X SPECIAL FEATURE: THE EUROPEAN POLICY FOR CLIMATE CHANGE AND ENERGY, THE PROTECTION OF THE ENVIRONMENT AND THE ENERGY SECTOR IN GREECE

I THE CHALLENGE OF CLIMATE CHANGE

The term "climate change" is used to describe changes in the global climate that are attributed to human activity and are mainly caused by the increase in the concentration of greenhouse gases in the atmosphere. **The increase in the planet's mean temperature is the key indicator of climate change.** According to the latest report of the **Intergovernmental Panel on Climate Change (IPCC)**,[1] global temperature is likely to rise up to 6°C by 2100. Besides, however, the increase in temperature, climate change will also lead to sea-level rise, increased flooding and droughts, extreme weather phenomena and the extinction of species and ecosystems. Furthermore, climate change will have important social and economic repercussions, such as the spreading of diseases, massive flows of refugees and migration, lower output, higher product prices, loss of jobs and, eventually, notable changes in lifestyle. According to the **Stern review (2006)**,[2] in order to avoid the worst impacts of climate change, the concentration of greenhouse gases in the atmosphere must be stabilised at 450-550 ppm (parts per million). **In order to achieve this, global emissions will need to be reduced by 80%-90% before the end of the century. Addressing climate change will thus require immediate political actions for a sharp reduction of greenhouse gas emissions on the one hand and, on the other, adoption of adjustment measures for the mitigation of adverse impacts.**

The main conclusion of the Stern report is that **the benefits of strong early action to prevent climate change** far outweigh the costs. As estimated in this review, if the current policies for the use of energy continue, the result will be equivalent with a reduction of *per capita* consumption (namely living standards) between 5% and 20% (and most likely closer to 20%) on a permanent basis from 2050 onwards. In contrast, the cost of the policies required for the reduction of greenhouse gas emissions leading to stabilisation by 2050 will be relatively low – around 1% of the annual global GDP. The Stern review has estimated that, with the appropriate policies, the net benefits globally will amount to $2.5 trillion a year.

An important finding of the Stern report is that what we do now can have only limited effect on the climate over the next 40 or 50 years, *i.e. until 2050*. On the other hand what we do in the next 10 or 20 years can have a profound effect on the climate *from 2050 onwards*. Furthermore, the longer action is delayed to drastically reduce greenhouse gas emissions, the more unachievable and *costly* it will become.

According to the Stern review, climate change is the greatest market failure the world has ever witnessed, which also involves interactions with a range of other market imperfections. Three elements of policy are required for a timely response to the problem:

- The first is the **appropriate pricing of carbon,** in a way that the price reflects the full social cost of its use and encourages a shift to alternative energy sources and technologies on a global scale: this can be achieved through tax and emission trading schemes or regulation for carbon use.

- The second is the **adoption of policies** to support the development of a range of low-carbon and high-efficiency technologies on an urgent timescale.

- The third is **action to remove barriers to behavioural change of businesses and consumers regarding energy efficiency and the reduction of greenhouse gas emissions:** this can be achieved through appropriate information and education, proper regulatory measures and economic incentives. At the same time, adaptation policies are required for dealing with the unavoidable impacts of climate change.

1 Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report, IPCC Fourth Assessment Report*, 2007.

2 *Stern Review: The Economics of Climate Change*, October 2006. A report compiled by a group of researchers under Sir Nicholas Stern, former chief economist of the World Bank, who, in 2005, was appointed by the British government to conduct reviews on the economic dimensions of climate change.

2 THE EUROPEAN POLICY FOR CLIMATE CHANGE AND ENERGY

2.1 EVOLUTION OVERTIME OF GREENHOUSE GAS EMISSIONS IN THE EUROPEAN UNION

Total greenhouse gas emissions in the EU-27, excluding the sector "land use, land use change and forestry" amounted to 5,143 million tonnes of CO_2 equivalents in 2006, i.e. 7.7% lower than in 1990. In 2006 the EU-15 (the "old" Member States) was responsible for the emission of 4,151 million tonnes (decreased by 2.2% compared to 1990), namely for 80.7% of total emissions (from 76.2% in 1990). In other words, the EU-15 countries, on the one hand, contribute more to pollution and, on the other hand, show a more limited progress in reducing emissions than the new Member States in the period between 1990 and 2006. Germany, the United Kingdom, Italy and France are the largest greenhouse gas emitters among the old Member States, accounting for 19.5%, 12.7% and 11.0% respectively. By contrast, Luxembourg (0.3%), Sweden (1.3%), Denmark (1.4%) and Finland (1.6%) are the lowest greenhouse gas emitting Member States. It is self-evident that the amount of contribution to emissions is associated with, *inter alia*, the size of each country.

As regards the emission distribution percentage among the six greenhouse gases in EU-27 in 2006, carbon dioxide (CO_2) has the largest share (82.8%). Methane (CH_4) and nitrous oxide (N_20) follow with smaller contribution percentages, i.e. 8.2% and 7.6% respectively. Concerning the origin of gas emissions (see Table X.1), energy-related activities accounted for 79.7% of EU-27 greenhouse gas emissions (4,099 million tonnes of CO_2 equivalent) in 2006. Most pollutants from energy-related activities are emitted by public electricity production (27.1%), transport (19.3%) —mainly road transport (18.0%)— and households (9.4%). Specifically, as regards the pollution caused by the generation of electric power, it is worth noting that there are considerable differences among the EU-15 Member States, as the percentage of these pollutants in total greenhouse gas emissions varies between 9%-11% (France, Luxembourg) and 37%-38% (Finland, Denmark and Greece). Namely, the production of electricity in certain European countries is more polluting than in others. The second largest source of greenhouse gas emissions after energy is agriculture (9.2%), followed by industrial processes (8.1%) and waste (2.9%).

2.2 THE KYOTO PROTOCOL

The Kyoto Protocol,[3] which is attached to the United Nations Framework Convention on Climate Change signed at the Rio Earth Summit in June 1992, constitutes the most significant regulatory tool for addressing climate change. The major feature of the Kyoto Protocol is that it sets binding targets for industrialised countries to reduce the emissions of six greenhouse gases[4] by 5.2% against 1990 levels over the period 2008-2012 (this percentage applies to the countries which have signed the Protocol as a whole – the level of commitment is different for each country). The Kyoto Protocol includes three flexible mechanisms[5] for the reduction of gas emissions. **The European Union ratified the Kyoto Protocol on 31 May 2002 and is committed to reducing the emission of the six greenhouse gases by 8% against 1990 levels within the 2008-2012 period.** Nevertheless, the arrangement of individual commitments among Member States, on the basis of the EU-15 burden-sharing agreement, varies considerably (see Table X.2). It is worth noting that most EU-15 Member States have not attained the Kyoto target and will have to take additional measures, besides those currently in force, in order to attain it by 2012.[6]

3 United Nations, *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 1998.

4 The Kyoto Protocol concerns the following gases: carbon dioxide (CO_2), which is the most important, methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF_6).

5 The Kyoto mechanisms are: *clean development mechanism*, which allows developed countries to fulfil part of their commitments by implementing emission-reduction projects in less developed countries, *the joint implementation mechanism*, which allows developed countries and countries with economies in transition to jointly implement emission reduction projects, and the *emissions trading mechanism*.

6 Along the lines of environmental commitments adopted at a European level with the ratification of the Kyoto Protocol, the EU has promoted electric power generation from renewable sources of energy with Directive 2001/77/EC, the emissions trading system with Directive 2003/87/EC, as well as energy saving, which is covered by a series of European Commission Directives.

Table X.1 Greenhouse gas emissions by source category: EU-27, EU-15 and Greece

(in million tons of CO_2 equivalents)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
EU-27													
Energy	4,277	4,029	4,141	4,037	4,024	3,965	3,974	4,058	4,030	4,131	4,137	4,109	4,099
Industrial processes	478	455	452	459	432	392	404	393	389	400	412	416	417
Solvent and other product use	13	11	11	11	11	11	11	11	10	10	10	10	10
Agriculture	592	513	515	515	513	509	501	493	487	482	481	474	473
Waste	216	210	206	198	191	185	179	171	167	161	155	151	148
*Total**	*5,572*	*5,214*	*5,320*	*5,216*	*5,167*	*5,058*	*5,066*	*5,121*	*5,080*	*5,180*	*5,191*	*5,157*	*5,143*
EU-15													
Energy	3,256	3,175	3,261	3,195	3,237	3,215	3,232	3,304	3,292	3,365	3,375	3,352	3,327
Industrial processes	373	371	368	378	358	325	329	321	319	324	330	332	328
Solvent and other product use		9	9	9	9	9	9	9	9	8	8	8	8
Agriculture	434	413	417	417	417	416	413	404	399	395	393	387	384
Waste	175	169	165	157	151	144	139	130	125	118	113	110	107
*Total **	*4,244*	*4,133*	*4,216*	*4,152*	*4,168*	*4,105*	*4,118*	*4,164*	*4,139*	*4,207*	*4,216*	*4,186*	*4,151*
Greece													
Energy	78	82	84	89	94	93	99	101	101	105	106	105	105
Industrial processes	9	11	12	13	13	14	13	13	13	13	13	13	13
Solvent and other product use	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Agriculture	14	12	13	12	12	12	12	12	12	12	12	12	12
Waste	4	4	4	4	4	4	4	3	3	3	3	3	4
*Total **	*105*	*110*	*114*	*119*	*124*	*124*	*128*	*130*	*129*	*134*	*134*	*134*	*133*

Sources: European Environment Agency, *Annual European Community greenhouse gas inventory 1990-2006 and inventory report 2008*, No 6/2008, Hellenic Ministry for the Environment, Physical Planning and Public Works, *Annual inventory submission under the convention and the Kyoto Protocol for greenhouse and other gases for the years 1990-2006*, April 2008.

