

THE ENERGY POLICY OF GREECE

by

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This paper presents the energy policy of Greece and deals with four energy sectors i. e. petroleum, natural gas, electricity/lignite, and renewable energy sources. Each of these sectors is described and its present state is presented. The Greek national strategy in each energy sector is examined while its international policy is discussed. The objectives of the new energy strategy that Greece is about to introduce are also presented.

Introduction

In the energy sector, the most important problems that Greece has to face are that:

- it does not have direct borders with other European Union (EU) Member States (MS) and, is therefore somehow “isolated”,
- there are many islands and mountains which are difficult and costly to supply with energy, and
- there is a lack of basic energy resources while the only energy resource, lignite, is poor in thermal value. This is the reason why, by the end of 2004, the dependence of Greece on basic energy resources was as high as 70% and it is expected that by year 2020 this will reach 75% [1].

The EU has to import most of its energy resources and in 2003 the imports amounted to 70% [2, 3]. Since the role of the EU to the MS is only coordinative, Greece, like all the other MS, has to manage for its own energy supply.

The energy consumption in Greece was [3]:

- 52.5 TWh of power (for 2004),
- 144,175,000 barrels of crude oil (for 2003), and
- 2.5 billion m³ of natural gas (for 2004).

Although Greece is in the last place with regard to *per capita* basic energy resources consumption, its fast rate of growth (4.7% for Greece compared to about 2.1% for the Euro area in 2004) causes consumption to increase [2, 4]. By mid-2005, the energy sector in Greece went through a transition period while there were attempts to liberate the energy market, natural gas was introduced into the energy balance and the important energy industries were privatized.

The four energy sectors of petrol, natural gas, electricity, and renewable energies are described. Since 99% of the lignite is used for power generation [1] this is discussed under the electricity sector.

Petrol sector

The first attempt for search and exploitation of hydrocarbons in Greece started in 1842 in the island of Zakynthos. By mid-2006, the only successful exploitation was in the field of Prinos in the North East Aegean. This oil deposit was discovered in 1973 and until mid-2006 was the only Greek hydrocarbon source. This was small and covered only a very small percentage of the total demand. By mid-2006, this deposit was almost exhausted.

The two large Greek petroleum enterprises, that are still active in the Greek market, were created two years before the discovery of the Prinos field. The first, the "Public Petroleum Company" was created in 1971. This has now been renamed as the "Hellenic Petroleum group of enterprises". By mid-2006, the company was owned by the Greek State (by 27.5%), which controls the company's management, by Greek businessmen (by 41.2%) and by the wider investment public (by 31.3%) [6]. The second, the "Motor Oil Hellas group of enterprises" was created in 1972. In March 2006, the company was owned by Greek businessmen (by 61.5%) and by the wider investment public (by 38.5%) [5]. The Hellenic Petroleum group of enterprises and Motor Oil Hellas:

- import crude oil and oil products to Greece in order to cover its increased demand. By the end of 2004, the demand for oil products reached 21 millions tons, representing, as from year 1996, an annual increase of 2.3%. The imports of crude oil are mainly from Iran, Saudi Arabia, and Libya (see tab. 1) while occasionally there are also crude oil imports from Russia. The field of Prinos covers 1.34% of the oil demand;
- keep in their possession the four refineries that operate in Greece, and located in Aspropyrgos, Elefsina, Agioi Theodoroi (near Corinth), and Thessaloniki;
- are present in business activities abroad and concretely:

- the Hellenic Petroleum group of enterprises has expanded its business in the refinery of FYROM, but also in Albania, Cyprus, Montenegro, and the Republic of Georgia. It is also prepared to extend its operation to Serbia and Bulgaria.

