 240-80x30 and 320x40Km2) to allow for local/regional scale studies of atmospheric trace gases.

This proposal aims to improve the characterisation of the fluctuations of the atmospheric trace gases content and to study the influences of these fluctuations over the local, regional and global climate change. The proposed methodologies are based on the combination of observations from different platforms (multispectral satellite data with high spectral resolution and ground based measurements). This is the first time in Portugal that studies on atmospheric compounds and pollutants are carried out from satellite and ground based data. This activity would contribute for the advance of climate studies in the Mediterranean regions.

Title

CARBERIAN - TERRESTRIAL VEGETATION CARBON TRENDS IN THE IBERIAN PENINSULA EXPLORATORY ANALYSIS FROM NORTHERN ATLANTIC OSCILLATION RELATED BEHAVIOR

Proposing Institution

Instituto do Mar – IMAR

Summary

The study of spatial and temporal vegetation trends is of high importance concerning the carbon cycle biosphere component, which is presently a challenging issue both at scientific level as well as at policy level regarding global change. Remote sensing data has been considered a privileged data source due to its spatial and temporal coverage, and its use successful in global change studies. Although included in global studies, the Iberian Peninsula (IP) is a target region due to its high vulnerability to climate change forcing. The main goals of CARBERIAN are (i) assessment of the intra and inter-annual trends of vegetation carbon balance through ENVISAT MERIS data in the IP, and (ii) exploratory analysis of the influence of the North Atlantic Oscillation (NAO) teleconnection patterns on those vegetation patterns.

Three scientific fields are covered by CARBERIAN:

(1) Biosphere modelling based on MGVI data. The CASA model has been selected, due to its ability to model terrestrial ecosystem production based on satellite data as proved by its wide application. Furthermore, the team has already been applying it successfully to the IP, based on GIMMS NDVI (NASA) datasets, whose results were used for a benchmarking analysis within the ATEAM European project. CASA model implementation implies the inter comparison analysis between MGVI and GIMMS NDVI, and the validation of modelled vegetation properties.
(2) Deriving vegetation biophysical properties from MERIS. CARBERIAN aims to develop algorithms to derive vegetation biophysical properties, namely above ground biomass (AGB), net primary productivity (NPP) and net ecosystem productivity (NEP) from MERIS data. Remote sensing of AGB and NPP relies on regression analysis based on inventory data for different land cover types and on other remotely sensed variables such as FAPAR and LAI. Furthermore, spectral analysis of MERIS dataset to assess NPP will be performed, based on the sensitivity of vegetation spectral response to variations in photosynthetic rate, stomatal resistance and respiration rate, through radiative transfer models and photosynthesis/resistance models.
(3) Assessment of the NAO impact on vegetation properties. Large-scale circulation patterns such as NAO can be responsible for major anomalies of climatic fields such as precipitation, temperature and radiative balance. Thus, one can hypothesize that the vegetation patterns in the IP are associated with NAO teleconnection patterns, through the hydrological cycle variability. Statistical modelling will support the exploratory analysis to identify the NAO response signal presented by the vegetation patterns. This relationship will assist the development of a seasonal forecasting scheme for the vegetation properties.

CARBERIAN has two novel research goals: modelling the carbon cycle biosphere component, using the European MERIS as the major dataset, and establishing a link between the variability of vegetation biophysical parameters and the corresponding variability of large-scale atmospheric circulation modes, such as NAO. Considering the IP as a functional unit of analysis is a major source of innovation, contributing to increase the knowledge of Mediterranean like ecosystems on the global carbon cycle.

2004

Projects related to Climate Change

CLIMATE CHANGE AND TOURISM IN PORTUGAL: POTENTIAL IMPACTS AND ADAPTATION MEASURES (CLITOP)
Fundação da Faculdade de Ciências

BIOARIDRISK – SPACE-TIME EVALUATION OF THE RISKS OF CLIMATE CHANGES BASED ON AN ARIDITY INDEX
Instituto Superior Técnico

CLIMATIC /ENVIRONMENTAL FACTORS AFFECTING THE POPULATION DYNAMICS OF *LYMNAEA TRUNCATULA* AND TRANSMISSION OF *FASCIOLA HEPATICA* IN PORTUGAL.
Instituto de Higiene e Medicina Tropical

PRESENT AND FUTURE PORTUGUESE COASTAL CLIMATE AND ITS IMPACT ON THE BIOLOGICAL COMMUNITIES (PORTCAST)
Fundação da Faculdade de Ciências

CLIMATE CHANGE INFERENCES FROM TREE RINGS IN THE MEDITERRANEAN AREA: A DATABASE FOR PORTUGAL
Instituto do Mar

CIDMEG - CONSTRUCTION OF A DESERTIFICATION SUSCEPTIBILITY INDEX FOR THE LEFT MARGIN OF GUADIANA
Instituto Superior Técnico

