

# The environment, our world!



PPC on track  
towards Sustainable Development

Athens 2009





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Dear Readers,

The effective protection of the environment constitutes a global demand for coping with climate change, which poses a major threat for the future of the generations to come.

PPC, fully sensitized to the demand of Greek society for a better environment, has set environmental protection as one of the basic priorities of its policy on modernization and development.

We fully recognize that the environmental upgrading of our power generation potential has been greatly delayed since the necessary investments should have been concluded in the past decade.

On the other hand, we have not managed as yet to communicate the significant work of PPC in the exploitation of the country's water potential through the development of significant Hydroelectric Power Plants.

How many of our fellow citizens know, for example, that PPC projects secure the water supply for 2,500,000 consumers and the irrigation of 450,000 hectares of agricultural land? How many know that approximately 8,000,000 trees have been planted in exhausted PPC mines in order to create big air replenishment areas?

Today, PPC executives and personnel do not only systematically follow all the developments on issues of climate change and environmental technologies, but also draw up the policies that will allow the Company to become the driving force behind the rapid development of a Green Economy in our country.

Our objective is not simply to observe the obligations arising from the European community and national environmental legislation.

Our strategic objective is to make PPC a modern and competitive energy company that will provide its customers with the best services, decisively support the security of the energy supply of the country and constitute a driving force behind Sustainable Development by implementing state-of-the-art environmental technologies.

# Letter of the Chairman and CEO

For all the reasons mentioned above, PPC has conducted an integrated Business Plan for the period 2009 – 2014, including investments of 13.5 billion Euros, the largest ever in our country, contributing, thus, to the decrease in greenhouse gas emissions.

Within the framework of our environmental policy, we would like to mention indicatively some of the targets we have set:

- Increase our natural gas participation in the portfolio of our Generation Power Plants;
- Replace our old Thermal Plants with modern ones, integrating the best pollution protective technologies and achieving the best energy performance;
- Further develop and rationally exploit the hydro-potential of the country in power generation through the construction and operation of nine (9) Hydroelectric Power Plants with a total capacity of 640 MW for the generation of clean energy;
- Dynamically expand in the field of Renewable Energy Sources with investments of approximately 2 billion Euros for the development of projects with a total capacity of 900 MW; and
- Environmentally upgrade and modernize our existing Plants.

This publication describes all the efforts recently made for the enhancement of PPC's environmental performance.

It is extremely important to stress out that many actions are already being implemented in our Power Plants, in the Mines, in Distribution and in Transmission.

PPC realizes the concerns caused by its activities and this is why it maintains an open dialogue with Local Communities and all other interested parties in order to improve its energy and environmental performance. PPC fully realizes its responsibilities to satisfy the reasonable demands of Local Communities in order to ensure a better Environment.

This is why PPC does not only adopt all the necessary measures, but also voluntarily proceeds with the certification of all its generation facilities for their Environmental Management Systems according to ISO 14001.

Thus, its care for the Environment is continuous and covers all the company activities:

- In the Mines Division, works are underway for the restoration and upgrading of the environment, the protection of the waterways and fauna, the exploitation of plants, the promotion of experimental cultivations, etc.
- In the Generation sector, the Best Available Techniques are used both in the existing, as well as in the new power plants; pollutant emissions are restricted with the use of new electrostatic ash and lignite filters, flue desulphurization complexes, complexes of wastewater treatment, use of low sulphur fuel oil, etc. All the above are accompanied by actions for energy saving and rational use, as well as the promotion of tele-heating of the neighboring cities of power plants.
- In the fields of Transmission and Distribution, the Lines and Substations are systematically studied and designed according to European and international standards; environmental disturbance is minimized by appropriately choosing the best possible routing, etc.

The basic conclusion of our environmental strategy is, therefore, the following:

We do our work with diligence, complying with national and European legislation and undertaking actions and initiatives for the protection of the environment. The work implemented in the environmental sector is important and we continuously strive to achieve better performance.

However, in no case do we relax in our vigilance. Our concern and interest shall be continuous and our Vision shall be the direction towards which we will transform Power Public Corporation into an innovative and pioneer company in an emerging Green Economy.

We have one basic obligation: to continue and expand the unique social work achieved by PPC in previous decades through new dynamic environmental policies and actions.

Panagiotis I. Athanasopoulos  
Chairman and CEO

PPC follows systematically, and with particular sensitivity, all scientific developments with regard to the protection of the environment, giving special emphasis to the problem of climate change. It actively participates in the efforts of the global community to tackle it.



### 1.1 The challenge of climate change

Almost the entire global scientific community agrees that the increase in global temperature, the melting of the ice caps, the increasing drought and flooding phenomena constitute clear indications of climate change, which is one of the most serious challenges of the years to come for the world. The threats for the planet and future generations are huge and measures must be taken in order to face them. The main factor which further burdens the above phenomenon is greenhouse gas (GHG) emissions (carbon dioxide, methane, nitrogen oxides, chloro-fluoride compounds, etc.) as a result of human activities and of the modern way of life.

PPC has set the protection of the environment as a basic parameter of its development policy, studying and taking the appropriate measures so that the environmental burden caused by PPC activities shall be the smallest possible.

The European Union recently adopted measures ("Package 20-20-20") on renewable energy sources and climate change, setting the following specific targets for 2020:

- 20% increase in the use of renewables of the total energy consumption in the EU.
- 20% increase in energy efficiency.
- 20% cut in greenhouse gas emissions below 1990 levels.

In order to achieve the target of reducing greenhouse gas emissions, the EU, inter alia, revised the Emissions Trading System with regard to electricity companies. Electricity producers will be obliged, as of 2013, to buy the total of their emissions in auctions held by the Member States. It is, thus, obvious that the EU electricity industry shall have to make a considerable effort to reduce greenhouse gas emissions in its facilities.

PPC, in order to reduce greenhouse gas emissions, has implemented, in recent years, a series of measures with spectacular results. The mean CO<sub>2</sub> emission coefficient of the overall generation system of PPC decreased from 1.30kg/kWh in 1990 to 1.00kg/kWh in 2008, which is equal to a 23.1% reduction.

PPC, in order to respond in the best possible way to the new EU requirements for climate change, is dynamically continuing in the same direction and has planned for related actions, such as:

- New investments for the replacement of the old power plants with new ones, equipped with spearhead technology and a high degree of efficiency
- More intense exploitation of renewable energy sources
- Further development of the country's hydro potential
- Implementation of Environmental Programs for the improvement of the environmental behavior of the existing Thermal Plants followed by:
  - monitoring and reporting of CO<sub>2</sub> emissions;
  - upgrading and modernization of the existing facilities and operation on the basis of the Best Available Techniques;
  - implementation of efficient lignite combustion technologies and participation in innovative research programs for CO<sub>2</sub> capture and storage;
- Promotion of further energy saving and rational use actions both in Power Generation and demand (urban teleheating, improvement of efficiency degree of Thermal Plants, etc.)
- Continuation of its participation in the Energy Wisdom Program (see 1.7).



## 1.2 New investments for the replacement of the old power plants with new ones equipped with spearhead technology and a high degree of efficiency

PPC has opportunely planned considerable investments for the construction of new high-performance Plants, using state-of-the-art technology that is in most cases related to the replacement of the old ones.

In particular, in accordance with the five-year PPC Business Plan for 2009-2014, the Generation Strategy includes overall investments of 7 billion Euros as follows:

- Investments in new Thermal Power Plants with a capacity of 3,887 MW according to the best available techniques;
- Decommissioning of old, non efficient and pollutant Power Plants, with an overall capacity of 2,400 MW;
- Increase in the efficiency degree and improvement of the operation of the existing Power Plants with the use of the Best Available Techniques;
- Construction of new Plants on non-interconnected

islands, with an overall capacity of 990 MW, and inter-connection of the Cyclades; and

- Investments in Hydroelectric Power Plants (640 MW).

New power plants are expected to be constructed on the basis of the Best Available Techniques pursuant to the extremely strict requirements of European and national legislation. They are, therefore, equipped with spearhead pollution protection equipment in order to minimize the impacts, both on a local level, as well as on the environment, in general. Moreover, according to the EU Green Package, said Power Plants will include, in their initial designing, a provision for the possibility of the future installation of equipment for CO<sub>2</sub> capture and underground storage when the related technologies become mature and safe, legal and cost effective.

The above investments are estimated to result in a 25% reduction of CO<sub>2</sub> emissions per produced kWh of the Thermal Power Plants in the Interconnected System in 2015 vs. 2006, that is, from 1.2 kg/kWh to 0.9 kg/kWh.

PPC is thus justified in supporting the strategic investments of the Generation Division, which constitute the biggest environmental investment in the history of the Country!







### 1.3 More intense exploitation of renewable energy sources

PPC has already proceeded with PPC Renewables, a 100% subsidiary company, for an ambitious investment plan of 2.1 billion Euros for the next 6 years, aiming by 2014, for a portfolio of 950 MW, that is 20% of the until then expected domestic RES market. Today, PPC Renewables has projects in operation of 105MW, mainly Wind Parks and Small -Scale Hydroelectric Power Plants.

PPC Renewables has a significant development investment program. The following projects are under construction or near the commencement of construction:

- Viotia Wind Park with a capacity of 38MW in cooperation with EDF Energies Nouvelles
- Megalopolis Photovoltaic Park, one of the biggest in the world, with a capacity of 50 MW
- Nine (9) Wind Parks on various Aegean islands and Crete, with a capacity of 35 MW
- Ikaria Hybrid Plant with a capacity of 6.2 MW, an innovative solution, the first one in Europe

- Ilarionas, Mesochora and Alatopetra Small- Scale Hydroelectric Power Plants, with a total capacity of 10 MW

Furthermore, PPC Renewables takes dynamic steps towards the development of the geothermal fields on Milos, Nisiros, Lesvos and Methana. The Nisiros project can supply a complex of nine (9) islands with guaranteed base power while the Milos project will be also supported by the Cyclades interconnection.

For further development, PPC Renewables focuses on big, technically difficult projects, for which the applications for Generation Permits have been submitted to the Regulatory Authority for Energy (RAE). More precisely:

- North Aegean Wind Park, with a capacity of 706 MW, in cooperation with Iberdrola/Rokas
- Andros Wind Park, with a capacity of 133 MW, in cooperation with Aeoliki Andros SA
- Rodopi Wind Park, with a capacity of 150 MW
- Kozani CSP (Concentrated Solar Power), with a capacity of 50 MW

## 1.4 Further development of the country's hydro-potential

PPC continues, at an intense pace, to exploit the country's hydro-potential. Nowadays, there are fifteen (15) big and nine (9) small Hydroelectric Power Plants in operation, with a total capacity of 3,060 MW. The power generated is approximately 8% of the overall generation (depending on the water reserves of the year). According to PPC Business Plan for 2009-2014, the construction of nine (9) new Power Plants with a total capacity of 640 MW has been planned, with obvious benefits such as the reduction of air pollutants and greenhouse gases.

## 1.5 Implementation of Environmental Programs for the improvement of the environmental behavior of the existing Thermal Power Plants

PPC SA implements the following Programs in order to improve the environmental behavior of its existing Thermal Power Plants, taking into account the country's commitments for the reduction of greenhouse gas emissions and compliance with the Kyoto Protocol.





### 1.5.1 Monitoring and reporting of CO<sub>2</sub> emissions

On January 1, 2005, the 1st period of the Emission Trading System (ETS) (2005-2007) started and PPC undertook the obligation to monitor and report CO<sub>2</sub> emissions for all its facilities that fall within the scope of application of Directive 2003/87/EC, pursuant to the demands of Decision 2004/156/EC.

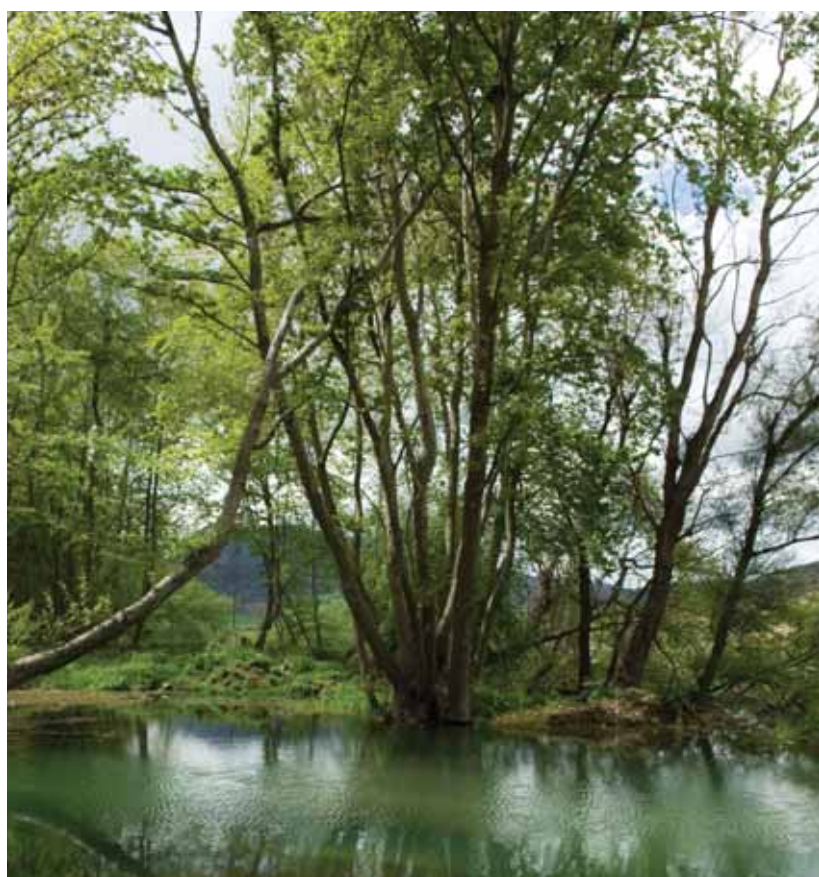
The 2nd period of the ETS started on January 2nd 2008, which coincides with the Kyoto Protocol Application Period (2008-2012); the commitment of PPC to monitor and report CO<sub>2</sub> emissions in all its facilities that fall within the scope of application of Directive 2003/87/EC, pursuant to the demands of Decision 2007/589/EC remains in force.

More precisely, PPC's commitment to monitor and report CO<sub>2</sub> emissions pertains to a total number of thirty one (31) facilities of the company: 8 lignite-fired power plants, 2 natural gas fired power plants, 1 natural gas –fuel oil fired power plant, 5 Fuel Oil-fired Power Plants in the interconnected System and on Crete-Rhodes and 15 autonomous fuel oil-fired power plants on the non-interconnected islands; all of them constitute the Group of Power Plants of PPC SA.

The monitoring and recording of CO<sub>2</sub> emissions for the PPC Power Plant Group has been assigned to the Generation Environment Department of the Generation Division.

CO<sub>2</sub> emissions of the aforementioned Power Plants have been monitored and recorded since 2005 on the basis of an efficient and centrally-developed Monitoring Plan. The plan in question is based on a unique approach according to the fuel used and adjusted in such a way so as to meet each power plant's particularities.

The core element of the Monitoring Plan lies in the Quality Assurance System (QAS) for Monitoring Greenhouse Gas Emissions (MGHGE).



Thanks to this system, PPC ensures the control of all GHG emissions-related activities, as well as the recording, monitoring and management of all relative data and information. The QAS - Monitoring GHG Emissions implemented in each one of the 31 Power Plants has the following four-level structure:

**EQUALITY PROCEDURES MANUAL  
FOR MONITORING GHG EMISSIONS**

**PROCEDURES AND DOCUMENTATION  
OF THE QAS- MGHGE**

**WORK INSTRUCTIONS**

**RECORDS**



The Monitoring Plan implemented in each PPC facility is submitted at the beginning of each period to the Competent Authority (Ministry for the Environment, Planning and Public Works- MEPPW) and after being approved, the Greenhouse Gas Emissions Permit is issued for each facility.

In accordance with the Greenhouse Gas Emissions Permits, the requirements laid down by the Law in force and the internal procedures of each facility, as stipulated in the approved Monitoring Plan, as well as the annual reports on CO2 emissions from PPC facilities were verified by accredited control bodies in March 2009. Thereafter, the verified reports, together with the respective verification declarations, were submitted to the Hellenic Ministry for the Environment, Planning and Public Works within the time limit prescribed by Law.

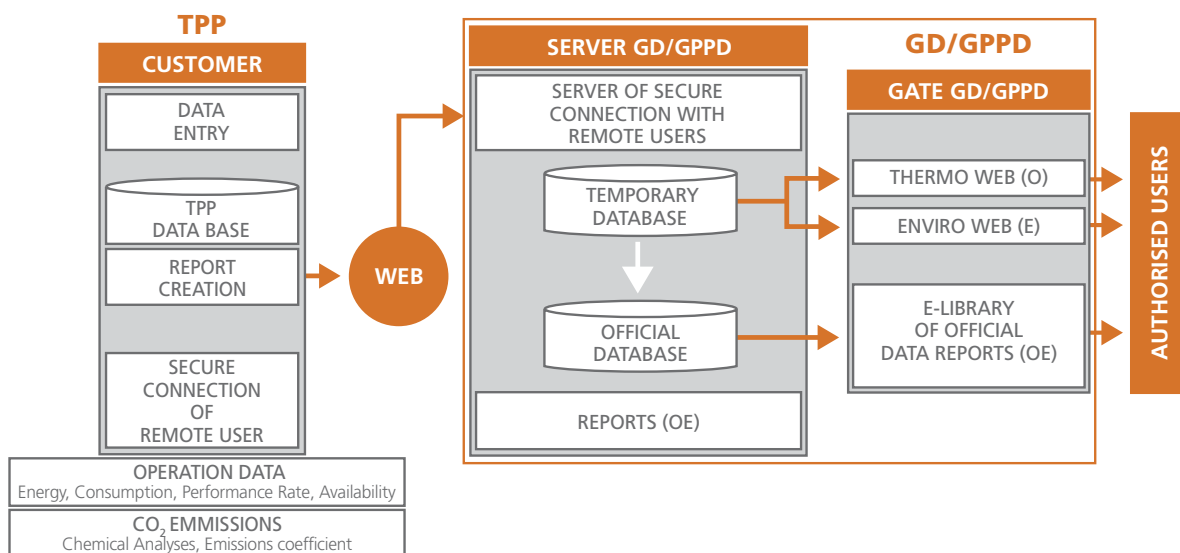
Furthermore, for the purposes of a systematic and

integrated management of all information on CO2 emissions, the ENVIRO software was installed for managing environmental operation data. This software includes:

- Integrated software for storing and managing environmental data related to Generation Power Plants as an extension to the existing THERMO software (TPP, APP/LPP).
- Installation of software in G/D IT center as well as in G/D Thermal Power Plants

THERMO and ENVIRO systems are presented in the following diagram:

THERMO: Thermal Power Plants Operation Monitoring System  
 ENVIRO: CO2 Emissions Monitoring System



In order to monitor the emissions, PPC SA, applying the related legislation, proceeded, in 2008, with the accreditation, according to EN 17025 of the chemical laboratory of the Megalopolis Energy Center (MEC), and the accreditation according to the same standard of the West Macedonia Energy Center (WMEC) will follow in 2009. PPC also proceeded with the completion of the enhancement program of lignite weighing with the

installation of new belt-weighing devices in all lignite-fired Power Plants.

The Company manages, in the best possible environmental and financial way, issues concerning trading rights by applying emission reduction actions and by using the flexible mechanisms of the Kyoto Protocol and the related European Community legislation.

### 1.5.2 Upgrading and modernization of existing facilities - investments for the improvement of energy efficiency and energy-saving

In order to decrease the emissions from the existing power plants and secure their operation on the basis of the Best Available Techniques, PPC has, in recent years, implemented significant environmental investments.

These investments aim, inter alia, at the enhancement of energy efficiency and energy-saving with a simultaneous reduction of the special pollutant and carbon dioxide emissions per generated kWh.

The most important of these investments, which for the mostpart have already been concluded, concern the big scale upgrading of steam turbines, cooling towers, upgrading of condensate preheating systems of Units, supply and installation of the efficiency measurement on-line system of Units, various other upgrading equipment projects, etc.

The following projects were concluded in 2008:

- Upgrading of cooling towers at Unit III of Ag. Dimitrios TPP, Unit III of Megalopolis A TPP and Unit II of Kardias TPP
- Upgrading of the steam turbine and the condensate preheating system at Unit III of Ag. Dimitrios TPP
- Supply and installation of the efficiency measurement on-line system at the Units of Ag. Dimitrios TPP
- Upgrade of lignite consumption measurement systems (belt-weighing devices) at all lignite-fired Power Plants

The following are also promoted:

- Installation of automatic solid fuel samplers and systems for determining the lowest calorific capacity of lignite
- Examining the installation of flue gases – water heat exchangers at Units I and II of Kardias TPP.
- Examining the upgrading of the Steam Turbine and the condensate preheating system at Unit IV of Ag. Dimitrios TPP or alternatively at one of the two Units of Amyndeon TPP
- Upgrading of the condensate preheating system at Units I and II of Ag. Dimitrios TPP



### 1.5.3 Use of flexible Mechanisms of the Kyoto Protocol

The Kyoto Protocol and the related European Community legislation allow for the use of Flexible Mechanisms so that member states can fulfill their commitment to achieve the determined GHG emission ceiling:

- CO<sub>2</sub> emission trading system
- “Clean Development Mechanisms” (CDM) and Joint Implementation (JI) projects, which are environmentally friendly (energy saving projects or projects of Renewable Energy Sources or GHG abatement projects) implemented in developing or transition-economy countries.

The concept of implementing CDM and JI projects lies in the fact that the effect of limiting GHG emissions is the same irrespective of where action is taken. Hence, it is logical to encourage the reduction of such emissions at regions where cost is low.

This is achieved through the aforementioned mechanisms that offer liable companies the opportunity to implement projects for the reduction of GHG emissions not necessarily within their installations but in regions where the cost is significantly lower.

Given the fact that the cost of implementing emission reduction projects in developing countries is particularly low, the CDM flexible mechanism has yet another significant advantage: the transfer of technology and expertise from developed countries (EU) to developing ones, further contributing to the development of these countries and the reduction of social and economic disparities.

Within this framework, PPC SA is actively involved in the Kyoto Protocol flexible mechanisms, mainly with regard to CDM projects.

More precisely, since 2005, PPC SA has participated in five major Carbon Funds together with various big European and Japanese companies.

The use of the aforementioned mechanisms will allow PPC to cover more than 50% of its emission requirements for the period 2005-2012, contributing at the same time to:

- meeting the Kyoto Protocol targets for global reduction of GHG emissions;
- the economic development of developing countries; and
- maintaining the cost of PPC GHG portfolio at a low level, thus minimizing the cost burden to the Greek consumer.







#### 1.5.4 Implementation of efficient lignite combustion technologies and participation in innovative research programs for CO<sub>2</sub> capture and storage

PPC SA aims at the construction of new Power Plants with the best possible technology and the fewest possible emissions. In particular, with regard to lignite, which is the only domestic fuel, new combustion techniques are under study with the objective of enhancing its energy efficiency which will further lead to the reduction of GHG emissions and pollutants.

Apart from the aforementioned measures in par. 1.5.2, PPC SA is implementing a pilot application of new measures aiming at the enhancement of the efficiency of the lignite-fired Plants with the technological upgrading of boilers, turbines, lignite grinders, cooling systems and other equipment. Furthermore, the advanced powdered fuel technology, fluidized-bed combustion and carbon gasification (IGCC) are some of the techniques monitored.