With regard to research and exploitation, the group expanded via consortia in Albania and Libya. It actually undertakes large investment initiatives in the Balkans, participating in large projects such as the pipelines of Thessaloniki-Skopje and Burgas-Alexandroupolis [2, 6]. The Burgas-Alexandroupolis pipeline project, signed in April 2005 between Greece and Russia, is the most important international memorandum, Greece has ever signed in the petrol sector. This pipeline also is anticipated to become an international oil passage;

Table 1. Imports of crude oil for 2003 [6]

Source	[%]	10 ³ tons
Prinos	1.34	160,60
Arabian light	11.35	1,358.40
Arabian extra light	5.46	652.90
Iranian heavy	21.10	2,524.40
Iranian light	15.49	1,852.90
Russia (Ural)	34.01	4,069.60
Libya (Sarir)	8.25	987.60
Forozan	3.00	358.70
Total	100.00	11,965.10

- the Motor Oil Hellas group of enterprises exports 25% of its production while it intends to penetrate in the Balkans by growing the network of sales through the LPC Company of oil products [5];
- finally, the Hellenic Petroleum group of enterprises has undertaken, to explore for hydrocarbons in the Greek territory on behalf of the Greek State [6, 7].

The Greek State has also changed its policy in the petrol sector with a view to liberalise this particular market. However, fundamental objectives remain the security of energy supply, the constant quality of the petroleum products, stable and competitive prices for the consumers and the protection of the environment.

Based on the international evolutions and directives of the EU, the future strategy of Greece will focus on the:

- increase of competition at all levels,
- proper operation of the petrol markets,
- incentives given to Greek petroleum companies for their further introduction into international markets,
- decrease of consumption of oil products and increase of national production in order to reduce the three million tons of deficit and hence reduce the imports of oil products, and
- intensification of the search for new hydrocarbon fields.

Natural gas sector

In 1983, the Public Petroleum Company made the first feasibility study for use of natural gas in Greece. In 1987, the first bilateral agreement for the supply of natural gas was signed between Greece and Russia. Two other agreements followed between the Public Petroleum Company and the Russian company Sojuzgazexport (currently called Gazexport) as well as the Algerian Sonatrach [8].

In 1988, the Public Gas Corporation (DEPA) was created as a subsidiary of the Public Petroleum Company with the aim to import, transport, store, distribute, and sell natural gas in the whole of Greece. By mid-2006, the company was owned by the Hellenic Petroleum group of enterprises (by 35%) and by the Greek State (by 65%).

In 1995, DEPA created three subsidiaries, which are the Gas Distribution Companies (EDA) of Attica, Thessaloniki, and Thessaly. Through these companies, DEPA possesses 51% of the Gas Supply Companies (EPA), which were created between 1996 and 2001 and to which DEPA granted the trading of natural gas, for consumers of medium and low pressure. The remaining 49% of the EPAs of Thessaloniki and Thessaly belong to the Italian gas company Italgas and 49% of the EPA of Attica to the consortium Cinergy-Shell, which also possesses the administration of three EPAs [8]. By the end of 2005, natural gas distribution existed only in Attica, Thessaloniki, Larissa and Volos and in the industrial area of Komotini. In order to extend the use of natural gas in other Greek cities, local EDAs and EPAs will also be created. Actually, there is a plan for the creation of three new EPAs in the Greek districts of Central Greece, Eastern and Central Macedonia, and Thrace. Those EPAs should be operational by the end of 2006.

The first agreement for the supply of natural gas was signed with Gazprom of Russia and supply began in 1997. DEPA receives natural gas in the Greek-Bulgarian border and distributes it to the rest of the country with a pipeline of 512 km that begins from the border and ends up in Attica. The agreement consists in supplying 2.24 billion m³/yr. with the possibility of an increase up to 2.8 billion m³/yr. by 2016.

By mid-2000, the second agreement was signed with the Algerian Sonatrach from which DEPA buys LNG. The agreement foresees a supply of 0.51 to 0.68 billions m³/yr. of natural gas as from November 1999 up to year 2021. Transport is carried out with tankers and reception is at the island of Revithousa, which lies in the Saronic gulf.

