EDP Environment Report 1999

EDP
Electricidade de Portugal, S.A.

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EDP Environment Report 1999

Basic Principles of the EDP Board of Directors declaration on environmental policy

Considering electric energy as a crucial factor for the development and improvement of life quality;

Recognising that the activities associated with electricity generation, transmission and distribution can produce adverse environmental effects;

In the incessant quest for the proper balance between its essential function and the safeguarding of environmental values;

EDP adopts the following principles:

- To consolidate environmental assessment of the company's activities and to audit its performance;
- To examine the importance of environmental issues in generation, transmission, distribution and final use of electricity;
- To encourage rational energy usage systems;
- To increase knowledge concerning the interaction of the company's activities with the environment;
- To promote nature conservation and cultural enhancement strategies;
- To guarantee appropriate mechanisms for environmental information;
- To encourage the use of clean technologies and suitable waste-management practices.

1994

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Chairman's Message

The EDP Group has been extensively involved in Environment related issues, adopting a proactive and socially-committed attitude towards safeguarding environmental values and criteria.

Such attitude has been a determining factor behind the implementation of important technological modifications and the undertaking of substantial investments directed at minimising the environmental impact associated with our activity. This report outlines the main initiatives embarked on by EDP in 1998 and 1999 in this domain.

Due to their strategic importance or their impact on the company's image, the following facts merit special reference in this period:

- The implementation of Environmental Management Systems in electricity generating sites received a major boost with the attribution of the Environmental Management Certificate in accordance with ISO 14 001 Standard, to the Setúbal thermoelectric power station;

- The emission of atmospheric pollutants and their environmental side effects have become a major concern worldwide. In the wake of its attentive monitoring of developments in this arena, EDP formed part of a group of European Union companies that participated in 1999 in an exercise – pioneer at European level – simulating a greenhouse gas emissions market, aiming to test the flexibility mechanisms envisaged in the Kyoto Protocol;

- Finally, we highlight with pride that in 1999 EDP was distinguished with the "Corporate Impact Assessment Achievement" award given by the IAIA (International Association for Impact Assessment) in recognition of the company's active and voluntary role in the Environment field.

It is EDP's firm intention to systematically implement the best practices to ensure an ongoing improvement in its environmental performance, disclosing publicly the results of its action by means of an annual report.

Francisco de la Fuente Sánchez

Presentation

EDP and the Environment

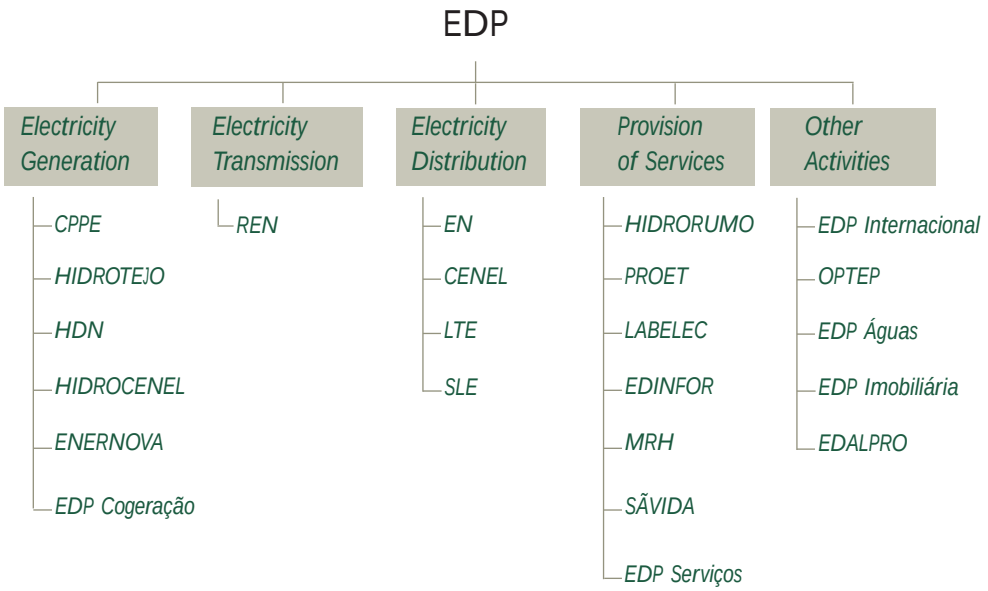
EDP has been part of a business group since 1994 and is today one of Portugal's largest companies. It plays a fundamental role in the National Electrical System. After the third phase of the reprivatisation process, initiated in 1997, some 49% of the Company's share capital was listed on the stock exchange by the end of 1999.

Traditionally centred on generation, transmission and distribution of electric power, EDP's activities extend to other areas such as engineering, laboratory activities, information systems and services.

Recently, the Company has been broadening its operations beyond the electricity sector, asserting itself in the telecommunications, gas, water and sanitation markets. This business diversification thrust has been evolved alongside the Group's internationalisation strategy, which presently involves shareholdings in companies based in Brazil, Guatemala, Macau and Cape Verde.

Seeking – through the use of consolidated environmental indicators – to outline the trend of the Company's global performance, EDP's Environment Report is currently restricted to its performance in the electricity sector. As a diversified business group with a publicly assumed commitment to the environment, EDP intends, in the future, to report progressively on the main environmental performance indicators pertaining to the other activities in which it is involved.

EDP and the Environment



1 – EDP Group Organisation Structure

By the end of 1999, EDP owned 81% of the installed generating capacity in the Public Service Electricity System – responsible for supplying 91% and 95% of the domestic electricity consumption in 1998 and 1999, respectively. It is also the concession holder of the transmission and distribution networks. Moreover, the company operates in the Independent Electricity System, where it owns an considerable number of small-scale hydroelectric plants and has progressively reinforced its position in wind-powered, biomass and cogeneration complexes.

EDP is also responsible, through Rede Eléctrica Nacional (REN), for guaranteeing the overall technical management of the national power-generating system.

By the end of 1999, EDP supplied electricity to some 5,300,000 customers in mainland Portugal.

EDP and the Environment

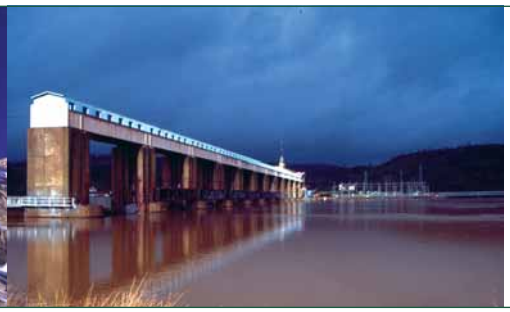
2 – EDP generating plants in operation at 31.12.99

EDP and the Environment

EDP has long assumed an active and responsible attitude in approaching the different environmental affects of its activities, ranging from the conception and construction of its installations to the operation practices.

The Company was pioneer in Portugal in the application of Environmental Impact Assessment practices, which, since the beginning of the 80's, encompass all the projects for large-scale national thermo- and hydroelectric power plants.

The publication in 1994 of the EDP Group's Declaration on Environmental Policy represented an important milestone in the progressive integration of environmental concerns into the company's strategic objectives. Since then, a number of mechanisms consistent with these objectives have been defined and applied in the Group's various activities, namely, the process, launched in 1996, of progressive implementation of the EDP Group Environmental Management System.



Highlights

The structure of EDP's power-generating facilities underwent certain changes during 1998 and 1999. The 2nd of the 3 generating units at the Tapada do Outeiro thermoelectric power station were withdrawn from service in December 1999 – now using exclusively fuel-oil after having ceased the burning of national coal. The deactivation process of this complex, started in 1997, continues with a number of rehabilitation measures of the previous coal and coal ash landfill sites.

Moreover, EDP reinforced its presence in the renewable energies sector, with a total increase of 20 MW resulting from the entry into full commercial service of Pena Suar wind farm in Serra do Marão (January 1999) and the start-up of Mortágua forest-waste thermoelectric power plant (August 1999).

The commitment to this sector also resulted in the constitution, in August 1998, of EDP Cogeração - Produção de Electricidade e Calor, S.A., via which the company widened its range of energy solutions for large industrial customers. It conducted studies and prepared projects for the combined production of electric and thermal energy by means of cogeneration processes with the aim of promoting the more efficient use of primary energy sources.

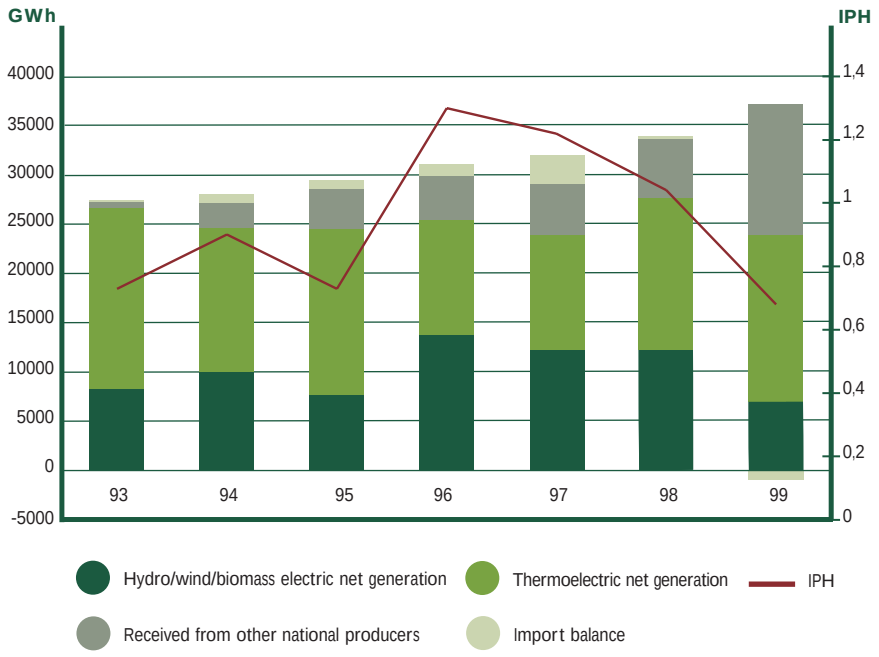
In global terms, electricity consumption in Portugal continued to growth significantly in 1998 and 1999. As a consequence of the progressive entry of electricity producers into the national market, the contribution from EDP generating plants to meeting overall consumption has progressively declined.

On the other hand, the specific characteristics of the Company's power-generating capability - with close to half of generating capacity installed at hydroelectric plants - makes the respective structure of annual production strongly dependent on hydrological conditions. This situation has an influence on the evolution of various environmental indicators, in particular the total emission of atmospheric pollutants by thermal power plants. This factor was particularly relevant in 1999, an extremely unfavourable year from the

Highlights

hydrological viewpoint, as evidenced by an Hydroelectric Capability Index (Portuguese acronym – IPH) of 0,68.

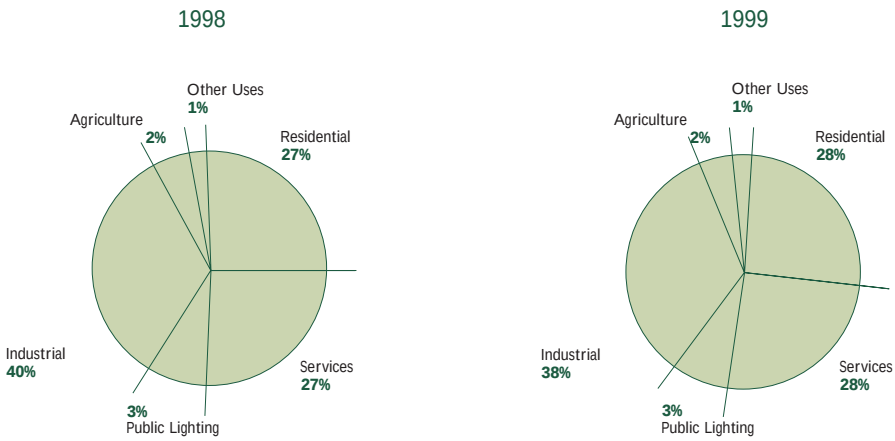
After a year in which electricity exchanges with Spain were virtually negligible, 1999 was also marked by the commencement of EDP Group's activity (via REN) as an external agent on the Spanish market, with the balance of exchanges for the first time ever being in favour of exports.



