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REPUBLIC OF CROATIA

Technology Needs Assessment Report

Under Project: Climate Change Enabling Activity (Phase II)

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CONTENT:

LIST OF ABBREVIATIONS

AHP - Analytical Hierarchy Process
BIOEN - Biomass and Waste Utilisation Programme
CARDS - Community Assistance for Reconstruction, Development and Stability
CDM - Clean Development Mechanism
CFL - Compact Fluorescent Light Bulb
CKD - Cement Kiln Dust
COP - Conference of the Parties
CROTOK - Island Energy Development Programme
CTI - Climate Technology Initiative
DOC - Degradable Organic Carbon
DSM - Demand-Side Management
EE - Energy Efficiency Project
EIHP - Energy Institute Hrvoje Požar
EIT - Economies in Transition
EKONERG - Energy Research and Environmental Protection Institute
ENWIND - Wind Energy Use Programme
ESCO - Croatian Energy Service Company
EST - Environmental Sound Technology
ET - Emission Trading
EU - European Union
GCOS - Global Climate Observing System
GDP - Gross Domestic Product
GEF - Global Environment Facility
GEOEN - Geothermal Energy Utilisation Programme
GHG - Greenhouse Gases
GWP - Global Warming Potential
HBOR - Croatian Bank for Reconstruction and Development
HEP - Croatian Electricity Utility Company
HMSC - Meteorological and Hydrological Service of Croatia
IBRD - International Bank for Reconstruction and Development
IEA - International Energy Agency
INA - Croatian Oil Industry
IPCC - Intergovernmental Panel on Climate Change
ISPA - Instrument for Structural Policies for Pre-Accession
JI - Joint Implementation
KOGEN - Cogeneration Programme
$KUEN_{building}$ - Energy Efficiency in Buildings
$KUEN_{cts}$ - Energy Efficiency of Centralized Thermal Systems
LIFE - The Financial Instrument for the Environment
LUCF - Land Use Change and Forestry
MAHE - Small Hydropower Programme
MCA - Multi-Criteria Analysis
MDB - The Multilateral Development Banks
MEPPPC - Ministry of Environmental Protection, Physical Planning and Construction
MIEE - Industrial Energy Efficiency Network
MSW - Municipal Solid Waste
NEAP - National Environmental Action Plan

NGO - Non Governmental Organizations
NSCR - Non-Selective Catalytic Reduction
NSI - National Systems of Innovation
ODA - Official Development Assistance
OECD - Organisation for Economic Co-operation and Development
PAP - Priority Activities Plan
PLINCRO - Gas Network Development Programme
PMU - Project Management Unit
PROHES - Croatian Energy Sector Development and Organization
PSC - Project Steering Committee
SMEs - Small and Medium-Size Enterprises
SUNEN - Solar Energy Utilisation Programme
SWDS - Solid Waste Disposal Site
TNA - Technology Needs Assessment
TRANCRO - Energy Efficiency in Transport
UNDP - United Nations Development Programme
UNEP - United Nations Environment Programme
UNFCCC - United Nations Framework Convention on Climate Change
UNOPS - United Nations Office for Project Services
USAID - United States Agency for International Development
WB - World Bank

Chemical Symbols:

CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
N_2O - nitrous oxide
NO_x - nitrogen oxides
HFCs - hydrofluorocarbons
PFCs - perfluorocarbons
SF_6 - sulphur hexafluoride
SO_2 - sulphur dioxide
NMVOCs - non-methane volatile organic compounds
O_3 - ozone

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SUMMARY

The project **Climate Change Enabling Activity; additional financing for capacity building in priority areas** is an add-on component and follow-on to the project "Enabling Croatia to prepare its First National Communication in Response to its Commitments to the UNFCCC" CRO/98/G31, respectively, represents Phase II of the First National Communication. The overall objectives of this project comprise technology needs assessment, activities associated with capacity building for participation in systematic observation networks, public awareness and education with main objective to raise the level of knowledge about causes and consequences of climate change, which encourage the creation of enabling environment for the transfer of environmentally sound technologies. Institutions responsible for project coordination and enforcement (Ministry of Environmental Protection, Physical Planning and Construction, MEPPPC; Energy Institute Hrvoje Požar, EIHP and Energy Research and Environmental Protection Institute, EKONERG) and the other participating institutions, constitute project team which have been participated in the preparation of the First National Communication.