For Greece, natural gas consists an important source of development. This has penetrated in many sectors such as the [8]:

- electricity generation, with emphasis on combined cycle units. 72% of its total use (1.8 billion m³/yr. in the end of 2004) is utilized in this sector. This percentage has already increased because of two new power plants, using natural gas, which are operating and more than four, which are about to be created. By 2010, the total use of natural gas is about to reach 3.6-4 billion m³/yr.,
- industrial, where natural gas is used either as a fuel or as a raw material for the production of chemicals,
- urban and commercial, mainly for heating, and
- transport, with a first application in the fuelling of 300 buses for urban transport in Attica (end of 2005).

At the same time, new uses are promoted for applications such as cogeneration units, greenhouses and fuel cells.

As mentioned, DEPA is the only natural gas company in Greece and consequently all steps taken in order to extend into international markets are carried out through this company. DEPA applies a strategy to become an important energy player in the wider region with the aim to establish Greece a “corridor of natural gas” between East and West. The basic objective is to have an unhindered flow of natural gas from its sources, in the wider region of the Caspian sea, the Middle East and Central Asia, towards the centres of consumption in Europe and the Balkan peninsula via Turkey and Greece.

In order to achieve this objective, the following steps have been taken [7, 8]:

- in 2002, a memorandum of collaboration was signed between DEPA and the Turkish BOTAS, for the interconnection of the Greek-Turkish networks,
- in 2002, a memorandum of collaboration between DEPA and the Italian Edison Gas was signed for the extension of the Greek infrastructure to the West and its interconnection with the Italian natural gas network,
- in 2002, a memorandum of collaboration was signed between DEPA and the Iranian NIOC in order to foresee the possibility of transport of Iranian gas with pipelines to Europe via the interconnection of Greece-Turkey and/or transport of liquefied natural gas from future liquefaction units in Iran to Greece,
- in 2002, a Common Declaration was signed between DEPA and SOCAR of Azerbaijan in Baku for the supply of Greece with natural gas and its transport from the Caspian region towards Central Europe via Turkey and Greece,

- a protocol was signed between DEPA, BOTAS, and gas companies from the Western Balkan countries which are MAKPETROL of FYROM, the Ministry of Industry and Energy of Albania, the Serbian natural gas company NIS-GAS, the Croatian natural gas company PLINACRO, the Slovenian natural gas company GEOPLIN, and BH-GAS company of Bosnia-Herzegovina. With this protocol, the parties, agreed to participate in a common study and in an investigation of natural gas transport potential from the Middle East and the Caspian countries,
- in 2004, started the construction of the natural gas pipeline between Italy and Greece. The Greek part starts in Komotini and ends in the Ionian Sea and will have a length of about 600 km while the undersea pipeline (part which connects Italy and Greece) will have about 220 km, and
- in 2005, a memorandum was signed for the construction of a pipeline connecting Turkey with Austria, via Greece, FYROM, Serbia, Bosnia, Croatia, and Hungary.

Greece will have to establish its policy for the coming years according to Directive 2003/55/EC for further natural gas market liberalisation, its further introduction into the energy balance and security of supply. The steps that it intends to take are the following:

- find alternative sources for the supply of natural gas,
- separate the activities of supply, distribution, transport, and trade according to Directive 2003/55/EC in order to enhance competition,
- maintain the transport network under State control and, for its management, create an administrator for the transport of natural gas according to the model of the Hellenic Transmission System Operator S. A. (the administrator of the electricity transmission system),
- establish motivations for the introduction of natural gas in the Greek energy market,
- intensify the exploration for new natural gas domestic fields, and finally, and
- develop the natural gas system, aiming at the uninterrupted and secure supply of all consumers in the country, with a single tariff.

Electricity sector

Electricity reached Greece in year 1889 with the lighting of the historical centre of Athens. Several small power companies were created in order to supply small regions of the country with electricity, but with schedules in electricity supply and unbearable tariffs. In 1950, the State united all these small companies to create the Public Power Company (PPC). Till mid-2004, the PPC was the only electricity production and trading company in Greece while in 2000 it provided 99.1% of the electricity that was consumed in the whole country [9]. Actually, the first company that produces power from natural gas besides PPC is “HERON THERMO-ELECTRIC SA” with an installed power of 148 MW [8]. Unfortunately there are not yet many data about the new power companies as far as the national electricity system is concerned. Thus the electricity sector will be examined through PPC.

