

XI INTERNATIONAL POLICY FOR ADDRESSING CLIMATE CHANGE, GREEK PERFORMANCE IN TERMS OF GHG EMISSIONS AND REDUCTION OF AIR POLLUTION, ENVIRONMENTAL POLICY AND THE DEVELOPMENT OF RENEWABLE ENERGY SOURCES IN GREECE

I POLICY FOR ADDRESSING CLIMATE CHANGE: INTERNATIONAL DEVELOPMENTS

I.1 THE STANCE OF THE INTERNATIONAL COMMUNITY: KEY POINTS IN THE DURBAN AGREEMENT (DECEMBER 2011)

The 17th United Nations Convention on climate change was held in Durban, South Africa from 28 November to 11 December 2011.¹ The key objective of this convention was the agreement among participating countries on how to implement the decisions taken at the previous convention held in Cancun in 2010,² mainly as regards the activation of the Green Climate Fund and the progress towards a global binding agreement, to achieve the agreed target of limiting the rise in the global average temperature to no more than 2°C. The importance of this convention lies in the fact that the Kyoto Protocol – the only international binding agreement to date – expires in December 2012, which means that unless countries take up commitments on the implementation of specific measures, there will be no restraint in greenhouse gas emissions. Significant difficulties arose during the convention, creating the risk of an impasse in negotiations. Major developed countries (Japan, Russia, Canada) were not willing to support EU positions, unless developing countries undertook similar commitments. On their part, developing countries pointed out that maintaining the Kyoto Protocol is a prerequisite for further negotiations, however they were not willing (e.g. China and India) to set limits on their emissions, given that developed countries (e.g. the United States) do not implement such limits. Finally, after intensive negotiations, around 190 countries agreed:

- to launch new negotiations in 2012, in order to reach a universal agreement to reduce emissions in developed and developing countries by 2015 and adopt this decision by 2020, after clarifying its exact legal nature. Moreover, the EU and other developed countries have agreed to a second commitment period of the Kyoto Protocol as of 1 January 2013 until the new

agreement enters into force in 2020. In addition, the USA and most developing countries have committed to reduce their emissions by 2020 under voluntary agreements,

- to plan a Green Climate Fund that would help poor countries deal with the impact of climate change by providing €100 billion annually until 2020. The funding sources and financing pattern for this fund, however, were not determined.

I.2 OECD ENVIRONMENTAL OUTLOOK TO 2050 – CONSEQUENCES OF INACTION

On 15 March 2012, the OECD issued the “OECD Environmental Outlook to 2050: The Consequences of Inaction”. According to the baseline (or “business-as-usual”) scenario described in the report, unless more ambitious policies are introduced, greenhouse gas emissions would increase by 50% by 2050 and the concentration of these emissions in the atmosphere could reach 685 parts per million (ppm) CO₂, i.e. a level much higher than the 450 ppm required to prevent a rise in the average temperature of more than 2°C (according to the target set during the 2010 UN Climate Change Conference in Cancun). The projected rise will stem mainly from the 70% growth in energy-related CO₂ emissions. Moreover, gas emissions from transports are expected to double, due to the projected large demand for cars in developing countries. Thus, although most gas emissions currently originate from developed countries, a rise in emissions in the future will come from economic growth in major emerging economies.

Of course, according to the same report, technological advancement and the restructuring of production and economic growth models in emerging economies (e.g. India, Brazil, China, South Africa) will significantly improve the energy intensity of these particular

¹ UNFCCC, “Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November 2011 to 11 December 2011”, 15.3.2012.

² See Bank of Greece, *Monetary Policy 2010-2011*, February 2011.

economies in the near future. However, this particular improvement at regional level shall be neutralized by a rise in global energy demand. At the same time, gas emissions from land use, changes in land use and forestry are expected to decrease over the next 30 years, and gas emissions in most emerging economies are expected to decline, as deforestation slows down.

Finally, the report highlights the need for immediate action in order to stabilise temperature rise at 2°C, as the cost of the required measures will have reached up to 5.5% of global GDP by 2050. Conversely, *delayed action up to 2020 would lead to around 50% higher costs in 2050 compared to timely action*: this is the cost of inaction. This is a crucial policy conclusion that confirms the main finding of the Stern review published in October 2006. Turning to policies required, the OECD report suggests the following:

- reform fossil fuel support policies,
- introduce regulatory instruments (e.g. carbon pricing, energy-efficiency standards in buildings),
- foster innovation, support new clean technology, etc.