* Excluding the source category of "land use, land use change and forestry".

Table X.2 Greenhouse* gas emissions and Kyoto Protocol targets

	1990	Kyoto Protocol (base year)**	2006	Change 1990-2006	Change of base year 2006	Kyoto targets 2008-2012
	in million tons of CO_2 equivalent			percentage changes		
Austria	79.2	79.0	91.1	15.1	15.2	-13.0
Belgium	144.5	145.7	137.0	-5.2	-6.0	-7.5
Denmark	69.0	69.3	70.5	2.1	1.7	-21.0
Finland	70.9	71.0	80.3	13.2	13.1	0.0
France	563.3	563.9	541.3	-3.9	-4.0	0.0
Germany	1,227.7	1,232.4	1,004.8	-18.2	-18.5	-21.0
Greece	*104.6*	*107.0*	*133.1*	*27.3*	*24.4*	*25.0*
Ireland	55.5	55.6	69.8	25.6	25.5	13.0
Italy	516.9	516.9	567.9	9.9	9.9	-6.5
Luxembourg	13.2	13.2	13.3	1.0	1.2	-28.0
Netherlands	211.7	213.0	207.5	-2.0	-2.6	-6.0
Portugal	59.1	60.1	83.2	40.7	38.3	27.0
Spain	287.7	289.8	433.3	50.6	49.5	15.0
Sweden	72.0	72.2	65.7	-8.7	-8.9	4.0
United Kingdom	768.5	776.3	652.3	-15.1	-16.0	-12.5
EU-15	**4,243.8**	**4,265.5**	**4,151.1**	**-2.2**	**-2.7**	**-8.0**

Source: European Environment Agency, *Annual European Community greenhouse gas inventory 1990-2006 and inventory report 2008*, No 6/2008.
* Total emissions excluding the "land uses, change of land uses and forestry" sector.
** For gases CO_2 , CH_4 and N_2O, all member-countries chose 1990 as base year. For gases HFC, PFC and SF_6, 12 member-countries chose 1995 as base year, while Austria, France and Italy chose 1990.

2.3 THE NEW EU STRATEGY FOR CLIMATE CHANGE AND ENERGY

The new European Union strategy for energy and the environment was adopted by the European Council on 8-9 March 2007 and comprises the following targets for 2020:

- **A 20% reduction in greenhouse gas emissions by 2020 compared to 1990 levels,**

- **20% increase in the share of Renewable Energy Sources (RES) in overall EU energy consumption and 10% in the share of biofuels in overall EU transport petrol and diesel consumption by 2020.**

- **20% improvement of energy efficiency by 2020 (namely, saving 20% of EU's energy consumption compared to projections for 2020).**

The European Council, taking into account the proposal of the European Commission,[7] also adopted an action plan for energy and climate change. The basic guidelines of the plan are: the integration of the EU internal market for gas and electricity, the cooperation between Member States for the security of energy supply, the improvement of the greenhouse gas emissions trading mechanism, the enhancement of energy efficiency and energy security as well as the increase in RES "penetration" (namely, the expansion of their use).

On 23 January 2008 the European Commission[8] presented proposals for cutting greenhouse gas emissions and developing RES in

7 European Commission Announcement, (COM 2007) 1 final.
8 European Commission Announcement (COM 2008) 30 final, 23 January 2008.

2013-2020. These proposals point out that the reduction of greenhouse gas emissions by 20% may rise to 30%, if there is an international agreement committing other developed countries to comparable emission reductions. Furthermore, the target for a 20% increase in the share of RES in overall EU energy consumption by 2020 is reiterated. As concerns energy-saving, the targets of Directive 2006/32/EC apply, which provide for a 9% of energy end-use efficiency by 2016 and a 20% reduction in total energy consumption by 2020. The means to achieve the aforementioned targets are the enhancement of the **European Union Greenhouse Gas Emission Trading System (EU ETS)** and the operational framework of RES, as presented below.

Moreover, as agreed by the European Council on 19-20 June 2008, emphasis is placed on financing actions for climate change adaptation and mitigation, particularly on investments in research and development of low-carbon fossil fuel technologies. In this context, the European Council supports the construction and operation of new power generation plants, including the 12 demonstration plants of power generation with carbon capture and storage, which will be operating by 2015.

Finally, on 19-20 March 2009 the European Council agreed that energy security is a key priority, which needs to be enhanced by improving energy efficiency and by diversifying energy suppliers, sources and supply routes. Specifically, proposals have been put forward to develop energy infrastructure, revise the legislation concerning the security of natural gas supply and develop a southern natural gas transport corridor including a mechanism to facilitate access to Caspian gas. **With regard to the financing of projects in the energy sector, the Council —in the framework of the implementation of the European Economic Recovery Plan— agreed upon a financial contribution of € 3,980 million in the two-year period 2009-2010.** Of this amount, € 2,365 million will be invested in gas and electricity infrastructure projects, €565 million in wind energy projects and €1,050 million in carbon capture and storage projects.

2.3.1 THE EUROPEAN UNION GREENHOUSE GAS EMISSION TRADING SYSTEM (EU ETS)

The European Commission's proposals for the improvement of the European Union Emissions Trading System (EU ETS)[9] provide for the following:

- The scope of the scheme will be extended to other greenhouse gases apart from carbon dioxide and to further major industrial emitters.

- The allowed emissions covered by the trading system will start at the mid-point of the 2008-2012 period and should decrease gradually by 1.74% on an annual basis until 2020.

- The national allocation plans for the emission allowances will be replaced by auctioning of allowances or allocation for free through community-wide allocation rules.

- Emission allowances for electricity generators shall be fully auctioned from 2013 onwards. Allowances for most of the other industries and aviation should decrease gradually until 2020 (resulting in full auctioning).

Emissions not covered by the trading scheme from sectors such as buildings, transport, agriculture, waste and other installations which do not fall under EU ETS are to be reduced by 10% below 2005 levels, while specific targets are set for certain Member States.

9 With Directive 2003/87/EC of 13 October 2003, the European Parliament and the Council of the European Union contributed to the fulfilment of the EU commitments to the environment. According to the Directive, each Member State shall develop a national plan stating the total quantity of allowances that it intends to allocate and the way it proposes to allocate them for each of the following periods: (a) the three-year period starting from 1 January 2005 and (b) the five-year period starting from 1 January 2008, and for each subsequent five-year period. For the three-year period, Member States shall allocate at least 95% of the allowances free of charge, while for the next five-year period, Member States shall allocate at least 90% of allowances free of charge. Member States shall ensure that greenhouse gas emissions are monitored and reported. The Directive also provides for penalties in the case of excess emissions.

2.3.2 RENEWABLE ENERGY SOURCES IN THE EU

Community policy for RES[10] has set the interim target of increasing the share of renewable energy to 12% of total energy consumption in the EU by 2010, in order to achieve the target of 20% by 2020. It is estimated, however, that the interim target will not be achieved (the share is currently at 9%). According to EU policy each country will adopt a National Action Plan putting forward differentiated targets that will be taking account of the different potential of each country. Furthermore, given that the cost for the exploitation of renewable energy sources varies, Member States require a certain degree of flexibility. Specifically, it is provided for that Member States will have the possibility to contribute to the development of renewable energy sources inside and outside their borders. More precisely, if Member States can achieve their targets by contributing to the development of RES in another Member State with a more efficient production of renewable energy, then they will be able to reduce the cost of compliance measures and at the same time provide another Member State with an additional source of revenue. This investment does not require a physical transport of resources and may be effected by transferable guarantees of origin (a proof that renewable energy has been produced).