LINKING WATER AND CARBON CYCLES IN EUCALYPT PLANTATIONS
Instituto Nacional de Investigação Agrária e das Pescas

ALQUEVA XXII - SHOOTING AT A MOVING TARGET. SCENARIOS OF AGRICULTURAL LAND USE OF THE ALQUEVA IRRIGATION PROJECT IN A CHANGING ENVIRONMENT. CLIMATE CHANGE, CROP OPTIONS AND WATER NEEDS.
Instituto Superior de Agronomia

IMPACT OF CLIMATIC AND ANTHROPIC VARIATIONS ON THE NORTHERN CONTINENTAL SHELF, GULF OF CADIZ
Universidade do Algarve

VULNERABILITY OF CORK OAK WOODLANDS TO CLIMATE CHANGE: A MODELLING APPROACH
Instituto Superior de Agronomia

URBAN FLOOD RISK AND POLLUTANT RELOCATION AS A RESULT OF GLOBAL CHANGE
Escola Superior Agrária de Coimbra

USE OF TRADITIONAL KNOWLEDGE TO ATTAIN WATER SUSTAINABLE MANAGEMENT UNDER DIFFERENT CLIMATE CHANGE SCENARIOS - TRADWATER
Universidade de Aveiro

LATITUDINAL VARIATION ON THE BIOLOGY OF ESTUARINE KEY-SPECIES AS A TOOL TO PREDICT CLIMATE CHANGE EFFECTS
Centro de Investigação Marinha e Ambiental

Other areas of investigation

Agricultural and Forest Sciences – General Investigation

SIMULATION OF THE EFFECT OF DIFFERENT FOREST MANAGEMENT STRATEGIES AND CLIMATE CHANGE ON WOOD/CORK AND CARBON SEQUESTRATION FOR THE MOST IMPORTANT SPECIES OF PORTUGUESE FOREST (CARBWOODCORK)
Instituto Superior de Agronomia

MEDITERRANEAN WOODY SPECIES OF MONTADOS: SURVIVING THE DROUGHT
Instituto Nacional de Investigação Agrária e das Pescas

Communications Science Area

THE POLITICS OF CLIMATE CHANGE: DISCOURSES AND REPRESENTATIONS
Universidade do Minho

Marine Sciences and Technologies Area

STUDYING THE IMPACT OF THE CLIMATE CHANGE IN THE PORTUGUESE COASTAL WATERS - THE AVEIRO COSTAL ECOSYSTEM - SIMCLAVE
Universidade de Aveiro

Funded By other Institutions

APA

2004

Title
ALTERAÇÕES CLIMÁTICAS EM PORTUGAL, CENÁRIOS, IMPACTES E MEDIDAS DE ADAPTAÇÃO (SIAM II)

Proposing Institution
Universidade de Lisboa – Fundação da Faculdade de Ciências

Summary

Phase II of the SIAM project, financed by the Portuguese Ministry of Cities, Spatial Planning, and the Environment continued the research started in phase I using updated climate models, with two additional components: an outreach and a case-study component. The former involved a series of outreach sessions held across the country in Beja, Bragança, Covilhã, Ílhavo, Olhão, Peniche and Oporto, in which the impacts of and adaptation measures to climate change upon locally relevant socio-economic sectors were discussed with a total of 125 representatives of government, academia, environmental NGOs, industry, and other representatives of civil society.

The case-study component, focusing predominantly on the Sado Estuary, sought to apply the general methodology of project SIAM (climate scenarios as an input to each sector's impact assessment) at a smaller geographic scale. The intention was to provide responses to decision makers in the public sector, at a scale compatible with decision making processes. The Sado Estuary was chosen as it is a geographic area where several socioeconomic and biophysical factors intersect, thus providing a good test for the methodology at a smaller scale.

Fundação Calouste Gulbenkian

2005

Title
Impact E – Impact of extreme events on health in Portugal: past, present and future.

Proposing Institution
Faculdade de Ciências da Universidade de Lisboa

Summary

A multidisciplinary team composed of researchers from several public national and international institutions in the fields of health, epidemiology, climatology, physics and environmental risk assessment was created to undertake this study. The aim is to provide an integrated study of the impact of meteorological and extreme climate events (cold spells, heat waves and drought) and related elements such as air pollution and forest fires on public health in Portugal. Past correlations and projections of future risks based on climate scenarios until the end of the century will be used.

