



Hrvatska
Elektroprivreda
and the Environment
1999 - 2000



HRVATSKA ELEKTROPRIVREDA

Hrvatska Elektroprivreda expenses
on environmental protection exceed
100 million Croatian Kunas a year.



02

Hrvatska Elektroprivreda, the leading business system in the Republic of Croatia, is fully aware of its corporate social responsibility for environmental protection.

Hrvatska Elektroprivreda and the Environment 1999-2000 Report is the second environmental report of our company and the first of the corporate Management appointed early in 2000. While the first report was an overview of numerous activities carried out from 1990 until and including 1998, this Report deals with the years 1999 and 2000. We have decided to publish the Report on biannual basis because we are convinced that the realistic, permanent and noticeable results of a system such as HEP are reached on a long run. However, valuable results and environmental protection improvement are achieved on a daily basis, particularly on a local operating level. Key aspects of environmental protection as the part of the business policy will continue to be published in brief in HEP's Annual Reports.

Commissioning of the Plomin 2 Thermal Power Plant in 2000 was the key event during the past period that reaches beyond the energy sector. This plant has been built according to the state-of-the-art concepts of environmental protection fully respecting the global practice in the field. Among other measures and activities relevant for the environmental protection and presented in this Report, I would like to highlight project preparation, and procurement and installation of equipment for continuous emission monitoring systems for the HEP's thermal power plants. Such systems have already been put into operation in the Plomin Thermal Power Plant and in EL-TO Zagreb combined heat and power plant, along with air quality monitoring systems in their surroundings.

Pursuant to the HEP's Environmental Policy, and within its systematic and careful approach to the environmental protection, HEP has initiated a number of activities that reflect the HEP's orientation expressed in the 2000-2003 Business Program of the Management. Despite currently unfavorable financial and business circumstances, HEP will undertake to finish started activities within the set up deadlines and realize the environmental protection plans. The restructuring of HEP's business system, as a process of adjustment to the oncoming entrance into the competitive electricity market, has started. We expect that HEP will reaffirm its position of a reliable and accountable partner to its clients and remain the major Croatian system for power generation, transmission, distribution and supply. We shall also strive to maintain our position among the Croatian environmental protection leaders, fully aware of the responsibility towards the environment as our common resource and to the natural, cultural and historical capital of our country. It is our profound commitment to join the Croatian companies and institutions that will, by implementing the best global practice and standards, accelerate Croatia's integration with the community of the European countries.

Ivo Čović
President of the Management Board





HEP's transmission system - a connection with the world

Hrvatska Elektroprivreda d.d. (HEP) is the state-owned company responsible for the generation, transmission and distribution of electricity, and for the management of the electric power system on the entire territory of the Republic of Croatia.

In the cities of Zagreb, Osijek and Sisak, HEP also produces heat and manages the district heating systems, and in Osijek it operates the natural gas distribution system. HEP was incorporated in 1990, and it is a legal successor to the power companies that had been operating in Croatia under different names since 1945.

Its power generation capacities total 3,822 MW, wherefrom 2,076 MW in hydro power plants, 1,519 MW in thermal power plants, and 332 MW in Krško Nuclear Power Plant. With imperative power imports, HEP meets about 95 percent of total electricity demand in Croatia (total of 13.8 TWh in 2000). The remaining five percent of the electricity is generated in industrial cogeneration plants, mainly covering the needs of their owners, and in private small hydro power plants. HEP's 15,910 employees supply with the power over 2 million consumers from the power generation facilities and through 140 high-voltage switchyards and 7,188 kilometers of transmission lines, and 22,739 medium- and low-voltage switchgears and 122,161 kilometers of distribution lines.

Total 2000 income from the power sales was HRK 5,285 million, which gives an average end-user net price per delivered kWh of HRK 0.45.

More detailed data and diagrams are given in attachment at the end of this brochure.

The HEP's Environmental Policy is based on the following main principles:

- incorporate environmental issues into HEP's development plans and strategy, and the criteria of environmental protection into its planning and decision-making processes;
- use the resources in an efficient and conservative way, reduce its emissions into the air, water, and soil, and reduce quantity and hazards of waste;
- preserve biological, environmental, and other natural wealth of the environment in the vicinity of HEP's facilities by implementing measures designed to protect flora, fauna, and natural, cultural, and historical heritage;
- install and maintain continuous environmental monitoring systems at each location where HEP's facilities are situated and publish the monitoring results;
- encourage the use of renewable energy sources and cogeneration units;
- develop and research on the application of cleaner and more efficient technologies in the generation, transmission, and distribution of electricity;
- educate and train HEP's employees to conduct their activities in an environmentally responsible manner;
- cooperate with state and local authorities, and with institutions and non-governmental organizations involved in environmental protection;

- advocate the efficient and conservative use of energy, both by HEP's customers and at the national level; and
- urge equipment suppliers, consultants, design engineers, and other business partners of HEP to develop their own environmental policy on the basis of these principles.

(From the 1996 HEP's Environmental Policy Statement)

At time when HEP's Environmental Policy was adopted, its basic principles were the first step towards incorporation of systematic environmental protection into the HEP's business policy. By adoption of the 2000-2003 Management Business Program, and aiming at realization of tasks set up therein, the HEP's Environmental Plan became the key document for introduction of the Environmental Management System (EMS) pursuant to ISO 14001 standard. The Plan, drafting of which started in 2000, has a task to set the initial steps to be taken at the top level of corporate management, other management levels, and core business functions of HEP, aiming at gradual and systematic integration of environmental issues into the company's business operations on principles of their continual improvement. The aforementioned basic environmental policy principles will be reviewed and revised in the Plan and adjusted to the requirements of a general environmental policy document on one hand, and to objectives and targets of an environmental management system on the other. Adopting of the Plan is expected in 2001.

According to the current HEP's organizational scheme, environmental issues are dealt with by its Development Department, and through pro-active involvement of experts from the HEP's core businesses and process units where numerous environmental issues are frequently encountered.

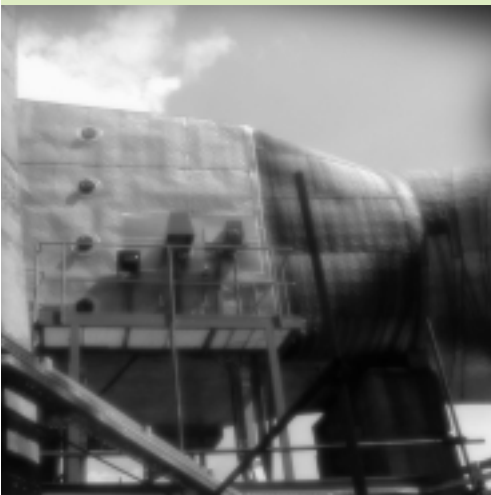
Motivated by numerous studies and practical activities focusing on the environmental issues conducted within the HEP's business, the HEP's Management set up the Environmental Procedures Coordination and Standardization Team in 2000. The Team is lead by the Development Department, and it involves all core business units (production, transmission distribution, economic affairs, business IT department). The Team's primary task is monitoring, guiding and coordination of environment-related activities relevant for the HEP's business system, cross-connecting and informing of the HEP's Management and the process units in which the environmental issues arise and directly affect their operation.