3 – Electricity consumption in Portugal

Highlights

Energy Balance	1998	1999
EDP hydroelectric generation (GWh)	12 425	7 010
EDP thermoelectric generation (GWh)	16 427	18 046
EDP wind-powered and biomass generation (GWh)	47	57
Consumption and losses at EDP power stations (GWh)	-1 237	-1 152
• EDP net generation (GWh)	27 662	23 961
Received from other national producers (GWh)	5 974	13 192
Import balance (GWh)	272	-858
Hydroelectric pumping (GWh)	-101	-491
• Net demand (GWh)	33 808	35 803
Trend in net demand (%)	5,8	5,9
Trend after correcting for temp. and week days (%)	5,2	4,8
Energy supplied (GWh)	30 363	32 280
Transmission and distribution losses (GWh)	-3 359	-3 421
Other sent out (GWh)	86	102
IPH	1,04	0,68



4 – Structure of electricity consumption in Portugal

Highlights

In 1998 and 1999 financial years, EDP invested, in its generating area alone, some PTE 7 billion on environment-related improvements. This capital expenditure was essentially directed at work involving the revamping and construction of wastewater treatment plants at thermoelectric power stations and the completion of two more phases of the Combustion Modification Programme at Sines power station.

The programme, embarked on in 1997, proceeded with the installation of new burners emitting lower volumes of nitrogen oxides (NO_x) at two of the four generating units. Once the programme is concluded (scheduled for the fist half of 2000) this power station's NO_x emissions should drop by nearly 50%.

1999 saw two important signs of the external recognition of EDP's work in the environmental field: in June, the company was honoured with the "Corporate Impact Assessment Achievement" award given by IAIA (International Association for Impact Assessment). This distinction rewards the voluntary and innovative manner in which the company has applied environmental management and impact assessment tools and encouraged public involvement in the early planning phases of new projects. In October, the Environment Management System implementing process received a major impulse with the environmental certification according to International Standard ISO 14 001 issued to the Setúbal thermoelectric power station, the first of EDP's power-generating centres to obtain this certification.

Deeper environmental concerns have been behind the adoption of progressively more stringent regulations, both at national and international level. In 1998 and 1999, the discussion focused on the regulatory instruments definition for several different areas: climate change; air and water quality and electromagnetic fields. EDP has paid close attention to the evolution of these issues, timeously evaluating the possible impact of a new regulatory framework on its activities.

Environmental Management

Limiting Atmospheric Emissions

The production of electric energy from the burning of fossil fuels is widely recognised as one of the chief sources of atmospheric environmental impact. The main pollutants in thermoelectric power stations' atmospheric emissions are sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter and carbon dioxide (CO_2).

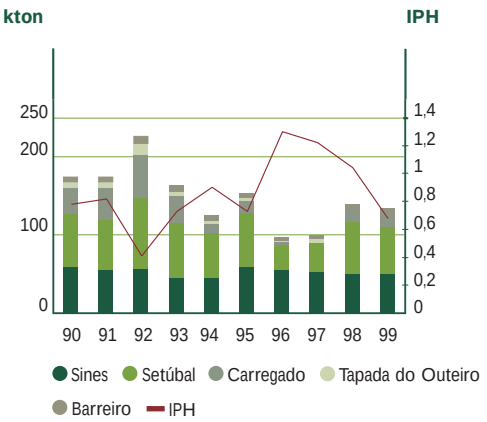
As part of the significant array of measures adopted by EDP, limitation of atmospheric pollutants emissions at CPPE's thermoelectric power plants, has been one of the Company's main concerns. This area has had the major investments, not only in curbing equipment, but also in initiatives targeted at control and monitoring.

Currently, the National Programme for the Reduction of Emissions from Large Combustion Plants, drawn up under Directive 88/609/EEC, constitutes a benchmark legislative framework, setting emission ceilings for SO_2 and NO_x for each of the industrial sectors covered, namely, the electricity sector.

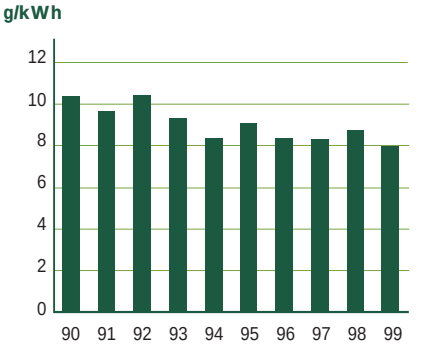
EDP monitors, on a year-to-year basis, the objectives laid down for the electricity sector by the above-mentioned programme, which have been systematically adhered to.

As for SO_2 emissions, compliance with the sectoral ceiling is possible through the use of low sulphur-content fuel-oil. In order to assess the need to anticipate the substitution of the currently used fuel (3% sulphur content) by low sulphur-content fuel-oil (1%), previsional models were developed for periodical estimation of annual emissions.

Limiting Atmospheric Emissions



5a – Total SO_2 emissions



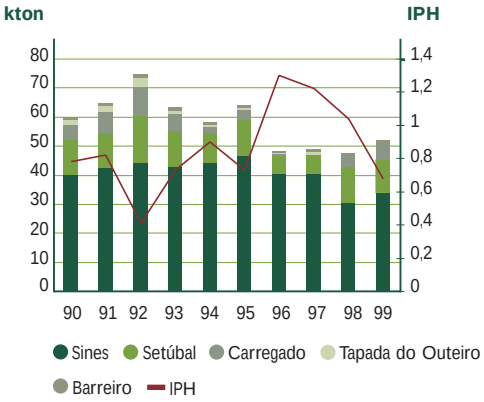
5b – Specific SO_2 emissions

For NO_x emissions, it was necessary to attain a significant reduction in order to comply with the respective sectoral ceiling. It was decided to attain this reduction at the thermoelectric power station with the highest emission values – Sines power station. This production site, the backbone of EDP's thermal subsystem, is responsible for generating an average 30% of the national electricity consumption.

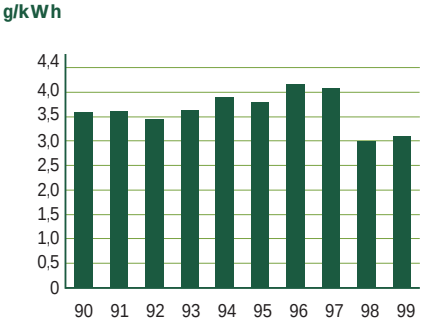
The Combustion Modifications Programme at Sines thermoelectric power station initiated in 1997, involves the installation of low NO_x burners in all generating units. This equipment will guarantee, from the outset, a reduction of about 50% in the site's NO_x emissions.

The installation of new burners at Sines generating unit no. III was concluded in July 1999. Now the power plant has three modified generating units. Changes to the remaining unit IV will be finished by May 2000.

Limiting Atmospheric Emissions



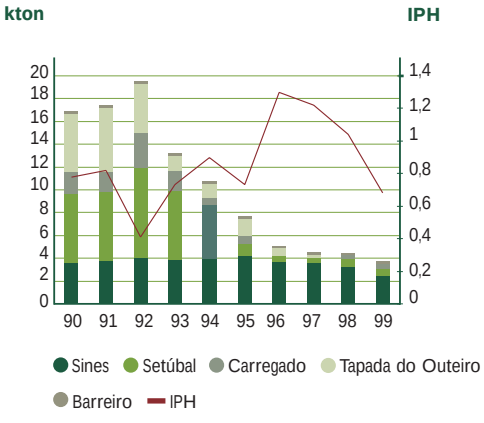
5c – Total NO_x emissions



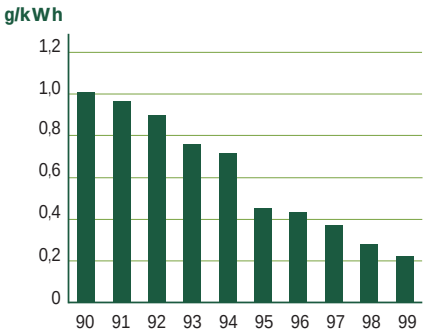
5d – Specific NO_x emissions

In overall terms, there was an increase in the total SO_2 and NO_x emissions in 1998 and 1999 at CPPE's thermoelectric power stations, compared with the previous year. This was due to the greater use of thermoelectric generation as a result of the unfavourable hydrological conditions. This increase was particularly noticeable for SO_2 due to the more intensive use of the fuel-oil-fired power stations of Setúbal and Carregado.

It is important to note that NO_x specific emission (g/kWh) have shown a downward trend, reflecting the implemented reduction methods.



5e – Total particulate matter emissions



5f – Specific particulate matter emissions

Limiting Atmospheric Emissions

The values relating to particulate matter emissions maintained the trend observed in recent years as a result of the high efficiency removal systems installed (electrostatic precipitators).

Given the importance of the atmospheric emissions limitation issue in the strategy pertaining to operation and expansion of power-generating centres, EDP participated actively in the analysis of determining environmental factors within the drawing up of the new Expansion Plan for the Public Service of the National Electricity System.

Monitoring Air Quality

Each of CPPE's thermoelectric power stations has an associated Air Quality Monitoring Network composed of a variable number (between three and five) of measurement stations. The networks' operation is carried out directly by each installation, except for the Sines network, the operation of which is the responsibility of the relevant department of the Ministry of the Environment and Territorial Planning (Portuguese acronym - MAOT).

The configuration of each monitoring network takes into account the characteristics of the pollutants released by the power stations, local meteorological factors determining atmospheric dispersion patterns, and the most important demographic aspects.

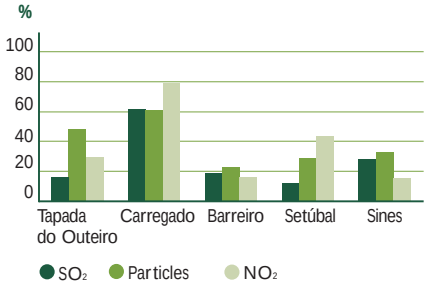
In order to assess the effective contribution of atmospheric emissions from each thermoelectric power station into the air quality in the surrounding zone, EDP's monitoring stations permanently measure airborne concentration of the following main pollutants: SO_2, NO_x and Total Suspended Particles. Networks are operated in real time and encompass an alert system.

An Air Quality Index was devised, in order to facilitate the presentation of measurements, at different sites. This index is defined as the highest value, as a percentage, of the limit values prescribed for each pollutant, in

Monitoring Air Quality

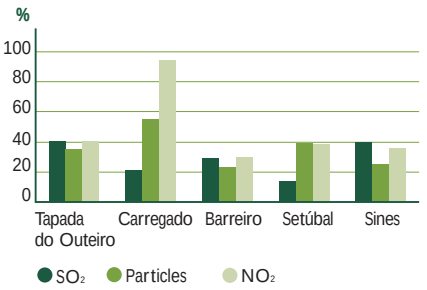
applicable legislation. The following charts refer to the highest values of the fore mentioned index for each pollutant at each network in 1998 and 1999.

1998



6a – Highest value for the Air Quality Index

1999



6b – Highest value for the Air Quality Index

The values show the atmospheric impact lays at socially acceptable levels in the areas surrounding thermoelectric power stations, bearing in mind that the index values are generally 50% below the respective legal limit value. These values record not only the thermal power stations' impact, but also the contribution of other anthropogenic sources present in the adjacent zones.