PPC SA keeps up with the developments in CO<sub>2</sub> capture and storage in Europe via the following actions:

- Participation in big European research programs in cooperation with the National Technical University of Athens for the development of technically- financially viable technologies for CO<sub>2</sub> capture, transport and storage (ENCAP, CASTOR, ISCC, CESAR, ECOSCRUB);

- Cooperation with EURELECTRIC on issues of CO<sub>2</sub> capture and storage (CCS), with regard to energy production and contribution to the industry positions, sent by the EU for the CCS draft Directive;
- Participation in the ZEPP-TP (Zero Emissions Power Plants -Technology Platform) of the EU; and
- Appointing the Institute for Solid Fuels Technology & Applications and the Institute of Geology and Mineral Exploitation to conduct a study on assessing the possibility and the cost of CO<sub>2</sub> capture and storage from solid fuel Units in West Macedonia and Evia.

Furthermore, PPC SA is interested in the energy exploitation of both urban waste and biomass, implementing research and demonstration actions in order to solve all technical issues related to the supply, preparation and combustion chain of said bio-fuels (research programs: RECOFUEL, DEBCO). The Company also participates in research actions in order to enhance the performance of solid fuel units by taking measures such as the reduction of boiler deposit slugging with the use of advanced soot removal systems and alternative design of heat exchangers (LIGPOWER project), as well as the application of innovative and less energy consuming fuel pre-drying technologies (DRYCOAL project).

## 1.6 Promotion of actions for energy saving and rational use of energy both in energy generation and demand (urban teleheating, enhancement of Thermal Power Plants' efficiency, etc.)

According to the short term program for energy saving measures, the Company has already adopted certain actions aiming at the more rational use of electric energy by the consumers, such as, correction of cosine( $\phi$ ) of medium voltage clients, replacement of incandescence lamps of municipal lighting networks with fluorescence lamps which reduce energy consumption by 75%, providing information for consumers via Mass Media (television, etc.), PPC Help Line for consumption and PPC brochures.

This program has been operating since 1994 and also includes energy saving actions within PPC in the following four sectors:

- Production
- Teleheating
- Transmission
- Distribution

Furthermore, PPC SA already implements rational energy use programs in cooperation with Municipalities, through the Tests- Research and Standards Center (TRSC) and the Supply Division and follows up all European actions to control the demand and guarantee the consumers' active participation. PPC SA also implements pilot programs as these will enable it to start big-scale projects after drawing its conclusions.

Moreover, PPC intends to invest 1 billion Euros in the installation of electronic meters and telemeters for all consumers aiming, inter alia, at the application of significant energy saving measures in demand.

PPC SA has made a series of investments in energy supply in the form of hot water for urban teleheating purposes, in an attempt to provide a method of continuous heating of urban residences, without the urban pollution of the environment, via seven (7) Power Plants: Ptolemais III (50 MWth), Aghios Dimitrios III (67 MWth), IV (67 MWth), V (70 MWth), Amyndeon (20 MWth), Megalopolis III (25 MWth) and LIPTOL (25 MWth).

The expansion - enhancement of teleheating the Municipality of Kozani from Ag. Dimitrios TPP (maximum teleheating capacity: 137 MWth) was concluded in 2008, while the teleheating interconnection of the Municipality of Ptolemais and Kardias TPP is expected to be assigned in 2009. Furthermore, the teleheating of Florina city from Meliti TPP (70 MWth) will have been concluded by 2010. There is also provision for energy supply for teleheating from the New Unit II of Meliti TPP (420-450 MWe): 70 MWth and the New Ptolemais Unit (550-660 MWe): 140 MWth.



## 1.7 Participation in the ENERGY WISDOM Program

PPC SA participates in the Energy Wisdom Program of EURELECTRIC, Union of the Electricity Industry.

This program is an initiative of the European electric companies that are members of the Union, for the improvement of energy efficiency and the reduction of Greenhouse Gas emissions.

Each participating company, PPC SA as well, presents actions-measures that it has taken on a voluntary basis since 1990, aiming at a measurable improvement in energy efficiency and at the reduction of GHG emissions. Four (4) cycles of this program have been concluded and

are related to projects and actions implemented after 1990 in the following periods: 1990-1999 (1st cycle), 2000-2002 (2nd cycle), 2003-2004 (3rd cycle) and 2005-2007 (4th cycle).

PPC SA has participated in all 4 cycles of the program, presenting projects related to energy generation (enhancement of lignite-fired Power Plants' efficiency, teleheating, inclusion of natural gas fired Units, Hydroelectric Power Plants, Wind Parks) and energy saving (in Mines and Distribution). The following table briefly presents the projects of PPC in the framework of this program and their contribution to the total reduction of CO<sub>2</sub> emissions.

### PPC participation in the ENERGY WISDOM 1990 - 2007 program

Energy Wisdom Program Cycle	1990-1999 (*)	2000-2002	2003-2004	2005-2007
PPC projects in the program	30	30	33	36
Total reduction in CO <sub>2</sub> emissions contributed by the above projects (million Tons)	5.1	15.5	15.4	25

(\*) During this period the 30 projects were gradually integrated depending on their implementation stage.

## 1.8 Conclusion

PPC follows an integrated strategy on the reduction of CO<sub>2</sub> emissions during energy generation at its facilities. The energy saving program implemented contributes, to a large extent, to the decrease of the forecasts for

electrical energy demand in the future. We participate in the European Emission Trading System, observing our commitments for the Kyoto protocol, and we continuously contribute to the achievement of national objectives on the reduction of Greenhouse Gas Emissions and the fight against climate change.





Aiming at improving air quality, important investments are being made, the European Community and national legislation is strictly observed and the Best Available Techniques for new and existing generation facilities are adopted.

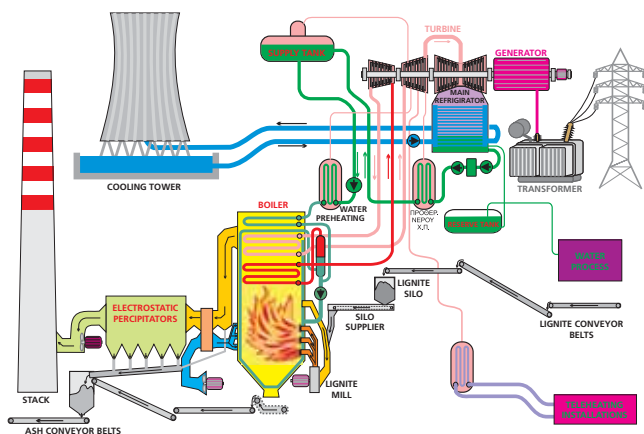


## 2.1 Reduction program of atmospheric pollutants

The main conventional atmospheric pollutants emitted during the operation of the Power Plants are sulphur dioxide (SO<sub>2</sub>), Nitrogen oxides (NO<sub>x</sub>) and particles (dust).

The quantity of emitted pollutants mainly depends on the type of fuel and the combustion technology used. All new Power Plants are now constructed with the most contemporary anti-pollutant technology, aiming at integrated pollution prevention and control. The application of the Best Available Techniques (BAT) minimizes the emissions of atmospheric pollutants, and as a result environmental impact, practically leading to the full convergence of the environmental performance of the Plants that use different type of fuels.

The basic legislation determining the emissions of atmospheric pollutants from Power Plants is:



- Directive 2008/01/EC - This Directive stipulates, inter alia, that all existing combustion facilities must operate as of November 2007 on the basis of BAT. The BAT Reference Documents on Large Combustion Plants (>50 MW<sub>th</sub>), (BREF LCP) are taken into account for their determination. The Reference Documents were issued in July 2006, in compliance with Directive 96/61/EC (IPPC), concerning Integrated Pollution Control and Prevention.

- Directive 2001/80/EC on Large Combustion Plants – This Directive stipulates that the existing combustion plants as of 01.01.2008 will either operate on the basis of limit values for SO<sub>2</sub>, NO<sub>x</sub> and dust or will be included in the National Emission Reduction Plan (NERP) with an equal result. Greece chose the NERP solution and the related Joint Ministerial Decision (JMD 33437/1904/E103, OGG B' 1634, 14.08.2008) was recently issued. Twenty two (22) existing PPC Large Combustion Plants (Units I and II of Megalopolis A' TPP are exempted from the obligation to observe limit values of emission and the NERP because they are under a limited operation status) and six (6) existing refinery Large Combustion Plants are included in the NERP.

In December 2007, the European Union (EU) initiated the process of issuing a new Directive on Industrial Emissions (COM(2007)844 FINAL, 21.12.2007) revising the two aforementioned Directives and recommending extremely low limit values for the emission of SO<sub>2</sub>, NO<sub>x</sub> and dust from the existing Large Combustion Plants, which will apply as of 01.01. 2016 according to the EU proposal.

The older Power Plants are gradually adapted to the new demands and with the installation of new modern anti-pollutant equipment they are improving their environmental operation. The application of the BAT in these facilities takes into account the technical characteristics of the specific facility, its geographical position and the local environmental conditions (Article 9.4, Directive 2008/1/EC).

The Joint Ministerial Decision (JMD) on the approval of the environmental terms and conditions for the operation of each power plant has incorporated in detail all the demands of the European Community and national legislation for the integrated protection of the environment from the operation of each installation. It includes, inter alia, the limit values for the emission of the above pollutants, their systematic monitoring and recording, air waste management as well as briefing of the competent authorities.

## 2.1.1 Control of dust emissions

Dust is produced from the inorganic part of the fuel. During combustion, the inorganic elements of the fuel are converted into ash, the biggest part of which is drifted by flue gas (fly ash). Big quantities of dust are created during the combustion of solid fuels, due to their composition, contrary to liquid fuels, while the related emissions during the combustion of natural gas are considered negligible.

The BAT for the reduction of dust emission from the lignite-fired Units, such as those of PPC, is the use of Electrostatic Precipitators (ESPs) for ash, with a high degree of efficiency.

Electrostatic Precipitators use electrostatic forces in order to separate dust particles from flue gases. They comprise a series of emitting electrodes (wires) and a series of collecting electrodes (plates) through which flue gases pass. A strong electric field is created that charges dust

particles, which are then led to the collecting electrodes and to special funnels.

### Control of dust emissions in new Power Plants

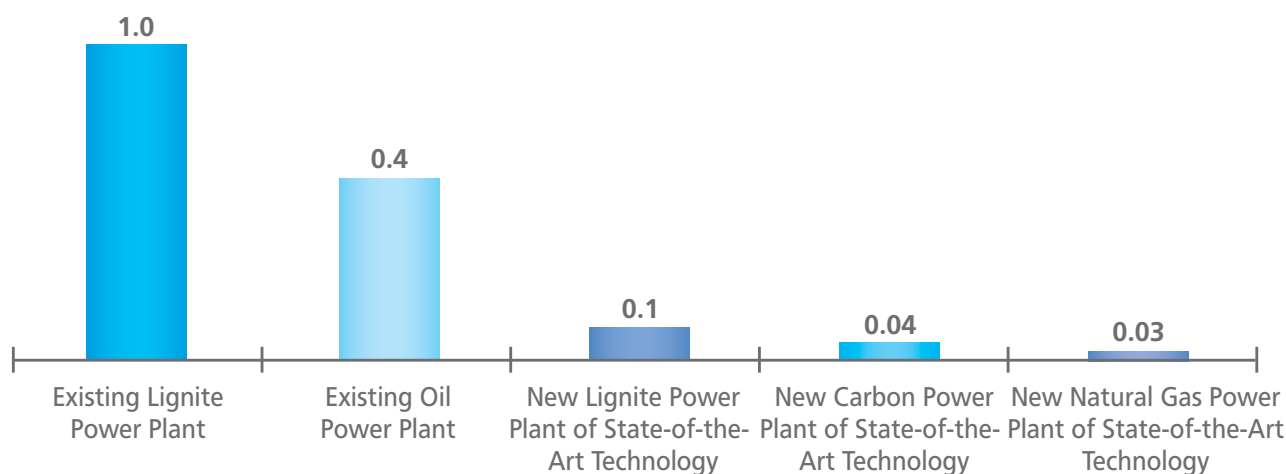
All new solid fuel PPC Units will have Electrostatic Precipitators (ESPs) with more than 99.95% degree of efficiency.

These new Units will have also flue gas desulphurization systems, of high degree of efficiency, and as a result dust emissions will be further decreased.

According to the BAT Reference Documents, the levels of dust emissions achieved a range between 5-20 mg/Nm<sup>3</sup> for new and existing Thermal Power Plants with a capacity over 300 MW.

The following diagram presents the special dust emissions (kg/MWh) from existing and new Power Plants using different types of fuels:

SPECIAL DUST EMISSIONS (kg/MWh)





### Control of dust emissions in existing Power Plants

PPC implements a program for replacing and upgrading the existing Electrostatic Precipitators (ESPs) as well as for adding new state-of-the-art high performance ESPs in accordance with the provisions of Directive 2008/01/EC, on integrated pollution prevention and control, and the Best Available Techniques Reference Documents on Large Combustion Plants.

Within the scope of the program in question, PPC has, since 1987, proceeded with the replacement of the existing ESPs at lignite Units I – IV of Kardias TPP, Units I,II,III and IV of Ptolemais TPP, Units I and II of LIPTOL TPP and of the fly ash and lignite ESPs at Unit III of Megalopolis A' TPP. In addition, aiming at the continuous improvement of the environment, intervention projects in the electronic and construction features of the existing ESPs have been concluded and maintenance and improvement projects of the existing ash and lignite ESPs at Units I and II of Megalopolis A TPP have been undertaken, aiming at the reduction of particle emission

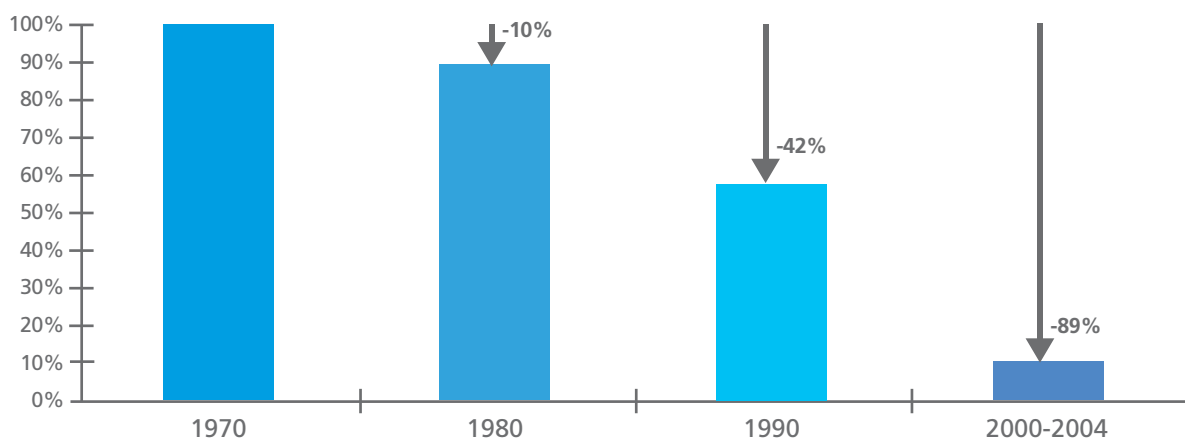
to levels in line with European Regulations and Greek Legislation.

The project of upgrading the existing electrostatic precipitators and installing new ones at Units I-IV of Ag. Dimitrios TPP was concluded in the 1st semester of 2008. The contractual price was 130 million Euros and the result was spectacular if we consider the drastic reduction of dust emissions.

For the reduction of particle emissions from oil-fired stations, a reduction program for the emitted particles is being implemented, mainly including the use of combustion improvement additives, as well as the replacement of the existing boilers with new ones of the steam atomization type.

All the above projects, combined with the introduction of natural gas to the national energy balance, resulted in the gradual reduction of particles emission specific factor (kg/MWh) from Large Combustion Plants, as shown in the following diagram:

PERCENTAGE REDUCTION OF PARTICLES EMISSION SPECIAL COEFFICIENT (kg/MWh) FROM LARGE COMBUSTION PLANTS COMPARED TO 1970



*The implementation of the program in PPC Power Plants so far has led to an impressive improvement in ambient air quality at the power plants' regions.*



### Control of dust emissions at lignite mines

In order to minimize the impact in the lignite mine regions and, specifically, during the excavation and transportation works, systematic measures are taken, such as:

- Asphalting of main transportation roads with increased traffic
- Wetting of dirt (secondary) roads with permanent networks or special tanker trucks
- Placement of appropriate covers on all trucks for the transportation of materials
- Decrease of trucks' speed and circulation on roads which are at least 200 meters away from institutionalized settlements
- Maintenance and control with regard to gas and dust emissions of all machinery and equipment

### 2.1.2 Measures for the reduction of SO<sub>2</sub> emissions

Sulphur dioxide is created during energy generation from thermal combustion units when the sulphur contained in the fuel is oxidized. Its emissions thus are directly related to the sulphur content of the fuel.

The first choice, therefore, for the control of sulphur dioxide emissions, is the use of low sulphur fuel or fuel desulphurization, which is feasible only in the cases of liquid fuels in the facilities of the refinery. When this is not feasible, the flue gas desulphurization systems drastically reduce sulphur dioxide emissions in the air. Talking about conventional fuels, the sulphur content of natural gas is negligible, while in liquid fuels the desulphurization process provides fuels with the desirable

low sulphur content. On the basis of the applicable legislation, the fuel oil sulphur content is not over 1% of its weight (low sulphur fuel oil) while this percentage is 0.005% in diesel.

In the case of solid fuels, the natural desulphurization of flue gases observed in certain plants that use solid fuels with low calorific value, low sulphur content and a high level of calcium oxide in ash has considerably reduced sulphur dioxide emissions. Natural desulphurization takes place at a high percentage that sometimes reaches 90%, as in the lignite deposits at the basin of the Prefecture of Kozani that supply Ptolemais, Kardias and Ag. Dimitrios TPPs.

Natural desulphurization is a Best Available Technique for low quality lignite, low sulphur content and high ash alkalinity, according to the BAT Reference Documents on Large Combustion Plants.

The limestone wet method is the most commonly known out of the flue gas desulphurization techniques available today. Approximately 80% of the internationally installed flue gas desulphurization systems are based on this method.

Flue gases go through an absorber tower, where they are showered with limestone aqueous suspension. Sulphur dioxide is converted into calcium sulphate (gypsum) and is collected at the bottom of the absorber tower. Limestone preferred to other raw materials as it is available in big quantities in most of the countries and at lower prices.

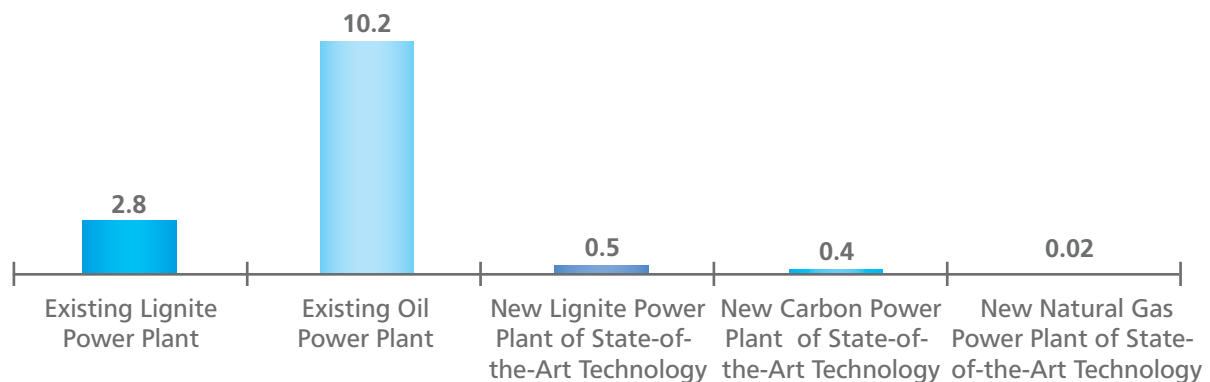
According to the BAT Reference Documents on Large Combustion Plants, the levels of emissions achieved by this method (desulphurization rate 85-98%) are:

- 20-150 mg/Nm<sup>3</sup> for new Power Plants
- 20-200 mg/Nm<sup>3</sup> for the existing ones

The new solid fuel Power Plants that PPC plans to install will be equipped with flue gas desulphurization systems of high efficiency, based on the limestone wet method.



The next diagram presents the special SO<sub>2</sub> emissions (kg/MWh) from existing and new Power Plants using different types of fuels:



### Control of SO<sub>2</sub> emissions in existing Power Plants

In order to reduce SO<sub>2</sub> emissions in the existing Power Plants, an installation program of flue gas desulphurization systems in lignite-fired Power Plants is being implemented with the aim of effectively abating sulphur dioxide emissions. Two such systems are already in operation:

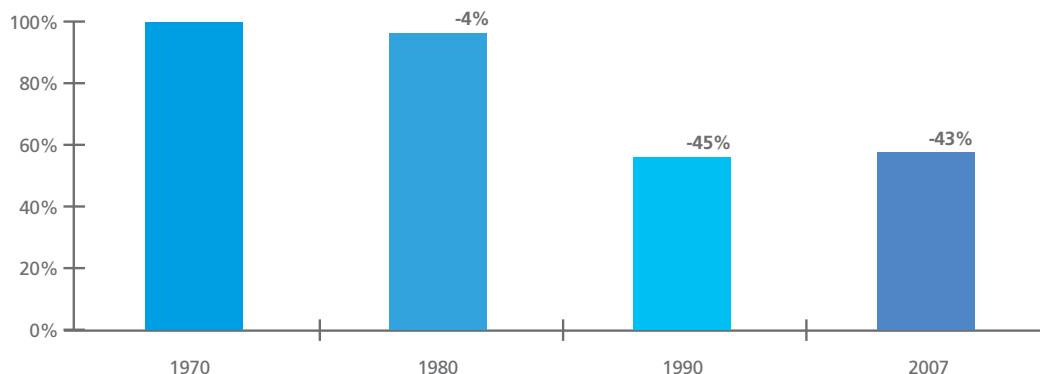
- at lignite-fired Unit IV, with a capacity of 300MW, of Megalopolis B' TPP. This system started operating in 1999 and in 2008 extensive upgrading works were carried out at its facilities; and
- at lignite-fired Unit, with a capacity of 330MW, of Meliti TPP, in the Prefecture of Florina.

Furthermore, the installation of a modern flue gas desulphurization system has been concluded at lignite-fired Unit III, with a capacity of 300MW, of Megalopolis A' TPP, at the contractual price of 84.7 million Euros. It is expected to start operating within 2009.

As of November 2007, all fuel oil fired Power Plants of the Company use low sulphur fuel oil.

These measures led to the gradual reduction of SO<sub>2</sub> emission specific factor from Large Combustion Plants as shown in the following diagram.

Percentage reduction of SO<sub>2</sub> emission specific coefficient from Large Combustion Plants compared to 1970





### 2.1.3 Measures for the reduction of nitrogen oxide emissions

Nitrogen oxides (NOx) are formed during the combustion of conventional fuels, in areas where high temperatures prevail, that is at the flame and around it. They comprise of nitrogen monoxide (NO) and nitrogen dioxide (NO<sub>2</sub>), at a 90-95% to 5-10% ratio, respectively.

Nitrogen oxides formed during combustion are divided into:

- NOx formed from the oxidation of nitrogen contained in the fuel (fuel NOx).
- NOx formed from the oxidation of nitrogen contained in the combustion air and related to the combustion temperature, the time of staying and the abundance of oxygen (thermal NOx).
- NOx formed from the oxidation of nitrogen contained in the combustion air due to the presence of radicals of nitrogen hydrocarbons (prompt NOx). Due to the combustion conditions, the formation of prompt NOx is insignificant at energy production facilities.

NOx emissions are controlled via primary measures (during energy production) and secondary measures after energy production.