According to its composition and tasks, the Team is expected to become a core of the HEP's Environmental Protection Department in the near future. This would be the first step in the integration and organizational adjustment of the environmental protection activity to the changes facing HEP at the point when this company undergoes its business restructuring and a process of the Croatian energy sector reform.

Along with the mentioned HEP's Environmental Plan, another related project was initiated - Development of HEP's Environmental Accounting - as the project dealing with one of important aspects of HEP's business that has not been given particular attention so far. Once these projects are fully implemented and integrated with the existing HEP's management structure,



Environmental Management System scheme according to ISO 14001



Sisak TPP - continuous emission monitoring system

and particularly after the environmental accounting has been established, more reliable information on the needs, activities, current costs and investment into the environmental protection for the complete business system will be available. This will create a sound basis for informed HEP's Management business decision-making on this business segment, and more efficient communication, both internal - within HEP, and external - with the international financing institutions and other partners regularly demanding information of the kind.

Development of the Sisak TPP Environmental Plan from 2000 should be highlighted as the first document of the kind and one from a HEP's production unit, which has actually paved the way for gradual introduction of the environmental management system in HEP's power plants.

The most significant environmental impacts of the HEP's facilities are emissions of pollutants into the air, industrial waste generation and wastewater discharge.

Atmospheric emissions, including those of SO₂, NO_x, CO₂ and particulate matter, are among the most important indicators of the power sector environmental impacts. Their levels and trends for HEP's thermal power plants are presented in tables and diagrams in the attachment. The average SO₂ emission during the last four years was reduced by approximately 50 percent compared to the eighties and early nineties. However, the emissions of particulate matter, NO_x and CO₂ remained at the approximately equal level. The reduction in SO₂ emission results from implementation of the business decision to burn low-sulfur fuels in HEP's thermal power plants. This particularly refers to the imported coal with less than 1 percent of sulfur in Plomin 1 and 2 TPPs, and low-sulfur fuel oil in the thermal power plants firing this fuel.

There is also a visible reduction in emission of all the above mentioned pollutants in 2000 compared to the year 1999, and also to 1998, although the electricity consumption increased in that period. The lower emission into the air is primarily the result of reduction in electricity generation in the HEP's thermal power plants (along with considerable increase of imports), with consequent decrease in consumption of fuel oil, and switching to higher quality fuels - imported low-sulfur coal and fuel oil.

Considering individual power plants, a key contribution to the reduction in SO₂ emission from the HEP's thermal power plants into the air in 2000 was that of commissioning of the Plomin 2 TPP firing the low-sulfur coal to which the Plomin 1 TPP also switched. Commissioning of the retrofitted flue gases electrostatic precipitator in the Plomin 1 TPP caused considerable reduction in particulates emission since 1999.

Atmospheric emissions of the major pollutants from the HEP's facilities reduced to a kWh of electricity supplied to the consumers (table in the attachment) are considerably lower than the comparable emissions from the energy sector in developed countries and particularly in the countries in transition. A comparatively low contribution of the energy sector (with major share of hydro power) is a main reason that the Republic of Croatia positioned itself among the European countries with the lowest total and average emission of the greenhouse (CO₂) and the so called acid (SO₂ and NO_x) gases.

A more realistic picture considering the HEP's facilities as the air polluters is gained from an overview of emissions reduced to a kWh of electricity generated in HEP's thermal power plants (table in attachment). It reflects gradual changes in a number of influential parameters of the fossil-fuel firing segment of the power generation sector.

Safe management of the HEP's industrial waste, and reporting thereon to the authorized bodies, are continuous activities conducted pursuant to the Croatian legislation and in line with good worldwide practice.

The Industrial Waste Inventory has been permanently kept and regularly updated for the waste generated from the HEP's generation, transmission and distribution activities. The project of waste oil and grease management (incineration) in the HEP's power generation facilities has also been continued.

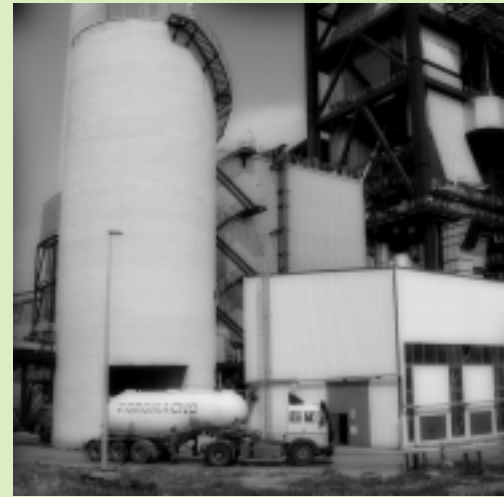
Total quantity of the industrial waste (both hazardous and non-hazardous) generated in operation of the HEP's facilities and recorded in the Inventory are shown in the diagrams. Commissioning of the Plomin 2 TPP caused considerable increase in total quantity of the industrial waste in 2000. These are increased quantities of bottom ash (slag) and flyash, the non-hazardous waste from the coal burning in the Plomin 1 and 2 TPPs. Considerable quantities of by-products from the Plomin 2 TPP operation, which are considered industrial waste, were in 2000 put to commercial use as secondary raw material for the TC Koromačno cement plant. This waste included 18,154 ton of fly ash, 2,480 ton of slag and 8,303 ton of gypsum. Such an approach results in considerable reduction in quantity of waste that would otherwise be landfilled in the power plant neighborhood.

The HEP's thermal power plants treat large quantities of waste oils of category 1 and 2 (over 300 ton in 1999 and 250 ton in 2000) in the environmentally sound way, by adding them into the fuel and firing in the process.

Gradual environmentally sound disposal of equipment containing insulation oils with PCBs has also been continued by their export abroad. Out of approximately 200 ton of equipment containing PCBs in 1993, when this activity was initiated, and 140 ton remaining in 1998, about 131 ton remained undisposed in 2000. An apparent slowdown in the disposal rate is due to the fact that the largest pieces of equipment were disposed first (transformers), while the smaller equipment (condensers) are being disposed according to the plans and legal deadlines, when replaced due to their failure.

The environmental impact monitoring at the HEP's facilities has recently been expanded by systematic monitoring of quality and quantity of wastewater discharged from thermal power plants.

In 1999 and 2000, the HEP's facilities operated in compliance with their water-rights agreements and other water legislation, and many facilities carried out or initiated the activities related to the waste water treatment and drainage. For example, the Sisak and Plomin TPP drainage systems have been rehabilitated and upgraded. However, a more thorough analysis of the conditions of these systems and regulations being drafted in this field highlight the need for these systems and numerous water-related issues in thermal power plants operation (e.g. water consumption, wastewater quality and the like) to be paid more systematic attention. Basic information on water sources and wastewater treatment systems in HEP's thermal power plants are presented in the attachment.



Plomin 2 TPP - transportation of flyash to TC Koromačno cement plant



Plomin 2 TPP -
desulfurization plant

The major HEP's investments into the new environmental protection facilities and systems in 1999 and 2000 are those made in the Plomin 2 TPP, construction of a new combined-cycle cogeneration plant in TE-TO Zagreb, and continuous emission monitoring systems for thermal power plants, including monitoring of air quality in their vicinity.