2.4 THE COPENHAGEN CONFERENCE – FUTURE TRENDS

On 28 January and 19-20 March 2009 the European Commission and the European Council, respectively, set out their proposals for a new global agreement to tackle climate change which is due to be concluded at the Copenhagen United Nations climate conference in December 2009. Specifically, in order to keep temperature increase below 2°C, the EU suggests the following:

- Global GHG emissions must be reduced to at least 50% of 1990 levels by 2050. The EU is committed to a 30% reduction in its emissions by 2020, provided that other developed countries commit themselves to comparable reductions. Developing countries, except least developed ones, will need to limit the rise in their emissions to 15-30% below their usual levels by 2010.

- In order to reduce global emissions, net global incremental investments must rise in the order of €175 billion on a year-on year basis, by 2020.

- Innovative international funding sources must be explored, based on the polluter-pays principle.

- EU Member States could use part of the revenue from auctioning allowances in the EU ETS to support developing countries.

- A global OECD-wide carbon market should be built by 2015, linking the EU ETS to comparable emissions cap and trade systems.

- The Kyoto Protocol's Clean Development Mechanism (CDM) should be phased out in favour of moving to a sectoral carbon market crediting mechanism and to the development of cap and trade systems.

Moreover, **the G-20 leaders (London, 2 April 2009) were committed to making the best possible use of investment funded by fiscal stimulus programmes towards a green recovery – i.e. making the transition towards clean, innovative, resource-efficient low-carbon technologies and infrastructure.**

3 THE GREEK POLICY FOR CLIMATE CHANGE AND ENERGY

3.1 GREENHOUSE GAS EMISSIONS IN GREECE

In 2006, the share of Greece in EU-27 total gas emissions was 2.6% (compared to 1.9% in

10 The promotion of electricity produced from renewable energy sources was achieved with the adoption of Directive 2001/77/EC in September 2001. According to this Directive, Member States may define mechanisms of support for RES at national level, make proposals which will contribute to the attainment of the target and establish the appropriate mechanisms that will guarantee that energy is produced from RES. Furthermore, the Directive lays down the obligations of the Member States to regularly submit progress reports regarding the use of RES. See also: European Commission, (a) *Renewable Energy Road Map*, COM (2006) 848 final, 10 January 2007, and (b) *Second strategic energy review – EU Energy security and solidarity action plan*, 13 November 2008.

1990). Total greenhouse gas emissions in Greece, excluding the sector "land use, land use change and forestry" amounted to 133.1 million tonnes of CO_2 equivalents in 2006, compared to 104.6 million tonnes in 1990, up by 27.3%. However, the increase by 2006 compared to the base year level of the Kyoto Protocol was 24.4% (gas emissions in the base year have been set at 106.9 million tonnes), against a targeted maximum increase of 25% by 2008-2012. Consequently, according to the European Environment Agency Report[11] Greece was among the four countries which in 2006 did not record an increase higher than the target set under the Kyoto Protocol for each one of them.[12] **The aim of course is that there will be no further increase in emissions in the 2008-2012 period, so that the increase between the base year and the 2008-2012 period is maintained below 25%.**

As concerns the percentage distribution of the emissions of the six greenhouse gases, carbon dioxide (CO_2) possessed the largest share (82.4%) in 2006. Nitrous oxide (N_20) and methane (CH_4) had lower participation shares, namely 7.8% and 6.3% respectively. With regard to the origin of gas emissions (see Table X.1), energy related activities are the major source of greenhouse gases with a percentage of 78.6% (104.7 million tonnes of CO_2 equivalents). Of these activities, most pollutants are emitted by public electricity production (38.4%), transport (18.1%) —mainly road transport (15.4%)— and households (7.2%). Hence, the modernisation of energy planning and the development of environment-friendly forms of energy must constitute key priorities of the national energy strategy. The second most significant source of greenhouse gases after energy is industrial processes (9.8%), followed by agriculture (8.7%) and waste (2.7%).

3.2 THE GREEK POLICY FOR CLIMATE CHANGE AND ENERGY

According to available estimates, Greece, because of its topography (long coastline, large number of islands), will be most severely affected by the consequences of climate change. Higher sea-level, desertification and the exhaustion of water resources may have a significant impact on certain areas and industries which contribute much to economic activity, e.g. tourism and agriculture.

The implementation of the European policy for energy and climate change in Greece requires, among others, better production management (with the introduction of technology for lower energy consumption) and better organisation of life in the cities (with better organisation of public transport, so as to reduce the use of energy-consuming means of transport, as well as with the use of new technologies and alternative energy sources for the insulation and heating of houses and other buildings). Such changes require appropriate planning and suitable incentives. Achieving the targets set by the new European policy is extremely important for Greece as this is necessary in order to respond to climate change and improve the quality of life. Additionally, it could lead to the implementation of large-scale investment and contribute to enhancing competition in the energy sector, the establishment of new businesses, the creation of many new jobs, a notable reduction of Greece's energy dependence and the respective downsizing of the current account deficit. The current juncture should not be considered an obstacle to such developments. By contrast, energy investment and the so-called "green" investment should provide an extremely useful boost to the recovery of economies, as pointed out also in the European Economy Recovery Plan.

The main targets of the Greek policy on climate change and energy —which have been set having taken into account the new European policy— are the reduction of greenhouse gas emissions and the achievement of the Kyoto

11 European Environment Agency, *Greenhouse gas emission trends and projections in Europe 2008*, No. 5/2008.
12 The other countries were France, Sweden and the United Kingdom.

Protocol targets, as well as the enhancement of RES penetration in the domestic energy markets. The achievement of these targets will be sought through the drawing-up of **the National Strategic Reference Framework 2007-2013 on the Environment** and the **National Allocation Plans,** the operation of the **Greenhouse Gas Emission Allowance Trading Registry,** the **institutional framework for Renewable Energy Sources,** as well as through a number of other actions, pertaining —among other things— to "green" entrepreneurship, energy efficiency of buildings, the adoption of best practices by polluting industries, the elaboration of business plans for addressing pollution in big urban centres and the intensification of environmental audits.

Besides government policy and private investment activity, the challenges associated with climate change, the protection of the environment and changing the energy pattern require a more **active participation of the society,** which, among others, requires **comprehensive and proper information.**

3.2.1 NATIONAL STRATEGIC DEVELOPMENT PLAN 2007-2013 FOR THE ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Addressing climate change constitutes one of the key priority axes of environmental policy in the next programming period.[13] Specifically, efforts will be made to reduce gas emissions that contribute to the greenhouse effect, promote the penetration of RES in the domestic energy market, apply a more rational use of natural and energy resources, as well as improve energy efficiency/effectiveness. More particularly, some of the actions that have already started to materialise for the reduction of emissions include the introduction of the use of natural gas in industry, households, transport and electric power generation, the application of the best available techniques in the major polluting industries, the use of more efficient and cleaner fuel in industry and transport, as well as the improvement of the "energy behaviour" of existing and new buildings. The completion of the spatial planning of Greece, as well as the sectoral and spatial planning for RES, may contribute to the increase in RES penetration in the domestic energy market (while preserving the natural environment).

3.2.2 NATIONAL ALLOCATION PLAN FOR EMISSION TRADING

The methodology for the allocation of emission allowances constitutes a decisive factor for the evolution of the Emission Allowances Trading System. Specifically, the total quantity of emission allowances, their allocation per activity, as well as all the basic rules regulating the allocation of allowances are defined in the two National Allocation Plans (NAPs) for Emission Trading.[14] The first NAP for the 2005-2007 period includes 141 businesses, while the second, for the 2008-2012 period, includes 140 businesses. Within the framework of the second plan, the forecasts of greenhouse gas emissions ("Business as Usual Scenario") adopted in the 2nd National Programme[15] for climate change were updated. As regards the allocation of the emission allowances for existing installations, **the activity with the largest share of allowances, both for the 2005-2007 and the 2008-2012 periods, is electricity generation,** with 73.1% and 70.8% respectively. Cement production comes second (15.5% and 16.6%), while the emission allowance shares for other types of installations vary from 0.1% to 6.3% (see Table X.3 below).

3.2.3 RENEWABLE ENERGY SOURCES IN GREECE

Securing energy supply and differentiating energy sources, promoting competitiveness

13 National Strategic Development Plan – Environment and Sustainable Development Sector – for the 2008-2012 period, October 2006.

14 National Allocation Plan for Emission Trading for the period 2005-2007 (December 2004), National Allocation Plan for Emission Trading for the period 2008-2012 (April 2008).