I.3 THE HILLS FUEL POVERTY REVIEW FOR THE UK

Also in March 2012, an independent committee under profession John Hills, commissioned by the British Department of Energy and Climate Change to measure and propose ways to tackle fuel poverty in the UK, published its report. The report (*Getting the measure of fuel poverty: Final Report of the Fuel Poverty Review - John Hills, March 2012*) confirmed that fuel poverty is a major problem, which is only expected to get worse. It affects lower income persons/households who have to spend more on energy than the typical cost for people of middle or higher income. According to the report, the “gap” is expected to widen and targeted policy measures for addressing the core of the problem are suggested. Specifically,

it highlights that interventions for improving the energy efficiency of buildings in which low-income households reside would be particularly effective.

The “Environmental, economic and social impact of climate change in Greece” report of the Climate Change Impacts Study Committee, published by the Bank of Greece in June 2011 (in Greek), writes:

“When designing strategies to combat poverty and social exclusion, policy-makers will need to take into account that the impacts of climate change will be more acute for lower-income earners (without the means to address the problems induced by climate change and, even less so, to take timely preventive measures). The adoption of adaptation or mitigation measures would require households to make certain capital expenditures today (e.g. to improve the insulation and energy efficiency of their homes, be able to use solar energy, relocate away from vulnerable coastal areas) if they want to face less expenses in the future, as opposed to a scenario where no protective action is taken. This, however, is beyond the means of poor households already facing liquidity constraints, without sufficient savings or access to bank credit. Therefore, poor households, minorities and immigrants already living in deprivation and facing significant environmental and social problems, not to mention inadequate access to social and health services, will see their situation deteriorate further in terms of housing, food, health, education and access to basic services. Equally questionable will be their ability to join energy-saving programmes, purchase advanced technology equipment and pay more for cleaner energy, as would be required under a policy for reducing greenhouse gas emissions. The poorer households thus risk losing out on the benefits from adaptation policies and measures, as well as on developments in terms of a low emissions economy, which will arise from climate change mitigation policy. The risk of a vicious cycle of poverty, lack of access to energy and technologies, and limited protection against losses

induced by climate change is therefore real and is expected to lead to an exacerbation of phenomena commonly referred to in the literature as “energy poverty” and “climate poverty”.

It is therefore positive that the Hills report markedly promotes the concerns regarding the methodology used to measure fuel poverty and the most effective way for addressing it.

2 RECENT DATA ON GHG EMISSIONS IN THE EU AND GREECE

In 2009 overall greenhouse gas emissions in EU-27, excluding “land use, change of land use and forestry”, as well as emissions from aviation and shipping stood at 4,615 million tonnes CO₂ equivalents, down by 17% compared to 1990. In the same year, greenhouse gas emissions in EU-15 was 3,724 million tonnes (13% less than in 1990), representing 81% of total emissions (against 76% in 1990). Among the older Member States, Germany and the UK were responsible for the largest part of greenhouse gas emissions in the EU in 2009 (29% of total EU-27 emissions and 40% of EU-15), followed by Italy and France (11% each). The smallest gas emission contributors are Luxembourg (0.3%), Sweden, Denmark and Ireland (1%), which all had similar shares in total EU-15 emissions (see Table XI.1).

Table XI.1 shows that countries which – due to their size – contribute more to overall greenhouse gas emissions are better-performing in terms of emissions per capita or per unit of GDP.³ By contrast Luxembourg and Finland – which are small contributors – are among those countries with the highest per capita emissions. Looking at the course of this particular index through time, almost all old Member States (with the exception of Greece, Spain and Portugal) have improved. As concerns GHG emissions per unit of GDP, there was a reduction for all EU-15 countries in 2009 compared to 1990. Sweden

is the best scorer (0.02 kg CO₂ equivalents/unit of GDP) and **Greece is the worst (0.61 kg CO₂ equivalents/unit of GDP), though it has to be noted that it has improved significantly since 1990.**