Combating Climate Change

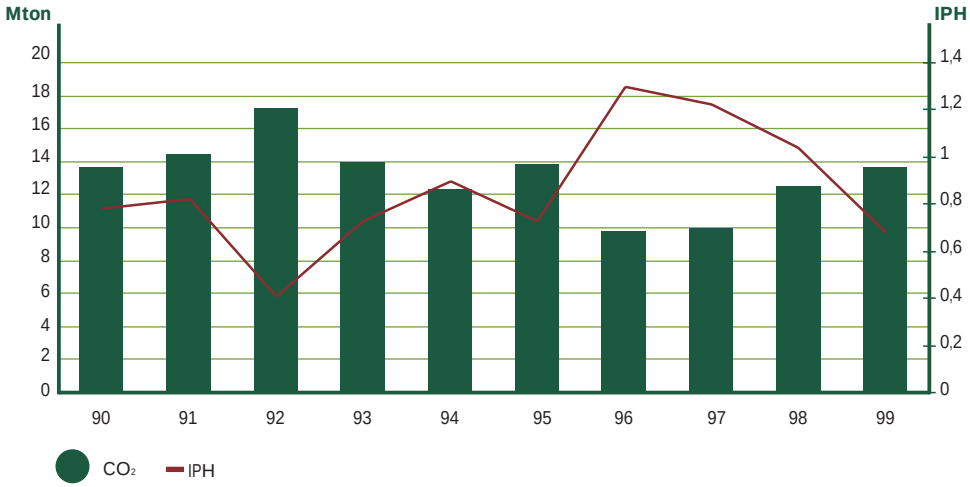
Climate change and its global level consequences is currently one of the most debated environmental topics world wide, and simultaneously represents an issue of escalating importance from the standpoint of public opinion.

In light of the unequivocal influence of human activities on global climate - today scientifically acknowledged, - efforts are now focused on finding solutions that allow reversing the universal upward trend observed in greenhouse gas (GHG) emission.

The Kyoto Protocol, adopted in December 1997 by the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change, laid down, for the first time ever, quantified and differentiated targets for the curbing of GHG emissions for a group of 38 developed countries. The European Union committed itself, as a whole, to reduce its GHG emissions by 8% in the period 2008-2012, from 1990 values. Within a community a burden sharing perspective, the European Union laid down internally, in 1998, the progressive emission targets for each Member States, taking into account each country's current state of development and economic growth prospects. This agreement allows Portugal to increase its total GHG emissions by 27% from 1990 levels, which represent a 40% increase in CO_2, the gas with the highest emissions at national level.

Although the allocation of GHG emissions amongst the different emitting sectors has not yet been defined – and considering electricity generation is the main source of the country's CO_2 emissions - EDP has followed closely the local and international developments in this domain, in order to ensure compliance with the future emission limitation objectives that come to be imposed upon it.

Combating Climate Change



7 – Total CO_2 EDP Group's thermal power stations' emissions and Hydroelectric Capability Index

Within this line of work, in 1999, EDP participated, together with electricity utilities from 14 European countries, in GETS1 – Greenhouse Gas and Electricity Trading Simulation. This innovative exercise involved the simulation of electricity and CO_2 emissions permit markets, aiming to test, one of the flexibility mechanisms of the Kyoto Protocol (see box).

Besides researching the ways of participating in a future emissions trading system, EDP also started the evaluation of specific measures to curb CO_2 emissions, such as efficiency gains in electricity generation and the design of energy services that promote its rational usage.

Combating Climate Change

GETS1: A simulation exercise on an electricity and carbon market

GETS1 – Greenhouse Gas and Electricity Trading Simulation, which took place between May and July 1999, was a simulation exercise on an electronic market for electricity and CO_2 emission permits.

Organised by EURELECTRIC – the association representing European electricity producers and distributors -, by Paris Stock Exchange and by the International Energy Agency, the "game" participants were 19 "virtual" electricity companies from 14 European countries. These firms traded simultaneously electricity and CO_2 emission permits in order to comply with predefined goals pertaining to electricity supply and emission reductions.

The period 2001–2012 was simulated for 8 consecutive weekly sessions, each representing 1 or 2 years of activity. The transactions were carried out on a specially-conceived electronic platform accessible via internet, were participants were confronted in real time with supply and demand for the two traded products.

The main conclusions drawn from the exercise were presented at the 5th Conference of the Parties to the United Nations Framework Convention on Climate Change, in Bonn in November 1999: the existence of parallel electricity and CO_2 markets allowed for an effective cost-benefit analysis of electricity exports/imports and investment costs associated with emissions reduction. It also led to the reduction of compliance costs, serving as a complement to internal reduction measures.

Promoting Renewable Energies

Reinforcing the use of renewable energy sources is a fundamental cornerstone for integrating environmental aspects into energy policies, within a sustainable development strategy.

In particular, electricity generation based on renewable sources (hydro, wind, solar, biomass, amongst others) is currently one of the possible responses, not only to environmental protection, but also to diversification of supply, today strongly dependent upon fossil fuels.

In 1998 the European Commission published a Green Paper on Renewable Energy Sources and set about the drafting of specific regulations for the contribution of electricity produced from renewable sources to meeting consumption needs. It was also assumed, at Community level, that this is one of the measures needed to comply with European undertakings for the reduction of greenhouse gas emissions under the Kyoto Protocol.

Since Portugal is a country with limited indigenous energy resources, the optimisation of existing renewable resources therefore assumes particular importance. In addition to the medium and large-size hydroelectric schemes – which presently account for roughly 55% of the Company's installed capacity -– EDP also owns a significant number of small-scale hydroelectric plants, and as recently invested substantially in other renewable sources, notably wind farms.

Created in 1994, ENERNOVA is an EDP Group company specialised in the development of renewable energy projects. It has been pioneer in Portugal with the introduction of medium-scale wind farms. In 1998 and 1999, EDP significantly reinforced its presence in renewables, with the commissioning of two new complexes - a wind farm and a biomass power plant – which added an extra 20 MW to the Company's installed renewable capacity.

Promoting Renewable Energies

Pena Suar wind farm entered into service in 1998. Located in Serra do Marão, in a high wind-power potential site, the complex occupies an area of 205 ha in the districts of Amarante and Vila Real. Involving an investment of approximately PTE 2.3 billion, the annual average of electricity generated is sufficient to supply a population cluster of some 15,000 inhabitants. This is EDP's second wind farm and boosted the total installed capacity in this type of facility to 20.2 MW, about one third of the country's installed wind-sourced capacity.

1999 saw the entry into operation of Mortágua forest-waste thermoelectric power plant, a government-sponsored initiative built and operated by EDP. This installation, the first of its kind in Portugal, produces electricity from the burning of forest waste and represents a capital outlay of almost PTE 5 billion. It was equipped with technology which guarantees low pollutant atmospheric emissions and has a closed water cooling circuit, therefore minimising its thermal impact on the nearby Aguieira reservoir.

EDP also has a portfolio of new projects, essentially in wind power field. Cabeço da Rainha wind farm in Serra de Alvelos is scheduled to enter into commercial service in 2000. The construction of this complex will be followed by another wind farm at Cadafaz, Serra da Lousã.

The Company has also intensified its activity in identifying sites with high wind power potential. By the end of 1999, it had 17 measurement points for gathering of wind data. The feasibility of implementing new projects depends, however, on the capacity of the transmission and distribution networks to support connection to these generating centres, an aspect that is being considered in the respective expansion studies.

Promoting Renewable Energies

Concerning demonstration projects, EDP has been supporting Porto Cachorro wave-power plant in the Azores, a testing centre for studying the use of wave power in electricity generation.

In 1998, EDP also started, to develop activities in the area of cogeneration, promoting new solutions for its industrial customers, aimed at improving efficiency in primary energy use, through the combined production of heat and electricity. Amongst the projects that EDP has accompanied and given technical support to, are the installations at SOPORCEL in Figueira da Foz, PORTUCEL in Mourão and SOLVAY in Vila Franca de Xira.

Protecting Hydro Resources

Water is an indispensable resource not only in hydroelectric but also in thermoelectric generation. Aware of this importance, EDP has dedicated particular attention to safeguarding the quality of water at reservoirs and controlling wastewater produced at its thermoelectric power stations.

Waste water

Thermoelectric generation makes different uses of water, from boiler's supply (water for steam production) through refrigeration of generating units. These usages give rise to waste water, which is subject to control and monitoring prior to its discharge. In quantitative terms, the emphasis is on cooling water. For example, each generating unit at Sines power station requires a refrigeration flow of 10 m^3/s, with the water temperature rising by around $10^{\circ}C$ between entering and exiting the condenser. However, this water is returned to receptor with a temperature increase of less than 3ºC.

In order to avoid the fouling of aquatic organisms in the intake and discharge canals and inside the condenser, especially when sea water is being used, it is necessary to inject chlorine into the cooling circuits. With the technical support of LABELEC, Sines thermoelectric power station is conducting an experimental study into the reduction of chlorine levels (see box).

Thermoelectric power stations also produce waste water in quantities that depend upon the respective functioning regime. All power stations are equipped with facilities for the separate handling and treatment of chemical, oily and domestic effluents.

In order to ensure high efficiency in effluent treatment, older facilities were revamped -as was the case at Setúbal thermoelectric power station - or completely substituted by new equipment – as happened at Carregado power station. The physical and chemical characteristics of the treated effluent, prior to any dilution and discharge, are subject to extensive analytical control by means of 24-hour compound samples on consecutive days, with around 20 parameters per sample. Simultaneously, a number of other parameters are continuously

Protecting Hydro Resources

Fouling control in water cooling circuits

In northern Europe, it is possible to limit chlorination of cooling water only to those months when sea water temperature rises above 10°C, beyond which reproduction of crustacean species occurs. The reduced use of chlorine clearly minimises the impact on water resources.

In Portugal, however, sea water temperature is consistently above the 12°C mark, and thus routine operation of thermoelectric power stations forces chlorination throughout the year.

Research work conducted at Sines power station since 1997/98 has revealed, however, that it is possible to suspend the chlorination process during limited periods of time. Control was based on the installation, in the intake area of the cooling water circuit of one generating unit, of two substratum plates for crustacean organisms. Although it is still an experimental project, the results of periodic observation by specialists show that, in the winter period, there is a marked decline in fouling.