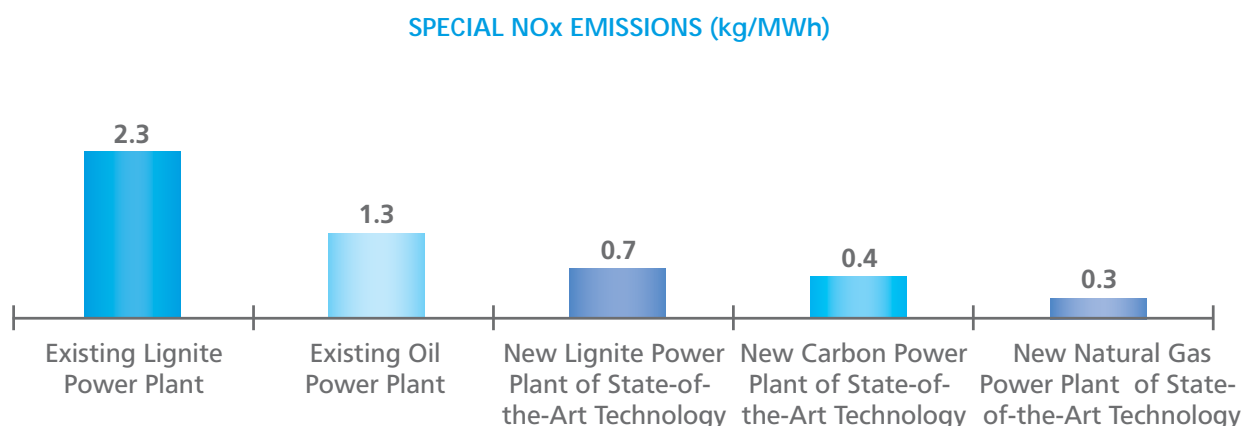
NOx emissions in the new Power Plants (lignite, natural gas) will be controlled via:

- Primary measures in lignite-fired Units, such as design of furnace and regulation of combustion conditions with low excess air, reduction of pre-heating of combustion air, re-circulation of flue gas, gradual supply of combustion air with low NOx burners and gradual supply of the fuel
- Primary measures at natural gas Power Plants, such as low NOx boilers

According to the BAT Reference Documents, the levels of NOx emissions achieved by these measures are:

- 50-200 mg/Nm<sup>3</sup> for solid fuels
- 20-50 mg/Nm<sup>3</sup> for natural gas

The following diagram presents the special NOx emissions (kg/MWh) from existing and new Power Plants using different types of fuels:



NOx emissions are controlled in the existing Power Plants via primary measures.

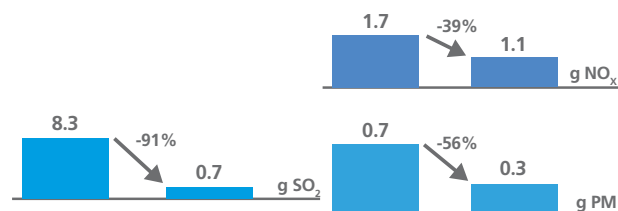
In the lignite -fired Power Plants, combustion temperatures are low, due to the quality of the fuel (low calorific value and high degree of humidity and ash). The low temperatures combined with the arrangement of the boilers, the re-circulation of flue gases and the gradual introduction of the fuel result in low NOx emission levels. Combustion air has been planned to be gradually introduced in Unit V of Ag. Dimitrios TPP; Meliti TPP Unit has also low NOx boilers and the same goes for the Combined Cycle Unit of Komotini TPP and the natural gas Units IV and V of Lavrio TPP.

NOx emissions in internal combustion engines installed on the non interconnected islands of the country and using low sulphur fuel oil are controlled with the use of primary measures, such as the optimization of the engine's operation for low NOx emissions, regulation of the timing for fuel injection, re-circulation of flue gases, direct water or water/fuel emulsion injection, etc. The use of secondary measures, such as the catalytic de-nitrification of flue gases, is not considered a Best Available Technique for internal combustion engines operating in electrically isolated networks with continuous load fluctuations, frequent stops and starts and restricted operation.

## 2.2 Results of PPC's Strategic Plan as regards the reduction of atmospheric pollutant emissions

The implementation of PPC S.A.'s investments for power generation according to the Strategic Plan in combination with the decommissioning of outdated Units will immediately benefit the environment and will result in the reduction of conventional atmospheric pollutant emissions, given that, despite the increased generation in order to meet demand for the period 2006-2015, there shall be a decrease for each kilowatt/hour from thermal power plants:

- ==> of 91% of sulphur dioxide (SO<sub>2</sub>)
- ==> of 39% of nitrogen oxides (NO<sub>x</sub>)
- ==> of 56% of particles (PM)



*% decrease of emissions for the period 2006-2015*



Furthermore, the conclusion of the Generation Strategy will considerably help the country to achieve its commitments pursuant to the ambitious targets of the

EU Thematic Strategy on Air Pollution which anticipates a very significant reduction of the emitted conventional pollutants by 2020.

## 2.3 Monitoring and Recording of the Emissions of Conventional Air Pollutants

PPC systematically monitors and records the emissions of conventional atmospheric pollutants from all power plants. There are continuous measurements for the power plants falling in the application field of Directive 2001/80/EC on Large Combustion Plants and periodical ones in the other Generation Power Plants.

The installation of new modern continuous measurement devices for the emission of atmospheric pollutants at Ag. Dimitrios TPP (Units I-IV), Kardia TPP, Ptolemais TPP and Megalopolis A' and B' TPP was concluded in 2008 pursuant to the requirements of ELOT EN ISO 14956 and EN 114181.

The competent authorities are systematically informed about the emissions of atmospheric pollutants in annual reports and quarterly reports in case of excess, whilst in cases of emission excess, damage to the anti-pollutant equipment, etc., they are informed immediately (within 24 hours).

## 2.4 Air Quality Measurement networks

In order to control the air quality in the wider region of operation of Power Plants and lignite centers, PPC started, in 1975, to systematically measure and keep records on air pollutants and meteorological parameters through networks of measurement stations equipped with semi-automatic analyzers.

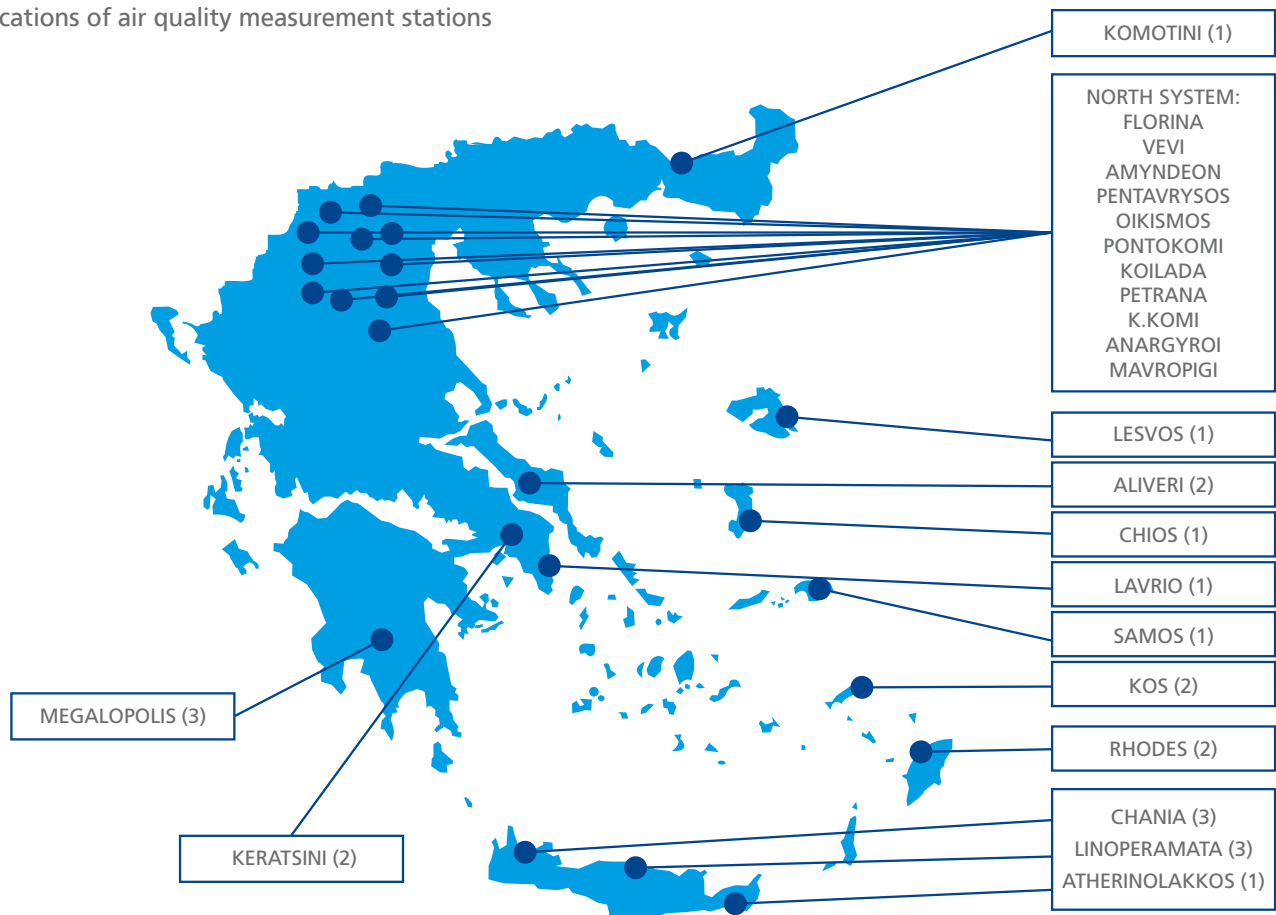
The gradual modernization of the existing networks of measurement stations started in 1997 with automatic electronic analyzers and meteorological sensors with computers for the collection and recording of data and an array for their teletransfer to specific receivers.

Furthermore, apart from the modernization of the existing measurement stations, new ones have been installed as well; today there are 34 measurement stations all over the country as shown in the following table:

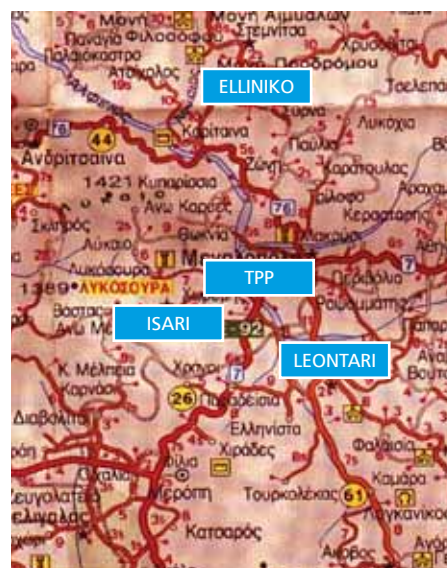
Location	No of Measuring Stations	Measured Atmospheric Pollutants
NORTH SYSTEM	11	SO <sub>2</sub> , NO <sub>x</sub> , PM10, PM2,5
KOMOTINI	1	NO <sub>x</sub>
KERATSINI	2	NO <sub>x</sub> , O <sub>3</sub>
CHANIA	3	NO <sub>x</sub>
RHODES	2	SO <sub>2</sub> , NO <sub>x</sub> , PM10
LAVRIO	1	SO <sub>2</sub> , NO <sub>x</sub> , PM10
MEGALOPOLIS	3	SO <sub>2</sub> , NO <sub>x</sub> , PM10
LINOPERAMATA	3	SO <sub>2</sub> , NO <sub>x</sub> , PM10
ALIVERI	2	SO <sub>2</sub> , NO <sub>x</sub> , PM10
SAMOS	1	SO <sub>2</sub> , PM10
ATHERINOLAKKOS	1	SO <sub>2</sub> , PM10
KOS	2	SO <sub>2</sub> , NO <sub>x</sub> , PM10, PM2,5
CHIOS	1	SO <sub>2</sub> , NO <sub>x</sub> , PM10, PM2,5
LESVOS	1	SO <sub>2</sub> , NO <sub>x</sub> , PM10, PM2,5
<b>TOTAL</b>	<b>34</b>	



Locations of air quality measurement stations



Air quality measurement networks in the wider region of the Power Plants at PPC energy center in West Macedonia - North System.



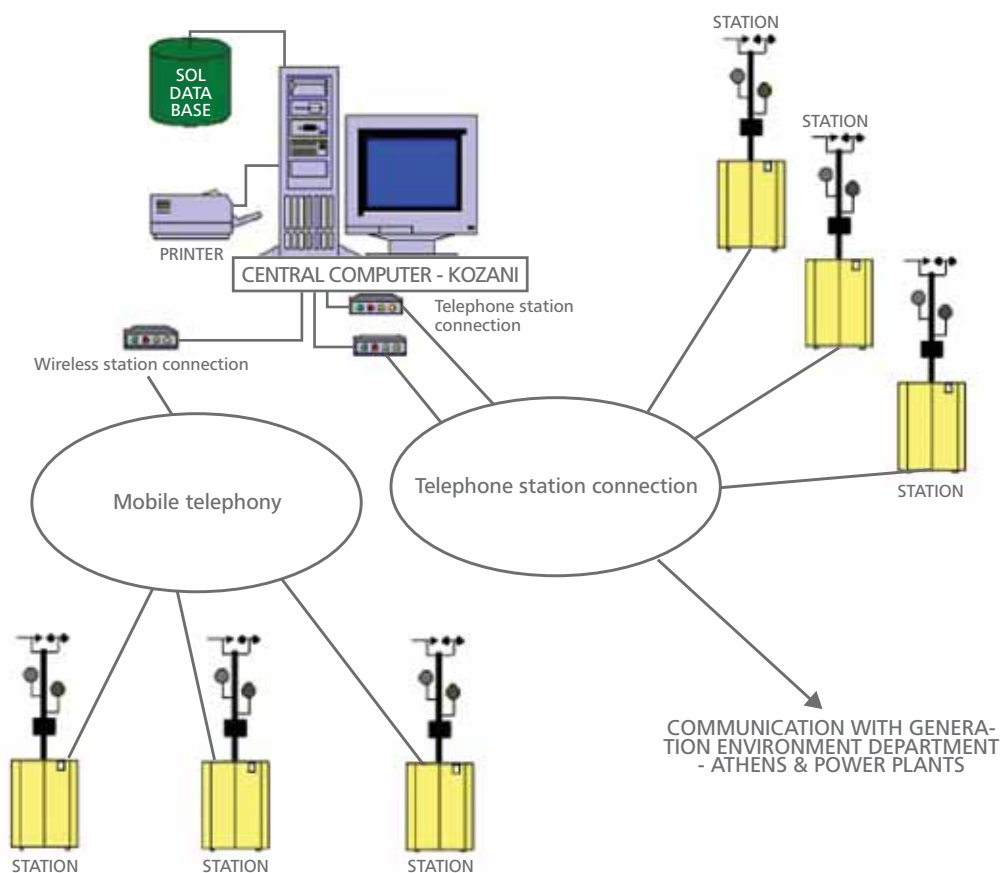
Air quality measurement networks in the wider region of the Power Plant in Megalopolis

The operation of measurement stations is stipulated in the Joint Ministerial Decisions for the Approval of Environmental Terms and Conditions (JMD/ AETC) for TPPs, Mines and Autonomous Power Plants on the non-interconnected islands. More precisely, the JMD/ AETC determine the number of measurement stations, the measured pollutants and meteorological parameters, the necessary infrastructure for the smooth operation of the equipment (air conditioning, etc.), the teletransferring of the data to specific recipients (e.g. Prefectural Authorities, Municipalities, etc.), as well as the collection and electronic storage of measurements.

The locations for the installation of the air quality measurement stations are selected by PPC according to studies on the diffusion - dispersion of atmospheric pollutants and then are recommended to the competent

agency of the Ministry for the Environment, Planning and Public Works as the appropriate and representative ones for the monitoring of atmospheric quality in the region in question. The measurement stations are installed and operate following their approval by the Ministry for the Environment, Planning and Public Works.

In the framework of systematic care for the reliable recording of atmospheric quality, the atmospheric quality measurement networks are continuously upgraded and modernized with the replacement of the old SO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub> analyzers with modern ones, equipped with state-of-the-art technology, as well as with the auxiliary electronic equipment and software for the collection, recording and teletransferring of the measurements.



*Presentation of the teletransferring system of the atmospheric quality measurement stations of the North System*

A related contract was recently implemented on the “procurement, installation, commissioning and maintenance of air quality measurement instruments”. Thus, the SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>10</sub> analyzers were replaced at the air quality measurement stations of the TPPs network of the North System and of Komotini TPP, two (2) new measurement stations were installed in the area of Kos Autonomous Power Plant, one (1) in the area of Lesvos Autonomous Power Plant and one (1) in the area of Chios Autonomous Power Plant.

Aiming at implementing the requirements of the new Directive 2008/50/EC on “ambient air quality and cleaner air for Europe” and assuring the absolute reliability of the measurements, provisions were made so that the analyzers of PM<sub>10</sub> inhaled particles can measure at the same time the fraction of the PM<sub>2.5</sub> inhaled particles.

PPC has the necessary specialized technical personnel and provides for systematic expenditure for the procurement of spare parts, disposable materials and calibration gasses in order to secure the unobtrusive operation of the measurement stations and the reliability of their measurements.



*Air Quality Measurement Station - ALIVERI settlement*







It is known that lignite-extraction and the operation of power plants, as well as the development of electricity transmission and distribution networks have a series of environmental consequences on the natural landscape and organic life. PPC, being fully aware of these consequences, manages the natural environment with respect, always aiming at the restoration of the environment where negative effects have arisen from its activities. Many times it undertakes actions and initiatives, beyond the requirements of the law, proving in practice its environmental orientation.



# Chapter 3

## GROUND - NATURAL ENVIRONMENT

### 3.1 Lignite exploitation

Lignite is the most important national energy source and the core element of PPC development and energy programs. Lignite exploitation has decisively contributed to the development of the Greek energy sector and it is estimated that it will continue contributing to the Greek energy balance for the next 40 years.

The development in question is related to the application and maintenance of an efficient Environmental Management System which focuses on the following basic principles:

1. General land planning of the areas to be restored (land use maps).
2. Knowledge and detection of the environmental conditions of each area with any kind of mining activity.
3. Systematic implementation of environmental protection and restoration programs pursuant to the specific Environmental Terms and Conditions for the exploitation of lignite mines and their accompanying works.
4. Continuous improvement of environmental performance in each activity .
5. Monitoring and evaluation of the results of the protection and restoration projects and activities in the context of implementing specialized studies by means of modern Geographical Information Systems.

PPC first launched into systematic lignite exploitation activities for the purposes of electricity generation in 1951 in the underground lignite mine of Aliveri. Later in 1955, PPC entered upon a large-scale mining effort focused on the exploitation of the lignite deposits found in Ptolemais (set up of LIPTOL company), with an open-pit lignite mine in the Main Field, with an annual capacity of 1.8 million tons/year, intended for the generation of electric power and the production of briquettes, dry lignite, chemicals and nitrogen fertilizers.

The West Macedonia Lignite Center (WMLC), with a production of 62.5 million tons of lignite and overall solid material transportation of 340 million m<sup>3</sup> in 2008, and the Megalopolis Lignite Center (MLC), with 13.2 million tons of lignite and overall material transportation of 40.1

million m<sup>3</sup> in 2008, comes under PPC SA Mines Division. These lignite mines supply twenty one (21) power plants with an installed capacity of 5,287 MW, which corresponds to 50% of the total installed capacity of the country.

Lignite exploitation is still based on the continuous method of excavation - transportation - deposition. The mining procedure of a lignite deposit includes extraction, transportation and deposition of materials (lignite and co-excavated waste materials).

The main equipment used consists of electrical bucket-wheel excavators, conveyor belts and stackers. The excavated lignite is then transported to the thermal power plants for combustion.

The co-excavated waste materials are transported and put back mainly in the excavation voids in an effort to minimize the impact on the landscape.

#### 3.1.1 Impact of lignite extraction

The open pit mining of lignite with the specific method mentioned in the previous paragraph results in:

- The occupation of extensive areas of land for long periods of time.
- The alteration of the soil's morphology.
- The disturbance of the region's flora and fauna.
- The need to relocate settlements and parts of the road and rail network.
- The emission of air pollutants and dust, creation of noise, vibrations and solid and liquid waste.

For PPC, the restoration of the environment, in its lignite mines and the minimization of environmental disturbances is an issue of major ecological, social and economic importance.

In compliance with the European Union and national legislation, PPC systematically sees to the restoration, at a rapid pace, of new lands and to the protection and upgrading of the environment.



## 3.2 Uses of restored lands

### 3.2.1 Planted regions

To date, more than 8 million trees (7,100 million trees in the West Macedonia Lignite Center and 850,000 trees in the Megalopolis Lignite Center) have been planted at a rate that exceeds 600,000 trees per year. The trees planted are: acacias, poplars, pines, Arizona cypresses, eucalyptuses as well as fruit bearing trees, such as apple trees, pear trees, plum trees, hazelnut trees, walnut trees and pistachio trees at selected locations of the mines. Treeplanting is carried out according to four (4) methods:

- Classic manual method: Experience has shown that approximately 500,000 small trees are planted annually with this method without the use of machinery.
- Plough method: The specific method is based on the opening of drills with the help of a plough drawn by a bulldozer or a tractor and the placement of small trees within the drill. This method allows for the planting of 1,200 small trees per hour.
- The method of transferring a root system: The planting of vegetation with this method is done very quickly and the created ecosystem is more similar to a natural one.
- Transplantation method: Grown trees are transplanted in another position, mainly where there is an urgent need for upgrading the aesthetics of the landscape.

### 3.2.2 Creation of farmland

The creation of experimental grain cultivation with a view to testing the fertility of the rehabilitated land dates back to 1986. The crops selected are durum and soft wheat, which are usually cultivated in the region.

According to the evaluation of the results so far, it seems that the productivity of the new land is at the same level as the productivity of the wider area and, in some cases, even exceeds it.

Apart from the cultivation of crops in the rehabilitated areas of the mines in the West Macedonia Lignite Center, a pilot greenhouse for hydroponic cultivations with the use of teleheating is being run in cooperation with the National Agricultural Research Foundation (N.AG. RE.F) and the Technological Educational Institute (TEI) of Florina.

A model orchard has been developed in the internal deposition area of the Main Field of the West Macedonia Lignite Center with apple trees, pear trees, plum trees, cherry trees and other species, as well as a vineyard for wine production for the purpose of demonstrating to the farmers of the region the possibility of developing agricultural activities with increased added value. In the Megalopolis Lignite Center, there have been experimental cultivations of specific plant species (e.g. potatoes, beans, tomatoes) with satisfactory results for potential cultivation, while the experimental crops of grains, oats and vetch produced results similar to those achieved in the greater area.

Finally, the West Macedonia Lignite Center Department (WMLCD) has leased to the farmers of the area approximately 1,167 hectares.





### 3.3 Special restoration works at Lignite Centers

In addition to large-scale works pertaining to the creation of cultivable land and forestland, special interventions are being carried out aiming at the optimum exploitation of the new lands.

All restored areas already host ecosystems gathering the fauna of others that have been disturbed, while at the same time they are enriched with species released from animal husbandry facilities.

The lakes that have been created at all depositions gather fauna and flora species and are also enriched with fish species.