This was the period when the majority of the activities on the largest investment in the energy sector and also in environmental protection was finished - the Plomin 2 TPP, a modern pulverized coal fired power plant construction was completed. Built as a joint investment of the German energy company RWE and HEP, this thermal power plant belongs to the state-of-the-art facilities regarding its process and environmental characteristics. Among numerous undertaken measures and conducted activities, those most important for the environmental protection are enlisted below:

- firing of high-quality low-sulfur imported coal (less than 1 percent of sulfur),
- wet flue gases desulfurization plant (efficiency over 95 percent),
- reduced emission of nitrogen oxides by application of primary measures on the boiler plant (phased combustion - OFA),
- modern electrostatic precipitator for reduction of particulate matter emissions into the air,
- integrated continuous monitoring of pollutant emissions into the air and pollutant concentrations (air quality) in the power plant neighborhood,
- joint wastewater treatment plant for the Plomin 1 and 2 TPPs, with stormwater treatment at the coal unloading jetty in the Plomin bay,
- enclosed coal unloading (from ship) and pipe conveyor system to the coal storage by the power plant,
- development of the Plomin bay and the port,
- additional noise attenuation measures, and
- reuse of solid byproducts of coal firing and desulfurization (flyash, slag, gypsum) based on a contract signed with the TC Koromačno cement plant.

In addition to resolving the wastewater issue in the joint treatment plant for both Plomin TPPs, for the Plomin 1 TPP the electrostatic precipitator was retrofitted. This is the main reason for considerable reduction of particulate matter emission from this power plant - in 2000 less than one tenth of 1998 emission per kWh.

Remediation of the existing Plomin TPP slag and ash disposal was continued, so that a lateral ditch was constructed to collect the stormwater. This is part of a comprehensive solution concept that includes discharge of the stormwater from the disposal into a settling basin, and its spilling over after treatment into the Bižac torrent (Čepić kanal) to be finally discharged into the Plomin bay. Construction of yet another thermal power plant makes the last two-year period very active in terms of investment. This is a new gas/steam turbine combined-cycle cogeneration plant within a fence of the existing TE-TO Zagreb plant, with total electric and heat output of 200 MW and 150 MJ/s, respectively. The new plant was not intended only to replace two old units, but also to increase the environmental protection level by firing natural gas instead of fuel oil, with higher energy efficiency of the new unit, and consequently, reduced emission of the pollutants into the air. It would also increase already high share of cogeneration in total power output in Croatia. Same as with all other plants of this type, special attention was paid to the

noise attenuation measures. Both building and process measures were undertaken (walls and roof of the operating building made of noise and thermally insulated slabs, installation of noise silencers at the air intakes and flue gas exhausts). The completion of the plant construction and trial run, namely its commissioning, is expected at the beginning of the 2001 heating season. Along with this project, and primarily to meet its fuel needs, a high-pressure gas pipeline was installed up to the TE-TO Zagreb location. It is planned to supply any future environmentally sound gas-fired power generating facilities possibly built on the same location.

Numerous activities have also been performed on setting up continuous emission monitoring systems for thermal power plants.

Initially the study was prepared on *Methods of Continuous Airborne Emission Monitoring for Thermal Power Plants*, which was used as a baseline for development of conceptual and final solutions for these systems for individual power plants. The design documentation was developed, bids invited, suppliers selected and contracts awarded. Good conditions were thus created that, by the end of 2001, all thermal power plants set up and put these systems into operation. In 2000, the first among these systems were put into operation: the one installed in the EL-TO Zagreb (for the gas-turbine cogeneration plant), and those in the Plomin 1 and 2 TPPs. The latter include continuous monitoring of mass concentrations of SO₂, NO_x, CO and particulate matter, of smoke, as well as of flue gas temperature and O₂ content. In the Plomin 2 TPP, which is fitted with the flue gases desulfurization plant, the desulfurization level is monitored continuously and the emissions are monitored even when the plant is out of operation. In 1999 and 2000, pursuant to the *By-law on Limit Values of Pollutant Emission from Stationary Sources to the Air*, individual emission measurements were conducted in all HEP's thermal power plants (i.e., measurements defined in the By-law as *initial*, or *periodical*).

A continuous air quality monitoring station was set up and put in operation in Zagreb, while installation of network of such stations started in the vicinity of the Plomin TPP.

The station in Zagreb is one of measures required for continuous monitoring of air impact of 2x26 MW gas-turbine cogeneration plant commissioned in 1998 and located within the EL-TO Zagreb plant, and also of other HEP's thermal power plants in Zagreb. In addition to its state-of-the-art and highly functional measurement equipment for NO_x/NO₂ and meteorological parameters, the station has attractive architectural design (architect Vjenceslav Richter) tailored to the residential part of the urban Zagreb zone.

Considering interest and sensitivity of the general public to air quality impact of the coal-fired thermal power plants, the beginning of construction of an air quality monitoring system in the vicinity of the Plomin TPP might prove even more important. The system comprises a network of five monitoring stations located in the vicinity of the power plant. The criterion for their siting was the fact that the studies confirmed them as the most representative of the environmental impact of the Plomin plants. Further, the system includes a CPU, a central data collecting, processing and presentation unit located in the Plomin 2 TPP control room. Depending on their location, the stations measure different air quality parameters. The system as a whole measures ground-level concentrations of SO₂, NO₂/NO_x and particulate matter, ground ozone



TE-TO Zagreb - construction of the new cogeneration unit



Air quality monitoring station
in Plomin Grad

and deposition, along with meteorological characteristics (wind direction and speed, temperature and relative air humidity, while insolation is measured in one station). Completion of the system construction and its interconnecting, testing and trial run, along with training of the operators is expected in 2001, when the first results of the imission measurements will be obtained. The system is also planned to be a part of the automatic air quality monitoring system in the Istria County which is planned to include a number of additional stationary monitoring stations (and one mobile) connected to a center in the City of Pula.

Conducting business in compliance with the laws and regulations is HEP's general committment and one of the key requirements of the environmental management system pursuant to ISO 14001.

Follow-up of comprehensive and diverse environmental legislation has regularly been carried out at HEP as a whole and its process units. An internal document with mandatory implementation - HEP's Bulletin No.89 "*Environmental Laws and Regulations Important for Power System Operation and Development - Guidelines*" was issued in 2000 in order to present environmental regulations relevant for HEP's operation in a single document. The document gives an overview and interpretation of environmental laws and regulations that might affect company's business operations and its future development. This document is the background for development of a specific system for identification, follow up and interpretation of the environmental laws and regulations in the HEP's specialized departments, and preparing concrete guidelines for specific fields.

Further, HEP plays an active role in drafting of new regulations by giving its expert opinions and proposals considering its field of expertise. Worth emphasizing was HEP's experts' contribution to drafting procedures for implementation of continuous monitoring /measurement of pollutant emission into the air. This added expertise and quality to preparation of by-laws and additional guidelines required for implementation of the said procedures and evaluation of obtained results, similar to the organization adopted by the European countries.

In compliance with applicable regulations, the HEP's hydro power plants prepared their *Emergency Action Plans for Water Pollution Accidents* in line with the new *National Water Resources Conservation Plan*. Thereby, a transparent and fully defined system of measures and procedures was created for prevention and limitation of possible consequences upon water streams at which the HEP's facilities are built. Further, preparations were carried out for coordinated development of the legally required *Environmental Emergency Action Plans* for all basic HEP's divisions, namely for all those process units that must draft such Plans due to their use of hazardous substances in amounts exceeding the legally determined values.

In 1999 and 2000, numerous of researches and studies were conducted on monitoring of environmental impact of the HEP's facilities and environmental protection technologies and measures.