Technology needs assessment is a first step in **technology transfer framework**, which also includes technology information, enabling environment, capacity building and mechanisms for technology transfer. For each of these stages or implementation steps, the stakeholders, technology transfer pathways, and barriers to technology transfer encountered will vary.

Technology needs assessment is accomplished by applying methodology proposed by UNFCCC and the other relevant institutions, such as GEF and Climate Technology Initiative. Applying methodology has been adjusted to county-specific circumstances and Croatia's TNA exercise has been conducted through the following activities: preliminary overview of options and resources; institutional arrangements and stakeholder engagement; establishing criteria for selecting mitigation measures priorities; defining priority sectors and sub-sectors; selecting priority measures and sectors; in-depth measure and barrier assessment and stakeholder consultation; selection of high priority actions for further development and implementation.

The Technology Needs Assessment Report is divided in two parts. The first part (Chapter 2) contains background information on Croatian UNFCCC commitments and Kyoto targets, summary of national emission and removal trends, projections and the total effects of policies and measures and overview of existing GEF projects addressing climate change. The second part (Chapters 3 and 4) refer the technology needs assessment exercise in Croatia and action plan to enhance technology transfer.

Preliminary overview of options and resources includes an overview of key sectors, with review of GHG emissions, measures and potentials to reduce GHG emissions. Overall decline of economic activities and energy consumption in the period 1991-1995, which was mainly the consequence of the war in Croatia, had directly caused the decline in total emissions of greenhouse gases in that period. Emissions have started to increase in the period 1996-2003 (2 to 3 percent per year) because of revitalisation of economy. Projections of GHG emissions show that even with implementation of all additional measures Croatia is not able to achieve the GHG emissions stabilisation on the level of the base year emission and Kyoto target.

Policy in particular sectors, such as economy, energy and environmental protection, has significant influence on the climate change mitigation. For the effective implementation of policy

objectives it is necessary to apply different instruments and implementing mechanisms in individual sectors, with including it in specific sectors strategies, plans and regulations. However, at the moment, defined objectives and measures are not adjusted completely, which indicates the emergency of better coordination between particular ministries as well as adjustment of legislation, inside and between sectors, with the aim to solve the priorities associated with the climate change.

Criteria for selecting mitigation measures priorities have been established. The basic criteria are: development benefits; implementation potentials and contribution to climate change response goals. Development benefits define climate change mitigation and adaptation technologies which offer the greatest value to the country in meeting its current national development priorities. Implementation potential defines scale of implementation and diffusion of the technology which can be realistically achieved if key barriers are overcame. Contribution to climate change response goals defines technologies which will make the biggest contributions to the country's efforts for mitigating greenhouse gas emissions and for facilitating adaptation to climate change.

TNA assessment process analyzed mitigation measures which were identified in the First National Communication of the Republic of Croatia to the UNFCCC, with implementation potential at 2010. Analysis of the other measures has not been performed, because of incapacity for aggregation of basic data (financial and time limitation), although numerous attractive and economic mitigation measures are occurred in each sector. By means of defined criteria, mitigation measures have been evaluated and selected, as follows: Wind Power Plants, Biomass in Heating Plants, Insulation Improvement and Energy Efficiency in Buildings and Construction, Biomass in Cogeneration Plants and Increase in Biodiesel Use.

The importance of criteria and evaluation of priority mitigation measures was determined by survey technique Delphi method which is based on expert judgements, because empirical and quantitative data are lacking. Assessment was based on multi-criteria techniques and this approach entails uncertainties associated with quality of information, activity data and biases in expert judgement. For the purpose of defining assessment reliability, sensitivity analysis has been performed by each criterion, criteria category and each expert. In order to reduce uncertainties related to selection of priority mitigation measures, usage of relevant technical-economic models, such as MARKAL and/or MESSAGE are recommended, as first step in future implementation activities primarily to review priority measures in terms of their cost-effectiveness and alignment with overall energy policy goals on national level.

Based on the experience of the other countries and proposed guidelines for determination of technology transfer barriers, the final list of barriers has been synthesized. Barriers assessment has been conducted with the aim to find common framework for identifying the highest priority measures and technology transfer activities. Barriers identified as relevant for mitigation measures transferring are legal, institutional, organizational, social and financial.

