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AIR QUALITY PROTECTION AND IMPROVEMENT PLAN OF THE REPUBLIC OF CROATIA FOR THE PERIOD 2008-2011

Zagreb, May 2008

THE GOVERNMENT OF THE REPUBLIC OF CROATIA

Pursuant to Article 9, paragraph 3 of the Air Protection Act (Official Gazette No. 178/04), the Government of the Republic of Croatia, at the session held on 8th May 2008, adopted the following

AIR QUALITY PROTECTION AND IMPROVEMENT PLAN OF THE REPUBLIC OF CROATIA FOR THE PERIOD 2008-2011

1. PURPOSE AND OBJECTIVES OF THE PLAN

The Air Protection Act (Official Gazette No. 178/04) laying down the measures and the methods of organizing, implementing and controlling the protection and improvement of ambient air quality in the Republic of Croatia constitutes the statutory basis for the development of the Air Quality Protection and Improvement Plan of the Republic of Croatia.

According to Article 9 of the Air Protection Act, the Air Quality Protection and Improvement Plan is an enforcement document of the Air Protection Strategy that constitutes an integral part of the Environmental Protection Strategy. The authority responsible for the development of the Plan is the Ministry of Environmental Protection, Physical Planning and Construction in collaboration with central government bodies responsible for the areas of health, industry, energy, agriculture, forestry, science, waters, transport, tourism and monitoring weather conditions and with other relevant institutions. The Plan covers the 4-year period from 2008 to 2011.

The purpose of the Plan is to define and elaborate objectives and measures by individual sectors of influence, including priorities, time frames and implementing agencies, with the aim to protect and permanently improve the air quality across the Republic of Croatia, especially in areas with the air quality category III and II. The objectives set must be specific, measurable and realistically achievable over the 4-year period from 2008-2001 covered by the Plan.

In this regard the Air Quality Protection and Improvement Plan includes principles and criteria for determination of objectives and priorities, assessment of ambient air quality, objectives and policies regarding ambient air quality protection and improvement, including intersectoral policies, priority measures and activities and the implementation schedule along with the cost-benefit analysis.

From a methodological perspective, the current legislative framework on air protection and the horizontal legislation prescribe a number of measures and instruments aiming at the quality protection and improvement, usually called existing measures and instruments. The present Plan has adopted the existing measures in full and used them as a foundation for additional measures found to be necessary for the accomplishment of set objectives, but also found to lack any foothold in regulations at the time of developing this document, or such regulations are at the stage of preparation or transposition of the EU acquis communitaire into the national law.

Although this is the first enforcement document of the air protection strategy, it should be noted that Croatia has a long tradition of monitoring air quality which dates back to the 1960s when the west European countries started tackling the same problems too. Since then the air quality has been constantly improving in inhabited areas where concentrations of sulphur dioxide and smoke used to be as much as three times larger than today.

In addition to increasingly stringent regulations on emission limit values and pollutant concentrations in the air, the air quality improvement in urban regions was positively affected by extension of the natural gas grid in towns of northern Croatia and connection to the district heating network. Some towns have banned the use of coal in town centres very early, but this energy form has never been an important factor in energy supply of the towns. The development of public transport in big towns, the reduction of the permissible lead content in petrol and the maintenance of roads have resulted in the mitigation of adverse traffic-related effects on ambient air quality in inhabited areas.

Pollutant emissions decreased substantially early in the 1990s mainly due to the decline in industrial production and the shutdown of major emission sources (the Bakar Coke Oven Plant, the Sisak Ironworks, non-ferrous metals factory in Šibenik). The transition to market-oriented economy and globalization processes caused the absence of capital and operational investments in upgrading and maintenance of industrial plants, which resulted in obsolete equipment, reduced efficiency and, consequently, in higher air emissions. In this context mention should be made of the cases of excessive air pollution by specific substances (H_2S, NH_3, SO_2, suspended particulate matter, benzene) in "industrial" towns of Sisak, Rijeka and Kutina. Some positive examples are the use of imported low-sulphur coal and installation of the first high-efficiency desulphurization plant in the coal-fired Plomin II thermal power plant.

In the future pollution prevention measures will ever more focus on the transport sector. The growth in the living standards and mobility has resulted in an ever-larger number of vehicles and kilometres covered, so that air emissions continue to rise despite a considerable reduction in specific emissions from new vehicles. Heavy traffic in towns contributes to formation of smog and ozone, which will, besides pollution with fine particulate matter, represent the major problem in the future.

From the regional point of view, Croatia faces a difficult situation given the problem of acidification, eutrophication and ground-level ozone that the country cannot permanently resolve alone by applying its own measures. Both in Croatia and in the majority of other European countries, only a segment of the total deposition and ground-level ozone originates from domestic sources. It is therefore their common goal to tackle these problems at the European level by complying with obligations under the Gothenburg Protocol to the LRTAP Convention. As the resolution of the problem in Croatia depends to a large extent on emission reduction in other countries, especially those in the neighbourhood, Croatia must be highly interested in a successful fulfilment of obligations under international treaties and cooperation with other countries.

Climate change is the dominant global environmental issue of the 21st century. The effects of the climate change are becoming more and more manifest and make itself felt in a number of phenomena: changes of temperature, amount of precipitation and water resources, raising sea levels, frequency of extreme meteorological conditions, changes in ecosystems, biodiversity, agriculture, forestry and health, and economic damage. The scientists forecast that changes will be more and more noticeable. Given its geographical position, ecological and environmental peculiarities and the economic orientation, Croatia may be considered a country highly susceptible to climate change. In this regard every effort should be made to reduce pressures and mitigate the consequences of climate change by adapting to it. In this regard the Ministry of Environmental Protection, Physical Planning and Construction

developed a draft National Strategy for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol, including the action plan whose objectives and policies have been incorporated in this document.

Finally, Croatia is undergoing the process of pre-accession negotiations and admission to full membership in the European Union, which opens new challenges, especially in alignment with the EU acquis communitaire in the field of environmental protection. The experience of ten new EU members, the majority of which are countries in transition to market-oriented economy as is the case with Croatia too, shows that convergence with the EU environmental policies and standards is extremely demanding and complex due to substantial differences in the legislative and administrative system.

Therefore, any harmonization with the EU acquis communitaire in the field of environmental protection calls for systematic institutional and organizational changes and capital investments in best available techniques, so as to accomplish the objectives with regard to the reduction and prevention of harmful impacts on all environmental components. In the period preceding the accession to the EU Croatia must develop action plans and carry out cost-benefit analyses of implementation of legislation by individual sectors and subsectors in order to be able to implement measures in a cost-effective way. As regards harmonization of legislation in the field of air protection, Croatia may be said to be in a relatively better position in comparison with other environmental components.

When developing the Air Quality Protection and Improvement Plan of the Republic of Croatia a large number of planning documents, studies, project analyses and other documents was used. The baseline documents applied for the development of the Plan are as follows:

- Environmental Protection Act (Official Gazette No. 110/07) and enforcement regulations enacted pursuant to the same Act;
- Air Protection Act (Official Gazette No. 178/04) and enforcement regulations enacted pursuant to the same Act;
- Environmental Protection Strategy and National Environmental Action Plan (Official Gazette No. 46/02);
- Energy Sector Development Strategy (Official Gazette No. 38/02);
- Strategic Development Framework 2006-2013, the Government of the Republic of Croatia, 2006;
- Strategy towards Approximation of EU Environmental Legislation, 2006;
- Draft National Strategy for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol including the action plan, MEPPPC, 2007;
- The Second, the Third and the Fourth National Communication of the Republic of Croatia under the UNFCCC, MEPPP, 2006;
- Enforcement and other regulations of the Republic of Croatia in force;
- EU planning documents in the field of air protection;
- State of the Environment Report, CEA, Official Gazette 2006;
- Preliminary Assessment of Air Quality in the Area of the Republic of Croatia, MHS, 2007;
- 2006 Annual Report on Monitoring Air Quality at National Network Stations for Continuous Air Quality Monitoring, IMR, 2007;
- Annual Report on Monitoring Air Quality in the Area of the Republic of Croatia, IMR, 2007;
- Air Quality Protection and Improvement Programmes of the counties, the City of Zagreb, municipalities and towns;
- Sectoral plans for the reduction of greenhouse gas emissions (power industry, cement industry);

- The Sixth Community Environment Action Programme, 1600/2002/EC;
- EU Thematic Strategy on Air Pollution, 2005;
- European Climate Change Programme, EC 2006;
- Baseline scenario of the Clean Air for Europe Programme (CAFE), IIASA, 2005;
- Energy Efficiency Master Plan, 2008-2016, MELE, UNDP.

The EU acquis communautaire relating to air protection is governed by regulations on ambient air quality assessment and management, emissions from stationary sources, product quality, exchange of information and mobile sources. The horizontal legislation of the EU acquis communautaire determines public participation, the procedure for issuing permits and access to information.

The following is an overview of the EU acquis communautaire in the field of air protection:

Air quality assessment and management:

- Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management
- Council Decision 97/101/EC of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States
- Council Decision 2001/752/EC of 17 October 2001 amending the Annexes to Council Decision 97/101/EC
- Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and nitrogen oxides, particulate matter and lead in ambient air
- Directive 2000/69/EC of the European Parliament and the Council of 16 November 2000 on limit values for benzene and carbon monoxide in ambient air
- Directive 2002/3/EC of the European Parliament and the Council of 12 February 2002 on ozone in ambient air
- Directive 2004/107/EC of the European Parliament and the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air

Industrial pollution and emissions

- Directive 2001/81/EC of the European Parliament and the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants
- Directive 2001/80/EC of the European Parliament and the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants
- Directive 2000/76/EC of the European Parliament and the Council of 4 December 2000 on the incineration of waste
- Directive 94/63/EC of the European Parliament and the Council of 20 December 1994 on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations
- Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations
- Directive 2003/87/EC of the European Parliament and the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC as amended by Directive 2004/101/EC
- Council Directive 2004/101/EC amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms

- Commission Decision 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol
- Commission Regulation No. 2216/2004 on a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and to Decision 280/2004/EC
- Commission Regulation No. 916/2007 amending Regulation No. 2216/2004 on a standardised and secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and to Decision 280/2004/EC
- Commission Decision 2005/166/EC laying down rules implementing Decision No. 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol
- Commission Decision 2005/381/EC establishing a questionnaire for reporting on the application of Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community
- Commission Decision 2007/589/EC establishing guidelines for the monitoring and reporting on greenhouse gas emissions pursuant to Directive 2003/87/EC
- Commission Decision 2006/780/EC on avoiding double counting of greenhouse gas emission reductions under the Community emissions trading scheme for project activities under the Kyoto Protocol pursuant to Directive 2003/87/EC

Product quality

- Directive 97/68/EC of the European Parliament and the Council of 16 December 1997 on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery, amended by the Directive 2002/88/EC of the European Parliament and the Council of 9 December 2002
- Directive 98/70/EC of the European Parliament and the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending the Council Directive 93/12/EEC
- Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels, amending the Directive 93/12/EEC amended by Directive 2005/33/EC
- Commission Directive 2000/71/EC of 7 November 2000 to adapt the measuring methods as laid down in Annexes I, II, III and IV to the Directive 98/70/EC of the European Parliament and the Council relating to technical progress as foreseen in Article 10 of that Directive
- Directive 2003/17/EC of the European Parliament and the Council of 3 March 2003 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels
- Directive 2003/30/EC of the European Parliament and the Council of 8 May 2003 on the promotion of the use of biofuel or other renewable fuels for transport
- Directive 1999/94/EC of the European Parliament and the Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars, as amended by the Commission Directive 2003/73/EC of 24 July 2003 amending Annex III to the Directive 1999/94/EC of the European Parliament and the Council (see also Commission Recommendation of 26 March 2003 on the application to other media of the provisions of Directive 1999/94/EC concerning promotional literature)
- Decision 1753/2000/EC of the European Parliament and the Council of 22 June 2000 establishing a scheme to monitor average specific emissions of CO_2 from new passenger cars
- Regulation 2037/2000/EC of the European Parliament and the Council of 29 June 2000 on ozone-depleting substances
- Directive 2004/42/EC of the European Parliament and the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic

solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC

- Regulation 842/2006 on certain fluorinated greenhouse gases.

2. PRINCIPLES AND CRITERIA FOR DETERMINATION OF OBJECTIVES AND PRIORITIES

The starting point for determination of objectives of air quality protection and improvement in the Republic of Croatia are generally accepted and fundamental principles of protecting the environment or its components, as stipulated by the umbrella Environmental Protection Act (Official Gazette No. 110/07) and the National Environmental Action Plan (Official Gazette No. 46/02).

Sustainable development principle – objectives and measures laid down by the Air Quality Protection and Improvement Plan must encourage sustainable development and the overall social development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Precautionary principle – when planning and carrying out an activity that raises threats of risk and harm to the environment, all precautionary environmental protection measures should be taken, which implies the application of good experiences and the use of environmentally most friendly products, equipment and devices, including production processes and maintenance systems.

Principle of substitution of an activity for another - an activity likely to have an adverse effect on the environment should be substituted for another that causes substantially less risk or threat, even in case that the costs exceed the value to be protected.

Polluter pays principle – the polluting party bears the costs of damage caused by environmental pollution, including the costs of rehabilitation and an equitable compensation for damage.

Access to information and public participation – the citizens of the Republic of Croatia have a right to be timely informed about the environmental pollution and the measures taken, including a right of free access to the state of environment information. The general public has a right to participate in the procedures of preparing and adopting environmental documents.

Access to justice - in order to protect the constitutional right on healthy life and sustainable environment, any person who may prove that this right has been permanently infringed by the location or impact of an activity may dispute the lawfulness of decisions in accordance with the law.

Partnership and shared responsibility – objectives may only be defined and accomplished in the partnership of all stakeholders, with everybody assuming his/her share of responsibility.

Change in producer and consumer behaviour patterns – objectives cannot be accomplished without changing the patterns of behaviour and the relationships in the production and consumption.

Use of a larger number of instruments for accomplishment of objectives – a larger number of traditional and economic instruments should be used to help achieve

objectives of air quality protection and improvement and their integration into other sectors affecting the air quality.

The above basic principles constitute a framework within which and in accordance with which objectives of air quality protection and improvement are set. In this context they make it possible to accomplish the objectives in conformity with the planning documents and regulations adopted.

The protection and improvement of air quality in the Republic of Croatia require:

- identification and implementation of measures in the field of air quality protection and improvement so as to avoid, prevent or mitigate harmful effects on human health, quality of life and environment as a whole;
- maintaining the quality of air if it is clean or slightly polluted and its improvement, if polluted;
- prevention and reduction of pollution that causes the ozone layer depletion and climate change;
- establishment, maintenance and improvement of an integrated air quality management system across the territory of the state;
- evaluation and acquisition of relevant air quality data based on standardized methods and criteria and making them available to the public;
- fulfilment of obligations assumed under international treaties and agreements to which the state is a party, and participation in international cooperation in the field of air quality protection and improvement.

In setting priorities relating to the accomplishment of objectives and implementation of measures the following criteria will be used for their evaluation:

1. ***Air pollution level:*** Priority is to be given to harmful substances and areas where level of pollution, as compared to limit values, exceeds tolerance values and critical levels of pollution.
2. ***Degree of harmfulness (threat, risk) of a pollutant to human health:*** Preference should be given to those objectives and measures whose accomplishment results in the reduction of emission of substances with marked harmful properties.
3. ***Size of population or ecosystem threatened:*** A key factor in setting the priorities is the size of population exposed to pollution and/or the surface and the diversity of the threatened ecosystem and cultural assets.
4. ***Susceptibility of recipients:*** As regards effects on health, children, the elderly and sick persons are considered susceptible population. The susceptibility of ecosystems is identified by critical levels of pollution.
5. ***Degree of discomfort caused by pollution:*** Apart from health effects and harmful impacts on the ecosystem, the pollution-caused discomfort, mostly unpleasant smell or reduced visibility, is a reason to take action.
6. ***Time frame for accomplishment of objectives/implementation of measures:*** According to the proposed time frame for implementation of measures priority is to be given to measures with a shorter implementation time or the start of implementation.

7. ***Provision of the finance, other resources and expert documents:*** Priority is given to measures for which necessary finance has been secured and the bidding procedure completed, unless in contravention of the previous two criteria.

8. ***Synergy effect:*** Priority is given to measures that, apart from the reduction of priority pollutants, have a positive impact on the reduction of other pollutants and/or mitigation of effects on other environmental components (water, soil/waste).

The application of the above mentioned criteria means that priority will be given to objectives and measures that result in lower emissions of pollutants with the most harmful impacts on human health and at the same time have the shortest time of implementation, secured finance and necessary expert and administrative documents ready, and a positive effect on the reduction of other pollutants, including a reduced impact on waters and the soil. In majority of cases the objectives and measures will be ranked by priorities taking into consideration relative importance of criteria.

3. REPUBLIC OF CROATIA AND INTERNATIONAL COMMITMENTS IN THE FIELD OF AIR PROTECTION

Convention on Long-range Transboundary Air Pollution (LRTAP Convention) sets up the legislative, organizational and scientific framework of activities developed by the UNECE member countries in response to recognized consequences of transboundary air pollution. At the same time this is the first international legally binding document to deal with problems of air pollution on a broad regional basis. According to the Convention, "the European air mass" is a common natural resource of the signatory countries and calls for a coordinated action for combating air pollution and common emission standards. The Convention was signed in Geneva in 1979 and entered into force in 1983. The Republic of Croatia joined the Convention on the basis of the notification of succession of 1991. The Convention was further extended by eight protocols laying down specific measures that the parties to the LRTAP Convention are bound to take in order to reduce the emission of pollutants in the air. These protocols are as follows:

- **Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)** defines instruments for international cost-sharing of the monitoring programme which forms the backbone for review and assessment of air pollution in Europe and for joining the agreements on emission reduction. The EMEP has three main components: collection of emission data for SO_2, NO_x, VOCs and other air pollutants; measurement of air and precipitation quality; and modelling of atmospheric dispersion. It was adopted in Geneva in 1984 and entered into force in 1988, but the Republic of Croatia joined it on the basis of the notification of succession of 1991.

- **Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent** aims at reducing emissions of one of the major air pollutants. By 1993 the sulphur emissions were reduced by more than 50 per cent. Based on the latest available data all Parties to the Protocol have met the reduction target. The Protocol was adopted in Helsinki in 1985 and entered into force in 1987, but has not been ratified yet by the Republic of Croatia.

- **Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes** aims at controlling and reducing anthropogenic emissions of nitrogen oxides (NO_x) which are transported by transboundary fluxes over large distances and whose atmospheric deposition has a harmful effect on

environmental components and human health. Apart from causing acidification and eutrophication of terrestrial and marine ecosystems, NO_x emissions contribute also to formation of ground-level ozone. Under this Protocol the Parties undertake to apply and improve national emission standards for nitrogen oxides coming from stationary and mobile sources, in order to take effective measures to control and reduce their national annual emissions of nitrogen oxides and their transboundary fluxes, taking into consideration the best available and economically feasible technologies described in the Technical Annex to the Protocol. The Protocol was adopted in Sophia in 1988, entered into force in 1991 and was ratified by the Republic of Croatia in 2007.

- **Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes** is highly important, because these compounds are responsible for the formation of ground-level ozone. The Protocol was adopted in 1991, it entered into force in 1997 and was ratified by the Republic of Croatia in 2007.

- **Protocol on Further Reduction of Sulphur Emissions** applies an effects-based approach consisting of the critical load concept, the best available technology, energy savings and the application of a number of economic instruments, that has led to a differentiation of emission reduction obligations of Parties to the Protocol. At the same time the effects-based approach sets long-term targets for reductions in sulphur emissions. It was adopted in Oslo in 1994, entered into force in 1998 and was ratified by the Republic of Croatia in 1999.

- **Protocol on Heavy Metals** aims at controlling the anthropogenic heavy metal emissions likely to have an adverse effect on human health and the environment. The Protocol lays down the basic obligations of the Parties with respect to emissions of lead (Pb), cadmium (Cd), mercury (Hg) and their products. The Parties are bound to reduce total annual emissions of these heavy metals in the atmosphere with respect to the emission level recorded in the year of assuming the obligation, being in principle 1990 or an alternative year between 1985 and 1995. Limit values of emissions from stationary sources laid down by the Protocol relate to emissions of particulate matter, because they are easier to monitor and the compliance with the limit values contributes to the reduction of heavy metal emissions. The Protocol was adopted in Aarhus in 1998 and entered into force 5 years later. It was ratified by the Republic of Croatia in 2007 and entered into force for Croatia on 5 December 2007.

- **Protocol on Persistent Organic Pollutants** aims to control, reduce or eliminate any discharges, emissions and losses of persistent organic pollutants. The Protocol bans the production and use of some products outright (aldrin, chlordane, chlordecone, dieldrin, endrin, hexabromobiphenyl, mirex and toxaphene) and some others are scheduled for elimination at a later stage (DDT, heptachlor, hexaclorobenzene, PCBs). For DDT, HCH (including lindane) and PCBs the Protocol lays down the methods and conditions under which these substances might be used. It also obliges Parties to reduce their total annual emissions of PAHs, dioxins and furans in comparison with the emission level of the year of assuming the obligation (in principle 1990 or an alternative year between 1985 and 1995). The Protocol defines permitted limit values for dioxins and furans from stationary sources, the best available technologies and emission reduction technologies. It also obliges the Parties to develop strategies, policies and programmes for fulfilment of obligations under the Protocol, including the annual emission inventory as an indispensable precondition. The Protocol was adopted in

Aarhus in 1998 and entered into force in 2003. It was ratified by the Republic of Croatia in 2007 and entered into force for Croatia on 5 December 2007.

- **Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)** sets at the same time emission ceilings for SO_2, NO_x, NMVOCs and NH_3 emissions, and thus affects acidification, eutrophication and ground-level ozone (multi-effects). The Protocol obliges the Parties to reduce the annual emission to the level laid down by the Protocol and to maintain the emission on that level in the future. They are also obliged to collect and keep data on national annual pollutant emissions and submit periodic reports to the Executive Body for the Convention. Emission reductions to be achieved by individual countries by 2010 are country-specific and determined according to the guidelines specified in the handbook issued by the Conference. The Protocol sets limit values for emissions of pollutants from stationary and mobile sources. It was adopted in Gothenburg in 1999 and entered into force in 2005. The Republic of Croatia will ratify the Protocol in 2008.

United Nations Framework Convention on Climate Change sets a framework for international efforts as a response to the challenge posed by climate change on a global scale. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. Among other things, the Parties to the Convention gather and exchange information on greenhouse gas emissions, national policies and best practices, and cooperate in preparing for adaptation to climate change. The Republic of Croatia ratified the Convention in 1996. According to Article 22, item 3 of the Convention the Republic of Croatia, as a country undergoing the process of transition to a market-oriented economy, assumed the obligations of an Annex I country relating to keeping the national greenhouse gas emissions at the 1990 level.

- **The Kyoto Protocol** to the United Nations Framework Convention on Climate Change was adopted with the aim to reduce emissions of carbon dioxide and other greenhouse gases (methane, oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride). The Protocol was adopted in 1997 and entered into force in 2005. After successful completion of negotiations on emission levels of the base year the Republic of Croatia ratified the Protocol in 2007.

Vienna Convention for the Protection of the Ozone Layer aims at the protection of human health and the environment and lays down specific measures to prevent modifications of the ozone layer. Its task is to encourage research and cooperation among countries and to share information. It is important to note that this Convention is a proof of a general awareness of the countries that global environmental issues are to be tackled before scientifically proved. The Convention was adopted in 1985, entered into force in 1988 and was joined by the Republic of Croatia on the basis of the notification of succession of 1991.

- **Montreal Protocol on Substances that Deplete the Ozone Layer** imposes the obligation of phasing out the production and consumption of substances responsible for ozone depletion and represents one of the most successful examples of international cooperation in combating global threats to the environment. Since its adoption in 1987 the Parties to the Montreal Protocol have continued adapting the system established in response to scientific proofs and development of technologies. The Protocol entered into force in 1989 and was joined by the Republic of Croatia on the basis of the notification of succession in 1991.

Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) makes it obligatory to the Parties to the Convention to guarantee any physical and legal person the right of access to environmental information held by a public or any other authority, without having to state the interest, whereby the public authority is obliged to make environmental information available to the general public to the highest degree possible, especially using information and communication technologies. The Convention may be divided into three basic parts: access to information, public participation and access to justice. It was adopted in 1998, entered into force in 2001 and was ratified by the Republic of Croatia in 2006.

- **Protocol on Pollutant Release and Transfer Registers** aims at enhancing public access to information through the establishment of coherent registers of pollutant release and transfer to the air, water and soil in form of a publicly available database. The Protocol is expected to exert a significant pressure to polluters so as to reduce the loads on environmental components. It was adopted in Kiev in 2003, but has still not entered into force.

Stockholm Convention on Persistent Organic Pollutants is a global treaty on the protection of human health and the environment against these compounds. They are highly persistent and may become widely distributed geographically. They accumulate in the fatty tissue of living organisms and are toxic to the environment and the living world. The purpose of the Convention is to take measures to eliminate or reduce the release of POPs into the environment. It was adopted in 2001, entered into force in 2004 and was ratified by Croatia in 2007.

Table 3-1: Status of international treaties

Title of international treaty	Adopted	Entered into force	No. of Parties	Ratified by Croatia
Convention on Long-range Transboundary Air Pollution (LRTAP)	1979	1983	51	1992
Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)	1984	1988	42	1992
Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent	1985	1987	23	-
Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes	1988	1991	31	2007
Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes	1991	1997	22	2007
Protocol on Further Reduction of Sulphur Emissions	1994	1998	27	1999

Protocol on Persistent Organic Pollutants	1998	2003	29	2007
Protocol on Heavy Metals	1998	2003	29	2007
Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol)	1999	2005	24	2008
United Nations Framework Convention on Climate Change	1992	1994	165	1996
Kyoto Protocol	1997	2005	179	2007
Vienna Convention for the Protection of the Ozone Layer	1985	1988	191	1992
Montreal Protocol on Substances that Deplete the Ozone Layer	1987	1989	191	1992
London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	1990	1992	186	1993
Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	1992	1994	179	1997
Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	1997	1999	159	2000
Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	1999	2002	135	2002
Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention	1998	2001	41	2006
Protocol on Pollutant Release and Transfer Registers	2003		6	2008
Stockholm Convention on Persistent Organic Pollutants	2001	2004	150	2007

4. AIR QUALITY ASSESSMENT

4.1. MEASUREMENT OF AIR QUALITY IN THE AREA OF THE REPUBLIC OF CROATIA

4.1.1. NATIONAL AIR QUALITY MONITORING NETWORK

The national air quality monitoring network is still in the process of establishment. Out of 22 stations planned across the national territory, in the period from 2003 to 2007 8 automatic measuring stations were installed in urban and industrial areas. The setting up of a complete network of stations in rural areas (7) and in national and nature parks and areas with

sensitive ecosystems (5) is expected to be completed by the end of 2009 within the context of the PHARE project implementation.

For the purpose of this assessment the data provided by the national network were analysed in detail. Table 4.1-1 shows air quality monitoring parameters by stations whose distribution is shown in Fig. 4.1-1.

Table 4.1-1: Measurement of air quality parameters at stations of the national air quality monitoring network, 2007

Station	Air quality parameters
Zagreb-1	SO_2, NO_2, CO, O_3 (February 2003-April 2006); PM_{10}, benzene, UVB radiation, meteorological parameters and concentrations of Pb,Cd and Mn (by 2007) and Ni (by 2007) and polycyclic aromatic hydrocarbons in samples of total suspended particulate matter (SPM, 2003 and 2004) and samples of PM_{10} since 2005 onward
Zagreb-2	SO_2, NO_2, CO, PM_{10}, meteorological parameters
Zagreb-3	SO_2, NO_2, CO, O_3 (since April 2006 onward), PM_{10}, meteorological parameters
Rijeka-1	SO_2, NO_2, CO, H_2S, PM_{10}, benzene, meteorological parameters
Rijeka-2	SO_2, NO_2, CO, O_3, PM_{10}, UVB radiation, meteorological parameters
Sisak	SO_2, NO_2, CO, H_2S, PM_{10}, benzene, meteorological parameters and concentrations of Pb, Cd, Ni and polycyclic aromatic hydrocarbons in samples of PM_{10} (since 2007)
Kutina	SO_2, NO_2, CO, NH_3, H_2S, PM_{10}, meteorological parameters
Osijek	SO_2, NO_2, CO, PM_{10}, benzene, meteorological parameters

4.1.2. PRECIPITATION QUALITY MONITORING NETWORK AND ATMOSPHERIC DEPOSITION OF POLLUTANTS

Measurements of the chemical composition of precipitation have been regularly carried out at meteorological stations of the MHS since 1981. This network consists of two stations (Puntijarka and Zavižan) that provide emission data for international exchange within the framework of the EMEP programme under the LRTAP Convention. The measurements include parameters shown in Table 4.1-2 and were carried out at 31 locations across Croatia in the period 1981-2004. The number of stations gradually decreased so that measurements are presently carried out at 18 stations. Analyses of daily precipitation samples are carried out at all stations. They serve as a basis for calculating deposition of all ionic components, especially sulphate, nitrate and ammonia ions responsible for problems of **acidification** and **eutrophication** of the environment.

Table 4.1-2: Chemical composition of precipitation

Medium	Quality indicator	Measurement frequency
Precipitation	Amount of precipitation; SO_4^{2-}, NO_3^-, Cl^-, pH, NH_4^+, Na^+, Mg^{2+}, Ca^{2+}, K^+, conductivity	daily sampling
Meteorological indicators	Wind direction and speed, air temperature, relative air humidity, precipitation amount and type	continuous measurement

Fig. 4.1-1. Automatic national network stations for air quality monitoring, 2007

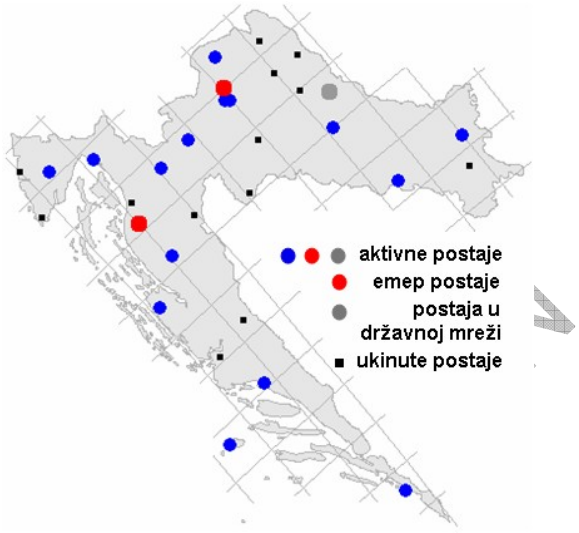

Fig. 4.1-2 Network of MHS stations for monitoring chemical composition of precipitation, 2007

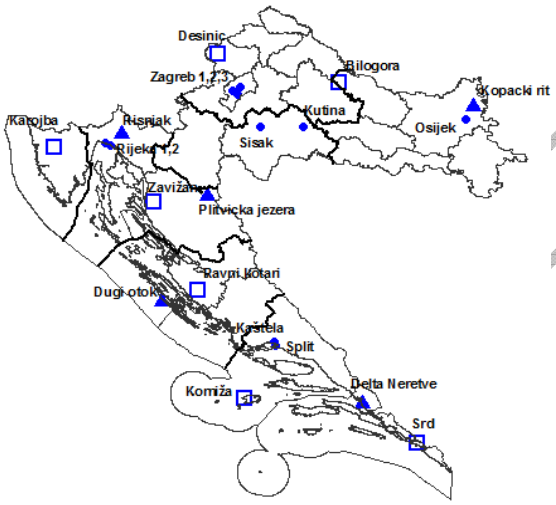

Fig. 4.1-3. National air quality monitoring network (under construction, 2007)

Fig. 4.1-4 Network of MHS stations for monitoring precipitation quality, 2007

(u slici 4.1-2: - active stations
- EMEP stations
- national network stations
- stations abolished)

Figure 4.1-2 shows the spatial distribution of measuring stations and a 50km x 50km grid (EMEP grid) used to calculate pollutant concentrations and deposition through modelling transboundary fluxes. The measurement results are used to verify and check the reliability of the model. Figures 4.1-3 and 4.1-4 show the existing precipitation quality monitoring network with marked zones and the planned network of national stations for continuous air quality monitoring. Once the national network is set up, the MHS network will be abolished for the most part, because most of its functions will be taken over by the national network. Measurements will only be carried out at stations of relevance to the analysis and study of specific atmospheric processes and conditions.

4.1.3. LOCAL AIR QUALITY MONITORING NETWORKS

Local air quality monitoring networks are organized across the country's territory and have the longest tradition of measuring the basic pollutants, i.e. SO_2, smoke, total deposited matter and metal content in the total deposited matter. These measurements were introduced in many European countries on the initiative of the World Health Organization in the 1960s. All over Europe this period was characterized by high levels of pollution, especially by sulphur dioxide, suspended matter of predominantly acid chemical composition, acid rains and photochemical pollution, which resulted in dying away of the living world in rivers and lakes of northern Europe and forests of the central and eastern Europe. Pollution levels and smog were a common phenomenon in urban areas especially in winters. These worrying pollution trends gave impetus to coordinated international activities of the World Health and the World Meteorological Organization relating to the protection of human health and the environment from atmospheric pollution. In public health institutes departments for environmental hygiene were established with the aim to measure and analyse air quality samples so as to monitor and protect human health. At the same time departments and laboratories for monitoring air quality and precipitation in rural areas were set up as a part of meteorological services for the purpose of monitoring the state and effects of atmospheric pollution on the environment.

Following the scientific developments in this area some of the local air quality monitoring networks kept spreading and developing in the course of the time, whereas the majority of them gradually lagged behind due to the shortage of funds needed for upgrading and technical support. Viewing the types of pollutants monitored by local networks it may be said that in Croatia the most developed local networks are located in the counties of Primorje-Gorski kotar and Istria, and partly in the City of Zagreb, owing to the commitment of the Institute for Medical Research and Occupational Health to maintain the continuity of measurements and monitor the developments in this area.

In 2006 measurements were carried out at a total of 137 measuring sites in 12 counties (Table 4.1-3):

Table 4.1-3: Overview of measurements by counties, 2006

County of	No. of measuring sites		Parameters
	within national network	within local networks	
Bjelovar-Bilogora	-	3	SO_2, smoke, total deposited matter, concentrations of Pb and Cd in TDM
City of Zagreb	3	7	SO_2, NO_2, smoke, O_3, NH_3, PM_{10}, concentrations of Pb, Cd, Mn, sulphates and BaP in PM_{10}, $PM_{2.5}$, total deposited matter and concentrations of Pb, Cd and Tl in TDM
Istria	-	32	SO_2, smoke, NO_2, total deposited matter, concentrations of Pb and Cd in TDM, meteorological parameters
Karlovac	-	5	SO_2, smoke, total deposited matter, concentrations of Pb and Cd in TDM
Krapina-Zagorje	-	1	SO_2, smoke, total deposited matter, concentrations of Pb and Cd in TDM
Osijek-Baranja	1	20	SO_2, smoke, total deposited matter, concentrations of Pb, Cd and Tl in TDM

Primorje-Gorski kotar	2	24	SO_2, smoke, NO_2, CO, O_3, H_2S, NH_3, PM_{10}, total deposited matter, concentrations of Pb and Cd in TDM, benzene, xylene, toluene, meteorological parameters
Sisak-Moslavina	2	12	SO_2, smoke, NO_2, H_2S, NH_3, PM_{10}, total deposited matter, concentrations of Pb, Cd, Hg, Ni and As in TDM, mercaptans, benzene, fluorides, meteorological parameters
Split-Dalmatia	-	15	SO_2, smoke, NO_2, total deposited matter, concentrations of Pb, Cd and Tl in TDM
Šibenik-Knin	-	6	SO2, smoke, NO_2, total deposited matter, concentrations of Pb, Cd and Tl in TDM
Virovitica-Podravina	-	1	SO_2, smoke, NO_2
Zadar	-	3	SO_2, smoke, NO_2, total deposited matter

Table 4.1-4: Overview of pollutant level measurements (SO_2, NO_x, PM_{10}, $PM_{2,5}$, benzene and TDM) by counties, 2006

County of	No. of measuring sites		Parameters					
	within national network	within local networks	SO_2	NO_x	PM_{10}	$PM_{2,5}$	benzene	TDM
Bjelovar-Bilogora	-	3	X					
		1						X
City of Zagreb	3	7	X					
	3	6		X				
	3	6			X			
	1	-					X	
	-	5						X
Istria	-	10	X					
		6		X				
		1			X	-		
		22						X
Karlovac	-	3	X					
		2						X
Krapina-Zagorje	-	1	X					X
Osijek-Baranja	1	3	X					
	1	1		X				
	1				X			

	1						X	
	-	19						X
Primorje-Gorski kotar	2	19	X					
	2	9		X				
	2	5			X			
	1	2					X	
	-	12						X
Sisak-Moslavina	2	7	X					
	2	12		X				
	2	-			X			
	1	-					X	
	-	10						X
Split-Dalmatia	-	4	X	X				
		3			X	X		
		15						X
Šibenik-Knin	-	1	X	X				
		6						X
Virovitica-Podravina	-	1	X	X				
Zadar	-	3	X	-				X

No measurements are carried out in 9 counties: Slavonski Brod-Posavina, Dubrovnik-Neretva, Koprivnica-Križevci, Lika-Senj, Međimurje, Požega-Slavonia, Varaždin, Vukovar-Srijem and Zagreb.

In the preparation of the Air Quality Monitoring Report of the Republic of Croatia for 2006 (IMR, 2007) reports and data provided by 18 legal entities authorized for air quality monitoring by the MEPPPC were used.

4.2. ASSESSMENT OF AIR QUALITY IN THE AREA OF THE REPUBLIC OF CROATIA

The air quality in the area of Croatia has been assessed on the basis of Croatian regulations[1] and in accordance with the instructions and EU directives. The purpose of the assessment was to identify the degree of pollution for all pollutants for which

[1] Air Protection Act (Official Gazette No. 178/04)

- data on pollutant emissions
- measurement data on the level of pollutants in the air and/or
- calculation data based on mathematical models

were available, and to prepare documents for identification of areas (zones) and inhabited areas (agglomerations) in the Republic of Croatia with respect to the spatial distribution of pollutant emissions, air quality criteria and categories, geographical characteristics and climate conditions of relevance to air quality monitoring.

For the purpose of air quality assessment the following data[2] were analysed:

- measurement data provided by national network stations for air quality monitoring;
- data contained in annual reports and provided by measuring sites of local air quality monitoring networks across Croatia[3];
- measurement data on chemical composition of precipitation provided by the MHS stations and
- calculation data on concentrations of pollutants and their deposition across Croatia, obtained by using a regional model for pollutant transmission and deposition in Europe (EMEP programme under the LRTAP Convention).

The assessment included the measured concentrations of the following pollutants: sulphur dioxide, nitrogen oxides, suspended particulate matter, benzene, carbon monoxide, ozone, ammonia, hydrogen sulphide, polyaromatic hydrocarbons and heavy metals (lead, cadmium, manganese and thallium) in suspended particulate matter and total deposited matter recorded in above mentioned towns.

The EMEP model for long-range transboundary transport of pollutants was used to assess concentrations and deposition of particulate matter across Croatia (pollution level in rural areas) for the following pollutants: sulphur dioxide, nitrogen oxides, suspended particulate matter, ozone, AOT40, ammonia, polyaromatic hydrocarbons (benzo(a)pyrene, dioxins and furans), including heavy metals (lead, cadmium and mercury) in a 50km x 50km grid.

Based on measurement data on chemical composition of precipitation provided by MHS stations and calculation data obtained by modelling regional and long-range transmission of pollutants (EMEP) the acidification and eutrophication conditions of the region of Croatia were analysed in a 50kmX50km spatial grid covering rural areas and the areas of national and nature parks and sensitive ecosystems.

Spatial data on pollutant emissions (sulphur dioxide, nitrogen oxides, volatile organic compounds, ammonia, carbon monoxide and suspended particulate matter) and emission

Regulation on Limit Values of Pollutant Emissions in the Air (Official Gazette No. 133/05)
Regulation on Critical Levels of Pollutants in the Air (Official Gazette No. 133/05)
Regulation on Ozone in the Air (Official Gazette No. 133/05)
Air Quality Monitoring Ordinance (Official Gazette No. 155/05)

[2] Sources of data:
- Croatian Environment Agency
- Ministry of Environmental Protection, Physical Planning and Construction
- Institute for Medical Research and Occupational Health
- Meteorological and Hydrological Service
- EMEP programme under the UNECE Convention on Long-range Transboundary Air Pollution: reports, emission data and calculation results

[3] *Annual Report on Air Quality Monitoring across the Republic of Croatia in 2006*, Institute for Medical Research and Occupational Health, Zagreb, CEA, July 2007
The Study of the Possibility to Reduce Air Pollution in Sisak, Ekonerg, Zagreb, 2005

data from the Environmental Emission Cadastre (EEC) were also analysed in a 50kmX50km spatial grid.

The analyses included climatologic data: spatial distribution of air temperature, relative humidity of air and amount of precipitation in the last standard climatologic period (1961-1990), including the data on population density by counties (1991).

When preparing the preliminary assessment, the underlying documents used to determine characteristic regions and inhabited areas of the Republic of Croatia (zones and agglomerations) were the guidelines of the European Environment Agency and the European Commission, or specifically: *"Guidance Report on Preliminary Assessment under EC Air Quality Directives" and " Guidance on Assessment Under the EU Air Quality Directives"*.

The methodology and criteria applied in preparation of the assessment are based on the analysis and evaluation of factors of relevance to the pollution distribution and level in a specific area, the analysis of air quality data obtained by measurements, where established, and the analysis of results obtained by calculation model showing the pollution figures for the area of Croatia. Therefore, the following criteria were used for the assessment and division of the country's territory:

- geographic characteristics of Croatia;
- meteorological and climatic conditions;
- spatial distribution of annual emissions by pollutants;
- location and annual emissions of major individual emission sources;
- results of air pollution measurements carried out at air quality monitoring stations in towns and settlements;
- results of precipitation pollution measurements carried out at main meteorological stations;
- calculation results for concentrations and deposition of pollutants across Croatia using the model of long-range transmission;
- pollution category of an area considering the following pollutants: sulphur dioxide, nitrogen oxides, suspended particulate matter, lead, benzene, carbon monoxide, ozone, polyaromatic hydrocarbons, cadmium, arsenic, nickel, mercury, ammonia and hydrogen sulphide.

For each area the level of each individual pollutant concentration was assessed, if measured and/or modelled data were available. In areas where no measurement data were available the assessment was based on modelling results, data on pollutant emissions and other factors. Since the number of measuring stations for air quality monitoring does not suffice for a complete assessment of the state in the area of Croatia, the preliminary assessment has not included all parameters with the same relevance. The greatest importance was attached to measured data, while other information served as an auxiliary means only.

Taking into consideration all the above information mentioned and analysed, Croatia was spatially divided into 7 areas/zones and 8 inhabited areas/agglomerations – urban and industrially developed areas (Table 4.2-1, Fig. 4.2-1).