15 The 2nd National Programme for Climate Change was adopted in 2002 (Cabinet Act 5/27 February 2003) and aimed at defining a set of measures and policies to reduce the emission of greenhouse gases (Business as Usual Scenario), in order for Greece to meet its national requirements stemming from the implementation of the Kyoto Protocol, and specifically the limitation of the increase in total emissions to 25% in comparison with 1990 emissions.

through "clean" energy technologies and protecting the environment constitute the basic axes of energy policies. In this context, RES penetration in the energy market is a main target of the Greek policy.[16] Electricity production from RES in Greece is subject to a number of regulations, which define the prerequisites and the procedures for the implementation of RES projects. Today, the development of RES is governed by Law 3468/2006. The main key points of this law are:

- The national target for the share of electricity generated from RES in the gross electricity consumption is set at 20.1% in 2010 and at 29% up to 2020.

- Simplified procedure for issuing permits for the installation or the operation of electric power generation plants using RES.

- Monitoring of the progress of licensed RES projects.

- Adjustment of the pricing system.

- Possibility to install offshore wind farms.

- Creation of a system for the issuance of guarantees of origin for electric power generation using RES.

- Improvement of the terms of purchase and sale of electric power produced, in order to facilitate project funding by banks.

As regards the problems and the course of investments in RES see further below (Section 3.2.4).

3.2.4 "GREEN ENTREPRENEURSHIP"

The intensification of the financial crisis, in conjunction with the deterioration of the energy problem and the anticipated impact of climate change, brought the so-called **"green entrepreneurship"** to the fore, **namely, the entrepreneurial action aimed at improving the quality of the environment, or at least preventing its deterioration.** According to its supporters, green entrepreneurship is in a position, on certain conditions, to combine the achievement of energy and, in a broader sense, environmental targets (such as the reduction of dependence on conventional energy sources and the curtailment of activities that are detrimental to the environment) with satisfactory performance of invested capital, owing to the fact that the relevant markets are expanding and are characterised by increased demand of end- or intermediate environment-friendly products and services.[17]

Financial performance and environmental benefits vary depending on the sector in which green entrepreneurial action takes place. Thus, investment aimed at restructuring generation processes[18] is estimated to be associated with more satisfactory performance in the long term, but also with more lasting environmental benefits. Entrepreneurial actions improving the mechanisms responsible for heavy charges (e.g. pollution abatement applications), as well as the condition of environmental resources (e.g. agrotourism activities preserving local habitats) can also be vigorous and sustainable. Furthermore, entrepreneurial initiatives improving the management of effects of environmental degradation, such as for instance, waste management, can yield considerable economic and social benefits, to the extent that the existing production mechanism has not yet been replaced by or complemented with an environment-friendly technology. It should be

16 The first efforts for the development of energy generation from RES in Greece are materialised by virtue of Law 1559/1985, which provided private producers, Local Authorities and DEI (i.e. the Public Power Corporation) with the possibility of producing electricity using RES. Law 2244/1994 allowed for a more integrated approach, as it gave strong economic incentives for the development of RES in Greece attracting private funding. The law defined renewable energy sale prices at a level of 90% of the general price list in average voltage and required DEI to buy energy produced by independent producers. Law 2773/1999 placed emphasis on the issue of access priority to the network. Law 2491/2001 dealt with the issue of RES installation in forests and forest areas, while Law 3175/2003 established the rational use of geothermic energy.

17 According to the Commissioner for the Environment Mr. Dimas, the European environmental industry has a turnover of €227 billion, which corresponds to 2.2% of GDP of the EU (see *Naftemporiki*, *Special Edition – Economy 2009*, March 2009).

18 Such as replacing conventional energy generation plants with plants powered by RES.

Table X.3 Allocation of emission allowances in existing industries

(in million tonnes of CO_2 equivalents)

Activities	Total allowances 2005-2007	Total allowances 2008-2012	% allocation 2005-2007	% allocation 2008-2012
Electricity production	156.2	230.1	73.1	70.8
Cement	33.2	53.9	15.5	16.6
Refineries	10.3	20.5	4.8	6.3
Other combustion	3.5	3.0	1.6	0.9
Lime	2.5	4.6	1.2	1.4
Metal friction	2.4	4.0	1.1	1.2
Iron and steel	2.4	2.8	1.1	0.9
Ceramics	2.4	4.6	1.1	1.4
Paper	0.6	0.9	0.3	0.3
Glass	0.3	0.3	0.1	0.1
Total	213.8	324.8	100.0	100.0

Source: Hellenic Ministry for the Environment, Physical Planning and Public Works, National Plan for the Allocation of Emission Entitlements for 2005-2007 (December 2004) and for 2008-2012 (April 2008).

noted that, while, historically, actions regarding the *management of the consequences* of environmental degradation came first, today economic and social conditions for actions aimed at *influencing the causes leading to degradation* are mature, namely the modification or radical change of production mechanisms and processes so as to be compatible with modern environmental standards.

The potential effects of the current financial crisis on the further development of green entrepreneurship constitute, however, an element of uncertainty. **Questions mainly focus on whether profitability concerns will affect business plans for green investment, as well as on the extent to which large fluctuations of fuel prices will discourage large-scale RES investment plans by entrepreneurial groups or states.[19] The question also arises as to whether and how green entrepreneurship will help curtailing job losses in the private sector.[20] Government initiatives for the development of research and technology, the adoption of incentives for the production and use of green products and services, as well as the timely regulation of licensing procedures and integration of green production plants (in order to minimise red-tape and the long wait period for potential investors) are expected to contribute significantly to dealing with these challenges effectively.**

Major institutional initiatives, entrepreneurial actions already underway (mainly in the energy sector) and the social partners'[21] ever-increasing interest in the environment have brought the issue of green entrepreneurship to the fore. The relevant arguments are mainly based on the fact that a number of geomorphological features and development lags,[22] which have led to a waste of financial and environmental resources (and also to the production of low added-value goods and services), extend to a different dimension under the current conditions. For instance, the fact that the Greek agriculture failed to successfully adopt the model of intensive cultivation that prevailed in Central Europe

19 The decision of Iberdrola (the largest RES operator in the world) to cut its investment in the United Kingdom by about 40% is expected to put the relevant programming of the British government at risk (*Naftemporiki*, 26 March 2009).

20 It is estimated that the generation of aeolic energy in Europe has already created 150,000 new jobs. According to the estimates of the Commissioner for the Environment Mr. Dimas, RES industry is expected to create 700,000 new jobs in Europe by 2020 (see footnote 17).

21 It should be noted that in November 2008 SEV (the Hellenic Federation of Enterprises) proposed the establishment of a Council for Sustainable Development.

22 Such as the existence of mountainous or semi-mountainous agricultural areas with low productivity, the large number of islands, the failure to develop heavy industry etc.

has become less important, as organic farming dynamics emerge, where this farming is based on the quality and the local character of production. Respectively, the provision of low-added value tourism services, in which Greece has now particularly powerful competitors, does not secure, as in the previous decades, satisfactory capital yields and jobs, unless it is combined with services featuring environmental, agro-tourism, sports and cultural aspects. Even more, the generation of electric power from sources that are detrimental to the environment (i.e. stand-alone petrol terminals) in islands with exceptionally high wind and solar energy potential does no longer hold strong economic or technological support nor is it socially acceptable. Thus, it becomes clearer that **the conditions supporting green entrepreneurial action do exist, particularly in the context of sustainable development. However, the conditions for the materialisation of this prospect are not only exogenous (state support policy, technology), but also endogenous, as they are related to the "organisational capital", the producers' and consumers' disposition towards innovation and their general stance on environmental issues.** In this sense, it is expected that green entrepreneurship will have to incorporate progressive elements not only regarding the environment, but also the form and the operation of the enterprise, including among others, its relation with innovation, its connection with research institutes, consumer information and its acceptance by local communities.

In recent years the state undertakes more initiatives on issues related directly or indirectly to green entrepreneurship, mainly in terms of institutional and other interventions in the energy sector. As mentioned above, by virtue of Law 3468/2006 a broad programme for electric power generation using RES was promoted and the terms for the incorporation of the relevant investment in development programmes were defined. The business community[23] and local communities have shown great interest, particularly in the development of photovoltaic stations and the utilisation of arable land in areas with high solar potential.

Law 3734/2009 (articles 27A and 28) seeks, among others, to resolve issues related to red tape procedures and pricing of the specific programme so as to facilitate the direct promotion of many pending[24] investment plans, the attraction of new investment and the regulation of various spatial issues. A legislative intervention is expected soon, according to the statements of the Minister of Development (press interviews 10 February 2009 and 19 March 2009), also for business investment in aeolic parks, where similar issues impede the implementation of many important investment plans.[25]

The development of green entrepreneurship, which of course, does not involve only energy production using RES, is supported by a **number of public initiatives,** many of which fall under NSRF 2007-2013.[26] These include the programmes "Green Enterprise" (Prasini Epiheirisi),[27] "Saving Energy" (Exikonomo) for local authoritis[28], the programme for the replacement or withdrawal of old energy-consuming house appliances, as well as the pilot programme for the "green island" (Ai-Stratis), where energy consumption will be exclusively covered by RES. Furthermore, the implementation of measures for the reduction of energy consumption of buildings

23 According to press clippings (see *Naftemporiki,* 11 July 2008 and 10 January 2009), the planned investments in Greece by large international private groups –before the financial crisis– amounted to €3.2 billion. Moreover, "PPC Renewables" (a subsidiary of DEI) is planning relevant investments of €2 billion by 2014.