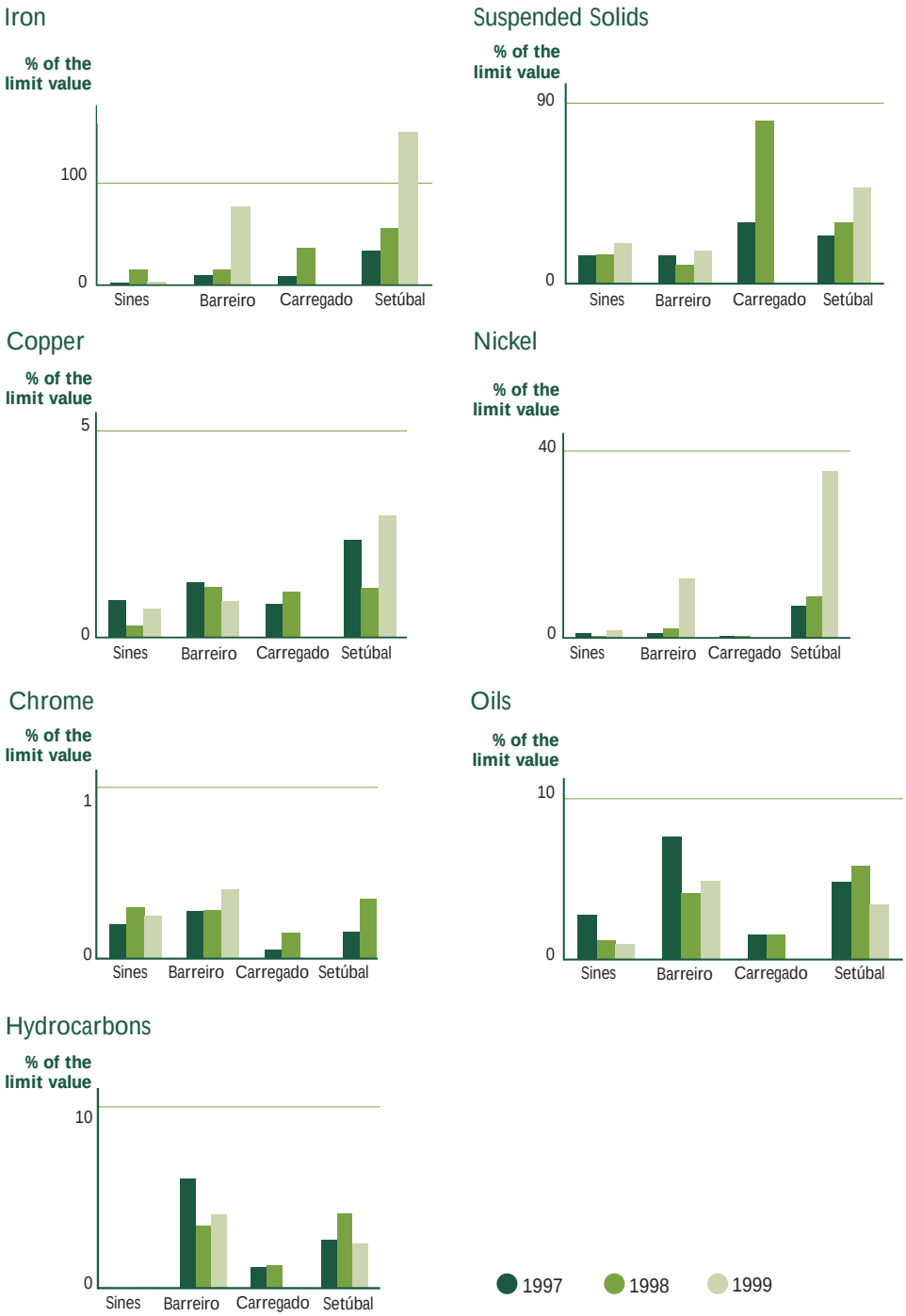
Based upon such findings, it was decided to suspend chlorination, initially only in January, with no detection of negative influence on the power station's functioning. Further development of this method could enable this period to be extended for further two months a year, and consider its extension to the other coastal or estuarial power plants (Setúbal and Barreiro).

monitored (e.g. dissolved oxygen, turbidity, pH and temperature).

The analytical values obtained are evaluated on the basis of limit values stated in the respective discharge permit, as well as on the values set by applicable legal provisions.

The figure presents the average daily concentrations for the main parameters (expressed as a percentage of the limit value for each parameter) obtained for a series of 24-hour compound samples, during 1998 and 1999.

Protecting Hydro Resources



8 – Characterisation of waste water at thermal power stations, as % of limit values

Protecting Hydro Resources

Reservoir water quality

The possible damage caused by reservoir water upon the dam structures is one of the main issues of the safety control of dams: Proper characterisation of the physical and chemical change processes within the materials that constitute the solid rock foundations and its impermeable and consolidation systems is one of the company's permanent activities.

Accordingly, EDP runs a stringent programme for the hydro-chemical control of reservoir water and water released by the drainage systems of dam foundations, monitoring all the relevant parameters so as to timeously assess any deterioration.

As regards reservoir water, the monitoring programme was extended, in recent years, so as to include parameters that allow for the physical, chemical and biological assessment of water quality, namely its trophic and pollution levels, with special concern to reservoirs connected to public water-supply systems.

Such surveillance programme is of particular importance in the dry season. Indeed, it is in Spring and Summer time that eutrophication is more intense. This is a natural phenomenon which explains the "ageing" of natural lakes, as a result, not only of climatic conditions, but mainly of inadequate agricultural practices and the discharge into rivers of untreated waste water. EDP has established, for its main reservoirs, programmes for water sampling and analysis which allow, in summary, the classification of water plans in terms of both microbiological pollution and trophic state. According to each programme, the reservoirs in operation are subjected to physical, chemical and bacteriological control

Protecting Hydro Resources

with variable frequencies: annual, bi-annual and tri-annual.

This analytical control programme involves significant laboratorial back-up, as borne out by the determination of around 1,100 parameters per reservoir and per annum, corresponding to more than 20,000 analyses per year.
Besides the annual programme laid down, un-programmed analyses are carried out whenever deemed necessary.

Waste Management

EDP's various activities give rise to a number of diversified waste categories, produced at a large number of facilities scattered throughout the country.

Because of either its hazardous characteristics or the significant quantities in which they are produced, certain waste categories have long since been the object of specific programmes implemented by EDP. Such is the case of electrical transformation equipment containing PCB (polychlorinated biphenyls), which is eliminated at a special facility outside the country, and coal fly ash which is used as a secondary raw material in the national cement industry.

Adopting integrated waste management procedures throughout the Company's various activities, EDP concentrated its efforts in 1998 and 1999 on improving the annual waste inventory programme, launched in 1995, which presently encompasses some 40 entities producing internal information. Unsuitable practices were identified and new solutions sought, disseminated and implemented throughout the organisation.

In 1999 EDP also updated the inventory of its PCB-containing equipment. The quantities and location of the remaining of this type of equipment were thoroughly confirmed. Moreover, the first phase

Waste Management

of a new inventory programme, involving the screening of contaminated equipment was concluded. (see box).

Still in 1999, a start was made to the widespread use of the Document Management Information System, which led to a meaningful decrease in the amount of paper consumed throughout the company, notably in administrative and service areas.

	1997		1998		1999	
	Total (ton)	% Rec.	Total (ton)	% Rec.	Total (ton)	% Rec.
Coal fly ash	307 429	100	271 901	100	346 780	100
Fuel-oil fly ash and bottom ash	73 625	0	33 626	0	37 658	0
Used oils	317	100	325	100	635	100
Equipment and oils with PCB	16 (*)	0	24	0	60	0
Metal scrap	4 696	100	3 248	100	3 656	100

(*) Value corrected from EDP's 1997 Environment Report

9 – Quantities and recovery rates for the main waste categories

Waste Management

Inventory of PCB containing Equipment in EDP Group

PCB (polychlorinated biphenyls) are synthetic organic compounds whose characteristics have led to widespread use in the electricity industry as insulating fluids in transformers and condensers.

However, in the late 70's its human health and environmental hazardous were revealed. This led EDP to draw up an inventory, labelling and controlled elimination programme covering all equipment containing this compound. This programme had three distinct phases.

Phase I – PCB containing equipment

In this phase, all transformers and condensers containing insulating fluids based on PCB were identified. A total of 780 tons of equipment containing 180 tons of fluid was identified. A contract was signed with a specialised French incineration facility for the phased elimination of this equipment. By the end of 1999, some 65% of the total identified equipment had been eliminated.

Phase II – PCB contaminated equipment – Power station and substation transformers

This phase, started in 1996, was intended to respond to the new legal framework, which classifies as PCB all insulating fluid in which this compound is present in more than 0.005%.

In order to detect transformers which could have became contaminated during their use, EDP started an exhaustive laboratorial screening programme for all the transformers in its power stations and substations. By the end of 1999, virtually all equipment had been analysed, and results showed a very low contamination level close to 1.5 %.

Phase III – PCB contaminated equipment – medium-low voltage transformers from distribution network

In 1999, albeit in a pilot phase, EDP started to widen the screening of PCB contamination to the distribution network, a vast universe of more than 40,000 transformers scattered throughout the country.

Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a fundamental decision-support tool, analysing the environmental, socio-economic and cultural consequences of a specific project and giving the public an opportunity to participate in the decision-making process.

EDP conducts Environmental Impact Assessment Studies covering projects for its power-generating centres since a time when these were not mandatory under Portuguese legislation. In 1999 EDP saw its commitment to the search for new and effective EIA methods recognised internationally with the "Corporate Impact Assessment Achievement" award by the IAIA. It rewards the Company's voluntary approach to the application of environmental impact assessment tools and its encouragement of public involvement in the early stages of new project planning.

The EIA process of the Portuguese-Spanish hydroelectric complex at Sela, on the Minho River, was concluded in 1998, in the wake of which it was decided not to go ahead with the project.

By the end of 1999 the EIA for Baixo Sabor hydroelectric project was also presented, a comprehensive environmental study started in 1997. In this process, EDP tested a number of innovative methods previously agreed upon with the Ministry of the Environment (MAOT): EIA was drafted in the project's Prior Study phase, in which alternative solutions from the standpoint of conception and dimension are kept open, and each alternative evaluated in depth for its environment impact. EIA conclusion is programmed for the second half of 2000, and the project's entry into service for 2007.

The quest for innovative approaches, improving the efficiency of EIA studies continued with a pilot-study launched in 1998 by EDP, via REN, with the support of MAOT: The high-voltage Alqueva-Sines 400 kV power line. The method used included, for the first time in Portugal, a public consultation process in the preliminary stages of the project, which allowed identification of the most significant socio-economic impact and the definition of the aspects to be analysed by the EIA (see box).

Environmental Impact Assessment

Project for a 400 kV high voltage Alqueva– Sines power line: a pilot exercise for a new EIA methodology

The multi-purpose Alqueva scheme is a regional development project including a hydroelectric power station with two generating units of 140 MW each. In order to connect the power station to the distribution network, a new 400 kV overhead power line was projected, crossing Alentejo region over a total 125 km. This line will supply of power for the connect irrigation systems and the power station's own pumping, conveying the energy produced for onward distribution via Sines substation.

Anticipating the new regulatory framework on EIA, REN proposed to MAOT, in March 1998, a pilot-study involving a public poll during the preliminary phase with a view to obtaining a vast spectrum of relevant information for the definition of aspects to be analysed in the EIA study.

REN began, even in the Prior Study stage, to define and map out in detail a 4 kms wide zone along the entire length of the line– called the "Study Area" – and a survey was conducted into the existing or projected land uses within this area. During 1998 MAOT promoted public polls involving potentially-interested public and private entities within the Study Area, disclosing basic details of the project and further colleting information concerning routing factors.

Based upon data gathered in this preliminary phase, the EIA study began in 1999. This study, the conclusion of which is scheduled for the end of 2000, considers a number of alternative solutions for the line's passage – 400 m wide strips inside of which the final routing will be set in the Execution Project phase. During this phase, the definitive routing will be chosen, considering the most favourable balance between environmental, socio-economic and cultural factors at play.

Anticipating the public poll and the analysis of the environmental impact of the project to its initial definition phase, EDP hopes to overcome the difficulties derived from the inflexibility of final projects to accommodating possible changes resulting from the EIA process.

Environmental Impact Assessment

Also in 1999, changes were made to the 400kV high-voltage Fanhões-Alto de Mira power line, and the respective EIA study totally redone.

In parallel, EDP continues to evolve EIA for projects not covered by the Portuguese legislation, incorporating its conclusions and recommendations in the project, construction and operation phases. ENERNOVA has been carrying out EIA studies for all its projected wind farms. Based on these studies, the company investigates and reduces to the minimum any possible impact associated with the use of this renewable energy form, namely, concerning landscape conservation, protection of sensitive or rare flora and fauna species and the preservation of archaeological sites.

A similar procedure was also followed in Mortágua forest-waste thermoelectric power plant, for which an EIA study was conducted, addressing specifically the project's contribution to atmospheric emissions and the thermal impact on the adjoining Aguieira reservoir.