Table 4.2-1: Geographical range of individual zones/areas with explanation

Area	Explanation
HR 1	Counties of Osijek-Baranja (except the Town of Osijek), Vukovar-Srijem, Slavonski Brod-Posavina, Požega-Slavonia and Virovitica-Podravina
	• By their geographical features they belong to the eastern part of lowland Croatia, which

Area	Explanation
	determines other parameters and conditions of relevance to air pollution; • They belong to an area with similar climatic characteristics; • They show similar characteristics as to the pollution and regional transmission of pollutants; • They show similar characteristics as to the prevailing pollutant emission sources (predominantly agricultural area).
HR 2	Counties of Bjelovar-Bilogora, Koprivnica-Križevci, Krapina- Zagorje, Varaždin, Međimurje, Zagreb (except the City of Zagreb)
	• By their geographical features they belong to the northern part of lowland Croatia; • They belong to an area with similar climatic characteristics; • They show similar characteristics as to the pollution and regional transmission of pollutants – increased nitrate and ammonia deposition load of the area; • By pollutant emissions they belong to an area of high emission values with respect to all parameters analysed.
HR 3	County of Karlovac and Sisak- Moslavina (except the towns of Kutina and Sisak)
	• By their geographical features they belong to central part of mildly mountainous area of Croatia; • They belong to an area with similar climatic characteristics; • They show similar characteristics as to the pollution and regional transmission of pollutants – increased sulphate and nitrate deposition load of the area; • By pollutant emissions they belong to an area of increased emission values with respect to some parameters.
HR 4	County of Istria
	• By the geographical features it belongs to the Istrian peninsula of characteristic geographic features and the Učka massif in the east as a natural physical obstacle; • It is characterized by climatic conditions that differentiate it from the rest of the littoral Croatia; • It shows similar characteristics as to the pollution and regional transmission of pollutants – an area of a high environmental load of ozone, sulphate and nitrate deposition and suspended particulate matter; • It is situated in the immediate vicinity of focal points of emission (the Bay of Trieste, the area of Rijeka); • By pollutant emissions it belongs to an area of medium-high emission values as regards the majority of parameters.
HR 5	Counties of Primorje-Gorski kotar (except the Town of Rijeka) and Lika-Senj
	• By the geographical features they belong to the central highland area of Croatia; • They show climatic conditions that differentiate them from the rest of Croatia; • These are the areas recording the highest load of dry and wet sulphate and nitrate deposition and acid deposition from suspended particulate matter; • These are the areas recording the highest load caused by long-range transmission of pollutants (due to physical and climatic features); • They are situated in the immediate vicinity of focal points of emission (the Bay of Trieste, the area of Rijeka, industrial areas of B&H); • By pollutant emissions they belong to areas of low and medium-high emission values as regards the majority of parameters.
HR 6	Counties of Zadar and Šibenik-Knin
	• By the geographical features they belong to the central part of the coastal region of Croatia; • They are characterized by climatic conditions that differentiate them from the northern and southern part of the coastal region of Croatia; • They show similar characteristics as to the pollution and regional transmission of pollutants – areas with a high ozone load and high potential of generating photochemical pollution; • By pollutant emissions they belong to areas of low emission values as regards the majority of parameters.
HR 7	Counties of Split-Dalmatia (except the Town of Split) and Dubrovnik-Neretva
	• By the geographical features they belong to the southern part of the coastal region of Croatia and represent geographically and climatically a self-contained whole;

Area	Explanation
	• They show characteristic climate conditions and characteristic conditions as regards the regional transmission of pollutants; • By pollutant emissions they belong to areas of low emission values as regards the majority of parameters.

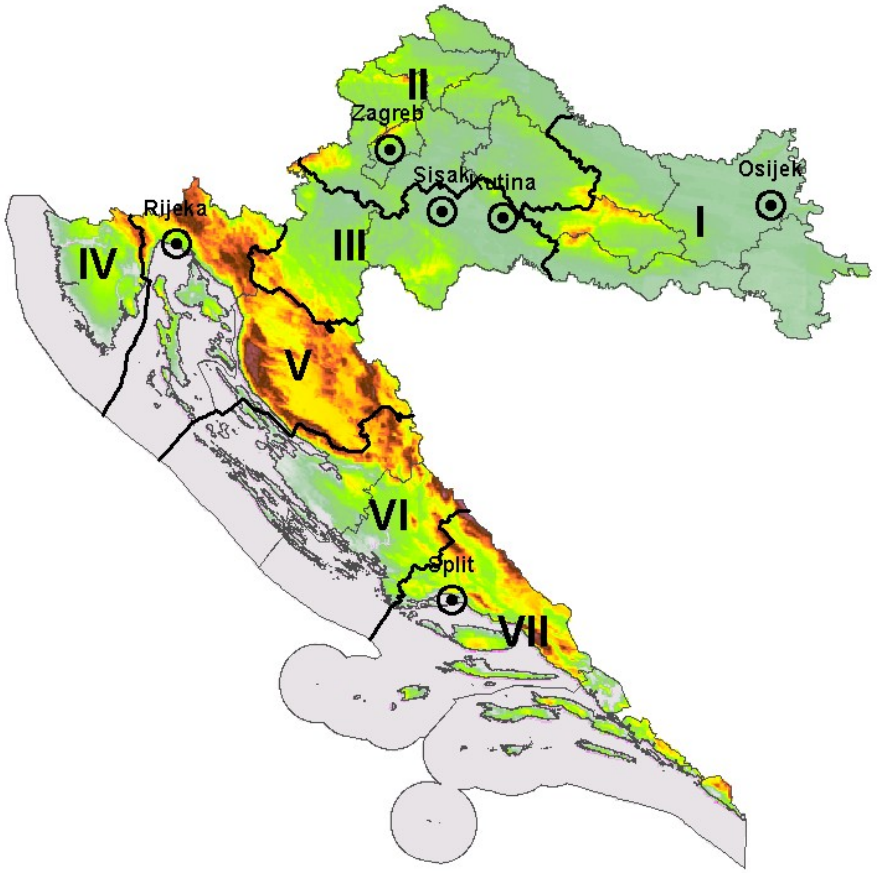

Fig. 4.2-1: Areas (zones) and inhabited areas (agglomerations)

The analysis of data showed sufficiently low levels of air pollution with sulphur dioxide, nitrogen oxides, suspended particulate matter, carbon monoxide, benzene and ozone concentrations in all zones (1-7), which consequently fall into the first category of air quality. However, according to the analysis of data obtained by a calculation (EMEP modelling) based on the ozone parameter AOT40 that showed the ozone concentrations to exceed the threshold value of 40 μg/m^3 in the period from May to July, the vegetation of the entire area of Croatia is considered at increased risk , because the number of hours of its exposure to elevated ozone concentrations has exceeded the limits set.

6 inhabited areas/agglomerations were identified within this area: Zagreb, Sisak, Kutina, Rijeka, Osijek and Split. In these agglomerations (that include industrial areas too) the situation is more complex. For the most part they belong to the first category of air quality considering sulphur dioxide, carbon monoxide and benzene. As regards other parameters they fall either into the second (NOx, benzene, ozone) or the third (suspended particulate matter, H_2S, SO_2) category of air quality, depending on the proximity of local pollution sources (oil refineries in Sisak and Rijeka, carbon black plant in Kutina). Characteristically

these inhabited areas are classified into the third category of air quality with respect to particulate matter (PM_{10}).

In general, the ambient air quality, except in urban and industrial areas, may be said to be satisfactory and to fall into the first category for the most part. The only exceptions are ozone concentrations in summer months when AOT40 is exceeded. There are two reasons for this exceedance. The first relates to the fact that in this period of time the solar radiation generates high ozone values, which is a natural phenomenon caused by geographical and climatic conditions, and the second reason is the long-range transboundary transmission of ozone precursors (photochemically active NMVOC and NOx compounds) and the ozone already generated. The EMEP modelled calculations of the transboundary transmission show the elevated ozone concentrations in Croatia to be mainly a consequence of precursor emissions in the adjacent countries. The reduction of NOx emissions in the country has very little effect on the improvement of the state and the reduction of the NMVOC emissions has almost no effect whatsoever in this area.

Regardless of the predominant cause of ozone formation, it has a harmful effect on the environment and human health. Similarly, this phenomenon occurs in western and central Europe and in Mediterranean countries too, where limit values for AOT40 are exceeded for the same reasons. This points to the need to address the problem of ozone not as a problem of Croatia only, but as an issue of international importance, through legal mechanisms of the Convention on Long-range Transboundary Air Pollution and its protocols (especially the Gothenburg Protocol of 1998 governing and mutually adjusting pollutant emissions from sources of NO_x, NMVOC, NH_x and SO_x compounds, which are at the same time the precursors responsible for the formation of photochemically harmful ozone).

Taking into consideration all the analyses and pollution parameters mentioned, Table 4.2-2 shows the division of the national territory by air quality categories.

Table 4.2-2: Air pollution levels by individual zones and agglomerations

Zone and agglomeration denotation	Air pollution level	
	Pollutants	Ozone*
HR 1	**I**	**II** (AOT40)
HR 2	**I**	**II** (AOT40)
HR 3	**I**	**II** (AOT40)
HR 4	**I**	**II** (AOT40)
HR 5	**I**	**II** (AOT40)
HR 6	**I**	**II** (AOT40)
HR 7	**I**	**II** (AOT40)
HR ZG	**I, II**	**II** (AOT40)
HR RI	**I, II**	**II** (AOT40)
HR ST	**I**	**II** (AOT40)
HR OS	**I**	**II** (AOT40)
HR SI	**I, II, III**	**II** (AOT40)
HR KT	**I, II, III**	**II** (AOT40)

* Pollution level for ozone relates to vegetation and is of a preliminary character only, because according to the Ozone Regulation the evaluation starts after 2010

A detailed breakdown of the air pollution level across the Republic of Croatia by individual harmful substances, taking into account both the lower and upper assessment limits apart from limit and tolerance values, is shown in Table 4.2-3.

Table 4.2-3: Breakdown of pollutant concentrations in individual polluted areas

Zone and agglomeration denotation	SO_2	NO_X	PM_{10}[4]	Ozone[5]	CO	Benzene	PAH	Pb	Cadmium	Manganese	Thallium	NH_3	H_2S
Zone													
HR 1[6]	7	7	7	3	7	7	7						
HR 2[6]	7	7	7	3	7	7	7						
HR 3[6]	7	7	7	3	7	7	7						
HR 4[6]	7	7	7	3	7	7	7						
HR 5[6]	7	7	7	3	7	7	7						
HR 6[6]	7	7	7	3	7	7	7						
HR 7[6]	7	7	7	3	7	7	7						
Agglomeration													
HR Zg[7]	7	4	4	3[7]	7	6	2	7	7	7	7	7	7
HR Ri[7]	6	6	4	3	7	6						7	2
HR St[7]	7	6	6	3	7								
HR Os[7]	7	6	6	3	7	6							
HR Si[7]	1[8]	6	4	3	7	6							1
Hr Kt[7]	7	6	4	3	7	6						2	1

Note: Data for lead, cadmium, manganese and thallium relate to these substances contained in suspended particulate matter PM10.

Where:

- Mark 1 denotes the exceedance of the limit value and permitted deviation, or the exceedance of the target value and the permitted deviation in case of ozone **(category III)**
- Mark 2 denotes concentrations between the limit and the tolerance value for the permitted number of days of deviations **(category II)**
- Mark 3 denotes ozone concentrations between the limit and the tolerance value when the number of days of permitted deviations was exceeded **(category II)**

[4] PM_{10} values for zones HR1-HR7 calculated by modelling long-range transmission of air pollutants range from 10-20 µg/m^3 which meets the recommendations of the World Health Organization, but is not covered by the Regulation on Limit Values (assessment limits for PM and NH3 with respect to protection of ecosystems and vegetation are not set). The mark 7 is therefore considered the most appropriate.

[5] In zones HR1-HR7 the pollution category is determined on the basis of the AOT40 value calculated by the EMEP model. The AOT40 value of 18,000 µg h m^{-3} is exceeded throughout Croatia's territory from May to July (agricultural crops) and from April to September (forests) according to results obtained both by the EMEP model and measurements at existing stations.

[6] Assessment values for zones HR1-HR7 were obtained by EMEP model calculations for 2003 and 2004.

[7] Determined on the basis of measurements carried out in the national and local air quality monitoring networks.

[8] TV of 350 µg/m^3 exceeded more than 24 times during the year.

- Mark 4 denotes concentrations between the upper assessment limit and the limit value for the permitted number of days of deviations **(category II)**
- Mark 5 denotes concentrations between the upper assessment limit and the limit value when the permitted number of days of deviations was exceeded **(category II)**
- Mark 6 denotes concentrations between the lower and the upper assessment limit for the permitted number of days of deviations **(category I)**
- Mark 7 denotes concentrations below the lower assessment limit, based on available measurements carried out at the national and/or local air quality monitoring networks **(category I).**

The table above and values entered for each parameter and each zone are used as a basis for the proposed delimitation of the country's territory and a preliminary assessment of air pollution levels according to air quality categories. Empty fields in Table 4.2-3 mean that due to the shortage of data and information it was not possible to determine the air quality level. The establishment of a measurement system that will include all parameters from Table 4.2-3 will make the assessment of all parameters required possible in the future.

4.3. AMBIENT AIR QUALITY

In Section 4.2. the delimitation of Croatia's territory according to the air pollution level was presented. Table 4.3-1 below gives a detailed overview of the ambient air quality in 2006. The overview is based on the Annual Report on Air Quality Monitoring at National Network Stations for Permanent Air Quality Monitoring and the Annual Report on Air Quality Monitoring at Local Network Stations throughout the Republic of Croatia (IMR, 2007).

Table 4.3-1: Assessment of the ambient air quality categories II and III in 2006

Town/Settlement	Category II	Category III
Zagreb	PM_{10}, $PM_{2.5}$, BaP, NO_2, O_3	PM_{10} (one measuring site)
Rijeka	SO_2, NO_2, PM_{10}, O_3	H_2S, SO_2, O_3 (one measuring site)
Urinj	SO_2	PM_{10}
Opatija	O_3	
Bakar	SO_2, benzene	H_2S, SO_2, PM_{10}
Viškovo	PM_{10}	O_3
Zoljan	NO_2	
Bjelovar	SO_2	
Kutina	NH_3, PM_{10}	H_2S (one measuring site)
Sisak Caprag	PM_{10}	H_2S, SO_2
Šibenik center	NO_2,	
Split Poljud	NO_2	
Solin	NO_2	

4.4. ACIDIFICATION. EUTROPHICATION AND GROUND-LEVEL OZONE

Acidification and eutrophication

Acidification results from emissions of sulphur dioxide, nitrogen oxides (NO, NO_2) and ammonia (NH_3). SO_2, NO and NO_2 oxidize in the atmosphere producing sulphuric and nitric acid. They may be eliminated from the atmosphere either by direct absorption into the soil (the so-called dry deposition) or they may be washed out by rain and snow (the so-called wet deposition) which is the origin of the name "acid rain". Since they remain in the atmosphere for 1-3 days and are transmitted over a distance of 500-1000 km on average, it is evident that in Europe large amounts of pollutants are transmitted from country to country.

In general, air pollution with harmful sulphur and nitrogen compounds in Croatia has decreased in comparison with the period 1990-1999 and is almost half the size in relation to the period 1981-1989 (Fig. 4.4-1, 4.4-2). The downward trend of emissions throughout Europe affects considerably the state of pollution in Croatia.

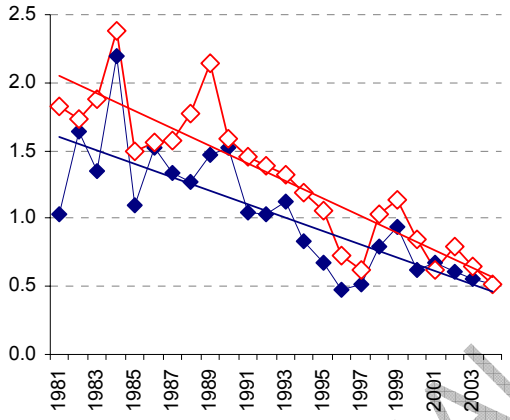

Fig. 4.4-1 Trend of sulphate concentrations at Zavižan (blue) and Puntijarka (red) stations, 1981-2004

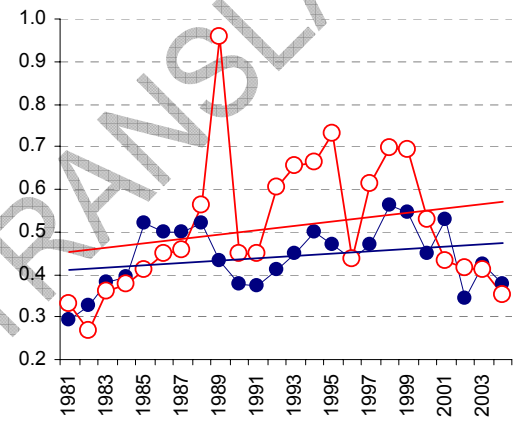

Fig. 4.4-2 Trend of nitrate concentrations at Zavižan (blue) and Puntijarka (red) stations, 1981-2004

Due to a strong influence of sea-water sulphates and large amounts of precipitation, most of the acid deposition is recorded in the area of the southern Adriatic. The contribution of sea-water sulphates in the Dubrovnik area amounts to as much as 60 per cent, which means that acid deposition of anthropogenic origin amounts to some 10-12 kg per hectare on average.

The highest load of sulphur and nitrogen compounds is recorded in the area of Gorski kotar, as a consequence of a dominating effect of transboundary transmission of pollution, especially from Italy, Bosnia and Herzegovina, Germany and Serbia (Fig. 4.4-3). The dominant role in the depositing of sulphates and nitrates is played by a large amount of precipitation. Concentrations and deposition of nitrogen compounds resulting from ammonia emissions primarily in agricultural and livestock breeding areas (ammonia ions in the precipitation) are the highest in the northern and eastern Croatia, including a large contribution of emissions from the adjacent Italy and Hungary. Although the concentrations of ammonia ions in the highland Croatia are not very high, the deposition is comparable to that of the eastern Croatia due to the amount of precipitation.

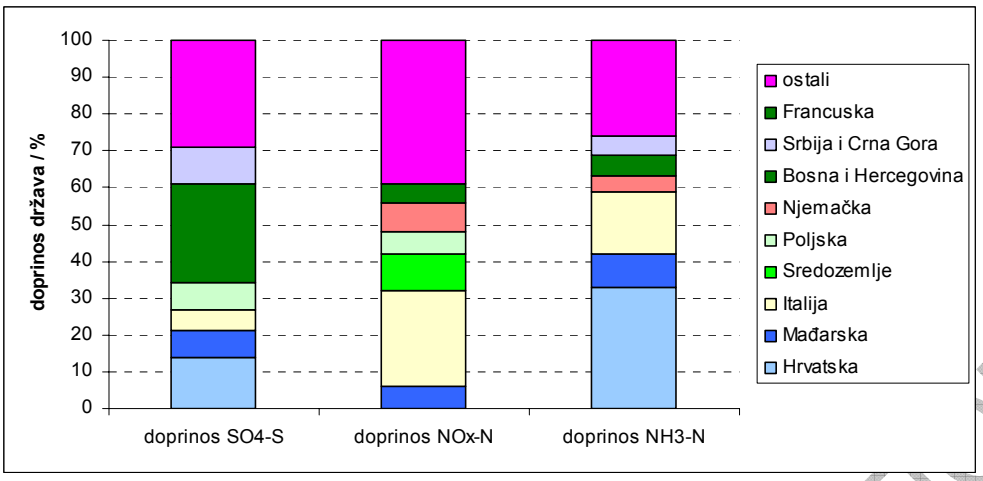

Fig. 4.4-3. Contribution of individual countries to deposition of sulphur (SO_x-S), oxidative nitrogen (NO_X-N) and reductive nitrogen (NH_3-N)

(Tekst u slici:
- National contribution / %
- Contribution of SO_4-S / NO_x-N / NH_3-N
- Other
- France
- Serbia and Montenegro
- Bosnia and Herzegovina
- Germany
- Poland
- Mediterranean
- Italy
- Hungary
- Croatia)

Croatia's forest ecosystems have been mapped with respect to acidification and eutrophication. Researches have been carried out in the areas of Gorski kotar, eastern Slavonia, north-western Croatia and Istria. The mapping included 60 most sensitive receptors. The mapping results show the exceedance of critical levels of acidification in a small segment of the space, but from the aspect of eutrophication considerable parts of the country are endangered. The research focusing on determination of critical freshwater levels is currently underway.

The degradation of forests correlates partly with the deposition of sulphur and nitrogen oxides from the atmosphere. The monitoring of the forest damage status shows that in 2005 damage (damage class 2-4 [9]) was recorded on 27.1 per cent of trees in Croatia. In coniferous forests the damage is present on 79.5 per cent and on deciduous forests on 19.2 per cent of trees. Since 1995 the degradation of coniferous forests has increased and that of deciduous forests decreased, but as a whole it remained at the same level as ten years ago. In other European countries forest damage ranges from 9 to 35 per cent.

Ground-level ozone

Apart from the ozone layer in the stratosphere acting as a protection against ultraviolet radiation from the sun, anthropogenic activities produce ozone at lower altitudes, i.e. in the troposphere too. This ozone is harmful to humans, animals, plants and materials. Ozone and other photochemical smog are known to affect the human health by irritating the eyes and the mucous membrane and higher concentrations may cause headache and respiratory

[9] According to the international scheme the forest damage is classified as follows : class 2 for 11-25 % damage, class 3 for 26-60 % damage, class 4 for the damage exceeding 60 %

problems. Ozone has also been found to have an adverse effect on plants even in concentrations only slightly exceeding the current background levels.

Ozone is formed by a series of chemical reactions whose sequence is complex, but relatively well known. The so-called precursors of ozone formation are primary pollutants, nitrogen oxides (NO_x) and volatile organic compounds known as VOCs, especially non-saturated VOCs.

The ground-level ozone concentration depends on a number of factors: intensity of solar radiation, atmospheric convection, the elevated inversion height, concentration of nitrogen oxides and VOCs and their ratio. The ratio of VOCs to nitrogen oxide concentrations most favourable to ozone formation ranges from 4:1 to 10:1.

The reduction in the ozone level requires the reduction in emissions of both nitrogen oxides and VOCs. However, in some areas it is more important to reduce nitrogen oxide emissions and in some other the VOCs are the priority. The decisive factor is how many times a nitrogen oxide molecule participates in reactions of ozone formation before reacting to form a nitric acid. In regions with a high air pollution load, such as the central Europe, this transformation occurs relatively rapidly. In such case the VOCs emission is a limiting factor in ozone formation. The less polluted air, the more ozone is formed from each molecule of nitrogen oxide, which makes nitrogen oxides the dominating factor in ozone formation.

When setting up a protection policy for volatile organic compounds on a regional and a local scale, the element to be considered for each VOC is its photochemical ozone creation potential (POCP). The POCP is defined as a change in the ozone formation caused by the change in its emission. The POCP value varies and may differ substantially for concentrations of short and long duration. The Regulation on Ozone Depleting Substances identifies main VOCs with the highest potential for photochemical ozone creation.

Considerable amounts of VOCs originating from nature are also involved in photochemical reactions. The problem is especially manifest in Mediterranean coastal areas covered by vegetation dominated by plants that produce ethereal oils in their tissue and release them into the atmosphere.

In Europe the exceedance of limit values is linked with rural areas. The Mediterranean area is particularly at risk due to increased solar radiation, climatic conditions and transboundary transmission of pollution. In areas of relatively low emissions and clean air the ozone formation is predominantly affected by the additional NO_x emission and in urban areas by the VOCs emission.

4.5. EXCEEDANCE OF WARNING AND CRITICAL LEVELS

Critical SO_2 and NO_2 and warning and critical ozone levels are laid down by the Regulation on Critical Levels, Official Gazette No. 133/05 (Section 6.2).

Sulphur dioxide

According to measurements carried out at national network stations (8 stations) in 2006 **the only exceedance of critical levels of SO_2 concentrations was recorded in Sisak.** During 2006 critical concentrations were exceeded in Sisak on 10 days (**3-hour mobile averages** over 500 $\mu g/m^3$). The exceedances occurred mostly during the heating season, but were also recorded twice in summer, with no influence of boiler rooms and small combustion plants.

Although in other towns critical levels were not exceeded, the measurements suggest that there is a risk of their occurrence. In 2006 hourly concentrations of 500 µg/m^3 were exceeded 7 times at the Zagreb-3 station, once at the Rijeka-2 station and for 125 hours during the year in Sisak.

The analyses showed the Sisak Oil Refinery to be the major cause of high concentrations, with an occasional contribution from the Sisak Thermal Power Plant. Maximum concentrations recorded in Rijeka are caused by emissions from the Urinj Oil Refinery and the INA Lubricants Plant on the Mlaka. The major cause of concentrations measured at the Zagreb-3 station in Zagreb is the Zagreb Heat and Power Plant in Žitnjak.

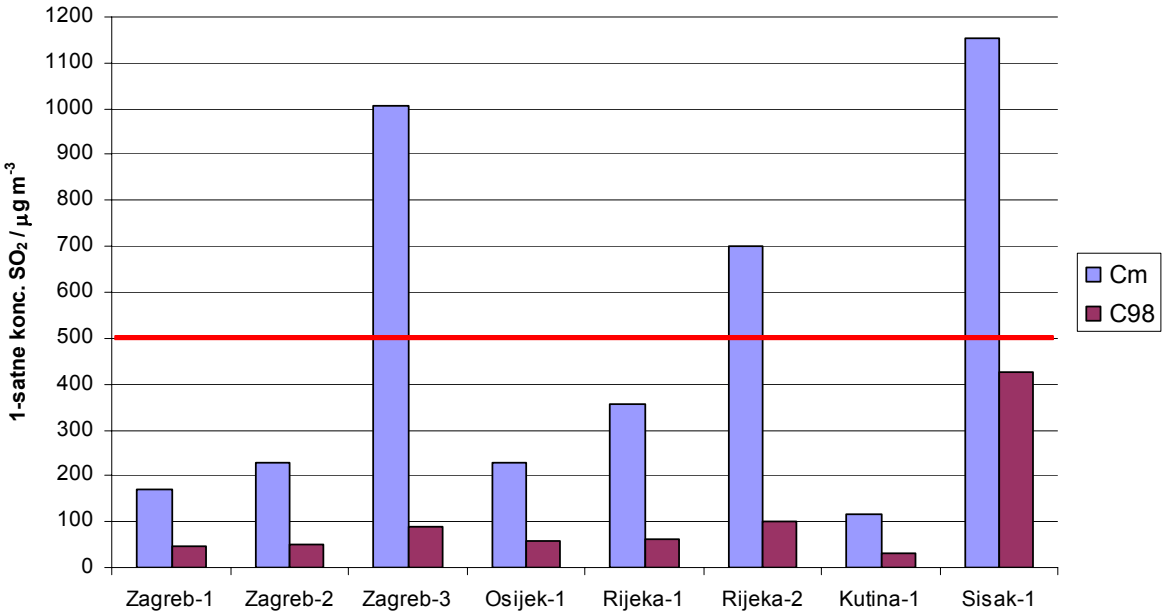

Fig. 4.5-1: Maximum hourly concentrations of SO_2 at national network stations in 2006 and 98 percentile of concentrations

(U slici: Hourly concentrations of SO_2/µg m^{-3})

At local network stations the ambient air quality is monitored by 24-hour sampling, which does not make it possible to assess the exceedance of critical levels. Nevertheless, the risk of short-time critical concentrations may be indirectly inferred from maximum 24-hour concentrations. The analysis of 58 local network stations confirms inferences drawn from the national network of automatic stations. The highest risk of occurrence is recorded in Sisak where daily maximum concentrations exceeded 150 µg/m^3 at three local stations. The highest concentrations found in Rijeka occur in Kraljevica, Mlaka, Kostrena and at the Rijeka-1 station in the town. Daily maximum concentrations measured at this stations amounted to 100-250 µg/m^3, which makes the occurrence of critical long-lasting pollution possible. In 2006 high maximum daily concentrations of SO_2 amounting to 350 µg/m^3 were measured at the Karlovac-2 station. Maximum daily SO_2 concentrations measured at all district network stations in Zagreb are relatively low, which confirms that a high concentration measured at the Zagreb-3 national network station is a consequence of a powerful influence of a point source.

Nitrogen oxides

In 2006 no National Network station recorded any exceedance of the critical concentration of NO_2 or the three-hour average of 400 µg/m^3. Fig. 4.5-2 shows that even maximum hourly concentrations lay considerably below critical levels. Consequently it may be stated that for NO_2 there is no risk of occurrence of critical levels.

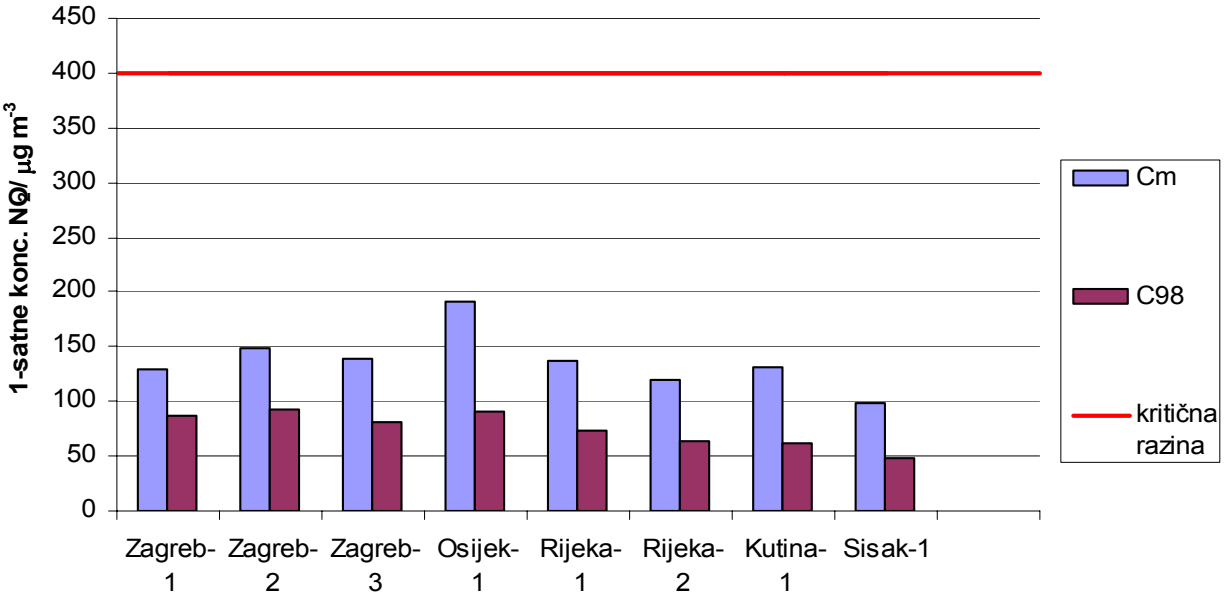

Fig. 4.5-2: Maximum hourly concentrations of NO_2 at National Network stations in 2006

(U slici: - Hourly concentrations of NO_2 / µg/m^3
- Critical level)

Ozone

Ozone concentrations were measured at one National Network station (Zagreb-1) for air quality monitoring in 2004 and 2005 and at two stations (Zagreb-3 and Rijeka-2) in 2006. Besides, in 2006 ozone concentration measurements started at two main meteorological stations of the MHS (Gradište and Makarska). As regards local networks, the data are available from the St. Catherine station in Istria (rural station). At the Zagreb-1 station the warning level was exceeded during a total of 25 hours in 2004 and 3 hours in 2005. A maximum hourly concentration amounted to 205 µg/m^3, which is below the critical level. In Rijeka the warning level was exceeded during a total of 4 hours, reaching the maximum of 187 µg/m^3. In 2006 no exceedance of any critical or warning level was recorded at the Zagreb-3 station in 2006. The maximum concentration measured at the St. Catherine station was 174 µg/m^3, which is below the warning level. At the stations of Makarska and Gradište the warning levels were exceeded for a number of hours, with maximum values reaching 217 and 221 µg/m^3.

Despite relatively high ozone concentrations throughout Croatia, they exceeded the warning levels for a short time only, never exceeding the critical levels.

Table 4.5-1 shows the number of exceedances of warning and critical ozone concentrations.

Table 4.5-1: Exceedances of warning and critical ozone pollution levels in 2006

Measuring station	No. of hours with exceedance of the warning level (180 μg/m^3)	No. of hours with exceedance of the critical level (240 μg/m^3)	Maximum hourly value, μg/m^3
Zagreb – 3*	0	0	141
Rijeka – 2	4	0	187
Gradište	36	0	221
Makarska	190	0	217
St. Catherine	0	0	174

* Data from the Zagreb - 3 measuring station relate to the period from 10.4.2006, because on 28.3.2006 ozone measurement moved from the Zagreb - 1 to the Zagreb – 3 station. Maximum hourly value for ozone measured at the Zagreb – 1 station in 2006 in the period until the end of March amounts to 138.2 μg/m^3, which means that the warning level of ozone pollution was not exceeded either.

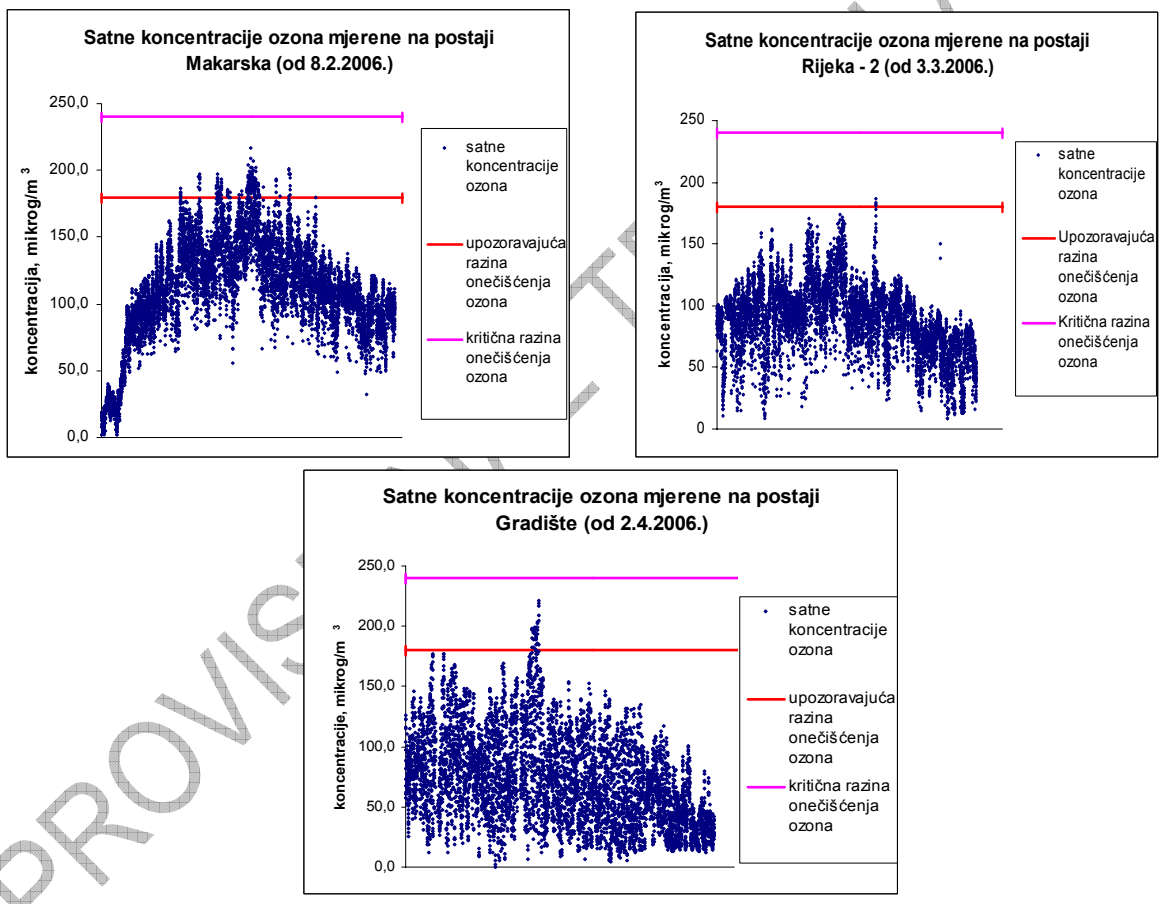

Fig. 4.5-3: Maximum hourly concentrations of ozone at the National Network station (Rijeka-2) and MHS stations (Makarska and Gradište)

(U slikama: Naslovi: Hourly ozone concentrations measured at the Makarska / Rijeka-2 / Gradište station (since 8.2.2006 / 3.3.2006 / 2.4.2006)
Lijevo: Concentrations, μg/m^3
Desno: - Hourly ozone concentrations
- Warning level of ozone pollution
- Critical level of ozone pollution)

4.6. POLLUTANT EMISSIONS ACROSS THE STATE

The following is an overview of pollutant emission trends across the area of the Republic of Croatia for the period 1990-2005 divided into four characteristic groups: (1) substances causing acidification, eutrophication and ground-level ozone formation (SO_2, NO_x, NMVOC and NH_3), (2) heavy metals (Pb, Hg, Cd), (3) persistent organic pollutants (polycyclic aromatic hydrocarbons, polycyclic dibenzodioxins and polycyclic dibenzofurans) and (4) particulate matter (PM_{10}, $PM_{2.5}$). In the figures the permissible emission value according to international treaties is marked with a red line.

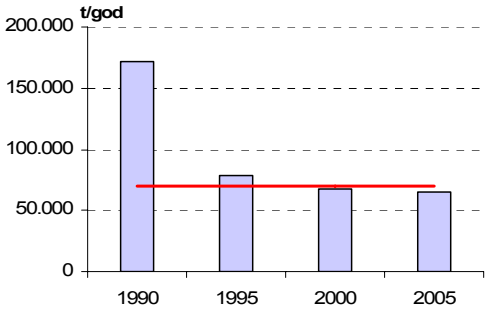

Fig. 4.6-1: SO_2 emission

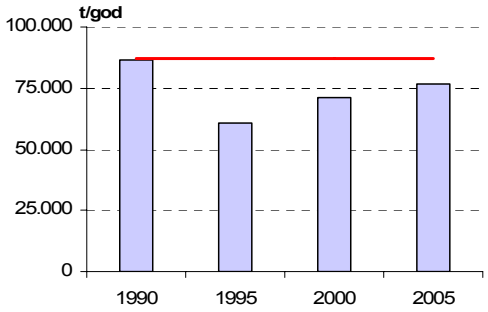

Fig. 4.6-2: NO_x emissions

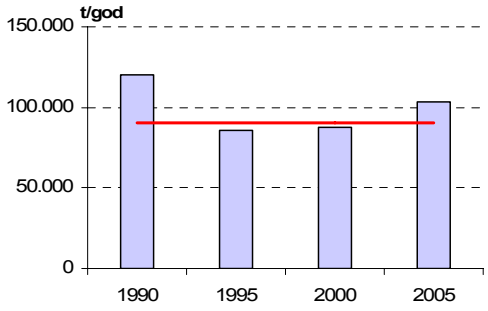

Fig. 4.6-3: NMVOC emissions

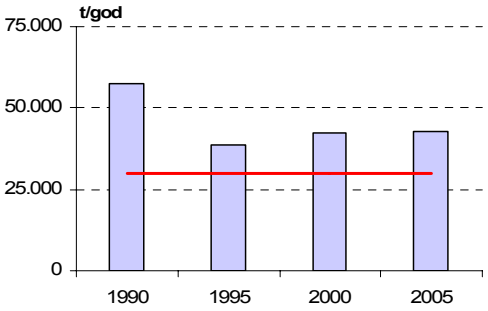

Fig. 4.6-4: NH_3 emissions

(U slici: t/year)

The comparison between the years 1990 and 2005 shows a considerable decline in SO_2 emissions due to the use of fuels with a low sulphur content and desulphurization equipment in coal-fired thermal power plants. The major contributor to SO_2 emissions is the combustion taking place in thermal power plants and refineries. The red line denotes the emission allowance under the Gothenburg protocol amounting to 70,000 tonnes/year.

In 2005 the NO_x emission decreased by some 12 per cent compared to 1990. It showed, however, an increasing trend in the period 2000-2005 as a consequence of an increase in fuel consumption in road traffic which is the major contributor to the NO_x emission with approximately 37 per cent. The emission allowance for Croatia under the Gothenburg protocol amounts to 87,000 tonnes/year.

NMVOC emissions were lower by 13 percent in 2005 than in 1990. The major contributor to NMVOC emissions is the use of solvents and other products. Under the Gothenburg Protocol

Croatia is bound to keep the NMVOC emissions at the level of 90,000 tonnes by 2010. The recent NMVOC emission inventory of 2007 resulted in the changed emission values for the period 1990-2003. The recalculated emission value of 1990 exceeds by 12.3 per cent the value assessed formerly.

In 2005 the NH_3 emissions amounted to approximately 43,000 tonnes, which is by 33 per cent lower than in 1990. The major source of these emissions is agriculture, contributing to total NH_3 emissions with 89 per cent. The recent NH_3 emission inventory for the period 1990-2003 developed in 2005 resulted in the increase in emissions over the entire period observed. The newly calculated value of NH_3 emissions in 1990 amounts to 57,300 tonnes, which is by 35 per cent above the emission values for this substance in 1990 as indicated in the Gothenburg Protocol.

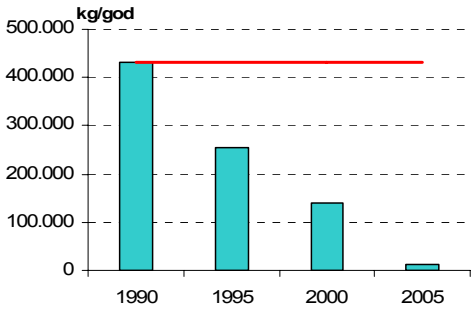

Fig. 4.6-5: Pb emissions (kg/year)

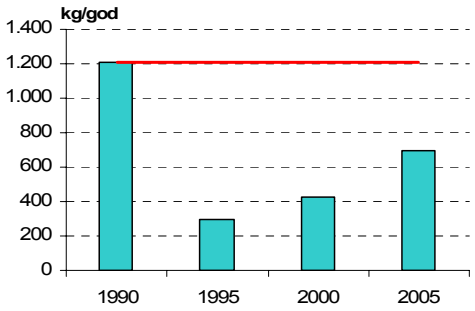

Fig. 4.6-6: Hg emissions (kg/year)

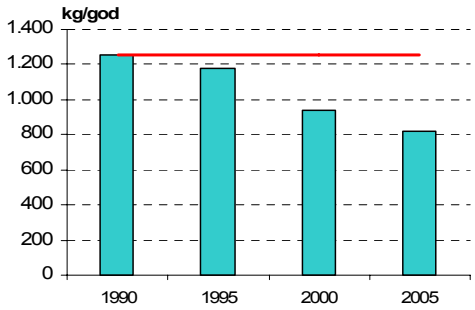

Fig .4.6-7: Cd emissions

(U slici: kg/year)

Heavy metal emissions from anthropogenic sources became the subject of international treaties (Protocol on Heavy Metals) after a number of studies had found this pollution to be subject to long-range atmospheric transmission and the atmospheric deposition in certain areas to have a significant, if not a predominant share in air and soil pollution. Since heavy metals are highly persistent, the entire amount of emissions lands in the soil or waters sooner or later. Due to their persistence, high toxicity and tendency to accumulate in ecosystems, heavy metals are also harmful to living organisms. Emissions of Pb and Cd in Croatia show a continuous downward trend in the period 1990-2005, especially as regards Pb emissions, as a result of a growing share of unleaded petrol in the total balance of car fuels. Hg emissions of 2005 are lower than in 1990, but in the period 2000-2005 they showed the upward trend as a consequence of the use of solid fuels in coal-fired thermal power plants.

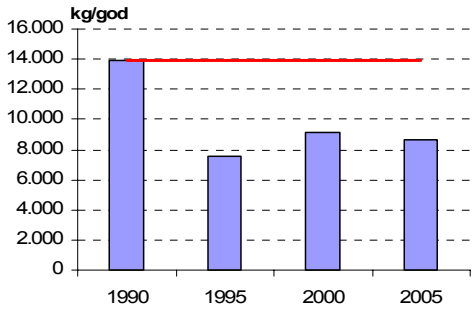

Fig. 4.6-8: PAH emissions (kglyear)

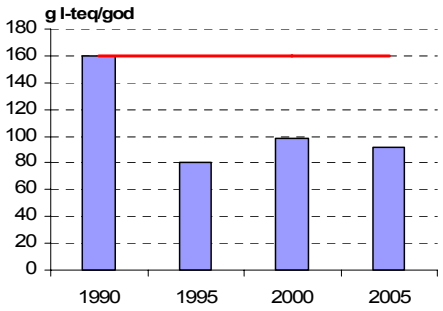

Fig. 4.6-9: DIOX emissions (g I-teq/year)

(U slici: kg/year; g I-teq/year)

Persistent organic pollutants (POPs) are toxic, organic, very persistent substances (resistant to chemical, photochemical and biological degradation). They accumulate in living organisms (bioaccumulation, mostly in fatty tissues) and are capable of long-range transmission. Due to their semi-volatility they are found at the vapour stage or get adsorbed to atmospheric particles and thus have an adverse effect on the environment and human health. As recommended by the Protocol on Persistent Organic Pollutants, the emission inventory includes four polycyclic aromatic hydrocarbons: benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene. Major sources of PAH emissions are combustion processes in households and coke and primary aluminium plants using Söderberg anodes. The shutdown of these plants in Croatia early in the 1990s cut the emissions by 39 per cent.