In 2001, the scene of the internal electricity market started to change with the beginning of liberalisation in order to harmonise Greek legislation (law 2773/99) with Directive 96/92/EC.

In the framework of this law, the role of the PPC changed since PPC became a *societe anonyme* and was introduced in the stock exchange. Two institutions were also created: the Regulation Authority of Energy (RAE) which is mainly a consultative and proposing authority; and the Hellenic Transmission System Operator (HTSO S. A.) which administers the electricity transport system. The consumers are classified in high, medium and low voltage ones and from there in consumers with a choice (consumers of high and medium voltage) and in consumers without a choice (for consumers in the islands and low voltage consumers). The consumers of the first class can choose their electricity supplier while the others remain customers of the PPC. In addition, after special permission, any private person can produce and sell electricity to customers who have a choice.

The problems that Greece had to face with regard to the liberalisation of the electricity market were twofold:

- the unique company for electricity production was State controlled. This was handled with the progressive privatisation of the company, the reduction of State influence and the split of the company into four smaller autonomous companies, and
- the question of how to define the customers with the right to choose their provider. This problem was handled with the decision to consider as customers with a choice those who consume electricity of medium and high voltage.

A new Directive 2003/54/EC imposed further liberalisation of the European electricity market so that all customers could choose their electricity provider.

As mentioned in the introduction, lignite is the unique energy resource of Greece that allows a long-lasting exploitation. In year 2003, lignite reserves reached 3.2 billion exploitable tons, while a total of 1.3 billion tons of lignite have already been mined. Lignite is a poor fuel and, for this reason, better quality coal is imported from South Africa, Russia, Venezuela, and Colombia to be mixed with local lignite and enhance its fuel quality [9].

In 1893 started the first important exploitation of the lignite field of Aliveri in Euboea. In 1959 and 1969, commenced the systematic exploitation of the two large lignite fields of Ptolemais in Western Macedonia and of Megalopoli in Central Peloponnese. By the end of 2004, the PPC extracted about 70 million tons/yr. of lignite; 99% of this was used for the generation of electricity. Today, Greece is in the third position with regard to extraction of lignite in the EU-25 after Germany and Poland, in the fifth in Europe and in the sixth worldwide [9].

PPC produces electricity with thermal stations (with fuels consisting of lignite, oil and natural gas), hydroelectric plants and renewable energy sources such as solar, wind and geothermal. Today, the eight lignite power stations of PPC comprise 44% of the country's total installed capacity and produce nearly 64% of the country's electricity. In the first half of 2004, the total installed power of the 98 PPC stations amounted to 12,224 MW (see fig. 1). In 2004, the net electricity production reached 52.5 TWh [9].