Preparation of **Technology Transfer Action Plan** (TT Action Plan) is defined as a first further implementation step. The purpose of **TT Action Plan** is to serve as a key policy document in stepping out from initial technology needs assessment phase towards concrete implementation of activities in technology transfer framework. From the perspective of Croatian commitments to Kyoto Protocol and planned economic growth, transfer of GHG mitigation technologies will play a crucial role in meeting Kyoto target.

1. INTRODUCTION

The purpose of **Technology Needs Assessment Report** (further in the document as: TNA Report) is evaluation and selection of priority greenhouse gas mitigation measures which were identified in the First National Communication of the Republic of Croatia to the United Nations Framework Convention on Climate Change (further in the document as: UNFCCC) [1] and identification of the main barriers in technology transfer process.

Technology needs assessment is a first step in **technology transfer framework**, which also includes technology information, enabling environment, capacity building and mechanisms for technology transfer.

Article 4.5 of UNFCCC states that developed country Parties and other developed Parties included in Annex II "shall take all practicable steps to promote, facilitate and finance, as appropriate, **the transfer of**, **or access to**, **environmentally sound technologies and know-how to other Parties**, particularly developing country Parties, to enable them to implement the provisions of the Convention."

According to the Intergovernmental Panel on Climate Change Special Report [2] (further in the document as: IPCC Report), the term "**technology transfer**" is defined as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as government, private sector entities, financial institutions, non governmental organizations (NGOs) and research/education institutions. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies. Technology for mitigating and adapting to climate change should be environmentally sound technology (EST) and should support sustainable development.

The TNA Report is divided in two parts. The first part (Chapter 2) contains background information on Croatian UNFCCC commitments and Kyoto targets, summary of national emission and removal trends, projections and the total effects of policies and measures and overview of existing GEF projects addressing climate change. The second part (Chapters 3 and 4) refer the technology needs assessment exercise in Croatia and action plan to enhance technology transfer.

According to technology needs assessment process which was performed by national experts in all sectors, following greenhouse gas (GHG) mitigations measures were selected as priorities: Wind Power Plants; Biomass in Heating Plants; Insulation Improvement and Energy Efficiency in Buildings and Construction; Biomass in Cogeneration and Increase in Biodiesel Use.

2. NATIONAL CLIMATE CHANGE MITIGATION POLICY AND MEASURES

The Republic of Croatia became a party to the UNFCCC in 1996. Pursuant to parliamentary Decree on Ratification (Official Gazette 55/1996) the Republic of Croatia has under Article 22 of the Convention undertaken the commitments outlined in Annex I as a country undergoing the transitional process to a market economy. Croatia has thus committed itself to maintain emissions of greenhouse gases at their 1990 levels.

The Republic of Croatia is also a signatory to the Kyoto Protocol. Upon its entering into force and its ratification by Parliament, Croatia shall commit to reduce its emissions of greenhouse gases by 5 percent in relation to the base year, over the commitment period from 2008 to 2012.

The implementation of the Kyoto Protocol's commitments will be an extremely difficult task for Croatia, perhaps even beyond its capacities. Considering the very low initial level of GHG emissions, the consequences of war and process of transition to market economy, the implementation of GHG mitigation measures will undoubtedly have significant implications on sustainable development. The Convention offers some benefits connected with the orientation towards sustainable development, including environment sound technologies, transfer of knowledge, experience and technologies and financing possibilities via various mechanisms such as the Global Environment Facility (GEF) and other international and bilateral funds.

2.1. SUMMARY OF NATIONAL EMISSIONS AND REMOVALS TRENDS

Overall decline of economic activities and energy consumption in the period 1991-1995, which was mainly the consequence of the war in Croatia, had directly caused the decline in total emissions of greenhouse gases in that period. With the entire national economy in transition process, some energy intensive industries reduced their activities or phased out certain productions, which was considerably reflected in GHG emissions. Emissions have started to increase in the period 1996-2003 in average of 3.3 percent per year, because of revitalisation of economy. The trend of aggregated emissions/removals, for the period 1990-2003, is shown in Tables 2.1-1 and 2.1-2. Overview of emissions and removals estimates has been undertaken from National Inventory Report [3].