Dioxins and furans are persistent organic compounds that are a by-product of combustion of organic substances containing chlorine (Cl) at a temperature between 250°C and 400°C and may be found in all sectors. The largest dioxin and furan emissions in Croatia come from the combustion of firewood in households. Other contributors to these emissions are the processes of iron production in electric arc furnaces, combustion of fuel in power plants (thermal power plants, district heating plants and energy transformation plants), waste incineration and cremation. In 2005 the dioxin and furan emissions were 91.4 g I-teq, which is 43 per cent below the 1990 emissions.

Compared to 1990, the PM_{10} and $PM_{2.5}$ emissions in 2005 were by 38 and 36 per cent lower respectively. Major sources of emissions are the combustion of fossil fuels and industrial processes.

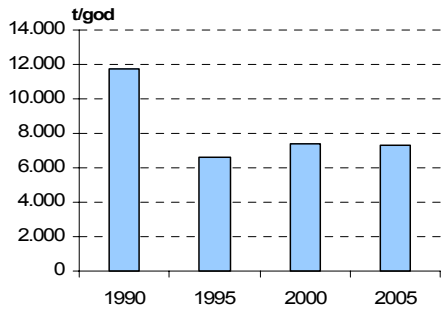

Fig. 4.6-10: PM10 emissions (t/year)

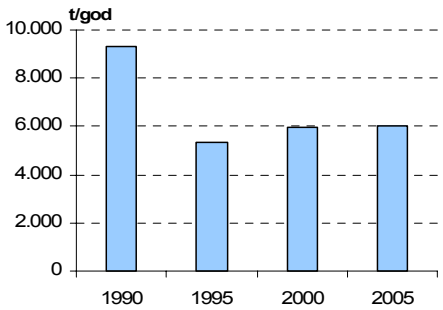

Fig. 4.6-11: PM2.5 emissions (t/year)

(U slici: t/year)

Table 4.6-1 shows SO_2 and NO_x emissions from large individual stationary sources in 2005.

Table 4.6-1: SO_2 and NO_x emissions from large emission sources in Croatia in 2005

	Emission sources	SO_2		NOx	
		t/year	%	t/year	%
1	Plomin 1 Thermal Power Plant	4,069.0	6.3	2,225.0	3.0
2	Plomin 2 Thermal Power Plant	612.0	0.9	1,547.0	2.1
3	Rijeka Thermal Power Plant	6,415.0	10.0	1,138.0	1.5
4	Sisak Thermal Power Plant	3,188.7	4.9	919.9	1.2
5	EL-TO Zagreb District Heating Cogeneration Plant	1,592.0	2.5	1,023.0	1.4
6	TE-TO Zagreb Heat and Power Plant	1,708.5	2.7	422.3	0.6
7	TE-TO Osijek Heat and Power Plant	1,181.6	1.8	285.9	0.4
8	Karlovac District Heating Plant	912.0	1.4	171.0	0.2
9	Kutina Petrochemical Industry	2,850.3	4.4	2,442.9	3.3
10	Sisak Oil Refinery	7,531.5	11.7	1,500.2	2.0
11	Rijeka Oil Refinery (Urinj)	7,431.8	11.5	1,168.4	1.6
12	Osijek Sugar Mill	797.2	1.2	161.8	0.2
13	Ina Lubricants Rijeka (Mlaka)	1,703.0	2.6	178.6	0.2
14	Našicecement	75.6	0.1	818.6	1.1
15	Dalmacijacement	2.80.4	0.4	3,418.1	4.6
16	Holcim (Koromačno Cement Works)	267.1	0.4	2,187.5	2.9
Large emission sources total		**40,616**	**63.0**	**19,608**	**26.3**
CROATIA total		**64,423**		**74,596**	

5. OBJECTIVES OF AIR QUALITY PROTECTION AND IMPROVEMENT

The Air Quality Protection and Improvement Plan (hereinafter referred to as: the Plan) is an enforcement document of the Air Protection Strategy that forms a constituent part of the Environmental Protection Strategy. The Plan covers a 4-year period from 2008 to 2011 inclusive.

The Environmental Protection Strategy and the National Environmental Action Plan (Official Gazette No. 46/02) laid down fundamental objectives of air quality protection and improvement and set out long-term measures for their accomplishment. The basic objectives are the alignment of the national legislation with the EU acquis communautaire, reduction of emissions of harmful substances to the level that has no effect on human health and the environment and the revision and upgrading of air quality and emission monitoring system.

The objectives set by the Strategy remain in force, but need to be partly updated and made more concrete. Based on evaluation of implementation of the Strategy objectives and other circumstances governing systematic and integrated activities in the field of air protection, general objectives for the period 2008-2001 are as follows:

General objectives of air quality protection and improvement in the Republic of Croatia in the period 2008-2011	
C1.	Gradual reduction of air pollution aiming at the protection of human health, the environment and material assets
C2.	Reduction of pollutant emissions with the aim to comply with obligations under international conventions and protocols (regional pollution, ozone layer protection and climate change mitigation)
C3.	Promotion of the sustainable development policy through integration of air protection policy objectives into sectoral strategies and plans, especially as regards the greenhouse gas emissions reduction and the Kyoto Protocol
C4.	Speeding up the transposition of EU acquis communautaire and positive practices of air protection
C5.	Institutional and organizational capacity building for implementation of objectives established, especially at the local level
C6.	Continuous upgrading of emission and air quality monitoring and reporting system, especially with respect to data quality assurance and control
C7.	Upgrading the system of public information and access to information on air protection issues
C8.	Fostering scientific research programmes, especially in the field of climate change
C9.	Improvement of activities and cooperation on an international scale

Measures and activities proposed for accomplishment of objectives are both short-term and long-term by nature, depending on the pollution type and intensity of impact. Measures and activities usually contribute to accomplishment of several objectives, which makes their strict classification and grouping by objectives not always reasonable. When selecting the most appropriate measures and activities the principles and criteria outlined in Section 2 were respected. What follows are general objectives described in detail by defining special objectives wherever feasible.

C1. – Gradual reduction of air pollution aiming at the protection of human health, the environment and material assets

Individual objectives are the following::

- to take preventive measures against air quality degradation and to facilitate permanent improvement in areas where the first category of air quality has been reached;
- to achieve the first category of air quality over the entire territory of the state by the end of 2011, while the time limit for ozone has yet to be defined. According to the Air Protection Act this is the level of concentrations at which the air is clean or slightly polluted and no limit value for any pollutant exceeded;
- to take emergency measures in places exposed to risk of occurrence of pollution levels that exceed the critical values;
- to reduce impacts on ecosystems, crops and material assets arising from acidification, eutrophication and formation of ground-level ozone.

C2. - Reduction of pollutant emissions with the aim to comply with obligations under international conventions and protocols (regional pollution, ozone layer protection and climate change mitigation)

The Republic of Croatia is a Party to all international treaties governing protection of the atmosphere. Its obligations include active promotion of pollutant emission reduction policies and building-up permanent capacities for reporting on the progress made. Conventions and protocols become legally binding for Croatia only after their ratification by the Croatian Parliament and, since being international treaties, their legal force is superior to national laws. International obligations of the Republic of Croatia relating to air protection are listed in Section 3. As part of specific sections dealing with measures needed to accomplish the objectives, the quantitative objectives established by international treaties are detailed too.

C3. - Promotion of the sustainable development policy through integration of air protection policy objectives into sectoral strategies and plans, especially as regards the reduction of greenhouse gas emissions and the Kyoto Protocol

Due to its complexity, an effective and efficient implementation of air protection policies calls for their integration in sectoral plans and strategies and communication between competent authorities during their implementation. This also results in synergic intersectoral effects. Here the issue of greenhouse gas emissions reduction is a top-priority due to high costs and uniform allocation of the obligation to individual sectors.

C4. - Speeding up the transposition of EU acquis communautaire and positive practices of air protection

The process of approximation and admittance of candidate countries as full members of the European Union offers new challenges, especially regarding harmonization of environmental acquis communautaire. The experience made by ten new EU members, most of which are undergoing a process of transition to market-oriented economy like Croatia too, shows the approximation of EU policies and standards in the field of environmental protection to be an extremely demanding and complex task due to fundamental differences in legislative and administrative systems.

In this regard the approximation with EU legislation in the field of environmental (air) protection calls for systematic institutional and organizational changes and capital investments in best available techniques, so as to meet the established objectives relating to the reduction and prevention of harmful effects on the environment. During the pre-accession period Croatia must develop in detail action plans including the cost-benefit analyses of the application of legislation in individual sectors and sub-sectors in order to be able to implement measures in a cost-effective manner.

C5. - Institutional and organizational capacity building for implementation of objectives established, especially at the local level

Considering the fact that the legislative framework in the field of air protection has assigned local and district (regional) self-government units a significant role in implementation of air protection policies, one of their objectives is building up and strengthening institutional and organizational/human resources for the accomplishment of objectives set by this Plan and the air protection policy in general. The former experiences show certain deficiencies and weaknesses in the development of air quality protection and improvement schemes and operationalization of locally established objectives.

C6. - Continuous upgrading of emission and air quality monitoring and reporting system, especially with respect to data quality assurance and control

An efficient system of air quality and emission monitoring and reporting is pre-conditioned by a clearly defined organization, competences and responsibilities of institutions involved in its management and upgrading, which consists of a number of steps to be taken in data collecting and processing, calculating, controlling and verifying air quality and emission data, including the documenting, filing and reporting to competent national and international institutions.

C7. - Upgrading the system of public information and access to information on air quality and protection issues

The public must be ensured the right of access to intelligible information as a pre-condition for active participation of the public in decision-making on air protection, and access to justice in environmental or rather air-related issues.

C8. - Fostering scientific research programmes, especially in the field of climate change

This objective implies a more active cooperation between scientific institutions and government bodies in the development and implementation of research and technological projects relating to the study of atmosphere, pollutant emission reduction and adaptation and reduction of harmful effects on individual environmental components.

C9. - Improvement of activities and cooperation on an international scale, especially in technology transfer

In narrower terms this objective relates to transfer of environmentally friendly technologies defined for the purpose of this Plan as a broad set of processes relating to transfer of knowledge, experience and equipment for mitigation of harmful effects on air quality and adaptation to effects between various stakeholders, such as government administration, agencies, private sector, financial institutions, non-governmental organizations and scientific/educational institutions, and those comparable in other countries. It includes the process of learning to understand, use and replicate technologies, and the ability to select them, adapt to local conditions and integrate with domestic technologies. This objective relates also to entering into strategic alliances for lobbying and negotiating about future obligations in the process of alignment with the EU environmental acquis communautaire and international treaties.

6. CURRENT AIR QUALITY PROTECTION AND IMPROVEMENT MEASURES

Fundamental documents that define policies and measures for air quality protection and improvement in the Republic of Croatia are the Environmental Strategy with the National Environmental Action Plan (Official Gazette No. 46/02), the Environmental Protection Act (Official Gazette No. 110/07) and the Air Protection Act (Official Gazette No. 178/04). These documents provide the adoption of a number of enforcement regulations that lay down, among other things, the methods to be used for air quality assessment and air quality monitoring, emission monitoring, limit values of emissions from stationary sources, limit and critical values of pollutant emissions in the air, requirements for technical equipment and

fuels, supervision of implementation, data quality requirements and measurements. Table 6.1 contains a list of acts and enforcement regulations directly or indirectly governing the air quality protection and improvement.

Table 6.1.: Overview of legislation directly or indirectly governing the air quality protection

Horizontal environmental legislation relevant to air protection	Official Gazette No.
Environmental Protection Act	110/07
National Environmental Strategy with the National Environmental Action Plan	46/02
Regulation on the Establishment of the Croatian Environment Agency	75/02
Act on the Environmental Protection and Energy Efficiency Fund	107/03
Statute of the Environmental Protection and Energy Efficiency Fund	193/03, 73/04
Regulation on Environmental Information System	74/99, 79/99
Environmental Impact Assessment Ordinance	59/00, 136/04, 85/06
Pollutant Emission Register Ordinance	35/08
Environmental Label Ordinance	64/96
Regulation on Conditions for Granting Permits to Perform Expert Environmental Activities	7/97
Environmental Contingency Plan	82/99, 86/99, 12/01
Ordinance on Environmental Achievement Acknowledgements and Awards	26/02, 36/02
List of Legal Entities with Granted Approval for Performing Expert Environmental Activities	71/05
Instructions on the Form, the Content and the Manner of Introducing the Records of Inspections Performed by Environmental Inspectors	79/95
Regulation on Technical Standards of Protecting the Environment against Emissions of Volatile Organic Compounds Coming from Petrol Storage and Distribution	135/06
Regulation on Unit Charges, Correction Coefficients and Approximate Criteria and Benchmarks for Determining the Charge on Carbon Dioxide Emissions into the Environment	73/07
Ordinance on the Method and Time Limits for Calculation and Payment of the Carbon Dioxide Emission Charge	77/07
Regulation on Unit Charges, Correction Coefficients and Approximate Criteria and Benchmarks for Determining the Charge on Emissions into the Environment of Sulphur Oxides in the Form of Sulphur Dioxide and Nitrogen Oxides in the Form of Nitrogen Dioxide	71/04
Ordinance on the Method and Time Limits for Calculation and Payment of a Charge on Emissions into the Environment of Sulphur Oxides in the Form of Sulphur Dioxide and Nitrogen Oxides in the Form of Nitrogen Dioxide	95/04

Ordinance on the Form, the Content and the Manner of Keeping Records of Persons Liable to Pay a Charge on Emissions into the Environment of Sulphur Oxides in the Form of Sulphur Dioxide	120/04
Ordinance on the Form, the Content and the Manner of Keeping Records of Persons Liable to Pay a Charge on Emissions into the Environment of Nitrogen Oxides in the Form of Nitrogen Dioxide	120/04
Regulation on Unit Charges, Correction Coefficients and Approximate Criteria and Benchmarks for Determining a Special Environmental Charge on Motor Vehicles	02/04
Ordinance on the Method and Time Limits for Calculation and Payment of a Special Environmental Charge on Motor Vehicles	20/04
Ordinance on the Form, the Content and the Manner of Keeping Records of Persons Liable to Pay a Special Environmental Charge on Motor Vehicles	44/04
Ordinance Establishing Conditions to be Met by Environmental Protection and Energy Efficiency Fund Beneficiaries	183/04
Ordinance Relating to Conditions and Methods of Allocating Monies from the Environmental Protection and Energy Efficiency Fund, Including Criteria and Benchmarks for Evaluating Applications for Fund Allocations	183/04
Ordinance Relating to the Procedure of Inviting Applications and Selecting Environmental Protection and Energy Efficiency Fund Beneficiaries	183/04
Ordinance on the Method of Monitoring the Purposeful Utilization of Environmental Protection and Energy Efficiency Fund Allocations and the Agreed Rights and Obligations	183/04
Air Protection Legislation	
Air Protection Act	178/04
Air Quality	
Regulation on Siting of National Network Stations for Continuous Air Quality Monitoring	04/02
Programme for Air Quality Measurement in the National Network for Continuous Air Quality Monitoring	43/02
Regulation on Limit Values of Pollutant Emissions into the Air	133/05
Regulation on Critical Levels of Pollutant Emissions into the Air	133/05
Regulation on Ozone in the Air	133/05
Air Quality Monitoring Ordinance	155/05
Ordinance on the Exchange of Information Relating to Data Provided by Continuous Air Quality Monitoring Networks	135/06
Ordinance on Granting a Permit or an Approval to Perform Activities of Air Quality Monitoring and Monitoring Emissions from Stationary Sources into the Air	79/06
Emissions into the Air	
Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air	21/07
Ordinance on Monitoring Pollutant Emissions from Stationary Sources into the Air	01/06
Regulation on Monitoring Greenhouse Gas Emissions in the Republic of Croatia	01/07
Regulation on Ozone Depleting Substances	120/05

Regulation on Technical Standards of Protecting the Environment against Emissions of Volatile Organic Compounds Resulting from Petrol Storage and Distribution	135/06
Regulation on Limit Values of Volatile Organic Compounds Contained in Certain Paints, Varnishes and Vehicle Refinishing Products	94/07
Ordinance Relating to Availability of Data on Fuel Economy and CO_2 Emission from New Passenger Cars	120/07
Ordinance on Technical Inspection of Vehicles (Eco-testing)	136/04
Legislation with Intersectoral Effects	
Fuel Quality	
Regulation on the Quality of Liquid Petroleum Fuels	53/06
Decision Relating to Determination of Annual Volume of Liquid Petroleum Fuels Allowed to be Put on the Domestic Market without Complying with Limit Values and Other Properties of Liquid Petroleum Fuel Quality as Stipulated by the Regulation on the Quality of Petroleum Fuels	90/06
Regulation on Biofuel Quality	141/05
Decision Relating to Biofuel Percentage in the Total Share of Fuels in 2007 and the Volume of Biofuel to be Placed on the Domestic Market in 2007	43/07
Programme for Monitoring Liquid Petroleum Fuel Quality	120/07

The National Environmental Strategy with the National Environmental Action Plan has established fundamental objectives of air quality protection and improvement and laid down long-term measures for their accomplishment. The fundamental objectives include aligning of the current legislation with the EU acquis communautaire, reducing emissions of harmful substances to the level that will not affect human health and the environment and reviewing and enhancing the air emission and quality monitoring system.

The following is an overview of existing priority measures for air quality protection and improvement divided into two groups: (1) current legislative measures in the field of environmental protection and (2) current legislative measures having intersectoral effects.

6.1. CURRENT LEGISLATIVE MEASURES IN THE FIELD OF ENVIRONMENTAL PROTECTION

6.1.1. HORIZONTAL ENVIRONMENTAL LEGISLATION

Measures Laid Down by Environmental Programmes

The Air Protection Act provides for the obligation of the county assemblies and the Zagreb City Assembly to enact the Air Quality Protection and Improvement Programme as part of the Environmental Programme covering the area of the county and the City of Zagreb. The programme must be previously approved by the state administration office responsible for environmental protection in the relevant counties. For the purpose of evaluating programme implementation, air quality status reports are prepared every two years or every year in case that pollution level in the respective area exceeds the tolerance values (TV).

So far, out of a total of 20 counties and the City of Zagreb, 10 counties and the City of Zagreb have enacted environmental protection programmes. The rest of the counties was obliged to do so in 2007.

Table 6.1-1: An overview of the status of environmental protection documents at the local level

County of	Environmental Protection Programmes	State of the Environment Report	Air Quality Status Report
Zagreb	November 2003	December 2005	-
Krapina-Zagorje	October 1997	-	
Sisak-Moslavina	December 2003	February 2003	2007
Karlovac	-	2004	2004
Varaždin	May 2003	2002-2005	-
Koprivnica-Križevci	March 2006	June 2004	-
Bjelovar-Bilogora	July 2003	March 2007	-
Primorje-Gorski kotar	2006-2009	December 2002	-
Lika-Senj	-	July 2004	-
Virovitica-Podravina	2003	November 2004	2006
Požega-Slavonija	-	-	-
Slavonski Brod-Posavina	January 2003	February 2005	-
Zadar	June 2006	June 2006	-
Osijek-Baranja	December 2005	December 2004	2006
Šibenik-Knin	-	-	-
Vukovar-Srijem	March 2007	December 2006	-
Split-Dalmatia		-	2007
Istria	May 2006	2006	2006
Dubrovnik-Neretva	-	-	-
Međimurje	-	-	-
City of Zagreb	May 1999	July 2006	2007

Determination of Integrated Environmental Conditions for Installations

Environmental protection measures for new developments or rebuilding activities are prescribed as part of the environmental impact assessment procedure. According to the Environmental Protection Act the operator of any new and existing installation whose operation is likely to cause emissions into the air, water and/or soil is obliged to obtain integrated environmental conditions before starting the construction works and putting the installation into operation, or after any significant modification of operation or rebuilding of the installation in question. In the process of granting the use permit, the compliance with conditions determined by the permit are checked. The preparation of baseline documents relating to determination of limit values of emissions in conformity with the best available techniques, and the establishment of an institutional and organizational structure for the granting of permits containing integrated environmental conditions are currently in progress.

Measures for Application of Economic Instruments under the Polluter Pays Principle

Economic instruments applied include charges on sulphur dioxide and nitrogen oxide emissions introduced in 2004 and charges on carbon dioxide missions introduced in 2007. Entities liable to pay charges on SO_2 and NO_x emissions are all sources of these emissions obliged to submit data to the Pollutant Emission Register. The unit charge on the emission of 1 tonne of SO_2 and NO_x amounts to 310 kunas. Since the limit costs of emission reduction measures exceed the unit charges by an order of magnitude only, plant operators are not stimulated to invest in them.

The carbon dioxide emission charge of 11 kunas/tonne was introduced in 2007 and will reach 14 kunas/tonne in 2008 and 18 kunas/tonne in 2009. For the collection of this charge various corrective coefficients are used, depending on the annual amount of emission, emission origin, project investments and programmes of energy efficiency and renewable energy sources, and on the preparation and implementation of emission reduction programmes through the use of best available techniques.

Moreover, in 2004 a special environmental charge on motor vehicles was introduced, which is paid on a yearly basis when registering a vehicle or verifying technical fitness of a vehicle. The amount of this charge is calculated by multiplying the unit charge, depending on the type of vehicle, with the corrective coefficient that depends on the age of the vehicle, engine volume and the type of engine and fuel used. The monies thus raised by the Environmental Protection and Energy Efficiency Fund are used to implement measures for environmental emission reduction. An important role in air quality improvement is played by a policy of the passenger car fleet renewal in Croatia. Excise duties for import of used cars are 50 per cent higher than those for new vehicles. This measure has substantially increased the sale of new passenger cars.

Air Quality Information System

According to the Air Protection Act, the air quality information system as part of the environmental information system is maintained by the Croatian Environment Agency for the needs of the Ministry. The air quality information system contains, among other things, air quality data provided by the national and local networks, data on critical level exceedances including measures for the protection of humans and the environment in such cases, and all other data of relevance to air quality. The Croatian Environment Agency shares the air quality data collected by the air quality information system with international bodies in compliance with the obligations arising from international treaties and other international obligations.

The air quality information system of the Croatian Environment Agency is in the process of development. Daily and monthly measurement data collected at national network stations are presently accessible on the web portal of the MEPPPC. The County of Istria has an access to measurement data on automatic stations across Istria. The national network stations located in towns have displays showing current measurement data.

Pollutant Emission Register

The Pollutant Emission Register Ordinance (Official Gazette No. 35/08) makes it obligatory to plant operators and owners respectively to submit to competent county authorities or the Zagreb City authorities annual data on air emissions of pollutants using adequate forms. The Croatian Environment Agency prepares a publicly available report on data contained in the Register. The Pollutant Emission Register has been brought in line with the requirements of the European Pollutant Release and Transfer Register (E-PRTR).

6.1.2. AIR PROTECTION LEGISLATION

General Measures Aimed at Air Quality Protection and Improvement

Article 18 of the Air Protection Act defines air quality categories based on pollution levels in relation to prescribed air quality limit values (LV) and tolerance values (TV) as follows:

- Air quality category I – clean or slightly polluted air: no exceedance of air quality limit values (LV) for any pollutant;
- Air quality category II – moderately polluted air: exceedance of the limit value (LV) for one or more pollutants and no exceedance of the tolerance value (TV) for any pollutant;
- Air quality category III – excessively polluted air: exceedance of tolerance values (TV) for one or more pollutants.

The Air Protection Act lays down general measures for air quality protection and improvement through:

- harmonization of physical planning documents and air quality protection and improvement programmes, i.e. through integrated planning;
- determination of limit values of emissions from stationary sources and limit values relating to the composition of specific products and/or other product quality features;
- application of other air protection measures laid down by an environmental impact assessment document or a permit issued under a special regulation for a certain development, designing, construction and use of air pollution sources;
- application of air protection measures laid down by a permit granted under a special regulation, unless the environmental impact assessment has been made obligatory for a certain development;
- setting emission allowances for specific pollutants;
- promotion of the use of clean technologies and renewable energy sources;
- encouraging the introduction of energy efficiency measures.

Principles to be respected when implementing the above measures include:

- In the area of air quality category I and II, a new development in the environment or reconstruction of the existing air pollution source should not threaten the current air quality category;

- In the area of air quality category III a siting, building or operating permit for a new air pollution source or for the reconstruction of the existing one may not be granted unless such a construction will ensure:
  - the replacement of the existing inappropriate stationary source with a new one which reduces air pollution, and
  - the increase in air pollution level near the stationary sources that does not exceed 10% of the air quality tolerance value (TV), provided that a rehabilitation programme for existing pollution sources is in place;
- In the area of air quality category III a siting, building and operating permit may be granted for a new air pollution source or for the reconstruction of the existing, if special-purpose measurements show that the air quality is not of the third category any more.

Air Quality Assessment and the Division of the Area of the Republic of Croatia by Air Pollution Level

This assessment is carried out on the basis of measurements made at the national and local network stations and special-purpose stations as part of the local networks. The scope and sites of measurements conducted by the national air quality monitoring network are determined by the Regulation on Siting of National Network Stations for Continuous Air Quality Monitoring (Official Gazette No. 4/02) and the Programme of Air Quality Measurement in the National Network for Continuous Air Quality Monitoring (Official Gazette No. 43/02). Legal entities involved in air quality monitoring must obtain a permit/approval for performance of specialized air quality monitoring activities on the basis of the Ordinance on Granting a Permit or an Approval to Perform Activities of Air Quality Monitoring and Monitoring Air Emissions from Stationary Sources (Official Gazette No. 79/06).

The limit, tolerance and target values for the protection of health and vegetation are defined by the Regulation on Air Quality Limit Values (Official Gazette No. 133/05) and the Regulation on Ozone in the Air (Official Gazette No. 133/05). When assessing the air quality status, data collected by the national network are supplemented with those provided by the local network and the network of the Meteorological and Hydrological Service. The methods for handling data and their availability are defined by the Ordinance on the Exchange of Information Relating to Data Provided by Continuous Air Quality Monitoring Networks.

Measures Laid Down by Action Plans for Air Pollution Reduction

According to the Air Protection Act, if an area records the air quality category II, the town and the municipal council respectively is bound to enact an Action Plan for Air Pollution Reduction, in order to gradually reach limit values. The Action Plan is based on the assessment of the air quality state and its contents are determined by the Air Protection Act. In case of collective emission sources both the formulation of the plan and implementation of measures are funded from the budget of towns and municipalities. The polluter is obliged to implement and finance measures for the reduction of pollutant emissions in the air as determined by the Action Plan.

So far only Sisak has drawn up the Action Plan for Air Pollution Reduction as part of the Programme for Air Quality Protection and Improvement in the Town of Sisak, and Kutina as part of the Environmental Programme (2008-2012). The preparation of the plan for the City of Zagreb has started.

Measures Laid Down by Rehabilitation Programmes for Areas Where Air Quality Tolerance Values Are Exceeded

In the area of the air quality category III (TVs exceeded) the town or the municipal council is to take the decision to develop a rehabilitation programme for a specific stationary source within the specified period. According to Article 44, paragraph 3 of the Air Protection Act the rehabilitation programme shall contain the description of consequences of excessive air pollution, the area covered by the rehabilitation programme, measures and selected technological and other solutions to be applied with the aim to improve the air quality, a cost-benefit analysis, the assessment of air quality after implementation of measures, the time-frame and the financial plan for implementation of the rehabilitation programme. The current implementation status of measures aimed to bring the air quality within tolerance values is as follows:

Sisak (Caprag area)

At the request of the Directorate for Inspection Affairs of the Ministry of Environmental Protection, Physical Planning and Construction, the INA Oil Industry developed the Rehabilitation Programme for the Reduction of Hydrogen Sulphide Emission/Imission from INA Sisak Oil Refinery (2000), the Operational Plan for Implementation of the Rehabilitation Programme for the Reduction of Hydrogen Sulphide Emission/Imission from INA Sisak Oil Refinery (2003) and the Rehabilitation Programme for the Reduction of Benzene Emission/Imission from INA Sisak Oil Refinery (2006).

In 2007 the Town Council of Sisak adopted the Air Quality Protection and Improvement Programme for the period until 2011. The programme contains a plan for air pollution reduction measures in areas with the second category of air quality in accordance with Article 43 of the Air Protection Act and all measures adopted as part of rehabilitation programmes for the reduction of hydrogen sulphide and benzene emission/imission in accordance with Article 44 of the same Act, including their approved versions revised with respect to implementation time limits.

The monitoring of air quality improvement in the Town of Sisak and the Sisak refinery upgrading activities will also be conducted by a special working group consisting of representatives of relevant ministries, the County of Sisak-Moslavina, the Town of Sisak and non-governmental organisations established by the Decision of the Government of the Republic of Croatia of 27 March 2007.

Rijeka (Mlaka area)

A lot of effort has been put into resolving the problem of air quality impacts by the Mlaka Refinery for 10 years now. These efforts have resulted in the establishment of a direct communication with the refinery and a special Commission for the Establishment of a System for an Integrated and Continuous Monitoring of Impacts of the INA Lubricants Rijeka on Air Pollution (1999). They include the Programme of Pollution Reduction Measures for the Impact Area of the INA Lubricants Rijeka and the Decision on Special Air Pollution Measurements (Official Gazette of the County of Primorje-Gorski kotar No. 10/01). In October 2002 an automatic measuring station was placed in the impact area of the refinery and in September 2004 it was connected to the central data collection and processing system of the Teaching Institute for Public Health of the County of Primorje-Gorski kotar. Major technical measures from the programme were carried out by the end of 2005. Following the obligation imposed by the decision on special measurements and the agreement signed with the refinery, the Teaching Institute for Public Health of the

County of Primorje-Gorski kotar monitors and reports to the commission on the air quality in the impact area of the refinery. Since 2005 all data on average hourly and daily air pollution levels measured at the automatic measuring station in the Trogirska Street are available to the public concerned on web pages of the Town of Rijeka and the Teaching Institute for Public Health of the County of Primorje-Gorski kotar. These data are monitored by the City Government Department for Development, Town Planning, Ecology and Land Management as part of the department's daily tasks.

The activities described have resulted in the reduced air pollution from refinery sources and, consequently, in the improved air quality in the vicinity of the refinery (from the third to the second category of air quality), as stated in the City Government Conclusion, Class No. 022-05/05-01/25-132 dated 8 June 2005.

Measurements conducted in 2006 and 2007 showed the deterioration of the state in the area affected (a drop from the second to the third category) due to excessive pollution by H_2S and SO_2. In the same period of time the citizens repeatedly complained about the unpleasant smell. The analyses proved the Mlaka Refinery to be the major source of emissions.

On 12 July 2007 the Town Council of Rijeka concluded that recent instances of excessive air pollution could not be reliably and permanently prevented by statutory air protection measures undertaken. As a result the Town Council started the procedure of a final shutdown of the Rijeka Oil Refinery in the Mlaka area by 1 January 2010. The request for the Government of the Republic of Croatia to take the final decision based on the provisions of Article 58 of the Environmental Protection Act (Official Gazette Nos. 82/94 and 128/99) is in the process of preparation.

Until the final shutdown of the plant the Council also requires the application of short-term measures in order to reach as high as possible air quality in the impact area, not below the second category. On 12 July 2007 the Town Assembly made the decision to develop a rehabilitation programme for the stationary source of emissions into the air – the Rijeka Oil Refinery in the Mlaka area – including the implementation timetable.

Kostrena Municipality

The Kostrena Municipality has launched no rehabilitation programme for PM_{10}, because concentrations originate from a number of different sources and therefore an analysis of the state is needed.

Kutina

Measurements conducted at the Kutina-1 national measuring station and local network measuring stations in 2006 showed the second category of air quality for ammonia and suspended particulate matter and the third category for hydrogen sulphide. In the course of 2007 the Administrative Department for Physical Planning, Environmental Protection and Cultural Heritage of Kutina initiated the activities on the preparation of the Action Plan for Air Pollution Reduction in the Town of Kutina and the Air Quality Protection and Improvement Programme for the Town of Kutina. Both documents were prepared in January 2008.

The Action Plan contains measures to turn the air quality category II into the air quality category I, with the air quality remaining unaltered in areas of category I. The Air Quality Protection and Improvement Programme for the Town of Kutina deals with measures to turn the air quality category III into the air quality category II. Both documents found the Kutina Petrochemical Industry to be the major air polluter in the area.

Priority measures for the reduction of air pollution by hydrogen sulphide coming from incineration of gases in carbon black production are defined by the rehabilitation programme developed by the Kutina Petrochemical Industry in 2007 and approved by the Town Council. The programme implementation deadline is April 2008.

Measures to Reach Limit Values within a Specified Period, if Exceeded

Table 6-2.1. shows deadlines for reaching limit values. Limit values for particulate matter are to be reached in two phases: the first ends on 31 November 2010 and the second on 31 December 2015. During the second phase the average annual limit value is to be reduced from 40 to 20 μg/m^3 and the 24-hour value (50 μg/m^3) may only be exceeded 7 times a year rather than 35 times. Under the criterion of the second phase the exceedance of the PM_{10} value would be recorded in much more towns in Croatia. Here it should be noted that PM_{10} includes solid matter and various aerosols, with a considerable share of sulphates and nitrates in the total volume. Each reduction in SO_2 and NOx emissions means therefore a reduction in PM_{10} and $PM_{2,5}$ pollution.

The deadline for reaching NO_2 limit values is 2014. For PM_{10} and NO_2 it will chiefly depend on achievements in the reduction of traffic-based pollution and substitution of fuel oil for cleaner fuels. Many European towns have been recording concentrations of PM_{10} and NO_2 that exceed the limit values and making every effort to abate this pollution for a long time.

Table 6.2-1: Deadlines for reaching the limit values defined (LV)

POLLUTANT	*DEADLINE*
SO_2	*2010*
NO_2	*2014*
PM_{10}, phase I	*2010*
PM_{10}, phase II	*2015*
$PM_{2,5}$	*2015*
Benzo(e)pyren	*2012*
H_2S	*2010*
Benzene	*2010*
CO	*2010*

Measures for the Prevention of Critical Level Exceedances

A critical level is a pollution level whose exceedance poses threat to human health during a short time of exposure and whose occurrence immediately requires adequate measures. A warning level is a level above which harmful effects on human health of certain sensitive segments of population may occur at a short time of exposure and which requires reporting on the current status. The legislative framework for the abatement of critical pollution levels is set by the Regulation on Critical Levels of Pollutants in the Air (Official Gazette No. 133/05). This Regulation defines critical levels of sulphur dioxide, nitrogen dioxide and ozone in the air, and special measures for the protection of human health and the environment to be taken when they occur.

Critical levels of sulphur dioxide in the air expressed as SO_2 and nitrogen oxides in the air expressed as NO_2 are the following:

Pollutant	Averaging time	Critical level
SO_2	three-hour shifting average	500 μg m^{-3}
NO_2	three-hour shifting average	400 μg m^{-3}

Critical and warning ozone levels in the air are as follows:

Level	Averaging time	Critical level
warning level	one-hour average	180 μg m^{-3}
critical level	one-hour average	240 μg m^{-3}

The exceedance of the critical level of pollutants in the air must be measured or predicted (for ozone) during three subsequent hours at least.

Critical and warning levels are monitored at national and local network stations for continuous air quality monitoring according to the Programme for Air Quality Monitoring by the National Network for Continuous Air Quality Monitoring and programmes for air quality monitoring by local networks.

In case that a warning or a critical level is exceeded, the governments of the City of Zagreb, the town or the municipality whose area is affected by this exceedance shall take special measures as required to protect the public health and the environment and define the way of their implementation in conformity with the Environmental Contingency Plan.

Special measures for the protection of public health and the environment that must be taken in the event of critical and warning levels include restrictions and bans relating to traffic and stationary sources. Exemptions from traffic bans are granted to public transport and taxis, vehicles for disabled persons, official police vehicles, military, railway and postal vehicles, public supply vehicles, fire engines, ambulances and vehicles for the transport of patients, doctors and medicines.

In the event of the exceedance of any critical and warning level the governments of the City of Zagreb, the town or the municipality are obliged to issue an announcement to the general public through mass media several times during the day. The termination of the critical and warning level will also be announced through mass media. The contents of announcements to be made through mass media are laid down by the Regulation.

Determination of Emission Limit Values, Emission Factors and Product Quality Features

The Regulation on Limit Values of Pollutant Emissions From Stationary Sources into the Air (Official Gazette No. 21/07) defines limit values for industrial installations, activities using substances that cause emissions of volatile organic compounds, combustion plants, gas turbines and waste thermal treatment processes. Limit values are brought in line with the EU Directive on Large Combustion Plants and Gas Turbines, the Waste Incineration Directive and the EU Directive on the Control of VOC Emissions. Limit values applying to certain industrial installations have been set according to the best available techniques.

As compared to the 1997 Regulation, the recent Regulation adopted in 2007 defines significantly stricter emission values for large combustion plants. For a plant with a capacity of over 100 MW it implies the application of high-efficiency techniques for emission reduction. In solid fuel and liquid fuel fired combustion plants ELVs for SO_2 may be reached by using the flue gas desulphurization technology and ELVs for NO_x by using DENOX installations. In the former regulation NO_x emissions were set at a level that enabled the application of the so-called primary measures for NO_x emission reduction. Today the largest installations must apply primary measures and use a DENOX installation which reduces emissions by 75-90 per cent. LVs for particulate matter resulting from large solid fuel and liquid fuel fired combustion plants are now much stricter and for an installation over 100 MWt they are reduced from 50 mg/m^3 to 30 mg/m^3. At the same time this reduction reduces emissions of heavy metals and other toxic substances too. The Regulation contains transitional provisions specifying the period of time for the adjustment of existing plants.

Homologation of Vehicles with Regard to Emission of Harmful Compounds

The By-law on Certification of Vehicles Regarding Harmful Compound Emissions in Accordance with Engine Fuel Types (Official Gazette No. 88/06) imposes an obligation to certify passenger cars and light-duty trucks, including used cars, with regard to emissions of carbon monoxide, nitrogen oxides and hydrocarbons when for the first time registered in the Republic of Croatia, according to the procedure and the defined limit values of pollutants.

Monitoring and Control of Pollutant Emissions from Stationary Sources

The Regulation on Limit Values of Pollutant Emissions From Stationary Sources into the Air (Official Gazette No. 21/07), the Ordinance on Monitoring Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 01/06) and rulings made on the basis of environmental impact assessments determine measures for monitoring and control of pollutant emissions from stationary sources. Depending on the characteristics of the source, emission monitoring may be continuous or discontinuous. Prior to putting into operation, each emission source must make initial measurements that will be used as a basis for drawing up a monitoring programme. Sources of emission undergoing continuous measurements must establish a connection for the submission of measurement results to the Croatian Environment Agency and these results must be publicly available. Legal entities conducting measurements must obtain a permit for performing emission measurement activities. The legislative framework for the control is fully in place and needs to be consistently implemented.

Development of the Programme for the Reduction of SO_2, NO_x and Particulate Matter Emissions into the Air and Harmonization of Emissions from Existing Large Combustion Plants and Gas Turbines with Emission Limit Values (ELV)

According to Articles 129 and 168 of the Regulation on Limit Values of Pollutant Emissions From Stationary Sources into the Air (Official Gazette No. 21/07) the owner or the operator of a large combustion plant and a gas turbine was obliged to submit to the Ministry of Environmental Protection, Physical Planning and Construction a programme for the reduction of pollutant emissions into the air and harmonization of emissions from existing large combustion plants and gas turbines with ELVs by 31 December 2007. Under existing stationary sources it is to understand those stationary sources that were in operation or possessed a building permit issued before the effective date of the

Regulation. The Regulation came into force on 1 March 2007. The purpose of the emission reduction programme is to make it possible for the operator to reach emissions by applying adequate measures that will be equivalent to the emission reduction attained by applying limit values.

The programme must contain:

- technical data on the large combustion plant (fuel type, power, annual operating hours, etc.),
- annual emissions of SO_2, NO_x and particulate matter in the period from 2000 to 2006,
- total annual waste gas flow in the period 2000-2006,
- emission reduction measures (e.g. changing the type of fuel, modification in combustion process management, introduction of new fuel combustion devices, application of emission reduction devices, shutdown of the installation, etc.),
- timetable for implementation of measures under the programme,
- estimate of funds needed for accomplishment of measures under the programme,
- cost-benefit analysis.

On the basis of individual programmes received, the MEPPPC is bound to prepare a plan for the reduction of SO_2, NO_x and particulate matter emissions resulting from large combustion plants and gas turbines, which is then adopted by the Government of the Republic of Croatia.

Emission Reduction Measures for Volatile Organic Compounds (VOCs)

Emission limit values for certain activities resulting in the VOCs emissions are defined by the Regulation on Limit Values of Pollutant Emissions From Stationary Sources into the Air, Section VI (Official Gazette No. 21/07), the Regulation on Technical Standards for Protecting the Environment against Emissions of Volatile Organic Compounds Generated by Petrol Storage and Distribution (Official Gazette No. 135/06) and the Regulation on Limit Values of Volatile Organic Compounds Contained in Certain Paints, Varnishes and Vehicle Refinishing Products (Official Gazette No. 94/07). The purpose of the Regulation on Limit Values of Volatile Organic Compounds Contained in Certain Paints, Varnishes and Vehicle Refinishing Products is to limit the total content of volatile organic compounds in certain paints, varnishes and vehicle refinishing products with the aim to prevent and reduce air pollution caused by emissions of those compounds into the air.

Measures for Phasing Out Ozone Depleting Substances

Measures for phasing out ozone depleting substances (hereinafter referred to as the ODSs) are laid down by the Regulation on Ozone Depleting Substances (Official Gazette No. 120/05) and adopted pursuant to the Air Protection Act (Official Gazette No. 178/04) and the Act on Ratification of Montreal Protocol on Substances that Deplete the Ozone Layer.

According to the Regulation the ODSs include:

- *controlled substances:* chlorofluorocarbons (CFC), other fully halogenated chlorofluorocarbons, halons, carbon tetrachloride, 1,1,1-trichloroethane), methyl bromide, hydrobromofluorocarbons (HBFC), hydrochlorofluorocarbons (HCFC) and bromochloromethane;

- *substitute substances:* hydrofluorocarbons (HFC), perfluorocarbons (PFC) and mixtures of substitute substances.

According to requirements of the Montreal Protocol and EU legislation, the Regulation lays down the measures for phasing out the consumption and handling of controlled substances that include:

- ban on production, sale, import/export and release of controlled substances,
- phasing out the consumption of controlled substances,
- measures of handling products containing ODSs,
- technical and organizational measures of ODS collection, reclamation, recovery and disposal, and
- measures for the prevention of uncontrolled ODS release.

Products that contain controlled and substitute substances include:

- refrigeration and air-conditioning equipment;
- products in form of aerosols, except those used for medical purposes;
- solvents;
- fire-extinguishing systems and devices;
- polymer materials.

In the period 1990-2005 the ODSs consumption in the Republic of Croatia fell by 80 per cent as a result of implementing the projects envisaged by the National Programme for Phasing Out Substances that Deplete the Ozone Layer (IM/0902-95-43, 1996) that covered institutional strengthening, phasing out freon CFC-11 in the production of flexible polyurethane foams and the pharmaceutical industry, substitution of methyl bromide in tobacco growing and refrigeration equipment management.

Ban on the production, sale, import/export and release of ODSs

- ban on the production of controlled substances, except in specified cases;
- ban on the production of products containing controlled substances;
- ban on importing / exporting of controlled substances without licence;
- ban on the retail sale of controlled substances;
- ban on the release of controlled and substitute substances into the air;
- ban on importing and exporting of controlled substances and products containing such substances to countries that are not a Party to the Protocol;
- ban on importing used, reclaimed and/or recovered controlled substances.