The aim was gaining better insight in possibilities of cost-efficient mitigation of the HEP's environmental impacts and better incorporation of environmental issues in overall business operations. The analyses were carried out in collaboration with authorized institutions and with application of the state-of-the-art computer tools, models and methods. The obtained results

are referred to when the long-term development plans and strategies are being adopted. Thus, updating of the existing and preparation of new environmental impact studies for the existing and planned thermal power plants, hydro power plants, transmission lines and other facilities are a continuous activity conducted for all the facilities under such legal obligation. For example, during the last two years, the environmental impact studies were developed for the Rijeka TPP (its current status) and for a prospective new 150 MW and 400 MW gas-turbine combined-cycle units at the TE-TO Osijek plant location. For the Sisak TPP location, an environmental impact study was developed and complete environmental impact assessment procedure carried out, including obtaining of the location permit for construction of a new 380 to 400 MW gas-turbine combined-cycle unit. The location permit application procedure was initiated for an identical unit at the TE-TO Zagreb location. The environmental impact studies were also prepared for the Lešće and Novo Virje hydro power plants.

HEP has permanently been focused on the sustainable development projects. During the subject period, HEP got pro-actively involved in a number of international projects on energy efficiency, renewable energy sources and environmental protection.

It is, primarily, the Energy Wisdom Programme (EWP), a voluntary initiative on sustainable development of power sector companies in the European Union (within the UNIPEDE/EURELECTRIC). As the first power utility from the countries in transition, HEP joined this program through installation of two gas-turbine cogeneration units in EL-TO Zagreb. This project is a major contribution to realization of one of the EWP objectives - achieving of measurable improvement in energy efficiency and mitigation of greenhouse gases emission (in this case, CO₂ emission reduction by 94,000 ton in 2000 compared to the baseline year 1998).

One of the earlier mentioned researches analyzed situation in the energy sector and the greenhouse gases emission mitigation measures undertaken and implemented in HEP so far. Its orientation towards water power (40-60 percent of generated power), cogeneration (combined heat and power generation), and comparatively low consumption of coal in thermal power plants, resulted in low greenhouse gases emission from the Croatian energy sector.

The continued research focused on determination of additional potential of possible measures the implementation of which is in HEP's scope. The measures considered included increased efficiency of power generation, transmission and distribution, switching to low-carbon fuels, intensified construction of hydro power plants, wind energy use, use of biomass and waste in cogeneration processes, and energy conservation by demand-side management. A "nuclear" scenario for development of the power system was considered as an ultimate option. Within the ESCO Project, carried out in collaboration with the World Bank, a number of activities has been undertaken related to energy conservation. HEP's ESCO Team was set up, which prepared ample supporting documentation for the future work (a Business Plan for future HEP ESCO Ltd., documentation necessary for the World Bank and GEF grants, etc.) in collaboration with local and foreign (US) consultants. Eight projects for energy efficiency increase have been prepared to the level of pre-feasibility studies on concrete locations, that should result in significant energy savings and mitigation of emission into the air. The projects are generally for HEP's distribution and district heating activities, and some relate to the commercial and public institutions (e.g. shopping center, school).



Hrvatska Elektroprivreda is
EWP Programme member



Air quality monitoring station in Zagreb

Other activities and projects that should be underscored include:

- initiation of systematic activities on development of additional renewable energy sources, also in collaboration with the World Bank,
- continuation of the Cleaner Production project in TE-TO Osijek in collaboration with ECOLINKS program of the USAID, focusing on decrease in production losses, generated waste quantity and its hazardousness, and
- Capacity for Climate, of the Regional Environmental Center (REC) for CEE countries and the World Resources Institute (WRI).

Environmental protection is one of important topics within the Computerized Maintenance Management System (SUPO).

The SUPO system is being introduced in HEP's production units for the purpose of achieving a cost-effective and systematic organization and efficient implementation of the maintenance activities. The systems have been completed or entered the final stage of trial operation in TE-TO Zagreb and in the hydro power plants at the Drava river in northern part of Croatia. The Plomin 2 TPP is entering the early stages of the system introduction. The SUPO concept includes the environmental protection principles on two levels.

The first, general, level involves reduction of emissions from the power plants through improved maintenance of equipment, and maintaining its optimum performance characteristics at which generation of polluting substances is minimized.

The second, concrete, level of the environmental protection includes determination of all maintenance items and/or activities which might cause environmental pollution, most frequently due to generation of waste that needs to be disposed of in a controlled manner in order to prevent the environmental pollution. Thus, the maintenance procedures for such activities will be stipulated to prevent or avoid inadequate practices and threat to the environment.

Good public relations and support to projects of overall social importance are permanent HEP's business orientation.

HEP's presence in all Croatian regions where its facilities, transmission lines and power plants are located, and contacts with local population are part of HEP's everyday life. Consequently, the examples of its cooperation with the local communities on creating and maintaining the friendly environment are numerous, often resulting in permanent cooperation.

Some of the events in which HEP has been participating are:

- improvement of municipal infrastructure in the areas surrounding production units (e.g., Plomin TPP, hydro power plants in the Cetina river basin, etc.),
- students' excursions, visits of professional associations, etc. to the HEP's production units, particularly to the Plomin TPP, TE-TO Zagreb, Jertovec CCGT and numerous hydro power plants,
- taking part in organization of the rowing regatta on the Gojak HPP Sabljaci reservoir and of rafting events on the Dobra river.

In addition to its local actions, HEP has also been supporting the activities that are of national interest. Examples are the support given to the preparation of the First National Communication to the UNFCCC and National Program for Ecosystems Critical Loads Calculation and Mapping, where HEP has been one of the major sponsors.

HEP is enhancing its public relations and cooperation with the non-governmental organizations and professional associations in the field of environmental protection and power generation,

such as Pokret Prijatelja Prirode Lijepa Naša, Croatian Air Pollution Prevention Association, Croatian Energy Association and the like.

HEP pays special attention to granting of scholarships and support to young and gifted students of high schools and technical universities. They are a guarantee that in the coming years HEP's human resources will have the capacity to meet the challenges of the new technologies gradually invading the energy sector, and ensure the continuity and development of its core businesses. Within its collaboration with the educational institutions, since 1995 HEP has been presenting its Best Student Award to students of primary and secondary schools achieving the best results in mathematics and physics contests.

The environmental protection is becoming one of HEP's growing cost items that demands systematic and adequate follow-up.

Therefore, in 2000, HEP started the project on introduction of environmental accounting. The project involves expansion and rework of the existing accounting system, the one in which the environmental protection was included in 1998 as just another regular operational costs item (without investment into the environmental protection on the HEP's facilities). Initiation of the environmental accounting project enabled collection and analysis of data on environmental protection costs, namely on regular environmental operating costs, environmental investment and environmental labor cost estimate for all the HEP's process units as cost centers in 1999. This was the first time the overall situation in this important segment of the HEP's financial operations was comprehensively covered.

HEP's environmental protection costs in 1999 amounted to almost HRK 140 million (1 DEM \doteq 3.85 HRK), that is 1.7 percent of total operational expenses in the same year. In HEP's capital investment, the environmental investment participated with HRK 88 million (4.9 percent), almost half of it being the investment into the Plomin 2 TPP environment related systems and plants. The regular operating costs related to the environmental protection (about HRK 44 million) accounted for somewhat less than 1 percent of total HEP's business expenditures (without the labor costs).