As far as the West Macedonia Lignite Center is concerned, in the area of the old mine of the Main Field where mining operations have been completed, the following have been constructed:

- An Expo Center, visited by more than 5,000 people from Greece and abroad every year.
- An artificial wet-land, adjacent to the Kozani-Ptolemais national road, which evolves into a major ecosystem and, with the cooperation of university bodies, is expected to be used as an environmental education reserve.
- A small animal reserve covering an area of 8 hectares and used by the Forestry Authority and the local Hunting Associations for the enrichment of the fauna of the area (with hares, partridges and pheasants)
- An open air theater constructed from old materials that were removed from the mines.
- A siviculture park, in the external deposition of the Main Field, where a model park was created with all the different tree species flourishing in Northern Greece.
- a railway history park.

Respectively, in the restored areas of the Megalopolis Lignite Center the following projects have been constructed:

- An Expo Center in order to inform visitors on the Lignite Center's activities.

- A recreational park (including a grove, a playground and playing fields) where various events are held in cooperation with the Municipality of Megalopolis.
- Artificial wetlands by creating artificial lakes, some of which have been enriched with fish.
- A motor cross track, which has repeatedly hosted international races and has been qualified as a model track by major international bodies of this sport.
- A runway used by private clubs to carry out flights of ultra light aircrafts.







### 3.4 Transmission Works and natural environment

The basic impact on the morphology of the ground from the new Transmission works is mainly due to the intervention at the support positions of the pylons and the opening of forest roads.

Construction works are small scale and of restricted duration. The foundations of the towers require a small area and the excavation does not cause any change in the morphological characteristics or the landscape. The

interventions are relatively small and upon conclusion of the construction, the area is restored through the natural growth of the area's ecosystem and no further cleaning of the ground is required.

Furthermore, there is no significant decrease in cultivations because, on the one hand, all types of agricultural activity are allowed under the Transmission Lines or near them and, on the other and in most cases, the substations and the extra high voltage centers as well as the transmission lines are installed in areas of small productive capacity.



### 3.5 Distribution Works and natural environment

PPC Distribution Division cooperates with environmental associations in scheduling pilot interventions in PPC facilities located in wetlands, etc. for the protection of endangered bird species from electric shock. Such an important project was carried out at Chalastra of Thessaloniki in cooperation with the Greek Center of Wild Animal Sheltering (GCWAS).

Finally, according to the data released by the Hellenic Ministry of Rural Development and Food, PPC is imputed with less than 1% of the total number of wildfires.

The reason why fires do not break out in the vicinity of distribution networks lies in a series of preventive measures taken on a yearly basis:

- Tree pruning in order to maintain safe distances from the overhead networks.
- Cutting of branches or unstable trees (e.g. burned or dried up trees) near networks.
- Clearing of vegetation (pesticide sprays) around selected poles.
- Installation of insulated cables.
- Cleaning of glass or porcelain insulators or installation of synthetic insulators in areas with increased air pollution.
- Installation of phase separators in low voltage networks with bare conductors (areas with strong winds, large openings, etc.).
- Systematic supervision of the networks with the use of ultra modern portable devices for the remote measurement of temperatures (thermal cameras).





PPC hydroelectric projects make the best use of domestic resources, reduce foreign energy dependency and substitute fossil fuels, contributing decisively to the reduction of CO<sub>2</sub> emissions and to the limitation of the greenhouse phenomenon. They also contribute to the upgrading of the natural environment with the creation of new ecosystems of high environmental and aesthetic value.



# Chapter 4

## WATER SYSTEMS

Water is a renewable natural resource and a vital factor for the survival of man, fauna, flora and the conservation of the natural environment. Its existence and adequacy are irrevocably connected to the progress of the society.

Nowadays, in an era of big ecological problems, the environment –and especially water- constitutes a continuously growing concern for the international community and plays, and will continue to play in the future, a fundamental role in the financial and political decisions of the society and the development strategies of the states sharing this natural resource.

Despite the fact that water is in abundance in nature, there are problems as regards its management.

In Greece, although there is adequate quantity of available water, there is a problem of shortage of the Water Resources due to the varying distribution of rainfall. This distribution is observed both with regards to the time variation (wet period – dry period) and between years (wet years – dry years), as well as locally (among the geographical divisions).

Due to the morphology of the ground, there is much rainfall in Western Greece (rain-side) and little in Eastern Greece (rain shadow). The problem of the Water Resources is also intensified by the varying distribution of water demand (big irrigated plains, big urban centers, industrial zones).

PPC recognizes that the water issue is not simply a technical matter but it is characterized by the multiplicity of its uses. For this reason, PPC adopts a series of measures and actions of preventive character as regards water protection and integrated management, feeling the great responsibility of its actions and focusing on the maximization of the overall social, regional, planning and environmental benefits from the combined uses of its projects.

PPC, taking advantage of the high natural relief of our country, constructed flow downstream dams and created artificial lakes or otherwise called water reservoirs, exploiting the hydro potential of Greece.

The reservoirs (artificial lakes) are not only used for power generation, which was the initial purpose for their construction, but they constitute as well projects of multiple benefits and serve multiple purposes such as irrigation, water supply, ecological supply and flood

protection. In most cases that reservoirs are created, the greater area changes with the new eco-systems and landscapes of special natural beauty are created, offering at the same time opportunities for tourist development to the local communities.







The following are taken into consideration during the planning and development of a Hydroelectric Project that includes the construction of a dam and the creation of water reservoirs:

- The geomorphologic characteristics of the area, the meteorological and hydrological features.
- The developmental capacity of the greater region, with the consensus of the local communities.
- Special environmental practices for the protection of the archaeological sites and conservation of cultural heritage.
- Examination of the impact on the greater region caused by the operation of a Hydroelectric Project.

In the Joint Ministerial Decisions for the Approval of Environmental Terms and Conditions (JMD/AETC) issued for these projects the following obligations are included:

- Maintenance of the required ecological supply .
- Restoration of man-made environment.
- Respect to the river basin management.
- Control of the water quality of the reservoirs.
- Control of the dams and reservoirs for the safe operation of the Hydroelectric Projects .
- Securing the free movement of the aquatic living organisms along the river banks aiming at the conservation of ichthyofauna and the creation of artificial wetlands .
- Total management of the river basin, where the project is located, so that there will be the best possible exploitation of the remarkable natural potential, especially after the conclusion of special studies.



*Kremasta dam*

With the construction of dams, PPC SA considerably contributes to the management of water resources and to meeting the needs of local communities. The big Hydroelectric Projects in operation exploit approximately 30-35% of the technically exploitable hydro potential of the country, meeting about 10% of the overall energy demand and providing about 30% of the total installed capacity of the Interconnected System. Furthermore, by exploiting domestic resources, these projects reduce foreign energy dependency and substitute fossil fuels contributing, thus, to the limitation of the greenhouse phenomenon.

Given that the demands for water (potentially a renewable resource) are continuously on the increase, the storage for its rational use has become an imperative need.

Below you will find an analytical reference to PPC SA artificial lakes, implemented programs to face the impact arising from the construction of Hydroelectric Projects, the special studies and programs drawn up for full compliance with the environmental legislation and the multiple services provided by the Hydroelectric Projects.



## 4.1. PPC S.A.'s artificial lakes

PPC has constructed artificial lakes at the following rivers: Tavropos (Megdovas), Acheloos, Aliakmonas, Edesseos, Nestos, Arachthos, Louros, Aaos and Ladonas.

### 4.1.1 Tavropos River (Megdovas)

N. Plastiras or Tavropos artificial lake was created after the construction of a dam on the Tavropos (Megdovas) River. The net volume is 300 million m<sup>3</sup> and it is a region of unique natural beauty. The Hydroelectric Project is a project of multiple purposes as it generates hydroelectric energy and at the same time it stores water for the regulation of irrigations on a daily basis, meeting, thus, the irrigation needs of the fertile plain of Karditsa, and, in addition, it contributes to the water supply of Karditsa and the neighboring Municipalities.

### 4.1.2 Acheloos River

There is a series of dams at Kremasta, Kastraki and Stratos I and II on the Acheloos River.

- The Kremasta reservoir is the biggest in the country and the net volume is 3.30 billion m<sup>3</sup>. The objective of the project is the hydroelectric generation and flood protection of the area.
- The Kastraki Station takes advantage of the outflows of Kremasta Hydroelectric Power Plant and the waters of Nachos tributary that flow in the project's reservoirs with a net volume of 53 million m<sup>3</sup>. The objective of the project, apart from hydroelectric generation, is the irrigation and water supply of the Municipality of Agrinio and the neighboring Municipalities.
- Stratos I and II Hydroelectric Power Plants, with net volume of 13 million m<sup>3</sup>, are projects of multiple purposes, generating energy and storing water for irrigation purposes on a daily basis, meeting, thus, the irrigation needs of the fertile plain of the Lower Acheloos River, as well as the ecological demands.



*Kastraki dam*



*View from Stratos reservoir*



### 4.1.3. Aliakmonas River

The dams of Polyfytos, Sfikia, Asomati and the re-regulating project of Ag. Varvara are located on the Aliakmonas River, which is full of tributaries and is one of the richest water resources in West Macedonia.



- The real hydroelectric development on the Aliakmonas River started with the construction of the Polyfytos Hydroelectric Power Plant with a net volume 1.22 billion m<sup>3</sup>. The project, apart from hydroelectric generation, supplies the Thermal Power Plants of the region with cooling water and contributes to the irrigation of Thessaloniki plain and to the water supply of the city of Thessaloniki. It also contributes to flood control.
- The Sfikia Hydroelectric Power Plant is the first pump - storage station constructed in Greece. It is located next to the Polyfytos project and the net volume of the reservoir is 17.6 million m<sup>3</sup>.
- The Asomati reservoir with a net volume of 10 million m<sup>3</sup> supplies with water the pumping Sfikia Hydroelectric Power Plant and meets the irrigation needs of the area.
- The water transportation canal starts practically from the Ag. Varvara reservoir, transporting water for the irrigation of Thessaloniki plain and the water supply of the city of Thessaloniki. The net volume is 3.5 million m<sup>3</sup>.

Downstream of the Asomati Hydroelectric Power Plant and on the existing irrigation canal, there is the small hydroelectric project of Makrochori, which covers, mainly in the summer, the required supplies for irrigation.

The most important tributary of the Aliakmonas River is Edesseos where the Agra and Edesseos Hydroelectric Power Plants are located. These plants contribute to the irrigation of the region and supply with water the neighboring communities and the famous Edessa waterfalls.

The re-regulating reservoir of the Agra Hydroelectric Power Plant has a net volume of 0.4 million m<sup>3</sup>, while the Edesseos Hydroelectric Power Plant is supplied with water from the loading tank, which has a net volume of 0.046 million m<sup>3</sup>, through a closed steel surface pipe.

The Ilarionas Hydroelectric Power Plant is under construction upstream of the Polyfytos reservoir. The dam has already been constructed and the Plant is expected to be completed and start its commercial operation by 2010.

The net volume is 410 million m<sup>3</sup>. The specific project will help the further enhancement of the waters of Aliakmonas River.



#### 4.1.4 Nestos River

The dams of Thisavros and Platanovrysi have been constructed on the Nestos River.

- The net volume of the Thisavros Hydroelectric Power Plant is 565 million m<sup>3</sup>. It is a pump-storage project serving multiple purposes and meeting the irrigation needs of the neighboring regions, providing at the same time flood protection.
- The reservoir of the Platanovrysi Hydroelectric Power Plant, after the Thisavros Hydroelectric Power Plant, with a net volume of 12 million m<sup>3</sup>, operates both as an energy generating plant, as well as a reservoir for the pump-storage Thisavros Hydroelectric Power Plant.

It should be noted that 6 km downstream of the Platanovrysi Hydroelectric Power Plant, the possibility of constructing one more Hydroelectric Power Plant, at Temenos (the third and last project of Nestos Complex) is under study; this plant will re-regulate the outflows of the Platanovrysi Hydroelectric Power Plant on a daily basis, supplying thus continuously the irrigation networks of the region and meeting, at the same time, environmental requirements.

#### 4.1.5 Arachthos River

Two dams, Pournari I, net volume of 303 million m<sup>3</sup>, and the re-regulating Pournari II, net volume of 4.1 million m<sup>3</sup>, have been constructed on the Arachthos River, securing the continuous flow of water along the riverbed and at the estuary of the Arachthos River during the year, contributing, thus, to the rational and effective utilization of the irrigation networks of the region.





#### 4.1.6 Aaos River

The Aaos Hydroelectric Power Plant, along the Aaos River, has a reservoir with a net volume of 145 million m<sup>3</sup>, collecting waters from Aaos river system and of the neighboring torrents.



*View from Aaos reservoir*

#### 4.1.7 Ladonas River

The net volume of Ladonas, located at Alfios tributary with the same name, is 46.2 million m<sup>3</sup>. This project, apart from power generation, takes into account the irrigation needs of the agricultural crops, supplies the neighboring communities with water and contributes to the conservation of the region's flora and fauna.



*Ladonas dam*

## 4.2. Rational Management of Water Resources during Hydroelectric Power Plant Operation

PPC reservoirs are not only used for power generation. In most cases, the Hydroelectric Projects serve multiple purposes. Thus, in addition to power generation, they are also used for irrigation, water supply, flood protection, industrial cooling, recreational activities, etc. The fifteen (15) major Hydroelectric Power Plants operated by PPC provide a net volume equal to 6.5 billion m<sup>3</sup> of water and considerably contribute to the management of the country's water resources and to meeting the water requirements of local communities (water supply, irrigation and other uses).

### 4.2.1 Power Generation

The power generated by hydroelectric power plants varies depending on annual rainfalls. The installed capacity of hydroelectric power plants is approximately 30% of the overall installed capacity of the Interconnected System. By exploiting 30%-35% of the technically exploitable hydro potential of the country, hydroelectric power plants cover approximately 10% of the annual energy needs. Apart from the obvious quantitative figures of power generation and installed capacity, the Hydroelectric Power Plants have excellent and reliable availability, providing at the same time multiple services to the national Interconnected System, such as:

- Control of interconnections and load variations in general.
- Generation of reactive power for the needs of the System which contributes to voltage regulation.
- Provision for system peak needs and, therefore, optimal operation of the Thermal Power Plants.
- Provision for spinning reserve due to rapid load undetaking.
- Cold reserve of the system installed capacity in order to deal with the adverse effects resulting from power-generation shortage.

#### 4.2.2 Exploitation of the reservoirs for water supply and recreational activities

PPC reservoirs, with their big capacity and high quality water, supply large volumes of potable water to approximately 2.5 million residents (in Arta, Preveza, Lefkada, Agrinio, Karditsa and Thessaloniki), at a time when the water, which is a natural resource invaluable for life, is in shortage due to increasing consumption and human activities that degrade its quality.

In order to achieve this goal, PPC has set as a first target the conservation of the good quality of water. Thus, the personnel is required to make continuous efforts towards reconciling all kinds of demands for activities in the artificial lakes (river transport, fish breeding, marine sports recreation, etc.).

PPC consents to activities that do not present any risk to the environment and to water quality and are mainly recreational. The high quality of PPC reservoirs' water has been proven in several studies mainly carried out by the Hellenic Center for Marine Research (HCMR) and other bodies

#### 4.2.3 Water supply for irrigation purposes

PPC reservoirs supply large quantities of water during summer, especially during the peaks of July and August, for the irrigation of extensive areas downstream of the dams. It is estimated that approximately 0.5 million hectares are irrigated in large plains (Agrinio, Arta, Thessaly, Emathia, Pieria, Kavala, Xanthi, etc.) increasing the cultivated land value, as well as the annual income of the farming population.

In this way, hydroelectric facilities contribute to the employment of a large part of the population while preserving the flora and fauna, which would be devastated in case of water shortage. Therefore, they contribute to the overall improvement of the environment and the protection of the flow that is a prerequisite for the preservation of river life and vegetation.

#### 4.2.4 Flood Protection

PPC, by constructing dams on the major Hellenic rivers, created the necessary conditions for boosting the country's agricultural economy and social development. More precisely, dams offer protection against floods at the near-by river areas and as a consequence they allow for the utilization of extensive areas of farmland. Without the risk of flooding, thousands of acres of fertile lands are cultivated near the estuaries of the rivers exploited by PPC for hydroelectric generation (the Ladonas, Acheloos, Arachthos, Aliakmonas, Nestos, Aoos, Tavropos, Louros, Glafkos, Agras, Edesseos Rivers, etc.). Flood protection has an environmental dimension as well, since by preventing serious damage, it has a positive effect on the environment.

The protection that a dam offers against floods depends on its net volume, as well as on the size of the flood it is called to control (intensity, duration and water volume). In all cases of extreme weather conditions, PPC's dams, reservoirs and the other flood protection projects have been effective and protected the inhabitants, river ecosystems and the downstream riverside areas. More precisely, the December 2006- January 2009 period saw bouts of rainfall of unprecedented intensity and duration that resulted in a large volume of water inflow into the Hydroelectric Power Plants of the Rivers Acheloos (Kremasta, Kastraki, Stratos I and II HPPs, Arachthos (Pournari I and II HPPs) and Nestos (Thisavros and Platanovrysi HPPs).

The large water reservoirs of Kremasta, Pournari I and Thisavros HPPs by stopping the power of water and controlling the volume of floods literally saved the life and property of people, since there were no victims or damage whatsoever.

The flooding of the Evros River, which flows from Bulgaria, during the same period of time, cannot be regulated due to the absence of an appropriate dam, contrary to the Nestos River, whose increased inflow from Bulgaria was largely controlled by the large water reservoir of Thisavros.





#### 4.2.5 Protection against drought - water shortage

The reservoirs of Hydroelectric Power Plants protect several regions of the country from extreme water shortage situations brought about by the prolonged droughts that frequently occur in Mediterranean areas. Therefore, they protect the natural environment and the welfare of millions of citizens.



### 4.3. Implementation of Environmental Programs in order to deal with the impact arising from the construction and operation of Big Hydroelectric Projects, in compliance with the JMD/AETC for their construction and operation

The basic legislation governing the management of water resources is the following:

- Directive 2000/60/EC on the establishment of a community framework in the water policy sector, as well as the accompanying texts of the Directive with guidelines about its application as they are drawn up by the EU Strategy Group and the related work groups of the EU member states.
- Directive 2006/118/EC on the protection of underground waters from the pollution and downgrading, in compliance with Directive 2000/60/EC.
- Directive 2007/60/EC on the assessment and management of flood risks, in compliance with Directive 2000/60/EC.
- Directive 2008/105/EC on the environment quality standards (Priority Substances), in compliance with Directive 2000/60/EC.

An extensive program of systematic monitoring and recording of all parameters, stipulated by the JMD/AETC for their construction and operation, is implemented in all HPPs.

The results of these controls are evaluated by the specialized scientific personnel of the Company and the related scientific personnel of the competent Services to which they are systematically communicated.

The actions in order to deal with the Environmental Impact arising from the construction and operation of the Hydroelectric Projects, in compliance with the stipulations in the JMD/AETC, include, inter alia, the following:



- Actions for the preservation of our cultural heritage.
- Man-made Environment – Dealing with problems due to flooding of crop fields and residences.
- Programs aiming at maintaining ecological flows.
- Programs - Studies aiming at the restoration of the environment of the Hydroelectric Projects.
- Studies for the protection and relocation of ichthyofauna.
- Monitoring of the quality and quantity of water resources.

#### 4.3.1 Actions for the preservation of our cultural heritage

The area occupied by the reservoir of a Hydroelectric Project, due to its extent, may encompass unexplored archaeological sites or monuments of the Byzantine era. In this case, PPC subsidizes the excavation works carried out under the responsibility of the Hellenic Ministry of Culture.

A big excavation project is in progress in the reservoir of Ilarionas Hydroelectric Power Plant in cooperation with the 11<sup>th</sup> Ephorate of Prehistoric and Classical Antiquities of Kozani. Furthermore, the excavation works at the area of Ag. Varvara reservoir in the Prefecture of Emathia have been concluded.

More precisely, it is worth mentioning the case of the Panaghia Tornikiou Monastery, a two-storey Byzantine monument near Ilarionas dam, which will be flooded once the reservoir is filled.

PPC has elaborated a study for the relocation of the monastery to a neighboring rise outside the reservoir. It has also completed the restoration works and has moved on to the maintenance of the murals in cooperation with the 17<sup>th</sup> Ephorate of Byzantine Antiquities of Kozani. Finally, PPC has completed the special studies with regard to Osios Nikanoras Monastery, which is situated in a steep location of Ilarionas future reservoir. The decision of the Ministry of Culture is expected in order to find a solution for the preservation of the monument. Among the measures on the preservation and highlighting of Byzantine monuments, we should

mention the works for the preservation of Ag. Georgios Myrofylos Monastery, which would have been flooded by the Sykia Hydroelectric Project under construction on the bank of the Acheloos River. Given the clear intention of the State to proceed to its completion, it was decided to lower the water level of Sykia Lake by 5 m, resulting in a significant reduction of the stored volume by 60 million m<sup>3</sup> of water, to make a protective embankment around the monastery and, then, to restore the area.

#### 4.3.2 Dealing with problems due to the flooding of crop fields and residences in the greater area of Hydroelectric Projects

Special care is also given by PPC to the man-made environment in order to deal with problems caused by the flooding of crop fields and residences.

It is noted that the Mesochora Hydroelectric Project was concluded in April 2001 and the remaining works are expected to be completed and start filling the reservoir in 2010.

The obligatory expropriation of the remaining areas required for the smooth operation of the Mesochora Hydroelectric Project was voted with L. 3734/28.01.2009 for reasons of public benefit of great importance. PPC will pay the compensation cost to the inhabitants, care of the Region of Thessaly.





### 4.3.3 Programs aiming at maintaining ecological flows

Once the construction of the dams of the Hydroelectric Project is completed, the natural river flow is modified and the downstream river bed does not have continuous water flow.

In order to deal with the drying problems of the river bed, a special construction at the foot of the dam allows for a minimum continuous water flow, the so called ecological flow, sufficient to preserve downstream river ecosystems.

Such constructions, with the use also of a small power unit, have been anticipated in the Mesochora, Sykia and Ilarionas Hydroelectric Projects under development.

Another means to cope with the problem is to construct a re-regulating reservoir downstream of the big Hydroelectric Project, securing ecological flow, apart from the other purposes served, such as irrigation and water supplies.

These reservoirs include: the Ag. Varvara re-regulating reservoir, downstream of the Asomati Hydroelectric Power Plant, and the Hydroelectric Project Pournari II, downstream of the Pournari I Hydroelectric Power Plant, which secure the provision of the ecological flow with the small Hydroelectric Power Plants they have.

### 4.3.4 Programs aiming at the restoration of the environment of the Hydroelectric Projects

In an effort to minimize the impact of Hydroelectric Projects, PPC implements various corrective measures on the basis of environmental impact assessment studies and in accordance with the environmental terms of its projects. Such actions involve rehabilitation works, such as those around the Arachthos River in the city of Arta and the treeplanting operations in the area of Stratos I & II dams on the Acheloos River.

It is noted that within the framework of the construction of the re-regulating dam of Ag. Varvara downstream of the Aliakmonas River near Veria, PPC constructed a new waste-burial site for the city of Veria in an area near the reservoir, downstream of the dam. The waste of the Municipality of Veria were hygienically stratified and the area was covered with earth and planted with trees. Therefore, on the waste disposal site covering the Project reservoir for so many years, a wetland has started being created and two artificial islands in the lake, used by wild birds as a refuge, have already been constructed. The banks of the lake have been used for the creation of paths for recreational purposes and walks as well as two large fishing platforms have been constructed for amateur fishing in the reservoir.





#### 4.3.5 Studies for the protection and relocation of ichthyofauna

Diverse ichthyofauna has been developed in the artificial lakes as is shown in various special studies to register the different species.

Fish is one of the groups recommended in Directive 2000/60/EC (Directive on the establishment of a Community Action Framework in the filed water policy) for the assessment of the good ecological condition of river systems.