Measures of phasing out the consumption of controlled substances

- ban on CFC imports aimed at trading on the domestic market as of 1 January 2006;
- ban on the consumption of halons as of 1 January 2010;
- ban on the consumption of other fully halogenated chlorofluorocarbons (CFC);
- import of up to 500 kg carbon tetrachloride, 1,1,1-trichloroethane annually to be placed on the domestic market for much-needed purposes is permitted;
- CFCs allowed for use as process agents in production processes;
- consumption of hydrochlorofluorocarbons (HCFC) allowed by 31 December 2015;
- ban on the consumption of hydrobromofluorocarbons (HBFC) and bromochloromethane;
- ban on the consumption of methyl bromide as of 1 January 2006, except for quarantine purposes;
- collected, reclaimed and/or recovered controlled substances allowed for use in the

maintenance and repair of refrigeration and air-conditioning equipment and fire-extinguishing systems and devices during their life-cycle, if their physical and chemical properties are equivalent to new substances.

Measures of handling products containing controlled substances

- ban on importing and placing products that contain CFCs, HCFCs and halons on the domestic market.

Technical and organizational measures of collection, reclamation, recovery and disposal of ODSs

- controlled and substitute substances contained in products shall be collected, reclaimed and/or recovered during maintenance works or elimination of such products from use or at the disposal site at the latest;
- controlled and substitute substances collected that cannot be reclaimed during maintenance and/or repair of products and/or equipment on site, or that are collected when eliminating products and/or equipment from use, excepting fire extinguishers and fire-fighting systems, shall be transferred to legal entities whose registered business activities include a special unit – a centre for the collection, reclamation and recovery of controlled and substitute substances;
- a dealer or an entrepreneur who imports controlled and substitute substances for the purpose of placing them on the domestic market shall pay a charge to the Environmental Protection and Energy Efficiency Fund for covering the costs of the disposal/destruction of controlled and substitute waste substances.

Measures for the prevention of uncontrolled ODS release

- plants containing > 3 kg controlled or substitute substances must be checked for leakage every 12 months;
- plants containing > 30 kg controlled or substitute substances must be checked for leakage every 6 months;
- obligatory installation of leak detection devices in systems containing 300 kg controlled or substitute substances by 31.12.2007.

Measures for the Reduction of Emissions of Persistent Organic Pollutants and Heavy Metals

The Protocol on Persistent Organic Pollutants outlining the measures and methods for the reduction of air pollution by the substances mentioned was adopted within the framework of the Convention on Long-range Transboundary Air Pollution in 1998, with the aim to reduce emissions of persistent organic pollutants. The Protocol on Persistent Organic Pollutants was ratified by the Republic of Croatia in 2007 (Official Gazette – International Treaties No. 05/07) and came into force on 5 December 2007.

The Republic of Croatia also ratified the Stockholm Convention on Persistent Organic Pollutants (Official Gazette – International Treaties No. 11/06) which came into force on 30 April 2007. The purpose of this international treaty is to eliminate the production, use, import and export of persistent organic pollutants on a global scale.

Persistent organic pollutants which are the subject matter of international treaties mentioned are indicated in Table 6.2-2.

Table 6.2-2: Persistent organic pollutants

Pollutant	LRTAP Convention	Stockholm Convention
Aldrin	*Annex I*	*Annex A (except chlordecone and hexabromobiphenyls not covered by the Convention)*
Chlordane		
Chlordecone		
Dieldrin		
Endrin		
Heptachlor		
Hexabromobiphenyl		
Hexachlorobenzene (HCB)		
Mirex		
Toxaphene		
PCB		
DDT		*Annex B*
Lindan (HCH)	*Annex II and III*	*Not covered by the Convention*
Dioxins/furans (PCDD/PCDF)	*Annex III*	*Annex C*
Polycyclic aromatic hydrocarbons (PAHs)		*Not covered by the Convention*

At present there is no production, import, export and use of POP pesticides in the Republic of Croatia, which complies with the regulations in force. Chlordane was prohibited for use in 1971, aldrin, dieldrin and DDT in 1972, HCB in 1980, toxaphene in 1982, endrin in 1989 and lindan in 2001. Mirex has never been permitted for use in Croatia.

Statutory regulations currently in force in Croatia allow imports of PCBs and equipment containing PCB compounds. The PCB compounds are, however, allowed in totally enclosed uses only. Mixtures of liquid PCBs have never been and are presently not produced in Croatia, but transformers containing PCBs used to be produced earlier. In Croatia PCB compounds are used in closed systems only (as dielectrics in transformers and capacitors). The use of PCBs in open systems (paints, coatings, etc.) has not been recorded.

The National Implementation Plan for the Stockholm Convention was drafted as part of the project *"Enabling Activities to Facilitate Early Action on the Implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in Croatia"* , defining activities and measures for the reduction and elimination of the production, use, import and export of POPs. The National Implementation Plan will be prepared in 2008.

The Protocol on Heavy Metals, aimed at the reduction of heavy metal emissions, was adopted in 1998 within the framework of the Convention on Long-Range Transboundary Air Pollution and determined measures and methods for the reduction of air pollution caused by the substances mentioned. The Protocol was ratified by the Republic of Croatia in April 2007 (Official Gazette – International Treaties No. 05/07) and came into force for the Republic of Croatia on 5 December 2007.

Measures for the reduction of heavy metal emissions include the compliance with emission limit values for certain combustion and production processes specified in the Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 21/07) and with the defined lead content in fuels in accordance with the Regulation on the Quality of Liquid Petroleum Fuels (Official Gazette No. 53/06).

Control of Emissions from Vehicles in Road Traffic (ECO test)

During regular annual technical inspections of vehicles, exhaust gases are checked (ECO test) both on petrol and diesel cars in accordance with the Ordinance on Technical Inspection of Vehicles (Official Gazette Nos. 136/04 and 11/07). An ECO test includes a visual inspection of the device and the recording of the exhaust gas composition. The measured and calculated exhaust gas values are then compared to manufacturing data for ECO testing or, if these data are not available, the measured and calculated values are compared with the values prescribed. Since 1 October 2004 the technical inspection may not be certified, if ECO test results show that the vehicle in question fails to meet the conditions prescribed. Exceptionally, for vehicles not equipped with a catalytic converter a regular technical inspection may be certified, if the exhaust gas values measured do not exceed the values set.

Inspection Control Measures

According to the Air Protection Act an environmental inspector is responsible for inspection control over implementation of the laws and regulations adopted pursuant to this Act, including individual documents, conditions and methods of work of legal and physical persons supervised. Inspection control over implementation of the Act and regulations made thereunder that define limit values relating to the product composition and/or other product quality features is exercised by a market inspector of the State Inspectorate in the manner as determined by a special law. The Air Protection Act has defined fines imposed on any legal and physical person violating the provisions of the Act and regulations made thereunder.

Monitoring and Reporting on Pollutant Emissions into the Air in the Area of the Republic of Croatia Under the International Obligations

The obligation to monitor and report on pollutant emissions in the area of the Republic of Croatia arises from the provisions of:

- the Convention on Long-range Transboundary Air Pollution (LRTAP Convention) and the Protocol relating to joint monitoring and evaluation of transboundary transmission of pollutants in Europe (EMEP Protocol);
- the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

From the organizational aspect a decentralized model was established enabling the Ministry of Environmental Protection, Physical Planning and Construction to transfer a segment of its activities and tasks within the monitoring and reporting process to domestic public and specialized institutions – bearers of rights. The key role in information system planning and management, data collection and reporting on pollutant emissions is played by the Croatian Environment Agency.

6.2. CURRENT LEGISLATIVE MEASURES WITH INTERSECTORAL IMPACTS

6.2.1. FUEL QUALITY REGULATION

The fuel quality is regulated by the Ordinance on the Quality of Liquid Petroleum Fuels (Official Gazette No. 53/06). The quality of liquid petroleum fuels was for the first time prescribed by the 1997 Ordinance amended several times. The recent Ordinance was adopted in the process of harmonization of Croatian legislation with the EU acquis communautaire in 2006. With effect from 1 January 2006 the sale of leaded petrol on the domestic market is prohibited.

The recent Ordinance on the Quality of Liquid Petroleum Fuels (Official Gazette No. 53/06) complies fully with the EU Directives 98/70/EC and 1999/32 and lays down:

- permitted limit values for leaded petrol, diesel fuel, gas oil, fuel oil, paraffin oil and marine fuel quality features;
- application areas for liquid petroleum fuels,
- the obligation to place on the domestic market certain volumes of petrol and diesel fuel with a sulphur content not exceeding 10 mg/kg, evenly distributed across the country with effect from 1 January 2008;
- the obligation of the supplier to issue the Declaration of Compliance with Prescribed Limit Values when placing the fuel on the domestic market;
- the obligation to apply CEN/ISO testing methods for determination of liquid petroleum fuel quality as specified in Annex I to the Ordinance;
- testing of liquid petroleum fuel quality only by accredited laboratories according to the requirements set down by the HRN EN ISO/IEC 17025;
- marking of petrol and diesel fuel on petrol stations;
- monitoring the quality of liquid petroleum fuels placed on the domestic market according to the annual fuel quality monitoring programme drawn up by the Ministry of Environmental Protection, Physical Planning and Construction and provided by the supplier.

The recent Ordinance on the Quality of Liquid Petroleum Fuels contains all provisions of the EU Directive 98/70/EC. However, in light of expected financial constraints on implementation of the provisions of this Directive relating to the required petrol and diesel fuel quality, the Ordinance has authorized the Government of the Republic of Croatia to determine annual volume of liquid petroleum fuels that may be placed on the domestic market , although failing to meet the required limit values. The Government shall make such a decision on the basis of a coordinated proposal submitted by the Ministry of Economy, Labour and Entrepreneurship and the Ministry of Environmental Protection, Physical Planning and Construction.

Following the Decision of the Government of the Republic of Croatia taken in 2004, in 2005 INA-Industrija nafte d.d. Zagreb (INA Oil Industry) prepared the Programme for Refinery Upgrading and Phasing Out the Sale of Liquid Petroleum Fuels Failing to Meet the Required Standards, including a detailed financial plan and timetable for the period 2005-2009. The necessary finance for the refinery upgrading programme amounts to some 850 million euro.

According to the Refinery Upgrading Programme and the scheduled investments in refinery upgrading, INA d.d. plans to start producing liquid petroleum fuels, i.e. unleaded petrol and diesel fuel of the European quality (EURO V) in 2009 and will in this manner meet the

standards set out in the EU Directives. Thanks to refinery upgrading INA will be able to produce gas, fuel and marine oils of the quality complying with EU regulations as of 2011. This will reduce sulphur emissions in the air coming from stationary sources that use fuel oils produced in Croatian refineries, which is very important in light of Croatia's obligations arising from the Protocol on Further Reduction of Sulphur Emissions under the Convention of Long-Range Transboundary Air Pollution that the country ratified.

The Ministry of Environmental Protection, Physical Planning and Construction is the body responsible for implementation of the Ordinance on the Quality of Liquid Petroleum Fuels. All data on the quality of liquid petroleum fuels needed by the Ministry are collected and entered into the air quality information system by the Croatian Environment Agency.

7. FURTHER MEASURES FOR AIR QUALITY PROTECTION AND IMPROVEMENT

7.1. MEASURES AND ACTIVITIES FOR PREVENTIVE PROTECTION OF AIR QUALITY

These measures and activities fall into two categories: measures of administrative and organizational type (A) and the investment-type measures and implementation (I).

7.1.1. Measures for Administrative and Organizational Capacity Building

- ***MPA-1. Legislation enforcement monitoring and improvement of legislation in line with recent EU legislation***

  By 2011 enforcement regulations in the field of air protection need to be updated with regard to recent knowledge about threats to human health and the ecosystem, the progress made and the air pollution level.

- ***MPA-2. Strategic environmental impact study and a more precise definition of the contents and methodology of analysis used in environmental impact studies***

  The recent Environmental Protection Act (Official Gazette No. 110/07) has established a new efficient pollution prevention instrument – a strategic environmental impact assessment. Another useful instrument is the procedure of defining the contents of the environmental impact assessment for a specific activity, if required by the entity responsible for the activity.

  A strategic assessment will be a must for physical planning documents to be adopted by the Croatian Parliament, county assemblies and the Zagreb City Assembly. A strategic assessment will also be carried out for sectoral plans relating to agriculture, forestry, fisheries, energy, mining, transport, telecommunications, tourism and water management, if such planning documents set out a framework of future activities subject to environmental impact assessment.

  Another instrument introduced is a preliminary evaluation of the need to carry out a strategic environmental impact assessment for new low-level physical planning documents and amendments thereto.

  According to the Ordinance, the person responsible for an activity may, prior to the preparation of the environmental impact study, submit a request in writing to the Ministry or the competent administrative body of the county and the City of Zagreb for

instructions relating to the contents of the study, taking into account the activity planned. The environmental impact study shall define in detail the contents, the analysis and methods.

The quality of studies varies, because the data, methods and procedures applied are sometimes insufficient for a proper assessment. On-site investigations are very rarely conducted. Due to a relatively high competition between companies carrying out such studies, their price is falling and they are not able to respond properly to ever-increasing requirements set down by the regulations and public enquiries.

The application of methodologies to certain issues is often discussed, such as e.g. the cost-benefit analysis. A consistent analysis as required by the strategic environmental impact assessment can hardly be financed by any person responsible for the activity. Therefore more specific guidelines in terms of methodology are needed and/or technical handbooks should be prepared. The strategic environmental impact studies and environmental studies should foster the method of analysing the entire product life-cycle so as to prevent the benefits derived in one location to be more harmful on another.

- ***MPA-3. Identification of areas and inhabited areas of the Republic of Croatia by the air pollution level***

The document entitled *Preliminary Assessment of Air Quality in the Territory of the State (*MHS, 2007*)* includes the evaluation of the state and delimitation of Croatia (description in Section 4). This delimitation represents the foundation for further prevention and rehabilitation activities as stipulated by the Air Protection Act. A further step is the enactment of an enforcement regulation on identification of areas and inhabited areas of the Republic of Croatia by air quality categories laid down in 2006.

- ***MPA-4. Integrated environmental conditions (transposition from the IPPC Directive)***

For installations whose operation is likely to produce air, water and/or soil polluting emissions the operator is bound, prior to the start of construction and start-up or after a substantial change in the operation or reconstruction of the installation, to apply for integrated environmental conditions. Integrated conditions will be laid down aiming at an integrated environmental protection through the maximum prevention and elimination of pollution, primarily on its source, and through ensuring a rational management of natural resources, pollution control and establishment of a sustainable balance between human activities and socio-economic development on one side and natural resources and the regenerative capacity of nature on the other. Installations subject to integrated conditions and the method of granting permits for new and existing installations will be determined by the Government of the Republic of Croatia.

- ***MPA-5. Certification of internal combustion engines fitted into non-road mobile machinery***

For all internal combustion engines fitted into non-road mobile machinery it is necessary to lay down the certification procedure.

- ***MPA-6. Air protection measures in new environmental protection programmes of the counties and the City of Zagreb***

Pursuant to the recent Air Protection Act (Official Gazette No. 178/04) the counties and the City of Zagreb are bound to enact environmental protection programmes laying down air protection measures in line with this Plan.

➲ ***MPA-7. Establishment of an air quality information system***

- Counties and towns need to define local air quality monitoring networks;
- CEA needs to provide conditions for the collection, control, filing away and presenting air quality measurement data;
- A pollutant emission register is to be established modelled on the European Pollutant Release and Transfer Register (EPRTR);
- Data on continuous measurements of emissions from large sources are to be made accessible. CEA should provide technical conditions and issue instructions on the methods of connecting and on the data transmission protocol;
- GIS-based system of gridding emissions across Croatia. A database on GIS based emissions including the possibility of presenting collective sources across a 50 km x 50 km and a 10 km x 10 km grid and a 1 km x 1 km grid for towns should be prepared at the national level by 2011. The project is expected to enable emission monitoring across counties, areas and inhabited areas and to provide assistance in international reporting for the needs of UNECE/EMEP and other reports and surveys;
- Methodological basis for analyses is to be developed.

➲ ***MPA-8. Education and professional improvement of the administrative and inspection staff***

Education and professional improvement needs to be organized for the employees of government bodies and administrative bodies of local and district (regional) government and self-government units and for inspectors. The survey of existing environmental programmes in some counties showed a low level of general knowledge of air protection. A large number of new statutory regulations from all areas of environmental protection makes it difficult for the staff of government bodies and inspectors to follow new information on the best emission reduction techniques, emission measurement equipment and air quality. Every two years a joint educational seminar is to be held for the purpose of sharing experiences from daily practice.

➲ ***MPA-9. Improvements in the system of air quality monitoring networks***

- to speed up the establishment / upgrading of local networks and their inclusion into the national system of air quality monitoring;
- to improve measurement quality system;
- to support the establishment of a national reference laboratory,
- to improve coordination in the construction, use and maintenance of continuous air quality monitoring networks;
- to entrust an independent specialized institution within the government bodies with the operational care of the national network (development, operation, maintenance, quality assurance, training).

➲ ***MPA-10. State examinations and accreditation of institutions***

According to the recent Environmental Protection Act all persons involved in environmental issues are bound to pass a state examination. This measure will substantially improve the general knowledge and, consequently, the overall efficiency of the system.

Air quality monitoring and pollutant emission measurements are conducted by legal persons registered for these activities. Legal persons must be professionally and technically qualified by the independent Croatian Accreditation Agency according to HRN EN ISO/IEC 17025 standard for air quality monitoring and emission measurement activities as provided for by the Ordinance on Granting a Permit or an Approval to Perform Activities of Air Quality Monitoring and Monitoring Emissions from Stationary Sources into the Air (Official Gazette No. 79/06).

According to the Regulation on Conditions for Granting Permits to Perform Expert Environmental Activities (Official Gazette No. 7/97), legal persons who were granted an approval to perform specialized activities of monitoring air quality and air emissions prior to the effective date of this Ordinance are bound to submit an acknowledgement of the national accreditation body stating that the procedure of a professional and technical competence evaluation as required by HRN EN ISO/IEC 17025 has been initiated.

➲ ***MPA-11. Strengthening institutional framework and coordination among stakeholders***

The MEPPPC, the Croatian Environment Agency and Environmental Protection and Energy Efficiency Fund (EPEEF) are fundamental government institutions responsible for setting up and implementation of the air protection policy. It is recommended to strengthen coordination among these institutions, including the inspectorates of relevant ministries on an operational scale. It is also necessary to improve contacts and coordination with local county departments and institutions entrusted by the local self-government with environmental protection activities. So far this deficiency has been particularly evident in the establishment of the Environmental Emission Cadastre, exchange of air quality measurement data, introduction of the air quality information system, preparation of inadequate plans and the lack of coordination in the prevention of critical loads and implementation of measures for rehabilitation programmes.

The quality system enhancement at all levels requires cooperation and sharing information with the State Office for Metrology (SOM), the Croatian Standards Institute (CSI) and the Croatian Accreditation Agency (CAA), including future accredited laboratories.

As to expert activities, the MEPPPC and the CEA have so far received support in air protection issues through collaboration with the MHS and by purchasing services through public tenders. There is no stable staff continuity needed for long-term activities, because certain works tend to be contracted at the project level and by annual agreements. This can be best illustrated by the maintenance of the National Air Quality Measurement Network, the preparation of the annual emission balance, projections, etc. Delays in reporting to international institutions are often due to administrative reasons. Activities that require highly qualified staff should be contracted on a long-term basis for a period of several years or for the plan implementation period. A good example is the introduction of entities responsible for reporting on greenhouse gas emissions, i.e. institutions authorized for highly specialized works. It is standard practice worldwide to define focal or reference centres for certain specialized topics,

particularly as regards cooperation within the framework of topics of international conventions and protocols.

➲ ***MPA–12. Education and raising public awareness***

Initiatives and air protection education and information projects carried out so far are few. The funding was provided by the EPEFF, but not solicited by any air protection project. The public should be made aware of basic air protection principles, possible options, benefits derived from pollution reduction and measures to be taken by each individual. Public awareness raising may be a catalyst for any action and may have a particularly powerful effect on encouraging the application of renewable sources and energy efficiency.

Education is needed for pollution emitters obliged to report to the Pollution Emission Register. Throughout the counties the CEA will organize courses for emission sources relating to submission of reports and use of the new software.

7.1.2. Investment-type Measures and Implementation

➲ ***MPI-13. Finalization of the national air quality monitoring network***

The national network needs to be finalized and supplemented with the following:

- **Additional station in the County of Slavonski Brod-Posavina** (Slavonski brod). The station should make it possible to monitor pollution coming from the adjacent country (Bosnia and Herzegovina), especially from the refinery installations in Bosanski Brod.
- **Establishment of $PM_{2,5}$ measurements at national and local network stations.** For the time being $PM_{2,5}$ is not measured by the national air quality monitoring network. There are plans to start measuring $PM_{2,5}$ at 9 rural and 5 urban stations. Rural stations are Desinić, Karojba (Višnjan), Ravni kotari, Komiža, Srđ (Žarkovica), Dugi otok, Neretva Delta, Plitvice Lakes and Kopački rit, and urban stations are Zagreb-1, Rijeka-1, Bay of Kaštela, Split and Osijek. As a top priority it is recommended to install measuring devices in urban stations so as to evaluate air pollution effects of these particles on human health.
- **Establishment of ozone measurements in the County of Sisak-Moslavina.** According to the division of the area of the Republic of Croatia, this is the only zone where ozone measurements are not conducted.

➲ ***MPI-14. Strategy and Plan for the Use of Liquefied Gas on Islands***

In November 2007 the Government of the Republic of Croatia adopted the Strategy for the Use of Liquefied Petroleum Gas (LPG) on Islands and the Programme for the Use of Liquefied Petroleum Gas on Islands (2008-2012) with the aim to encourage the use of a replacement source of energy (LPG) on Croatia's islands, which is both acceptable in energy terms and environmentally friendly. The funding needed for the programme implementation totalling 34.4 mil. kunas will be provided by the government budget of the Republic of Croatia under budget items of the Ministry of Economy, Labour and Entrepreneurship and the Ministry of the Sea, Transport and Infrastructure, and by the Financial Plan and the Work Programme of the EPEEF. The necessary funds for implementation of the Programme in the period 2008-2012 to the total amount of 17 mil. kunas will be secured by the EPEEF. The Fund will finance the preparation of a publication as part of the information/promotional campaign, pilot projects for installation of systems needed for the use of LPG and solar energy in facilities owned by the state

and local and district (regional) self-government units, preparation of project solutions and introduction of LPG and solar energy installations into households.

7.2. SHORT-TERM MEASURES IN CASE OF A RISK OF CRITICAL LEVEL EXCEEDANCE

7.2.1. Measures for Administrative and Organizational Capacity Building

➲ ***MKA-1. To investigate the need to define critical levels for H_2S and ammonia***

Following the recommendations made by the World Health Organization (WHO, 2005), the EU legislation recommends that critical/warning levels should be defined for sulphur dioxide, nitrogen dioxide and ozone. Croatia has adopted the EU approach in full. According to the American approach, for all the so-called 'criteria-specific' harmful substances (PM_{10}, SO_2, NO_2, ozone) the air quality index (AQI) ranges from 0-500 through 6 categories defining the air as good, moderately polluted, unhealthy for sensitive groups, unhealthy, very unhealthy and hazardous. Given the fact that in some towns of Croatia H_2S and NH_3 occur in very high concentrations, there is a ground to analyse the reasonableness of introducing / non-introducing critical levels for those pollutants (below).

H_2S concentrations occur over a short period of time at levels 20 times above limit values (e.g. in Sisak maximum hourly concentrations reached 190-330 µg/m^3 and daily concentrations 80 µg/m^3 in 2006). According to the WHO, the lowest-observed-adverse-effects level (LOAEL) causing eye irritation amounts to 15000 µg/m^3. Assuming the related evaluation uncertainty factor, the WHO recommends the value of 150 µg/m^3 as a maximum 24-hour value. For the protection against unpleasant smells the WHO recommends a limit of 7 µg/m^3 for a 30-hour average. In Croatia the value for H_2S was set from the aspect of smell threshold rather than the protection of health, i.e. with the aim to prevent smell nuisance (*LV* is 7 µg/m^3 and may be exceeded for 7 hours during a calendar year). From this it follows that even the highest H_2S concentrations measured in Sisak are five times lower than the LOAEL.

The exceedance of 24-hour concentrations of **ammonia (NH_3)** was recorded in Kutina, where the LV was exceeded 6 times. In 2006 the maximum 24-hour ammonia concentration measured in Kutina amounted to 565 µg/m^3. According to the WHO, the smell threshold for ammonia ranges from 500 to 2700 µg/m^3. The lowest-observed-adverse-effects level (LOAEL) accompanied by the skin irritation amounts to 3000 µg/m^3. As a result of an 8-hour exposure to a concentration of 17500 µg/m^3 the urea concentration in blood rises. In other words, just as in case of H_2S, the Croatian rule is set from the aspect of smell threshold rather that the protection of health. Similarly, it can be inferred that a maximum 24-hour concentration recorded in Kutina is five times lower than the LOAEL.

➲ ***MKA-2. To supplement the measurement programme of the national/local network with ozone measurements in the County of Sisak-Moslavina***

According to the Programme for Air Quality Measurement in the National Network for Continuous Air Quality Monitoring (Official Gazette No. 43/02) and the Regulation on Siting of National Network Stations for Continuous Air Quality Monitoring (Official Gazette No. 04/02) the national network will consist of a total of 22 stations, of which 7 in rural, 5 in protected and 10 in urban areas and industrial centres.

So far 8 stations have been constructed in urban areas. From the aspect of their being representative of critical levels, the locations for SO_2 and NO_2 measurement may be said to be selected well. In locations for O_3 measurement in urban areas no maximum levels are expected and therefore at present national network stations do not give an accurate picture of the state. This picture is supplemented by measurements conducted by the MHS, in Makarska, Gradište and the local network location at St. Catherine in Istria.

Once completed, the national network will comprise 22 stations. Each air quality zone identified by this Plan will accommodate at least one station, both in rural and protected areas, which is adequate in light of the existing risk and nature of ozone pollution. In populated areas the ozone measurement has covered the major agglomeration emissions: Zagreb and Rijeka. Measurements are only missing in the County of Sisak-Moslavina. Therefore a construction of an ozone station in this county should be included in the Plan for National Network Construction. In construction the priority is to be given to the establishment of a station in **Split** , important due to the volume of solar radiation, and on the **Risnjak** Mountain because of the expected impact of sources from the area of Kvarner and Istria and the transboundary pollution. Apart from these stations, data will also be available from the stations of MHS and local networks.

➲ ***MKA-3. To develop software application for automatic reporting on warning and critical concentration levels***

The MEPPPC in collaboration with the CEA shall ensure that the occurrence of warning and critical levels is automatically identified in time and such information made available to the competent local self-government, the National Protection and Rescue Directorate and the MEPPPC/Environmental Inspection.

➲ ***MKA-4. Operational implementation guidance of the MEPPPC for emergency measures plans in case of critical air pollution levels (coordination aspects, information transfer protocols and measurement quality system)***

The operational implementation of the Emergency Measures Plan shall be coordinated with the MEPPPC/Environmental Inspection. When the local self-government issues an announcement to the general public, the information must also be provided to the MEPPPC/Environmental Inspection and the CEA. The same information must be accessible on the web portal for air quality monitoring. All actions taken during critical pollution episodes shall be coordinated between the MEPPPC/Environmental Inspection and the competent local self-government unit. Orders issued to emission sources shall be recorded, since certain actions may affect the national power sector, transport, etc. Specific features and details should be worked out in the course of plan preparation, with the local self-government consulting the MEPPPC.

➲ ***MKA-5. Drawing up / reviewing operational plans for implementation of the Regulation on Critical Levels of Pollutants in the Air (Official Gazette No. 133/06)***

The Regulation provides a statutory foundation for implementation of all necessary activities operationally delegated by the Regulation to local communities. According to the Regulation the local communities are required to inform the general public of possible exceedances and take pollution reduction measures. The Regulation has been in place since 2007.

In 2007, the Town of Sisak, exposed to the highest risk of critical pollution levels, adopted the operational emergency plan as part of the Air Quality Protection and Improvement Plan. This plan implies that all data on 10-minute pollutant levels are submitted by a special software from the Sisak-1 automatic measuring station to the National Protection and Rescue Directorate (County Centre 112 Sisak). In case of an exceedance the persons on duty in the Sisak INA Oil Refinery, the Sisak Thermal Power Plant and other authorized persons must be contacted by phone. In case of an exceedance lasting continuously for 3 hours a shift foreman shall, apart from the above mentioned, contact the Croatian TV through 112 Centre with the request to put out the information on the exceedance of the critical level of sulphur dioxide in the area of Sisak and invite local radio stations (Sisak Radio and Quirinus Radio) to inform the population. The critical level of sulphur dioxide may persist for several hours after the occurrence (three hours of a concentration above 500 $\mu g/m^3$). If the concentration does not drop below 500 $\mu g/m^3$, the environmental inspection and the Eco-centre take appropriate actions.

Preparation of plans is a priority task of other towns as shown in the table below.

Table 7.2-1: Priorities in preparation and revision of emergency plans for warning and critical levels of pollution

Region	Pollutants
Town of Sisak	SO_2 (plan in place)
County of Primorje-Gorski kotar – Town of Rijeka	SO_2 , O_3(1)
City of Zagreb and the Zagreb County	SO_2, O_3(1)
County of Istria	O_3(1)
County of Split-Dalmatia	O_3(2)

(1) Decision on ozone is to be verified by measurement results of 2007, and measures are to be based on the analysis of the local ozone formation

(2) After installation of the ozone station in Split

To take actions under the Emergency Plan or, in general, to make a decision on the start of actions it is necessary to have pollution forecasts available. Such models are already in place as part of rehabilitation programmes implemented by some emission sources (Mlaka Refinery). Such models should take into consideration major sources which require application of emission reduction measures, with due regard to the development of weather forecasts. The models should be easily applicable. At a later stage they will be expanded, if required, especially in relation to ozone formation.

➲ ***MKA-6. Amending regulations that govern the operation of an installation in case of defective emission reduction equipment, during start-up, suspension and test run***

According to Article 128 of the Regulation on Limit Values of Pollutant Emissions from Stationary Sources (Official Gazette), in case of defective emission reduction equipment the installation may be continuously run for 24 hours at the most or for a total of 120 hours yearly. This Article should be amended. Firstly, an installation should not be operated in case of a failure of particulate traps in large thermal power plants, because this could cause very high pollution with adverse effects on human health. Secondly, the decision to go on with the operation of the installation must be brought in line with the Emergency Measures Plan and regulations relating to the field of construction.

➲ ***MKA-7. Prompt response of inspectors***

According to the Environmental Protection Act, inspectors may at any time inspect the installation and issue a ruling on certain measures, if an exceedance of emission limit values likely to pose threat to human health, assets and the environment is suspected. The Action Plan in Case of Critical Pollution Levels must foresee an inspection of the emission status at sources that are major contributors to pollution in the area observed as the initial step under the scenario of actions.

7.2.2. Investment-type Measures and Implementation

➲ ***MKI-8. Providing conditions for emergency reduction of emissions from stationary sources and transport (by applying technical and organizational measures)***

When drawing up the Plan, due account must be taken of technical feasibility and costs of measures. In case of the emergency reduction of sulphur dioxide emissions, the solution is the use of low sulphur fuels or a temporary production reduction. The use of low sulphur fuels implies that the installation must have an additional tank available for low sulphur fuel, which is fairly expensive and not feasible in certain locations. A production reduction, here relating to refineries in Sisak and Rijeka and the Rijeka thermal power plant , entails also high costs and the duration of implementation is limited. Refineries and thermal power plants are parts of the energy system and therefore every switch in production must be announced well in advance. A reduction in the production of Zagreb district heating plants is an especially delicate task in winter, when problems in heat supply might occur. If a pollution episode is forecast to last for a short time, i.e. from several hours to one day, priority should be given to measures of a reduced exposure of population. This means that it is recommended to avoid staying long outdoors and to decrease the ventilation rates of the rooms (instructions given by the Regulation on Critical Levels of Pollutants in the Air, Official Gazette No. 133/05). The indoor concentrations of SO_2, NO_2 and ozone are half the size of those measured outdoors. A good level of protection is, therefore, reached already by staying indoors. In case of the occurrence of critical ozone levels we speak of a forecast pollution episode lasting several days, because ozone is formed by chemical reactions of precursor gases (mainly as a result of NO_2 and VOC reactions) in the presence of the sunlight. High concentrations may occur during summer, so that actions should focus on transport and large sources of VOCs and NO_x emissions. Here it should be noted that installations can decrease production in order to reduce NO_x emissions over a short period of time only, which should be thoroughly analysed from the cost-benefit aspect.

7.3. MEASURES TO REACH TOLERANCE VALUES, IF EXCEEDED

The Air Protection Act provides that in the area with the third category of air quality rehabilitation measures shall be taken in order to reach tolerance values *(TV)* in the short and limit values *(LV*) in the long run. Tolerance values represent temporarily a milder limit. The Regulation on Limit Values of Pollutants in the Air (Official Gazette No. 133/05) defines tolerance values for SO_2, NO_2, smoke, PM_{10}, $PM_{2,5,}$ benzo(a)pyrene, H_2S, benzene and CO. These values will be considered acceptable until the date specified by the Regulation, being 31 December 2010, with the exception of $PM_{2,5}$ (2015), benzo(a)pyrene (2012) and annual mean tolerance value for NO_2 (2014). These deadlines are longer for substances that are mostly a consequence of traffic-related emissions, whose elimination will take several years. The tolerance values scheme established complies with the EU Directive on Ambient Air Quality Assessment and Management (96/62/EC) and accompanying EU legislation on emission limit values.

The exceedance of tolerance values or the air quality category III occurs in urban and industrial agglomerations of **Sisak, Rijeka (Mlaka, Kostrena, Viškovo), Zagreb and Kutina**.

Table 7.3-1: Exceedance of tolerance values (TV) as measured in 2006 at national and local network stations

Station	Pollutant	Type of exceedance
Sisak 1[1)]	SO_2	1-hour
	H_2S	1-hour, annual average
Sisak - suburb[2)]	H_2S, SO_2	24-hour
Rijeka 1[1)]	H_2S	1-hour
Rijeka 2[1)]	O_3	8-hour and 24-hour
Rijeka-Trogirska ulica[2)]	H_2S, SO_2	1-hour
Zagreb - Prilaz baruna Filipovića[2)]	PM_{10}	24-hour
Kutina 1[1)]	H_2S	1-hour
Kostrena - Urinj[2)]	PM_{10}	24-hour
Viškovo - Viševac[2)]	O_3	8-hour and 24-hour

1) National network stations
2) Local network stations

Major sulphur dioxide and hydrogen sulphide polluters are the refineries in Rijeka and Sisak and the Carbon Black Plant and Petrochemical Industry in Kutina, while traffic-related emissions, emissions from combustion plants and fugitive emissions contribute to the particulate matter (PM_{10}) pollution. It should be noted, however, that a tolerance value does not imply a risk for health, because values surely affecting human health are from ten to a hundred times as large, except certain substances such as suspended particulate matter for which there is no threshold of harmful effect.

Additional measures and activities required

➲ ***MTI-(1-5). Implementation of rehabilitation programmes to achieve the air quality category II***

Sisak (MTI-1)

The rehabilitation programme to be applied by the Town of Sisak is in place. INA should make every effort to rebuild the installations in order to meet the deadlines set. In the short run it would be particularly useful if INA introduced a pollution forecasting model and applied specific emission reduction measures based on forecasts. Some experiences in this connection has already had the Mlaka Refinery.

Rijeka (MTI-2)

By implementing a programme of short-term measures the Rijeka Refinery must reach the air quality category II. Through consistent implementation of the programme the Mlaka Refinery should prove that measures are both implementable and effective and the shutdown of the plant not justified, because it would inflict substantial economic and

social damage. In the meantime the Refinery is expected to draw up a long-term programme for mitigation of effects with the aim to prove that by applying additional measures this effect may be kept within limits that make it possible to reach the air quality category I. With effect from 2010 no tolerance values (*TV*) will apply and the Refinery, including all other emission sources in the area, will have to comply with new more stringent limit values.

Kutina (MTI-3)

The Petrochemical Industry (Petrokemija d.d.) developed a rehabilitation programme for the reduction of H_2S emissions that was adopted by the Town Council late in 2007. The measures laid down by the rehabilitation programme were given priority in the Programme for Air Quality Protection and Improvement in force in Kutina and are expected to be implemented during 2008.

Zagreb (PM_{10})(MTI-4)

The particulate matter (PM_{10}) pollution in Zagreb comes from various sources: traffic, large combustion plants, district heating plants, small combustion plants, industrial and fugitive emissions. When pollution causes are unknown, a rehabilitation programme is enacted by the local government. Within the framework of the programme it is necessary to investigate the spatial distribution and dominant pollution sources. Account should be taken of the fact that PM_{10} pollution consists of solid particles, sulphates, nitrates and various forms of pollutants in form of aerosols. The reduction of PM_{10} pollution means the reduction of the $PM_{2,5}$ pollution too. Since 1999 $PM_{2,5}$ data have been measured at a measuring station in Zagreb that in 2006 recorded the air quality category II (Zagreb – Ksaverska cesta). The $PM_{2,5}$ measurement data will be of top priority in relation to air pollution in urban areas over the next ten years. When developing the programme for achieving *TVs* it should be noted that by 2010 the concentrations are expected to drop below *LVs.* Only two years are left for short-term measures, which makes it necessary to carefully select cost-effective measures. As regards $PM_{2,5}$ the *LV*s are to be met by 2015.

Kostrena (MTI-5)

The particulate pollution of the Municipality of Kostrena is a result of emissions coming from the refinery, the Rijeka Thermal Power Plant and the Viktor Lenac plant. The plan for Kostrena will be prepared in 2008 and the Rehabilitation Programme for Mitigating the Effects of Benzene is currently undergoing the process of adoption.

➲ ***MTI-6. Identification of actual state in locations that the population complain about***

As known, in some locations of Croatia, close to emission sources, the population complains about the air quality, mostly in relation to unpleasant smells and particulate matter. Local governments should identify the actual state in such locations through targeted measurements or pollution modelling.

7.4. MEASURES TO REACH LIMIT VALUES, IF EXCEEDED

In 2006 the exceedance of limit values was recorded in 16 towns of Croatia. The highest loads were recorded in Sisak, Rijeka, Bakar, Kutina and Zagreb. The substances causing the air quality category II are in most cases PM_{10}, NO_2, SO_2 and O_3.

Table 7.4-1. gives an overview of the air quality category II at individual stations (concentrations above the LV, but below the TV).

Table7.4-1. LV exceedances at national and local network stations in 2006

Area	Pollutant	Type of exceedance
Zagreb-1[1)]	PM_{10}	24-hour
	BaP	yearly average
Zagreb-2[1)]	PM_{10}	24-hour
	NO_2	yearly average
Zagreb-3[1)]	PM_{10}	yearly average and 24-hour
	O_3	8-hour
Zagreb-Đorđićeva[2)]	NO_2	yearly average
	PM_{10}	24-hour
Zagreb-Ksaverska cesta[2)]	NO_2	yearly average , 24-hour
	O_3	8-hour
	PM_{10}	yearly average , 24-hour
	BaP, $PM_{2.5}$	yearly average
Zagreb-Prilaz baruna Filipovića[2)]	PM_{10}	24-hour
Zagreb-Pešćenica[2)]	PM_{10}	24-hour
Zagreb-Siget[2)]	NO_2	yearly average
	O_3	24-hour
	PM_{10}	yearly average and 24-hour
Zagreb-Susedgrad[2)]	PM_{10}	yearly average and 24-hour
Kutina-1[1)]	NH_3, PM_{10}	yearly average and 24-hour
Kutina-Meteorološki krug (K3)[2)]	NH_3	24-hour
Sisak -1[1)]	PM_{10}	yearly average and 24-hour
Sisak – suburb[2)]	PM_{10}	24-hour
Bjelovar - Matice hrvatske[2)]	SO_2	24-hour
Pazin - kam. Vranja-2[2)]	TDM	monthly average
Opatija - Gorovo[2)]	O_3	8-hour and 24-hour
Rijeka - Čandekova ulica[2)]	SO_2	24-hour
Rijeka - F. la Guardia[2)]	NO_2	24-hour
Rijeka - Krešimirova ulica[2)]	PM_{10}	24-hour
	O_3	8-hour
Rijeka – Mlaka[2)]	SO_2	24-hour

Kostrena - Urinj[2)]	SO_2	1-hour, 24-hour
Kostrena - Paveki[2)]	SO_2	1-hour, 24-hour
	benzene	yearly average
Viškovo - Viševac[2)]	PM_{10}	24-satne
Split - Poljud[2)]	NO_2	24-satne
Šibenik - centre[2)]	NO_2	24-satne
Šibenik – Vukovac [(2)]	TDM	monthly average

1) National network stations
2) Local network stations

The following is an overview of additional measures. One of very important existing measures is the adaptation of large combustion plants to new ELVs, especially those relating to SO_2 emissions.

➲ ***MGA-1. Local plans for air quality protection and improvement***

Plans have been prepared for Rijeka and Sisak and those for Kostrena and the City of Zagreb are in the process of preparation. Plans for Pazin, Viškovo, Našice, Bjelovar, Šibenik, Split, Solin and Kaštel Sućurac have yet to be drawn up.

The most wide-spread problem is the PM_{10}, SO_2 and NO_2 pollution. In the City of Zagreb the PM_{10} values are exceeded all over the city area, both the average yearly and short-time 24-hour values. The $PM_{2,5}$ value is presently measured at one measuring station in Zagreb (Zagreb-Ksaverska cesta) and three measuring stations in the area of the County of Split-Dalmatia (Kaštel Sućurac, Sv. Kajo, Solin and Split Centre). For PM_{10} and $PM_{2,5}$ there is the solidest evidence of impacts on human health, or, specifically, of chronic and acute impacts on respiratory and cardiovascular functions. The City of Zagreb, as the most densely populated area, must start solving this problem as soon as possible. The measurements show that the largest contribution to pollution in Zagreb comes from the traffic and combustion plants. Rijeka, Sisak and Kutina are exposed to a somewhat stronger impact of large point sources too.

The plans relating to PM_{10} should propose measures to reach the air quality category I by 2010 (the first stage criteria under the Regulation No. 133/05) and 2015 (the second stage criteria under the Regulation No. 133/05) respectively. The plans for NO_2 should propose measures to reach the air quality category I after 2014.

The problem with NO_2 lies mostly in the fact that it is traffic-related, with the exception of Našice, Split and Solin where a part of emission probably originates from the cement plant.

Consultations held with towns that have not yet adopted plans show that human and financial resources to address this issue are lacking. In order to be able to determine cost-effective measures that comply with the sustainable development principles it is necessary to carry out a high-standard and expert survey of the state. Decision-makers are basically not willing to finance preliminary research needed, which includes traffic studies, extra measurements, modelling and development of a spatial emission cadastre. It is therefore vital to secure stable sources of finance at the level of the local community, taking into account the damage caused by air pollution. The State may help by funding general studies, research and pilot projects. This Plan proposes the preparation of a

national transport sector study (Section: Transport) intended to assist local communities in formulation of a cost-effective policy.

SO_2 emissions in Rijeka and Sisak arise from the operation of refineries and partly thermal power plants. This should be solved by implementation of the ELV regulation, which implies the use of low-sulphur fuel oil after 2010. The City of Zagreb has banned the use of coal in boiler-houses. The existing coal-fired boiler-houses in the city are to be replaced and it is necessary to continue introducing the gas grid and extending the long-distance heating system. District heating plants should be constructed as cogeneration plants and actively involved in the promotion of energy efficiency measures and the use of renewable energy sources. New constructions and refurbishing of public institutions should meet the highest energy conservation standards.

Pollution coming from excessive deposition is connected with local sources and known polluters and all related problems are to be solved in the shortest time possible.

Measures for the reduction of ozone concentrations are discussed in Section 7.6.