Acronyms

ABAE	European Blue Flag Association/FEE (Foundation for Environmental Education) Portugal
ACAP	Portuguese Automobile Trade Association
ACP	African, Caribbean and Pacific Countries
ADPA	Association for Environmental Defence and Protection
AFN	Portuguese Authority for the Forest
ANA	Airports of Portugal, S.A.
APA	Portuguese Agency for the Environment
APs	Public Administrations
ARENA	Regional Energy Agency for the Azores Autonomous Region
ASPEA	Portuguese Association of Environmental Education
BUW	Biodegradable Urban Waste
CAC	Climate Change Commission
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CP	*Comboios de Portugal* (National Train Company)
CPLP	Community of Portuguese Speaking Countries
CQ1	Level 1 Quality Control Procedures
CQ2	Level 2 Quality Control Procedures
CRF	Common Reporting Format
CTS/A	Science, Technology, Society and Environment
DAC	Development Assistance Committee
DGEG	Directorate-General for Energy and Geology
DGS	Directorate-General for Health
EC	European Commission
ENGO	Environmental Non-Governmental Organisation
ETAR	Wastewater Treatment Plant
EU	European Union
EU-ETS	European Union Emissions Trading Scheme
EURONATURA	Centre for Environmental Law and Sustainable Development
FAPAS	Fund for the Protection of Wildlife
FCT	Science and Technology Foundation
FEADER	European Agricultural Fund for Rural Development
FFP	Permanent Forestry Fund
GB	Guinea-Bissau
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEOTA	Research Group on Spatial Planning and the Environment
GHG	Greenhouse Gas(es)
GPG	Good Practice Guide
GVA	Gross Value Added
GWP	Global Warming Potential
hab	Inhabitant
HFC	Hydrofluorocarbon
HIW	Hazardous Industrial Waste
HPI	Hydroelectric Productivity Index
HW	Hospital Waste

I&CLC2000	Image and CORINE Land Cover 2000
IGP	Portuguese Geographic Institute
INE	Statistics Portugal
INERPA	National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants
IPAD	Portuguese Institute for Development Support
IPCC	Intergovernmental Panel on Climate Change
IPT	Inter-urban Passenger Transport
ISMS	Integrated IT System for the Management of the SNIERPA
IW	Industrial Waste
KP	Kyoto Protocol
LDC	Least Developed Countries
LDCF	Least Developed Countries Fund
LPN	League for the Protection of Nature
LULUCF	Land Use, Land Use Change and Forestry
MADRP	Ministry of Agriculture, Rural Development and Fisheries (includes Forestry)
MAI	Ministry of Internal Administration
MAOT	Ministry of the Environment, Spatial Planning and Regional Development
MCTES	Ministry of Science, Technology and Higher Education
ME	Ministry of Education
MEID	Ministry of Economy, Innovation and Development (includes Energy and Industry)
MFAP	Ministry of Finance and Public Administration
GPEARI	Drectorate-General for European Community Affairs
DGTF	Directorate-General for Technical and Economic Affairs
ML	Lisbon Metro
MNE	Ministry of Foreign Affairs
MOP	Meeting of the Parties
MOPTC	Ministry of Public Works, Transports and Communications
MP	Oporto Metro
MSW	Municipal Solid Waste
MW	Municipal Waste
N_2O	Nitrous Oxide
NAPA	National Adaptation Plan of Action
NGO	Non-Governmental Organisation
NIR	National Inventory Report
NMVOC	Non-methanic volatile organic compounds
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PALOP	(Portuguese Speaking African Countries)
PATO	Association for the Protection of "Paúl da Tornada"
PDM	Methodological Development Programme
PEAASAR	Strategic Plan for Water Supply, Sewerage and Wastewater Treatment 2000–2006
PERSU	Strategic Plan for Urban Solid Waste
PIC	Indicative Co-operation Programmes
pkm	Passengers-kilometers
PLOP	Portuguese Speaking Countries
PNAC	National Climate Change Programme
PNALE	National Allocation Plan
PNDFCI	National Plan for Protection Against Forest Fires
PROFs	Regional Plans for Forestry Planning
QA	Quality Assurance
QUERCUS	National Association for Nature Conservation
RCM	Council of Ministers Resolution
RELAC	Portuguese Speaking Countries Climate Change Network

RES	Renewable Energy Sources
RIOCC	Iberian-American Climate Change Network
RNAP	National Network of Protected Areas
SB	Subsidiary Bodies to the Convention
SCCF	Special Climate Change Fund
SCGQ	Quality Control and Assurance System
SEA	Secretary of State for the Environment
SGIR	Information Management System on Waste
SGP	Stability and Growth Pact
SIDCLIMAD	Climate and Sea Information System for Sustainable Development
SNBPC	Fire and Civil Protection National Service
SNIERPA	Portuguese National System for the Estimation of Emissions by Sources and Removals by Sinks of Air Pollutants
SoER	State of the Environment Report
SPV	"Sociedade Ponto Verde" (national packaging collection and recycling company)
TAP	Air Portugal (national airline)
tkm	Tonnes-kilometer
toe	Tonnes of oil equivalent
UAA	Utilised Agricultural Area
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Education, Science and Culture Organisation
UNFCCC	United Nations Framework Convention on Climate Change
ZIF (FIZ)	Forestry Intervention Zones