PPC in cooperation with the Hellenic Center for Marine Research (HCMR) has drawn up studies on ichthyofauna, as well as Special Technical Studies; these refer to the following:

- A study of the ichthyofauna on the upper flow of the Aliakmonas and Geropotamos Rivers of the Prefecture of Florida, both before and after the construction of

Ilarionas and Skopos-Papadia dams, as well as along the water-bearing network of the Nestos River by the National Agricultural Research Foundation (N.AG.RE.F). Both quantitative and qualitative research was carried out on the fish species that live in various parts of the rivers, both upstream and downstream of the related dams, during various seasons of the year. The research proposed the necessary measures for the preservation of ichthyofauna.

- Preparation of Special Technical Studies on the reservoir and the diversion part of the river where the Hydroelectric Power Plant of Ladonas is located with regard to the enrichment and preservation of ichthyofauna
- Installation and operation of an experimental collection station for upstream eels on the Acheloos River





#### 4.3.6 Monitoring of the quantity and quality of water resources

Aiming at the hydrological support of the Hydroelectric Projects, PPC maintains a model monitoring network of water resources. This network, being in operation for more than 45 years, consists of two parts: a highly reliable rain gauging network comprising more than 189 measurement stations located mainly in mountainous areas and a hydrometric network comprising 47 river water supply measurement stations. The latter is unique in Greece in its capacity to systematically collect comprehensive and reliable information for the estimation of the river-water supply on a continuous or daily basis.

Apart from their obvious usefulness for the company's needs and the reliable design of public and private projects, the data collected are necessary for the country's compliance with the provisions of Directive 2000/60/EC regarding the development of river basin management plans, the preparation of environmental impact assessment studies and, generally, the monitoring of the quality of the water environment. These data have already served as a basis for the preparation of three Management Studies carried out by the Ministry of Development entitled "Development of Systems and Tools for Water Resources Management at the Departments of Epirus- Central Greece - Thessaly, Peloponnesus,

Macedonia- Thrace".

However, in addition to the monitoring of water quantities, a continuous monitoring of physical/ chemical quality parameters at certain hydrometric stations has commenced in recent years, while the monitoring of biological parameters is anticipated for the future, pursuant to Directive 2000/60/EC and the environmental terms for the issuance of an operation permit for Hydroelectric Projects. Seven stations of this type are already in operation at characteristic sites along the Nestos River, in cooperation with the Aristotle University of Thessaloniki (REMOS telemetry network) and are expected to be expanded to other rivers where PPC is active.

In an effort to further improve the quality of collected information while reducing human errors and the impact of adverse weather conditions, the company has systematically promoted the upgrading of its network through the introduction of the Best Available Technology, both with respect to the measuring instruments, as well as the transmission and storing of information. The gradual replacement of conventional instruments with electronic telemetric ones has already started. Thus, in the aforementioned hydrometric and rain gauging stations, there are twenty six (26) electronic rain gauges and twenty eight (28) electronic river flow gauges, all with on-line communication and control capabilities.

### 4.3.7 Special Studies - Programs

Special studies and programs are carried out aiming at achieving full compliance with the legislation in force as well as at meeting the requirements of future legislation. The following programs and studies are indicatively mentioned:

- Monitoring programs of the physical/chemical and biological parameters related to the water quality in reservoirs and their uses.
- Monitoring programs of ichthyofauna in reservoirs.
- Monitoring programs of the dams and the stability of the declivities around the reservoirs.

### 4.3.8 Implementation of Research Programs in cooperation with Educational Institutes and Bodies

In addition to the studies, measurements and programs stipulated by the legislation, PPC SA implements a series of programs in collaboration with Higher Educational Institutes and Bodies, aiming at evaluating the environmental impact caused by the operation of its Power Plants, as well as at developing innovative pollution abatement technologies.

Some of the completed programs are the following:

- Examination of the Acheloos riverbed in order to identify sediments and specify their position.
- Research on the condition of Aaos and Pournari I HPP reservoirs.
- Research work on the exact determination of the volume of Ladonas, Aaos sources and Kremasta HPP reservoirs.







PPC, strictly observing the legal framework in force and respecting the environment, implements an integrated waste management policy, operating in addition the alternative management systems of its materials.

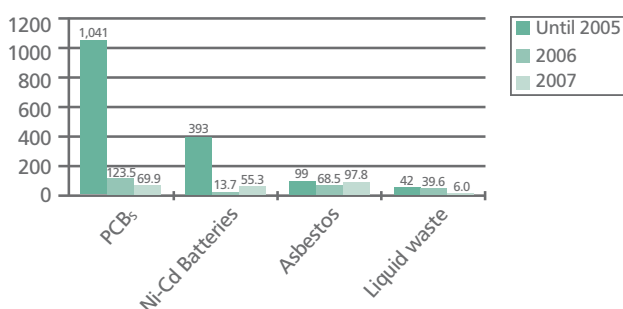




The company takes special care for the management of any kind of waste arising from its activities. The management, though, of the waste faces many difficulties as the legislative framework is still unclear in many points and in our country there are no infrastructures (licensed areas) for industrial and hazardous waste management.

A unique exception is the area for PPC Industrial Waste Management, licensed by the co-competent Bodies, which operates at Kardia mine, inside the West Macedonia Energy Center. There PPC applies its central strategy on waste management after taking into account, inter alia, the proximity and self-sufficiency principles, which are basic principles of the national and European Community law on waste management.

The care for the policy concerning the management of hazardous or non-hazardous waste belongs to PPC Occupational Health and Safety Department. The extension of the operation of the alternative management systems for packaging and other waste, as stipulated in Law 2939/Government Gazette 179A/6.8.2001, led to progress in alternative waste management. The final waste management of the implicitly hazardous waste takes place by sending these abroad, using specially licensed companies. There were significant problems in 2008 with the export of hazardous waste since the boarding ports (Piraeus and Thessaloniki ports) did not operate more than 8 hours a day due to the dockers' strikes and as a result, the ships carrying hazardous cargo did not approach the ports for clearly financial reasons. This was a problem not only for PPC but for all the companies exporting hazardous waste.



## 5.1 Hazardous waste

### 5.1.1 PCBs

The implementation of the program to decommission all devices filled with or contaminated by PCBs continued.

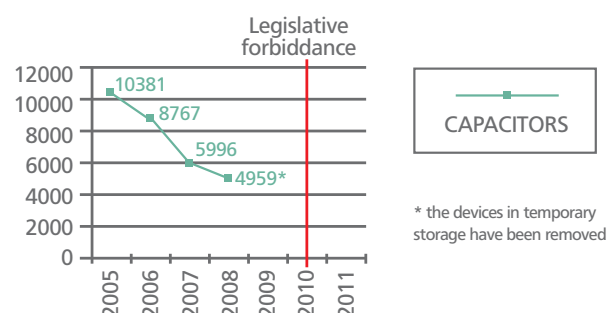
The time horizon for the completion of the decommissioning/ decontamination program is transferred to 2010, within the limits set by the law, due to disposal problems abroad by the specially licensed companies as mentioned above.

All devices decommissioned from the networks are subjected to a 100% control for the possible presence of PCBs even when there is no suspicion of contamination.

In 2008, three Transformers of 10-12.5 MVA, ALSTOM 1962, contaminated with small quantities of highly chlorinated PCBs (identified with Aroclor 1260) were decontaminated.

The dehalogenation process was used for the decontamination which prevents the creation of hazardous waste containing PCBs because the contained dielectric oil can be sold upon conclusion of the decontamination works as Waste Lubricating Oil to the Waste Lubricating Oil Alternative Management system, the Hellenic Solid Management Association (HSMA).

This process is implemented with the continuous flow of the insulating oil to be decontaminated through special catalysts in a closed circuit, with the continuous operation of the devices, which safeguards the re-use of the transformer within few hours if needed. Also the transformer body, if intended for disposal, can be sold as scrap material.



## 5.1.2 Asbestos

The actions initiated in previous years have continued. In order to guarantee the protection of employees' health. Non-friable asbestos products have been decommissioned from work places, although there is no relevant obligation set by the Law.

Significant quantities of asbestos-cement from the power plants of the West Macedonia Energy Center have been managed until the last stage of disposal by PPC, pursuant

to the related Joint Ministerial Decision for the Approval of Environmental Terms, with the use of the Best Available Techniques.

In the context of upgrading the operation of the cooling tower of Unit III of Megalopolis A' Thermal Power Plant, asbestos cement sheets, of overall weight approximately 4,500,000 kg, were replaced. They will be exported for the final disposal and the cost of the disposal procedure will arise to 1,500,000 Euros.

POSITION	ELAIDA	LAVRIO TPP	FALIRO TPP	AG. DIMITRIOS TPP	KARDIA TPP
WORK	ROOF DISMANTLING 2005	ROOF AND SIDE DISMANTLING 2007-2008	AREA RECLAMATION 2007-2008	COLLECTION OF FRIABLE ASBESTOS 2008	FRIABLE ASBESTOS COLLECTION 2008
KIND OF MATERIAL	ASBESTOS CEMENT	ASBESTOS CEMENT	FRIABLE ASBESTOS	FRIABLE ASBESTOS	FRIABLE ASBESTOS
SURFACE OR WEIGHT	304 m <sup>2</sup>	17,568 kg	1,000,000 kg	1,500 kg	4,500 kg
COST €	10,311	43,881	2,940,888	15,000	15,000
OWNER	NETWORK DEPARTMENT	TPPOD/ LAVRIO TPP	FACILITIES & REAL ESTATE SERVICES DEPARTMENT (FRESO)	TPPOD / AG. DIMITRIOS TPP	TPPOD / KARDIA TPP

WORKS WITH ASBESTOS MATERIALS

HEALTH & SAFETY DEPARTMENT/ TEDA

POSITION	DIMEON COAST, PATRA	N. FALIRO YSOF	ASPROPYRGOS BEACH	KALAVRYTA BEACH	TESTS-RESEARCH & STANDARDS CENTER (TRSC)
WORK	ROOF AND SIDE DISMANTLING 2007-2008	ROOF DISMANTLING 2008	ROOF DISMANTLING 2008	ROOF DISMANTLING 2008	ROOF DISMANTLING 2006
KIND OF MATERIAL	ASBESTOS CEMENT	ASBESTOS CEMENT	ASBESTOS CEMENT	ASBESTOS CEMENT	ASBESTOS CEMENT
SURFACE OR WEIGHT	1,000 m <sup>2</sup>	1,400 m <sup>2</sup>	28,000 kg	200 m <sup>2</sup>	200 m <sup>2</sup>
COST €	30,000	36,000	33,600	5,960	8,250
OWNER	PELOPONNESE- EPIRUS REGION DEPARTMENT (D/P-ERD)	TRANSMISSION MATERIAL & PURCHASING	DEPARTMENT (T/MPD)	TRANSMISSION MATERIAL & PURCHASING DEPARTMENT	PELOPONNESE- EPIRUS REGION DEPARTMENT TRSC

WORKS WITH ASBESTOS MATERIALS

HEALTH & SAFETY DEPARTMENT/ TEDA

### 5.1.3 Ni-Cd Batteries

The implementation of a program for the management and exportation of Ni-Cd batteries on the basis of the alternative management system SYDESYS (Alternative Battery Management System) continued.

The quantities to be disposed of are gathered in special collection bins in the units and after contacting SYDESYS, the collectors of the system collect and export them.

### 5.1.4 Management of other liquid hazardous waste

To date, a total of 87 tons of hazardous liquid waste have been decommissioned and exported abroad for processing.

This process belongs to a long-term contract that the Company has concluded with a private company licensed by the Ministry for the Environment, Planning and Public Works for cross-border transportation and distribution of hazardous waste.

### 5.1.5 Management of aqueous waste

All power plants have modern processing systems for their aqueous waste, pursuant to the Decisions for the Approval of Environmental Terms of each facility and the Best Available Techniques Reference Documents on Large Combustion Plants.

In 2008:

- The installation of a new modern liquid waste processing system at Units I-III of Megalopolis A' TPP was completed at the contractual price of 4.5 million Euros;
- The actions for the installation of a modern waste processing system at Syros Autonomous Power Plant, which was commissioned in the first semester of 2009, started and a similar project is planned for Mykonos Autonomous Power Plant.

Special care is taken both for the prevention of waste production, as well as for the recycling of clean aqueous waste.

Clean aqueous waste is disposed of either to natural surface recipients or underground, depending on the

position of the facility and the relevant approvals.

The quality of the processed aqueous waste is continuously monitored and the competent bodies are systematically informed pursuant to the Joint Ministerial Decisions for the Approval of Environmental Terms of the TPPs (annual reports, quarter exceeding reports), while the information in cases of exceeding the limit values, damage of the pollution control equipment, etc., is immediate (within 24 hours).

### 5.1.6 SF6 Management

The support actions which have been undertaken in previous years continued. We aim at the reduction of possible leaks to the environment through the control and training certification of the employees responsible for the management of devices containing SF<sub>6</sub>.



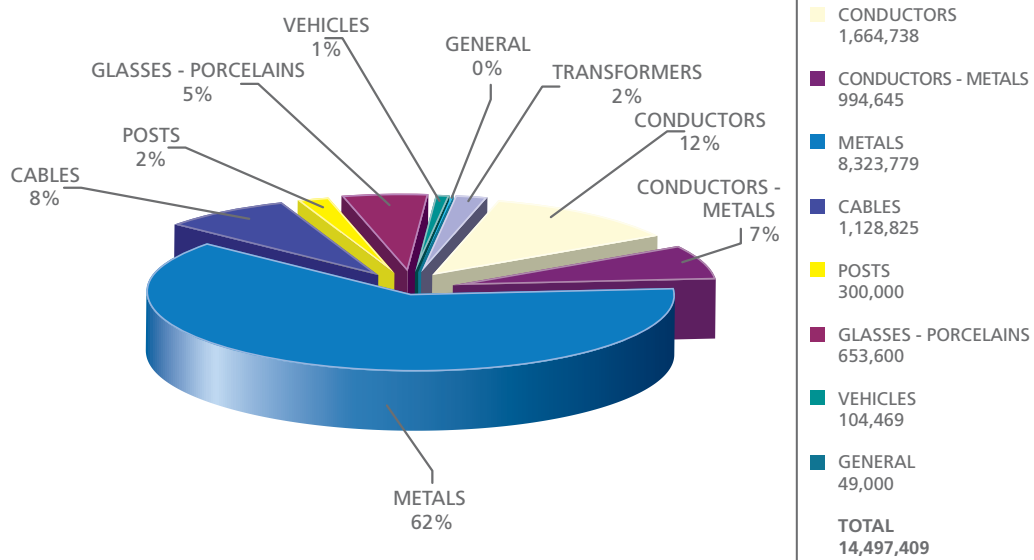


## 5.2 Non hazardous waste

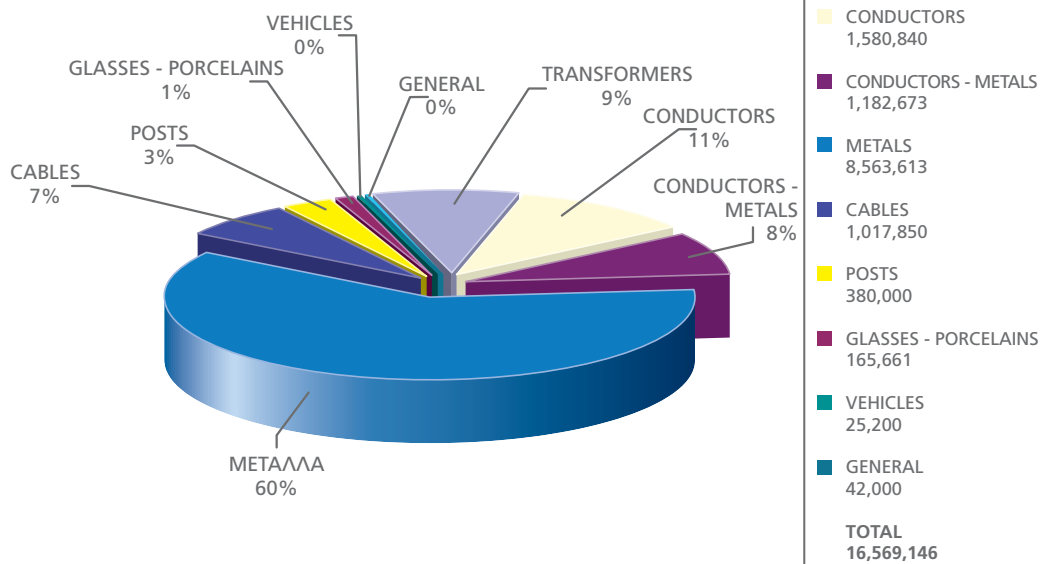
It is the management of other solid waste outside the scope of alternative management systems. In the course

of the period 2007-2008, a total of 31,000 tons of solid waste, mostly metals, was disposed of through specially licensed companies to be used as secondary raw material.

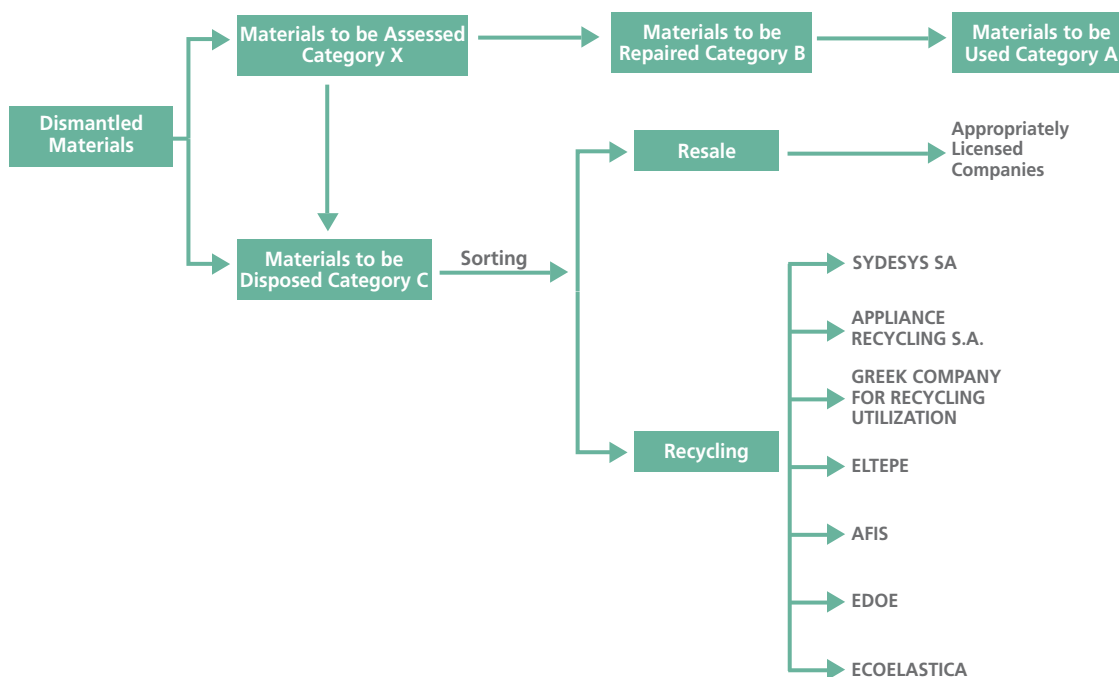
### SELL OUT OF MATERIALS IN KILOS IN 2007



### SELL OUT OF MATERIALS IN KILOS IN 2008



The management process of the materials to be recycled is carried out in PPC SA according to the following diagram.



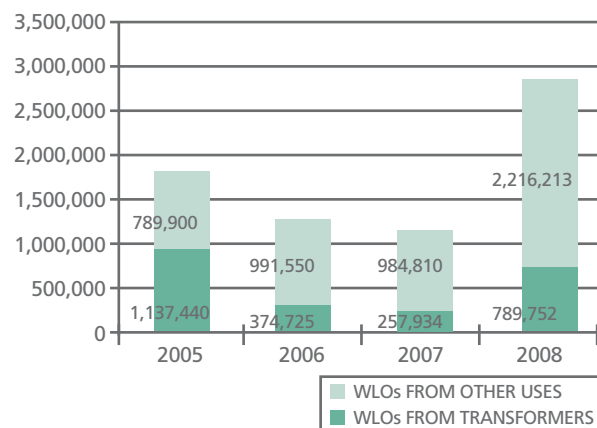
### 5.3 Alternative Management Systems

With the operation of the alternative management systems for packaging and other waste, as stipulated in Law 2939/Government Gazette 179A/6.8.2001 and the Presidential Decrees that followed, PPC SA was immediately integrated in most of the systems with central agreements which bind all its Units all over the country.

#### 5.3.1 Management of waste mineral oils

The actions undertaken in previous years still continue. In the framework of contracts signed by PPC SA and ELTEPE SA, the national collective alternative system of waste oil, Waste Oils of all types (lubricating, insulating, hydraulic, etc.) were collected and disposed of as shown in the following table:

WASTE LUBRICATING OILS (WLOs)



For the collection, control and selling of the used oils of the Distribution transformers, the construction of special facilities (drains) is in progress. Such an important project was completed in the Regional Warehouse at Rio and includes a small building for oil collection with approximately ten (10) simultaneous transformers and five (5) oil collection tanks so that its collection can be carried out without any leaking to the environment.

It has been stipulated that the new Substations will be provided with transformer deposit beds which are connected with tanks for the collection of the transformers' mineral oils and the prevention of their leakage to the environment in case of damage.

During the changing and filling up of lubricants carried out in the lignite mines, all necessary measures are taken in order to abolish leakages and collect the used lubricants in tanks located in areas of the lignite mines or first in barrels and then in tanks.

With regard to lubricant changes implemented in workshops, all necessary measures are taken for the collection of lubricants in appropriate containers first and then for their transportation to tanks.

### 5.3.2 Management of Pb-acid accumulators

As regards lead accumulators, they are recycled in the domestic market through the Alternative Management System, SYDESYS, and on a basis of a centralized contract for the disposal of lead accumulators on a continuous basis.

### 5.3.3 Management of portable batteries

As for portable batteries, the corresponding alternative management system, AFIS SA, provides services for the over five hundred (500) collection points of the Company in its work places.

### 5.3.4 Management of End-of-Life-Cycle Vehicles (ELVs)

The end-of-life- cycle vehicles are given to the Alternative Management System, EDOE (Hellenic Alternative Vehicle Management).

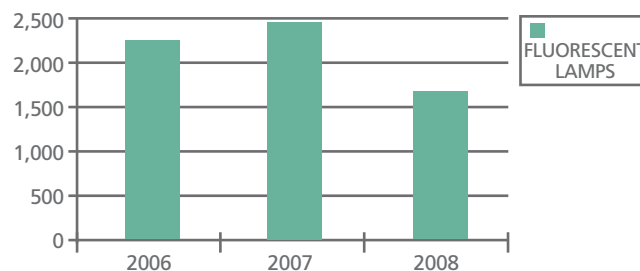
### 5.3.5 Management of used tyres

The worn tyres of the vehicles of the lignite mines, after their replacement, are transferred to appropriate places of temporary collection, and then they are given to a licensed company for their alternative management. This is done pursuant to Presidential Decree 109/2004 (Government Gazette 75/A/05-03-2004). Ecoelastica, a company approved by the Ministry for the Environment, Planning and Public Works (Government Gazette 1145/28.7.2004), undertakes the collection, temporary storage, transportation, exploitation and re-use of the tyres, including recycling (tyres up to 1,400 mm in diameter).

### 5.3.6 Management of Waste Electrical and Electronic Equipment (WEEE)

The disposal of WEEE through the related system ANAKYKLOSI SYSKEVON SA is of high priority for our company. Fluorescent lamps are already collected in special boxes and delivered to the collectors of the Alternative Management System.

#### FLUORESCENT LAMPS



Computers, white electrical appliances and other electronic instruments are also delivered to this system.