➲ ***MGA-2. Programme for technical and financial support to preparation of local air quality protection and improvement plans – financial incentives of the EPEEF***

Former experience shows that in towns with LV or TV exceedances much has been argued over polluters and their contributions to pollution. Some shift the blame on somebody else and local sources point the finger at transport and small combustion plants. Surveys that might give answers are very rarely commissioned. For most of the towns such surveys are too expensive and the sources are not willing to provide funds because not obliged by the law. Human resources are insufficiently competent for preparation of such plans and consulting firms fail to provide adequate answers. The state of the environment reports demonstrate a low level of knowledge, even the ignorance of elementary facts. For example, from many plans it is evident that 'experts' sum up emissions of various pollutants and produce total figures, which is professionally unacceptable. The Plan envisages the establishment of a technical and financial support to the preparation and implementation of local air protection plans. This support will be particularly needed when towns start combating ozone, very small particles, smog and toxic substances.

Resolution of issues relating to LV exceedances will be largely assisted by the following measures that are laid down by the current legislation or would be taken regardless of the Plan.

➲ **MGI-3. Further extension of the gas supply system throughout Croatia and giving priority to the use of gas in small household combustion plants**

Natural gas has been available for the towns of northern Croatia for a number of years already. The construction and start of operation of the gas pipeline from Pula to Karlovac in November 2006 provided the possibility to introduce the gas supply system into the counties of Istria and Primorje-Gorski kotar and to improve gas supply of the County of Karlovac. A gas pipeline branch to be constructed on the route Bosiljevo-Split will mean the extension of the gas supply system towards Dalmatia.

The available volumes of natural gas in Croatia will play a key role in the reduction of PM_{10} and NO_2 pollution. At present cogeneration plants in Zagreb, Osijek and Sisak are powered by natural gas and fuel oil, but gas supplies do not suffice at production peaks

and the highest levels of air pollution. Certain supplies of gas are secured by storing gas in underground gas storage facilities, but the overall gas supply and size of underground storage facilities of INA are insufficient. Priority should be given to the use of gas in small household combustion plants, while in thermal power plants it should be used in high-efficiency cogeneration plants for energy conversion.

It is expected that after 2012 Croatia might be allocated new gas import quotas, which would provide good conditions for the reduction of PM_{10} and NO_2 emissions in all towns, especially in Zagreb, Osijek and Sisak. It should be noted that NO_x emissions are also produced by gas combustion, but the volumes are 30-50 per cent below those coming from the use of liquid fuels.

➲ **MGI-4. Encouraging the use of centralized heating systems in towns**

The objective of eliminating emissions from towns may be accomplished by applying long-distance heating. Croatia has a long tradition of the use of centralized heating systems. Simultaneous generation of electrical and heating energy is accompanied by the generation of useful energy at an efficiency factor of 75 – 90 per cent.

➲ **MGI-5. Giving priority to the use of gas in cogeneration plants**

The use of natural gas in classical direct-process installations, in existing thermal power plants and as a substitute for fuel oil or coal is neither cost-effective nor is it a solution that should be fostered. It should be noted that 30-40 per cent of energy is lost in this way. The use of natural gas must focus on new high-efficient cogeneration plants.

7.5. MEASURES FOR THE REDUCTION OF TOTAL TRAFFIC-RELATED EMISSIONS

In the period 2000-2005 the consumption of fuel kept increasing at an annual rate of 4.4 per cent on average. The growth mentioned is a result of a marked increase in the use of diesel fuel at a rate of 5.2 per cent over the last five years, while the consumption of petrol dropped by 2 per cent. In 2005 the diesel fuel accounted for 53.9 per cent and petrol for 38.4 per cent. Road transport accounted for 99.7 per cent of traffic-related fuel consumption, the rail transport for 2.4 per cent, the public transport for 1.8 per cent, the air transport for 5.2 per cent and other types for 0.1 per cent.

In 2004 there were 1.65 mil. vehicles in Croatia, of which 1.29 mil. passenger cars. The age of the existing vehicle fleet is about 10 years on average. The number of vehicles increases yearly by 4-5 per cent. An important segment of traffic in Croatia are the transit and the tourist transport. In these transport forms the fuel consumption will continue to rise.

Internal combustion engines produce a number of harmful substances: nitrogen oxides (NOx), volatile organic compounds (VOC), sulphur oxides (SO_x), carbon monoxide (CO), greenhouse gases, fine particulate matter (PM_{10}, $PM_{2,5}$), heavy metals, benzene, 1-3 butadiene, formaldehyde, acetaldehyde and other toxic and potentially toxic compounds. Those emissions primarily depend on the vehicle/engine technology and fuel properties. In view of the fact that the efficiency of emission reduction techniques used in vehicles depends on the fuel too, effective measures must include standards for fuels and standards for vehicles/engines. Apart from measures for the reduction of emissions coming from vehicles, another effective measure is the substitution of road transport with other forms of transportation.

Besides being caused by fuel combustion, emissions are also produced by evaporation of fuels, especially petrol. The wear and tear of brake linings and tyres causes emissions of particulate matter. Especially high emissions are a result of the road dust suspended in the air, which has become a serious problem in many towns and is very likely one of the major causes of elevated pollution levels at some locations. Other major contributors to emissions apart from the road transport are mobile sources and the machinery.

Vehicle emission standards are expressed in grams of the matter emitted per km travelled on average for a typical drive cycle. There are emission standards that apply to light (passenger cars and light-duty commercial vehicles) and heavy-duty vehicles (trucks and buses). The titles of the EU regulations for light-duty vehicles are abbreviated to EURO 1, EURO 2, etc. and for heavy-duty vehicles to EURO I, EURO II, etc. The standards are applied to limit CO, HC, NO_x and PM emissions. The EU legislative framework consists of a number of directives, with the first dating back to 1970. The main directives defining the EURO emission standard are:

EURO 1 (1993)	For passenger cars For passenger cars and light-duty trucks	91/441/EEC 93/59/EEC
EURO 2 (1996)	For passenger cars	94/12/EC, 96/69/EC
EURO 3 (2000)	For all vehicles	98/69/EC
EURO 4 (2005)	For all vehicles	98/69/EC, 2002/80/EC
EURO 5 (2008/9/10)	For all vehicles	Draft COM(2005)683
EURO 6 (2014)	For all vehicles	EU Thematic strategy (2006)

The EURO 4 is in force, whereas EURO 5 and EURO 6 are currently under negotiation to be implemented with effect from September 2009 and 2014 respectively. As compared to EURO 4 light-duty vehicles, those covered by EURO 5 will produce five times lower PM and 66 per cent lower NO_x emissions. Emissions coming from petrol engines will not decrease substantially (23 per cent for NO_x emissions). Under the EURO 4 standard petrol engines produce four times lower NO_x emissions and negligible PM emissions, but CO emissions are two times higher and, unlike diesel engines, they also produce HC emissions.

In the total emission of Croatia, the road transport is the major contributor to emissions of lead, NO_x, CO and particulate matter. It accounts for 36 per cent of the share in the national emissions of NO_x; in towns this figure might be even higher. As to emissions caused by road transport, passenger cars account for 54 per cent and heavy-duty vehicles for 31 per cent of NO_x emissions. It should be noted that road transport accounts for about 20 per cent of NMVOC emissions, suggesting that problems of ozone precursors lie for the most part in other emission sources.

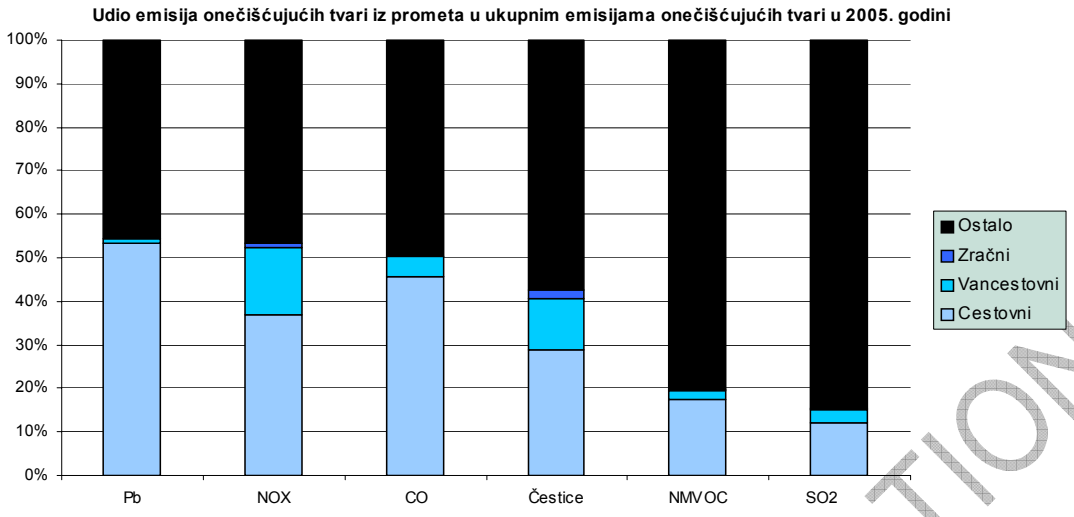

Fig. 7.5-1: Share of traffic-related pollutant emissions in total emissions of pollutants in Croatia in 2005 (Source: EKONERG, 2006)

(Prijevod u grafu:
Naslov: Share of traffic-related pollutant emissions in total emissions of pollutants in 2005
U redu ispod grafa: čestice = PM
Tekst desno: - Other
- Air transport
- Non-road transport
- Road transport)

Emissions of CO and NMVOCs show a decreasing trend, while emissions of other pollutants remained at approximately the same level. The NMVOC emissions are decreasing due to the falling share of petrol in the consumption and less fugitive emissions from new cars. In 2005 the number of cars equipped with catalytic converters was 552,000 and is rising by 10 per cent annually (vehicles inspected at stations for technical inspection of vehicles).

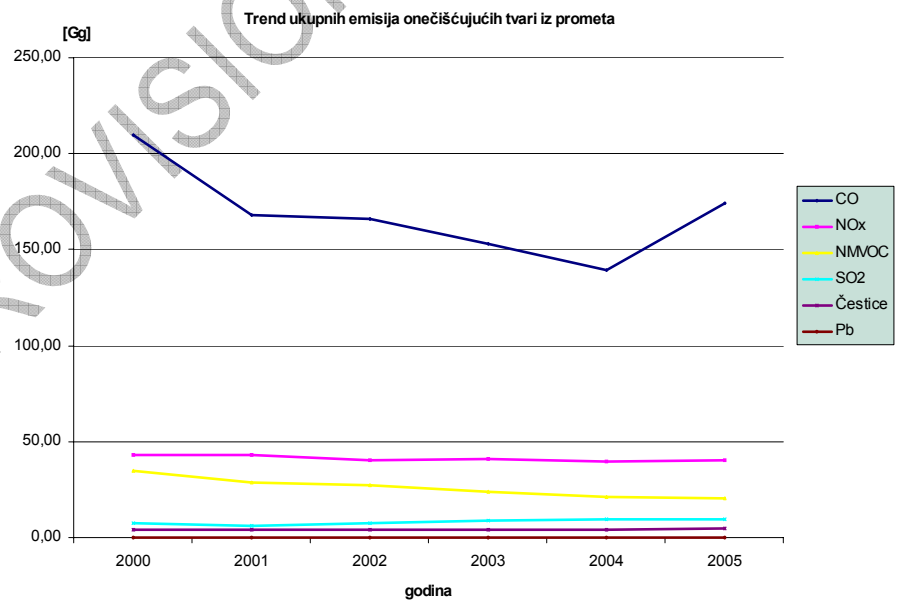

Fig. 7.5-2: Trend of emissions caused by road vehicles in the period 2000-2005 (Source: EKONERG, 2006)

(Prijevod u grafu:
Naslov: Trend of total traffic-related pollutant emissions
Ispod grafa: Year
Tekst desno: Čestice = PM)

Traffic-related emissions will be the most difficult to abate. The measures relate for the most part to technical improvements of motor vehicles and their implementation is making very slow progress. In the car industry the legislative requirements are to be announced 5-10 years in advance and the total replacement of the fleet takes as long as 20 years.

To reduce total traffic-related emissions, a mere increase in energy efficiency of cars or a reduction of emissions of exhaust gases from motor vehicles cannot suffice. The entire transport system should be reorganized and the need for travelling and travelling times reduced. For that reason Croatia needs to place greater emphasis on the establishment of a sustainable organization of the transport system. A major breakthrough can be made in this area only, because measures relating to the efficiency of vehicles and emission reductions are in the hands of technology owners and will be a result of global agreements made between the car industry and fuel producers.

The following measures relating to the transport sector are proposed in addition to those provided by the National Environmental Action Plan. Transport-related measures are also included in Section 8.

- ***MPRA-1. Spatial and urban development planning on the sustainable transport principle***

  The spatial and urban development planning are to reduce the need for travelling, raise the attractiveness of public transport, promote the use of non-motor transport and encourage the transport of goods and people with low fuel consumption and low emissions. These principles should be taken into account by each plan and their inclusion in county plans evaluated through strategic studies.

- ***MPRA-2. Higher financial incentives of the EPEEF for sustainable transport projects***

  The EPEEF must provide higher financial resources for the preparation of sustainable transport projects, promotional activities for cleaner transport and pilot projects of good transport practices, and co-finance project implementation. The preparation of transport projects is not easy, because it requires cooperation of various sectors, and local governments lack good transport studies and databases on traffic density.

- ***MPRA-3. Preparation of the study "Analysis of the Possibility to Reduce Traffic-related Impacts on Air Pollution in Towns of Croatia"***

  This study should answer certain questions put by local planers and town governments. It is expected to help in the preparation of town plans and development plans, including air quality protection and improvement programmes. An analysis should, for example, cover the selective restrictions in the access to pollution zones, justifiability of large town garages, parking lots and garages at town entrances, the possibility and ways of encouraging the use of bicycles, subsidies for good quality public transport, benefits of town tunnels and underground transport, introduction of electric vehicles, technical possibilities of intelligent traffic regulation, etc. Measures should be analysed from the aspect of costs and benefits, and possible financing methods recommended. A good

example is, for instance, the first cost-effectiveness study for the use of biodiesel in public transport prepared by the MEPPPC, which was then followed by Zagreb and Osijek. It is proposed to develop a study to be financed by the EPEEF and the Ministry of Sea, Transport and Infrastructure with possible participation of local governments. Most of the counties lack necessary expert human resources for such studies and the repetition of surveys is not cost-effective.

➲ ***MPRA-4. Evaluation of the state in towns at the level of roads and streets***

National and local network stations do not cover entire urban areas. In towns where various levels are likely to occur, zoning should be carried out with respect to pollution. To obtain a complete picture of the state it is recommended to use mobile stations, occasional measurements and modelling. The towns with the air quality category II and III are also recommended to prepare a GIS cadastre of emissions from collective sources and the transport sector.

➲ ***MPRA-5. Pilot project of restricting and charging for the entry of vehicles into high pollution zones (CO, NO_x, NMVOC and PM)***

In many towns worldwide the ban on the entry of high emission vehicles and/or selective charging for such entry have proved an efficient pollution reduction measure. The manner of implementing such a measure should be checked by a pilot-project and good experiences subsequently disseminated. For an operational implementation it is necessary to identify the vehicle category, the amount of charge depending on the emission, selective approach criteria, technical organization of charging and restricting the entry, the method of monitoring effects of the measure on air quality and administrative and financial aspects.

It should be remembered that one vehicle under the EURO 1 category produces the emission as three EURO 4 vehicles, one truck as ten passenger cars. The measure is applicable to towns with the air quality category II and III and the traffic as the major polluter.

➲ ***MPRA-6. Use of gas and biofuel, especially in public transport and on islands***

The use of gas reduces the emissions of NMVOCs and SO_2, including the emissions of greenhouse gases (Section 8). This measure enjoys a strong economic incentive, since the price of gas is considerably lower than the price of liquid fuels. This is one of top-priority measures in towns with the air quality category II and III and is suitable for islands too.

➲ ***MPRA-7. Application of MARPOL regulations for ships***

The MARPOL convention regulations for ships should be complied with.

7.6. MEASURES FOR MITIGATION OF ADVERSE EFFECTS OF ACIDIFICATION, EUTROPHICATION AND GROUND-LEVEL OZONE

Despite implementation of the Gothenburg Protocol, critical loads relating to acidification and eutrophication of forest ecosystems and surface waters[10] will still be exceeded in a great part of Europe. In 1990 an exceedance of acidification was found on 60 per cent of the forest land and in 2010 it will amount to 20 per cent. As regards eutrophication, in 2010 the exceedance will cover 45 per cent of forest vegetation. The target ozone concentrations of 120 μg/m^3 needed to protect human health will hardly be achieved across Europe. Realistically, a long-term objective of an accumulated exceedance above 40 μg/m3 (AOT40) for vegetation below 6,000 ug/m^3/h may only be achieved in ten or more years. For that reason the emission reduction quotas set by the Gothenburg Protocol will soon be revised and made more stringent.

In Croatia a major breakthrough has been made regarding the reduction of 'acid' gas emissions. As compared to 1990 the SO_2 emissions dropped by as much as 62 per cent and the emissions of NO_x and ammonia by some 20 per cent. In recent years emissions of NO_x and NH_3 have been gradually increasing. The emission of gases contributing to acidification has dropped by a total of 40 per cent.

7.6.1. ADDITIONAL MEASURES AND ACTIVITIES REQUIRED

The Republic of Croatia is not able to solve the problem of acidification, eutrophication and ground-level ozone by taking measures on its own. Just like in the majority of other European countries, only a part of total deposition and ground-level ozone in Croatia comes from in-country sources. In previous sections it was showed that ground-level ozone concentrations at rural stations in Makarska and Gadište exceeded those measured in Rijeka, Zagreb or in the surroundings of the Plomin Thermal Power Plant. This problem should therefore be solved jointly at the European level, by complying with the obligations under the Gothenburg Protocol and the LRTAP Convention. Since the resolution of this issue in Croatia depends for the most part on emission reduction in other countries, especially the neighbouring, Croatia must be interested in a successful implementation of obligations under the protocol. This implies participation in activities of numerous working groups involved in the defining of obligations of individual states through expert documents and calculations.

Apart from the reduction of total precursor emissions according to obligations under the LRTAP Convention, it is necessary to investigate and apply measures not entailing excessive costs for the country's emission sources. The coastal region and especially the Bay of Kvarner and Istria are areas of the primary concern. Pollution modelling for typical zones of Europe carried out within the framework of surveys needed for the development of the European ground-level ozone abatement policies indicated that in the Mediterranean (e.g. in Athens) local impacts may be more powerful due to daily circulations of the air and topography.

By its National Environmental Plan Croatia has set the objective of reducing emissions of SO_2, NO_x, NH_3 and NMVOCs in accordance with the Protocol on the Abatement of Acidification, Eutrophication and Ground-level Ozone.

In 2010 emissions should be reduced compared to 1990 by the following amounts:

[10] Critical load is defined as a quantitative estimate of the level of exposure to one or more harmful substances below which, according to present knowledge, no significant harmful effect on a specific sensitive individual in the environment is expected. A sensitive element of an ecosystem may be a part of an ecosystem and/or an ecosystem as a whole.

SO_2	61 %
NO_x	0 %
NMVOC	14 %
NH_3	19 %

➲ ***MZA-1. Preparation of the national plan for the reduction of emissions of sulphur dioxide, nitrogen oxides and particulate matter from large combustion plants***

By the end of 2008 the MEPPPC will prepare a comprehensive national plan for the reduction of emissions of sulphur dioxide, nitrogen oxides and particulate matter from large combustion plants and gas turbines.

➲ ***MZA-2. Implementation of the National Plan for the Reduction of Emissions from Existing Large Combustion Plants and Gas Turbines***

By the end of 2007 the operators submitted programmes for the reduction of emissions of SO_2, NO_x, and particulate matter into the air and reports on complying with ELVs as set by the recent Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 21/07). Emissions are expected to drop considerably by 2012, not so much owing to rebuilding the installations as through the construction of new substitute combustion plants. The Croatian Electric Power Industry has chosen the strategy of an accelerated phasing out of old production units and the replacing of old units with new high efficiency natural-gas-fired plants. Installation of desulphurization plants and DENOX equipment would not be cost-effective for old boilers. By 2012 one 230 MWe gas-fired cogeneration plant will have been constructed in the Sisak Thermal Power Plant (50 MWt for heat supply) and one 100 MWe plant in the Zagreb Heat and Power Plant (80 MWt for heat supply). This will contribute to the reduction of fuel oil consumption in thermal power plants. After 2010 the sulphur content in fuel oil shall be below 1 per cent, which will substantially reduce emissions of SO_2 and indirectly of PM_{10} from thermal power plants in Zagreb, Rijeka, Osijek and Sisak.

➲ ***MZA-3. Programmes for the reduction of VOC emissions from activities with ELV exceedances***

The Regulation on Emission Limit Values provides that by the end of 2007 programmes for the reduction of VOC emissions must be drawn up for activities producing excessive emissions of VOCs.

➲ ***MZA-4. Setting national emission ceilings and determination of framework measures to meet the same***

Croatia is bound to transpose the EU Directive 2001/81/EC on national emission ceilings for certain pollutants (NEC Directive). The NEC Directive has been adopted as an implementation instrument of the Gothenburg protocol, but emission ceilings for certain states are even more stringent than regulated by the Protocol. Here account should be taken of the announced revision of the Gothenburg protocol and the NEC Directive. Emission reduction quotas and implementation rules will be defined by a special regulation.

➲ ***MZA-5. Drawing up the National Ozone Pollution Reduction Plan***

The issue of the ground-level ozone is present throughout the Republic of Croatia, both in rural and urban areas. Given the complexity of the problem as regards regional pollution sources, local emission sources, climatic factors and orography, the local governments will not find it simple to lay down cost-effective measures. The plan should provide framework guidelines with instructions intended for individual sectors and specific areas. The plan may also set framework emission ceilings for ozone precursors and lay down guidelines for certain areas of Croatia. For the development of this plan it is necessary to establish the Pollutant Emission Register and prepare the spatial distribution of emissions across Croatia in the GIS grid.

➲ ***MZA-6. Bilateral talks on emission reduction plans***

The major contributors to transboundary pollution are Italy, Bosnia and Herzegovina, Serbia, Hungary and Germany. Therefore a bilateral exchange of information on the status, measures and plans is required. In this regard use should be made of the obligations for EU countries arising from the Espoo Convention on the assessment of transboundary impacts of new activities.

➲ ***MZA-7. Active participation in working groups of the LRTAP/UNECE Protocol***

The Gothenburg Protocol revision is currently in the process of preparation. The first simulations of the 2020 scenario and, consequently, of new obligations for the states have been created. Croatia has not yet joined these analyses, so that the data used are relatively old or assumed in the best possible manner by international institutions that prepare inventories. In view of the fact that a successful protection against acidification, eutrophication and ground-level ozone depends on the results, Croatia should become actively involved in working groups, primarily in the process of preparing a new Gothenburg Protocol draft. For each of the topics the national focal centres (some are available) and competences among cooperating institutions are to be defined and continuous funding provided.

➲ ***MZA-8. Ozone modelling project for the Kvarner Bay and Istria***

The entire coastal region of the Adriatic is exposed to a high risk of ozone. The areas of the Kvarner Bay and Istria are particularly interesting in view of development plans and the existence of a number of large sources of ozone precursor emissions, with exceedances of ozone tolerance values occurring both in urban and rural areas. To determine measures it is first of all necessary to identify ozone formation causes and processes. The experiences will later be used for other areas. The project includes identification of the spatial distribution of emissions, targeted measurements of ozone precursors, preparation of meteorological data, linking with regional European models, model selection and calibration, calculation based on complex models, interpretation of results and recommendations for protection policies.

➲ ***MZA-9. Acidification, eutrophication and ground-level ozone to be attached appropriate importance in strategic environmental impact studies***

When determining the contents of a strategic environmental impact study a prominent role is to be given to acidification, eutrophication and ground-level ozone aspects.

➲ ***MZA-10. Development of the Code of Good Agricultural Practices***

The reduction of ammonia emissions calls for the development of the Code of Good Agricultural Practices and introduction of financial incentives for their application.

➲ ***MZA-11. Establishment and support to focal centres for LRTAP Convention issues***

Within the framework of the LRTAP Convention there are a lot of working groups dealing with emissions, strategies, effects, critical load mapping and calculation, international cooperation project for forests (*ICP Forest*), international cooperation project for waters (*ICP Waters*) and a working group for integrated assessment modelling. The countries are obliged to cooperate in all working groups. So far Croatia has been actively involved in cooperation relating to emissions, critical load mapping for forest ecosystems and monitoring the degradation of forests, and participates currently in the *ICP Waters.* It is necessary to appoint technical focal centres for key issues and to finance priority activities and projects. At present it is vital to maintain activities relating to emission inventories, emission projections and surveys related to critical loads and dynamic modelling.

➲ ***MZA-12. Reduction of emissions of volatile organic compounds in certain products***

The Regulation on Limit Values of Volatile Organic Compounds Contained in Certain Paints, Varnishes and Vehicle Refinishing Products (Official Gazette No. 94/07) complies fully with the EU Directive 2004/42/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products amending the Directive 1999/13/EC.

The main purpose of this Regulation is to limit the total content of volatile organic compounds in certain paints and varnishes and vehicle refinishing products in order to prevent and reduce air pollution caused by the emission of these compounds into the air.

The Regulation defines limit values for the content of volatile organic compounds in certain paints and varnishes and vehicle refinishing products that may be placed on the market of the Republic of Croatia, deadlines for the achievement of those values, marking, the quality assessment methods and the method of proving the compliance.

7.7. MEASURES FOR THE REDUCTION OF EMISSIONS OF PERSISTENT ORGANIC POLLUTANTS AND HEAVY METALS

➲ ***MPOA-1. Definition of limit values of POP emissions into the air from stationary sources for which values have not been set, and application of technical guidelines***

The Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 21/07) defines the ELV of 0.1 ng/m^3 for dioxins and furans in waste gases coming from waste incinerating plants and in waste gases resulting from co-incineration of wastes in industrial and power plants. This limit value complies with the EU Directive 2000/76/EC relating to all types of waste incinerating plants and co-incineration of wastes.

It is necessary to analyse and define emission limit values for POPs, or technical measures for the reduction of POP emissions in those production processes that are potential sources of POP emissions, such as:

- pulp production using elementary chlorine or chemicals generating elementary chlorine for bleaching;
- secondary copper production;
- sintering plants in the iron and steel industry;
- secondary aluminium production, and
- secondary zinc production.

➲ ***MPOA-2. Issuance of technical guidelines on the reduction/elimination of the production and use of substances and products containing POPs under the Stockholm Convention***

Technical guidelines on the reduction / elimination of the production and use of substances and products containing POPs, which will be detailed in the POP inventory, should be issued with the aim to reduce / eliminate the discharge of by-products into the environment.

➲ ***MPOA-3. Enacting a programme for implementation of the IPPC Directive and application of best available techniques for reducing emissions of POPs***

A programme for the application of the principle of best available techniques is in to the process of preparation. The programme may follow the guidelines from the UNEP document *Best available techniques (BAT) and best available practices (BEP) for reducing and/or eliminating emission of POPs by-products*.

➲ ***MPOA-4. Development and application of the system for controlling the implementation of regulations on POPs***

The control over implementation of regulations requires an efficient inspection control. The inspection control system needs to be improved for the sake of an effective control over implementation of regulations on POPs.

➲ ***MPOA-5. Voluntary agreements with companies or industrial groups***

One of the fundamental environmental policy determinants that complies with the EU environmental policy and requirements arising from the Stockholm Convention is the establishment of the partnership between economic development and environmental standards. A partnership approach may be established through agreements made with companies or industrial groups that aim at reducing / eliminating the discharge of by-products into the environment. Special agreements and benefits should encourage investments into environmental protection, introduction of cleaner and sustainable technologies and application of BAT technologies.

➲ ***MPOA-6. Mapping of critical loads of heavy metals and establishment of monitoring***

The methodology of mapping critical loads of heavy metals was identified in the context of the international cooperative programme on "Mapping and Modelling of Critical Loads" under the LRTAP Convention. These mapping activities cover ecosystems, vegetation and surface waters. In Croatia mapping has yet to be carried out and adequate monitoring proposed on the basis of threat assessment.

➲ ***MPOA-7. Reporting and public information activities***

Activities of educating, reporting and informing stakeholder groups and the general public are of utmost importance for a successful implementation of the Plan. They are aimed at providing an easy and timely access to information and encouraging and facilitating participation in the decision-making process. It is necessary to develop information exchange mechanisms and educational programmes and to organize trainings.

The programme of activities should include:

- development of educational programmes and organization of trainings for implementation of the Plan;
- preparation of instructions, assessment of the progress made in implementation of the Plan and reporting in line with the requirements under the Stockholm Convention;
- providing the general public and all stakeholders with information on implementation of the Plan.

➲ ***MPOI-7. Phasing out substances and products polluted with POPs or likely to generate POPs, handling and final disposal of wastes polluted with POPs, remediation of sites polluted with POPs***

According to the requirements of the Stockholm Convention it is necessary:

- to elaborate objectives and implementation procedures for phasing out substances and products polluted with or likely to generate POPs;
- to elaborate implementation procedures for handling and final disposal of wastes polluted with POPs;
- to identify potential locations polluted with POPs and elaborate objectives and implementation procedures for remediation of such locations.

8. REDUCTION OF GREENHOUSE GAS EMISSIONS, PROMOTION OF ENERGY EFFICIENCY ENHANCEMENT AND USE OF RENEWABLE ENERGY SOURCES

8.1. CLIMATE CHANGE

The issue of changes in the Earth's climate is considered a predominant environmental concern of the 21st century. Climate change and its effects are reflected in a number of phenomena: temperature change, change in the amount and pattern of precipitation, sea-level rise, frequency of extreme weather events, changes in water resources, ecosystems, biodiversity, agriculture, forestry and health, and in considerable economic damage.

During the last 100 years the air temperature increased by 0.7 °C on a global and by 1 °C on a European scale. The year 2000 was the warmest year in Europe and seven warmest years were recorded in the last 14 years. Climate model projections indicate that in the next 100 hundred years the average annual temperature is likely to increase by 1.4 – 5.8 °C globally and by 2.0 – 6.3 °C in Europe.

The decade from 1991 to 2000 was the warmest decade of the 20th century both worldwide and in Croatia. In that period the rise in the mean annual air temperature was more marked in the coastal area than on the mainland. During the 20th century annual amounts of precipitation showed a downward trend throughout Croatia. Changes in the incidence of days with low-intensity rain and a higher incidence of dry days contribute to the reduction in annual amounts of precipitation.

According to the climate change scenario for Croatia, the future climate between the years 2040 and 2050 will be characterized by the rise in temperature, especially at ground level (up to a height of 2 m) regardless of the season. Warming will be stronger in summer than in winter; in some places the seasonal average will be more than 2.5°C higher.

The issue of climate change at the global level is addressed by the United Nations Framework Convention on Climate Changes (UNFCCC). The Convention was open for signature at the Rio de Janeiro summit in 1992 and has been since ratified by 190 countries.

The Republic of Croatia became a Party to the UNFCCC in 1996 when the Croatian Parliament passed the Act on its ratification (Official Gazette – International Treaties, No. 2/96). By the same Act and pursuant to Article 22 of the Convention, Croatia, as a country undergoing a process of transition to market-oriented economy, assumed the scope of its obligations under Annex I to the Convention. By doing this Croatia has pledged, among other things, to keep its greenhouse gas emissions at their 1990 levels.

The Protocol to the UN Framework Convention on Climate Change was adopted in 1997 and came into force on 16 February 2005, after having been ratified by 66 Annex I countries whose total emissions exceed 55 per cent of total emissions measured in Annex I countries (1990 emissions).

The Republic of Croatia signed the Kyoto Protocol in 1999, but has not ratified the same due to negotiations about the base year. Pursuant to Annex B of the Protocol Croatia is bound to reduce greenhouse gas emissions in the period 2008-2012 by 5 per cent in relation to the base year. After five years of negotiations the Decision 7/CP.12 on the level of greenhouse gas emissions for the base year in Croatia was adopted at the Twelfth Conference of Parties to the UNFCCC held in Nairobi in November 2006. The Conference of Parties decided: "… that Croatia, having invoked Article 4.6 of the Convention shall be allowed to add 3500 Gg CO_2 equivalent to its 1990 level of greenhouse gas emissions for the purpose of establishing

the level of emissions for the base year for implementation of its commitments under Article 4.2 of the Convention."

On 27 April 2007 the Croatian Parliament passed the *Act to Ratify the Kyoto Protocol to the United Nations Framework Convention on Climate Change* (Official Gazette – International Treaties, No. 5/07). On 28 August 2007 the Kyoto Protocol came into effect for the Republic of Croatia as the 174th country that ratified. With the aim to ensure the implementation of commitments assumed by the Parties with regard to the reduction of emissions defined by the Protocol, a decision was taken laying down procedures and mechanisms relating to the compliance with the obligations specified. Regarding quantified emission limitations the decision provides that should the emissions of a Party in the period 2008-2012 exceed the assigned amounts, this exceedance shall be multiplied by 1.3 and subtracted from the assigned amount for the second commitment period 2012-2020.

8.2. EU CLIMATE CHANGE POLICY

The European Union is a world leader in global efforts to combat climate change and intends to keep this position in the future. It has been recognized that benefits of taking early actions far surpass the damages likely to occur in the future and risks with regard to the competitiveness of the European economy. The first (2000-2004) and the second (2005-) European Climate Change Programme charted the long-term route towards economy based on a minimum of carbon and major changes in energy generation, consumption and transport.

In 2003 EU emissions accounted for 14 per cent of overall global greenhouse gas emissions. Under the Kyoto Protocol the EU pledged to reduce emissions by 8 per cent (EU-15), at the same time agreeing on a certain degree of flexibility allowed by an internal reduction scheme for certain states.

The EU Environment Council supports the target of limiting the global temperature rise to a maximum of 2°C in comparison with the pre-industrial era. In this regard the EU has recently set the emission reduction target of 20 per cent in 2020 against 1990, and is even ready to reduce emissions by up to 30 per cent, provided that other industrialized countries do the same.

8.3. GREENHOUSE GAS EMISSIONS IN CROATIA

The annual inventory of greenhouse gas emissions of the Republic of Croatia has been continuously prepared according to the guidelines of the UNFCCC Secretariat and the methodology introduced by Intergovernmental Panel on Climate Change[11] since 2001, when it was developed for the first time in the context of preparing the First National Communication. Until now Croatia has submitted to the UNFCCC Secretariat four reports on emissions, the last one in 2008. Each report shows improvements in the accuracy of inventory in terms of methodology and input data. Within the framework of the annual communication Croatia is bound to make recalculation of the entire series of historical emissions from the last year to the base year 1990.

[11] Intergovernmental Panel on Climate Change - IPCC

According to the Decision 7/CP.12 made by the Conference of Parties to the UNFCCC Croatia was allowed to add 3500 Gg CO_2 eq to the 1990 emission, which means that **Croatia's base year emission amounts to 34620 Gg CO_2 eq.**[12]

In 1990 the aggregate greenhouse gas emission was 31124 Gg CO_2 eq and in 2004 29432 Gg CO_2 eq. In 2004 carbon dioxide (CO_2) accounted for 76.6 per cent, methane (CH_4) emissions for 10.2 per cent and nitrous oxide (N_2O) for 12.4 per cent of emissions. The rest were hydrochlorofluorocarbons (HFC, PFC) and sulphur hexafluoride (SF_6).

Table 8.3.-1:Greenhouse gas emissions/removals in the period 1990-2004 (Gg CO_2 eq), by sectors

Sector	1990	1995	2000	2001	2002	2003	2004	Average rise 2000-2004 %
Energy	22,489	16,391	18,858	19,907	21,137	22,536	22,050	3.8
Industrial processes	3,930	2,021	2,840	2,816	2,704	2,823	3,181	2.8
Agriculture	4,406	3,121	3,095	3,196	3,235	3,278	3,558	3.4
Waste management	298	380	475	504	533	555	642	7.2
Total emission	**31,124**	**21,913**	**25,268**	**26,424**	**27,609**	**29,192**	**29,432**	3.7
Land use change and forestry	-14,437	-20,535	-19,285	-17,777	-16,796	-16,648	-16,321	-4.2
Net emission	**16,687**	**1,378**	**5,983**	**8,647**	**10,813**	**12,544**	**13,111**	17.8

Table 8.3.-2: Greenhouse gas emissions/removals in the period 1990-2004 (Gg CO_2-eq), by gases

Greenhouse gas	1990	1995	2000	2001	2002	2003	2004
Carbon dioxide	23,035	16,250	19,417	20,434	21,498	22,883	22,551
Methane	3,233	2,532	2,544	2,690	2,745	2,925	3,015
Nitrous oxide	3,920	3,123	3,284	3,251	3,317	3,221	3,677
HFCs, PFCs, SF_6	937	8	23	49	49	164	189
Total emission	**31,124**	**21,913**	**25,268**	**26,424**	**27,609**	**29,192**	**29,432**
Carbon dioxide (removal)	-14,437	-20,535	-19,285	-17,77	-16,796	-16,648	-16,321
Net emission	**16,687**	**1,378**	**5,983**	**8,647**	**10,813**	**12,544**	**13,111**

[12] During preparation of the Air Quality Protection and Improvement Plan for the Republic of Croatia the Greenhouse Gas Inventory Report for the Period 1990-2005 (NIR 2007) was prepared too. Due to the recalculation made in certain sectors the greenhouse gas emission in 1990 amounted to 31,552 Gg CO_2 which is by 1.38 per cent higher than in the previous report that covered the period 1990-2004 (see Table 13-1).

Figure 8.3-1 shows the contribution of individual sectors to the overall emission and greenhouse gas sinks in 2004. The major contributors are the energy sector (74.9 per cent), agriculture (12.1 per cent), industrial processes (10.8 per cent) and waste management (2.2 per cent). This structure with some slight changes remained during the entire observed period from 1990 to 2004. In the period 2000-2004 the emission increased at a rate of 3.7 per cent, except the energy sector (3.8 per cent). The "coverage" of greenhouse gas emissions by the removal of carbon dioxide in the forestry sector amounted to 55.5 per cent.

The total greenhouse gas emission per capita in Croatia is among the lowest in comparison with the EU and Annex I countries. The total contribution of Croatia to greenhouse gas emissions is particularly low from the aspect of net emissions. Over a half of emissions is absorbed into the forest increment. The share of emissions coming from electricity generation is lower than in other countries because of a large share of hydropower plants and the fact that electricity coming from other republics of ex-Yugoslavia has been compensated by larger imports in the period until recently.

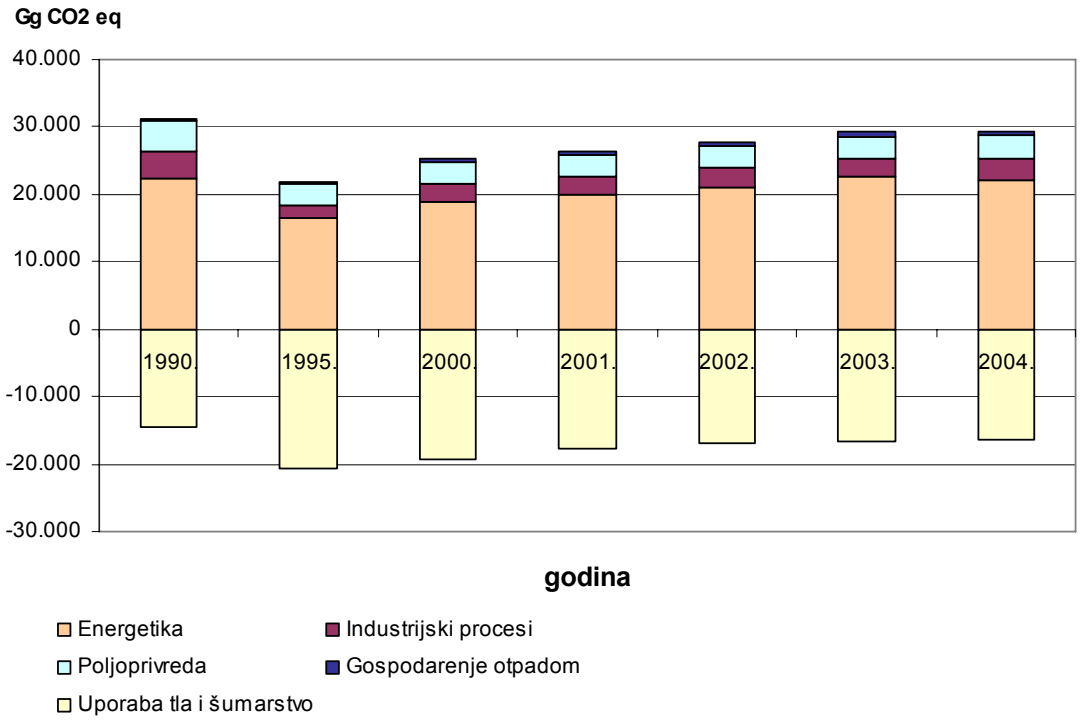

Figure 8.3.-3. Greenhouse gas emissions and removals by sectors in Croatia in the period 1990-2004 (Gg CO_2 eq)

Prijevod u slici:

Year

- Energy
- Industrial processes
- Agriculture
- Waste management
- Land use and forestry

8.4. OBJECTIVES BY THE YEAR 2012

The objective is to restrain the rise in greenhouse gas emissions in the period 2008-2012[13] in order to reduce the overall emission of such gases by at least 5 per cent

[13] Seen as the annual average in the period 2008-2012.

below the base year level. This objective is to be accomplished by application of cost-effective measures, possibly without any significant international trading in emission reduction rights.

Individual objectives set for the period by 2012 are as follows:

- establishment of necessary organizational and administrative capacities for implementation of the UNFCCC and the Kyoto Protocol;
- expediting to a maximum degree the transposition of the EU acquis communautaire in the field of climate change;
- integration of the climate change policy into sectoral strategies;
- active participation of Croatia in development of the commitment scheme for the period after 2012;
- establishment of a research and development programme on climate change issues.

The principal measures are:

- use of renewable energy sources;
- energy efficiency improvement in generation, transmission and consumption of energy,
- use of low-carbon fuels, particularly natural gas;
- measures in industrial processes, where cost-effective;
- waste management measures.

Specific priority measures are:

- use of wind power plants;
- use of biomass for heat generation;
- improvement of insulation and energy efficiency in building construction;
- use of biomass in cogeneration plants;
- use of biodiesel and other biofuels in transport.

These measures have been given priority from the aspect of development benefits, feasibility and contribution to objectives of abating climate change.

The following is an overview of major activities and measures. For each measure the main implementation instruments have been identified, mostly regulations or a financial scheme.

8.5. MEASURES AND ACTIVITIES IN ENERGY GENERATION SECTOR

The energy generation sector includes installations for generation of electrical and thermal energy in public power and thermal power plants and installations for the production and processing of oil and gas.

Major activities and measures are:

➲ ***MCI-1. Promoting the application of renewable energy sources in electricity generation***

By 2010 the share of renewable energy sources in electricity generation will be minimum 1100 GWh/year, i.e. 5.8 per cent of the total electrical energy. The greatest part of this production will be realized by the construction of wind power plants, followed by biomass, small hydropower, geothermal and solar plants. The application of renewable sources will be the major contributor to the reduction of greenhouse gas emissions in the period until 2012.

At present Croatia has a total of 17.15 MW of installed production capacities in wind power plants in two locations: on the island of Pag (VE Ravne-1) and in the Šibenik hinterland (VE Trtar-Kritolin). The construction of further wind power parks with the capacities of 10 – 30 MW is in the process of preparation and has aroused great interest of domestic and foreign investors. In 2006 the Croatian Electric Power Industry (HEP) founded a separate company HEP Renewable Energy Sources with highly ambitious construction plans.

Croatia has relatively great potentials for the use of biomass coming from forestry, agriculture and wood processing industry. This relates to the use of biomass appearing as a by-product and wastes generated in forestry, agriculture and industry. For the time being energy plantations (plantations of quickly growing trees, energy grasses, algae and oil rape plantations) are no suitable solutions for Croatia.

Croatia's power system includes currently 16 small hydropower plants with the total capacity of 27 MW (5-MW power plants) of which two are industrial and three are privately owned. These last were constructed in 1997. It is expected that by 2012 about ten new power plants with the total production capacity of 24 GWh in 2010 will have been constructed.

As to the use of other renewable energy sources, the use of geothermal energy has good prospects, especially for heating purposes. The foreseeable capacities for electricity generation by the year 2012 are about 5 MW.