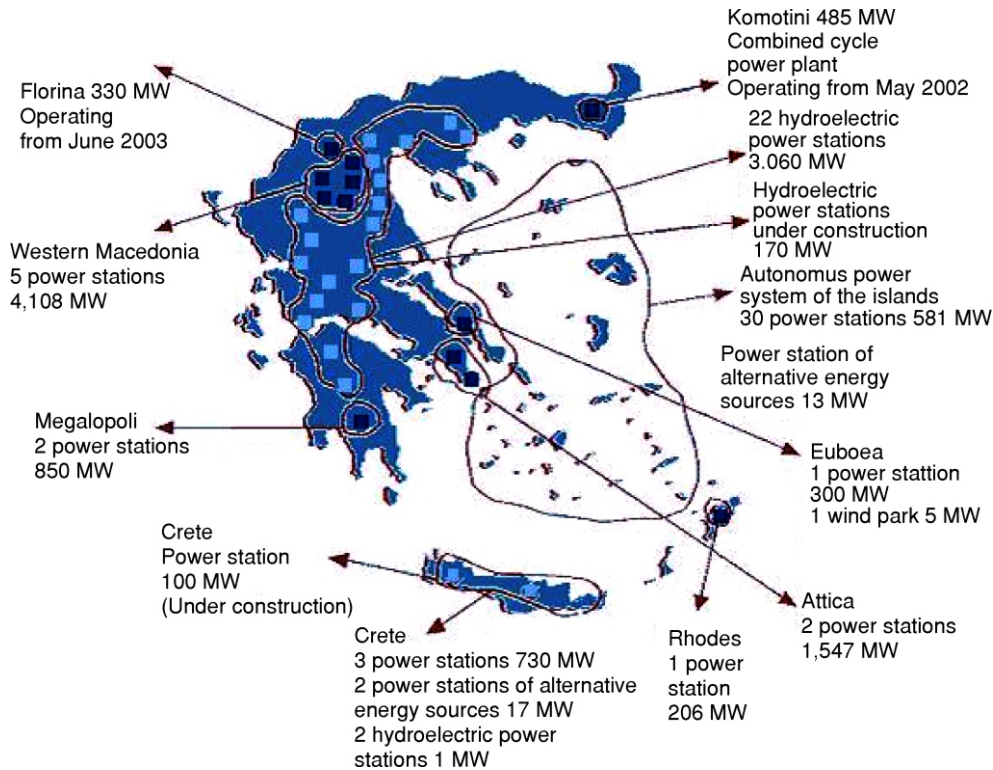


Figure 1. Detailed map of PPC's production stations [9]

There are also some big and a lot of small producers but there are not yet enough data about their participation in the Greek electricity system. They produce power from natural gas and from renewable energy sources such as solar, wind, biomass, and hydro. The big ones produce power mainly from natural gas and by the end of year 2005 there were two with an installed capacity of 538 MW. By the end of 2006, two other private plants might get into the production system; they will also use natural gas with an installed capacity of 746 MW [8].

The Greek electricity transport system is connected with the neighbouring electricity systems of Balkan states and of Italy. The interconnections with Albania and FYROM are with two lines; the one of 400 kV and the other of 150 kV. With Bulgaria, the interconnection is carried out with a unique line of 400 kV. Between Greece and Italy, a direct line of 400 kV of direct current (DC link) and 500 MW is in operation since summer 2002. This line has a length of 270 km, 163 km of which are underwater. By the end of 2006, the PPC in agreement with the HTSO intends to establish a connection line of 400 kV with Turkey. All these international connections are shown in fig. 2. The installed power of the interconnections is 4,400 MW. Greece is a member of the Union for Coordi-