HEP's fundamental and permanent orientation is incorporation of environmental protection in its business operations, orientation confirmed by numerous undertaken or initiated activities.

The HEP's Environmental Plan, which should soon be adopted, will also initiate some new activities relying on the projects that have already been launched. Use of cleaner fuels, setting up of continuous monitoring of atmospheric emissions and imissions and analyses of the monitoring results, improvement in systematic approach to water quality and conservation issues - these are the key areas and environmental activities to be implemented in the existing and new thermal power plants. Within the process of introducing the environmental management system, HEP will set up an efficient Environmental Protection Department in order to build capacities apt to respond to increasingly stringent environmental protection requirements. Integration of the environmental costs into the HEP's accounting system and initiation of development of the corporate-wide environmental information system are the activities that will make the environmental protection issues an unavoidable and widely present segment of the HEP's business operations on all levels.



Gojak HPP regatta champions

Croatian electric power system 2000

- ⊙ 400/220/110 kV
- ⊙ 400/110 kV
- ⊙ 220/110 kV
- TPP
- HPP
- Industrial TPP
- NPP
- 400 kV
- 400 kV double - circuit line
- 220 kV
- 220 kV double - circuit line

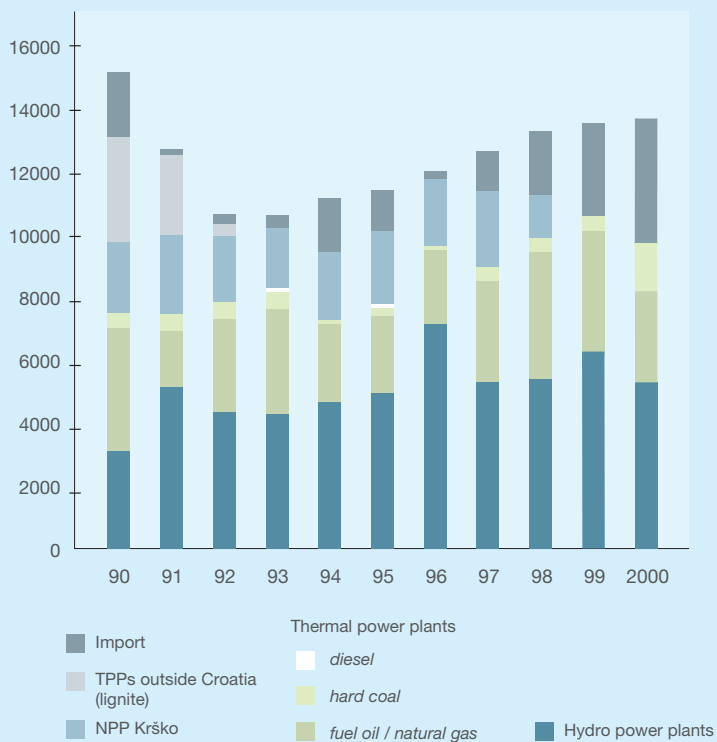
The map shows only generating facilities and 400 kV and 220 kV transmission network. 110 kV network has not been plotted.



Switchyards			Lines (km)			
voltage level	No.	MVA	voltage (kV) • total • overhead • cable			
400/x kV	5*	3400	400	1157	1157	-
220/110 kV	15	3150	220	1224	1224	-
110/x kV	142	7425.5	110	4807	4698	109
HEP's property	120	6342				
35/10 (20) kV	357	4138	35;20;10	35695	26787	8908
10 (20)/0,4 kV	22382	6169	0.4	86466	66831	19635
High voltage (400, 220, 110 kV)	162	13976		7188	7079	109
Medium & low voltage	22739	10307		122161	93618	28543
HEP's property						
High voltage (400, 220, 110 kV)	140	12892		7188	7079	109
Medium & low voltage	22739	10307		122161	93618	28543

* Ernestinovo substation, 2x3000 MVA is out of operation.

Power generation per fuel (GWh)



Generating capacities owned by HEP

Hydro power plants	available power (MW)		type of power plant
	generator	total	
HPP SENJ	3x72	216	A
HPP SKLOPE	1x22.5	22.5	A
HPP VINODOL	3x28	84	A
PSP FUŽINE	4/(-4.2)	4/-4.2	A
HPP PERUČA	2x20.8	41.6	A
HPP ORLOVAC	3x79	237	A
PS BUŠKO BLATO	11.3/(-10.3)	11.3/-10.3	A
HPP ZAKUČAC	2x108 2x135	486	A
RHP VELEBIT	2x138/(-120)	276/-240	A
HPP DUBROVNIK	2x108	216	A
HPP ĐALE	2x20.4	40.8	A
HPP KRALJEVAC	12.8+2x20.8+4.8	59.2	A
HPP RIJEKA	2x18	36	P
HPP MILJACKA	4.8+3x6.4	24	P
HPP GOLUBIĆ	2x3.27	6.5	P
HPP GOJAK	3x16	48	P
HPP VARAŽDIN	2x43	86	P
HPP ČAKOVEC	2x40.3	80.6	P
HPP DUBRAVA	2x40.3	80.6	P
HPP OZALJ	2x1+1x0.8+2x1.1	5	P
HPP JARUGA	2x2.8	5.6	P
SMALL HPPs (6)	6/(-1.5)	11.6/-1.5	P
BIO MINIMUM HPPs (3)	3.4	3.4	P
Total HPPs		2076.1/-256	

A - reservoir P - run-of-river

Thermal power plants	available power (MW)		fuel
	generator	net output	
TPP PLOMIN 1	1x105	98	U
TPP PLOMIN 2*	1x210	192	U
TPP RIJEKA	1x320	303	LU
TPP SISAK	2x210	396	LU/PP
TE-TO ZAGREB	25+110	135	LU/PP
EL-TO ZAGREB	12.5+32+52	90	LU/PP
CCGT JERTOVEC	2x42.5	83	PP/ELU
GTPP OSIJEK	2x25	48	PP/ELU
TE-TO OSIJEK	45	42	LU/PP
NPP KRŠKO (50%)**	332	316	UO ₂
EMERGENCY DIESEL (4)	29	29	D2
EMERGENCY GAS (1)	13.5	13.5	2GT
TOTAL TPPs + NPP	1851	1745.5	
TOTAL HPPs + TPPs + NPP		3821.6	

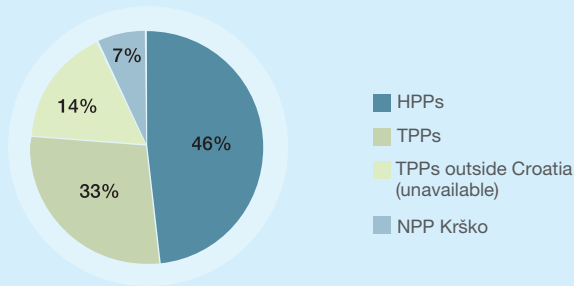
U - coal; LU - fuel oil; PP - natural gas; ELU - extra light fuel oil; UO₂ - uranium oxide; D2/2GT - special fuel oils for operation of emergency TPPs

Note: The table doesn't contain HEP's thermal power plants outside Croatia and not available (total output of 650 MW); TPP Obrenovac (300 MW) in Serbia and TPP Tuzla (200 MW), TPP Kakanj (50 MW) and TPP Gacko (100 MW) in Bosnia and Herzegovina.