Protecting Fauna and Flora

EDP has progressively tried integrating its facilities within surrounding zones. Its concerns start in the project stage and continue throughout construction and operating phases, namely, with the adoption of measures to minimise the impact on local fauna and flora.

In the case of hydroelectric generation, one of the problems is the obstacle that dams represent to the passage of migratory river species. Five of the hydroelectric complexes of the Douro cascade are equipped with fish locks existing and Touvedo hydroelectric power plant on the Lima river has a fish lift, the only structure of its kind in Portugal. As this is a rather difficult optimisation equipment, EDP seeks - by means of cooperation protocols with universities and central administrative bodies - to undertake studies monitoring the operation and improving the efficiency of such devices.

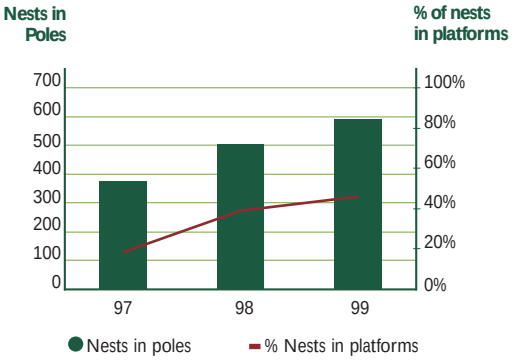
For electricity transmission, EDP has undertaken a survey of Portugal's mainland ecological sensitive areas and migratory birds zones. This procedure enables the Company to integrate - from the preliminary conception phase - nature conservation concerns within the routing of overhead power lines and to adjust its design so as to minimise the felling of trees and foreseeing the installation of flight signallers in critical zones for reduction of bird collisions.

REN is developing, in partnership with the Nature Conservation Institute (ICN), a project aimed at ensuring full operability of the electricity grid without disturbing the nesting habits of the white stork *(Ciconia ciconia)* in electricity transmission poles.

Protecting Fauna and Flora

This project has already enabled a substantial recovery in the Portuguese population of this species and the re-colonisation of areas that had become abandoned in recent years.

In 1998 and 1999, and with ICN's approval, the company continued the transfer of nests to specially built platforms in safe parts of the poles, and the installation of diverters inhibiting nesting in critical zones. By the end of 1999, 650 nesting platforms had been installed in very high-voltage poles. The total number of nests, as well as the percentage installed in platforms, also continued to increase consistently.



10 – Stork nests in Transmission Network poles

EDP also supports and participates in projects developed by external entities, the results of which can contribute to improve the company's knowledge of the impact of its activities on fauna and flora and for establishing appropriate corrective measures.

Amongst these projects, is the Cooperation Protocol for the Reforestation of Serra da Arrábida established by CPPE in 1996 and which has the participation of ICN and INETI (National Institute of Industrial Engineering and Technology). The aim is to recoup the vegetation cover of Serra da Arrábida by means of the implantation of species of original local flora cultivated in special heated greenhouses. These greenhouses are supplied with heat recovered from Setubal thermoelectric power station's thermal effluent. After an initial pilot stage, new greenhouses were built in 1999 for the project follow-up and expansion.

CPPE also collaborates with the Science College of Lisbon University

Protecting Fauna and Flora

in the Study into the Impact of Dams on the Distribution and Ecology of the Otter in Portugal: The Case of the Aguieira Dam, the second phase of which started in 1998. The project's aim is to obtain scientific data to confirm the importance of the rivers and streams associated with Aguieira reservoir on the otter's ecology and to propose suitable management practices at the Aguieira and surrounding water basin.

Electric and Magnetic Fields

Exposure to electric and magnetic fields originated from human activity and the possible risks associated therewith, is a growing public opinion concern. This issue has merited EDP's utmost attention.

The matter has been followed closely by the Company, through its active participation in conferences and representative working groups at international level, as well as keeping permanently abreast of opinions issued by leading independent scientific associations that analyse and validate the findings of worldwide research work.

The Company participated at the "1999 International Workshop on EMF", organised by Edison Electricity Institute (EEI), which brought together the world's leading specialists to debate research advances in this domain.

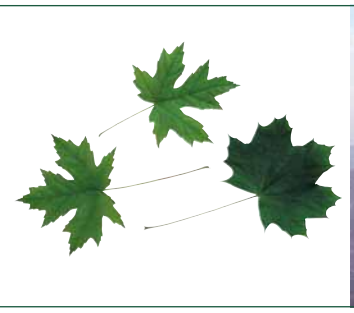
Despite 20 years of scientific research and several hundred papers published on this topic, no evidence has been found which indicates that electric and magnetic fields induce or accelerate the development of cancer in human beings. Research into the biological effects will continue. However, regardless of the area, science will never be able to demonstrate the non-existence of effects on health, but only that, with existing knowledge, it is not possible to produce evidence of its existence.

In 1999 the Council of the European Union issued a recommendation (Recommendation 1999/519/CE) relating to the limitation of population exposure to electromagnetic fields (0 Hz – 300 GHz), which is fully in line with the position of the International Committee on Non-Ionising Radiation Protection (ICNIRP) on this matter. In this recommendation, the maximum levels of electric and magnetic field readings proposed for permanent public exposure are 50 times lower than the values for which any type of biological or sensorial reactions are known.

These values are adopted by EDP, namely in projects for Very High Voltage lines, and at the same time constitute a reference guidance for assessing the field intensity measurements in residential areas.

Electric and Magnetic Fields

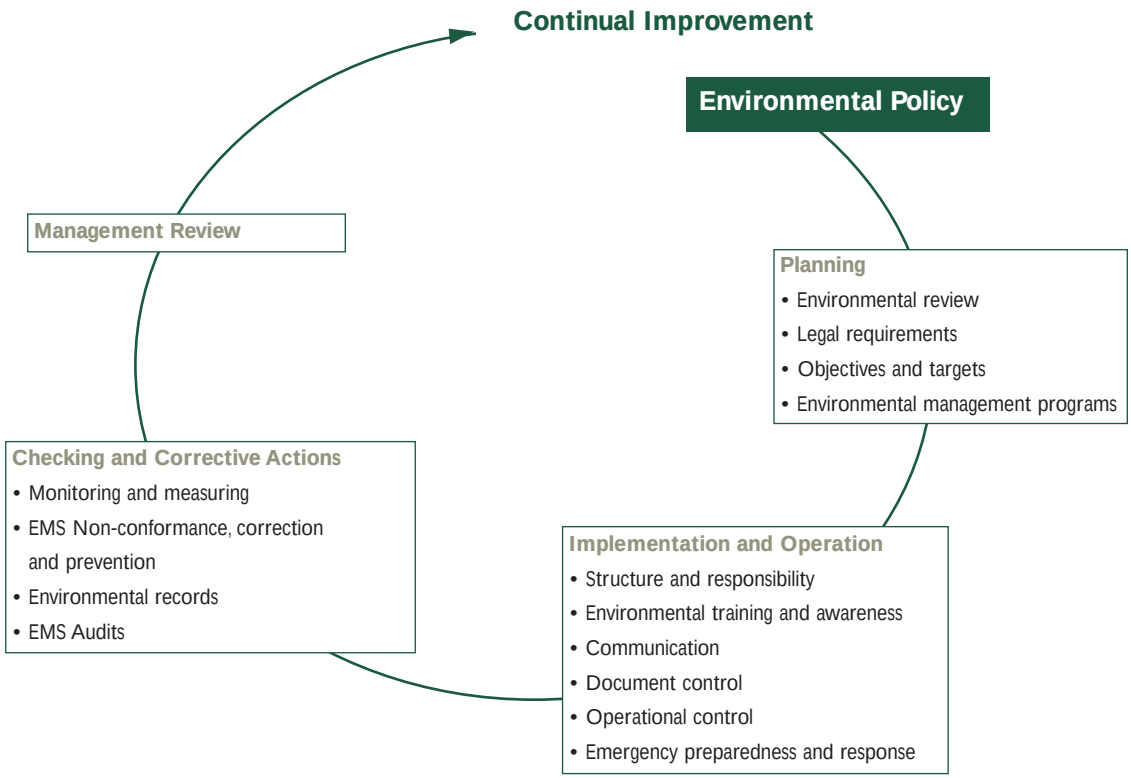
Objective and unbiased communication with the public on this issue assumes crucial importance. For this reason, EDP sponsored the Portuguese version of the document "Electromagnetic Fields" published in 1999 by the Regional Centre for Europe of the World Health Organisation. This document is primarily directed at local health and environmental entities. With its wide range distribution, EDP strives to contribute to the circulation of unbiased and effective information on this issue.



Implementing Environmental Management Systems

An Environmental Management System (EMS) forms integral part of a company's overall management system, including the functional structure, procedures and resources for fulfilling, developing and continuously improving its environmental performance.

This ongoing improvement has to be quantifiable, and it is from this perspective that environmental audits constitute an indispensable tool for monitoring and evaluating the application of measures and procedures laid down by the company's EMS.



11 – Model of an Environmental Management System

Implementing Environmental Management Systems

In effect, the conduction of environmental audits - right from the initial phases of implementation of an EMS - allows for the recognition of the most sensitive points and the identification of situations that need to be reviewed, proposing corrective measures conducive to continuing improvement in the company's environmental performance.

In 1996, EDP set itself the goal of gradually implementing Environmental Management Systems, starting at CPPE's thermoelectric power stations and subsequently extending to hydroelectric power stations and, in the final stage, to the remaining of EDP's facilities.

In the first half of 1999, a consultancy firm with recognised experience in this field carried out a preliminary assessment of Setubal thermoelectric power station's EMS, so as ensure its compatibility with ISO 14 001 Standard. Following this audit, it was possible to conclude that implementation was in a maturity phase compatible with the obtainment of the approval certificate, which occurred in October 1999 after the Environment Certification audit.

The implementation of EMS will extend over the next few years, stating with Barreiro and Carregado thermoelectric power stations, scheduled for 2000.

Thermal Power Stations

Barreiro Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Lavradio. 2835 BARREIRO

Characteristics	
Type of power station	Steam turbine
Fuel	Fuel-oil
Installed capacity (MW)	56
No. of generating units	2
Entry into service	1978
Stack height (m)	104
Air quality surveillance network	3 posts
Fuel gas treatment system	None
Combustion modifications	None

Operational Data

	Net electricity generation (MWh)	Steam production (GJ)	Fuel consumption (t)
1998	208 577	2 195 380	104 623
1999	245 826	1 726 535	108 332

Central Termoeléctrica do Barreiro

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Lavradio. 2835 BARREIRO

Environmental Data

Atmospheric Emissions [1]

	SO_2 Total (kt)	SO_2 Spce. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Partículate Total (kt)	Partículate Spec.(g/kWh)
1998	6,2	8,4	0,9	1,2	320	431	0,15	0,2
1999	5,7	8,6	0,9	1,4	332	503	0,14	0,2

Air Quality

	SO_2 ($\mu g/m^3$)				Particles ($\mu g/m^3$)				NO_2 ($\mu g/m^3$)	
Sampling Stations	1998		1999		1998		1999		1998	1999
	Median	P98 DMV	Median	P98 DMV	Average	P95 DMV	Average	P95 DMV	P98 DMV	P98 DMV
Alto da Paiva	12	43	13	58	34	69	29	69	33	59
B. Banheira	10	48	12	72	–	–	8	13	–	–
Barreiro	1	12	2	23	17	40	27	63	–	–

Waste Water

	Suspended solids (mg/l)	Iron (mg/lFe)	Cooper (mg/l Cu)	Zinc (mg/l Zn)	Nickel (mg/l Ni)	Vanadium (mg/l V)	Chrome (mg/l Cr)	Oils (mg/l)	Hydrocarbons (mg/l)
1998	5.81	0.30	0.01	0.10	0.04	0.29	0.01	0.62	0.34
1999	9.66	1.54	0.01	0.07	0.25	0.92	0.01	0.74	0.41