This measure is implemented by the Regulation on the Minimum Share of Electrical Energy Produced by Renewable Energy Sources and Cogeneration That Are Encouraged (Official Gazette No. 33/07) which has set the targets with regard to the share in production from renewable energy sources. The Regulation on Financial Incentives to Encourage Electricity Production from Renewable Energy Sources and Cogeneration (Official Gazette No. 33/07) defines the charge collected from the consumers in addition to the electricity charge with the aim to secure the monies needed for financing the incentive tariff. The Tariff System for Generation of Electricity from Renewable Energy Sources and Cogeneration (Official Gazette No. 33/07) defines incentive tariffs for various forms of renewable sources (sources below 10 MW), distinguishing between sources up to 1 MW and over 1 MW. The highest incentive tariffs relate to solar and geothermal power plants.

Moreover, it is planned that some measures with a specific effect on the reduction of greenhouse gas emissions will be implemented even without a special financial incentive.

A part of reductions might be due to savings achieved in the sector of oil and gas production, as a result of upgrading the refineries. The plan presupposes a continuous supply of electrical energy from the Krško Nuclear Power Plant and a slight increase in the production as a result of increased capacities (cooling system extension). The reference scenario includes the enhanced energy conversion efficiency of thermal power plants due to the replacement of old power plants with the new ones. Thanks to two new combined cycle cogeneration gas power plants planned to be constructed by 2010 the consumption of fuel oil will be cut.

- ***MCI-2. Promoting the application of cogeneration (simultaneous generation of thermal and electrical energy)***

Simultaneous generation of electrical and thermal energy enhances the effect of conversion of fuel into useful energy and helps reach the total conversion degree of 75-

90 per cent. Cogeneration is economically justified in case of long-lasting energy demands and a sufficiently high consumption of heat and, if possible, the demand for industrial steam.

In Croatia cogeneration has a long tradition, with the first plants dating back to the beginning of the 20th century. When speaking of the application of cogeneration we distinguish cogeneration for the purpose of long-distance heating as part of public district heating plants, industrial cogeneration plants and small-scale and micro cogenerations in the household and services sector.

Currently installed cogeneration capacities in Croatia amount to 675 MW (492 MW in public district heating plants and 180 MW in industrial heating plants) which is about 14 per cent of the total electricity generation capacities. In 2004 large public district heating plants generated 2,120 GWh electrical energy, of which some 1,270 GWh may be considered cogeneration. Industrial heating plants generated further 535 GWh, so that in 2004 the aggregate cogeneration accounted for 13.5 per cent of electricity generated.

The rise in cogeneration of public power plants is considered a common practice scenario, or a 'without measures' scenario. **The Plan defines the additional production target of 400 GWh from new industrial cogenerations in 2010.** This target is set by the Regulation on the Minimum Share of Electrical Energy Produced by Renewable Energy Sources and Cogeneration That Are Encouraged (Official Gazette No. 33/07) and the above mentioned subordinate legislation defines incentive tariffs and methods of collecting the incentive monies.

8.6. MEASURES AND ACTIVITIES IN ENERGY CONSUMING SECTORS – INDUSTRY, HOUSEHOLDS AND SERVICES

Energy consumption in industry contributed with 10 per cent to the total emission of greenhouse gases. In the period 1990-1995 emissions coming from this sector decreased from 5.600 Gg CO_2 /year to 3.200 Gg CO_2/year in 2003. This emission reduction is for the most part a result of the shutdown of the Bakar Coke Oven Plant and the blast furnaces of the Sisak Ironworks, and the drop in the production of cement works and fertilizers production. The shutdown of the non-ferrous metals factory in Šibenik caused a considerable drop in electricity consumption (this emission is recoded in the balance under the power plants sector). The major contributor to emissions is the production of construction materials and mineral products accounting for 60 per cent, chemical industry for 15.1 per cent and food production with 14.7 per cent.

The greatest attention is to be paid to the household and services sector, because it shows the relatively highest energy reduction potentials. About 40 per cent of emissions come from energy consumption in this sector. The problem lies, however, in the fact that these measures need to be implemented over a long period of time. Many measures prove cost-effective if new equipment and techniques are applied upon expiry of the life cycle of old equipment only or if refurbishing is needed (improvement of insulation of buildings).

In 2007 the Energy Efficiency Master Plan (EEMP) for the period 2008-2016 was drawn up by the Ministry of Economy, Labour and Entrepreneurship in collaboration with the UNDP. The Master Plan covers the sector of households, services and industry and defines objectives in line with the European Directive on Energy Conservation 2006/32/EC. The objective is to enhance energy efficiency by 1 per cent yearly. The Air Protection Plan takes into account measures under the EEMP and sets out a somewhat more ambitious yearly target of a 1.5 per cent rise in energy efficiency for the households and services sector and a 1 per cent rise in the industry sector.

➲ ***MCI-3. Reduction in fossil fuel consumption through utilization of biodegradable municipal wastes in district heating plants or landfill biogas***

The thermal utilization of wastes is understood to be in line with the Waste Management Plan of the Republic of Croatia (Official Gazette No. 85/07) according to which the waste management concept consists of three basic principles – avoidance, evaluation, deposition. At the same time this implies implementation of landfill remediation and closure measures and the development and establishment of regional and county waste management centres with pretreatment of wastes before final disposal or deposition that includes the mechanical-biological waste treatment procedures.

Here it should be noted that, in case of thermal treatment of wastes, only the portion of biogenic origin (wood, paper, straw, shells, etc.) contributes to the reduction of greenhouse gas emissions.

Besides generating electrical and/or thermal energy, the thermal treatment of wastes reduces considerably the greenhouse gas emissions in comparison with waste deposition at dumps where no system for biogas collection and burning is available. If thermal incineration is compared with the deposition in a landfill equipped with the methane collection system, and if all of this methane is used for energy generation purposes, then the difference is relatively smaller, providing that the observation period is longer. However, one should remember that the use of landfill biogas for energy purposes is not economically justified for small landfills and that greater thermal capacities can hardly be achieved. The first landfill-gas-fired power plant in Croatia has been operating since 2004 on the Prudinec-Jakuševac landfill in Zagreb (2x1 MW). All other landfills whose gas cannot be used for energy generation should be remedied and equipped with gas collection and treatment systems. When assessing the benefits of the construction of thermal waste treatment plants all variants are to be analysed taking into consideration the overall waste management system.

As regards the reduction of greenhouse gas emissions, this Plan presumes that a thermal waste treatment plant will be constructed pursuant to the decision taken by the City of Zagreb to construct such a plant.

MCI-4. Reduction in fossil fuel consumption through the use of biodegradable municipal wastes in cement industry

It is assumed that by 2012 fossil fuels used in cement industry will be replaced by the so-called refuse derived fuels (RDF) to the amount of 20 per cent. The Waste Management Plan defines technological procedures of municipal waste treatment and use before final disposal to waste management centres, whereby the procedures of mechanical-biological waste treatment are considered the RDF generation procedures. The use of RDFs results in a lower consumption of primary energy sources – conventional fossil fuels. The RDF component of the biological origin is considered neutral with regard to CO_2 which contributes directly to CO_2 emission reduction. Incineration of wastes of fossil origin has no positive effect on the reduction of greenhouse gas emissions (waste oil, plastics, rubber, etc.), but it saves fossil fuels. A precondition for implementation of this measure is the provision of wastes of a stable volume, composition and structure. As yet implementation instruments for these two measures have not been elaborated, because associated with a certain risk. This risk relates to project approval at the local level and harmonization of interests of public utilities, energy sector and cement industry. Another key element is the public perception of those projects. Their importance lies in the fact that through application of all waste

management measures (methane emission reduction, fossil fuel substitution, etc.) emissions can be reduced by 780 Gg CO_2 eq in 2012, or by 2.2 per cent of the base year emission.

➲ ***MCA-5. Credit supply programme for the preparation of renewable energy sources projects in Croatia through the Croatian Bank for Reconstruction and Development***

The credit supply programme for the preparation of renewable energy sources projects is a part of the *GEF/IBRD* grant awarded to the Republic of Croatia for implementation of the Renewable Energy Resources Project. The basic purpose of the grant is to encourage the development of an economically and ecologically sustainable market of renewable energy sources in the Republic of Croatia and to create a stimulating surroundings for investments in renewable energy sources utilization projects. Credits are granted for preparation of projects dealing with renewable energy sources, including biomass, small hydropower plants (up to 10 MW), geothermal and solar energy (wind power plant projects are excluded). The credit is used to finance preparation of public and private sector projects. The project implementation agency is the Croatian Bank for Reconstruction and Development and the EPEEF participates in the project as a partner – co-financer in the segment of preparing and financing the development of specific projects. The role of the Fund is to evaluate projects proposed by credit candidates from the technical and technological aspect and to assume debt servicing obligations if the credit has not been used. The programme implementation activities are faced with barriers, because the construction of renewable energy sources is governed by a number of regulations that fall within the competence of various government bodies whose activities are insufficiently coordinated.

➲ ***MCA-6. Promoting the use of renewable energy sources and energy efficiency through the Environmental Protection and Energy Efficiency Fund***

This Fund was established by the Act on the Environmental Protection and Energy Efficiency Fund (Official Gazette No. 107/03) with the aim to secure finance for preparation, implementation and development of programmes and projects dealing with environmental protection, energy efficiency and use of renewable energy sources, including the climate change mitigation. The necessary finance is secured from earmarked Fund revenues raised from "polluter pays" charges, which include charges for nitrogen oxide, sulphur dioxide and carbon dioxide emissions, environmental user charges, charges for environmental load by waste and special environmental charges for motor vehicles.

When co-financing the projects, the EPEEF pools the financial resources and coordinates activities with financial instruments of the Ministry of Economy, Labour and Entrepreneurship and the Croatian Bank for Reconstruction and Development. In programmes relating to co-financing of commitments the EPEEF must fully comply with the strategy of implementing the UNFCCC and the Kyoto Protocol in the Republic of Croatia.

The past experience of the EPEEF shows that good quality projects are lacking. This is partly due to the fact that so far stimulation conditions were mostly based on credits with relatively small financial share. It turned out that entrepreneurs lacked information, knowledge and capacities needed to prepare projects. The practice applied by the Fund to provide finance for energy reviews is a good way to launch projects. In the future the Fund should dedicate a portion of the finances to project preparation and establish a

project cycle on the GEF model, where a project develops through a number of stages depending on the amount of co-financing. This is of particular relevance to Croatia, because cost-effectiveness of certain measures may only be achieved by aggregating small-scale projects and thus achieving synergy and reducing organizational and other costs. The Fund should give attention to all stages of a life cycle of a technological solution. This means, from the point of production and fuel preparation, energy transformation and generation plants, to the disposal and re-use of by-products and wastes. Each project evaluation must take into consideration the following criteria:

- **cost-effectiveness** (profitability, marginal cost of CO_2 emission reduction, commercial availability of the technology applied);
- **contribution to Environmental Strategy and Protection objectives** (greenhouse gas emission reduction, reduction of other emissions, energy and fossil fuels savings);
- **development benefits** (job creation, building up capacities and know-how, effects on export and development, agricultural security).

Projects showing very high profitability and emission reduction effects should be financed by the Fund in the total amount, in the first place according to the ESCO model (remuneration from energy savings). However, in order for an ESCO model to start functioning a number of shifts is to be made, for example those relating to aspects of regulating legal relationships among the parties. It turned out that companies did not have confidence in such a concept and that those who understand its operation find the risk that the funds will not be repaid to the investor too high. If a client fails to pay for the services to an ESCO company, its chances to have the investments repaid within a reasonable time are very small. It is therefore necessary to introduce instruments to reduce the risks of various parties in the business, clients, the ESCO company and banks. The Fund could cover the risk or at least a greater part of the risk until the judiciary becomes operational.

From the CO_2 charge the Fund will have 10-20 million Euro available yearly, of which at least 80 per cent should be used to encourage projects and programmes and the rest to finance the construction of new facilities and co-finance research and operating costs. The finance allocated to encourage projects may partly be used to purchase emission allowances on the international market, if the emission allowance prices on the international market will be lower than costs of domestic measures.

➲ ***MCA-7. Promoting energy efficiency through implementation of the project "Removal of Barriers to Energy Efficiency in Croatia"***

This four-year project was launched by the Ministry of Economy, Labour and Entrepreneurship and the United Nations Development Programme (UNDP) in July 2005 with the aim to promote application of cost-effective energy efficiency technologies and procedures in the sectors of households and services in Croatia, so as to reduce energy consumption and the related greenhouse gas emissions. The necessary finance to the amount of 4.4 million USD was secured by the Global Environmental Facility (GEF), while the domestic financial institutions are expected to co-finance the project during its implementation with 7.9 million USD. Target groups of the project are households, service sector facilities and public facilities responsible for about 40 per cent of total energy consumption in Croatia. The project aims to raise public awareness, assist local governments of the counties and towns in application of measures intended to public facilities and support the capacity building for systematic energy management at local levels. In 2006 two pilot projects for energy efficiency enhancement were launched – "Systematic Energy Management in Towns – Sisak" and "Home in Order". A systematic

capacity building is currently in progress in the counties of Sisak-Moslavina, Karlovac and Split and in the towns of Sisak, Koprivnica, Bjelovar, Karlovac and Split.

The EPEEF participates also in co-financing the information campaign of the project with a total of 9 million kunas in the period 2007-2009. The Fund is expected to join the project "Systematic Energy Management in Towns and Counties" with a total of 20 million kunas in 2008 and 2012, and in the programme "House in Order" with a total of over 47 million kuna in the period 2008-2012. The total anticipated share of the Fund will exceed 76 million kunas.

➲ *MCA-8. HEP ESCO energy efficiency programme*

The energy efficiency programme for Croatia was initiated by the International Bank for Reconstruction and Development (IBRD) and the Global Environmental Facility (GEF) in collaboration with the Croatian Electric Power Industry (HEP) and the Croatian Bank for Reconstruction and Development (HBOR). The purpose of the project is to increase consumer demand and the market-based supply of services and energy efficiency projects.

To this end HEP founded a company for the provision of energy services (HEP ESCO) tasked with the preparation, financing and implementation of energy efficiency projects. The total project value including cooperation of domestic banks is estimated at 40 million USD to be provided during 6 years of project implementation. HEP ESCO was extended a loan by the World Bank to the amount of 4.4 million USD and a GEF grant amounting to 5 million USD. The project beneficiaries are owners and occupants of various types of buildings, thermal energy consumers, building industry associations, manufacturers of construction machinery and materials, building renovators, local offices for street lighting, etc. HEP ESCO is currently running over 50 projects in the field of street lighting, building construction, industry and energy supply system, at various stages of development, implementation and financing. By 2012 the project finance is anticipated to amount to 10 million USD yearly.

➲ *MCI-9. Measures of energy efficiency upgrading in building construction*

Energy efficiency in building construction may be upgraded by a number of measures, but primarily by reducing heat losses. The target set as a measure to improve thermal insulation of new constructions is the maximum heat loss of 100 kWh/m^2 for new apartments, which is below the former EU average for new constructions (100-150 kWh/year). In comparison with the present average heat losses of 200-250 kWh/m^2 this is an improvement by over 70 per cent.

The implementation instrument for this measure is a set of laws transposing the EU Directive 2002/91/EC on Energy Performance of Buildings. So far this Directive has been only partly transposed into Croatian legislation: the segment relating to minimum energy performance requirements has been transposed into the provisions of the Building Act and related subordinate legislation (Technical Regulation on Thermal Energy Savings and Thermal Protection of Buildings (Official Gazette Nos. 79/05, 155/05, 74/06), and the Ordinance on Required Energy Efficiency Grades for New Hot Water Boilers Fired by Liquid and Gaseous Fuel (Official Gazette No. 135/05) has set down requirements for energy efficiency grades of new 4-400 kW hot water boilers fired by liquid and gaseous fuel, introduced the energy efficiency labelling and laid down conformity assessment procedures.

This Directive will be transposed in full by the Ministry of Environmental Protection, Physical Planning and Construction through amending the Building Act and enacting enforcement regulations in 2008 regulating:

- the area of air-conditioning and ventilation of buildings (regulation in the process of preparation);
- design, construction and maintenance of heating systems in buildings;
- certification of new and existing buildings, certification ways and methods and certificate contents;
- conditions and criteria for assigning authorization to certificate issuers, building auditors and persons who inspect certain parts of buildings in order to identify energy performance, and
- education programmes for independent experts responsible for building certification and inspection relating to energy performance.

The Ministry of Economy, Labour and Entrepreneurship is in charge of the transposition of the Directive through enactment of enforcement regulations in the field of energy and industry in 2008 regulating:

- the method of carrying out regular inspections of hot water boilers and air-conditioning systems;
- conditions and criteria for authorizing persons for such inspections;
- education programme for independent experts responsible for inspection of hot water boilers and air-conditioning systems.

➲ ***MCA-10. Energy efficiency labelling of household appliances***

The 2005 Ordinance on Energy Efficiency Labelling of Household Appliances (Official Gazette No. 133/05) provides that electricity-driven household appliances produced in or imported into the Republic of Croatia must be energy efficiency labelled before placing on the market. The Ordinance applies to electric refrigerators, freezers, household washing machines, tumble-driers, dishwashers, household lighting, air-conditioners and ovens. In line with the European standards energy efficiency classes A++, A+, A, B, C, D and E were introduced. Class A++ freezers and refrigerators use up to 70 per cent less energy than old appliances. The application of this measure requires continuous public awareness raising and education, especially education of salespersons and building their active approach.

➲ ***MCA-11. Setting up a framework for the establishment of ecological design requirements***

This measure will be implemented through transposition of the EU Directive on Eco-Design. The Ministry of Economy, Labour and Entrepreneurship and the Ministry of Environmental Protection, Physical Planning and Construction will transpose this directive through a separate regulation in 2008.

8.7 MEASURES AND ACTIVITIES IN THE TRANSPORT SECTOR

In the period 1998-2003 the traffic-related yearly consumption of fuel increased by 4.4 per cent on average and even by 7.6 per cent over recent years. This rise is a consequence of a considerable increase in the use of diesel fuel by 9.9 per cent and petrol by 0.6 per cent in the last five years. The most difficult task in the transport sector will be to reduce greenhouse

gas emissions. Measures are implemented at a slow pace and relate mainly to improvements in technical performances of vehicles. The experience shows that traffic-related measures may sometimes have an adverse effect; for example, the improved flow rate of vehicles may increase the overall size of the traffic and thus the emissions too.

Transport sector related measures have a considerable impact on the reduction of emissions of other harmful substances and were outlined in previous sections. A particularly efficient measure for Croatian towns is the construction of bike lanes, improvement of the public transport quality and intelligent traffic regulation.

➲ ***MCI-12. Raising attractiveness of rail transport***

To become attractive for the conveyance of passengers and goods, the rail transport quality needs to be improved. This implies the development of suburban passenger rail transport, terminals at city entrances, truck transport terminals, railways electrification, opening of new corridors, introduction of excursion trains for bike transport, shortening the journey times, adaptation of the timetable to passenger needs, harmonization of the timetable with Jadrolinija, etc. In towns the public rail transport should be encouraged by an attractive pricing policy and by merging transport zones. In this regard some good projects and initiatives have been recorded in Croatia recently – a truck terminal in Spačva, extension of passenger platforms around Zagreb, etc.

➲ ***MCI-13. Introduction of biofuel***

An important instrument for implementation of this measure is the Ordinance on Biofuel Quality (Official Gazette No. 141/05) whose national indicative target is the replacement of 5.75 per cent of total liquid fuels with biogas by 2010. The Decision Relating to the Biofuel Percentage in the Total Share of Fuels in 2007 and the Volume of Biofuels to be Placed on the Domestic Market in 2007 (Official Gazette no. 43/07) shows the share of biofuels in the total energy-related fuel consumption in 2007 to be 0.9 per cent, which is equivalent to 22,000 tonnes of biodiesel. In Croatia the biodiesel production has started in the Ozalj plant with a production capacity of 20,000 tonnes/year and in Virovitica 6,300 tonnes/year are produced from waste edible oil. There are plans to construct a bioethanol production plant of a large capacity. According to the Strategy, in 2010 a total of 15 per cent of diesel fuel and petrol will be replaced with biofuels. The accomplishment of this objective requires a proactive agricultural policy. The domestic production is currently heavily insufficient, so that new production facilities rely on import raw materials.

➲ ***MCA-14. Promoting the use of low CO_2 vehicles***

Passenger cars manufactured in 1995 emitted about 180 g CO_2/km and those in 2003 about 164 g CO_2/km. The goal of the European Climate Change Programme is to develop low consumption vehicles emitting 140 g CO_2/km (equivalent to a consumption of 4.5 l/100 km for diesel fuel and 5 l/100 km for petrol) by 2008-2009 and 120 g CO_2/km by 2010-2012. The EU is negotiating with car manufacturer associations in Korea, Japan and Europe (KAMA, JAMA, ACEA) on reaching the above mentioned goals which is not progressing at a planned pace. Hybrid vehicles produce also emissions of this size. In order for this measure to be effective, a better consumer information is needed. In this regard, in 1999 the EU launched the fuel economy and CO_2 labelling scheme for new passenger cars. Fuel consumption may be reduced up to 25 per cent by driving economically, without any extra technical measures. In November 2007 the Ordinance

Relating to Availability of Data on Fuel Efficiency and CO_2 Emissions from New Passenger Cars (Official Gazette No. 120/07) was adopted, whereby each supplier of new passenger cars intended for sale must provide information on fuel and CO_2 efficiency at each point of sale, including promotional fairs. Moreover, a guide is prepared on a yearly basis containing a list of all new passenger car models available on the market in the Republic of Croatia in the current year and a list of ten new passenger car models showing the highest fuel efficiency by values of a specific official CO_2 emission arranged in ascending order. The guide gives also a recommendation to drivers relating to the proper use and regular maintenance of their cars and driving habits that reduce fuel consumption and, consequently, the CO_2 emissions too.

➲ ***MCA-15. Promoting the use of gas in vehicles***

In Croatia round 15,000 tonnes of liquefied petroleum gas (LPG) are used by motor vehicles yearly, which is 4 per cent of the total liquefied petroleum gas consumption and round 1 per cent of diesel fuel and petrol used. Croatia has about 90 liquefied petroleum gas filling stations and the total number of passenger cars run on gas is estimated at 30,000. In 2006 the Vehicle Centre of Croatia issued 10,492 certificates for passenger cars running on gas (3,463 in 2005). Besides the LPG, there are currently about a hundred cars operating on compressed natural gas (CNG) with the total annual consumption of 90,000 cubic metres. In comparison with petrol, the use of LPG causes no significant reduction in CO_2 emissions because emissions by the GJ of fuel used differ by 10 per cent only, whereby the gas-powered vehicles have a slightly higher consumption. Differences could be notable, if gas-powered vehicles replace those run on diesel fuel in the future. It is assumed that the number of LPG powered motor vehicles will increase fivefold (150,000 vehicles) by 2010. Currents incentives are very attractive, because the costs of gas are half the size of liquid fuel costs, so that conversion to gas pays off in a short time.

8.8. MEASURES AND ACTIVITIES IN THE SECTOR OF INDUSTRIAL PROCESSES (NON-ENERGY EMISSIONS)

This sector participates in total emissions with some 11 per cent, of which 90 per cent originate from the production of cement, nitric acid and ammonia. Emission reduction in the process of cement production may be achieved through the reduction of the share of clinker in cement (energy-related measures in the cement industry are laid down in the sector of industrial energy consumption). This measure by itself will be dependent on the market and new production standards and cannot be imposed by regulations.

➲ ***MCA-16. N_2O emission reduction measure in nitric acid production***

A measure for N_2O emission reduction in nitric acid production is the application of non-selective catalytic reduction (NSCR), which means that N_2O is reduced to N_2 by using ammonia with a conversion efficiency of 80-90 per cent. Due to relatively low limit costs and a high emission reduction potential this measure is very attractive and profitable. It may be implemented by defining emission limit values for N_2O as part of integrated environmental protection conditions and its co-financing will be made possible through the incentive scheme of the EPEEF or corrective factors within the framework of CO_2 charges.

8.9. MEASURES AND ACTIVITIES IN THE WASTE MANAGEMENT SECTOR

In the total greenhouse gas emission of Croatia the waste management participates with around 2 per cent. In line with the Waste Management Strategy measures to be taken are based on three principles: avoidance, evaluation, deposition. By proper waste management emissions may be reduced through separation of the biodegradable portion of waste prior to deposition and methane at the landfill itself. An even greater reduction is achieved by using wastes instead of fossil fuels.

➲ ***MCI-17. Burning or thermal utilization of methane captured at landfills***

At municipal landfills conditions must be provided for the **burning or thermal utilization of methane** wherever possible. As a result of waste recovery measures, the share of biodegradable wastes deposited to landfills will gradually decline in the future.

8.10. MEASURES AND ACTIVITIES IN THE SECTOR OF AGRICULTURE

This sector is responsible for 12 per cent of greenhouse gas emissions. A number of measures can be implemented in agriculture: carbon storage in agricultural soils, improvements in application or organic and mineral fertilizers for the purpose of reducing nitrous oxide emissions, emission reduction due to internal fermentation reduction, anaerobic fermentation associated with degradation of organic fertilizers and biogas production. There are predispositions for agriculture to provide raw materials for biogas production. By 2010 further 90,000 – 100,000 hectares of agricultural land should be planted in oilseed rape and the cultivation of other biogas crops encouraged. Certain amounts of biogas and plant residues are foreseen to be used for energy purposes, but this is of minor relevance compared to other measures. The application of other measures in agriculture entails socio-economic risks that cannot be adequately perceived at the moment. Other measures can be taken into consideration once a plan for greenhouse gas emission reduction in agriculture is developed, which is foreseen for 2009.

➲ ***MCA-18. Action plan for the sector of agriculture from the aspect of adjustment to climate change and reduction of greenhouse gas emissions***

This plan should analyse possible agricultural measures and socio-economic aspects of their application.

8.11. MEASURES AND ACTIVITIES IN THE SECTOR OF LAND USE, LAND USE CHANGE AND FORESTRY

According to the provisions of the Kyoto Protocol, in the sector of land use, land use change and forestry (*LULUCF*) two types of activities are allowed which can be emission sources or sinks. Emission sinks occur in a country when total carbon reserves in biomass increase due to anthropogenic activities. Sinks can be achieved through afforestation of areas not covered by forests, taking into consideration activities after 1990. In Croatia an area of some 300,000 hectares of forest land is available on which, by afforestation and planting of fast-growing pioneer types of trees, carbon reserves of several thousands of Gg CO_2/year might be created. After 1990 afforestation was very rare in Croatia and therefore sinks due to new afforestation cannot be used for the first commitment period under the Kyoto Protocol, i.e. by 2012. This measure is of relevance to the period after the Kyoto Protocol. Another way is to

use the removal by greenhouse gas sinks caused by re-vegetation, forest management and agricultural land management activities. In this connection Croatia needs to select activities and notify accordingly the Conference of Parties not later than a year after having become a full member of the Kyoto Protocol. Reduction on any other grounds based on forest management activities is only possible up to a limited assigned amount, for Croatia not more than 972 Gg CO_2/year. In order to submit an application to take advantage of Article 3.4 expert analyses are to be carried out and data prepared in accordance with the prescribed requirements.

➲ ***MCA-19. Decision on taking advantage of Article 3.4 of the Kyoto Protocol***

Given the stable forest increment recorded so far in Croatia and not expected to change in the foreseeable future, it is estimated that there are good reasons for Croatia to apply for the application of Article 3.4. All aspects of this decision need to be analysed and a final decision on the selection of activities taken on the basis of an expert analysis, which should include the Initial Communication that Croatia is bound to submit to the UNFCCC Secretariat by the end of August 2008.

Apart from the above mentioned measures, in the forestry sector the exploitation efficiency and the use of wood need to be increased. Wood mass residues from all processing stages must be used. Energy measures imply greater use of forest biomass in the generation of electrical energy by small co-generation plants, industrial boiler rooms and individual household combustion plants. In 2002 Croatian Forests launched a pilot project of forest biomass-fired district heating plants entitled "16 Forest Management Boards – 16 Biomass-fired District Heating Plants". Until now district heating plants have been constructed in Ogulin and Gospić and are planned to be constructed in Delnice, Našice, Đurđevac and Krasno. These district heating plants are part of a centralized heating system to which, apart from the Forest Management Board, the adjacent users from the local self-government unit are connected, such as public institutions, hospitals, schools, town governments, kindergartens, etc. In March 2007 a company was founded named Forest Biomass in charge of the collection of stacked and fine energy generating wood, splintering and baling of wood chips.

8.12. INTERSECTORAL MEASURES AND ACTIVITIES

➲ ***MCA-20. Establishment of the system of trading in CO_2 emission allowances***

The system of trading in CO_2 emission allowances will be introduced in Croatia on the model of the EU Emissions Trading Scheme. In line with this scheme, the system of trading in emission allowances will cover all combustion plants over 20 MW, refineries, coke oven plants, production of iron, cement, lime and other mineral products, and paper and pulp production. The scheme established in this manner would cover approximately one third of all greenhouse gas emissions in Croatia with a total of fifty installations. The MEPPPC will consider the possibility of extending the list of installations so as to increase the market solvency and the effectiveness of the entire emissions trading scheme. The inclusion of Croatia into the European trading scheme is planned for 2010, which means that domestic installations will join the scheme in the middle of the first commitment period under the Kyoto Protocol (2008-2012), or rather in the middle of the second phase of the EU ETS.

To establish a trading scheme it is first necessary to draw up a **National Allocation Plan for Greenhouse Gas Emission Allowances** and to introduce a **National**

Greenhouse Gas Emissions Registry and a system for monitoring, reporting on and verification of greenhouse gas emissions. The trading will include emission reduction/ certified emission reduction units resulting from implementation of JI and CDM of international projects. When preparing the allocation plan for emission allowances a number of criteria according to the EU recommendations are to be respected. The essential criterion is that the total quantity of emission allowances must be in line with the target to be met under the Kyoto Protocol. In the period 2008-2012 it is foreseen that at least 90 per cent of emission allowances will be allocated freely and the rest will be sold by auctioning. When defining the amount to be allocated to individual installations account will be taken of their emissions in the previous period, the possibility of applying additional measures and development plans. In the course of 2008 the National Allocation Plan for Emission Allowances will be prepared and the National Registry established as part of the Component II. Climate Change of the CARDS 2004 project.

➲ ***MCA-21. Increasing CO_2 charge***

The CO_2 charge was introduced in 2007. The funds collected from the charge should be used to promote projects and research work. At the moment the charges are relatively low and are not expected to have a direct effect on CO_2 emission reduction. It is therefore necessary to consider the justifiability of increasing the unit charge in the period after 2009 and to analyse the relationship between the emission trading scheme and payment of the CO_2 charge, including introduction of a charge for sources not covered by it.

Should after 2009 the CO_2 charge for sources that will be included in the emission allowances trading scheme be abolished, the EPEEF will be left without a considerable portion of funds needed for promotion of energy efficiency and renewable energy sources. This calls for the development of a feasibility study for the introduction of a charge/tax on carbon in fuels that would cover all fossil fuel users with the exception of those included in the emission allowances trading scheme.

➲ ***MCA-22 Reporting under the UNFCCC and the Kyoto Protocol***

By ratifying the Kyoto Protocol the Republic of Croatia assumed a number of additional requirements and obligations relating to a comprehensive reporting on greenhouse gas emissions and emission reduction measures taken, or specifically: annual reports on emissions, biennial reports on implementation of measures and projections, and periodical reports on all issues relating to the implementation of the Kyoto Protocol in the relevant state. The Parties to the Convention are obliged to submit national communications on implementation of the provisions of the Convention in the form and with the contents as laid down for member states listed in Annex I. So far Croatia submitted the First National Communication on Climate Change in 2001 and the Consolidated Second, Third and Fourth National Communication in February 2007. The following communication is scheduled for 2009. With the view to ensure the fulfilment of obligations of the Parties with regard to communications required by the Protocol, a decision was taken as to the procedures and mechanisms relating to the compliance with the said obligations. As regards communications, should a Party fail to submit the communications required within the specified time, the right of this Party to use the Kyoto Protocol mechanisms, i.e. trading in greenhouse gas emission allowances, will be suspended. For Croatia this entails the non-adoption of the EU acquis communautaire in the segment relating to the establishment of the greenhouse gas emission trading scheme and the transposition of the Directive 87/2003/EC. The Ordinance on the Greenhouse Gas Emission Monitoring in the Republic of Croatia has set time limits for the Ministry to submit the annual Report on Greenhouse Gas Inventory (15 April), but

after accession to the EU this deadline will be shifted to 15 January. It is therefore vital that the ministries responsible for individual sectors covered by the reports (energy, transport, industry, forestry and agriculture) and the National Bureau of Statistics submit necessary information on activities within the time limits specified by the Ordinance, in order to meet the deadlines for the submission of reports under the UNFCCC and the Kyoto Protocol.

➲ ***MCA-23. Capacity building programme for implementation of the Convention and the Kyoto Protocol***

The main areas of capacity building of the national system for implementation of the Convention and the Protocol are: national greenhouse gas inventory, greenhouse gas emission projections, policy and measures including assessment of their effects, impact assessment and adaptation to climate change, research and systematic climate observation, education and public awareness, transfer of environmentally friendly technologies, national communications and national action plans, national systems for the greenhouse gas emission assessment and inventory, inventorying methods connected to targets, deadlines and national registries, reporting obligations and flexible mechanisms under the Kyoto Protocol. The project "Capacity Building for Implementation of the UNFCCC and the Kyoto Protocol in the Republic of Croatia" co-financed by LIFE Third Countries Programme of the European Commission was finished in October 2007. Further activities relating to capacity building for Implementation of the Convention and the Kyoto Protocol" need to be defined.

➲ ***MCA-24. Active participation in international negotiations about the commitment period after 2012 («Post-Kyoto»)***

In the time while common opinions are only being formulated, Croatia knows well what it means to be active in negotiations. Once the decisions are adopted, subsequent interventions are painstaking and their outcome is very uncertain, regardless of the power of argument. As is known, the request made by the Republic of Croatia to be allowed a certain degree of flexibility according to Article 4.6 of the UNFCCC relating to the emission level of the base year was approved after five years of hard negotiations.

The negotiations about the scheme of obligations after the Kyoto Protocol started in 2006. At the moment possible basic principles and the action plan are being discussed. Decisions of the UNFCCC are taken by consensus, which means that each party has equal rights in the process of negotiations and decision-making. Croatia needs to promote the approach that respects as many as possible objective issues: contribution to global emission, starting points, energy features, emission reduction potentials, economic possibilities and specific local features (Section 4.3). Specific features of Croatia have been recognized and approved by the Decision 7/CP.12 of the Conference of Parties, and should be applied as such in future consideration of obligations.

At the moment the views of developed and developing countries differ widely. Developing countries do not accept strict obligations and find the current system that limits emissions of Annex I countries good, because, as a result, they are interested in investing into projects implemented in the developing countries (CDM projects). Developed countries are willing to assume much greater obligations, with the EU being the leader only if all of them accept a quantified reduction obligation. There is disagreement, however, among the developed countries, because some of the countries with developed economies do not shrink from obligations, but see the solution

in technological development and voluntary actions, with a firm promise to continue leading in emission reduction and financial support.

In negotiations Croatia should apply the experience gathered and positions gained so far. The continuity of presence and active participation needs to be ensured, which implies permanent professional support in analysing consequences of diverse proposals.

➲ ***MCA-25. Preparation of plans, programmes and studies for efficient implementation and creation of the climate change policy***

Documents of special relevance that need to be prepared are: greenhouse gas emission projections for the period 2012-2050 (2008), a study on the definition of reference solutions for the assessment of effects of greenhouse gas emission reduction projects and programmes (2008), a study on the application of Article 3.4 of the Kyoto Protocol (2008), a study on identification of climate research programmes (2008), a national emission reduction plan with measures for the forestry sector (2009), adaptation and completion of energy development strategy of the Republic of Croatia (2008) and a national climate change adaptation plan (2010).

➲ ***MCA-26. Establishment of a research and development programme focusing on climate change issues***

Technological development should be a mainstay in combating climate change in the long run. It is known from experience that technological solutions, when commercially applied, tend to become cheaper and cheaper and their application frequently surpasses the most optimistic forecasts. Those who recognize trends in time and take the right direction have a chance to master very soon the technologies still not interesting to big businesses. For example, more than ten years ago Croatia had larger capacities for solar collector production than today and was the regional leader. By its professional potentials and technical capacities it could have become a manufacturer on a global scale until today.

So far there have been no systematic research works and development programmes to study impacts and adaptation to climate change in Croatia. One of the objectives of this Plan is the establishment of a research and development programme with the Ministry of Science, Education and Sports to be financially supported by the EPEEF. This is at the same time a precondition for the inclusion of domestic institutions in international research programmes. Research and development should focus on two areas: 1) reduction of emissions and increase of sinks and 2) climate change adaptation measures. In the long run Croatia has two options, both expected to promote the research and maintain capacities. Nuclear energy might be a solution, as it is for a number of developed countries lacking in their own energy sources. The existing research and professional human capacities should be preserved and provided the opportunity to keep pace with technological development, as they have managed to do on a shoestring budget so far. Another important option that requires research is the CO_2 injection into underground oil and gas fields, for which human capacities are available and projects prepared.

➲ ***MCA-27. National energy programmes***

The Energy Act has introduced energy programmes for the promotion of research into, planning and implementation of energy efficiency measures and renewable energy sources in various areas: PLINCRO – Gas Introduction Programme for Croatia; KOGEN – Cogeneration Development and Promotion Programme; MIEE – Industrial Energy

Efficiency Network; MAHE – Small Hydropower Plant Construction Programme; SUNEN – Solar Energy Utilization Programme; BIOEN – Biomass and Waste Utilization Programme; ENWIND – Wind Energy Utilization Programme; GEOEN – Geothermal Energy Utilization Programme; $KUEN_{zgrada}$ – Programme for Energy Efficiency in Building Construction; CROTOK – Programme for Energy Development of Croatian Islands and Development of Integrated Energy Conservation Projects for Islands, and TRANCRO – Transport Energy Efficiency Programme.

The programmes are funded from the government budget and the EPEEF and coordinated by the Ministry of Economy, Labour and Entrepreneurship. The programmes need to be adapted to and harmonized with the needs of the present Plan.

➲ ***MCA-28. Public education and information programme***

In recent years information and education activities relating to climate issues have been launched through press and electronic media. In the period until 2012 and in the future until 2025 public education and information will develop in two basic rounds, following the experience of other European countries.

Before that it should be noted, however, that a critical initial mass of educators is still missing and should be created in a carefully planned and conceived manner in accordance with the needs of the society. This core of educators will conduct educational activities and will be generated through new projects implemented in specialized institutions, at colleges and scientific institutes and citizens' associations as well. In these institutions the educational tools of various formats will be developed too.

As regards the education, the process shall take place in two rounds:

The first round will focus on continuation and systematic development of information and general education on climate change in the role of shaping public attitudes towards climate change. These activities, territorial by nature, will cover general public, citizens, and the young generation directly affected by climate change consequences, which means the government administration at the local, county and national level. This round of education is aimed at "supplying" the social environment with basic, accurate and always fresh information and knowledge about climate change issues and how they affect conditions and quality of life of humans and the overall living world. Being initial, this round has priority in the period by the year 2009. Systematic efforts in this regard started in 2006/2007 as part of the implementation of the EU LIFE Third Countries Project.[14]

The second round will focus on the applied and specialized education of individuals – actors in entrepreneurial, manufacturing and service branches of activities contributing directly or indirectly to greenhouse gas emissions in Croatia. These actors come from the sectors of energy generation, some industrial activities, agriculture (fertilizers and livestock breeding in the first line), transport and waste management. These activities need to be previously prepared by educational tools and adequate closely targeted educational supply. The overall education in this area will last from 2008 to 2010 and onward. Existing greenhouse gas emissions in Croatia require new knowledge to be acquired, extended and applied. And this is not all. The issue is wider than merely

[14] LIFE04 TCY/CRO/029 Capacity Building for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol in the Republic of Croatia

educational. Every emission reduction presupposes the organizational, financial, technological and social restructuring of actions and behaviour of immediate actors.

Education and raising public awareness are of vital importance for implementation of measures, because each individual may be actively involved through steps taken in the office, factory or at home, or at any other place. The success in implementing a number of measures is closely associated with the status of public awareness. Therefore almost every action is usually accompanied with a well conceived promotional campaign.

➲ ***MCA-29. Support to programmes and projects of the technology and know-how transfer***

A barrier to a successful implementation of measures is an insufficient level of information and knowledge of technologies available on the Croatian market. The government will foster transfer and application of new technologies through diverse activities, especially donations, and by co-financing demonstration projects and financing projects aimed at expanding knowledge of technologies and their application. The initial status of the needs for technology and know-how transfer was identified through the project *"Activities of Capacity Building for Mitigation of Climate Change: Assessment of Needs for Technology Transfer (EKONERG, 2005)*.[15] Priority has been given to technologies that will accelerate the use of wind power plants and biomass for heating, the reduction of heat losses and enhancement of energy efficiency in buildings, and the use of biofuels in transport.

8.13. APPLICATIONS OF FLEXIBLE MECHANISMS UNDER THE KYOTO PROTOCOL

The Kyoto Protocol has defined three flexible mechanisms: a joint implementation of projects shared by Annex I countries (*Joint implementation - JI*), a mechanism of climatically "clean" development projects (*Clean Development Mechanism - CDM*) and international emission trading *(IET)*.

Flexible mechanisms are a supplementary means that any Party included in Annex I to the Convention may apply to meet more easily the emission reduction target, while domestic emissions reduction measures retain the primary importance. The application of these mechanisms is voluntary for all Parties to the Convention and the Protocol, and they are expected to make every possible effort to apply measures at the national level. The application of flexible mechanisms under the Kyoto Protocol will assist in achieving emission reduction in a cost-effective way, through investments where cheapest.

The analyses show that in the first commitment period Croatia can comply with the obligations under the Kyoto Protocol by applying its own measures, should a scenario 'with measures' (see Section 7.8.10) take place, meaning that application of flexible mechanisms is not planned. In the event of underachievement in implementation of domestic measures likely to endanger the meeting of obligations under the Kyoto Protocol, the application of the emission trading mechanism is to be considered, or rather the purchase of emission units directly on the open international market.

It is expected that negotiations about commitments after the Kyoto Protocol (after 2012) will result in even more stringent requirements and that once the specific potential for emission

[15] The project was co-financed by the Global Environment Facility as part of the standard programme of support provided to Parties to the UNFCCC, with the UNDP acting as the implementing agency on the part of the GEF.

reduction by applying domestic measures is exhausted, the option of purchasing emission units from abroad will become more interesting. As yet the regulatory framework for the period after 2012 has not been established, but there is however a broad consensus within the international society that their implementation should continue with slightly changed rules, especially the CDM. It is therefore in the best interest of Croatia to become, in the first commitment period, qualified for the use of other options that will arise from international legislation defining the framework of activities after 2012.

➲ ***MCA-30. Establishment of infrastructure for application of flexible mechanisms under the Kyoto Protocol – authorization of the EPEEF for international purchase of emission reduction units***

Looking at the institutional adaptation of implementation of mechanisms from the formal aspect, Croatia needs to designate a competent authority (*designated national authority – DNA)* responsible for implementation of clean development mechanisms (*CDM*), or, specifically, a focal point (*designated focal point*) for joint implementation mechanisms (*JI*). The functions of these bodies in Croatia will be exercised by the existing organizational unit of the Ministry of Environmental Protection, Physical Planning and Construction responsible for climate change. In certain countries included in Annex I to the Convention there are cases where one and the same actor is responsible for implementation of both project mechanisms.

Legislative activities started in 2007 with preparation of laws and subordinate legislation to regulate implementation of these mechanisms. The Regulation on Monitoring Greenhouse Gas Emissions (Official Gazette No. 1/07) has defined competences for maintaining greenhouse gas emission registries as one of the prerequisite conditions for application of mechanisms. The Registry is established by the MEPPPC through the CEA which is also in charge of its maintenance. The issues of flexible mechanisms implementation in Croatia will be covered by a special regulation.