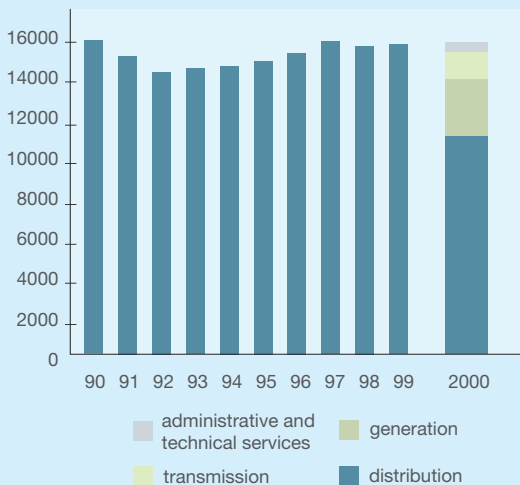
*TPP PLOMIN 2 in 50:50 ownership of HEP and RWE Power

**NPP Krško (50%) was not available for the electric power system of Croatia since August 1998.

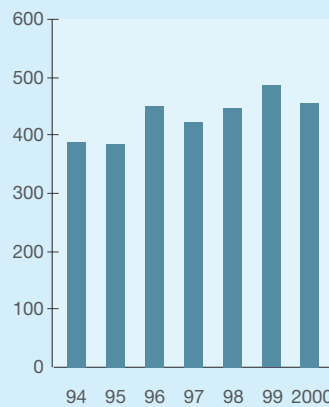
Generating capacities 2000



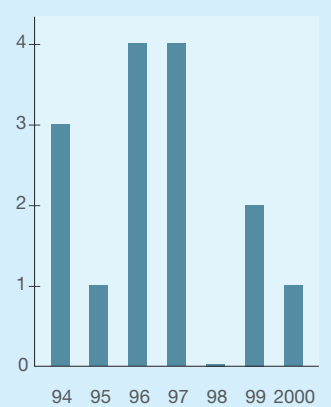
Data on employees



Safety at work statistics - injuries



Safety at work statistics - fatalities



Characteristics of operation and atmospheric emissions from HEP's thermal power plants in Croatia in 1999

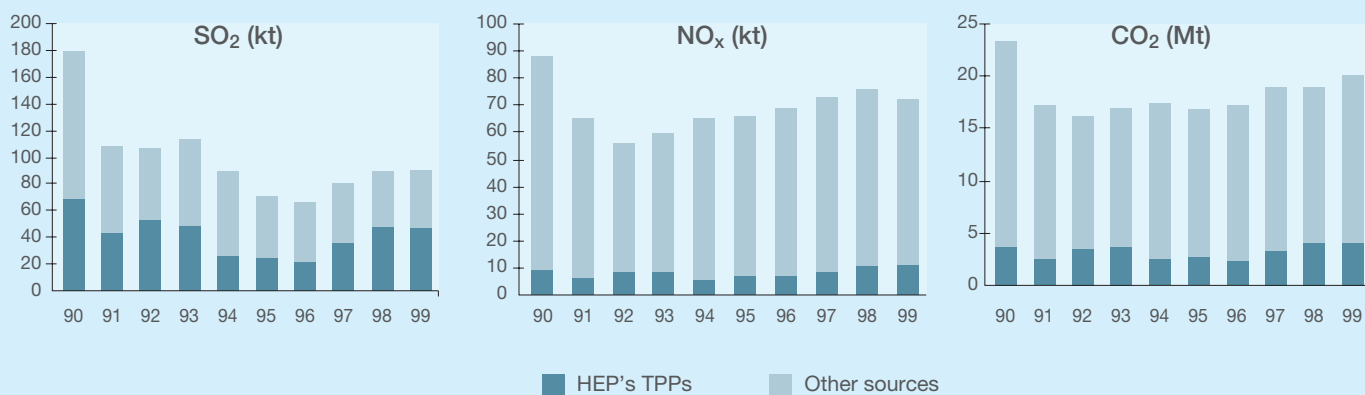
Thermal power plants	Generation		Fuel					Emissions			
	Power GWh	Heat TJ	Coal 10 ³ t	Sulfur %	Fuel oil 10 ³ t	Sulfur %	Natural gas 10 ⁶ m ³	SO ₂ (t)	NO _x (t)	Particulates (t)	CO ₂ (kt)
TPP PLOMIN 1	433		195	3.13				10729	1353	185	466
TPP RIJEKA	1670				384	2.33		16071	3300	1116	1187
TPP SISAČ	1639				343	2.08	88	12834	3322	1022	1234
TE-TO ZAGREB	347	4137			130	2.25	63	5259	1361	149	521
EL-TO ZAGREB	418	3816			34	2.19	157	1325	1286	68	396
TE-TO OSIJEK	118	839			24	2.04	38	875	260	70	145
GTPP OSIJEK	84	121					37	0	319	0	69
CCGT JERTOVEC	85						28	0	306	0	52
TOTAL	4794	8913	195	3.13	914	2.21	411	47092	11507	2610	4071

Characteristics of operation and atmospheric emissions from HEP's thermal power plants in Croatia in 2000