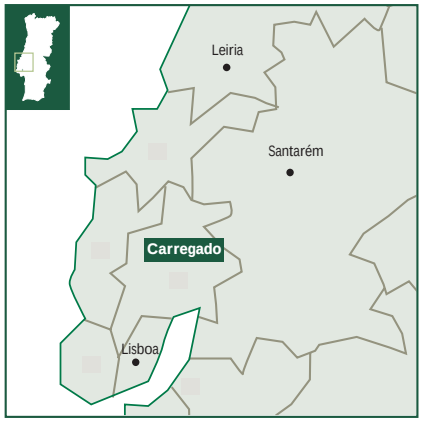
Waste [2]

	Fuel-oil fly ash and bottom ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metal Scrap (t)
1998	(3)	–	2,8	–	56
1999	(3)	–	5,8	1,68	21

[1] Total emissions calculated on the basis of CORINAIR 90 emission factors. Specific emissions calculated on the basis of net electricity generation, including steam production for industrial purposes.
[2] Includes waste produced at Alto de Mira and Tunes thermal power station.
[3] Power station without dust-removal system

Carregado Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Vala do Carregado. 2580-480 CARREGADO



Characteristics	
Type of power station	Steam turbine
Fuel	Fuel-oil/Natural Gas
Installed Capacity (MW)	710,2
No. of generating units	6
Entry into service	1968
Stack height (m)	100
Air quality surveillance network	6 posts
Flue gas treatment system	Electrostatic precipitators
Combustion modifications	None

Operational Data

	Net electricity generation (MWh)	Fuel consumption	
		Fuel-oil (t)	Natural gas (Nm^3)
1998	1 682 242	255 412	163 726 218
1999	2 713 772	303 797	376 277 716

Carregado Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Vala do Carregado. 2580-480 CARREGADO

Environmental Data

Atmospheric Emissions [1]

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (Mt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec. (g/kWh)
1998	15,2	9,0	3,7	2,2	1112	661	0,26	0,2
1999	16,9	6,2	5,6	2,0	1733	631	0,25	0,1

Air Quality

	SO_2 ($\mu g/m^3$)				Particles ($\mu g/m^3$)				NO_2 ($\mu g/m^3$)	
Sampling stations	1998		1999		1998		1999		1998	1999
	Median	P98 DMV	Median	P98 DMV	Average	P95 DMV	Average	P95 DMV	P98 VMD	P98 DMV
Castanheira	13	124	3	53	85	136	66	102	–	–
Faiel	17	126	3	26	71	105	68	101	188	150
Ironfer	10	99	2	9	91	154	82	125	–	–
RDP	13	153	4	31	81	122	74	110	–	–
TAK	12	82	3	25	73	115	70	99	–	–
Vinha	24	153	4	29	71	108	72	115	–	–

Waste Water

	Suspended solids (mg/l)	Iron (mg/l Fe)	Copper (mg/l Cu)	Zinc (mg/l Zn)	Nickel (mg/l Ni)	Vanadium (mg/l V)	Chrome (mg/l Cr)	Oils (mg/l)	Hydrocarbons (mg/l)
1998	48.90	0.72	0.01	0.02	0.01	0.04	0.00	0.23	0.13
1999	*	*	*	*	*	*	*	*	*

* Waste water treatment station in trial and commissioning phase

Waste

	Fuel-oil fly ash and bottom ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	1087	–	2,8	–	25
1999	1234	–	11,5	21,71	154

[1] Total emissions calculated on the basis of CORINAIR 90 emission factors. Specific emissions calculated on the basis of net electricity generation,

Setúbal Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Praias do Sado. 2910 SETÚBAL

Characteristics	
Type of power station	Steam turbine
Fuel	Fuel-oil
Installed capacity (MW)	946,4
No. of generating units	4
Entry into service	1979
Stack height (m)	200
Air quality surveillance network	7 posts
Fuel gas treatment system	Electrostatic precipitators
Combustion modifications	None

Operational Data

	Net electricity generation (MWh)	Fuel consumption (t)
1998	5 034 739	1 179 901
1999	4 636 212	1 095 032

Setúbal Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: Praias do Sado. 2910 SETÚBAL

Environmental Data

Atmospheric Emissions [1]

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec.(g/kWh)
1998	66,8	13,3	12,3	2,4	3607	716	0,73	0,2
1999	59,6	12,9	11,4	2,5	3350	723	0,46	0,2

Air Quality

	SO_2 ($\mu g/m^3$)				Particles ($\mu g/m^3$)				NO_2 ($\mu g/m^3$)	
Sampling stations	1998		1999		1998		1999		1998	1999
	Median	P98 DMV	Median	P98 DMV	Average	P95 DMV	Average	P95 DMV	P98 DMV	P98 DMV
Palmela	6	30	4	34	43	79	43	73	_	_
S. Filipe	5	30	4	24	27	53	43	118	_	_
S. Ovídio	1	2	1	3	25	56	33	63	7	8
Subestação	3	26	2	19	26	55	47	87	79	68
Tróia	1	13	1	8	23	53	27	56	87	76

Waste Water

	Suspended solids (mg/l)	Iron (mg/l Fe)	Copper (mg/l Cu)	Zinc (mg/l Zn)	Nickel (mg/l Ni)	Vanadium (mg/l V)	Chrome (mg/l Cr)	Oils (mg/l)	Hydrocarbons (mg/l)
1998	17.98	1.12	0.01	0.08	0.18	0.65	0.01	0.88	0.41
1999	28.75	3.01	0.03	0.20	0.71	4.49	0.01	0.52	0.25

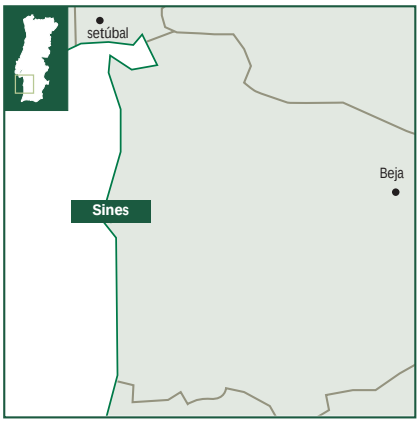
Waste

	Fuel-oil fly ash and bottom ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	2 529	–	97,4	0,08	14
1999	5 650	–	182,5	23,40	73

[1] Total emissions calculated on the basis of CORINAIR 90 emission factors. Specific emissions calculated on the basis of net electricity generation.

Sines Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: S. Torpes. 7520-089 SINES



Characteristics	
Type of power station	Steam turbine
Fuel	bituminous coal
Installed capacity (MW)	1 192
No. of generating units	4
Entry into service	1985
Stack height (m)	225
Air quality surveillance network	5 posts
Fuel gas treatment system	Electrostatic precipitators
Combustion modifications	Low NO_x burners in 3 of 4 units

Operational Data

	Net electricity generation (MWh)	Fuel consumption	
		Fuel-oil (t)	Coal (t)
1998	8 384 777	7 008	3 054 232
1999	9 319 181	4 953	3 415 196

Sines Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Address: S. Torpes. 7520-089 SINES

Environmental Data

Atmospheric Emissions [1]

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec.(g/kWh)
1998	49,6	5,9	30,7	3,7	7546	900	3,30	0,4
1999	50,2	5,4	34,9	3,7	8313	892	2,40	0,3

Air Quality

	SO_2 ($\mu g/m^3$)				Particles ($\mu g/m^3$)				NO_2 ($\mu g/m^3$)	
Sampling stations	1998		1999		1998		1999		1998	1999
	Median	P98 DMV	Median	P98 DMV	Average	P95 DMV	Average	P95 DMV	P98 DMV	P98 DMV
Monte Chãos	14	70	10	60	_	_	_	_	19	71
Sonega	12	49	11	44	_	_	_	_	15	13
Santiago	9	67	10	34	_	_	_	_	32	30
Monte Velho	5	25	3	100	_	_	_	_	19	17
Carbogal	_	_	_	_	40	69	33	75	_	_
Provença	_	_	_	_	44	92	29	62	_	_
EDP – N	_	_	_	_	31	68	32	74	_	_
EDP – S	_	_	_	_	41	98	31	75	_	_

Waste Water

	Suspended solids (mg/l)	Iron (mg/l Fe)	Copper (mg/l Cu)	Zinc (mg/l Zn)	Nickel (mg/l Ni)	Vanadium (mg/l V)	Chrome (mg/l Cr)	Oils (mg/l)	Hydrocarbons (mg/l)
1998	8.60	0.30	0.00	0.02	0.01	0.30	0.01	0.18	_
1999	12.20	0.08	0.01	0.03	0.03	0.05	0.01	0.15	_

Waste

	coal bottom ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	29 910	271 900	20,1	_	275
1999	30 658	346 780	121,1	_	297

[1] Total emissions calculated on the basis of CORINAIR 90 emission factors. Specific calculated on the basis of net electricity generation.

Tapada do Outeiro Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Location: Broalhos-Mêdas. 4420 GONDOMAR

Characteristics	
Type of power station	Steam turbine
Fuel	Local coal/ /fuel-oil(1)
Installed capacity (MW)	93.8
No. of generating units	2(2)
Entry into service	1959
Stack height (m)	60
Air quality surveillance network	5 posts
Fuel gas treatment system	Electrostatic precipitators
Combustion modifications	None

(1) Burning of local coal ceased in October 1997
(2) 2nd generating unit decommissioned in December 1999

Operational Data	Net electricity generation (MWh)	Fuel consumption (t)[1]
1998	73 194	22 513
1999	84 911	27 039

(1) Since 1997 only fuel-oil is being used.

Tapada do Outeiro Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Location: Broalhos-Mêdas. 4420 GONDOMAR

Environmental Data

Atmospheric Emissions [3]

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec.(g/kWh)
1998	1,1	15,1	0,2	2,6	69	944	0,03	0,4
1999	1,3	14,9	0,2	2,7	83	980	0,04	0,5

Air Quality

	SO_2 ($\mu g/m^3$)				Particles ($\mu g/m^3$)				NO_2 ($\mu g/m^3$)	
Sampling stations	1998		1999		1998		1999		1998	1999
	Median	P98 DMV	Median	P98 DMV	Average	P95 DMV	Average	P95 DMV	P98 DMV	P98 DMV
Aldeia Nova	3	38	4	47	42	94	28	63	60	81
Lever	6	41	8	66	63	145	52	105	_	_
Lixa	7	26	15	32	47	103	38	82	_	_
Vila Cova	10	38	7	101	36	84	31	66	_	_

Waste

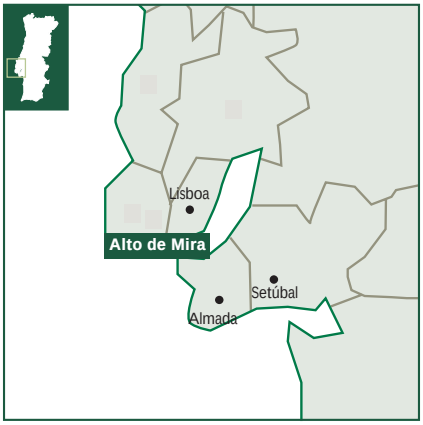
	Fuel-oil fly ash and bottom ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	100	_	0	_	94
1999	116	_	0	_	0

[3] Total emissions calculated on the basis of CORINAIR 90 emission factors. Specific emissions calculated on the basis of net electricity generation.

Alto de Mira Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.