24 The vivid interest for investment in renewables, in conjunction with the accumulation of pending cases (related to DEI network connection and security, as well as the spatial and other environmental arrangements) and the heavy work load for the evaluation of applications by the Regulatory Authority for Energy (RAE) had led to a temporary suspension of the submission of applications (Ministerial Decision, 24 March 2008) and a slowdown in the realisation of investment plans.

25 According to an ICAP survey for the RES energy generation industry (*Naftemporiki,* 1 April 2009), the main inhibitor in the faster development of the RES industry is deemed to be the low degree of investment materialisation, which is attributed to the complex and time-consuming licensing procedure.

26 According to the Commissioner for Regional Policy issues, Mrs Hübner, green economy investment for the period 2007-2013 will amount to €105 billion, while the corresponding Greek participation will come to about €5.5 billion (statements in the Greek press, 14 March 2009).

27 This is the sub-programme of the programme "Epixeiro 2009", which subsidises, for the first time to such an extent, businesses implementing environmental-friendly actions. It is expected to start in the first half of 2009.

28 This is an energy-saving programme in all public buildings, at least for municipalities with population of more than 10,000 inhabitants.

(Law 3661/2008) is considered particularly important both because it is expected that they will help limit energy waste in the medium term and because they may contribute to the creation of jobs in technical professions and the development of relevant entrepreneurial action.[29] **It is equally important to achieve greater progress in the recycling sector,** which involves the prevention of waste generation, the reuse and recycling of materials, waste to energy solutions, as well as the safe final disposal in organised landfill sites. The basic legal regulations are included in Law 2939/2001 and in a number of presidential decrees and ministerial decisions issued by virtue of this law. According to data of the Ministry for the Environment, Physical Planning and Public Works, **recycled household waste came to 25% in 2008, from 6% in 2004; it is, however, evident that it remains relatively low.** Faster progress is also necessary as regards energy-saving due to recycling, which in 2008 came to 2,600,000 GJ (it was below 500,000 GJ in 2004), and CO_2 emissions reduction owing to recycling, which in 2008 amounted to 360,000 tonnes (from 87,500 in 2004). Also in this sector, there is much that can be done by local authorities and private enterprises.

In order to multiply business initiatives related to environmentally friendly products and services, funding is of crucial importance, particularly at the early stages of the investment. Given that the market for venture capital ("business angels" etc.) is not developed in Greece —besides, their development would be exceptionally difficult under the current conditions— **the evolution of financing will mainly depend on the ability of credit institutions to choose and support appropriate green entrepreneurial opportunities.** Already, on the occasion of the photovoltaic stations programme, many commercial banks plan to fund various initiatives, extending from the production of energy using RES to the replacement of conventional transport or production equipment with green technology.

4 THE ENERGY SECTOR IN GREECE

4.1 ELECTRIC POWER GENERATION AND CONSUMPTION IN GREECE

Electric power generation in Greece from 1960 onwards has been mainly based on the exploitation of domestic sources, namely lignite and, to a lesser extent, water. According to Eurostat data, in 1990 lignite-fired plants covered 71.5% of total net energy production,[30] hydroelectric plants 6.2%, while the rest came from petrol terminals, a large part of which cover to date the needs of non-interconnected islands.

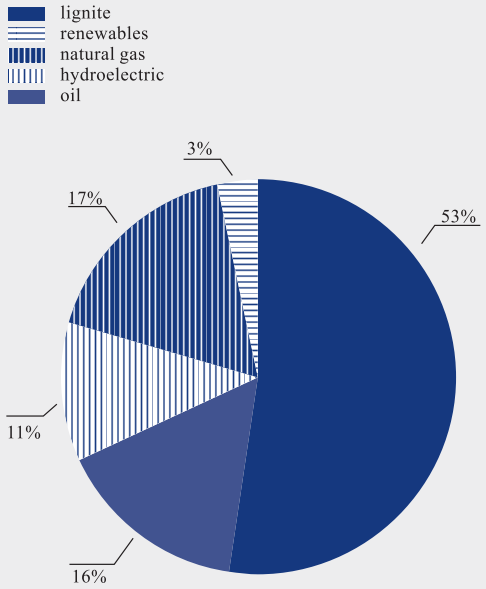
The introduction of the use of natural gas in the Greek energy system since 1997 and the gradual —very slow in the beginning— development of RES mainly since 1994 led to the change in the structure of electric power generation. Thus, in 2006 total net production amounted to 56.5 TWh, from 32.1 TWh in 1990 (and corresponded to total installed capacity of 13.6 GW, compared to 8.5 GW in 1990), from which 52.5% came from lignite-fired stations, 17.3% from natural gas terminals, 15.6% from oil terminals, while 11.4% of total net production came from hydroelectric stations and 3% from renewable sources (see Chart X.1). In the 1990-2006 period, total net electric power generation increased at an average annual rate of 3.6%. However, the growth rate declined since 2001 (with the exception of 2003), and as a result during the triennium 2004-2006 electricity production increased at an average annual rate of 1.3% (see Chart X.2).

In the 1990-2006 period the demand for electric power in Greece by end consumers increased at higher rates (3.9% on annual average). Demand by the household sector (4.3%) and the services sector (7.5%), regarding mainly the use for commercial activity, grew at

29 According to WWF-Greece, the implementation of Directive 2002/91/EC on energy consumption in buildings is expected to create 530,000 new jobs in the EU.

30 Net electric power generation is equal to total electric power generation minus electric power inland consumption which is the result of the generation process.

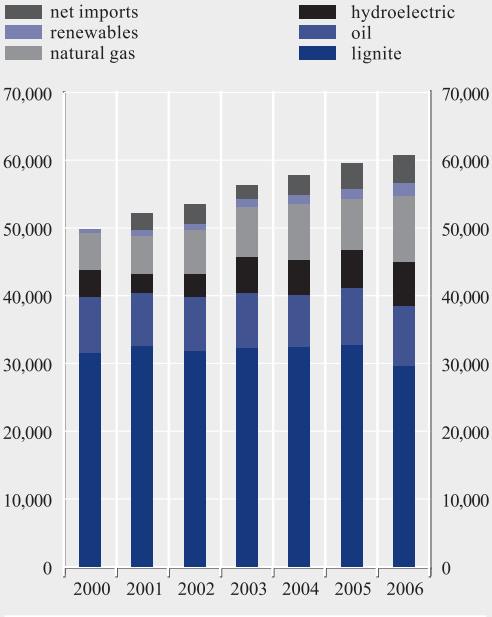
Chart X.1 Electricity production by source in Greece (2006)



Source: Eurostat.

Chart X.2 Net electricity production and trade (2000-2006)

(Gwh)



Source: Eurostat.

a faster average annual rate, while demand by industry increased at a lower rate (1%). Thus, in 2006 the households and services represented 33.7% and 33.8% respectively of final consumption (see Chart X.3). By contrast, the share of industry in final consumption was limited to 27% in 2006 (from 42.5% in 1990), while the share of the agricultural sector remained small (5.2% in 2006, from 5.5% in 1990).

After 2000, the divergence between energy produced and energy required led to the increase in the share of imports in the electric power system of Greece, which became stronger in the 2004-2006 period (see Chart X.2), with net imports increasing at an average annual rate of 26.2%.

The penetration of net electric power imports in the energy balance of Greece continued also in 2007 (they increased by 3.6%) and was particularly intensified in 2008 (when imports increased by 28.6%). As shown by HTSO (Hellenic Transmission System Operator) data, total demand in the interconnected Greek system[31] increased in 2007 by 4%, together with a proportionate increase in net production. In 2008 the rise in total demand was smaller (+0.6%) and was covered mainly by imports, while net production was reduced (-1.7%), mainly owing to the decline in the production by lignite and hydroelectric stations.[32] However, in 2008 the production by RES and SITHIA[33] plants (including photovoltaic stations) in the interconnected system increased considerably (+26.1%) and came to 2,203 GWh (compared with 1,747 GWh in 2007 and 1,521 GWh in 2006), which led to a further increase in their share in electric power generation.[34]

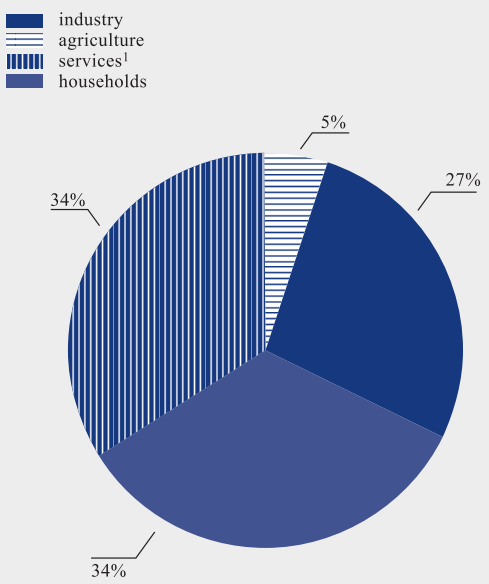
31 HTSO – according to the institutional framework of the deregulated electric power market – is responsible for the interconnected system serving mainland Greece and certain interconnected islands.