The delivery of house meters collected by the company is still pending, given that, due to the presence of semi-precious metals, there has been no agreement yet on their delivery price.

Finally, the Company actively participates in a decentralized way to projects for the recycling of paper and aluminum, inks from printers and photocopiers.



## 5.4 Management of by-products of lignite combustion

Lignite is the most important raw material used for power generation in the country. Fly and wet ash, as well as gypsum from the flue desulphurization complex are solid by-products of lignite combustion.

It is estimated that in the EU of the 27 Member States more than 90 million tons of such by-products are produced annually mainly by electricity companies. These by-products are widely used as additives in cement production, directly as a cement substitute, in road construction, restoration of exhausted mines, in the gypsum production industry, etc. Applications for the production of bricks and ceramics have also been mentioned and studies have shown that lignite ash can also be used as geopolymer or the management/ binding of toxic waste.

On the basis of the European Regulation REACH (1907/2006/EC), the quantities of these by-products found in the market must not be seen as waste but as chemical substances/ preparations. For this reason, the pre-registration procedure has been completed, while the registration procedures are in progress, pursuant to the Regulation's requirements, so that they can still be sold in the market after 2010.

Approximately 12 million tons of fly and wet ash were produced from PPC SA facilities in 2008. A 10% (1.2 million tons) were used by the cement industry and a 17-20% was used for road paving in the mines. The remaining quantity was used along with the waste materials for the restoration of exhausted mines and the stabilization of the declivities.

## 5.5 Management actions

The implementation of actions related to the enhancing of the application infrastructures of the environmental policy of the company and the related legislation continued and intensified. These actions include:

- Dealing with the legal challenges of the company with regard to environmental issues in collaboration with the divisions involved as the case may be;

- Provision of technical and procedural support to the central and regional Units on matters of waste management and transfer of the related know-how;
- Care for the supply of Units with the necessary equipment for temporary waste storage, pending collection, as well as with spill-control materials.

## 5.6 Safety Management Control

The Safety Management Control includes the following:

- Support to all Business Units in detecting, locating and managing hazardous and non-hazardous waste, as well as in keeping up-to-date records on PCBs, asbestos products, batteries, etc.
- Inspections and studies for the management of waste such as asbestos, PCBs, Ni-Cd batteries, etc.;
- Inspection and studies on environmental management pertaining to solid and liquid waste of the company;
- Studies on the environmental impact arising from hazardous and non-hazardous waste; and
- Proposal on the organization of the company's storage areas and the proper management of stored materials with regard to the impacts on the environment (separation, stowage, disposal).

Training and constant briefing of the company's personnel on the management of hazardous or non-hazardous waste. The following have been implemented:

- a. Republication of the manual "Guidelines on the Management of Hazardous and non-Hazardous Waste"
- b. Republication of a manual "Instructions on PCBs management"
- c. Creation of a training video on "Management of Waste Lubricating Oils"

During the construction and operation of its facilities, PPC strictly observes the requirements set by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) and the World Health Organization (WHO), guaranteeing the determined limits, with large safety margins.



# Chapter 6

## ELECTROMAGNETIC FIELDS

In accordance with the international and national regulations that integrate the results of the scientific research on human protection, it may be stated that the electric and magnetic fields of industrial network frequencies emitted by PPC's facilities present no health hazard as they are constantly below the limits set by the strict national and international regulations.

Due to their extremely low frequency (50 Hz), these fields transmit very low energy which cannot cause harmful thermal or genetic phenomena in living organisms. The intensity of these fields weakens gradually as the distance from their source increases and, therefore, the possible visual contact with electric lines does not necessarily mean burdening from an electric or magnetic field.

More specifically, the magnetic field values, which have been the subject of scientific research during the last 15 years due to their potential impact on human health, are tens to hundreds times lower than the limits set by the Regulations. It must be noted that in a distance of some tens of meters from the Transmission Lines axis, the values of both the electric and the magnetic fields are minimized and, practically, become zero.

The conclusions and the results of the scientific research on human protection after their weighing and acceptance are integrated in the regulations governing the study, construction and operation of technical works.

The most recent regulations in force are:

- a. The guidelines of the International Committee on Non-Ionizing Radiation Protection (ICNIRP - April 1998), which cooperates with the World Health Organization
- b. The Recommendation of the Council of the European Union 8550/5.7.99 "On the restrictions of public exposure to electromagnetic fields (0 Hz - 300 GHz), based on the ICNIRP directive"

The common limits of the ICNIRP guidelines and the recommendation issued by the Council of the European Union on the exposure of the public to frequency fields of 50 Hz are:

For magnetic induction:  $B = 100 \mu\text{T}$ .

For the intensity of the electric field:  $E = 5 \text{ kV/m}$ .

The limits mentioned above are in force in Greece in accordance with the Joint Ministerial Decision No 3060 (FOR) 238, Government Gazette 512 / B 25.4.2002: "Civilian protection measures against devices emitting low frequency electromagnetic fields".

The Hellenic Transmission System observes the limits of the abovementioned regulations. The observance of the maximum limits laid down in the regulations ensures human protection against electric and magnetic fields. The abovementioned limits are not considered risk limits, as they include very high safety factors in order to make up for any lack of clarity resulting from the limited knowledge about the field influence, as well as to meet the requirement for prevention of adverse effects. The issue of possible impact on human health caused by the electric and magnetic field of the High Voltage Transmission Lines has been for many years the concern of PPC, which closely follows international developments. PPC, during the Transmission System Study, chooses such methods so as to further reduce field values. By applying the appropriate optimal phase arrangement, considerable reduction is achieved in electric and magnetic field values. With the upgrading program of the single-circuit Transmission Lines to double-circuit Transmission Lines, we increase the transmission capacity of the specific Transmission Line and reduce the magnetic field because of the phase arrangement. Similar results are achieved by elevating Transmission Lines in areas where building construction came after the initial installation of Transmission Lines.

Both theoretical studies as well as measurements in transmission and distribution installations have shown that the field values are considerably lower than the limit laid down in the abovementioned Regulations.

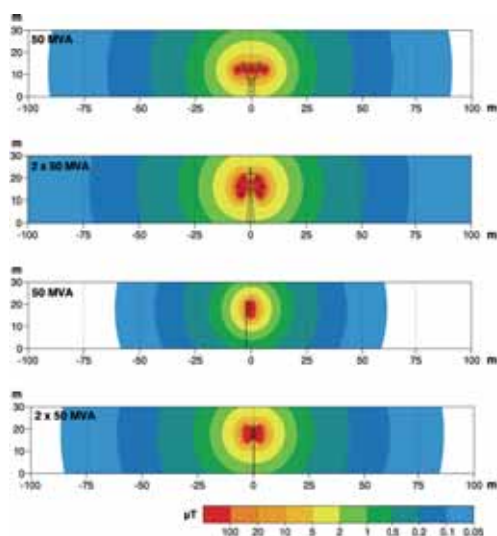
In case of complaints, on-site measurements of the fields are carried out in the specific PPC facilities both by the Transmission Division as well as the Greek Atomic Energy Committee (GAEC) which has been assigned as the overall competent organization for the measurements of electromagnetic fields. These measurements confirm our calculations and, many times, are lower than the limits set by strict regulations, confirming, thus, that PPC observes safety limits.



Below are some measurement results conducted by the Office of Non-Ionizing Radiation of the Greek Atomic Energy Committee and other university bodies:

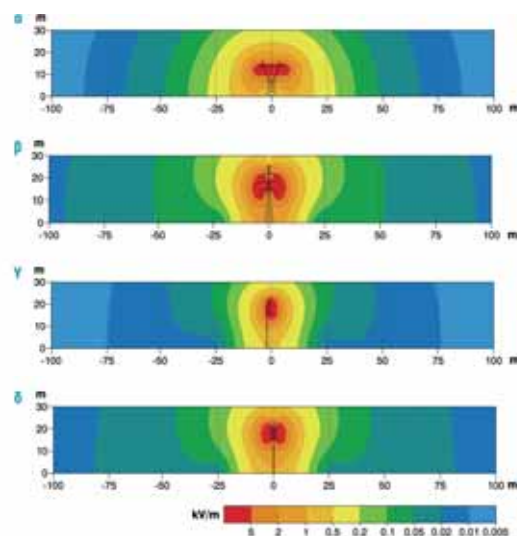
### Electric and magnetic field values at a height of 1.5m from the ground in an environment of overhead power lines

		MAGNETIC FIELD ( $\mu\text{T}$ )	ELECTRIC FIELD (V/m)
400kV (metal pylons)	Maximum value (under the conductors)	25	5000
	Typical value (under the conductors)	1-4	2000-4000
	Typical value (25 m alongside)	0.5-2	200-500
150kV (metal pylons)	Maximum value (under the conductors)	15	2000
	Typical value (under the conductors)	0.5-2	1000-2000
	Typical value (25 m alongside)	0.1-0.2	100-300
150kV (metal pylons)	Maximum value (under the conductors)	10	1200
	Typical value (under the conductors)	0.3-1.5	500-1000
	Typical value (25 m alongside)	0.05-0.2	50-100



Magnetic induction from 150kV overhead lines of the Hellenic Electric Power System

- a) single-circuit line with metal lattices during the transmission of power of 50 MVA.
- b) double-circuit line with metal lattices during the transmission of power of 100 MVA (2\*50 MVA).
- c) single-circuit line with towers during the transmission of power of 50 MVA.
- d) double-circuit line with towers during the transmission of power of 100 MVA (2\*50 MVA).



Intensity of electrical field caused by 150kV overhead lines of the Hellenic Electric Power System

- a) single-circuit line with metal lattices (power transmission capacity of 138 MVA or 202 MVA depending on the type)
- b) double-circuit line with metal lattices (total power transmission capacity of 404 MVA)
- c) single-circuit line with towers (power transmission capacity of 138 MVA or 202 MVA depending on the type)
- d) double-circuit line with towers (total power transmission capacity of 404 MVA)


In the above drawings, the height of towers and pylons is not realistic. The levels of the fields at a typical height (12m) of the lines closer to the earth, between two pylons are depicted.

**Electric and magnetic field values at a height of 1.5m from the ground  
in an environment of overhead power lines**

STUDIES \ VALUES OF FIELD INTENSITIES	Magnetic Induction ( $\mu\text{T}$ )	Intensity of Electric Field E (kV/m)
Measurements at Oinofyta Substation conducted by PPC SA	0.05 - 1.42	-
Study carried out by the University of Patras on the electric-magnetic field at the substations of 150/20kV	0.16 - 1.99	0.018 - 0.145
Report of the Greek Atomic Energy Commission of the Ministry of Development on Volos I Substation	0.019 - 1.648	0.022 - 0.524
Report of the Greek Atomic Energy Commission of the Ministry of Development on Ag. Vassilios Substation	0.195 - 0.852	0.018 - 0.379

**Electric and magnetic field values at a height of 1.5m from the ground  
in an environment of overhead power lines**

	Study of the University of Patras on the Extra-High Voltage Center of Lagadas		Study of the University of Patras on the Extra-High Voltage Center of Argyroupolis	
	MIN	MAX	MIN	MAX
Magnetic Induction ( $\mu\text{T}$ )	0.08	18.8	0.0092	10.2
Intensity of Electric Field E (kV/m)	0.03	4.47	0.0012	2.57



PPC, with its ecological consciousness, systematically cares for the harmonious co-existence of its activities with the surrounding area, by minimizing the aesthetic impact caused by the operation of its lignite mines and the development of Power Transmission and Distribution Facilities.





# Chapter 7

## AESTHETIC IMPACT – LANDSCAPE AESTHETICS

### 7.1 Land rehabilitation in lignite mines

Lignite exploitation, due to the geological and other characteristics of the deposits, is carried out with the opening of open-pit lignite mines. During the operation of lignite mines, the morphological and topographical features of the area are influenced, due to the nature of the project, by the excavation and deposition works.

PPC is fully aware that the restoration of the environment in its lignite mines is an issue of major ecological and social importance. For this reason during their operation as well as after they become exhausted, it implements land rehabilitation projects aiming at the creation of a relief similar to that of the initial natural landscape.

The basic restoration stages include:

- Leveling and smoothing of final surfaces so that topographic anomalies arising from the way the materials are deposited can be fully covered;
- Control of the declivities on the perimeter of depositions for the minimization of possible movements, erosions and landslides;
- Control of the fertility of new surfaces created by material deposition;
- Enhancement of land fertility with the enrichment of the surface layer with additional organic matter or chemical fertilization in selected sites;
- Treeplanting of declivities with forest species chosen bearing in mind their adaptability to the edaphic and climatic conditions of the region in combination with herbaceous species that create grassing, so that depositions can be immediately contained and regenerated;
- Creation of lands for agricultural use and cultivation and giving them to the inhabitants of the areas around the lignite mines; and
- Creation of infrastructures for the monitoring and protection of the newly treeplanted and agricultural areas including the appropriate road network, permanent or semi-permanent irrigation network, fencing, fire protection zones, points of water intake, observatories, emergency telephones, information signs, etc.

### 7.2 Environmental incorporation of the Transmission facilities

The Transmission System has a smaller or greater impact on the landscape depending on whether it is developed in urban, agricultural or forest areas.

The impact is taken into account during the studies on the expansion of the Transmission System and efforts are made to minimize it by means of proper siting of the new Transmission Lines (TL), Substations (SS) and Extra-High Voltage Centers (EHVC).



## 7.2.1 Transmission project design

The primary aim in choosing the routing of the transmission networks and the sites of the Substations and Extra-High Voltage Centers, apart from the safety criteria and technical- economic factors, is the minimization of the environmental impact. The siting of the projects is done in such a way so as to avoid or minimize nuisance and, therefore, the reaction of the public and of the competent bodies. This is why PPC seeks to meet the following criteria:

- Ensure the maximum distance possible between transmission lines and settlements so that the former do not interact with the man-made environment and select routing through infertile and bare areas
- Avoid as much as possible the areas protected under special status or characterized as areas of special natural beauty (RAMSAR wetlands, NATURA 2000, national parks, forests of special aesthetics, etc.), as well as areas where known archaeological sites are located.
- Construct Substations and Extra-High Voltage Centers at the load's center of gravity in order to avoid the installation of distribution lines of great length.
- Ensure that the nature of the soil at the site of Substations and Extra-High Voltage Centers is such that the minimum leveling interventions are required.
- The transmission projects must be near a suitable road network so that there is no need to build new roads for the transportation of heavy equipment.

Modern computer tools, such as GIS, CAD, etc., are used both for the pre-drawing of the new projects as well as for the final study. Furthermore, data and information are collected and processed by various bodies. In order to record the routing of the line at a pre-drawing level, a big volume of information is gathered aiming at the preparation of the "suitability map and exclusion zones" for the project's site.

These data are gathered and processed during the drawing-up of Environmental Impact Assessment Studies on Transmission Lines, Substations and Extra-High Voltage Centers might be the following as the case may be:

- Topographic maps of the Military Geographical Service.
- Orthorectified maps of the Ministry of Rural Development and Food.
- Land use maps of the Ministry for the Environment, Planning and Public Works.
- Maps for protected areas of the Ministry for the Environment, Planning and Public Works.
- Aerial and satellite photos.
- Data on areas of archaeological, cultural and tourist interest.
- Town planning maps and settlement boundaries.
- Climate data from the Hellenic National Meteorological Service (HNMS).
- Geological maps of the Institute of Geology and Mineral Exploration.

Another important tool is also the GIS system of the Transmission Division which provides data and information for the existing facilities of the Division.

Data processing allows for the optimal identification of the areas where the project shall be installed (influence zones) as well as the areas to be considered as forbidden (exclusion zones).

Then, a site inspection is carried out by engineers of the Transmission New Projects Department in the greater area and various sites are found in the pre-selected areas with the appropriate technical ground characteristics for the construction of the project.

Following the recording and evaluation of the special characteristics of all alternative sites, as well as the weighing of the advantages and disadvantages they present, a single site is selected as the proposed one.



## 7.2.2 Methods for harmonizing Transmission projects with the environment

PPC systematically addresses the issue of harmonious coexistence of the transmission system with the environment. The following methods are applied in order to reduce the visual impact of Transmission Lines, Substations and Extra-High Voltage Centers.

- **Transmission Lines, Substations and Extra-High Voltage Centers Siting**

Transmission lines, Substations and Extra-High Voltage Centers are installed near landmarks, such as forests, road networks, industrial zones, etc., but at a distance from isolated elements, such as houses, small bridges, etc. and, thus, the visual impact caused is reduced.

Furthermore, for aesthetic reasons, the parallel routing or crossing of the line with roads of considerable traffic is avoided. Agricultural roads are preferred in order to facilitate the construction and maintenance of the line.

Factors such as the region's climate conditions and geological background are of the utmost importance for an effective data analysis, as well as extreme weather conditions or crumbling soils that can cause damage to Transmission Lines and further interventions to the environment might be required. Areas with an existing agricultural or forest road network are chosen so as to avoid opening new ones.

- **Ridge routing**

The location of transmission line towers, their heights and lengths of the openings are selected on the basis of the soil's morphology and the specifications of the transmission line standard materials. Therefore, areas in high altitude and mountainous areas are avoided. Obstacles such as ravines, canyons, main roads, etc. are crossed in suitable locations. Hillsides are preferred but ridges and, in general, locations where there is an unobstructed view of the horizon are avoided.

- **Parallel Transmission Lines**

Efforts are made to install transmission lines at short distances from the already existing ones and the pylons to be placed in parallel positions, so as to enable the merging of several lines into one multiple-circuit line,

provided that this does not cause a significant alteration to the landscape. This avoids the dispersion of lines in a large area and to the reduction of visual nuisance from a distance.

- **Integration of Transmission Lines into the Forest Environment**

In the event that the Transmission Line passes through forest areas or other dense vegetation, steel towers are painted dark green so that they blend with the environment in the most satisfactory way.

During the maintenance of the existing network, the insulators are cleaned and some trees are cut in order to maintain the necessary safety gap, helping, thus, to avoid fires.

- **Construction of towers in compliance with aesthetic requirements**

A systematic international study is carried out in order to ensure the aesthetic harmonization of the towers with the environment.







The objective is that transmission towers will be considered elements that embellish the surrounding area in the same way as vegetation or a beautiful and stylish building, etc. The following are considered criteria of aesthetic construction:

- Simplicity of the form consisting of delicate elements with no visible connections;
- Harmonious balance between the various parts of the construction.
- Unobtrusive forms so that the construction (tower) can be integrated into the environment or will attract positive attention due to its architectural design.
- Underground installation of parts of new Transmission Lines in order to reach existing Substations situated within settlements or in order to pass through urban areas, wherever possible.

• **Way of construction and maintenance;**

Construction and maintenance are planned in such periods so as to have the minimum possible impact on

the natural environment and cultivations. With the use of appropriate vehicles and work methods, both the interventions in the natural environment, as well as the nuisance to cultivations are reduced and in the event of agricultural damages, the legal compensation is paid.

More specifically, with the agreement of the competent Forest Authority, roads of approximately 4m width are opened during the construction in order to meet the temporary needs of construction and materials that do not disintegrate when left in nature are avoided.

Vehicles and machinery used to construct the project are specially designed to use all terrain (All Terrain Vehicles) and, generally, there is no need for a big intervention in order to achieve the necessary accessibility.

Dirt roads are created, which, given the fact that they will not be used afterwards, will be integrated again into the environment within a small period of time after completion of the project.



In any case, the competent Forestry Authority sets specific restrictions and terms as regards the creation of roads so as to minimize the adverse effect on the environment and the possibility of their further use as fire-protection roads.

Furthermore, before and after the commencement of works, there is cooperation with the forestry authorities. In addition, archaeologists are hired at PPC expense in order to locate any antiquities not immediately visible. If antiquities of any kind are found, PPC complies with the recommendations of the competent bodies. All the equipment used is environmentally friendly pursuant to the latest regulations of the International Electrotechnical Commission (IEC).

Care is taken so that the work sites for the construction of projects of Transmission Lines and Substations are located outside protected areas included in the Natura 2000 network and outside regions characterized as priority habitats according to the European Community directive 92/43/EEC.

- **Transmission Lines of reduced dimensions**

Such lines make a considerably reduced contribution to the environment as regards visual impact as their body has smaller dimensions, not visible from a long distance.

Furthermore, the land required for their foundation is smaller and, thus, a smaller part is neutralized, a fact, especially important for urban areas or areas presenting special natural beauty.

During the upgrading of single circuit transmission lines and their replacement by double circuit ones, PPC tries to install the new pylons in the already expropriated sites of the existing pylons so as not to cause any further nuisance. Thus, in many cases, "narrow" towers have been installed in a number of upgraded lines.

Depending on the technical conditions, special poles are used, mainly in urban areas, in order to reduce the impact. Moreover, research is underway for a more significant reduction of the volume of transmission lines, while ensuring the same level of reliability.

- **Substations of reduced dimensions**

The increased demand of cities for high quality electric power and the need to minimize visual impact resulted

in the design and construction of new high-voltage substations of closed type (located within buildings). Such substations (GIS) are better integrated into the environment, as their equipment of 400kV or 150kV and 20kV is installed within a building.

Such substations operate today in various major European urban areas. Their supply is underground, given that it is impossible to pass high voltage overhead lines in densely populated areas.

Similar closed type substations have been in operation in Athens since the early 70s. Today, there are fourteen (14) such substations in Attica, one (1) in Thessaloniki, one (1) in Atherinolakkos, Crete, and one (1) in Rodini, Rhodes, that operate with remarkable results. Moreover, since 1994, a part of the open type substations (the 20kV side) has been installed within a building.

In spite of the high cost involved, PPC intends to construct such substations in densely populated areas or areas to be developed in the future or in ecologically sensitive areas.

- **Marking spheres**

PPC places special spheres on the Transmission Lines so that passing airplanes can distinguish them. Their manufacturers support that they are also useful for the marking of powerlines so that birds do not crash on them. For this reason, wherever deemed necessary on the basis of environmental terms, marking spheres are used.

Moreover, the powerlines are placed in such a way so that the gaps between them are big enough to allow for the passage of birds.







- **Treeplanting of Substations – Extra-High Voltage Centers**

PPC creates green belts with fast-growing trees along the fence of Substations and Extra-High Voltage Centers so that there is no visual contact with the facilities, offering thus an air replenishment area to the surroundings, contributing thus to its upgrading. In addition, electric elements of neutral color and environmentally friendly are to be used in the new Substations and Extra-High Voltage Centers.

- **Changes of existing facilities**

Showing respect to the cultural development, PPC undertakes the harmonization cost of the Transmission Lines to the environmental demands of each region by applying changes of its existing facilities such as:

- Removal of existing lines during their upgrading from residentially developed areas or areas of cultural interest (Asprovalta, Stavros); and
- Replacement of pylons with poles in areas of intense residential development or special cultural interest provided it is technically possible (Aigio, Pallini, Thouria, Knossos, 3 lines of parallel poles).

### 7.2.3 Elaboration of special studies – Seeking new technologies

- Wiring of Transmission Lines with the use of helicopters instead of conventional methods, reducing, thus, the environmental impact (e.g. 150 kV Soronis-Aphantos Transmission Line – Gennadios Substation, 150 kV Argos II – Astros Transmission Line, 150 kV Corinth – Patras Transmission Line);
- Assigning the preparation of studies to University Institutes for the measurement of electric and magnetic fields in various types of Transmission Lines;
- Following up technological developments for the use of new cables, insulators and, in general, construction materials of better performance and more environmentally-friendly; and
- Creation of a work group comprising scientists of various specializations for a more environmentally proper study of the new Transmission Lines.





## 7.2.4. Environmental upgrading of Distribution facilities

### • Use of overhead insulated cables

PPC has initiated the use of insulated cables at low voltage almost over 20 years ago. Overhead insulated cables have fully substituted bare conductors in the new low voltage networks.