Location: Alto de Mira. 2700 Amadora



Characteristics	
Type of power station	Gas turbine
Fuel	Diesel
Installed capacity (MW)	132
No. of generating units	6
Entry into service	1975
Air quality surveillance network	None
Fuel gas treatment system	None
Combustion modifications	None

Operational Data

	Net electricity generation (MWh)	Fuel consumption (kl)
1998	3 858	2 105
1999	406	752

Environmental Data

Atmospheric Emissions

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec. (g/kWh)
1998	0,013	–	0,008	–	6,6	–	–	–
1999	0,005	–	0,003	–	2,4	–	–	–

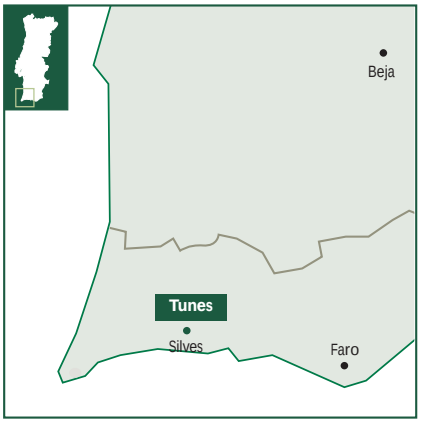
Waste [1]

[1] Waste produced at Alto de Mira thermal power station is accounted for jointly with that produced at Barreiro thermal power station

Tunes Thermal Power Station

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.

Location: Tunes. 8365-906 Silves



Characteristics	
Type of power station	Gas turbine
Fuel	Diesel
Installed capacity (MW)	197
No. of generating units	4
Entry into service	1973
Air quality surveillance network	None
Fuel gas treatment system	None
Combustion modifications	None

Operational Data

	Net electricity generation (MWh)	Fuel consumption (kl)
1998	4 591	1 630
1999	1 999	854

Environmental Data

Atmospheric Emissions

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec.(g/kWh)
1998	0,011	–	0,007	–	5,7	–	–	–
1999	0,006	–	0,004	–	5,0	–	–	–

Waste (1)

(1) Waste produced at Tunes thermal power station is accounted for jointly with that produced at Barreiro thermal power station

Cávado-Lima Generating Centre

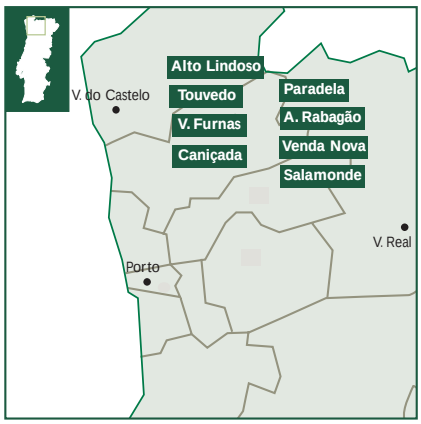
CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Head office address: Paradela de Valdosende. 4845 GERÊS

Characteristics

Power plant	Water course	Type of head installation	Hydrographic basin area (km²)	Normal operat. capac. (hm³)	Installed capac. (MW)	No. of genera. units	Entry into service
Alto Lindoso	Lima	Reservoir	1 525	347,9	630	2	1992
Touvedo	Lima	Reservoir	1 700	4,5	22	1	1993
Alto Rabagão	Rabagão	Reservoir	210	550,1	68	2	1964
Vila Nova/Venda Nova	Rabagão	Reservoir	356	92,1	90	3	1951
Vila Nova/Paradela	Cávado	Reservoir	168	158,2	54	1	1956
Salamonde	Cávado	Reservoir	642	55	42	2	1953
Vilarinho das Furnas	Homem	Reservoir	77	69,7	125	2	1972
Caniçada	Cávado	Reservoir	860	144,4	62	2	1954

Operational Data

Net electricity generation (MWh)	
1998	2 693 514
1999	1 699 163



Operational Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	5,6	–	15
1999	22,8	–	144

Douro Generating Centre

CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Head office address: Bagaúste. 5050 PESO DA RÉGUA

Characteristics

Power plant	Water course	Type of head installation	Hydro. basin area (km²)	Normal oper. capacity (hm³)	Installed capacity (MW)	No. of gener. units	Entry into service
Miranda	Douro	Run-of-river	63 500	6,7	369	4	1960(1)
Picote	Douro	Run-of-river	63 750	13,4	195	3	1958
Bemposta	Douro	Run-of-river	63 850	20	240	3	1964
Pocinho	Douro	Run-of-river	81 005	12,2	186	3	1983
Valeira	Douro	Run-of-river	85 395	13	240	3	1976
Vilar-Tabuaço	Távora	Reservoir	359	95,5	58	2	1965
Régua	Douro	Run-of-river	90 800	12	180	3	1973
Carrapatelo	Douro	Run-of-river	92 040	13,8	201	3	1971
Torrão	Tâmega	Reservoir	3 252	58,5	140	2	1988
Crestuma-Lever	Douro	Run-of-river	96 520	22,3	117	3	1985

(1) The entry into service of the 4th generating unit occurred in 1995

Operational Data

Net electricity generation (MWh)	
1998	7 082 008
1999	3 891 398

Operational Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	–	–	–
1999	8,0	–	20

Tejo-Mondego Generating Centre

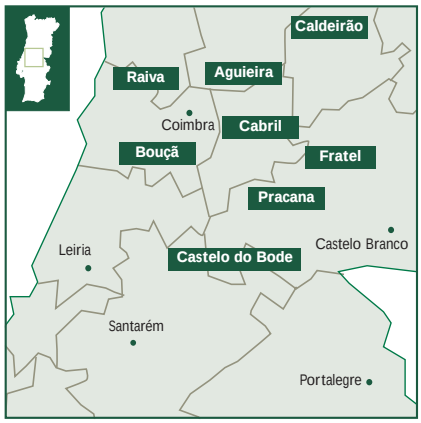
CPPE – Companhia Portuguesa de Produção de Electricidade, S.A.
Head office address: Castelo do Bode. 2300 S. PEDRO DE TOMAR

Characteristics

Power plant	Water course	Type of head installation	Hydrographic basin area (km²)	Normal oper. capacity (hm³)	Installed capacity (MW)	No. of gener. units	Entry into service
Caldeirão	Caldeirão	Reservoir	38	3,5	40	1	1994
Aguieira	Mondego	Reservoir	3 113	216	336	3	1981
Raiva	Mondego	Reservoir	3 339	12	24	2	1982
Cabril	Zêzere	Reservoir	2 340	615	108	2	1954
Bouçã	Zêzere	Reservoir	2 525	7,9	44	2	1955
Castelo do Bode	Zêzere	Reservoir	3 950	902,5	159	3	1951
Pracana	Ocreza	Reservoir	1 410	95,6	41	3	1993
Fratel	Tejo	Run-of-river	59 562	21,0	132	3	1974

Operational Data

	Net electricity generation (MWh)
1998	1 730 970
1999	865 999



Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	32,6	–	–
1999	10,5	–	–

Tejo Region Small-Scale Generating Center

Hidrotejo – Hidroeléctrica do Tejo, S.A.
Head office address: Ortiga. 6120 GAVIÃO

Characteristics

Power plant	Water course	Type of head installation	Hydrographic basin area (km²)	Normal operating capacity (hm³)	Installed capacity (MW)	No. of gener. units	Entry into service
Belver	Tejo	Run-of-river	62 802	7,5	80,7	6	1952
Póvoa	Rib. Nisa	Reservoir	155	21,5	0,7	1	1927
Bruceira	Rib. Nisa	Reservoir	11	4,1	1,6	1	1929
Velada	Rib. Nisa	Reservoir	57	0,4	1,9	1	1935
Caldeirão	Almonda	Run-of-river	25	–	0,1	2	1927

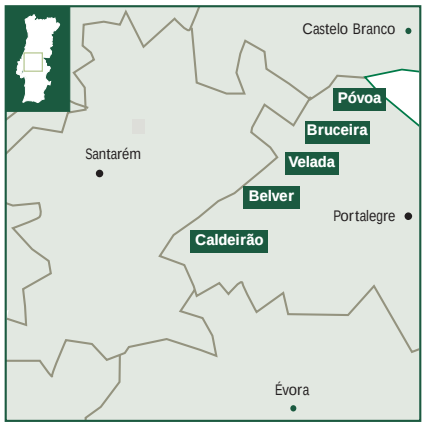
Operational Data

Net electricity generation (MWh)	
1998	216 347
1999	85 024

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	1,3	–	–
1999	–	–	17



Northern Region Small-Scale Hydro Generating Centre

HDN – Energia do Norte, S.A.
Head office address: R. do Caires, 292. 4704-516 BRAGA

Characteristics

Power plant	Water course	Type of head installation	Hydrographic basin area (km²)	Normal operating capacity (hm³)	Installed capacity (MW)	No. of gener. units	Entry into service
Guilhofrei	Ave	Reservoir	122	20,4	4,6	1	1939
Ermal	Ave	Run-of-river with reg.(1)	122	21,2	10,8	2	1947
Ponte da Esperança	Ave	Run-of-river with reg.(1)	122	21,2	2,8	1	1942
Senhora do Porto	Ave	Run-of-river with reg.(1)	28	0,2	8,8	2	1945
Lindoso	Lima	Run-of-river	1 506	0,5	42,0	2	1922
France	Coura	Run-of-river	176	0,1	7,7	1	1974
Penide I e II	Cávado	Run-of-river	1 321	0,5	4,8	2	1951
Varosa	Varosa	Reservoir	306	12,9	24,7	3	1934
Freigil	Cabrum	Run-of-river	54	0,3	4,6	1	1926
Aregos	Cabrum	Run-of-river	1	–	3,2	2	1958
Cefra	Ouro	Run-of-river	–	0,1	1,5	2	1950

(1) Run-of-river with regulation. Run-of-river power plant in cascade, where the generating company operates the upstream installation with regulating capacity.

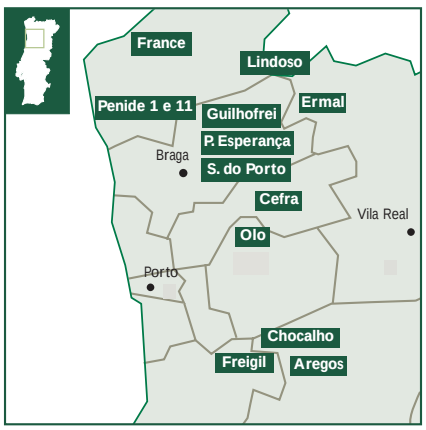
Operational Data

Net electricity generation (MWh)	
1998	215 327
1999	186 565

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	0,9	–	18
1999	–	–	–



Central Region Small-Scale Hydro Generating Centers

HIDROCENEL – Energia do Centro, S.A.

Head office address: Quintela. 6270 SEIA

Characteristics

Power plant	Water course	Type of head installation	Hydrographic basin area (km²)	Normal operating capacity (hm³)	Installed capacity (MW)	No. of gener. units	Entry into service
Sabugueiro I	Rib. Caniça	Reservoir	19	15	13,2	3	1947
Sabugueiro II	Rib. Covão Urso	Reservoir	14	1,5	10	1	1993
Desterro I	Alva	Run-of-river with reg. (1)	74 + 39	–	14	4	1959
Ponte de Jugais	Alva	Run-of-river with reg. (1)	34	–	19,3	4	1923
Vila Cova	Alva	Run-of-river with reg. (1)	4	–	11,8	3	1937
Drizes	Vouga	Run-of-river	–	–	0,1	2	1917
Riba-Côa	Côa	Run-of-river	1	–	0,1	1	1906
Pateiro	Mondego	Run-of-river	138	–	0,5	2	1938
Figueiral	Carvalhinho	Run-of-river	–	–	0,2	1	1955
Pisões	Dinha	Run-of-river	–	–	0,1	2	1927
Rei de Moinhos	Alva	Run-of-river	500	–	0,7	1	1993
Ermida	Rib. S. João	Run-of-river	13	–	0,4	2	1943
Santa Luzia	Unhais	Reservoir	88	51,4	23,2	4	1943
Ribafeita	Vouga	Run-of-river	273	0,1	0,9	2	1955

(1) Run-of-river with regulation. Run-of-river power plant in cascade, where the generating company operates the upstream installation with regulating capacity.