Should implementation of domestic measures fail to meet expectations, financial resources will have to be provided to purchase emission units needed to meet the commitments assumed by Croatia under the Kyoto Protocol. It is planned to use financial resources of the EPEEF, but if they prove insufficient, the finance will have to be secured from the government budget in coordination with the Ministry of Finance.

As a rule, the price of units that may be immediately purchased on the market exceed the price of units generated by project mechanisms. In the case, however, that the quantity of units to be purchased is not expected to be large, a direct purchase of smaller quantities on the market is justified. The establishment of an infrastructure for the purchase of emission reduction units is only justified when larger quantities are being purchased, which is here not the case.

A direct purchase of emission units on the market may be carried out through bilateral agreements or they can be exchange or off-the-board traded. Given the complexity of market relationships and other reasons, such as those regulatory and political by nature, the future price per tonne of CO_2 on the open market in 2008 is very hard to forecast and the price to be defined by the market at the end of the commitment period of 2012 even harder. It is currently estimated that this price might range relatively widely from 15 to 35 Euro/tonne.

➲ ***MCI-31. Implementation of JI projects in Croatia***

As regards JI projects, Croatia as a state or any legal entity in Croatia concerned may play two roles: a role of *investor* investing into emission reduction in another country which is a Party to the Kyoto Protocol, and that of a *project implementing agency (host)* in Croatia. In the first commitment period (2008-2012) no implementation of any major JI projects is planned that would include foreign investors putting their money into emission reduction and acquiring rights on emission reduction units to be transferred from Croatia to the investor's account. Similarly, no implementation of JI projects with legal entities from Croatia playing the role of investors primarily due to Central and Eastern European market saturation is expected either. Implementation of JI projects in Croatia may only be accepted in the sectors of agriculture, transport and waste management, i.e. sectors where measures cannot be taken in the short run or where limit costs of implementing measures in the post-Kyoto period are relatively high.

➲ ***MCA-32. Facilitating investments in CDM and JI project activities in other countries***

The procedure for implementation of mechanisms under the Kyoto Protocol is planned to be introduced in the course of 2008 so as to make it possible for Croatia to participate as an investor in *CDM* and *JI* project activities for emission reduction in other countries. To make investments into these projects it will be necessary to make available specialized staff for the assessment of project feasibility, project risks and actual energy savings resulting from the project. The possibility of a realistic assessment has a direct impact on the position in the negotiation process and the favourableness of emission reduction purchase contract to be entered into with the emission reduction seller, and on the reduction of risk of shortfall in the supply of units planned. Legal entities in Croatia are to be allowed to put their money independently into *CDM* and *JI* project activities as provided by the EU Directive 2004/101/EC. This Directive is part of the European emission trading scheme as described below. In case that measures under the Strategy are implemented, the country will not need to purchase emission units, but will make it possible for economic operators to invest in such projects and to trade in emission units on the market.

➲ ***MCA-33 Inclusion of Croatia into the European emission trading scheme***

On the assumption that the Republic of Croatia will be admitted to full membership in the European Union, installations in Croatia that meet the criteria of the European directive on emission allowance trading (Directive 2003/87/EC) will become compulsory participants in the European emission trading scheme. The scheme represents a form of international emission trading mechanism confined to EU member countries. The EU emission trading scheme is associated with the flexible mechanisms under the Kyoto Protocol in such a manner that legal entities included in the scheme may to a certain extent take advantage of CDM and JI project mechanisms through which they acquire units needed to meet their obligations. The emission allowance trading scheme has proved efficient in case when the amount of emission allowance units on the market lies below actual greenhouse gas emissions produced by the participants in the scheme, or specifically, when there is demand on the market. It is therefore assumed that the inclusion of Croatia into the EU ETS will have positive effects on emission reduction. The inclusion of Croatia into the EU ETS is also possible prior to formal accession to the EU.

The inclusion of Croatia into the EU ETS is scheduled for 2010, which is the beginning of the first commitment period under the Kyoto Protocol and at the same time the second period of the EU ETS.

The major activities relating to flexible mechanisms are:

2008 – Regulation on Greenhouse Gas Emission Allowance Trading
2008 – Establishment of the greenhouse gas registry
2008 – Regulation on the Conditions for Implementation of Flexible Mechanisms under the Kyoto Protocol
2010 – Inclusion into the EU emission allowance trading scheme
2010 – Evaluating the implementation of measures and the Kyoto Protocol
2010 – Introduction of the EPEEF programme for mechanisms (optional)

Within the European Commission project "LIFE Third Countries – Capacity Building of the Republic of Croatia for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol" expert documents have been prepared for the purpose of implementing flexible mechanisms and emission unit trading in the Republic of Croatia. Through implementation of the CARDS 2004 project financial support will be provided for the establishment of the registry and preparation of the Allocation Plan for Greenhouse Gas Emission Allowances. A number of workshops are being planned in cooperation with the World Bank so as to provide installations covered by the emission allowance trading scheme with information relating to their obligations of monitoring emissions from installations, organization of the report reviews, emission unit trading methods, etc.

8.14. EFFECTS OF THE IMPLEMENTATION OF MEASURES – PROJECTIONS UNTIL 2012 WITH THE VIEW TO 2020

For future projections two scenarios were considered:

- **'Without measures' scenario.** This scenario implies the continuation of the current practices, including new technologies, how it would be if there were no greenhouse gas emission reduction targets. It should be noted that the 'without measures' scenario does not represent a pure extrapolation of the present status and historical trends. The extrapolation of emission trends over the last ten years would result in the emission increase at a rate of 3.4 per cent. The 'without measures' scenario for the period 2004-2012 shows a trend lower than extrapolation of the past increase which amounts to 2.5 per cent. This scenario anticipates the construction of facilities in the power industry in accordance with the construction plan under the Energy Development Strategy (reference scenario S1).

- **'With measures' scenario**. This scenario implies implementation of all measures as provided by the Plan. It should be noted that the analysis of measures related, as a rule, to measures entailing costs below 20 euro/tonne CO_2, with some exceptions. According to this scenario, in the period 2005-2012 the emissions should increase at a rate of over 1.2 per cent which is a rise of some 370 Gg CO_2 eq/year.

Figure 8.14-1 shows clearly that under the 'without measures' scenario the emission would exceed the Kyoto target by 2,300 Gg CO_2 eq in 2010. By application of all cost-effective measures proposed by the Plan the emissions will lie below the Kyoto target during the entire period from 2010 to 2012.

If all measures are successfully implemented, the 2010 emission will lie 6.6 per cent below the base year, which is slightly more that the reduction target of 5 per cent in comparison with the base year.

The emission under the 'with measures' scenario will rise yearly by 1.6 per cent in the period until 2010 and by 0.2 per cent until 2010.

The greatest emission reduction in relation to the 'without measures' scenario will be recorded in the sector of power installations, especially electricity generation. This is mainly due to the use of renewable energy sources and application of energy efficiency measures in immediate consumption (Fig. 8.14-2). The major individual measure in the sector of industrial processes is the N_2O emission reduction in the production of nitric acid. 41 per cent of the total reduction is achieved by using renewable energy sources, 24 per cent by energy efficiency measures and 28.7 per cent in industrial processes (Fig. 8.14-3). Waste management measures will gain importance after 2010 when waste will be thermally treated in urban district heating plants and cement industry, thus reducing the emissions by about 780 Gg CO_2 eq in 2012.

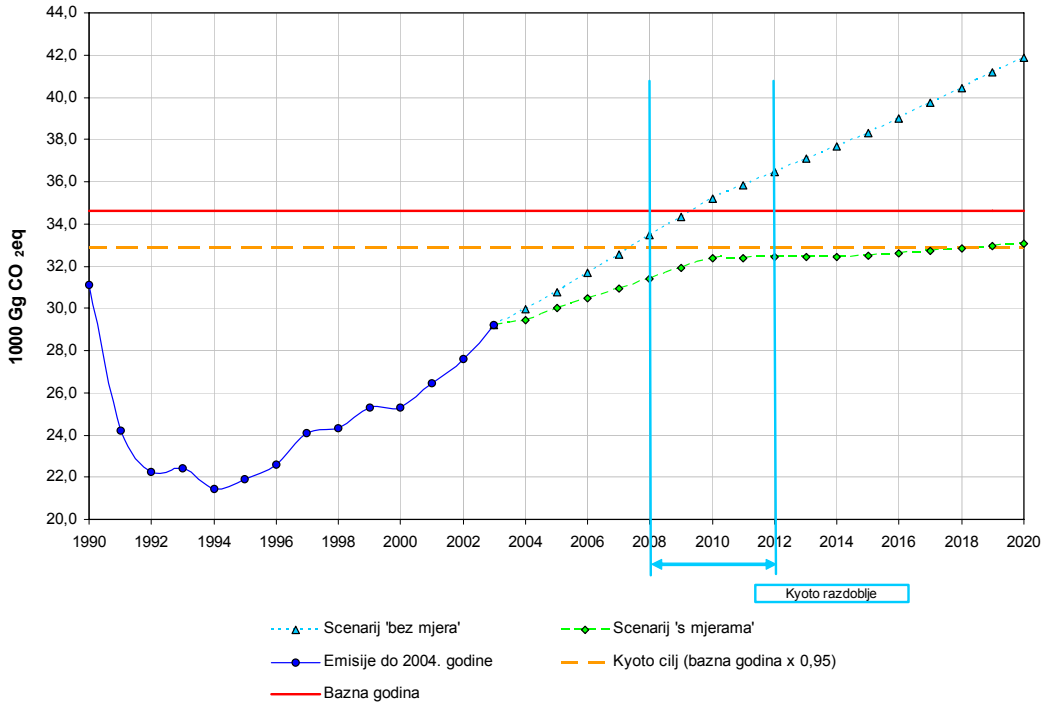

Fig. 8.14-1: Greenhouse gas emission projections for Croatia

(U slici:
- Kyoto period
- 'Without measures' scenario
- 'With measures' scenario
- Emissions by 2004
- Kyoto target (base year x 0.95)
- Base year)

Should Croatia decide to take advantage of Article 3.4 of the Kyoto Protocol allowing the emission reduction due to the rise in carbon stocks of the wood mass (sustainable forest management activities), emissions might be additionally reduced by 972 Gg CO_2eq. With these additional 2.8 per cent the total reduction potential of 2010 might reach 9.4 per cent compared to the 'without measures' scenario.

The second commitment period under the Kyoto Protocol starts after 2012 and the commitments of individual countries are yet to be defined.

From the current perspective of anticipating future it is evident that Croatia could stabilize its emissions in the long run around the year 2020. Reductions over 5 per cent in 2020 in relation to the base year may only be achieved at considerably higher costs and by applying one of the three measures not taken into consideration in this Strategy: afforestation, CO_2 separation and storage into underground storages, and construction of nuclear power plants. Additional reduction potentials need to be thoroughly analysed and the results used for the purpose of current negotiations about the post-Kyoto period.

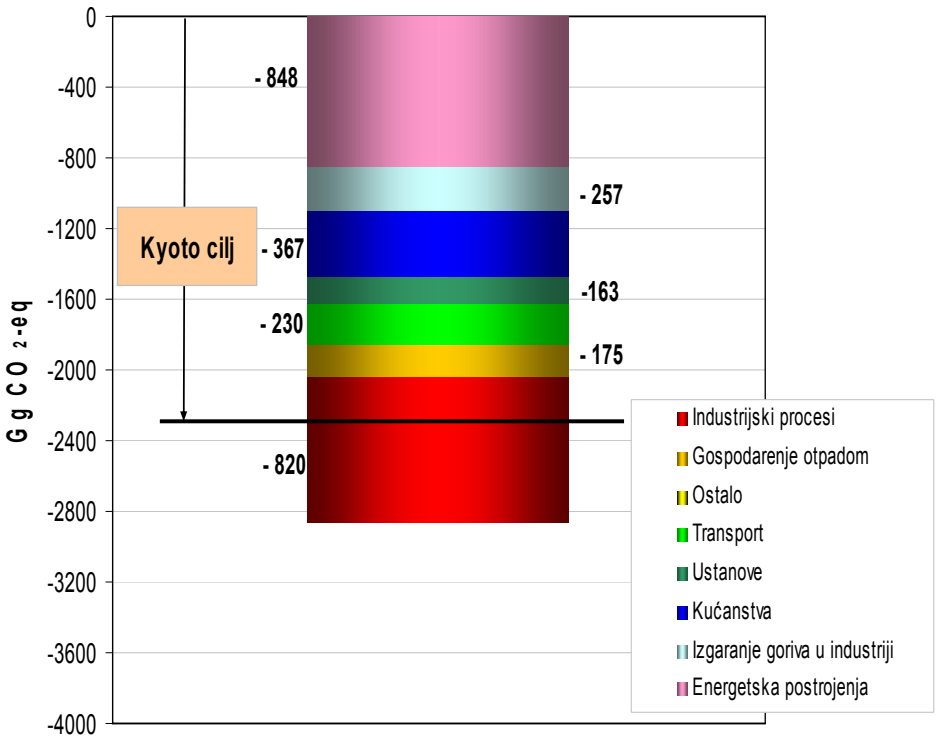

Fig. 8.14-2: Emission reduction by sectors in 2010 in relation to the Kyoto Protocol targets

(U slici: Kyoto target
- Industrial processes
- Waste management
- Other
- Transport
- Institutions
- Households
- Fuel combustion in industry
- Power plants)

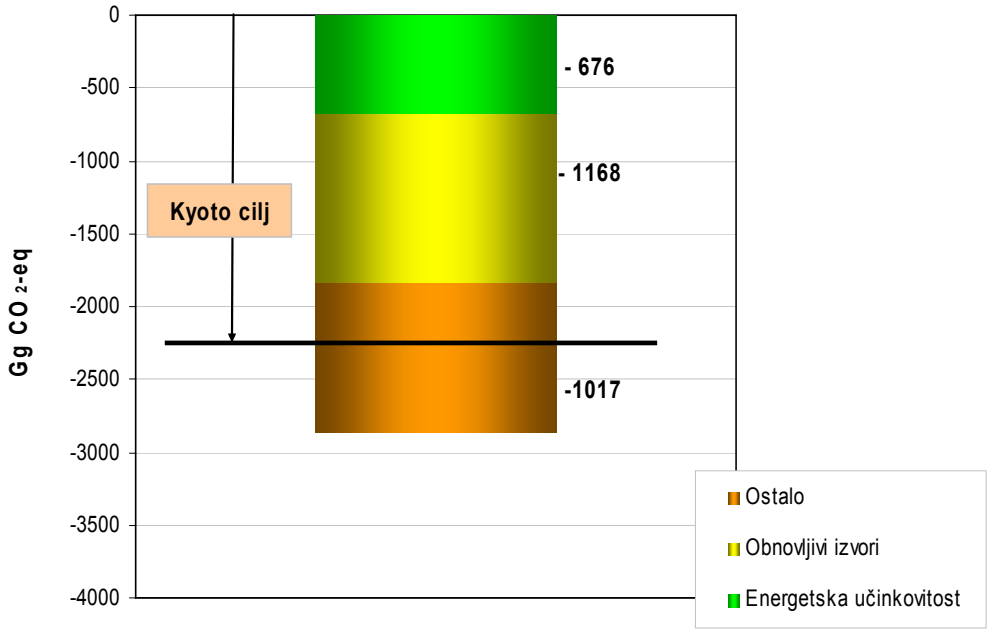

Fig. 8.14-3: Contribution of energy efficiency and use of renewable energy sources to emission reduction in 2010

(U slici: Kyoto target
- Other
- Renewable sources
- Energy efficiency

8.15. INSTITUTIONAL FRAMEWORK FOR IMPLEMENTATION OF MEASURES

The institutional framework for implementation of measures aimed at reducing greenhouse gas emissions is based on existing institutions of the State and a network of higher education, scientific, research and specialized institutions as shown in Table 8.15-1.

Table 8.15-1: Institutions responsible for implementation of measures in the field of climate change

Institution	Activity
MEPPPC	Responsible for planning and implementing policies and measures for mitigation of climate change. Operational implementation takes places through the Department for Atmosphere Protection of the Sector for Atmosphere, Sea and Soil. The MEPPPC issues permits for emission units and acts as the implementing body for application of flexible mechanisms under the Kyoto Protocol.
Council for Sustainable Development and Environmental Protection	Supervision of implementation of policies and measures; proposing amendments and new activities

Working Group for Intersectoral Coordination of Central Government Bodies	Coordination of activities of the Ministry and other government bodies at the operational level with the aim to ensure continuity of activities and a more efficient cooperation.
Ad hoc working groups and expert councils	The MEPPPC sets up working groups for certain issues and sectors, as required. An expert commission will be required for evaluation of JI and CDM projects.
EPEEF	In charge of: - calculation and collection of the CO_2 emission charge - financial support to projects and programmes in line with objectives and priorities of the Strategy and the Action Plan - purchasing emission allowances on the international market.
CEA	In charge of greenhouse gas emission management, emission data collection and filing, maintenance of the national system for greenhouse gas emission inventory, preparation of reports on emissions and for quality assurance and control of emission data within the national system.
MHS	In charge of climatological issues and inclusion into the Global Climate Change Monitoring System.
Ministry of Economy, Labour and Entrepreneurship	In charge of the construction of facilities and implementation of programmes in the segment relating to power generation, especially application of energy efficiency and renewable energy sources. Prepares laws in the field of energy efficiency and renewable energy sources. Provides support to projects that contribute to greenhouse gas emission reduction and coordinates its activities with the MEPPPC. Responsible for submission of data needed for preparation of the Greenhouse Gas Emission Inventory in the segment relating to power generation and industry.
Ministry of Regional Development, Forestry and Water Management	In charge of the construction of facilities and implementation of programmes in forestry and timber and wood industry. Responsible for submission of data needed for preparation of the Greenhouse Gas Emission Inventory in the segment relating to forestry.
Ministry of Sea, Transport and Infrastructure	In charge of the construction of facilities and implementation of programmes in the transport sector. Responsible for submission of data needed for preparation of the Greenhouse Gas Emission Inventory in the segment relating to transport.
Ministry of Science, Education and Sports	In charge of the promotion of technological development and transfer of climate change mitigation technologies, development of research programmes on climate change impacts and research into adaptation to climate change.
National Bureau of Statistics	Adaptation of data collection to the needs of the Plan.
Educational and higher education institutions	Promotion and implementation of educational programmes; participate in the same and propose actions. A course on climate change needs to be introduced at colleges. Climate change issue should be incorporated into other relevant courses.
Local and district (regional) self-government units	In charge of promotion and implementation of the sustainable development concept in planning and management of towns,

	municipalities and counties, especially in connection with greenhouse gas emission reduction, promotion of renewable energy sources and energy efficiency, and the sustainable transport.
Scientific and specialized institutions	Assistance in execution of capacity-building programmes, system maintenance, preparation of the emission inventory, reporting and an independent survey. They propose, launch and implement programmes of research, technological development and technology transfer. An interdisciplinary approach and international cooperation are desirable.
Civil society organizations	Initiating preparation and implementation of programmes and projects, especially those relating to public promotion and education.
Industry	Intensification of initiatives in implementation of this Plan and in practical application of the sustainable development concept in general is expected.

The proposed institutional framework is adapted to operate under the conditions of limited financial and human resources and has been unofficially applied since the preparation of the First National Communication on Climate Change (2001).

In the period until 2010 national institutions need to be strengthened in terms of personnel. It is extremely important to ensure continuity of the personnel, because tasks are very complex and require several-years education and capacity-building. In the first place this relates to complying with commitments under the Kyoto Protocol, whose non-compliance within the specified period entails certain consequences for the state. It is therefore necessary to establish long-term contractual and partnership relations with institutions of scientific competence and expertise. For key issues arising during capacity-building and implementation *ad hoc* working groups need to be set up with a clearly defined mandate and the finance secured for their operation.

In Table 8.5-1 the major stakeholders – citizens – are not shown. The prime moving force is each individual and his ecological and social responsibility. Each of us individually can actively contribute in the office, at home, through civil society organizations. Without public awareness of the need to change the behaviour no breakthroughs are possible. In the time by 2012 a major part will be achieved through purely legislative instruments, but the problem will appear later with ever-increasing emission reduction requirements.

8.16. LEGISLATIVE FRAMEWORK

Until recently, no specific legislative instruments for tackling climate change issues were available in Croatia. The Air Protection Act (Official Gazette No. 178/04) as part of the Air Quality Protection and Improvement Plan has imposed a formal obligation to develop a plan for climate change mitigation. The same Act laid the legal foundations for determination of emission allowances and the emission allowance market. Amendments to this Act that will facilitate the transposition of the EU legislation governing issues of climate change will be adopted in the second quarter of 2008.

The development of legislation in Croatia will be based on the transposition of the EU acquis communautaire, but to meet the targets set a number of other instruments will be required too. The transposition of the EU acquis communautaire is planned to be completed by the end of 2008, which means that implementation effects will only be visible at the end of the Kyoto period. The European practices show that measures imposed by EU directives produce very different effects in different countries and that some targets have hardly been

met. In the transposition of directives relating to the prevention of climate change no negotiations about a postponement of application are foreseen, because that would endanger the accomplishment of the objectives of this Plan. Moreover, in relation to the EU legislation there will be a few enforcement regulations only. The preparation of regulation falls within the competence of the Ministry of Environmental Protection, Physical Planning and Construction and the Ministry of Economy, Labour and Entrepreneurship. At a later stage the Ministry of Sea, Transport and Infrastructure and the Ministry of Regional Development, Forestry and Water Management will become more actively involved too. Table 8.16-2 gives an overview of recent regulations or those that need to be amended.

Table 8.16-2: Amendments to current legislation and key new regulations for implementation of the Plan

Type of regulation	Contents	Adoption deadline
Regulation on Monitoring Greenhouse Gas Emissions in the Republic of Croatia	Laying down the obligation and method of monitoring greenhouse gas emissions in the Republic of Croatia, including monitoring and reporting on: - all anthropogenic emissions from sources and removals by greenhouse gas sinks - implementation and effects (achievements) of policies and measures for emission reduction and increase in sinks - greenhouse gas emission projections	Official Gazette No. 01/07
Regulations relating to the promotion of biofuel use in transport Regulation on Biofuel Quality	Setting an indicative target of the minimum share of biofuels, promotion of the biofuel use, regulations on technical requirements for biofuels. In 2008 the MELE will prepare the Biofuels Act containing penalty provisions for non-compliance with the obligation to place the prescribed share of biofuels on the domestic market.	Partly adopted, the rest in 2008 Official Gazette No. 141/05
Regulation on CO_2 Emission Charges with accompanying enforcement regulations	Types and sizes of sources liable to charge, greenhouse gases liable to charge, amount of charge, charge discounts on investments in greenhouse gas emission reduction measures	Official Gazette Nos. 73/07, 77/07
Regulation on Emission Allowances Trading in the Republic of Croatia	Preparation of the Allocation Plan for Greenhouse Gas Emission Allowances, the method of emission allowances transaction, review of emission reports, rules of the greenhouse gas registry operation	2008
Decision on the Merger between the Domestic and EU and Other Markets	Conditions and methods of AAU, ERU and CER transactions between the Croatian and the European emission allowance market	2009
Regulations on the criteria for implementation of flexible mechanisms under the Kyoto Protocol	Criteria for approving JI and CDM projects, methods of their verification and monitoring	2008-2009
Regulations on energy efficiency in building construction	Energy performance certificate for buildings. Technical standards for HVAC losses. Inspection of boilers, especially those over 15 years old. Obligatory cost-effectiveness analysis for connection to	Partly adopted, the rest in 2008

	centralized supply system.	
Regulations on the promotion of renewable energy sources and cogeneration in electricity generation	Determination of the minimum share of renewable energy sources and cogeneration in power supply. Rules on preferential energy producers Incentive tariffs for renewable sources and cogeneration	Official Gazette No. 33/07
Regulations on the promotion of heat generation in centralized biomass-fired systems	Incentive tariff for heat from the public system for biomass-generated energy	2008
Regulations on energy efficiency in direct energy consumption and energy services	Financial incentive schemes for ESCO models Charging by individual consumption in centralized systems Efficiency control of small boilers fired by liquid and solid fuels Thermal insulation improvement programmes Energy audit Obligation for energy distributors to implement energy efficiency programmes	Partly adopted, the rest by 2009
Eco-designing	Regulation on setting up a framework for the establishment of eco-design requirements for energy consuming products and the related Council Directive 92/42/EEZ and Directives 96/57/EZ and 2000/55/E	2009
Ordinance Relating to Availability of Data on Fuel Efficiency and CO_2 Emissions	Obligation to indicate CO_2 emission when selling passenger cars	Official Gazette No. 120/07
Energy Efficiency of Household Appliances	Act on Technical Requirements for Products and compliance assessment through the Ordinance Relating to Energy Efficiency Requirements for Household Electrical Refrigerators, Freezers and Their Combinations	Adopted
Labelling Energy Efficiency of Household Appliances	The Ordinance governs energy efficiency labelling of household appliances: refrigerators, freezers and their combinations; washing machines, tumble-driers and their combinations; dish-washers; ovens, sources of light; air-conditioning devices.	Regulations mostly adopted Official Gazette No. 133/05

A Progress Evaluation Report is to be prepared every three years. This progress report contains an overview of the implementation status, assessment of the effects of measures in relation to targets and commitments under the UNFCCC and the Kyoto Protocol and obligations towards the EU. The report puts forward the proposals for improvements required to meet the targets. The implementation of activities will be controlled by the Working Group for Intersectoral Coordination between the ministries and government bodies and the consulting services will be supplied by the Sustainable Development and Environmental Protection Council.

9. PRIORITY MEASURES

High priority measures
Conditions need to be provided in the Sisak Refinery for emergency emission reduction in case that critical SO_2 limits are exceeded.
Implementation of remedial programmes to achieve **air quality category II** in urban agglomerations of Sisak, Rijeka, Kutina and Zagreb and the Town of Bakar in the short run.
Other priority measures by 2011
Implementation of air quality protection and improvement plans in local self-government units to achieve **air quality category I** in urban agglomerations of Zagreb, Rijeka, Kutina, Split and the towns of Solin, Bakar, Urinj, Zoljan, Šibenik, Bjelovar, Viškovo and Našice.
Use of petrol and diesel fuel of EURO 5 quality not later than 2010.
Use of only low-sulphur fuel oil not later than 2011.
Implementation of the National Plan for the Reduction of Emissions of Sulphur Dioxide, Nitrogen Oxides and Particulate Matter for Large Combustion Plants and Gas Turbines.
Implementation of the Kyoto Protocol: • renewable sources in electricity generation (mostly wind power plants and biomass) • cogeneration of electrical and thermal energy • incentives from the EPEEF for application of energy efficiency and renewable energy sources in the sectors of households, services and industry • N_2O emission reduction in the nitric acid production • use of biodegradable municipal waste as fuel for district heating plants and cement industry • use of biofuel in transport • introduction of the CO_2 emission market • decision on implementation of Article 3.4 of the Kyoto Protocol in calculation of sinks due to forest management • emission reporting • preparation of a post-Kyoto study including emission projections
Implementation of the national plan for the reduction of persistent organic pollutants according to international obligations
Implementation of the programme for phasing out ozone depleting substances and their disposal in an environmentally friendly manner
Priority activities of strengthening infrastructure
National network and local networks for air quality monitoring: • to finish the establishment of national network across the entire territory • to upgrade local networks in line with EU directives • to establish an efficient programme for measurement quality assurance and control and for measurement data processing • to install analyzers for $PM_{2,5}$ measurement • among rural stations of the national network to give priority to the Risnjak site • new national network station at the location of Slavonski Brod
Air quality information system: • information on the exceedance of warning and critical levels • inclusion of local networks and pollutant emissions from stationary sources into the

continuous control and information system • establishment of Pollutant Emission Register according to the requirements of the European Registry (E-PRTR) • spatial distribution of emissions across the territory in a 10X10 km and a 1x1 km GIS grid in urban agglomerations
Regulations, planning documents, studies, surveys
Regulation on Identification of Areas and Inhabited Areas of the Republic of Croatia by the Air Pollution Level
Regulation on National Peak Emissions of SO_2, NOx, NH_3 and NMVOC
Regulation on Greenhouse Gas Emissions Trading and Application of Flexible Mechanisms
Greenhouse Gas Emission Projections by 2020 for the Purpose of Negotiating About the Post-Kyoto Period
Ground-level Ozone Study of Istria and the Kvarner Bay
National Plan for the Reduction of Ground-level Ozone Pollution
National Plan for Adaptation to Climate Change
National Plan for the Reduction of Greenhouse Gas Emissions through Forestry Measures
National Plan for the Reduction of Greenhouse Gas Emissions through Agricultural Measures
Survey and Preparation for Verification of the Project of CO_2 Absorption and Storing into Underground Gas and Oil Storages

10. METHOD OF IMPLEMENTING MEASURES

Implementation instruments are legislative and economical, based on individual initiative, raising the level of information and promotion. The greatest effects are achieved through a combination of diverse measures and instruments. In the area of air protection implementation instruments show a very high level of development in relation to the EU acquis communautaire, except the area of preventing VOC emissions and climate change which is only in its beginnings.

The sequence, deadlines and entities liable to implement measures/activities are shown in Tables 10.1.1. – 10.1.7. The measures are grouped thematically.

Table 10.1.1. PREVENTIVE AIR QUALITY PRESERVATION MEASURES

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1,C2	MPI-14	Implementation of the Strategy and Plan for the Use of Liquefied Gas on Islands	MELE	MSTI, EPEEF	Applied since 2007
C1-C4	MPA-2	Start of implementation of the Strategic Environmental Impact Study and a more precise definition of the contents and methodology of analysis used in EIS	MEPPPC		2008-2009
C1	MPA-3	Regulation on determination of areas and inhabited areas of the Republic of Croatia by the air pollution level	MEPPPC	MHS	2008
C1, C2, C6	MPA-4	Start of implementation of integrated environmental conditions (transposition of the IPPC Directive)	MEPPPC	Local self-government units	2009-2011
C1, C2	MPA-5	Certification of internal combustion engines fitted into non-road mobile machinery and equipment	State Office for Metrology	MEPPPC, MI VCC	2009
C1, C2	MPA-6	Air protection measures in new environmental plans of the counties and the City of Zagreb	Local self-government units	MEPPPC	2009
C4-C6	MPA-9	Improvements in the system of the national air quality monitoring network	MEPPPC	MHS, specialized institutions	2010
C6, C7	MPA-7	Establishment of the air quality information system	CEA	MEPPPC, MHS, specialized institutions	2008-2010
C1, C5	MPA-8	Education and professional improvement of the administrative and inspection staff	MEPPPC	Specialized institutions	2009-2011
C1, C5	MPA-10	State examinations and accreditation of institutions	MEPPPC CAA	Local governments	2009-2011
C9	MPA-11	Strengthening institutional framework and cooperation among stakeholders	MEPPPC	CEA, MHS, EPEEF	2008-2010

Table 10.1.2. MEASURES FOR TACKLING THE PROBLEM OF OCCURRENCE OF WARNING AND CRITICAL LEVELS OF AIR POLLUTION

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1, C6, C7	MKA-2	To supplement the measurement programme of the national/local network with ozone measurements in the County of Sisak-Moslavina (Town of Sisak)	MEPPPC/local self-government units	EPEEF	2010
C6, C7	MKA-3 MKA-4	Operational implementation guidance of the MEPPPC for emergency measures plans in case of critical air pollution levels Development of software support	MEPPPC CEA	Local self-government units	2008-2009
C6, C7	MKA-5	Drawing up/reviewing operational plans for implementation of the Regulation on Critical Levels of Pollutants in the Air (Official Gazette No. 133/06)	Local self-government units (Rijeka, Zagreb)	Industrial plants Local public institutions responsible for transport	2009
C6	MKA-6	Amending regulations governing the operation of an installation in case of defective emission reduction equipment, start-up, suspension and test run	MEPPPC		2009
C3	MKA-7	Prompt response of the inspection	MEPPPC	Inspection	2008-2010
C1, C6	MKI-8	Providing conditions for emergency reduction of emissions from stationary sources and transport (to decrease production or investing into equipment, and organizational costs)	Industrial plants Local public institutions responsible for transport	Local self-government units in counties and towns	2008-2009

Table 10.1.3. MEASURES IN CASE OF A RISK OF TOLERANCE VALUE EXCEEDANCES

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1, C2	MTI-1	Implementation of a rehabilitation programme for H_2S and SO_2 in order to achieve the air quality category II in Sisak	INA Sisak Refinery, other sources	Town of Sisak	Immediately-2010
C1, C2	MTI-2	Implementation of a rehabilitation programme for H_2S and	INA Oil Rafinery	Town of Rijeka	Immediately-2010

		SO_2 in order to achieve the air quality category II in Rijeka	Mlaka		
C1	MTI- 3	Execution of the H_2S flaring project in Kutina in order to achieve the air quality category II	Black Carbon Plant, Kutina	Town of Kutina	Immediately-2010
C1	MTI-4	Start of execution of the rehabilitation programme for PM_{10} in Zagreb in order to achieve the air quality category II	City of Zagreb	City of Zagreb	2008-2010
C1	MTI-5	Implementation of the rehabilitation programme for PM_{10} in Kostrena in order to achieve the air quality category II	INA Oil Rafinery Urinj, Rijeka Thermal Power Plant, Viktor Lenac	Municipality of Kostrena	Immediately-2010
C!	MTI-6	Identification of actual state in locations that the population complains about	Local self-government units		2009-2010

Table 10.1.4. MEASURES TO REACH LIMIT VALUES WITHIN THE SPECIFIED TIME, IF EXCEEDED

C5	MGI-1	Local air quality protection and improvement plans (Rijeka, Bakar, Sisak, Zagreb, Viškovo, Našice, Zoljan, Bjelovar, Šibenik, Split - Solin)	Local self-governments of towns	MEPPPC, EPEEF, CEA	2009-2010
C5	MGA-2	Programme for technical and financial support to preparation of local air quality protection and improvement plans	EPEEF Local self-government units	MEPPPC	2009-2010

Table 10.1.5. MEASURES AGAINST ACIDIFICATION, EUTROPHICATION AND GROUND-LEVEL OZONE

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1, C2	MZA-1	Ratification of the Gothenburg Protocol	MEPPPC	MELE	2008
C1, C2	MZA-2	Preparation of the National Plan for the Reduction of Emissions of Sulphur Dioxide, Nitrogen Oxides and Particulate Matter from Large Combustion Plants	MEPPPC	MELE, CCC	2008

C1, C2	MZA-3	Implementation of the National Plan for the Reduction of Emissions of Sulphur Dioxide, Nitrogen Oxides and Particulate Matter from Large Combustion Plants and Gas Turbines	Polluters	Specialized institutions	2009-2011 and onward
C1, C2	MZA-4	Implementation of measures for the reduction of VOC emissions from activities where ELVs are exceeded, petrol storing, petrol stations	Polluters	Polluters	2008-2011
C1, C2	MZA-5	Determination of the national emission allowance and framework measures to reach the same	MEPPPC	MELE,CEA	2008
C1, C2	MZA-6	Preparation of the National Plan for the Reduction of Ozone Pollution	MEPPPC	MHS, specialized institutions	2010
C9	MZA-7	Bilateral talks with neighbouring countries about emission reduction plans	MEPPPC		2009 and onward
C9	MZA-8	Active participation in working groups of the LRTAP/UNECE protocol	MEPPPC	CEA, MHS, specialized institutions	2008 and onward
C6	MZA-9	Ozone modelling project for the area of the Kvarner Bay and Istria	MEPPPC	Local self-government units, MHS, specialized institutions	2009-2010
C3	MZA-10	Acidification, eutrophication and ground-level ozone to be attached appropriate importance in strategic environmental impact studies	MEPPPC		2009 and onward
C3	MZA-11	Development of an advisory code of good agricultural practices	MAFRD	MEPPPC	2008
C5	MZA-12	Establishment and support to local centres for LRTAP Convention issues	MEPPPC	CEA	2009-2011

Table 10.1.6. TRANSPORT-RELATED MEASURES

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1, C2,C3	MPRA-1	Spatial and urban development planning on sustainable development principle	MSTI	MEPPPC	2009-2011

C1, C3	MPRA-2	Higher incentives for sustainable transport projects	EPEEF	MSTI, MEPPPC, MELE	2009-2011
C8	MPRA-3	Preparation of the study "Analysis of the Possibility to Reduce Traffic-related Impacts on Air Pollution in Towns of Croatia"	Local self-government units	MEPPPC, MSTI, specialized institutions	2009-2010
C8	MPRA-4	Evaluation of the state in towns at the level of roads and streets	Local self-government units	EPEEF	2009-2010
C1, C3, C7	MPRA-5	Pilot project of restricting and charging for the entry of vehicles into high pollution zones (CO, NO_x, NMVOC and PM)	MI	MEPPPC	2009-2010
C1,C2,	MPRA-6	Use of gas and biofuel, especially in public transport and on islands	Local self-government units, MELE	MEPPPC, EPEEF	2009-2011
C1, C2, C3	MPRA-7	Application of MARPOL regulations for ships	MSTI	MEPPPC	2008-2011

Table10.1.7. MEASURES FOR THE REDUCTION OF GREENHOUSE GAS EMISSIONS, ENERGY EFFICIENCY PROMOTION AND USE OF RENEWABLE ENERGY SOUCES

Target	Measure	Activity / Measure	Implemented by	Supported by	Implementation period
C1, C3	MCI-1	Promoting the application of renewable energy sources in electricity generation	MELE	HROTE	2007-2012
C1, C3	MCI-2	Promoting the application of cogeneration (simultaneous generation of thermal and electrical energy)	MELE	HROTE	2007-2012
C1, C3	MCI-3	Reduction in fossil fuel consumption through utilization of biodegradable municipal wastes in district heating plants or landfill biogas	MEPPPC	Public utility services	2011
C1, C3	MCI-4	Reduction in fossil fuel consumption through the use of biodegradable municipal wastes in cement industry	MEPPPC	Cement industry Local governments	2009-2011
C8	MCA-5	Credit supply programme of GEF/World Bank for the preparation of renewable energy sources projects	HBOR	MELE	2006-2011
C3	MCA-6	Promoting the use of renewable energy sources and energy	EPEEF	MELE, MEPPPC	2008-2011

		efficiency through the Environmental Protection and Energy Efficiency Fund			
C1, C3	MCA-7	Promoting energy efficiency through implementation of the project "Removal of Barriers to Energy Efficiency in Croatia", GEF/UNDP	UNDP	HBOR, MELE	2004-2010
C1, C3	MCA-8	HEP ESCO energy efficiency programme	HEP-ESCO	HEP, GEF	2008-2011
C1, C3	MCA-9	Measures of energy efficiency upgrading in building construction	MEPPPC	Building trade associations	2008-2011
C1, C3	MCA-10	Energy efficiency labelling of household appliances	MELE	MEPPPC	Applied since 2007
C3	MCA-11	Setting up a framework for the establishment of ecological design requirements	MEPPPC		2009
C1, C3	MCI-13	Introduction of biofuel	MELE	MEPPPC	2008-2010
C1, C3	MCI-14	Promoting the use of low CO_2 vehicles	MEPPPC	MI	2008-2010
C1, C3	MCI-15	Promoting the use of LPG in vehicles	MELE	MEPPPC, public utility companies	2008-2010
C1, C2, C3	MCI-16	Reduction of N_2O emission in nitric acid production	EPEEF, Kutina Petrochemical Industry	MEPPPC	2009-2011
C1, C2, C3	MCI-17	Burning or thermal utilization of methane captured at landfills	EPEEF	MEPPPC	2008-2011
C3	MCA-18	Action plan for the sector of agriculture from the aspect of adjustment to climate change and reduction of greenhouse gas emissions	MAFRD	MEPPPC	2009
C3	MCA-19	Decision on taking advantage of Article 3.4 of the Kyoto Protocol	MEPPPC	Specialized institutions	2008
C1, C2, C3	MCA-20	Establishment of the system of trading in CO_2 emission allowances	MEPPPC	MELE, CEA	2010
C3	MCA-21	Increasing the CO_2 charge	EPEEF	MEPPPC	2009-2011
C6, C7, C9	MCA-22	Reporting under the UNFCCC and the Kyoto Protocol	MEPPPC	CEA	Immediately - 2011
C1, C2,	MCA-				

C3, C8, C9	23	Capacity building programme for implementation of the Convention and the Kyoto Protocol	MEPPPC	CEA	Immediately - 2011
C9	MCA-24	Active participation in international negotiations about the commitment period after 2012 («Post-Kyoto»)	MEPPPC	MFAEI, MELE	Immediately - 2011
C3, C4,C7,C8	MCA-25	Preparation of plans, programmes and studies for efficient implementation and creation of the climate change policy	MEPPPC	MELE, MAFWM	Immediately - 2011
C8	MCA-26	Establishment of a research and development programme focusing on climate change issues	MHES	MEPPPC, EPEEF	2009-2011
C8	MCA-27	National energy programme	MELE	EPEEF, specilaized institutions	2008-2011
C7	MCA-28	Public education and information programme	MEPPPC	MSES	2009-2011
C8	MCA-29	Support to programmes and projects of the technology and know-how transfer	MSES	MEPPPC	2008-2011
C3, C5	MCA-30	Establishment of infrastructure for application of flexible mechanisms under the Kyoto Protocol	MEPPPC	CEA, EPEEF	2008-2011
C1, C2, C3	MCA-31	Implementation of JI projects in Croatia	MEPPPC	CEA	2010 and onward
C1, C2, C3, C9	MCA-32	Facilitating investments in CDM and JI project activities in other countries	MEPPPC	CEA	2010 and onward

11. ESTIMATE OF FUNDS NECESSARY FOR IMPLEMENTATION OF THE PLAN

The estimate of funds is mostly based on the so-called *top-down* approach where investment and operating costs are estimated on the basis of aggregate data at the level of sectors and subsectors observed and data on specific or limit/incremental costs. This approach is acceptable for analyses used to identify the magnitude of costs without detailing individual installations. Some data are obtained directly from the private sector or local governments through cost estimates for rehabilitation programmes. The most precise estimates are provided for a segment of costs to be financed from the budget and EPEEF incentives.

When estimating costs it should be taken into consideration that measures are applied according to a specific dynamics, which can extend implementation of some measures over a period of as much as 10 years. In this regard administrative costs relating to establishment of an institutional infrastructure needed for an efficient implementation of measures also appear initially apart from investment costs.

The implementation of the Plan is mostly based on instruments of the EU acquis communautaire. Therefore, when determining costs, they are grouped according to the EU directives, which at the same time allows a transparent indication of the price of transposing the EU acquis communautaire in the field of air protection.

The costs include investment, operating and administrative costs relating to additional implementation costs. For the costs, for which the estimate of total capital investments and deadlines were known, the investment dynamics by years in the period 2008-2012 was assumed to be more or less uniform.

Table 11.-1. gives an aggregate overview of all air protection costs in the period 2008-2011. The costs of implementing measures to reach the air quality category I in towns with LVs exceeded could not be estimated in full, i.e. in the segment relating to collective sources of emission, small combustion plants and transport. In Table 11.-1. the costs of emergency measures in case of the exceedance of air pollution critical levels are not included.

Table 11.-1.: Total costs of air quality protection and improvement, period 2008-2012

	Type of cost	Annual average cost 2008-2012 million kunas
1	Air quality management	14
2	Financing local air quality networks	10
3	Rehabilitation measures in Sisak and Kutina (H_2S) and in Rijeka and Mlaka refineries (SO_2 and H_2S) to reach air quality category II	150
4	Implementation of the UNFCCC and the Kyoto Protocol	399
5	Ozone depleting substances	4
6	Technical adaptation of equipment for the storage of petrol and its distribution from terminals to petrol stations – application of technical standards for reduction of volatile organic compounds emissions (Directive 94/63/EC)	163
7	Technical adaptation of existing large combustion plants (Directive 2001/80/EC)	933

8	Technical adaptation of oil refineries – production of liquid petroleum fuels of EU quality (Directive 2003/43/EC)	1163
9	Technical adaptation of installations using organic solvents for certain activities (Directives 99/13 and 2004/42/EC)	75
10	Other IPPC installations (landfills, cement works, etc.)	1233
	Total	4144
	Million euro/year Euro per capita % of GDP in 2006	571 129 1.67

Total costs amount to 4.144 billion kunas yearly (571 million euro yearly) which is 1.65 per cent of the gross domestic product. The highest uncertainty of this estimate relates to implementation of the Directive on Industrial Pollution Prevention and Control, where estimates were made without knowing the deadlines, so that for the needs of the table above the implementation term was assumed to be 2020.