An essential advantage arising from their use is the significant reduction of the required tree pruning in the vicinity of these networks. Today, a low voltage network of approximately 40,000 km with overhead insulated cables (about 40% of the total overhead network) is installed. Moreover, overhead insulated cables have been standardized for medium voltage networks which are installed in forest areas so as to reduce tree cutting.

### • Compact Substations

Instead of two-pole constructions, the Distribution Division installs compact substations in areas with high aesthetic environmental demands, such as squares, traditional settlements, etc. These compact substations are small kiosks, with well-designed exterior, in which the required equipment for the operation and protection of a medium/low voltage substation is installed.

### • Underground networks

In settlements of high importance from a cultural or tourist perspective (e.g. traditional settlements), as well as in certain city centers with a continuous building system, narrow streets and chaotic town development, the overhead distribution networks are one of the factors that aesthetically burden the environment.

In these cases, PPC has implemented for 6 years (1996 - 2002) a program for making its networks underground in cooperation with local authorities (mainly Organizations of Local Authorities). The total cost of underground network projects to date amounts to approximately 26.5 million Euros and PPC has co-financed them with a contribution of approximately 13 million Euros. In 2008, PPC re-activated the program of aesthetic upgrading (underground networks) of the distribution networks.



### • Closed type substations

As it is known, electric power is transmitted from the power plants to positions near consumption centers (cities, etc.) via high voltage networks. In these positions, the voltage is reduced from high to medium in order to be distributed to consumers through medium voltage networks, distribution substations and low voltage networks.

The facilities used by PPC in recent years in order to reduce high voltage to medium voltage, near or inside big urban centers are the Distribution Centers, that is, closed type Gas Insulated Substations (GIS) of high/medium voltage.

These Substations are of much smaller size compared to the open-air ones. Moreover, their operation is more reliable because they are not influenced by external factors, have no aesthetic impact on the surrounding area and are perhaps the only possible choice for densely populated areas.

During the drawing up of the specifications of the technical requirements as well as during equipment operation, the appropriate measures are taken in order to guarantee its safe operation. The following centers are already in operation: 14 Distribution Centers in Attica, one (1) in Thessaloniki and one (1) in Rhodes. Moreover, two (2) more Distribution Centers are scheduled to be constructed in Thessaloniki and one (1) in Rhodes.



PPC strictly observes the permissible noise limits pursuant to the law in force and takes measures for the protection of the public and its employees from the noise.





### 8.1 Protection measures from the noise caused in lignite mines

The noise created in the area of lignite mines comes from the operation of the machinery during the excavation, deposition and breaking of the lignite and the construction of infrastructure works required for the smooth operation of lignite mines (crews, roads, trenches, water accommodation, etc.).

In order to reduce noise, measures are taken pursuant to the Mining and Quarrying Activities Regulation (MQAR) and the related European Community and national legislation in the implementation framework of the Joint Ministerial Decisions on the Approval for Environmental Terms and Conditions for the exploitation of lignite mines.

Sound barriers made of earth are constructed in order to minimize the noise disturbance of the residents of the nearby settlements, while necessary measures are taken for the protection of the employees such as:

- Use of equipment that complies with the appropriate specifications as regards noise emission;
- Observance of the specifications for the proper operation of the machinery;
- Regular maintenance of the mechanical equipment;
- Observance of the permissible limits of acoustic power on the basis of the Joint Ministerial Decision 37393/2028/2003 (Government Gazette 1418/B/01.10.03); and
- Provision of individual protection means (e.g. earplugs) for all employees who, due to the nature of their work, are often exposed to high levels of noise.

A modern mobile station for measuring noise and vibrations is used in the lignite centers in order to keep records of noise pollution and its management.





## 8.2 Management of noise in power plants

According to the Joint Ministerial Decisions on the Approval of Construction and Operation of Power Plants, all necessary sound insulating and shock proof measures are taken in order to observe the permissible noise level which at the borders of the Power Plant land is 55db(A) in mixed areas with the residential element prevailing or 65db(A) in mixed areas with the industrial element prevailing.

In case of exceeding the permissible limit, supplementary noise protection measures are taken. During the operation of the Power Plants, care is taken so that the doors and windows of the workshops stay closed in order to drastically reduce noise.

Noise studies are implemented in the Autonomous Power Plants and Local Power Stations on the Islands using type I measurement instruments, pursuant to the international and national standards (ISO 1996/73 part I, part II & part III and ELOT 360).

On the basis of these studies and the provisions of the Joint Ministerial Decisions for the Approval of the Environmental Terms and Conditions for their construction and operation for the period 2008-2009, sound-reduction projects have been scheduled and are in progress in the Autonomous Power Plants of Lesvos and the Local Power Stations of Symi, Sifnos, Patmos and Agathonisi. These projects include interventions in the existing buildings of the engine rooms, where at the same time, new sound insulated Power Units are installed.



## 8.3 Low noise levels in Transmission facilities

As regards the noise produced in the facilities of the Transmission System, although low, it can be produced by the Substations, the Extra-High Voltage Centers and the Transmission Lines:

### Noise from Substations- Extra-High Voltage Centers

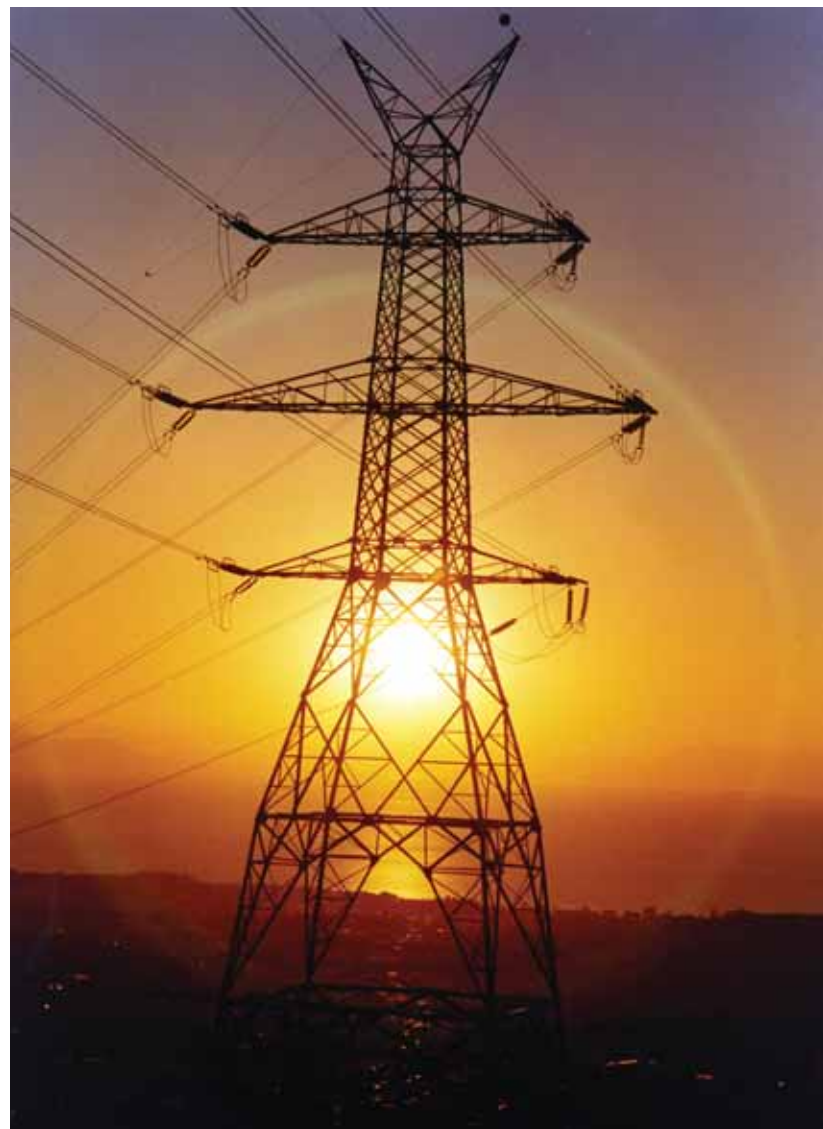
The noise-producing sources of Substations - Extra-High Voltage Centers are mainly transformers or autotransformers due to the vibration of the windings and the operation of the cooling ventilators. On the basis of specifications, the total noise level at the border of Substations- Extra-High Voltage Centers does not exceed 50 db. This noise limit also applies to the vicinity of Substations - Extra-High Voltage Centers pursuant to Presidential Decree 1180 / 06.10.81.

### Noise from Transmission Lines

Under normal operating and good weather conditions, transmission lines do not emit any perceptible noise. Nevertheless, whenever noise is created, it can be the result of the following phenomena:

- Noise due to the CORONA phenomenon: The CORONA phenomenon is an electrical phenomenon and when it occurs on a high voltage Transmission Line, it produces a characteristic "crackling" sound. The main factors that determine the intensity of this noise are the voltage of the line, the distance from the line and the weather conditions. The noise generated by the CORONA phenomenon is more intense in humid weather and decreases in normal weather conditions.
- Noise produced by the wind: This noise is mainly created by the incidence of the wind against the metallic elements, the insulator chains and the conductors of the line. The occurrence of this noise is independent of the operation of the Transmission Line.


The noise limits for both types of noise mentioned above are lower than those set by the Joint Ministerial Decision 37393/2028/2003, and its recent amendment by Ministerial Decision H.Π. 9272/471/07 (Government Gazette 286/B/02.03.07), harmonizing Presidential Decree 1180/06.10.81 on noise emissions into the environment



(article 2, table1) with the European Union's Directives 2003/10/EC. The spatial and time limits are restricted and do not, in any way, result in the exposure of humans to a high level of noise.

During the construction works of Transmission Lines, Substations and Extra-High Voltage Centers, the animals of the area, mainly birds, may leave the area due to the noise. Experience has shown, however, that once such projects are completed and the tranquility of the area is restored, the animals return.





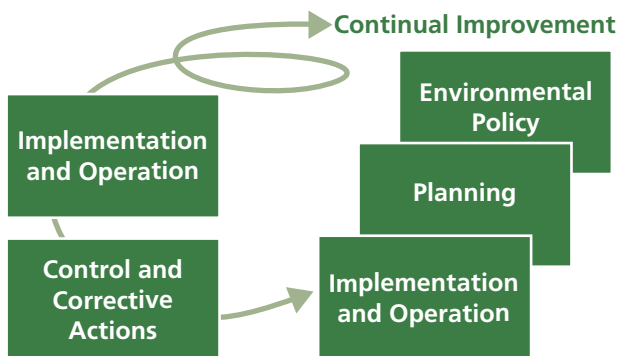
The value of certification of the Environmental Management Systems for Power Plants and Lignite Centers is now widely recognized and for this reason it is the primary aim of the Environmental Policy of PPC.





### 9.1. Environmental Management Systems

The Environmental Management System (EMS) is the part of the overall management system of a company that includes the organizational structure, planning activities, responsibilities, practices and resources for the development, implementation, continuous evaluation and maintenance of the environmental policy of the Company. In other words, it is a methodology of systematization of the procedures of a Company aiming at the improvement of its environmental, social and financial performance.



The principles of EMS are presented as follows:

In order to implement and continuously evaluate its Environmental Policy, PPC promotes gradual certification according to ISO 14001:2004 of the existing internal EMS of all Power Plants and Lignite Centers. The certification procedure, according to ISO 14001:2004, of the Environmental Management Systems of the Thermal Power Plants (TPPs), the Hydroelectric Power Plants (HPPs) and Lignite Centers started with the certification in 2006 of Aghios Dimitrios TPP (the biggest lignite-fired Power Plant of the country) and Chania TPP (oil-fired). Then the certification of the EMS of the West Macedonia Lignite Center (WMLC) followed in June 2007 and the lignite-fired TPPs of Kardias, Amyndeon and Meliti in February 2009. The certification of the EMS of seven (7) more TPPs is expected to be completed in 2009 (Komotini, Aliveri, Lavrio, Keratsini, Megalopolis A, Megalopolis B and Rhodes) and 2 HPPs (Nestos and

Ladonas) and the certification of the remaining TPPs and HPPs, Autonomous Power Plants and Megalopolis Lignite Center will follow.

The Development and Implementation of an EMS according to ISO 14001 in the facilities mentioned above includes the following:

- Definition of the Environmental Policy of the Power Plants and Lignite Centers;
- System Planning;
  - Identification of the activities of Power Plants that interact with the environment and evaluation of their environmental aspects;
  - Definition of the environmental objectives and targets of the facilities, as well as of the actions to be taken so as to improve the environmental performance of Power Plants and to create environmental management programs- actions and a timetable for their implementation.
- Implementation and operation of the EMS, including, inter alia, the special training of the personnel of the facility participating in the EMS implementation;
- Internal audits and Corrective Actions;
- Review of the EMS by the Environmental Management Committee of each Power Plant.



## 9.2 Environmental Training of Generation Division's Managers

The intensification of the personnel's briefing and training, aiming at the improvement of the company's environmental image in matters of generation environment takes place in collaboration with the Communications and Training Departments and includes:

- Elaboration and implementation of training programs for the competent personnel on Environmental Legislation issues (National, European and International), the forthcoming developments and the application of the Environmental Management Systems in Units and Power Plants;
- Briefing of the competent managers on the Environmental image of the Company and implementation of a regular meeting schedule for the exchange of experience and proposals aiming at improving internal communication; and
- Internal conferences on specific environmental issues.

Most of the managers staffing the Departments of the Generation Division and Thermal Power Plants in charge of environmental management issues have already attended specialized environmental seminars and obtained the title of Environment Auditor, approved by the Institute of Environmental Management and Assessment (IEMA).

Moreover, the Generation Division systematically promotes the training of the Company managers on current environmental issues. In 2008, the following were held:

- Seminar on "Technological potential for the reduction of greenhouse gas emissions – Possibilities of their application in Greek companies"

In the framework of the program "Human Research and Technological Training Networks - 2nd Cycle", a seminar on "Technological potential for the reduction of greenhouse gas emissions - Possibilities of their application in Greek companies" was held by PPC and the Center for Research and Technology Hellas (CERTH)/ Institute of Solid Fuels Technology and Applications (ISFTA) with great success.



The program is financed by the 3rd Community Support Framework, Operational Program "Competitiveness". The coordinator of the 5-day seminar was the Generation Environment Department and 22 employees of the company were trained in total. The speakers were PPC executives, members of the CERTH/ ISFTA and the special guest, Mr. John Gale, General Manager of the International Energy Agency GHG R&D Program.

The objective of the program was training on issues of CO<sub>2</sub> capture and storage and knowledge transfer to the Greek companies. A wide range of issues, which are briefly shown below, was presented in the seminar:

- Presentation of existing state-of-the-art technological development on CO<sub>2</sub> capture and storage.
- Findings of research programs on CO<sub>2</sub> capture and storage and expected technological developments.
- Financial evaluation of technologies and feasibility of application.
- The legislative framework to be developed.
- Clean carbon technologies.
- Kyoto protocol and flexible mechanisms .
- EU ETS 2008 – 2012 and post Kyoto period.
- Connection of trading system with CO<sub>2</sub> capture and storage technologies.

- Presentation on the “European Regulation REACH - PPC’s obligations as producer, supplier and user of chemical substances”.

In the framework of the obligations arising for the Company from the application of the European Regulation REACH (1907/2006/EC), due to its activities as producer, supplier and user of chemical substances, a presentation was held on 28.11.2008, with the initiative of the Generation Environment Department, on the “European Regulation REACH - PPC obligations as producer, supplier and user of chemical substances”.

The presentation was made by managers of the Generation Environment Department and Ms I. Aggelopoulou, Head of the Department of Hazardous Substances, Preparations and Objects of the Environmental Department of the General Chemical State Laboratory (GCSL), as representative of the national helpdesk for the Regulation REACH of the competent national authority.

Approximately 40 company managers attended the presentations and the discussion that followed.

Reference was made to the pre-registration and registration procedures of chemical substances produced and distributed on the market by PPC (ash) as well as to the actions required by the chemical substances suppliers of PPC in order to allow the marketing of the substances and their use by the Company.

Following the presentation, there was continuous briefing of the competent PPC managers, whenever required, as regards all developments taking place in the framework of the registration procedures of chemical substances.

### 9.3 Laboratory Management Systems

The ISO 17025:2005 standard includes specialized technical requirements concerning:

- Verification of test methods,
- calibrations, controls and internal verifications of the test equipment,
- participation in test evaluation procedures,
- calculation of measurement uncertainty,

- internal quality control.

PPC has a laboratory certified according to ISO 17025:2005 in the South System (Megalopolis) and a laboratory that is going to be certified in the North System.

For the past 25 years, the Tests - Research and Standards Center (TRSC) has been responsible for the quality control and reliable operation of PPC by performing inspections of the equipment and facilities of the company. TRSC laboratories attempt to find solutions to environmental problems in compliance with the Greek law and EU directives.

The sixteen (16) modern laboratories of the TRSC perform tests, controls and analyses of the materials, machinery, expendables, supplies and equipment. Furthermore, the TRSC is involved in activities such as accreditation, inspections of the materials and equipment acceptance, opinion issuing, applied research, updating of specifications and calibration of measuring devices.

Apart from the certification with the International Standard ELOT EN ISO 9001:2000, the TRSC has a big number of analyses, controls and tests certified with the ELOT EN ISO/IEC 17025:2005 standard.







PPC SA plays an important and pioneering role in the achievement of the energy policy of our country regarding the Renewable Energy Sources (RES).



# Chapter 10

## RENEWABLE ENERGY SOURCES

PPC SA started being active in the RES field in the 70s by carrying out measurements of the wind and solar potential of the islands and the mainland. Moreover, it continued the research for the development of geothermal energy. The first facilities based on the three basic energy sources (solar, wind and geothermal energy) were constructed at the beginning of the 80s, when PPC SA was the only Company involved in the development of the RES. The experience acquired from the first PPC projects was very useful for other facilities in the RES field. As of 2006, PPC Renewables SA, 100% subsidiary of PPC SA, has taken over the management of projects exploiting the RES.

### PPC Renewables SA

PPC Renewables is today the only Greek company active in the four main RES fields (Wind, Hydroelectric, Solar and Geothermal). Its scope is power generation with zero impact on the environment. Furthermore, the company studies and develops innovative solutions in alternative power generation sectors, such as hybrid systems and bio-fuels.

With a vast portfolio of installed projects and projects to be developed and in the process of study, the company aims at achieving the leading position in the field and, moreover, through its socially responsible actions, it creates a cleaner, ecological and safe environment for the future generations.

Today, the company has 105 MW installed capacity in Wind Parks, small-scale hydroelectric plants and photovoltaic plants, 90MW of projects are under construction or near the construction phase and many other projects are in various study and development stages. In 2008, through the operation of the company's power plants and parks, the generated "green" energy arose to 203,000 MWh. The environmental benefits arising from PPC Renewables projects are many, but the most important is the fact that their operation prevents CO<sub>2</sub> emissions and, thus, reduces, to a large extent, the impact on the environmental chain. Furthermore, PPC Renewables participates in the financial development of the country and its projects upgrade the quality of life of local communities all over Greece. New jobs, improvement of the existing infrastructures and development of new ones, energy autonomy and tourist strengthening are just a few of the benefits arising from the activities of the company at a local level.

With respect to mankind and the environment, with a spirit of cooperation and with the attention turned to the generations to come, PPC Renewables takes steps towards the energy future of the country.

### Hydroelectric Energy

PPC Renewables SA exploits the power of water as a driving force for the operation of Small-scale Hydroelectric Plants and the generation of "green" energy. Its portfolio today includes 13 Small-scale Hydroelectric Plants in operation and 5 more under construction. The total installed capacity of its projects comes up to approximately 61 MW, and with the completion of the five (5) new Small-scale Hydroelectric Plants, 15.1 MW shall be added.

#### Small-scale Hydroelectric Power Plant

Small-scale Hydroelectric Plants	Region	Capacity (MW)
Louros	Preveza	10.3
Giona	Amfissa	8.4
Stratos II	Agrinio	6.3
Makrochori	Veria	10.8
Glafkos	Patras	3.6
Vermio	Veria	1.5
Almyros	Chania	0.3
Ag. Ioannis	Serres	0.7
Gitanis*	Igoumenitsa	2.1
Voreinos*	Aridea	2.1
Smokovo	Karditsa	10.4
Ag. Varvara	Veria	0.9
Eleousa*	Thessaloniki	3.2
<b>TOTAL</b>		<b>60.6</b>

PPC Renewables has scheduled the completion of the construction of Papadia Small-scale Hydroelectric Plant (Florina) in 2009. The Small-scale Hydroelectric Plant of Ikaria Hybrid Project, Ilariona Small-scale Hydroelectric Plant (Kozani) and Alatopetra Small-scale Hydroelectric Plant (Grevena) are expected to have been completed by 2010. Finally, the operation of Mesochora Small-scale Hydroelectric Plant is expected to start in 2011.



## Environmental Benefits of small-scale Hydroelectric Power Plants

- It is estimated that from the operation of the Small-scale Hydroelectric Plants in 2009 alone, the total emission of 150,000 tons CO<sub>2</sub>, 1,750 tons SO<sub>2</sub> and 302 tons of NO<sub>x</sub> and 153 tons of suspended particles shall be averted.
- Agias and Almyros Small-scale Hydroelectric Plants in the Prefecture of Chania are projects of high environmental importance as their reservoirs, characterized as protected Natura areas, have especially developed fauna and flora and offer shelter to rare species of birds, fish and amphibians.
- In the case of Aghia Varvara, the Project's area was environmentally upgraded –an area that in the past operated as a landfill- with the removal and sanitary leveling of hundreds of thousands of tons of rubbish. A significant wetland was thus created in the region of Veria and, moreover, the Delta of the Aliakmonas River, with its diverse flora and fauna, was supported.

- The Lake of Agia, a favorite tourist and educational excursions destination in Crete, with Agia Hydroelectric Power Plant, were conceded in May 2009 to the Prefectural Authorities of Chania, proving, thus, in practice the interest of PPC Group for close cooperation and support of local communities.
- The landscaping in the region of Stratos HPPs allows for sea sport activities (rowing, water ski), downstream of Stratos II Small-scale Hydroelectric Power Plant, while the development of recreational activities is also favoured, especially in the areas around Louros and Stratos II Small-scale Hydroelectric Power Plants.
- Cultivating a feeling of respect towards the water, special areas have been created in the historical Glafkos and Aghios Ioannis Power Plants in order to promote and highlight the versatile value of the water for people.

## Small-Scale Hydroelectric Power Plants under Construction

Small-scale Hydroelectric Plants	Region	Capacity (MW)
Papadia	Florina	0.5
Ilarionas	Kozani	4.2
Mesochora	Trikala	1.6
Ikaria	Ikaria	6.5
Alatopetra*	Grevena	2.3
<b>TOTAL</b>		<b>15.1</b>

\* Gitanis, Voreinos, Eleousa and Alatopetra Power Plants belong to PPC Renewables subsidiaries and the mentioned capacity is the percentage that corresponds to PPC Renewables





## Solar Power

Solar power is an energy source that can never be depleted in a country, with so much sunshine as Greece. PPC Renewables exploits solar energy for power generation through two (2) Photovoltaic Parks that operate in two (2) island regions of the country, Sifnos and Kythnos. Kythnos Photovoltaic Park, which was created in 1983, was the first project of this kind in Europe. As of the first year of its operation to date, it is estimated that 3,380 MWh have been generated, equalling to a reduction of 2,332.2 tons of CO<sub>2</sub>, 35.4 tons of SO<sub>2</sub> and 6.8 tons of NO<sub>x</sub>.