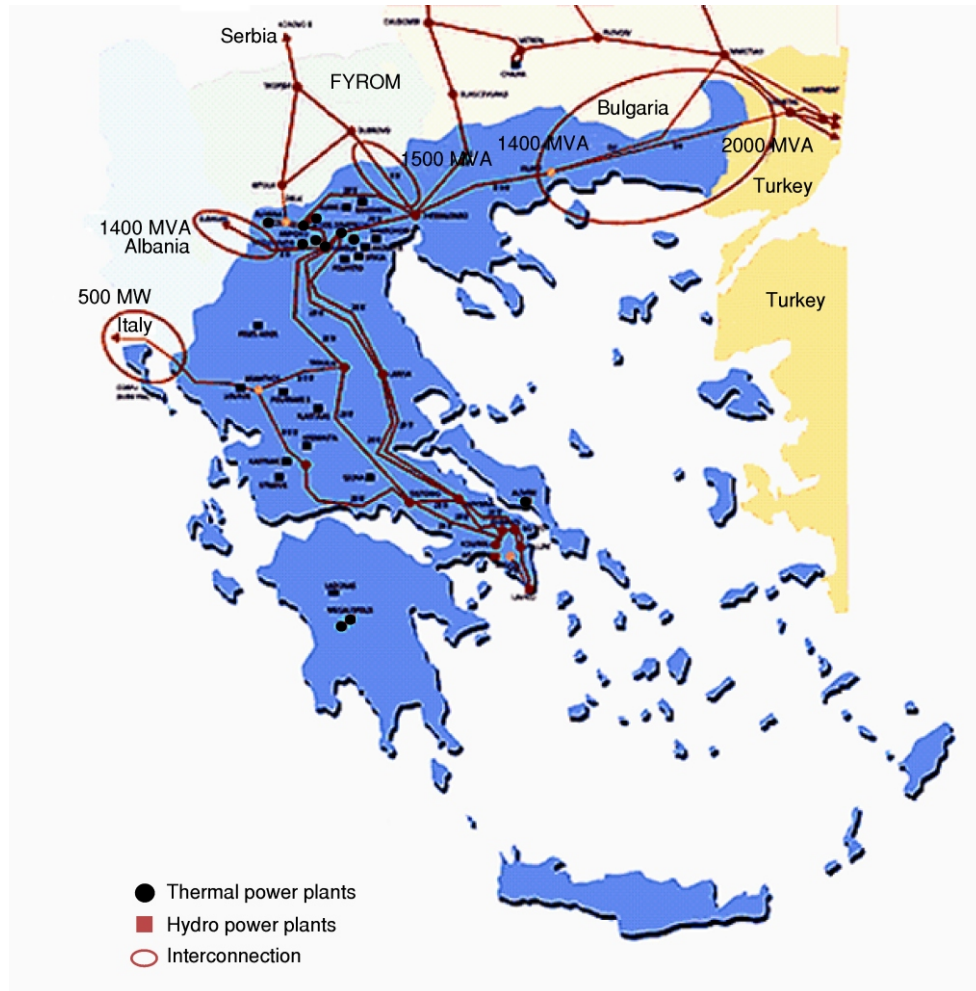


Figure 2. International interconnections of Greece [9]

nation of Transmission of Electricity (UCTE) and its electricity transport system operates synchronous and parallel with the European transport system [10].

During the period 2000-2002, the electricity demand increased by 6.5%/yr. (Greece is the second EU-15 MS after Ireland in this respect) which is much higher than the EU-15 average, which is 3.6%/yr. This trend is expected to continue for two reasons. The first is that electricity consumption in Greece is lower than the EU-15 average (4.1 MWh/capita for Greece vs. 6.5 MWh/capita for the EU). The second is that the

household tariffs are the lowest in the EU-15 (Greece is at the last place with 6.3 €/100 kWh behind Finland with 8.66 €/100 kWh) [11].

In order to enter the new EU electricity market, the strategic objectives that Greece will try to achieve are mainly as follows:

- all customers, including household consumers, do become selecting, according to Directive 2003/54/EC,
- PPC is modernised to make it a basic competitive producer in the liberalised electricity market. This will be achieved with the progressive replacement of all old production units with equivalent ones of new technology and higher efficiency, and
- there will be a guarantee of a competitive operation of the market and sufficiency of electricity supply.

Renewable energy sector

In the sector of Renewable Energy Sources (RES), Greece can be considered privileged by nature. The climate is Mediterranean with a lot of sunlight and the winds that prevail, especially in the islands of the Aegean, have both enhanced duration and intensity. With regard to investments in RES, Greece is in the sixth best position in the EU and in the eighth in the world [12].

The PPC began with RE during the 1970s with certain measurements and research, while the first installations began in the 1980s, based on three sources of energy *i. e.* solar, wind and geothermal. In 1995, with law 2244/95, important investment efforts began mainly by private investors. The law allowed self and independent producers to install up to 50 MW units. By mid-2004, about 10% of the generated electricity was from RES. RES also represented about 6% of the total energy production. Table 2 shows some historical data and the future trends of the RES sector in the Greek electricity system [13].

Table 2. Historical data and future trends of the RES sector in the Greek electricity system [1]

Year		1998	1999	2000	2001	2010
Installed power	MW	10,016	10,997	10,990	11,607	18,422
Higher demand	MW	7,372	7,366	8,531	8,550	12,200
Load demand	TWh	43.5	45.0	48.3	50.6	72.2
RES installed power (non-hydroelectric)	MW	83	129	214	350	1,550
Production from large hydroelectric plants	TWh	3.7	4.7	4.0	4.2	4.4
Production from RES (non-hydroelectric)	TWh	0.29		0.72	1.23	5.43
Energy demand from large hydroelectric plants	%	8.5	10.4	8.2	8.2	6.1
Contribution of RES to the energy balance	%	9.2	11.4	9.6	10.6	13.6