Of the total costs only a minor part of **7 – 10 million kunas will be financed from the budget.** Other costs are paid by polluters and physical entities through various charges or direct investments. At the moment physical entities are included in payment through a charge for incentive tariffs for the use of renewable energy sources and cogeneration.

Capital investments needed for approximation of Croatian legislation brought in line with the requirements of the European Union acquis communautaire in the field of industrial pollution with respect to air pollution reduction measures are estimated at round 1.97 billion euro (14.6 billion kunas).

The following is an outline of individual groups of costs.

11.1. ESTIMATE OF FUNDS NEEDED FOR AIR QUALITY MANAGEMENT

Key responsibilities involved in air quality management are:

- planning, organization, control and coordination of monitoring at the national and local level,
- preparation of technical guidelines,
- data monitoring and processing,
- quality assurance,
- data filing,
- implementation of regulations, and
- reporting.

It should be stressed that the funds estimated below represent at the same time the costs of alignment with Directives 96/62/EC, 1999/30/EC, 2000/69/EC, 2002/3/EC and 2004/107/EC.

In this connection important roles are played by a number of competent authorities: the Ministry of Environmental Protection, Physical Planning and Construction, the Croatian Environment Agency entrusted with the maintenance of the air quality information system and reporting, and, in the ideal case, another institution responsible for conducting measurement of air pollution levels in the national network and other tasks related to processing of measurement results, data validation, preparation of reports and provision of servicing, maintenance and calibration services for the equipment installed.

Investment costs of finishing the national network include the costs of 12 new stations and one more in Slavonski Brod. Operating costs are relatively high, because besides the regular maintenance and servicing of the network a plant is needed for laboratory measurements and for measuring heavy metals and PAHs. The national network will include all existing measurements conducted by MHS in connection with the chemical composition of precipitation, whereby the number of stations will be reduced. A considerable segment of costs will be the maintenance of the system for assurance and control of the measurement and data processing quality .

Investment costs of the air quality information system relate to the connecting of national and local network of air quality stations and continuous systems of monitoring emissions from major polluters, the establishment of a new pollutant emission register, the preparation of a GIS for spatial distribution of emissions and reporting under international treaties.

The plan for funds needed for air quality monitoring to be secured from the government budget is shown in Table 11.1.1.

Table 11.1.1.: Air quality management - a plan for funds to be secured from the government budget

Relevant *acquis* --- ACTIVITIES (LEGISLATIVE AND IMPLEMENTING) COMPETENT AUTHORITY	SOURCE OF FUNDS	FUNDS PLANNED / HRK		
		2008	2009	2010
Preparation of planning documents in the field of air and climate protection (MEPPPC)	Government budget	1,800,000	1,700,000	1,700,000
Maintenance of stations and air quality measurement (MEPPCG)	Government budget	3,040,000	3,060,000	5,150,000
Setting up a national air quality monitoring network (MEPPPC)	Government budget	4,000,000	1,000,000	1,000,000
Current and investment maintenance services (MEPPPC)	Government budget	700,000	300,000	300,000
Establishment of an air quality monitoring and management system. PHARE 2006 (MEPPPC)	Government budget	500,000	3,500,000	
Annual reporting on greenhouse gas emission with corrections of a historical series from 1990 (NIR+CRF), including an overview (CEA)	Government budget	400,000	400,000	400,000
Report on implementation of measures and projections	Government budget		200,000	
Development of an air protection information system (CEA)	Government budget	450,000	600,000	600,000
Maintenance of the Register (CEA)	Government budget	280,000	200,000	200,000
Purchase of equipment needed for maintenance of the Register (CEA)	Government budget	240,000		
TOTAL AMOUNT	**Government budget**	**11,410,000**	**10,960,000**	**9,350,000**
PHARE 2006 – construction of stations in rural and protected areas	EU (Phare)	1,200,000	5,000,000	

11.2. COSTS OF REHABILITATION PROGRAMMES TO REACH THE SECOND CATEGORY OF AIR QUALITY AND LOCAL PLANS TO REACH THE FIRST CATEGORY OF AIR QUALITY

Costs of short-term measures to reach the air quality category II are known for Sisak, Kutina and Rijeka, where rehabilitation programmes have been prepared. It was impossible to estimate the cost level for plans aimed at reaching the air quality category I, because pollution is caused by collective stationary sources and by transport whose contribution to pollution is to be analysed in the first place.

The Plan recommends that programmes and projects aimed at air quality improvement in settlements with air quality categories II and III should be co-financed through the EPEEF. Energy efficiency incentives will contribute greatly to their execution. **Priority in the promotion of energy efficiency measures should be given to towns with the air quality category II and III, if application of measures will reduce fossil fuel consumption in the area observed.**

Table 11.2.1. shows investment costs for local air quality monitoring networks

11.2.1.: LOCAL AIR QUALITY MONITORING NETWORKS – Budgets of local and district (regional) self-government and private sector

	COUNTY	Sources of funds	2007	2008	2009
1	OSIJEK-BARANJA	County	120,000	75,000	75,000
		Town of Osijek	98,000	-	-
		Našice cement	70,000	70,000	70,000
2	CITY OF ZAGREB	City of Zagreb	1,200,000	1,200,000	1,200,000
		HEP EL TO	50,000	50,000	50,000
3	PRIMORJE-GORSKI KOTAR	County	629,150	529,150	529,150
		Towns of Bakar, Kraljevica, Mali Lošinj	82,000	82,000	82,000
		INA, Čistoća	964,000	964,000	964,000
4	SISAK-MOSLAVINA	County	320,000	500,000	450,000
		Town of Sisak	189,000	500,000	200,000
		Town of Petrinja	95,000	95,000	95,000
		INA	856,000	1,300,000	1,300,000
		Grad Kutina	80,000	500,000	200,000
		Petrochemical Industry	550,000	1,000,000	700,000
		EPEEF	158,480	960,000	
5	ŠIBENIK-KNIN	County	80,000	120,000	120,000
6	SPLIT-DALMATIA	Town of Split	81,112	95,200	95,000
		Dalmacija cement	1,000,000	1,000,000	1,000,000
7	BJELOVAR-BILOGORA	Town of Bjelovar	137,000	160,000	160,000
8	KRAPINA-ZAGORJE	County	200,000	200,000	200,000
9.	ZADAR	County	30,000	150,000	150,000
		Town of Zadar	150,000	200,000	250,000
10.	ISTRIA	County	350,000	500,000	500,000

		TE Plomin	300,000	300,000	300,000
		Town of Pula	140,000	140,000	140,000
		Town of Umag	30,000	30,000	30,000
		Quarries	42,300	42,300	42,300
		Holcim	60,000	60,000	60,000
Total amount from local and regional self-government budgets			**4,011,262**	**5,076,150**	**4,461,150**
Private sector			**3,892,300**	**4,786,300**	**4,486,300**
Charges (EPEEF)			**158,480**	**960,000**	

11.3. ESTIMATE OF FUNDS NEEDED FOR TRANSPOSITION OF THE IPPC DIRECTIVE INTO CROATIAN LEGISLATION

The alignment with the Council Directive 96/61/EC has been carried out partly and will be completed by the end of 2008 through the adoption of an enforcement regulation (Regulation on Integrated Environmental Conditions). The Ministry of Environmental Protection, Physical Planning and Construction has been designated as a body responsible for implementation of the IPPC Directive in the segment relating to the issuance of integrated environmental conditions (Directorate for Environmental Management) and control over its implementation (Directorate for Inspection Affairs), including the adoption of the enforcement regulation.

Given the complexity of the IPPC Directive both in terms of a changed approach to addressing the effects of industrial and other activities on the environment, and the expertise required for resolution of complex technical issues, the existing administrative and technical mechanisms will have to be not only included and adapted, but substantially strengthened too. Administrative capacity building relates in the first place to training of all participants involved in the system (authorities responsible for granting permits and their control, industry, specialized and technical institutions, general public), apart from the increase in the number of staff and experts involved in the system.

The Environmental Protection Act adopted in October 2007 made it obligatory for existing installations to prepare by 2010 an analysis of the condition of installations with respect to environmental conditions and a study of the method of aligning (adaptation plan) with the provisions of the IPPC Directive. The implementation of these plans may start as of 2008 already, after adoption of the Regulation on Integrated Environmental Conditions, but not later than 2011. For the preparation of these documents only the amount of 110,000,000 kunas (14,865,000 euro) will be needed from the private sector sources in the period from 2008-2009.

According to preliminary estimates there are 150 possible IPPC installations. The costs of alignment with the IPPC Directive are estimated at some **2.0 billion euro (14.8 billion kunas)**. With regard to air pollution reduction measures it is estimated that the necessary capital investments will amount to some 1.97 billion euro (14.6 billion kunas) which together with the costs relating to the IPPC Directive amounts to **3.97 billion euro (29.4 billion kunas).**

The transitional provisions of the Environmental Protection Act lay down the procedure for existing installations. The operator is bound to prepare an analysis of the installation condition and a study on the method of its alignment with the provisions of the Environmental Protection Act (alignment plan). After obtainment of a positive opinion of the Ministry, the operator will apply for an IPPC permit within 6 months. The Environmental Protection Act allows a transitional period for those existing installations that will not be able to meet the requirements for issuance of the IPPC permit. Such installations may be granted a temporary permit according to the transitional provisions laid down by special acts (on the air, waste, soil, etc.).

The temporary permit will make it obligatory for such installations to be brought in line with the requirements within the period specified by a separate regulation.

The costs will be further elaborated for each individual installation. The CEA appropriations will be used to upgrade the existing databases as required by the Directives 96/61/EC and 96/82/EC and the EC Regulation 166/2006 with accompanying user manuals, and for the establishment of new reporting mechanisms.

Investments in the implementation of the IPPC Directive have a wider character – they are intended for an overall reconstruction of the industry and energy sectors aimed at the alignment with the LCP Directive, and for energy efficiency, air quality standards and production upgrading. This can be best illustrated by the rebuilding of the largest refinery in Croatia which is due to air pollution caused by fuel production and at the same time aims at the fuel quality improvement (Euro V). The investment amounts to some 0.8 billion euro (5.9 billion kunas).

Apart from private sector funds, the government budget for 2008 and 2009 will secure the finance necessary for preparation of the Regulation on Integrated Environmental Conditions and for establishment of the system for issuing integrated environmental conditions. This primarily refers to training of all participants involved in the system and to establishment of the best available techniques monitoring system. In addition to the government budget, the finance will also be secured from EU funds. Implementation of the CARDS 2004 project “Support for the Further Approximation of Croatian Legislation with the EU Environmental Acquis Communautaire” started in September 2007, providing 1,000,000 euro (7.4 million kunas) for the development of the system for issuing integrated environmental conditions and supervision of implementation, and for the development of national guidelines for best available techniques.

11.4. ESTIMATE OF FUNDS NEEDED FOR COMPLIANCE OF EXISTING LARGE COMBUSTION PLANTS WITH DETERMINED LIMIT VALUES OF POLLUTANT EMISSIONS INTO THE AIR

The Directive 2001/80/EC on the Limitation of Emissions of Certain Pollutants into the Air from Large Combustion Plants has been transposed into the national legislation in full through the Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 21/2007).

In Croatia there is a total of 35 existing large combustion plants located in 14 industrial or power facilities, of which two are coal-fired and the rest are fired by liquid or gaseous fuel. Only one large combustion plant constructed in 1999 – PLOMIN II with an output of 525 MW – uses modern equipment for the reduction of pollutant emissions into the air and complies with emission limit values for existing combustion plants defined by the Regulation, or rather by the provisions of the Directive 2001/80/EC.

10 out of 14 industrial facilities contain more than one large combustion plant that generate energy for the same purpose and use the same stack. The “common stack” approach, however, cannot be applied, because they were constructed before 1986.

The majority of the combustion plants, i.e. a total of 22, are owned by the Croatian Electric Power Industry - HEP d.d.

Investment costs of emission reduction measures aimed at complying with the Directive 2001/80/EC are expected to be considerable, given the fact that most of Croatia’s plants do not meet the emission limit values set. Besides, the MEPPPC and the CEA will suffer administrative costs too.

The costs of alignment of existing installations are estimated at approximately 1,015 million euro for the scenario of fitting all existing installations with the most advanced emission reduction equipment. The costs of a scenario according to which some establishments would be exempt and the emission allowance would be assigned at the level of all facilities, i.e. one and the same emission as if the emission limit were applied individually to each facility, are estimated to be much lower. At the moment a rehabilitation programme that will define actual values is in the process of preparation. As mentioned earlier, another scenario refers to an expedited construction of new combustion plants to replace those for which the installation of emission reduction equipment is not worth while, except the use of cleaner fuels.

11.5. ESTIMATE OF FUNDS NEEDED FOR TECHNICAL ADAPTATION OF PETROL STORAGE AND DISTRIBUTION AT TERMINALS

The Directive 94/63/EC on the control of volatile organic compound emissions resulting from the storage of petrol and its distribution from terminals to petrol stations has been transposed into the Croatian legislation through the Regulation on Technical Standards of Protecting the Environment against Emissions of Volatile Organic Compounds Resulting from Petrol Storage and Distribution (Official Gazette No. 135/2006).

The Regulation lays down technical measures for the reduction of volatile organic compound emissions produced by petrol storage installations at terminals, when loading and unloading mobile containers at terminals, by mobile containers and petrol storage at service stations.

According to the Regulation, existing terminals and petrol stations are bound to comply with the EC Directive requirements by the end of 2011.

In the Republic of Croatia nine terminals for petrol storage and distribution with a capacity ranging from 8,500 to 250,000 cubic metres possess a permit for petrol storage activities (two terminals are part of the Rijeka and the Sisak oil refineries; others are located on the island of Krk, in Zadar, Zagreb, Zabok, Osijek, Solin and Ploče).

In Croatia 697 petrol stations were in operation in 2006, of which 419 stations are owned by the INA Oil Industry, 35 by TIFON, 30 by Petrol Zagreb and 53 by OMV. Other petrol stations are owned by some small-scale companies. INA is estimated to cover about 70 per cent of the entire petrol market. The survey conducted showed that petrol stations constructed after 1997, mostly owned by TIFON, OMV and other small-scale companies, are equipped with ….????

Investment costs relating to existing terminals and petrol stations suffered by their owner and operators respectively are estimated at 815.4 million kunas (111 million euro). The sources of finance are the private sector of economic operators and loans.

11.6. ESTIMATE OD FUNDS NEEDED FOR TECHNICAL ADAPTATION OF PLANTS / INSTALLATIONS USING VOLATILE ORGANIC COMPOUNDS

Directive 1999/13/EC (volatile organic compounds): The Regulation on Limit Values of Pollutant Emissions from Stationary Sources into the Air (Official Gazette No. 21/2007) complies fully with the Council Directive 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations.

According to the Regulation, the Ministry of Environmental Protection, Physical Planning and Construction established a register of legal and physical entities that use organic solvents or products containing volatile organic compounds within their activities. Legal or physical entities were bound to register by 30 May 2007. The deadline for reaching prescribed emission limit

values in waste gases or prescribed fugitive emission values, i.e. total limit values is 31 December 2015. Until 31 December 2009 target emissions may be exceeded 3 times. In the period from 31 December 2009 to 31 December 2015 target emissions may be exceeded 1.5 times.

The owner and/or the operator of an existing installation that does not meet emission limit values for volatile organic compounds from exhausts, emission limit values for fugitive emissions or total limit emissions was bound to prepare an emission reduction programme and submit the same to the Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC) by 31 December 2007.

The costs of aligning the installation with the requirements of the EC Directive are borne by owners or operators of the installation and are estimated at 518 million kunas (70 million euro).

Directive 2004/42/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicles finishing products will be transposed into the national legislation through the adoption of the Regulation on Limit Values for the Content of Volatile Organic Compounds in Certain Paints and Varnishes and Vehicles Refinishing Products adopted in September 2007 (Official Gazette No. 96/2007).

The Regulation specifies the time limits for the start of using paints and varnishes and/or vehicle refinishing products with a low content of volatile organic compounds. However, in contacts with the industry during preparation of the Regulation it was heard that products currently environmentally friendly made this option more expensive due to the changes in recipes and the purchase of new machinery, raw materials and control equipment.

The costs of adapting the recipes for the production of paints, varnishes and vehicle refinishing products borne by the private sector are estimated at some 5 million kunas (0.67 million euro).

On the basis of statistical data provided by the CCC, Department for Industry, under the product code of NIPUM 2004 (Official Gazette No. 19/2004) relating to the entire product group of paints, varnishes and similar coatings, printing colours and putties, in 2006 the industrial production amounted to about 800,000 tonnes.

11.7. ESTIMATE OF FUNDS NEEDED FOR ADAPTATION OF OIL REFINERIES

Directives 2003/17/EC on the quality of petrol and diesel fuels (replacing the Directive 98/70/EC) and 2005/33/EC replacing the Directive 1999/32/EC relating to the reduction of sulphur content in certain liquid petroleum fuels have been transposed into the national legislation through the Regulation on the Quality of Liquid Petroleum Fuels (Official Gazette No. 53/2006).

Directive 98/70/EC
The Directive defines limit values of sulphur, lead and aromatic hydrocarbons in petrol and diesel fuels, as well as deadlines for complying with the values prescribed. Tables 11.-6.-1. and 11.6.-2. show basic requirements relating to the sulphur and lead content, while exemptions and derogations as to the application deadlines are specified in detail in the Directive.

Table 11.6.-1. Limit values according to the Directive 98/70/EC

Petrol	150	0.005	as of 01.01.2000
	50	0.005	as of 01.01.2005
	10		as of 01.01.2008
Diesel fuel	350	-	as of 01.01.2000
	50		as of 01.01.2005
	10		as of 01.01.2008

Table 11.6.-2.: Limit values according to the national legislation

Type of fuel	S (mg/kg)	Lead (g/l)	Deadline
Petrol	50	0.005	as of 01.06.2006
	10		as of 01.01.2009
Diesel fuel	50	-	as of 01.06.2006
	10	-	as of 01.01.2009

The bringing of existing refineries in line with the requirements set depends in the first line on the upgrading of refinery installations with the aim to reach limit values coming into force in the EU legislation on 1 January 2009 according to the Directive 2003/17/EC.

Directive 1999/32/EC

The objective of this Directive is to reduce emissions of sulphur dioxide (SO_2) into the air produced during combustion of certain types of liquid fuels. The emission reduction should be achieved by setting limit values for sulphur content in liquid fuels as follows[16]:

Table 11.6.-3.: Limit values according to the Directive 1999/32/EC

Types of fuels	Mass% S	Deadline
Fuel oil	≤ 1.00	as of 01.01.2003
Gaseous oils	≤ 0.20	as of July 2000
	≤ 0.10	as of 01.01.2008

Table 11.6.-4.: Limit values according to national legislation

Types of fuels	Mass% S	Deadline
Fuel oil	≤ 1.00	as of 01.06.2006
Gaseous oil	≤ 0.20	as of 01.06.2006
Gaseous oil	≤ 0.10	as of 01.01.2009

The bringing in line of existing refineries depends in the first line on the upgrading of refinery installations with the aim to reach limit values defined.

Investment costs

When the ongoing upgrading of refineries will be completed, both refineries will produce liquid petroleum fuels of the quality prescribed in the territory of the EU countries. This primarily relates to a low sulphur content in fuels and includes the following liquid petroleum fuels: petrol, diesel fuels, gaseous oil, fuel oil and marine fuels.

The costs of complying with the requirements of EC Directives will be borne by the refinery owners or operators and are estimated at 5,815.9 million kunas (796 million euro).

[16] Derogations from deadlines specified are indicated in the Directive 1999/32/EC.

11.8. CLIMATE CHANGE (emission trading, the Kyoto Protocol)

The Republic of Croatia has been a Party to the Kyoto Protocol since 28.08.2007. The Commission Decisions 280/2004/EC and 2005/166EC have been transposed in full into the Croatian legislation through the Regulation on Monitoring Greenhouse Gas Emissions in the Republic of Croatia (Official Gazette No. 1/2007).

Cost of greenhouse gas emission reduction measures

The costs are defined as a difference in costs under the 'with measures' and 'without measures' scenarios. It should be taken into consideration that total annual costs represent a difference between equivalent annual costs and equivalent annual profit. Most of the energy efficiency measures yield profit after 5 years, or, in terms of arithmetic, show negative costs on average.

The costs of emission reduction measures are estimated at some 40.5 million euro/year, with an average price of reduction being 14 euro/(t CO_2 eq). If the reduction is planned to be above 2,800 Gg CO_2, the curve denoting the cost of measures rises sharply and the costs exceed 30 euro/tonne CO_2 eq. Further reductions above the values set by this Plan would mean that Croatia should purchase emission allowances, because these costs would lie below those of additional national measures, especially if the reductions are achieved through CDM projects. Accordingly, the estimate of costs shows that Croatia must seriously take into account the application of the Kyoto Protocol mechanisms in the commitment period after the Protocol.

The sources of finance needed for implementation of measures are indicated in table 8.18.-1. The major source of finance are monies collected from electricity consumers through the charge aimed at promoting the electricity generation from renewable energy sources and cogeneration (collected by *HROTE, Croatian Energy Market Operator*). Another important source is the CO_2 charge on stationary point sources collected by the EPEEF in addition to other existing environmental charges. It is also planned to introduce a charge aimed at promoting the generation of thermal and electrical energy from renewable sources. If the CO_2 charge on stationary point sources is abolished for installations covered by the emission trading scheme, new sources of finance will have to be introduced. As mentioned earlier, a feasibility study for introduction of a charge on carbon in fossil fuels to be paid by all consumers needs to be prepared and the aspects (political, economical and sociological) of introducing a vignette system for foreign vehicles in Croatia analysed. It is justifiable, because an environmental charge is already paid by all existing vehicles bearing a Croatian number plate.

Administrative costs of capacity building

In the context of implementing the project LIFE04 TCY/CRO/029 "Capacity Building for Implementation of the UN Framework Climate Change Convention and the Kyoto Protocol in the Republic of Croatia" amounting to 529,268 euro (3,916,583 kunas) the following documents and regulations were prepared in the period from September 2006 to October 2007: the Draft National Strategy for Implementation of the UNFCCC and the Kyoto Protocol Including the Action Plan; the Draft Proposal for the Regulation on Emission Allowances and Methods of Trading in Greenhouse Gas Emission Allowances, including the explanation of individual provisions; and Technical and Economic Guidelines for the Sectoral Operational Programme: Energy, Waste, Agriculture.

The main objective of the EC project "Technical Assistance in Implementation of the Kyoto Protocol: Emission Trading and Other Cost-effective Emission Reduction Measures" to the value of 130,000 euro (962,000 kunas) is to provide assistance to the Republic of Croatia in setting out effective policies and measures with the aim to meet the target under the Kyoto Protocol and continue reducing greenhouse gas emissions after 2012, especially through the

possibility of introducing a national emission trading scheme on the model of the European Union.

The climate change area is one of the three components of the CARDS 2004 project "Support for the Further Approximation of Croatian Legislation with the EU Environmental Acquis Communautaire". The project implementation started in September 2007. The climate change component provides financial assistance amounting to 500,000 euro (3,700,000 kunas). Through implementation of this project the Republic of Croatia will be provided support in the preparation of the National Allocation Plan for Greenhouse Gas Emission Allowances (NAP) pursuant to the Directive 2003/87/EC establishing a greenhouse gas emission trading scheme, and in the purchase of technical equipment for the establishment of the Greenhouse Gas Emission Registry.

The provisions of the Directives 2003/87/EC and 2004/101/EC on emission trading and the Decisions 2004/156/EC and 2005/381/EC will be incorporated into the national legislation in 2008 through the Regulation on Greenhouse Gas Allowances and Methods of Trading in Emission Allowances that will establish a greenhouse gas emission trading scheme in Croatia. The Regulation will come into effect not later than 2010, when the scheme is planned to join the EU emission allowances trading scheme. In the first half of 2008 the National Allocation Plan will be prepared within the framework of the CARDS 2004 project, specifying the total amount to be allocated to installations carrying on the activities listed in Annex I to the Directive. Emission allowances will be allocated to individual installations according to the Plan. During 2008 the Government of the Republic of Croatia will adopt the National Allocation Plan for Emission Allowances. The costs of annual reports to be submitted by entities (50) liable to emission trading and the costs of report reviews as of 2010 are estimated at 30,000 euro (222,000 kunas). The costs of meeting the emission reduction obligations for entities liable to emission reduction are included in the total costs of the Republic of Croatia under the Kyoto Protocol in the period 2008-2012 and estimated at 40.5 million euro (300 million kunas) yearly.

The Commission Regulation 2216/2004/EC has been transposed into the Croatian legislation through the Regulation on Monitoring Greenhouse Gas Emissions in the Republic of Croatia (Official Gazette No. 1/2007). The system will be established and connected to the International Transaction Log (ITL) and the Community International Transaction Log (CITL) in 2009. According to the Air Protection Act (Official Gazette No. 78/2004) the CEA is responsible for maintaining the Greenhouse Gas Emission Registry.

Administrative costs of implementing these measures amount to 1.5-2.0 million euro/year.

11.9. OZONE LAYER PROTECTION

The handling of ozone depleting substances is governed by the Regulation on Ozone Depleting Substances (Official Gazette No. 120/05) harmonized with the EC Regulation 2037/2000 on substances that deplete the ozone layer.

The Regulation makes it obligatory to legal and physical entities, owners and/or operators of refrigeration and air-conditioning equipment and fire-extinguishing systems to remove and collect the controlled substances contained in such equipment until 1 January 2011. Legal and physical entities, owners and/or operators of such equipment are bound to ensure financial resources for the replacement of ozone depleting substances and equipment with those that do not deplete the ozone layer.

Financial resources needed for the disposal and destruction of ozone depleting substances when they turn into waste are provided by the Environmental Protection and Energy Efficiency Fund on the basis of the Regulation fixing an annual charge of 3 kunas per kg of an imported

substance. According to the Regulation, a dealer or an entrepreneur importing such substances for the purpose of placing them on the domestic market or for his own needs shall pay a charge to the Environmental Protection and Energy Efficiency Fund for the purpose of covering the costs of disposal/destruction of controlled and replacement waste material.

The costs of freon and halon disposal and destruction in the period 2007-2011 is estimated at 1,340,000 kunas (181,000 euro) and will be covered by the EPEEF.

The costs relating to installation of fire extinguishing systems containing substances that do not deplete the ozone layer will be borne by the owners or operators of such systems and are estimated at some 30,000,000 kunas (4,045,000 euro) in the period 2008-2011.

The costs of replacing freon used in refrigeration equipment with substances that do not deplete the ozone layer, or the replacing of existing refrigeration equipment in the period 2008-2011 are estimated at 30,000,000 kunas (4,045,000 euro) and will be covered by economic operators themselves.

Financial resources provided by the Multilateral Fund (MF), or specifically UNIDO as its implementing agency will be used to replace some of the chillers in public institutions (a total of 1,500,000 kunas / 202,700 euro). The rest of the costs of replacing the ozone depleting substances in the refrigeration sector will be covered by economic operators themselves.

The finance necessary for the project of establishing a halon collection centre will be secured by the MF or rather in cooperation with the GTZ, Germany (a total of 300,000 kunas / 40,500 euro).

12. BENEFITS OF AIR QUALITY IMPROVEMENT AND GREENHOUSE GAS EMISSION REDUCTION

The benefit of the air pollution reduction is reflected in less impact on human health and ecosystem. The following is an overview of major impacts intended to give an insight into the types of impacts and pollutants which are the major contributors. For some time now, when creating an environmental policy on a European and a national scale, the monetary evaluation of the damage has been increasingly applied as an auxiliary means. This is, however, questionable and avoided by many who find it unethical to evaluate human health, and especially human life through money. Nevertheless, the environmental policy of the EU is more and more based on cost-benefit analyses. When interpreting the costs, one should know the size of the area to which the costs relate. The costs avoided, as indicated below, refer only to benefits achieved in towns with the supposed air quality improvement, without taking into account the overall pollution reduction across Croatia or Europe likely to be achieved by the measures taken. Moreover, the avoided damage of the greenhouse gas emission reduction was not quantified nor was the possible global reduction of climate impacts assessed. Adequate methods for such extensive and comprehensive assessments are currently far from being available.

Considering the order of magnitude, the benefits achieved are evidently at the level of the necessary investments in air protection (Section 11), but they are definitely underestimated in relation to the above. In this connection it should be stressed again that every evaluation of the damage avoided is to be understood qualitatively, through understanding the order of magnitude, because the calculation is subject to a number of questionable starting points[17].

[17] The results are informative by nature and prepared for the purpose of this Plan. They represent no recommendation in terms of activities, criteria and methodology at local levels or at the level of an individual activity in the space.

12.1. BENEFITS OF AIR QUALITY IMPROVEMENT

12.1.1. REDUCTION OF EFFECTS ON HUMAN HEALTH

The incidence of health effects is associated with pollutant concentrations, duration of exposure, the size of population subject to exposure, the age structure, a general health status and other socio-economic factors (diet, other pollutions, etc.).

Table 12.1.-1. shows major air pollution impacts by individual pollutant types (*ExternE, Externalities of Energy, Methodolgy 2005 Update*). Primary pollutants are those produced by emission sources. Secondary pollutants are a result of chemical reactions in the atmosphere and usually occur far from emission sources. It should be noted that SO_2 turns into sulphates and NOx into nitrates and participates in the ozone formation. Secondary effects of these substances are greater than their primary ones.

Table 12.1.-1.: Major air pollution impacts

Primary pollutants	Secondary pollutants	Impacts
Particulate matter (PM_{10}, $PM_{2,5}$, black smoke)		Mortality, cardiopulmonary diseases (cerebrovascular hospitalization, heart attack, chronic bronchitis, chronic cough with children, mild respiratory symptoms, asthmatic cough)
SO_2		Mortality, cardiopulmonary diseases (hospitalization, consultations with doctors, asthma, sick leaves, limited activities)
SO_2	sulphates	Same as particulate matter
NOx		Morbidity
NOx	nitrates	Same as particulate matter
NOx + VOC	ozone	Mortality, diseases (respiratory hospitalization, reduced daily activity, asthmatic attacks, days with marked symptoms)
CO		Mortality (cardiac arrest), diseases (cardiovascular)
PAH		Cancer
As, Cd, Cr-VI, Ni		Cancer, other diseases
Hg, Pb		Diseases (neurotoxicity)

According to the theory of a sequence of impacts, the monetary value of a harmful impact may be described in following terms (*Methodology for Cost – Benefit Analysis for CAFE, Pye and Watkiss, 2005)*:

(Impact = pollution x risk x effect function)

Economic damage = impact x unit value of impact

The *AirQ* Model recommended for the assessment of air quality impacts on human health by the World Health Organization may be used to calculate effects, i.e. risks arising from a short-term and long-term exposure to air pollution.

The reduction of air pollution aimed at compling with the minimum conditions for reaching the air quality category I brings about the reduction of adverse effects on human health as estimated for the following towns and pollutants on the basis of the 2006 pollution:

- **Zagreb**: NO_2, O_3 -8h, PM_{10} and PM_{10} long-term effects
- **Rijeka**: O_3 – 8h and O_3 – 1h
- **Sisak**: SO_2, PM_{10} i PM_{10} long-term effects
- **Kutina**: PM_{10} and PM_{10} long-term effects

Table 12.1.-2. shows the difference in risks between the current air quality status and the status if the air quality category I were achieved.

Table 12.1-2. Review of the reduction of health risks if the air quality category I were achieved

Health consequence	Risk reduction (number of cases) if air quality category I were achieved					
	O_3-8h	O_3-1h	NO_2	SO_2	PM_{10}	$PM_{10dug.dj}$
total mortality	2.3	1.5	-	1.6	**32.8**	**278.2**
cardiovascular mortality	0.9	0.7	0	1.5	**17.2**	**-**
respiratory mortality	0.3	0.2	-	0.2	**3.3**	**-**
hospitalization*	0.9	0.2	0	0.7	**60.7**	**-**
asthma (children+adults)	-	-	-	-	**0**	**-**
chronic bronchitis	-	-	-	-	**-**	**0**
heart attack	-	-	0	0.3	**-**	**-**
*hospitalization includes hospitalization due to respiratory and cardiovascular diseases and asthmatic attacks						

From Table 12.1.-2. it is evident that **suspended particulate matter is the major contributor to health risks,** especially mortality. The reduction of NO_2 concentrations to the first category level is not reflected in the reduction of risks (based on results), because only a few concentrations exceeded the LVs in 2006.

12.1.2. MONETARY VALUES OF DEATHS

To quantify the impacts and express them in monetary values evaluation must be carried out, using market prices, if available (crops, materials, etc.). For many impacts, however, such as the increased risk of death, there are no direct market prices to be applied. The evaluation of human life is carried out on the basis of the amount that an individual is willing to pay for the reduction in the death risk (*willingness to pay,* WTP) or on the basis of a charge that an individual is willing to accept for assuming the death risk (*willingness to accept*, WTA).

The value of statistical life has been calculated in several European studies. In the CAFE (*Clear Air for Europe)* documents on the cost-benefit analysis the reference value of statistical life (VSL) amounts to 2,000,000 euro. The evaluation of death is, however, still subject to argument. It is an ethical question whether such an approach is acceptable at all. Apart from the method of evaluating the statistical life (VSL) that relates to changes in the number of deaths, there is a more recent method relating to changes in the value of the life year (VOLY). For that reason both methods were applied to evaluate deaths. Some authors recommend that costs should be brought down to national conditions, i.e. simply reduced by the difference in GDP as compared to the value in countries where VSL or VOLY have been determined. For Croatia this means that the reduction factor of external costs might be 0.45, being the amount by which the country lags behind the average GDP of the EU.

Table 12.1.-4. shows monetary values of deaths due to air pollution caused by ozone, sulphur dioxide, nitrogen oxides and particulate matter for the current air quality in Zagreb, Rijeka, Sisak and Kutina (without the correction factor 0.45). Monetary values have also been calculated for cases (theoretical) that the air quality category I is achieved, as well as the difference of these

two qualities for the towns mentioned. **The major contribution to mortality is a consequence of exposure to elevated concentrations of particulate matter, especially in case of long-term exposure to particulate matter.**

Table 12.1.-3.: Monetary values of 'chronic' mortality risks calculated using the method of the value of statistical life

Monetary values of 'chronic' mortality risks calculated using the VSL* method			
	Current air quality, euro/year	Theoretical air quality**, euro/year	Benefit of theoretical air quality, euro/year
PM_{10} long-term effects	4,131,400,000	3,575,000,000	**556,400,000**
* VSL (*Value of statistical life*) amounts to 2,000,000 euro according to CAFE ** Theoretical air quality corresponding to the minimum reduction of pollution concentrations (2006) in order to reach the air quality category I			

Table 12.1.-4.: Monetary value of mortality risks calculated by the method of assessing the years of life lost (premature death)

Monetary values of mortality risks calculated using the VOLY* method			
	Current air quality, euro/year	Theoretical air quality, euro/year	Benefit of theoretical air quality, euro/year
"Chronic" mortality (YOLL)**			
PM_{10} long-term effects	1,342,705,000	1,161,875,000	**180,830,000**
"Acute" mortality (YOLL)***			
PM_{10}	17,658,000	14,706,000	**2,952,000**
O_3,8h	23,850,000	23,643,000	**207,000**
O_3, 1h	5,805,000	5,670,000	**135,000**
SO_2	738,000	594,000	**144,000**
NO_2	2,151,000	2,151,000	**0**
Total "acute" YOLL	**49,689,000**	**46,368,000**	**3,438,000**
*VOLY – *value of life year* **YOLL as a "chronic" mortality (*Years of life lost*) is calculated by VOLY amounting to 52,000 euro according to CAFE ***YOLL as an "acute" mortality is calculated by VOLY amounting to 120,000 euro according to CAFE			

In **Kutina and Sisak** the problem lies in elevated concentrations of **hydrogen sulphide and ammonia** in the air, which is the reason why these towns do not belong to the first, but to the second/third air quality category. These two pollutants are not listed in the European Directive on the air quality, but are characteristic for Croatia's conditions and therefore not included in the calculation of the *AirQ* model.

Hydrogen sulphide is a highly toxic and flammable gas responsible for foul odour of "rotten eggs". In urban areas the H_2S concentration is usually below 8 $\mu g/m^3$. According to the World Health Organization (WHO) the lowest threshold of harmful effects (eye irritation) is thousand times higher than the odour detection threshold. Due to its foul odour, the WHO has recommended a very low level of 7 $\mu g/m^3$, being roughly the level at which fifty per cent of the population will smell it out.

Ammonia is used as a raw material in the production of fertilizers, plastics, explosives, colouring agents and medicines (in the past also used as a cooling medium). It is a gas of a

pungent and prickling smell. Ammonia is present in the atmosphere due to the natural process of putrefaction of nitrogenous animal and vegetable matter, mostly at levels not harmful to human health. In case of industrial accidents that include the spilling of large volumes, it causes chemical burns of the respiratory system. The exposure to a concentration of 3,000 $\mu g/m^3$ causes irritation of eyes and to a concentration of 300,000 $\mu g/m^3$ for 30 minutes causes respiratory irritation and increase in the respiratory volume. A concentration of 3,530,000 $\mu g/m^3$ causes death in less than 30 minutes.

12.1.3. REDUCTION OF EFFECTS ON MATERIALS

For a number of materials the dry deposition of SO_2 has proved to be the most destructive, while the effect of wet deposition is less destructive. SO_2 causes damage to stone in the first line (especially limestone) and mortar. According to CAFÉ CBA the critical thickness of natural stone and mortar to be maintained is 3-5 mm, the thickness of galvanized steel ranges from 15 – 120 μm and that of colour 20 – 100 μm. Ozone as a highly oxidizing agent causes damage primarily to polymeric materials. The effect of nitrogen oxides on materials is still unexplained.

12.1.4. REDUCTION OF EFFECTS ON CROPS

Wet and dry deposition of SO_2 have an adverse effect on crops and reduce the yield. The nitrogen deposition has a positive effect on the ecosystem, because nitrogen is the essential component of biological molecules. However, large amounts of nitrogen cause eutrophication, i.e. the excessive growth of species not particularly important for the conservation of biodiversity. Ozone also affects adversely the crops and reduces the yield. Besides acting as a very strong oxidant, in reactions with nitrogen oxides it generates nitrates environmentally not friendly.

12.1.5. REDUCTION OF EFFECTS ON FORESTS

As in the case of impacts on crops, adverse impacts on forests are also attributed to wet and dry deposition of sulphur oxides, ozone, nitrogen oxides or nitrates, acid and nitrogen deposition.

Acid rains resulting from the reaction of sulphur and nitrogen oxides with water vapour have a particularly adverse effect on forest vegetation. Their spread depends on the meteorological conditions. The effect is particularly detrimental on conifers. Harmful effect thresholds are determined for various combinations of forest vegetation and soil.

12.2. BENEFITS OF GREENOUSE GAS EMISSION REDUCTIONS

Implementation of measures for the reduction of greenhouse gas emissions has numerous benefits. On a global scale it contributes to the reduction of concentrations in the atmosphere and thus mitigates harmful effects of the temperature rise and climate change. In this way it also reduces the dependence on fossil fuels. This means that about 1 million t_{oe} /year of fossil fuels will be saved, mostly liquid fuels, coal and natural gas. The economy becomes less vulnerable to the rise of crude oil prices and the power supply safer due to a greater diversification of energy sources and lower dependence on import. It offers new opportunities for the entrepreneurship and employment, reduces the emission of harmful substances affecting human health and biodiversity. The application of measures for the reduction of greenhouse gas emissions will indirectly reduce the emissions of SO_2 in Croatia in 2010 by about 8,500 tonnes/year (11 per cent reduction), of NO_X by 5,000 tonnes/year (6.8 per cent reduction) and of particulate matter by about 250 tonnes/year. This will at the same time facilitate Croatia's

access to the Gothenburg Protocol to the Convention on Long-range Transboundary Air Pollution.

Viewing from the aspect of a household, the application of measures will have positive financial effects on household budgets. In a typical Croatian household, if low-consumption devices, adequate thermal insulation and low-consumption car were used, the amount of fossil fuel bills might be halved.

13. PUBLICATION OF THE AIR QUALITY PROTECTION AND IMPROVEMENT PLAN OF THE REPUBLIC OF CROATIA FOR THE PERIOD 2008-2011

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Prime Minister
Dr Ivo Sanader, signed

ABBREVIATIONS

AAU – Assigned Amount of Unit
AOT40 – a parameter expressed in (µg/m3)-h and meaning the sum of the differences between the hourly concentration above 80 µg/m^3 (=40 ppb) and 80 µg/m^3 during a specified period, taking into account only values measured for each hour of a day between 8:00 and 22:00 CET
BAT – Best Available Technologies
CAFE – Clean Air For Europe
CARDS – Community Assistance for Reconstruction, Development and Stabilization
CCC- Croatian Chamber of Commerce
CDM – Clean Development Mechanism
CEA – Croatian Environment Agency
CER – Certified Emission Reduction
CITL – Community Independent Transaction Log
EC – European Commission
ELV – Emission Limit Value
EMEP – Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EPEEF – Environmental Protection and Energy Efficiency Fund
ERPA – Emissions Reduction Purchase Agreement
ERU – Emission Reduction Unit
ESPOO Convention – Convention on Environmental Impact Assessment in a Transboundary Context
EU – European Union
GDP – Gross Domestic Product
GEF – Global Environmental Facility
GIS – Geographic Information System
HBOR – Croatian Bank for Reconstruction and Development
HROTE – Croatian Energy Market Operator
IBRD – International Bank for Reconstruction and Development
ICP – International Co-operative
IET – International Emission Trading
IIASA – International Institute for Applied Systems Analyses)
IMR – Institute for Medical Research and Occupational Health
IPCC – International Panel on Climate Change
ITL – International Transaction Log
JI – Joint Implementation
LCP Directive – Directive on Large Combustion Plants
LOAEL – Lowest Observed Adverse Effects Level
LPG – liquefied petroleum gas
LRTAP – Convention on Long-Range Transboundary Air Pollution
LULUCF – Land Use, Land Use Change and Forestry
LV – limit value of pollutant concentration in the air
MAFRD – Ministry of Agriculture, Fisheries and Rural Development
MARPOL – International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
MCA – administrative measure for climate change mitigation
MCI – investment-type measure for climate change mitigation
MELE – Ministry of Economy, Labour and Entrepreneurship
MEPPPC – Ministry of Environmental Protection, Physical Planning and Construction
MFAEI – Ministry of Foreign Affairs and European Integration
MGA – administrative measure for tackling the issue of air quality limit value exceedance
MGI – investment-type measure for tackling the issue of air quality limit value exceedance
MHS – Meteorological and Hydrological Service

MI – Ministry of Interior
MKA – administrative measure for tackling critical pollution levels
MKI – investment-type measure for tackling critical pollution levels
MPA – administrative measure for preventive air protection
MPOA – administrative measure for persistent organic pollutants and heavy metals
MPOI – investment-type measure for persistent organic pollutants and heavy metals
MPRA – administrative measure for transport
MPRI – investment-type measure for transport
MSES – Ministry of Science, Education and Sports
MSTI – Ministry of Sea, Transport and Infrastructure
MTI – investment-type measure for tackling the issue of air quality tolerance value exceedance
MZA – administrative measure for the Gothenburg Protocol
MZI – investment-type measure for the Gothenburg Protocol
NEC Directive - Directive on national emission ceilings for certain atmospheric pollutants
NMVOC – Non-methane Volatile Organic Compound
ODS – Ozone Depleting Substance
PAH – Polyaromatic Hydrocarbon
PHARE - Pologne et Hongrie-Aide á Restructuration Economique
POCP – Photochemical Creation Potential
POP – Persistent Organic Pollutant
PRTR – Pollutant Release and Transfer Register
RDF – Refuse Derived Fuel
TDM – Total Deposited Matter
TPM – Total Particulate Matter
TV – tolerance value for concentration of a pollutant in the air
UNECE – United Nations Economic Commission for Europe
UNFCCC – United Nations Framework Convention on Climate Change
VOC– Volatile Organic Compound
VOLY – Value of Life Year
VSL – Value of Statistical Life
WHO – World Health Organization