32 Besides, on the basis of HTSO data, electric power generation in the interconnected system continued to fall (-4.9%) between January and February 2009, while demand recorded an even larger drop in the same period (-5.9%).

33 "High Efficiency Cogeneration of Electricity and Heat" (or Combined Head and Power – CHP) stations.

34 At the same time, the *installed power capacity* of RES and SITHIA plants along with the photovoltaic systems in the interconnected system amounted to 1,098 MW in 2008 from 880 MW in 2007 and 768 MW in 2006.

Chart X.3 Electricity consumption by sector in 2006



Source: Eurostat.
1 Includes trade, transport and public buildings.

On the basis of the Council for National Energy Strategy (SEES)[35] report for 2008 *(Measures and means for a sustainable and competitive energy policy)*, the demand for electric power in the interconnected system is expected to increase in the 2010-2020 period at an average annual rate of 2.7% (if energy saving measures are implemented, the average rate could be limited to 1.7% during the same period).[36]

On the basis of the European Union policy for energy and climate change, targets have been set —as already mentioned— regarding the reduction of greenhouse gas emissions, as well as the further penetration of renewable sources in the internal energy market.[37] Given, however, that the electric power sector in Greece is accountable for 38.4% of CO_2 emissions (2006 data), the differentiation of the fuel mixture currently used becomes imperative so as to cover the increase in demand by 2020.

In the 2008 SEES report it is ascertained that the national energy policy targets can be achieved with the use of: (a) lignite-fired plants, but in a smaller percentage, (b) natural gas plants, in a percentage proportionate to fuel imports on the basis of long-term contracts, (c) large hydroelectric stations, (d) aeolic and other renewable sources and (e) certain new technology coal plants. Nevertheless, on the basis of the recent statements of the Minister of Development on the **new National Energy Strategy** of the Ministry of Development,[38] investment programmes in coal are cancelled, while natural gas and renewable energy sources will play the primary role in the energy mixture of Greece. At the same time, priority is given to international energy interconnections (natural gas pipelines and the Burgas-Alexandroupoli oil pipeline),[39] as well as in

35 The Council for National Energy Strategy (SEES) was established by Law 3438/2006; it comes under the Ministry of Development and constitutes a body making proposals to the government and particularly to the Minister of Development on issues regarding the long-term planning of Greece's energy policy.

36 Because of the increased uncertainty due to the financial crisis, SEES has recently announced that it postpones the publication of its 2009 Report on long-term energy planning (which may include revised forecasts) for September 2009.

37 Greece must cut down the rise in greenhouse gas emissions by 25% in the 2008-2012 period compared to 1990 levels, with an aim to attain its Kyoto Protocol targets. Furthermore, by virtue of Directive 77/2001, the national target set for Greece is to increase the share of electricity produced by RES in the gross electric power consumption to 20.1% by 2010. Moreover, on the basis of the new European policy for energy and climate change adopted by the European Council in the past two years, Greece should reduce its greenhouse gas emissions by 4% compared to 2005 (for industries not participating in the emissions trading system), while the participation of renewable sources in total energy consumption must rise to 18% by 2020 (corresponding to a share of 30-35% in gross *electric power* consumption).

38 10 February 2009.

39 The Ministry of Development is planning the establishment of a company for the South Stream pipeline in 2009, following the signature of a memorandum of cooperation between the Greek and the Russian government in April 2008. Also, in June 2008 the establishment act of the company "IGI Poseidon" was signed, which will construct and develop the Greece-Italy submarine natural gas pipeline. The construction of the pipeline, which forms part of the greater Turkey-Greece-Italy pipelines system, is expected to start in 2009 and the system will be put into operation in 2012. It is noted that the EU has approved the exception of third party access to the project for 25 years, in the course of which DEPA (the Public Gas Corporation) and the Italian company Edison will have exclusive exploitation rights. As concerns the fuel, Greece and Italy have already embarked upon deliberations with countries of the Caspian region and particularly with Azerbaijan. Furthermore, as regards the Burgas-Alexandroupolis pipeline, the Ministry of Development is planning the sanctioning of the agreement governing the passing through of the pipeline by the Parliament by June 2009, following the signature (on 18 January 2008) of the agreement for the establishment of the international company that has undertaken its construction and operation. It should be reminded that Russian companies participate in the company by 51% and Greek and Bulgarian companies by 49% equally. The commencement of the construction of the project has been set for June 2010 and is expected to upgrade Greece's position in the energy map, securing advantages related to energy security, the attraction of investment and the creation of jobs.

negotiations with Russia for the supply of natural gas from 2016 onwards. Moreover, further expansion of natural gas pipelines in Greece is being promoted, as well as the acceleration of the interconnection of the Cyclades with the national network. Regarding the promotion of RES, the Ministry of Development is tabling a new bill, which will lay emphasis on aeolic parks.

4.2 ENERGY AND PROTECTION OF THE ENVIRONMENT IN GREECE

As mentioned above, the largest percentage of greenhouse gas emissions in Greece (79% in 2006 – see Table X.1) comes from the energy sector, and this holds true for both the side of production and the side of consumption. The most polluting activities related to the use of energy are electric power generation, transport and household activities (such as house heating and the use of private passenger cars).

It is worth noting that the production of **energy, which mainly involves electric power generation, contributes to total greenhouse gas emissions almost as much as all the other sectors of the economy together,** which, however, consume the largest part (about 95%) of total gross domestic energy consumption. This, however, does not seem to be the case in the other EU-15 countries. The difference may be due to the fact that electric power generation with the use of lignite is a considerably more polluting activity than power generation from other raw materials in other countries.

4.3 ENERGY INTENSITY OF THE GREEK ECONOMY[40]

Energy consumption is directly associated with a country's energy intensity, namely the extent to which energy is used effectively in the production process. Energy intensity is defined as the ratio of gross inland energy consumption[41] to GDP. Lower energy intensity implies higher effectiveness in the use of energy for each unit of output, i.e. output increases faster that energy consumption. Respectively, oil intensity is defined as the ratio of gross domestic oil consumption to GDP.

In the 1995-2006 period Greece became more effective by 14.9% as regards energy use and 15% as regards the use of oil for each unit of output. The euro area became more effective by 9.6% and 17% respectively. **Compared to the euro area as a whole Greece remains more energy-consuming (this difference has been reduced, from 12.5% in 1995 to 6% in 2006) and oil-consuming (this difference has been increased, from 50% in 1995 to 54% in 2006) in all branches of economic activity.**

For each industrial output unit, Greece consumes 47% more energy and 319% more oil than the euro area, in agriculture 24% more energy and 56% more oil and in transport 12% more energy and 14% more oil. Finally, 5% more energy but 109% more oil is required for each unit of output in the sector of households and services (see Chart X.4).

The share of oil products in total energy consumption has remained unchanged in Greece since 1990, while it has been reduced in the euro area and EU-27. This development suggests that **in Greece the substitution of oil products by other forms of energy, such as natural gas, electric power[42] and RES, proceeds very slowly and remains very low.** In 1990-2006 oil products accounted for about 58% of gross inland energy consumption in Greece, the third highest among EU-27, while this share for industry, households and agriculture was considerably higher in comparison with EU-27 and the euro area.

The extra quantity of energy Greece required in relation to the euro area for the production

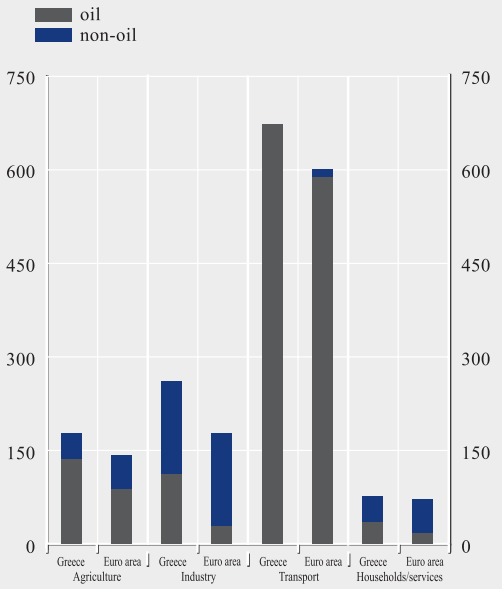
40 See also *Monetary Policy-Interim Report 2008*, October 2008, Annex II to Chapter V, pp. 93-96.