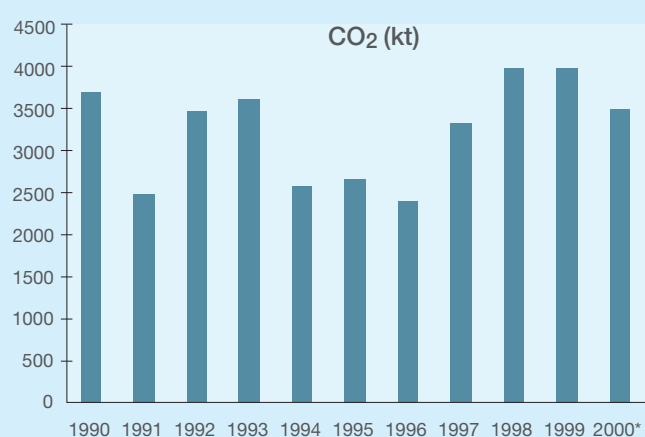
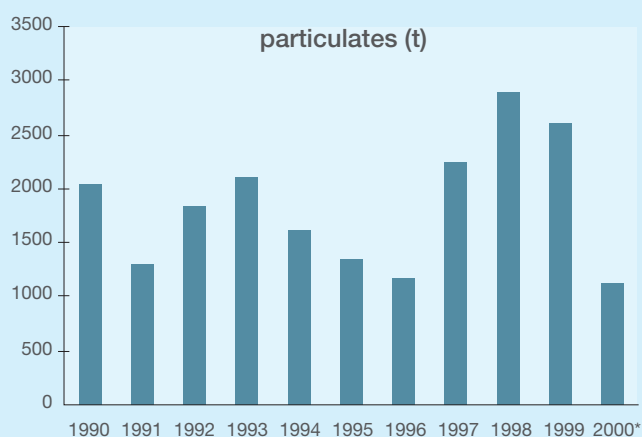
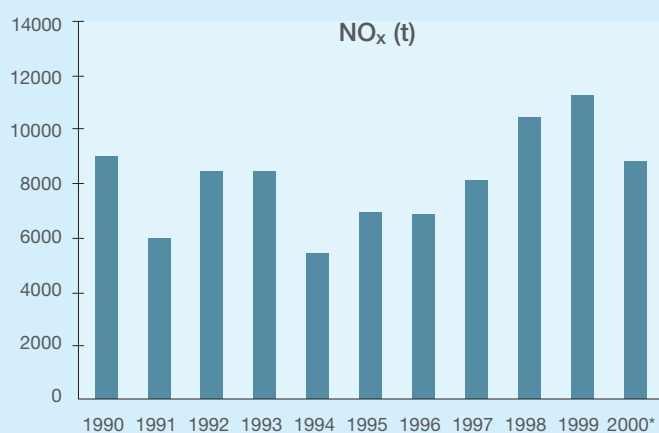
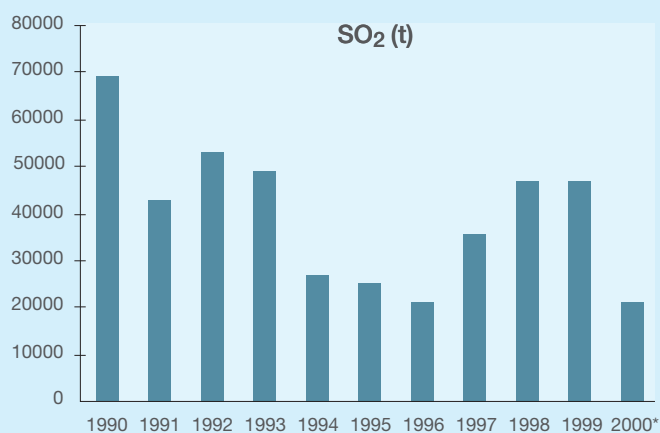
Thermal power plants	Generation		Fuel					Emissions			
	Power GWh	Heat TJ	Coal 10 ³ t	Sulfur %	Fuel oil 10 ³ t	Sulfur %	Natural gas 10 ⁶ m ³	SO ₂ (t)	NO _x (t)	Particulates (t)	CO ₂ (kt)
TPP PLOMIN 1	624		267	0.70	1	0.12		3284	1856	94	634
TPP PLOMIN 2	777		302	0.70	6	0.12		3731	2148	109	735
TPP RIJEKA	604				145	2.08		5341	848	371	450
TPP SISAČ	1024				138	2.12	149	4852	1461	390	708
TE-TO ZAGREB	295	3612			74	2.03	102	2707	949	85	421
EL-TO ZAGREB	398	3350			22	2.12	164	833	1251	33	372
TE-TO OSIJEK	155	973			13	1.92	66	434	228	35	162
GTPP OSIJEK	61	43			1	0.12	26	2	235	0	50
CCGT JERTOVEC	20						6	0	69	0	12
TOTAL	3958	7978	569	0.70	400	2.04	513	21183	9046	1117	3544

* Preliminary emission data for 2000

HEP's share in total SO₂, NO_x and CO₂ emissions in Croatia



Atmospheric emissions



Emissions of SO₂, NO_x, CO₂ and particulates from HEP's TPPs reduced to a kWh

Emission	g/kWh of total electricity available ¹			g/kWh of total electricity generated in TPPs ²		
	1998	1999	2000*	1998	1999	2000*
SO ₂ emission	3.53	3.44	1.53	9.25	9.05	4.47
NO _x emission	0.80	0.84	0.65	2.00	2.10	1.86
Particulates emission	0.22	0.19	0.08	0.58	0.52	0.25
CO ₂ emission	304	298	256	751	743	748

* - 2000 data are preliminary

1 - emission of HEP's TPPs reduced to a kWh of total electricity supplied to consumers in Croatia from all sources

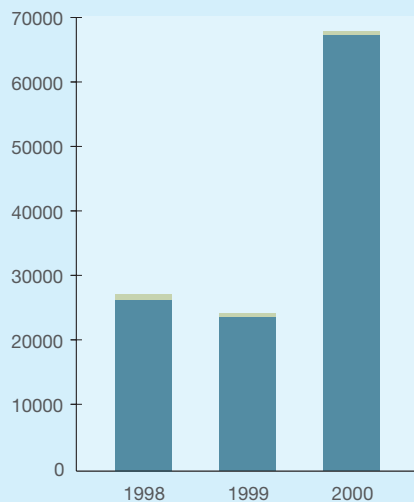
2 - emission of HEP's TPPs (excluding emission due to CHP production) reduced to a kWh of electricity produced in HEP's TPPs

Qualitative data on wastewater from HEP's thermal power plants

TPPs	Water source	Type of wastewater	Treatment system	Discharged to	Quality control of wastewater
TPP Plomin 1 and 2	Bubić jama	process water	treatment equipment	Čepić canal through which it empties into Plomin Bay	Under the water licence there are regular measurements every three months performed by authorized laboratories. Recorded data are submitted to the Croatian Waters and the County Water Office
		precipitation water from coal storage	lamella settling pond		
	Bubić jama (water supply system as a reserve)	oily water	oil separation		
	sea	sanitary water	BIO - equipment		
TPP Rijeka	public water supply system	cooling water	no treatment	submerged sea discharges	
		process water	pre-treatment equipment		
		oily water	oil separation		
	sea	sanitary water	BIO - equipment	surface sea discharge	
TPP Sisak	river Sava	cooling water	no treatment	by precipitation sewer to river Sava	
		process water	pre-treatment equipment		
	public water supply system	sanitary water	no treatment	to Sava	
	river Sava	cooling water	no treatment	to Sava	
TE-TO Zagreb	water wells (in the area of TE-TO Zagreb)	process water from CPW	neutralization and settling	to Savica	
		other process water	pre-treatment equipment		
		oily water	oil separation + mechanical barriers with oil coagulation additive		
	river Sava	sanitary and precipitation water	no treatment	to Sava	
EL-TO Zagreb	river Sava	cooling water	no treatment	town sewage system	
	public water supply system	sanitary water	no treatment		
	water wells	process water	pre-treatment		
		oily water	oil separation		
CCGT Jertovec	river Krapina	cooling water for cooling towers	cooling and recirculation	open canal to Jertovec brook (Krapina tributary)	
		process water	pre-treatment		
	public water supply system	oily water	separation and active coal filters		
	river Krapina	sanitary and sewage water	BIO - equipment		
GTPP and TE-TO Osijek	river Drava	cooling water for cooling towers	cooling and recirculation	town sewage system	
		wastewater from CPW	neutralization and settling		
		other wastewater	settling ponds		
		oily water	oil separation	Palčić canal to river Drava	
		precipitation water from clean surfaces	no treatment		
	public water supply system	cooling water for cooling towers	cooling and recirculation	town sewage system	
	sanitary water	no treatment	town sewage system		

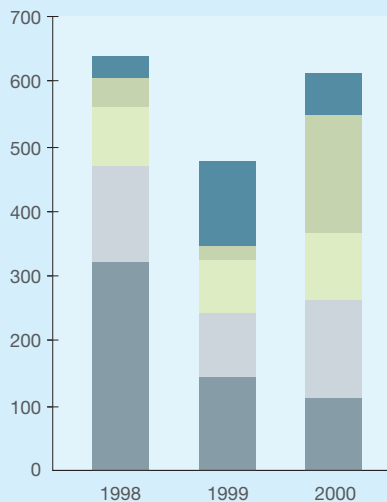
Production of industrial waste

Total industrial waste (t)