As regards the breakdown of the six greenhouse gases in EU-27 in 2009, carbon dioxide (CO₂) accounts, by far, for the largest share (82%), followed by methane (CH₄) and nitrous oxide (N₂O) with much smaller shares of 9% and 8% respectively. Looking at the emission trends for these greenhouse gases, CO₂ emissions were 14% lower than in 1990 (at 3,765 million tonnes in 2009), while in the same year, methane (CH₄) and nitrous oxide (N₂O) emissions stood at 418 and 358 million tonnes CO₂ equivalents (32% and 33% below 1990 levels respectively). As for the sources of GHG emissions (see Table XI.2), energy related activities were the largest contributors, with 3,660 million tonnes CO₂ equivalents (79% in EU-27 in 2009). The second largest source of greenhouse gas emissions is agriculture, with a share of 10% (476 million tonnes CO₂ equivalents), followed by industrial processes and waste, with shares of 7% and 3% (321 and 147 million tonnes CO₂ equivalents respectively).

As regards the evolution of greenhouse gas emissions vis-à-vis the targets set under the Kyoto Protocol, it is worth noting that most EU-15 Member States have met their country-specific targets (see Table XI.3). Specifically, the United Kingdom, Sweden and Belgium have already exceeded their Kyoto commitments, while Spain and Austria are the countries farthest off-track. As for **Greece, the Kyoto Protocol target is to limit the rise in greenhouse gas emissions to 25% over 2008-2012 compared to base year emissions. Greece’s GHG emissions were 18.6% higher in 2008 relative to 1990 (i.e. on track), and further improved to 14.5% in 2009.**

³ This can be due to differences in terms of energy efficiency of power plants and other factories, energy saving of households and enterprises, the deregulation of the energy market etc.

Table XI.1 Greenhouse gas emissions¹ in EU-15 and EU-27

	Greenhouse gas emissions (in million tonnes of CO ₂ equivalents)			Shares in EU-15 total (%)			Greenhouse gas emissions per capita (in tonnes of CO ₂ equivalents)			Greenhouse gas emissions per unit of GDP (in kg of CO ₂ equivalents)		
	1990	2000	2008	1990	2000	2008	1990	2000	2008	1990	2000	2009
Austria	78	80	80	1.8	1.9	2.1	10.2	10.0	9.6	0.45	0.35	0.31
Belgium	143	145	124	3.4	3.5	3.3	14.4	14.2	11.5	0.64	0.52	0.39
Denmark	68	68	61	1.6	1.6	1.6	13.2	12.8	11.1	0.06	0.05	0.04
Finland	70	69	66	1.7	1.7	1.8	14.2	13.3	12.4	0.62	0.50	0.41
France	563	567	517	13.2	13.7	13.9	10.0	9.4	8.0	0.43	0.36	0.30
Germany	1,248	1,042	920	29.3	25.2	24.7	15.8	12.7	11.2	0.67	0.48	0.40
Greece	104	126	123	2.4	3.0	3.3	10.3	11.6	10.9	0.83	0.80	0.61
Ireland	55	68	62	1.3	1.6	1.7	15.6	18.0	13.9	0.86	0.53	0.38
Italy	519	552	491	12.2	13.3	13.2	9.2	9.7	8.2	0.44	0.40	0.35
Luxembourg	13	10	12	0.3	0.2	0.3	34.3	23.0	24.3	0.84	0.39	0.37
Netherlands	212	213	199	5.0	5.1	5.3	14.2	13.4	12.1	0.60	0.44	0.37
Portugal	59	81	75	1.4	2.0	2.0	5.9	7.9	7.1	0.54	0.55	0.48
Spain	283	380	368	6.6	9.2	9.9	7.3	9.5	8.0	0.48	0.49	0.39
Sweden	72	69	60	1.7	1.7	1.6	8.5	7.8	6.5	0.04	0.03	0.02
United Kingdom	776	670	566	18.2	16.2	15.2	13.6	11.4	9.2	0.92	0.62	0.45
EU-15	4,265	4,140	3,724	100.0	100.0	100.0	14.4	13.5	11.5	0.68	0.43	0.35
EU-27	5,589	5,086	4,615				11.9	10.5	9.2	0.67	0.50	0.41

Source: European Environment Agency, "Annual European Union greenhouse gas inventory 1990-2009 and inventory report" 2011, 27 May 2011.

¹ Excluding international aviation and maritime transport as well as the "land use, land-use change and forestry" sector.