The total installed capacity of PPC Renewables Photovoltaic Parks is 160 KW. Today, the company proceeds with the development of one of the biggest Photovoltaic Parks in the world, in Megalopolis.

The total capacity of the park will be 50 MW and it is estimated that its power generation will meet 42% of the energy needs of the Prefecture of Arcadia, which practically means 28,000 households. The project's contribution to the protection of the environment will be valuable, as approximately 65,000 MWh/ year will be generated and the emission of 65,000 tons of CO<sub>2</sub>, 680 tons of SO<sub>2</sub> and 131 tons of NO<sub>x</sub> annually will be avoided. Moreover, the project is the first step towards the promotion of the area to an energy center of RES in our country.

## Photovoltaic Parks in operation

Photovoltaic Park	Capacity (kW)
Kythnos	100
Sifnos	60
<b>TOTAL</b>	<b>160</b>

## Photovoltaic Parks under or near Construction

Photovoltaic Park	Capacity (kW)
Photovoltaic Atherinolakkos Crete	480
Photovoltaic ISAP IRENE STATION	20
Photovoltaic ILPAP	20
Photovoltaic ETHEL	20
Photovoltaic Xirolimni Crete	720
Photovoltaic on roofs of PPC buildings	240
Photovoltaic in Schools of the Municipality of Athens	260
Photovoltaic on the roofs of buildings of the Ministry of Development	40
<b>TOTAL</b>	<b>2,160</b>



## Wind Power

PPC Renewables exploits wind power by creating Wind Parks on Greek Islands. Apart from the environmental benefits arising from this specific activity, the creation of Wind Parks on islands, such as Crete, Leros, Karpathos, Samothrace, is extremely important as in this way their energy autonomy is supported. It is indicative that the operation of a 10 MW Wind Park can provide the annual equivalent electric power for 7,250 households and contributes to saving the equivalent of approximately 7,000 tons of oil.

In total, the installed capacity of PPC Renewables Wind Parks comes up to approximately 44 MW. In 2008, power generation came up to 92,000 MWh and, as a consequence, the operation of the Wind Parks prevented the emission of 63,652 tons of CO<sub>2</sub>, meeting the needs in energy of 20,500 Greek households.

Finally, the company is planning the development of new projects with a total capacity of approximately 49MW. Among these projects, there are nine (9) Wind Parks on Rhodes, Paros, Lesvos, Sifnos, Crete, Lemnos and Samos, to be completed by 2010.



## Wind Parks in operation

Wind Park	Region	Capacity (MW)
Kythnos	Koukouvagia	0.5
Kythnos	Chora - Myloi	0.17
Limnos	Vounarou	0.44
Samothrace	Akrotiri	0.22
Karpathos	Ag. Ioannis	0.28
Limnos	Vigla	0.7
Ikaria	Perdiki	0.39
Evia	Marmari	5.1
Samos	Pythgoreio	2.03
Lesvos	Sigri	1.80
Samos	Marathokampos	0.9
Chios	Melanios	2.48
Chios	Potamia	1.0
Psara	Prof. Elias	2.03
Xirolimni I	Crete	4.8
Xirolimni II	Crete	5.4
Xirolimni III	Crete	3.0
Toplou Monastery	Crete	6.6
Kos - Leros	Dodecanese	4.12
Andros	Kalyvari	1.58
<b>TOTAL</b>		<b>43.54</b>

## Wind Parks under or near Construction

Wind Park	Region	Capacity (MW)
Paros	Kamares	3.0
Rhodes	Kattavia	5.25
Lesvos	Skalochori	2.7
Sifnos	Tragoudisti	1.2
Rethymno	Akoumia	7.2
Rethymno	Koprino	9.9
Limnos	Ag. Sozon	1.3
Samos	Pythgoreio	0.6
Samos	Marathokampos	1.2
Viotia	Kastro	17.7
<b>TOTAL</b>		<b>48.85</b>





## Geothermal Energy

Geothermal Energy is another field that PPC Renewables has a comparative advantage from PPC legacy as the mother company has implemented considerable investments in the research of geothermal fields of the country since 1973.

Today, PPC Renewables is ready to utilize this considerable legacy as it is the only company in Greece that has a generation permit for the exploitation of Lesvos 8 MW geothermal field, aiming at covering the basic load of the island. Furthermore, the company studies the exploitation of the rich geothermal field of Nisiros. The company's plan, at a first stage, is the creation of a model pilot unit of total re-introduction, of 5 MW capacity which will provide electric power for the whole island of Nisiros. After the documentation of the successful operation of the project, the extension of the plant is planned to 25 MW covering the energy basic needs of 8 more Islands of the area (Leipsi, Leros, Kalymnos, Telendos, Kos, Pserimos, Gyali, Telos).

The profound scientific knowledge of the data of Nisiros geothermal field in combination with the state-of-the-art technology to be used for the specific project guarantee that there will be no impact on the environment.

## Innovation

As regards PPC Renewables SA, that is the pioneering company in the sector, innovation is considered to be its biggest challenge and obligation. A recent example is the cooperation of the company with the Ministry of Development for the creation of the first in Greece and the fourth worldwide "green" island, Ai Stratis, an island that will fully meet its energy needs from RES (Wind Parks, Photovoltaic systems, bio-energy plant, etc.). PPC Renewables has undertaken the project's coordination which is now in the stage of technical-financial study.

The implementation/ construction of the first stage of the project, which will be the power supply of the island from RES, is expected to start in autumn 2009, aiming at being concluded by 2010.

Another innovative project of PPC Renewables, both at a local as well as at a European level, is Ikaria Hybrid Energy Project, the operation of which is based on the combination of two different RES types: wind and hydroelectric power. The annual power generation of the Hybrid Energy Project is estimated at 10.96 GWh and will be sufficient in order to meet all the power needs of the island during winter months and 45% of the demand during summer months. The project is expected to have been completed by 2010.



In the future PPC shall communicate even more systematically, in order to promote sufficiently its positions and targets on the environment and thus create more concrete conditions of cooperation and understanding for its investment plans by local communities and interested parties.



# Chapter 11

## COMMUNICATION ON ENVIRONMENTAL ISSUES

### The major Communication “Challenges”

Nowadays, citizens are far more aware of the environmental protection issues. This awareness is profound at a global level and significant initiatives are undertaken all over the world in order to deal with climate change through international and national environmental policies. European and Greek legislation is becoming increasingly stricter on environmental issues and measures are taken for the reduction of pollutant emissions.

Moreover, rational energy use is becoming more and more a pressing need, as the world reserves of energy raw materials start to drain. On the parallel, the ever-increasing power demand has also a negative impact on the environment. The energy crisis of 2008 has made the need for rational use of energy resources even more imperative, turning the balance more towards the Renewable Energy Sources.

The sensitization of the Greek Society on environmental management issues has put more pressure on the demand for the adoption of stricter measures and specifications for activities that have an impact on the environment, such as the activities related to the electricity industry.

Under those new conditions, the interested parties have inevitably focused on PPC's power generation and other activities. In recent years, a big increase in publications, articles, reactions of local communities, actions of non government organizations, etc. has been notified, focusing on environmental issues that directly affect PPC corporate image, as regards its environmental performance. In some cases, this led to the blockage of major energy projects with negative consequences for the energy sufficiency, the improvement of the electricity quality, even for the environment itself.

For example, it is often observed that, on the pretext of environmental protection, the development of RES projects is also obstructed – projects that will improve the environment as the pollutant emissions caused by the combustion of energy raw materials will be reduced. Therefore, based on those new conditions, it was inevitable for PPC to intensify during 2008 its efforts to communicate to the public the environmental policies it implements.

The communication “challenges” that PPC faces in this sector are extremely big and this has been fully realized at all administrative levels by the executives and its employees. Taking into account the huge impact the ecological messages have at all levels of the Greek Society, it is obvious that the communication policy of the Company should be even more intense in order to promote:

- The environmental work already implemented in various sectors, such as the small-scale and big hydroelectric projects, that generate clean energy without any impact on the environment; and
- The new major environmental targets set by the Company to be implemented in the coming years.



## Communication Policy on Environmental Issues

The communication strategy of PPC and the targets required to achieve it, are fully harmonized with the priority strategies and actions that the Company has undertaken as well as its focus on communicating its commitment for a more effective protection of the environment.

The Company's Priority Strategies, published in November 2007, and the Business Plan 2009-2014 issued a year later, form the of a more systematic communication on PPC's environmental targets and positioning.

Based on these Priorities initially and the Business Plan 2009-2014 on a later stage, specific actions were planned and implemented regarding the promotion of the environmental work and visions of the Group during the years 2007-2008, that will continue within the first semester of 2009.

The Business Plan 2009-2014 which is under implementation, provides clear directions for the planning and development of communication with all interested parties (clients, shareholders, suppliers, Mass Media, local communities, employees, etc.) regarding the environmental issues and aims at creating and aims at promoting the modern PPC through the dimension of sustainable development, which means a balanced business development with respect to Man and the Environment. Under that dimension was designed the communication for the external and internal public of the Company.

Furthermore, specific efforts were made in order to support PPC Business Units in the development of Communicational programs on environmental issues within the field of their responsibility.

Information actions were drawn for the Company's employees so that all valuable information reach even the most remote Plants, thus ensuring, the effective participation and response of the personnel to the environmental issues set by the Company.





## Communication Actions

As mentioned above, two of the main targets of the communication policy in 2008 were:

1. The publication of the Business Plan for years 2009-2014 and its positive potentials for the environment; and
2. The promotion of the Company's environmental work aiming at informing the citizens about the benefits offered by PPC to the country to date.

The actions, through which the Company has communicated its work on the environment, as well as its positions concerning important energy issues directly connected with it, were various and some of them raised the public's concern and were the basis for greater awareness.

Among the most successful communication actions for the last two years are the following:

### Making environmental targets public

- Briefing of the competent Parliament Committee about PPC's Business Plan and environmental actions;
- Publishing all the positive consequences on the environment that will be derived from the implementation of PPC's Business Plan 2009-2014 to the international investment public, the Greek Mass Media, etc.;
- Announcing the progress of specific investment plans (e.g. new natural gas-fired Plants in Megalopolis and Aliveri) with positive consequences for the environment on a local level;
- Promoting via PPC senior executives the Company's positions on important issues related to the safety of the energy supply of the country and the environment (through articles, speeches at conferences and meetings, etc.);
- Integrating briefing of the Company's executives as regards the Priority Strategies (end of 2007) and the Business Plan (end of 2008) to the degree these are

related to the new investments for the environment;

- Promoting the significant investments, amounting to 2 billion Euros, that PPC Renewables will implement in the RES field;
- Briefing of the local authorities on the new generation investments that the Company intends to make in their region (West Macedonia, Megalopolis, Crete, Rhodes, Mytilene, etc.) and the environmental benefits arising from them; and
- Publicizing Questions & Answers on issues of environmental interest for the consumers, aiming at the better briefing and understanding of the investment plans of the Company.

### Promotion of new environmental projects

During the first semester of 2009, the communication policy focused on the promotion of new energy and environmental investments through the inauguration of the following projects:

- Small-scale Hydroelectric Power Plant of Aghia Varvara.
- Small-scale Hydroelectric Power Plant of Smokovo.
- Thermal Power Plant of Atherinolakkos and Wind Park of Xirolimni.

The inauguration of those three projects provided PPC and its subsidiary, PPC Renewables, with the opportunity to promote the environmental, energy, financial and social benefits that the local communities (Emathia, Karditsa and Crete) will enjoy from their operation. Moreover, the inauguration of the above projects was utilized on a communication level for the briefing of the wider public through:

- The issue of Press Releases for all local and national Mass Media;
- Advertisements in local newspapers; and
- Press conferences of the Company's Management.



## Advertising Campaigns

The axes of the advertising campaigns of 2008 were two:

- Rational energy use and
- Promotion of the Company's environmental work, mainly at a local level

The campaign for rational energy use, implemented for the 3rd year, calls for the first time the citizen to use rationally the electricity by applying "smart moves", which will protect - as a consequence - the environment.

The wide-spread campaign included:

- Insertion of brochures on rational energy use in all clients bills;
- Preparation and printing of a brochure – "guide" on rational energy use for businesses and distribution through various promotional activities;
- Utilization of the Company's customer offices for the promotion of environmental messages; and
- Promotion, through the Internet, of simple activities that all citizens could apply for energy saving.

All the above actions aimed at the enhancement of the effective management and use of energy, having as an indirect result the reduction of the greenhouse gas emissions.

The campaigns for the promotion of the Company's environmental work were implemented as following:

- At a local level, with the issuance of brochures, and folders, promotional activities to local inhabitants of areas, such as Aliveri, as well as radio and TV spots at local level;
- At a national level, through articles on nationwide newspapers, mainly through Special Issues on the Environment and Energy;
- Press Releases issued during environmental world celebration dates, where the environmental contribution of the Company to date, as well as its investment plans in this field, were presented.





## Production of Communication Material

### Printed material

The Company edited and published a special folder on the Environment and PPC's contribution to its protection, restoration and development. A special branding with environmentally friendly orientation was created in order to communicate rational energy use and was attached to all customer bills and pay slips of the employees. The abovementioned material on rational energy use, the general one and the special one for businesses, were also included in the special publications.

### Video

In 2008, on the occasion of the 73<sup>rd</sup> Thessaloniki

International Trade Fair and its reference to the environment, the Company produced a new corporate video on the Environment with the activities and targets related to its protection and restoration in each Business Unit.

The video was also presented in other expos in which PPC participated, where special reference was made to the Environment.

### Corporate Website, [www.dei.gr](http://www.dei.gr)

PPC continuously enriches the special section created for the Environment in its corporate website, with analytical references to its relevant activities. Moreover, special reference is made to Renewable Resources and to rational use of energy.

This information is also supported by photos as well as previous Corporate Environmental Reports.





Our vision for the future is a clean planet using scientific progress and technology in order to generate energy with zero emissions in the atmosphere. However, in order to make our vision come true, many steps need to be taken... by all of us.



# Chapter 12

## COMMITMENTS FOR A BETTER ENVIRONMENT

Today, more and more efforts are being made at a global level in order to reduce the negative impact on the natural environment caused by human activity. It is becoming increasingly clear that the production and generation of goods, electric power included, has a negative impact – be it small or large on the environment and measures must be taken in order to eliminate this negative impact. The EU countries, including Greece, are taking considerable steps in order to reduce the negative impact on the environment due to electric power generation.

The 2008 energy crisis showed that it is imperative that the efforts to generate clean energy from Renewable Resources be intensified and that, gradually, the use of energy raw materials that negatively influence the environment be reduced.

It is extremely important that the electricity industries of the European Union countries this year, on March 18, 2009, with the joint Declaration\* of 61 of their Chief Executives, committed themselves to the obliteration of the negative consequences caused by the use of carbon by 2050, through the adoption of the necessary measures required to achieve this very important target: The Declaration is a very big challenge for all PPC executives and employees who are asked to support

and develop the following three pillars of the European energy policy:


- Safety of energy supply.
- Better quality of services at competitive electricity prices.
- Effective protection of the environment.

The realization of the very big investments that have started being implemented based on the Company's Priority Strategies and the Business Plan for the period 2009-2014 is the necessary prerequisite that will decisively contribute to the implementation of the three EU energy pillars.

In order to achieve the strategic targets related to the environment set by the Company, all employees are committed so that more and more environmental targets are achieved through their daily activities, and continue to do so.



\* See Annex



The environmental targets can be achieved through collective and individual commitments that will secure a continuous process of improving the performance at all levels:

- Acceleration of investments so that the Company can commission new Plants that will be more environmentally friendly;
- Continuous improvement of financial performance at all levels, so that new resources will be created to fund new investments and the integrated development of the Company;
- Internal savings so as to find new financial resources that will facilitate investment funding;
- Provision of better services for the customers so that they will be satisfied and will support the Company's investment and environmental policies;
- Strengthening of the Company's competitiveness, inside and outside Greece, so that it will be continuously developing and implementing new environmental actions within the new business environment;
- Promotion of the scheduled investments in Renewable Energy Resources, creating not only new revenue sources for the company but also actively contributing to the development of a green economy;
- Adoption of the most advanced environmental technologies and innovations so that the Company can be a pioneer in the application of state-of-the-art environmental solutions;
- Continuous training of the personnel so that they can acquire the required flexibility in order to adopt the most effective energy and environmental methods, making the best use of the new low emission technologies;
- Promotion of the energy efficiency in order to tackle climate change with the proper briefing of the customers so that they, on their behalf, can realize their contribution in dealing with common environmental problems;
- Essential dialogue with all interested parties in order to lift the existing misunderstandings and secure the smooth operation of the electricity market, based on

the healthy rules of competition and facilitating the investments required by the next generations;

- Cooperation with all interested parties in order to lift all bureaucratic problems and isolated reactions that hinder the implementation of environmental investments; and
- Utilization of the possibilities of cooperation with other companies, inside or outside Greece, in order to support the Company's power to play a more decisive role in the effective protection of the environment in the greater region of SE Europe.

The employees, applying all these commitments in their daily practice, will create the necessary conditions so that PPC will continue in the next years to develop at even faster paces, creating new values for its customers and all interested parties, with multiple benefits for the environment.

By implementing the new environmental investments and adopting the principles, values and sensitivities of the society for the environment, PPC will be a pioneer in achieving its very important goal in Sustainable Development.

These are our commitments for a better Environment...





## Declaration of the CEOs of the electricity companies of Europe on Climate Change (March 2009)

The European electricity companies committed themselves in a joint declaration to fight in order to achieve neutral-carbon electricity supply by 2050, to strive for an integrated European electricity market that will be financially efficient and reliable and to promote energy effective electricity applications as the basic key for the energy-climate challenge.

The companies commit themselves to apply an international approach to the global challenge of reducing greenhouse gas emissions, to support Research and Development in the carbon capture and storage technologies, to recognize the need to form electricity prices through mechanisms of the market and to integrate renewable energy sources in the power generation and distribution system.

The Declaration of the 61 CEOs – heads of the electricity companies, members of EURELECTRIC - is as follows:

**Recognizing** that climate change is a serious global environmental, economic and social challenge which requires urgent action; acknowledging that the power sector, as a significant emitter of greenhouse gases, needs to achieve a carbon-neutral power supply by the middle of this century;

**Convinced** that an integrated market, based on clear and harmonized rules, brings about considerable cost efficiencies; striving to deliver competitive prices and customer choice;

**Believing** that energy efficiency is a cornerstone of climate change policy; identifying important synergies between carbon-neutral electricity supply and energy-efficient electric technologies which need to be exploited to the full;

**Stressing** that as one of the most-capital intensive industries, the electricity sector needs to have access to liquid capital markets in order to make the necessary investment to ensure security of supply and adapt to environmental targets;

**Pointing** to the fact that in order to replace ageing plants, develop the grid, face rising demand and meet its environmental targets, our sector needs to invest € 1.8 trillion by 2030; insisting that this requires a stable, coherent and market-oriented investment framework;

**Fully aware** that electricity companies have a basic mission to provide a secure power supply; underlining that this can be best achieved via a diversified portfolio of power plants, decreasing dependency on imported fuels, and through integrated electricity markets.

**WE WILL achieve carbon-neutral power supply in Europe by 2050.**

To this end, we will progressively make use of all available and economically sound low-carbon and carbon-free options when investing in power generation assets, taking into account national energy policies: renewable energies, nuclear power, high efficiency combined heat & power and efficient clean fossil technologies including carbon capture and storage.

In addition, we will continue to seek to operate our plants and grids in the most efficient way, while investing in the development of innovative low-emitting technologies.

# DECLARATION ON CLIMATE CHANGE

## **Deliver power cost-efficiently and reliably through an integrated electricity market**

Since a competitive, integrated market is the best way to provide power at the lowest cost – supporting thus European growth – we are actively contributing to the establishment of regional system operations and regional regulatory supervision as a step towards an integrated pan-European electricity market. We are determined to offer a competitive and reliable supply of electricity to European citizens.

## **Promote energy efficiency and electricity use as solutions to mitigate climate change**

Our companies are developing innovative ways to inform customers on energy-efficient solutions and to encourage the use of electricity when it contributes to reducing greenhouse gas emissions. In particular, we will invest or promote investment in the necessary infrastructure to foster the development of electric vehicles, including support for the standardization necessary for their deployment. We will also encourage energy efficiency for sustainable cities.





PPC	Public Power Corporation
ISO	International Standardization Organization
MW	Megawatt - Unit measuring the capacity of generation power plants
RES	Renewable Energy Sources
W/P	Wind Parks
SHPPs	Small-scale Hydroelectric Power Plants
RAE	Regulatory Authority for Energy
CSP	Concentrated Solar Power
ETS	Emission Trading System
GD	Generation Division
QAS - GHGM	Quality Assurance System for Greenhouse Gas Monitoring
MEPPPW	Ministry of the Environment, Physical Planning and Public Works
ENVIRO	Special software for environmental data analysis
THERMO	Special software for monitoring-operation of PPC Thermal Power Plants
EN 17025	Certification standard for laboratory organisation and accreditation
TPP	Thermal Power Plant
CDM	Clean Development Mechanism
JI	Joint Implementation
IGCC	Integrated Gasification Combined Cycle
CCS	Carbon Capture and Storage
MWth	Unit of Thermal Capacity of Plants
MWe	Unit of power capacity of plants
IPPC	Integrated Pollution Prevention and Control
BAT	Best Available Techniques
LCPs	Large Combustion Plants
NERP	National Emission Reduction Plan
ESPs	Electrostatic Precipitators
BREFD LCP	BAT Reference Documents on Large Combustion Plants
SCR	Selective Catalytic Reduction (Catalytic conversion of nitrogen oxides)
JMD	Joint Ministerial Decision
AETC	Approval of Environmental Terms And Conditions
AGPP	Autonomous Generation Power Plant (on islands)
WMLCD	West Macedonia Lignite Center Department
MLCD	Megalopolis Lignite Center Department
N.AG.RE.F	National Agricultural Research Foundation
S/S	Substation
EHVC	Extra-High Voltage Center
GCWAS	Greek Center of Wild Animal Sheltering
HPs	Hydroelectric Projects
HPP	Hydroelectric Power Plant

# ABBREVIATIONS

HCMR	Hellenic Center for Marine Research
EPCA	Ephorate for Prehistoric and Classical Antiquities
EBA	Ephorate of Byzantine Antiquities
STS	Special Technical Study
MoD	Ministry of Development
PCB	Polychlorinated biphenyl
SYDESYS (AMS)	Alternative Management System
WLOs	Waste Lubricating Oils
T/F	Transformer
AMSE	Alternative Management System
ENV 50/66	Standard for electromagnetic radiation
ICNIRP	International Committee for Non-Ionizing Radiation Protection of the World Health Organisation
TL	Transmission Lines
GAEC	Greek Atomic Energy Committee
GIS	Geographic Information System
CAD	Computer Aided Design
IEC	International Electro technical Commission
RV	Voltage measurement unit
MV	Medium Voltage
LV	Low Voltage
DC	Distribution Center
GIS substation	Closed Type Substations (Gas Insulated Switchgear)
dB(A)	Noise Measurement Unit (decibel)
ELOT	Hellenic Organisation for Standardization
MD	Ministerial Decision
TRSC	PPC Tests-Research and Standards Center
EMS	Environmental Management System
IEMA	Institute of Environmental Management and Assessment
CERTH/ISFTA	Center for Research and Technology Hellas/Institute for Solid Fuels Technology and Applications
EU ETS	European Union Emission Trading System
GED	Generation Environment Department
GCSL	General Chemical State Laboratory
P/V	Photovoltaic Park
GWh	Gigawatt hour - Power measurement unit = 1,000,000 kWh
KWh	Kilowatt hour - Power Measurement Unit
HNMS	Hellenic National Meteorological Service

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