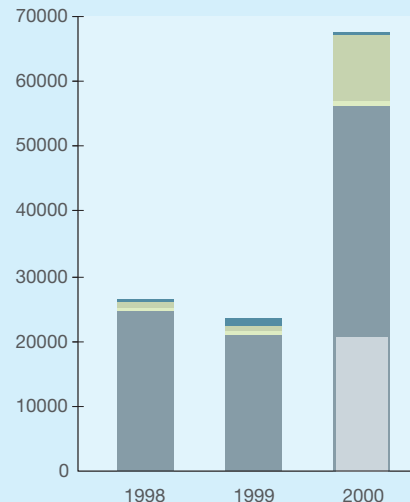
- hazardous industrial waste
- non-hazardous industrial waste

Hazardous industrial waste (t)



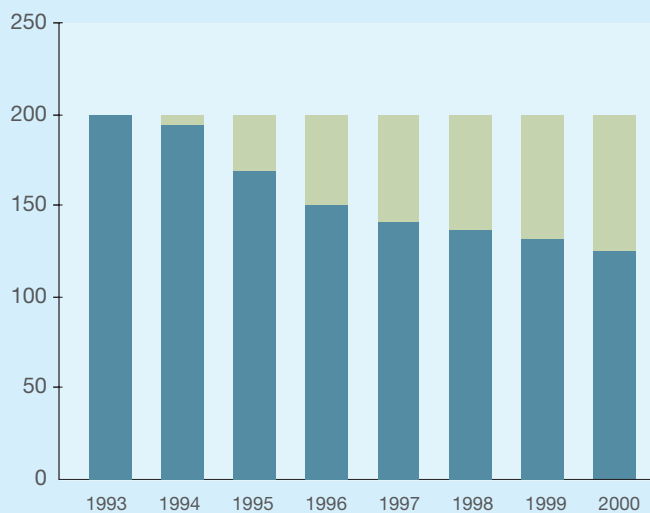
- other hazardous waste
- oil waste not otherwise specified
- oil fly ash
- oil wastes
- metal hydroxide sludges and other sludges from metal insolubilization treatment

Non-hazardous industrial waste (t)



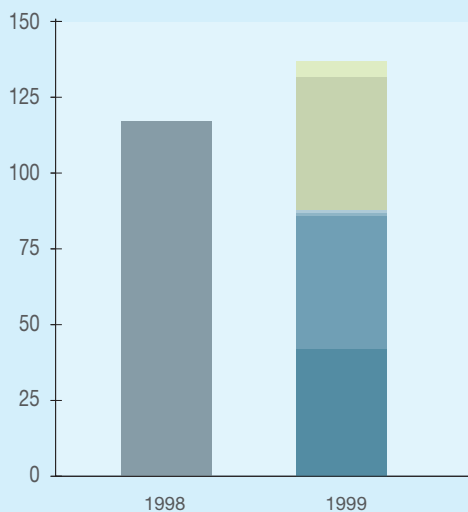
- other non-hazardous waste
- sludges from decarbonation
- iron and steel
- bottom and fly ash from Plomin TPPs
- consumed as raw material by TC Koromačno cement plant

Management of PCB-containing equipment (t)



- totally managed till the year ...
- still to be managed

Environmental protection costs (mil. HRK)



- total
- labor costs
- regular operating costs
- env. investments
- distribution
- transmission
- HPPs
- other TPPs
- Plomin 2 TPP

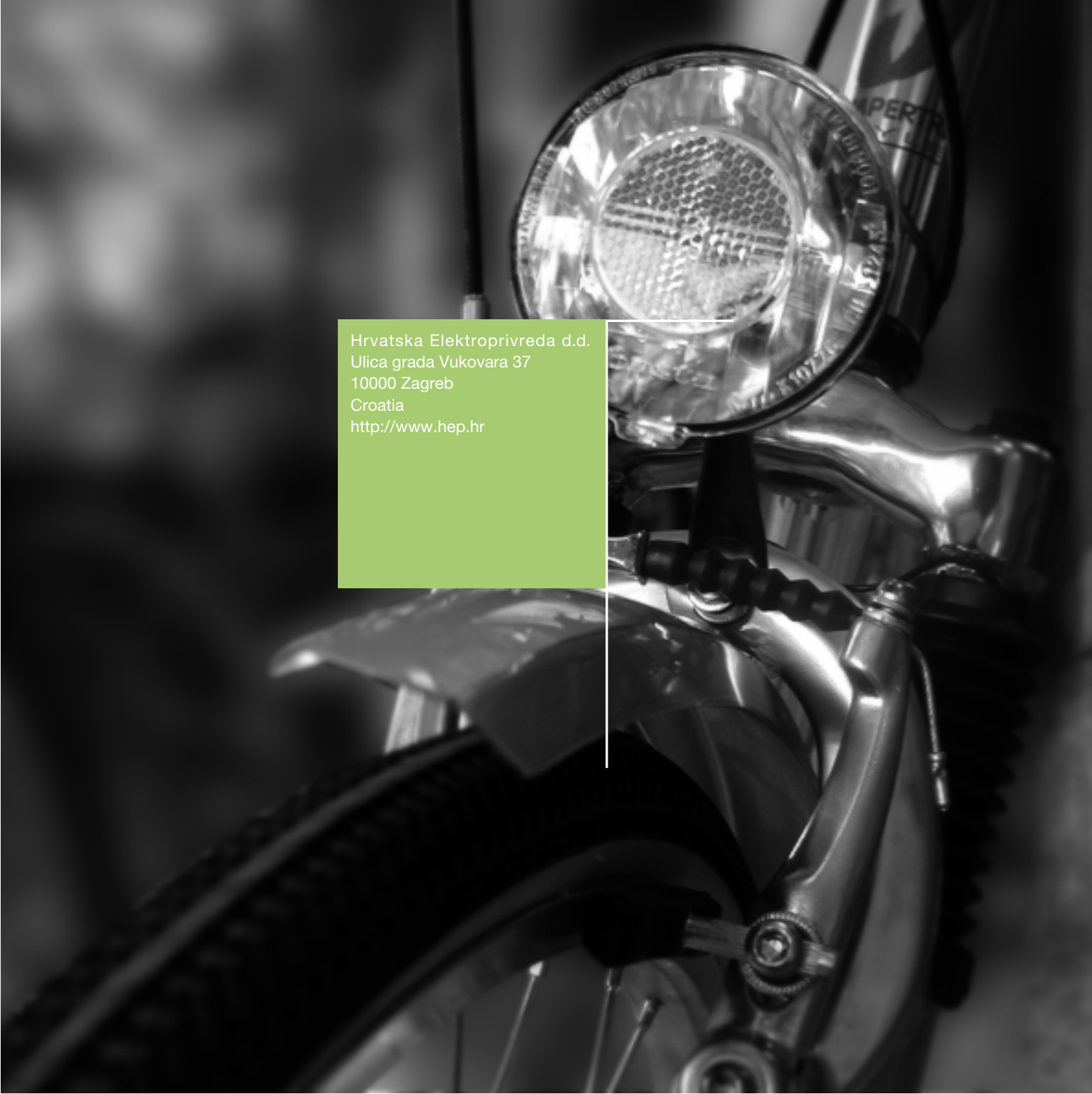
1 DEM₉₈ = 3.60 HRK
1 DEM₉₉ = 3.85 HRK

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