Table XI.2 Greenhouse gas emissions by source: EU-27, EU-15 and Greece

(in million tonnes of CO₂ equivalents)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EU-27												
Energy	4,284	4,044	3,984	4,071	4,043	4,116	4,113	4,085	4,073	4,010	3,934	3,660
Industrial processes	463	441	391	377	372	385	398	403	400	411	387	321
Solvents and other product use	17	14	14	14	13	13	13	13	13	13	12	11
Agriculture	610	528	515	507	503	496	495	490	487	485	487	476
Waste	214	205	182	176	174	168	162	159	157	152	149	147
<i>Total</i> ¹	5,589	5,232	5,086	5,145	5,105	5,177	5,181	5,149	5,129	5,071	4,969	4,615
EU-15												
Energy	3,274	3,200	3,252	3,323	3,313	3,361	3,363	3,342	3,317	3,258	3,196	2,973
Industrial processes	353	351	309	298	295	303	311	309	302	306	290	250
Solvents and other product use	14	12	12	12	11	11	10	11	11	10	10	9
Agriculture	441	419	419	410	404	399	398	393	387	388	387	379
Waste	184	173	148	142	138	132	126	123	121	117	115	112
<i>Total</i> ¹	4,265	4,155	4,140	4,185	4,162	4,205	4,208	4,178	4,137	4,080	3,998	3,724
Greece												
Energy	77	81	97	99	99	103	103	107	105	108	104	100
Industrial processes	10	12	14	13	13	13	14	14	12	12	11	9
Solvents and other product use	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Agriculture	11	10	10	10	10	10	10	10	9	10	9	9
Waste	5	5	5	5	4	4	4	4	4	4	4	4
<i>Total</i> ¹	104	109	126	127	127	131	131	134	131	133	129	123

Sources: European Environment Agency, *Annual European Community greenhouse gas inventory 1990-2009 and inventory report 2011*, 27 May 2011; Ministry of Environment, Energy and Climate change, *Annual inventory submission under the convention and the Kyoto Protocol for greenhouse and other gases for the years 1990-2009*, April 2011.

¹ Excluding "land use, land use change and forestry" sector.

Table XI.3 Greenhouse gas emissions¹ and the Kyoto Protocol targets

	1990	Kyoto Protocol (base year) ²	2009	Change 2009 over 2008	Change 2009 over 1990	Change 2009 over base year	Kyoto targets 2008-2012
	(in million tonnes of CO ₂ equivalents)			(percentage changes)			
Austria	78.2	79.0	80.1	-7.9	2.4	1.3	-13.0
Belgium	143.3	145.7	124.4	-7.9	-13.2	-14.6	-7.5
Denmark	68.0	69.3	61.0	-4.2	-10.3	-12.0	-21.0
Finland	70.4	71.0	66.3	-5.8	-5.7	-6.6	0.0
France	562.9	563.9	517.2	-4.1	-8.1	-8.3	0.0
Germany	1,247.9	1,232.4	919.7	-6.3	-26.3	-25.4	-21.0
Greece	104.4	107.0	122.5	-4.7	17.4	14.5	25.0
Ireland	54.8	55.6	62.4	-8.0	13.8	12.2	13.0
Italy	519.2	516.9	491.1	-9.3	-5.4	-5.0	-6.5
Luxembourg	12.8	13.2	11.7	-4.7	-8.9	-11.3	-28.0
Netherlands	211.9	213.0	198.9	-2.8	-6.1	-6.6	-6.0
Portugal	59.4	60.1	74.6	-4.3	25.5	24.0	27.0
Spain	283.2	289.8	367.5	-9.2	29.8	26.8	15.0
Sweden	72.5	72.2	60.0	-5.6	-17.2	-16.9	4.0
United Kingdom	776.1	776.3	566.2	-8.7	-27.0	-27.1	-12.5
EU-15	4,264.9	4,265.5	3,723.7	-6.9	-12.7	-12.7	-8.0

Source: European Environment Agency, *Annual European Union greenhouse gas inventory 1990-2008 and inventory report 2011*, 27 May 2011.
 1 Total emissions excluding the "land use, land use change and forestry" sector.
 2 For CO₂, CH₄ and N₂O, all Member States chose 1990 as their base year. For HFC, PFC and SF₆, 12 Member States chose 1995 as their base year, while Austria, France and Italy chose 1990.