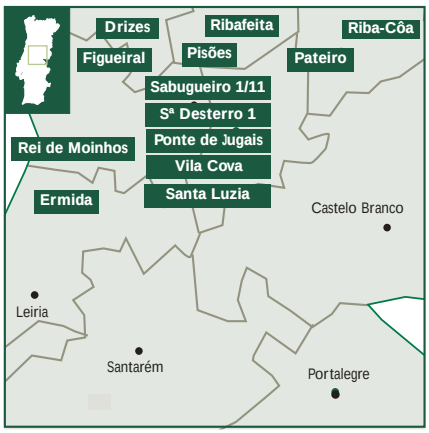
Operational Data

Net electricity generation (MWh)	
1998	286 435
1999	175 616

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	0,3	–	843
1999	7,7	–	218



Fonte da Mesa Wind Farm

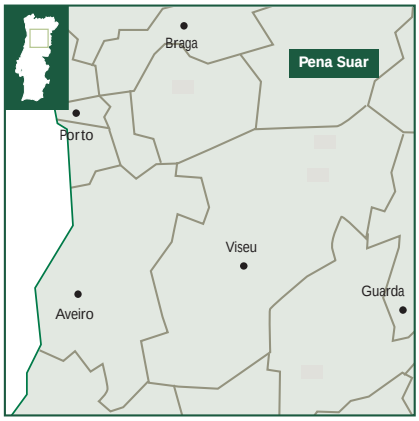
ENERNOVA – Novas Energias, S.A.
Address: Fonte da Mesa. 5100 LAMEGO

Characteristics	
Implantation area (ha)	340
No. of generators	17
Tower height (m)	40,5
Diameter of blades (m)	42
Installed capacity (MW)	10,2
Average wind speed (m/s)	7,7
Minimum wind speed for normal power (m/s)	17
Expected gross generation (GWh/ano)	28,6
Entry into service	1996

Operational Data	
Net electricity generation (MWh)	
1998	22 629
1999	24 273

Pena Suar Wind Farm

ENERNOVA – Novas Energias, S.A.
Address: Pena Suar. 5000 VILA REAL



Characteristics	
Implantation area (ha)	205
No. of generators	20
Tower height (m)	44
Diameter of blades (m)	40,2
Installed capacity (MW)	10
Average wind speed (m/s)	8,9
Minimum wind speed for normal power (m/s)	13
Expected gross generation (GWh/ano)	29,0
Entry into service	1997

Operational Data	
Net electricity generation (MWh)	
1998	23 286
1999	28 628

Mortágua Forest-Waste Thermoelectric Power Station

ENERNOVA – Novas Energias, S.A.
Address: Mortágua. 3450 Mortágua

Characteristics

Type of power station	steam turbine
Fuel	Forest waste
Installed capacity (MW)	10
No. of generating units	1
Entry into service	1999
Air quality surveillance network	—
Flue gas treatment	—
Combustion modifications	—

Operational Data

	Net electricity generation (MWh)	Fuel consumption (t)
1998	–	–
1999	2716	10968

Environmental Data

Atmospheric Emissions[1]

	SO_2 Total (kt)	SO_2 Spec. (g/kWh)	NO_x Total (kt)	NO_x Spec. (g/kWh)	CO_2 Total (kt)	CO_2 Spec. (g/kWh)	Particulate Total (kt)	Particulate Spec. (g/kWh)
1998	–	–	–	–	–	–	–	–
1999	–	–	–	–	–	–	–	–

Waste[1]

	Scoriae and fuel-oil ash (t)	Coal fly ash (t)	Used oils (t)	Equipment with PCB (t)	Metallic waste (t)
1998	–	–	–	–	–
1999	–	–	–	–	–

[1] Reliable data still not available as the power plant entered into service in 1999.

Northem Region Distribution Network

EN – Electricidade do Norte, S.A.
Head office address: R. Duque de Loulé, 148. 4000-325 PORTO

Distribution Centres

CD Aveiro	R. Engº Von Haffe, 24. 3800-176 Aveiro
CD Braga	R. Pedro Magalhães Gônvado, 147. 4704-502 Braga
CD Bragança	R. Miguel Torga. 5301-858 Bragança
CD Guimarães	Av. D. Afonso Henriques. 4810-431 Guimarães
CD Maia	R. Carlos Pires Felgueiras. 4470 Maia
CD Matosinhos	R. Alfredo Cunha, 440. 4454-508 Matosinhos
CD Penafiel	Agra. 4560 Penafiel
CD Porto	R. João das Regras, 247. 4000-293 Porto
CD Viana do Castelo	Praça da Galiza, 60. 4900-476 Viana do Castelo
CD Vila Nova de Gaia	R. José Pereira Araújo, 155. 4400-199 Vila Nova de Gaia
CD Vila Real	Av. Rainha Santa Isabel. 5000-434 Vila Real

Operational Data

	No. of substations	Substation installed capacity (MVA)	No. of transf. stations	Transf. stations installed capacity (MVA)	Overhead lines HV (km)	Overh. lines MV (km)	Overh. lines LV (km)	Under ground lines HV (km)	Under ground lines MV (km)	Under ground lines LV (km)
1998	98	4 856	15 545	4 714	1 954	14 067	38 491	60	2 044	7 627
1999	101	4 929	16 107	4 924	1 995	14 233	39 006	60	2 170	7 861

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	16	3	686
1999	34	3	727

Central Region Distribution Network

CENEL – Electricidade do Centro, S.A.
Head office address: R. do Brasil, 1. 3030-175 COIMBRA

Distribution Centres

Name	Address
CD Caldas da Rainha	R. Columbano Bordalo Pinheiro. 2500 Caldas da Rainha
CD Coimbra	Av. Fernão de Magalhães, 511. 3000-177 Coimbra
CD Guarda	R. Batalha Reis, 4. 6301-860 Guarda
CD Leiria	Ponte Hintze Ribeiro. 2410-109 Leiria
CD Lousã	R. Engº Duarte Pacheco. 3200-239 Lousã
CD Seia	Lg. Marques da Silva. 6270 Seia
CD Viseu	R. Direita, 94. 3504-507 Viseu

Operational Data

	No. of substations	Substation installed capacity (MVA)	No. of transf. stations	Transf. stations installed capacity (MVA)	Over head lines HV (km)	Over head lines MV (km)	Over head lines LV (km)	Under ground lines HV (km)	Under ground lines MV (km)	Under ground lines LV (km)
1998	70	2 244	10 687	1 790	1 564	13 383	23 718	0	781	1 421
1999	70	2 179	10 972	1 855	1 594	13 573	24 311	0	833	1 590

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	17	12	381
1999	103	-	669

Lisbon and Vale do Tejo Region Distribution Network

LTE – Electricidade de Lisboa e Vale do Tejo, S.A.
Head office address: R. Camilo Castelo Branco, 43. 1050-044 LISBOA

Distribution Centres

Name	Address
CD Castelo Branco	Av. Nuno Álvares., 3. 6000-083 Castelo Branco
CD Lisboa	Av. Infante Santo, 17-1º. 1350-175 Lisboa
CD Oeste	Av. Alm. Gago Coutinho, 125. 2700-405 Amadora
CD Portalegre	R. Casa da Saúde, 2. 7301-852 Portalegre
CD Santarém	Av. Madre Andaluz. 2000-210 Santarém
CD Torres Vedras	Av. Gen. Humberto Delgado, Lt. 14. 2560 Torres Vedras
CD Vale do Tejo	R. 4 de Outubro, 5. Urb. Ulmeiras. 2670-466 Loures

Operational Data

	No. of substations	Substation installed capacity (MVA)	No. of transf. stations	Transf. stations installed capacity (MVA)	Over head lines HV (km)	Over head lines MV (km)	Over head lines LV (km)	Under ground lines HV (km)	Under ground lines MV (km)	Under ground lines LV (km)
1998	106	3 143	9 752	3 100	1 553	10 109	12 718	246	4 397	7 868
1999	110	3 208	10 092	3 234	1 615	10 295	12 972	245	4 574	8 360

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	23	9	460
1999	45	-	875

Southern Region Distribution Netwotk

SLE – Electricidade do Sul, S.A.
Head office address: R. D. Francisco Manuel de Melo, 23A. 1099-022 LISBOA

Distribution Centres

Name	Address
CD Algarve	Estrada da Penha. 8000 Faro
CD Almada	R. Bernardo Francisco da Costa, 34. 2800-029 Almada
CD Beja	R. António Sardinha, 22. 7800-447 Beja
CD Évora	Lg. Alexandre Herculano, 5. 7004-508 Évora
CD Setúbal	Estrada dos Ciprestes, 15. 2900-319 Setúbal

Operational Data

	No. of substations	Substation installed capacity (MVA)	No. of transf. stations	Transf. stations installed capacity (MVA)	Over head lines HV (km)	Over head lines MV (km)	Over head lines LV (km)	Under ground lines HV (km)	Under ground lines MV (km)	Under ground lines LV (km)
1998	84	2 447	8 636	2 059	1 542	11 179	15 417	52	2 103	4 815
1999	84	2 437	8 963	2 156	1 513	11 415	15 731	51	2 202	5 082

Environmental Data

Waste

	Used oils (t)	Equipment with PCB (t)	Metal scrap (t)
1998	6	–	292
1999	4	–	441

National Transmission Grid

REN – Rede Eléctrica Nacional, S.A.
Head office address: Av. Estados Unidos da América, 55. 1749-061 LISBOA

Operating Unit	
Name	**Address**
Operating group	R. Casal dos Mogos. Vermoin. 4470 Maia

Operational Data				
	No. of substations	**Substations installed capac. (MVA)**	**Overhead lines (km)**	**No. poles**
1998	43	16 269	5 982	13 891
1999	43	16 652	5 990	14 046

Environmental Data		
	1998	**1999**
No. of nesting inhibiting devices	347	699
No. of nests in poles	502	588
No. of transferred nests	71	105

Waste			
	Used oils (t)	**Equipment with PCB (t)**	**Metal scrap (t)**
1998	99,2	–	89
1999	79,0	10,10	–

Acronyms and Units

EIA	• Environmental Impact Assessment
CPPE	• Companhia Portuguesa de Produção de Electricidade
EIS	• Environmental Impact Study
GG	• Greenhouse gas
IAIA	• International Association for Impact Assessment
NCI	• Nature Conservation Institute
INETI	• National Institute of Industrial Engineering and Technology
HCI	• Hydroelectric Capability Index
MAOT	• Ministério do Ambiente e do Ordenamento do Território (Ministry of the Environment and Territorial Planning)
PCB	• Polychlorinated biphenyl
SRP	• Special Regime Producers
TPS	• Total Particles in Suspension
REN	• Rede Eléctrica Nacional
NTG	• Nation Transmission Grid
IES	• Independent Electrical System
NES	• National Electrical System
NBES	• Non-Binding Electrical System
PES	• Public Electrical System
EMS	• Environmental Management System
Hertz [Hz]	• Unit of frequency. 1 Hertz is the frequency of a periodic phenomenon that has a periodic time of 1 second.
Watt [W]	• Unit of power. 1 Watt is the power of an energy system in wich an energy of 1 joule per second is uniformly transferred.
Watt hour [Wh]	• Unit of measurement of electricity produced or consumed. 1 Watt hour is the energy needed for the functioning of an electrical equipment with 1 Watt power during one hour.

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