41 Gross inland consumption or "primary energy supply" represents the quantity of energy consumed within a geographical entity. It is calculated as follows: Primary production + recovered products + total imports + variations of stocks + total exports + bunkers (i.e. quantities delivered to sea-going vessels). The measurement unit is the tonne of oil equivalent (TOE).

42 It is noted that the main hydroelectric and lignite plants in Greece were constructed before 1990.

Chart X.4 Energy intensity by sector in Greece and the euro area

(TOE per €1 million of GDP, 2000-2006 average)



Source: Bank of Greece (calculations based on Eurostat data).

of one unit of output is exclusively oil. Of the extra oil quantity used, 4.4% in industry, 15% in transport, 30% in agriculture and 81% in households covers the lack of supply or reduced demand for other forms of energy, while the remaining extra oil is the result of the ineffective use of oil or of structural factors. A particular feature of Greece is that households and services have gradually increased the use of oil per unit of output,[43] unlike the euro area and EU-27, which have reduced it.

The needs for energy and oil as well as consumers' energy behaviour vary among countries due to economic, social and other characteristics, such as climate conditions, kilometric distances, the abundance of energy resources and infrastructure. Energy prices, the structural characteristics of the economy and the implementation of policies encouraging a more effective use of energy are of equal importance.

In many countries, the increase in the share of services in total GDP against the respective share of industry, the modernisation of production processes in industry, the turn to other forms of energy, better thermal insulation of buildings and the turn from heating oil to natural gas and the promotion of low fuel-consumption or hybrid vehicles have in recent years contributed to the reduction of energy and oil intensity. Furthermore, many countries have adopted policies which encourage energy saving and lower use of oil, such as increased competition through the deregulation of the energy market, lower subsidies or higher fuel tax, subsidies for biofuels and research on new more energy-efficient technologies.

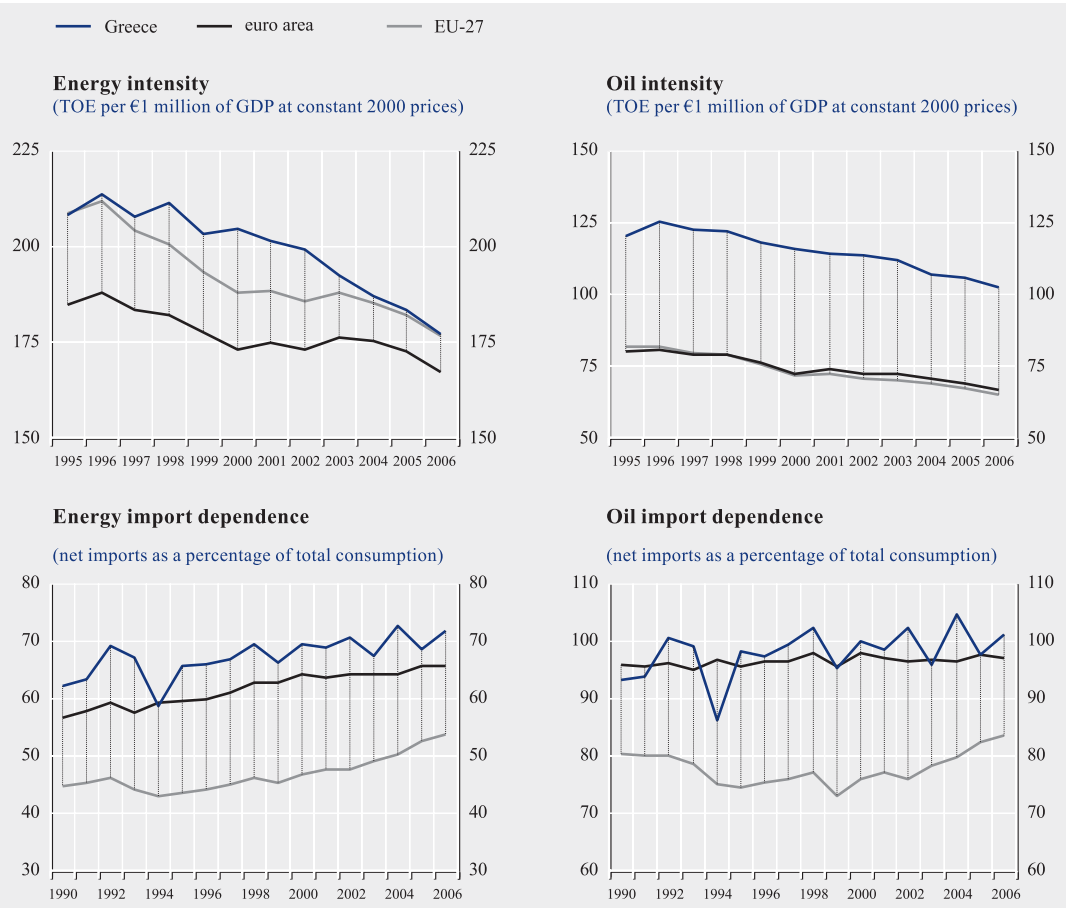
There is plenty of room for further reduction in energy and particularly oil intensity in *Greece*, as the penetration of natural gas in end consumers is still very limited in comparison with the European standards, while, at the same time, the percentage of primary energy production using RES remains very low. Moreover, the challenges from the continuing increase in the number of means of transport, particularly private passenger cars,[44] and the demand for road transport as well as passenger and freight air transport are also important.

4.4 ENERGY DEPENDENCE OF THE GREEK ECONOMY[45]

A country's energy dependence, i.e. the ratio of net energy imports to total gross inland energy consumption, has changed at around the same average annual rate as that of the euro area as a whole. However, oil dependence has increased at the highest average annual rate among euro area countries (see Chart X.5). By contrast, in countries comparable with Greece, such as Portugal and Ireland, oil dependence was reduced in the 1990-2006 period. Greece's energy dependence amounted to 67% and oil dependence to 98% on average in the 1990-2006 period. **The expected increase**

43 Services or goods destined for own use are calculated as household output.
44 International Energy Agency, *Worldwide Trends in Energy Use and Efficiency*, 2008, pp. 60, 62 and 64.
45 See also *Monetary Policy-Interim Report 2008*, October 2008, Annex II to Chapter V, pp. 93-96.

Chart X.5 Energy and oil intensity and dependence in the EU-27, the euro area and Greece



Source: Bank of Greece (calculations based on Eurostat data).

in the penetration of natural gas in Greece is estimated to limit the use of oil products, without, however, reducing fuel dependence, as natural gas is also imported. The substitution of oil for domestic energy sources, such as RES, could gradually reduce Greece's energy dependence.

5 LEGAL FRAMEWORK AND COMPETITION CONDITIONS IN THE GREEK ENERGY MARKET – INVESTMENT PROSPECTS

5.1 LEGAL FRAMEWORK

The deregulation of the electricity market in Greece formally started in February 2001 by Law 2773/1999, which aimed at aligning the Greek legislation with Directive 1996/92/EC (for the establishment of common rules for the internal market in electricity in the European Union).

Over time the institutional framework was supplemented and amended by the provisions of other laws, among which the most important were Law 3175/2003 and Law 3426/2005 "accelerating the process of deregulation in the electricity market". At the same time, the institutional framework was aligned with the rules of Directive 2003/54/EC.

On the basis of the institutional framework as

it was finally set by virtue of Law 3426/2005, the electricity market has been fully deregulated as of 1 July 2007, with the recognition of the consumers' right to choose their electricity supplier.[46] At the same time, the role of institutional bodies has been enhanced as the HTSO (Hellenic Transmission System Operator) will be exclusively responsible for the development and maintenance of the transfer system (i.e. the high voltage network), as well as for the operation of the new electricity market.[47] The institutional framework in force also provides for the distinction between distribution network management activities (for average and high voltage) and network *ownership* activities.[48]

As regards the regulatory framework, an important step towards the operation of the deregulated electricity market is the new Grid Control and Power Exchange Code for Electricity (KDSSHE), issued in 2005 and further amended in 2006. However, the new code will be fully implemented in 2009, as the transition to the new market model was not directly feasible, because its operation rules were complex and participants could not easily assimilate them.[49] Besides, the Grid Code has also been brought to public consultation and the same applies for the new Supply Code. As soon as these codes are put into force, the access of electricity suppliers to the distribution network (low and average voltage) will be facilitated.