3 REPORT OF THE EUROPEAN ENVIRONMENT AGENCY ON AIR POLLUTION: POSITIVE SCORES FOR GREECE

In the context of monitoring the progress towards meeting the 2010 national emission ceilings set in the relevant EU Directive and in addressing air pollution, the European Environment Agency recently published a report on EU-27 gas emissions for 2010.⁴ It covers four main air pollutants: sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds and ammonia, which can cause respiratory problems and contribute to the acidification of soil and surface water. Eleven Member States (Austria, Belgium, Denmark, France, Germany, Ireland, Luxembourg, Malta, Netherlands, Spain and Sweden) exceeded their respective national emission ceilings. Most exceedances were registered in

nitrogen oxides and the main sector behind it is road transport (contributing approximately 40% of total EU-27 emissions). This is because the road transport sector has grown in the past twenty years to a degree that eliminates the positive effects of improved vehicle efficiency.

Significant progress has been achieved in Greece. 2010 emissions were: 315.5 kilotonnes of nitrogen oxides (against the target of 344 kilotonnes), 183.5 kilotonnes of volatile organic compounds (against the target of 261 kilotonnes), 265.6 kilotonnes of sulphur dioxide (against the target of 523 kilotonnes) and 64.6 kilotonnes of ammonia (against the target of 73 kilotonnes). **However, lower emissions were largely due to the financial recession, which has led to a decrease in industrial production and**

⁴ European Environment Agency, Press release 22.2.2012.

electricity consumption and to reduced need for heating and transport.

4 RECENT LEGISLATION AND POLICY ON ISSUES RELATED TO THE ENVIRONMENT, ENERGY AND CLIMATE CHANGE

- Law 4042/2012 on the protection of the environment through criminal law – Transposition into domestic law of Directive 2008/99/EC – Framework for the production and the treatment of waste – Transposition into domestic law of Directive 2008/98/EC

Law 4042/2012 (“Protection of the environment through criminal law – Transposition into domestic law of Directive 2008/99/EC – Framework for waste generation and management – Transposition into domestic law of Directive 2008/99/EC – Arrangement of issues related to the Ministry of the Environment, Energy and Climate Change”) enhances the interventionist role of the State in shaping and implementing effective environmental policies and also prevents actions that could prove harmful for the environment.

More specifically, the provisions included in section A (transposition of Directive 2008/99/EC)⁵ introduce dissuasive, proportionate and effective penalties through criminal law for environmentally harmful activities which typically cause or are likely to cause environmental pollution or deterioration. More specifically, the relevant provisions include:

- adopting specific measures to enhance the role of *environmental inspectors* with investigating powers, in order to prevent and avert the creation (and the extent) of environmental offences,
- broadening the scope of other criminal laws to include crimes against the environment and more particularly – as regards environmental offences committed by criminal groups – the deprivation of income deriving from activities

against the environment and the waiving of privacy protection in communications and

- tightening of existing regulations as regards the criminalisation of environmental offences (Article 28 Law 1650/1986).⁶

The provisions included in section B (transposition of Directive 2008/98/EC)⁷ introduce measures for the overall regulation of waste management in order to effectively protect the environment and human health, and also save natural resources by re-using and recycling waste and by recovering materials and energy from waste. More specifically:

- new concepts are introduced to domestic legislation and the definitions of waste, re-use, recycling, recovery and disposal are clarified,
- waste prevention strategies are put on track and waste management tasks are prioritised, while waste recovery and the re-use of recovered material is encouraged, all with the view to sustaining natural resources and protecting human health and the environment,
- the *European List of Waste* is fully adopted, in order to avoid misinterpretations,
- the *extended responsibility of the producer is introduced* (Article 25), meaning that the producer is responsible to handle all waste resulting from the production process. This responsibility is divided among all actors involved (waste producers, holders, brokers and dealers), while administrative and criminal sanctions are provided for in cases of infringement,

5 Directive 2008/99/EC of the European Parliament and of the Council of 19 November 2008 on the protection of the environment through criminal law provides for a minimum common framework of penal rules against environmental offences across the European Union, by introducing at the same time common principles and approaches for all Member States.

6 It should be noted that, apart from Directive 2008/99/EC, many other EU Directives on the environment have been transposed into domestic legislation by virtue of Law 1650/1986.

7 Framework Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste provides setting up common rules for the management of all types of waste for EU Member States as a whole (including hazardous waste).