A 1997 white paper of the EU on “Energy for the Future: Renewable Sources of Energy – a Community Strategy and Action Plan” determines the targets in the sector of RES. The main objective set for the EU-15 was to double the share of RES in the gross internal energy consumption from 6% in 1997 to become 12% in 2010. Directive 2001/77/EC aimed at the increase of electricity generation from RES, from 14% in 1997 to 22% in 2010. Therefore, the Greek Ministry of Development set as an objective to increase electricity generation from RES from 5.5 to 11% by 2005 and to 22% by 2010. By the end of 2004, electricity generation from RES reached 10% [1, 14].

According to Directive 2003/30/EC, the MS will have to introduce a minimal part of bio-fuels into their markets. This consists in 2% of the total gas and Diesel that the MS use in their markets by the end of 2005 and to reach 5,75% by the end of 2010. In Greece by 2005, the bio-diesel production was about 67,000 tons which consisted in 2% of the demand. Table 3 shows the estimation of bio-diesel consumption in Greece from 2006 to 2010 [15].

Table 3. Estimation of bio-diesel consumption in Greece from 2006 to 2010 [15]

Year	Diesel consumption estimation [10 ³ tons]	Use of bio-diesel [%]	Required bio-diesel
2006	2,125	3.00	71,851
2007	2,167	4.00	97,695
2008	2,208	4.50	111,986
2009	2,249	5.00	126,739
2010	2,290	5.75	148,407

In order to achieve the EU objectives, the policies set for the coming years are:

- to develop land planning for the installation of RES units. This will result in the exploitation of the country’s potential,
- to create an infrastructure that would strengthen the electricity transport system in regions of high wind potential,
- to give incentives for investments in the RES sector, and
- to develop further bio-fuels technology and to make use of the already existing one mainly in the transport sector.

Energy and environment

The environmental policy introduced as from year 2000 and still in development concentrates in three fundamental aspects:

- to better supervise all emissions, and particularly the greenhouse ones according to the Kyoto protocol, so that they do not increase by more than 25% by 2008-2012 with

respect to 1990. For this purpose, high technology systems for pollutants retention were introduced. However, in 1990 there were 110,212.31 ktms CO₂ eq. emissions and in 2002 these increased by 20.9% [7],

- to reinforce the application of existing regulations on air quality, especially with regard to lignite fields, and
- to re-instate the old mines. The PPC is already reforesting old open-air mines, while there are efforts to convert those areas into cultivable land.

Conclusions

Greece succeeded in its objectives set as from year 1950 and up to the mid-90s. Since, it has progressively introduced new objectives, based on EU directives or International Energy Agency (IEA) and other international organisations recommendations.

The objectives set for the period starting as from the mid-90's are:

- to guarantee energy supply in primary energy sources and from multiple sources,
- to progressively liberalise the entire energy market, up to the point that the role of the state will only be legislative and regulating,
- to protect the environment, starting with the objectives set by the Kyoto Protocol,
- to develop RES to the target limits imposed by the EU,
- to promote rational use of energy and savings of energy and to further develop co-generation, and
- to establish equal access for all consumers to low-cost and good quality energy.

As from the beginning of 2000, the energy policy of Greece is at a turning point and requires important decisions since many and difficult objectives are set. During the next decade, important changes will take place in the energy scenario. This is due to the liberalisation of the energy market, the new investment opportunities in new technologies, the need to adapt to the environmental requirements particularly with regard to Kyoto and to the extension of activities to the European and Balkan markets. The transition period is critical since it has to be harmonized with the three main objectives: competitiveness of industry, protection of the environment, and security of energy supply. An important divergence would have considerable consequences.

In conclusion, the liberalization of the energy market should continue while ensuring that there will be no problems with energy supply. The funds obtained from privatisation should also be properly invested. New investors in the energy market should be ensured and, naturally, measures for the protection of the environment should be taken. Finally, the development of RES and energy savings should be enhanced.

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