The deregulation of the electricity market carried along the deregulation in the natural gas market, given that over 70% of the fuel is consumed by electric power producers. The natural gas market was initially "opened up" by virtue of Law 3175/2003 (as of 1 July 2005) for electric power producers consuming over 25 million cubic metres of natural gas on an annual basis. Following the adoption of Law 3248/2005 for the deregulation of the natural gas market, which set the framework for the transposition of Directive 2003/55/EC into national law, the free choice of supplier was extended to all authorised electricity and heat production-cogeneration suppliers with an annual demand over 100 MWh.[50]

The legislative framework for granting licenses to electricity generation plants using *renewable energy sources* (RES) and to *High Efficiency Cogeneration of Electricity and Heat* (SITHIA) plants was regularised by Law 3468/2006. The law provisions led to a considerable simplification and acceleration of the licensing processes for the relevant projects so as to safeguard their materialisation. Moreover, this law aimed at the alignment of the Greek legislation with Community Directive 2001/77 and its adaptation to the aforementioned commitments arising from the Kyoto Protocol regarding the RES share in electricity production. As regards the promotion of cogeneration of two or more useful forms of energy, the institutional framework was further supplemented with the provisions of Law 3734/2009, thus fully aligning with Directive 2004/8/EC. The new law also includes provisions by which the regime governing the foundation and operation of photovoltaic stations initially established by Law 3468/2006 is finalised.

5.2 COMPETITION IN THE ENERGY MARKET – INVESTMENT PROSPECTS

Private individuals' interest in the materialisation of investments in electricity production has

46 This law does not apply for consumers of micro-isolated networks in non-interconnected islands.

47 PPC reserves the right for exclusive ownership of the transmission grid's fixed assets. Besides PPC, other companies are eligible to be granted licenses for the construction and management of electricity transmission lines, so that they can directly supply their plants, subsidiaries and customers.

48 PPC reserves the right for the exclusive ownership of the distribution network, while the operation of the distribution network has been undertaken by a new company, under the name "Distribution Network Operator", which is a 100% subsidiary of PPC.

49 The new market established on the basis of the new Code consists of two parts: (a) *the daily wholesale energy market,* in which transactions are conducted on total electricity produced and consumed in the territory (i.e. domestic producers and importers offer electricity and are remunerated therefor, while suppliers and exporters absorb it) and (b) *the long-term capacity reliability market,* in which producers are paid for the maintenance of their plants in operational alertness and which aims at reducing producers' business risk, to ensure the possibility of installation and operation of new plants.

50 Since November 2008 these include non-household customers located in areas outside the jurisdiction of the Gas Supply Companies (EPA), while as from November 2009 the market will be opened up for household customers, except those who fall under the jurisdiction of EPA.

Table X.4 Electricity production licences issued between 1 February 2001 and 12 January 2009, by plant type

Plant type	Number	Power (MW)
1. Renewables	857	7,739.1
1.1 Wind power	501	6,858.8
1.2 Small hydroelectric	277	670.1
1.3 Biomass – geothermal	17	84.5
1.4 Photovoltaic	62	125.7
2. Combined heat and power	31	430.9
3. Large hydroelectric	1	60.0
4. Large thermoelectric	21	6,976.2
4.1 Large private thermoelectric	14	5,476.0
5. Other	134	1,682.1
6. Total	1,044	16,888.3

Source: Regulatory Authority for Energy (RAE), registry of electricity production licences.

been vivid since the beginning of the formal deregulation of the electricity market by virtue of Law 2773/1999. According to RAE data, from **February 2001 until January 2009 1,044 power generation licences had been issued, for plants with a total capacity of 16,888 MW** (see Table X.4). Of these, the highest share (46%) concerns licenses for RES stations (mainly wind power generation plants: 40.6%), while an important percentage is covered by licences for large thermoelectric stations (41.3%).

Specifically, as regards thermoelectric stations, 14 out of the 21 licences issued, are for private stations with a total power of 5,476 MW.

However, the licensed investment plans have not proceeded as scheduled. This is associated with delays both in establishing the regulatory framework for the operation of the deregulated market as well as in the conduct of tenders (by the System Operator – HTSO) between independent producers for the conclusion of capacity availability contracts provided for by law. Thus, after a two-year procedure the first tender was completed in July 2008 (it had been announced in December 2006): it concerned the construction of a natural gas plant of 447 MW, which is expected to be put to commercial operation at end-2010.[51]

However, irrespective of tender procedures, there are **two plants currently operating – besides PPC, which remains dominant in electricity production and supply – and one large private heating and electricity cogeneration plant has also been put into trial operation since summer 2008. As a result the total installed capacity of private plants amounts to 884 MW.[52]**

Besides, in the past two years, there has been strong mobility by energy groups eager to conclude agreements with international energy agents for the creation of joint ventures, so that they can secure their participation in the inter-

51 The tender was awarded to ENELCO S.A. According to law, the commencement of operation of the new plant is set in 27 months from the date at which the contracts were signed (15 July 2008) between HTSO and ENELCO S.A., while the capacity of the new plant will be bought by the Operator at a pre-fixed price for 12 years. It should be recalled that the tender procedure for 900 MW power supply contracts had originally been introduced by Law 3175/2003, which provided that the incorporation to the capacity credit system would be completed by 2007. However, owing to the delay in the materialisation of private electricity production projects, the deadline was extended to 2012.

52 This is the Gas Turbin plant "HERON I" (160 MW) of "HERON Thermoelectric SA", which has been operating since 2004 in order to secure spare power, the "Energiaki Thessalonikis" plant of Hellenic Petroleum (ELPE – 390 MW), which was set in operation in 2006, as well as the new cogeneration plant of Endesa Hellas (334 MW).

nal electricity production and trade.[53] **Three new combined cycle plants for electricity production powered by natural gas with total power of about 1300 MW are already under construction. They belong to three large private groups and are expected to be incorporated into the system in 2010.[54]**

At the same time, **PPC is implementing a €4 billion worth programme, for the gradual replacement of its obsolete and polluting facilities with new modern technology thermal plants which will be more environment-friendly.[55]** Furthermore, **the Corporation's new investment programme, which will be concluded by 2014, also envisages the materialisation of new projects involving renewable energy sources, with total capacity of 950 MW, worth €2 billion.**

The materialisation of investment in new modern and clean technology stations in the sector of electricity production, both on behalf of private groups and the PPC is expected to enhance the adequacy of electric power in the forthcoming years and also contribute to the reduction of emissions of conventional pollutants, thus helping in the fulfilment of Greece's obligations.[56]

Finally, it is worth noting that in **the past two years, private individuals show more interest in the supply of electricity. Thus, according to RAE, 50 licences for the supply of a total of 21,284 MW had been granted by January 2009, 49 of which (9,784MW) concern independent suppliers. Furthermore, private suppliers have recently turned to major commercial consumers, as PPC bills for this category of customers (average voltage bills) leave room for lucrative activity on behalf of other "players" in the market.[57]** Besides, the finalisation of the regulatory framework, when the Grid Code is put into force, is expected to facilitate private suppliers' access also to household consumers.

53 In this context an important development in the area of electric power is the establishment of the company "Elpedison", between ELPE and the Italian Edison, on the basis of the agreement signed by the two groups in July 2008, aimed at creating electricity production plants of 2000 MW. Similar moves were also made by other groups, such as the one signed between the "GEK Terna" group with the Gaz de France-Suez (18 December 2008) which provides for the participation of the second by 50% in the share capital of "HERON Thermoelectric". Moreover, on 31 March 2009 the European Commission approved the creation of a joint venture between the Mytilinaios and Motor Oil groups for energy production (it concerns the construction of an electricity production station with a capacity of 396 MW).

54 This is a plant of 435 MW of "HERON Thermoelectric", a plant of 412 MW of Endesa Hellas and a plant of 421 MW of Edison.

55 It is noted that originally, as provided for by Law 3175/2003, the PPC may renew and replace obsolete facilities of a capacity of up to 1600 MW. However, on the basis of the recent law 3734/2009 (article 33), the PPC may proceed to the replacement of its old plants with new modern technology plants, without capacity limitations. The programme also includes the construction of a combined cycle plant in Aliveri (427MW), as well as another thermoelectric plant in Meliti, Florina (420 MW), powered by lignite and the possibility of providing thermal energy for teleheating. Moreover, the works for the construction of 5 hydroelectric stations with total capacity of 725 MW are almost completed.

56 As regards power adequacy for 2009, it is noted that demand requirements will be met by the existing PPC plants and private plants already in operation, as no new plants will be incorporated in the system. However, it is estimated that there will not be serious problems in meeting demand requirements, as a result of the lower consumption observed (mainly in the industrial sector), but also of the increase in water reserves for the operation of hydroelectric plants.

57 Thus, six new Greek and foreign companies operating in the electricity sector have already signed electricity supply contracts with large supermarket chains and retail stores.