- the National Waste Management Plan (drawn up by the Ministry of the Environment, Energy and Climate Change) is adopted, defining the strategy, policies and objectives of waste management at national level; Regional Management Plans are also adopted, regarding the management of waste generated at regional level,

- continuous inspections and audits are introduced, through fully distinguished roles among central and regional administration,

- documenting and monitoring the generation of waste are introduced, while the electronic registering of businesses, licenses and controls is established, in order to ensure transparency and accessibility to all interested parties.

Finally, sections C and D of the Law include amending provisions primarily related to issues within the competences of the Ministry of the Environment, Energy and Climate Change. These provisions regard land use, urban planning and urban renovation, the remediation of existing illegal landfills and the regulation of energy issues, i.e. the introduction of a single tax (two euro per MWh of produced electricity) on lignite-fired electricity plants.

- **Law 4062/2012 including the “HELIOS” project, promotion of the use of energy from renewable energy sources (transposition of Directive 2009/28/EC) and sustainability criteria for biofuels and bioliquids (transposition of Directive 2009/30/EC)**

Greece aspires to become the first EU Member State to implement large-scale interstate transfer of energy produced from RES.⁸ This can be achieved through the HELIOS project in the context of Law 4062 enacted at end-March. The project envisages the development, generation and export of electricity produced from solar power across the Greek territory and includes, among other things, the establishment of the body that will undertake the full implementation of the project. Article 12 of the law provides for the free transfer of

state property to the aforementioned body or the direct letting of property owned by legal entities in public law or by local authorities. In this context, almost 0,1% of the territory is expected to be reserved for the installation of reflectors, while interested investors will be informed through geospatial information systems. The implementation of the project is supported by a prioritisation system for the relevant tenders in order to ensure a clear, transparent and rapid licensing process.

The HELIOS project unfolds into energy, environmental and economic aspects: low carbon economy, the single European market for electric energy and the exploitation of the country’s comparative advantages,⁹ dynamic entry of private investors in domestic electricity production, creation of new jobs and fiscal relief. It should however be noted that since this is a large-scale project involving ambitious and heterogeneous targets, it is possible – under certain negative conditions – that its massive potential is compromised. Some of the crucial factors are the technical capacity of the existing energy grid for the transfer of such massive amount of electric energy¹⁰ and the price in which the European counterparties will be buying the energy transferred.¹¹ Moreover, it is expected that other factors shall also play an important role, such as the degree of mobilisation of domestic and foreign private capital amid the crisis and the credit crunch, as well as the response of the competent authorities to the need for rapid and transparent realisation of investment requests. Finally, other developmental and environmental issues have to be taken into consideration, e.g. the possibility to

⁸ Directive 2009/28/EC, which was transposed into Greek legislation by virtue of the same law.

⁹ According to a speech delivered by the Prime Minister at a conference by the Ministry of the Environment, Energy and Climate Change (3.4.2012), the exact same investment in a Central European country would incur an additional cost of €6 billion, given that our country has 50% higher solar potential.

¹⁰ According to the competent Minister, the initial export capacity of the existing grids reaches 2,000-3,000 MW compared to the suggested amount of 10,000 MW, which is expected to be serviced with the integration of Greece in the European smart grids.

¹¹ According to statements of the German Deputy Minister of Energy, the price of electricity from photovoltaic systems currently applying in Greece would be disproportionately high for German consumers.

domestically produce the capital equipment required for the project and the prevention of an excessive burden on those areas where the plants will be installed.

- **Greek Energy Roadmap to 2050**

The National Energy Strategy Committee of the Ministry of the Environment, Energy and Climate Change designed and presented in March 2012 the Greek Energy Roadmap to 2050. According to it, the energy landscape of the country will unfold around a significant reduction in the use of oil products, a sharp increase in the production of electricity from renewable energy sources (RES) and the use of biofuels in transport to a share of 31%-34% by 2050. The Energy Roadmap examines three alternative scenarios:

(i) the *Existing Policies* scenario, according to which there is a moderate improvement in RES penetration and energy savings, but not enough to meet national and European targets,

(ii) the *Maximisation of RES Measures* scenario, according to which RES penetration reaches 100% in electricity generation and

(iii) the *Minimum Cost of Environmental Measures* scenario, according to which RES penetration in electricity generation is linked with the minimum investment cost.

In any case, high leveraged investment funds in RES are needed, together with a timely technological planning of the Greek energy system.