Table2.1-1: Aggregated emissions and removals of GHG by sectors (1990-2003)

Source	Emissions and removals of GHG (kt CO_2-eq)					
	1990	**1995**	**2000**	**2001**	**2002**	**2003**
Energy	22489	16393	18843	19958	21202	22637
Industrial Processes	3932	2021	2815	2785	2717	2702
Agriculture	4411	3121	3097	3195	3235	3238
Waste	933	995	1162	1201	1239	1289
Total	**31765**	**22530**	**25917**	**27140**	**28393**	**29867**
Removals (LUCF)	-12688	-12688	-14442	-14442	-15373	-15373
NET EMISSION	**19077**	**9842**	**11475**	**12698**	**13020**	**14494**

Table 2.1-2: Aggregated emissions and removals of GHG by gases (1990-2003)

Gas	Emissions and removals of GHG (kt CO_2-eq)					
	1990	**1995**	**2000**	**2001**	**2002**	**2003**
Carbon dioxide (CO_2)	23035	16251	19378	20454	21576	23000
Methane (CH_4)	3809	3107	3233	3383	3452	3611
Nitrous oxide (N_2O)	3983	3163	3284	3254	3316	3230
HFCs, PFCs and SF_6	939	8	23	49	49	27
Total	**31765**	**22530**	**25917**	**27140**	**28393**	**29867**
Removals (LUCF)	-12688	-12688	-14442	-14442	-15373	-15373
NET EMISSION	**19077**	**9842**	**11475**	**12698**	**13020**	**14494**

CARBON DIOXIDE EMISSIONS

The most significant anthropogenic source of CO_2 is the energy sector (mainly fossil fuel combustion) and some industrial processes (e.g. cement production). The results of CO_2 emission estimates in the period 1990-2003 are shown in Table 2.1-3.

Table 2.1-3: Total CO_2 emissions and removals in the period 1990-2003

Source	CO_2 emissions and removals (kt)					
	1990	**1995**	**2000**	**2001**	**2002**	**2003**
Energy	20985	15082	17446	18443	19611	20988
Industrial Processes	2050	1170	1932	2011	1965	2012
Forest (sink)	-12688	-12688	-14442	-14442	-15373	-15373
Total	**23035**	**16251**	**19378**	**20454**	**21576**	**23000**
NET EMISSION	**10347**	**3564**	**4936**	**6012**	**6203**	**7627**

The methodology used for estimating CO_2 emissions in energy sector follows the *Revised 1996 IPCC Guidelines.* According to calculation results there are two emission intensive subsectors in energy sector i.e. Energy Industries and Manufacturing Industries and Construction. Transport is also one of the important emission sources of CO_2. Emission estimates are based on fuel consumption data given in National Energy Balance, where energy demand and supply is given at sufficiently detailed level, what allows emissions estimation by sectors and subsectors (IPCC Methodology, Sectoral approach). Also, the CO_2 emission is estimated by Reference approach, which considered only total energy balance, without subsectors analyses. Comparison between these approaches was made, and the difference is not greater than 5.2 percent.

Greenhouse gas emissions in industrial processes are produced as by-products of non-energy processes in which raw materials are chemically transformed to final products. Industrial processes whose contribution to CO_2 emissions is identified as significant are production of cement, lime, ammonia, ferroalloy, as well as use of limestone and soda ash in different industrial activities. The general methodology applied to estimate emissions associated with each industrial process, recommended by *Revised 1996 IPCC Guidelines*, involves the product of amount of material produced or consumed, and an associated emission factor per unit of consumption/production.

Removals

According to General Forest Management Plan of the Republic of Croatia forests and forest land in Croatia cover 43.5 percent of the whole area. In Croatia forests were formed by natural regeneration over 95 percent of the area and 5 percent of the forests are grown artificially. Of all forested area and forest land, 2,061,609 ha (84 percent) is under forests, 315,166 ha (13 percent) is non – forest productive land, and 80,973 ha (3 percent) is bare unproductive and infertile soil.

The annual increment in Croatia forests is around 9,643,000 m^3 of wood. The increment is an increase in the forest timber stock over a specific period and it is calculated as an annual, periodical and average increment. The check method or the method of bore-spills is most often used in Croatia to identify the increment. The quality and quantity of increment can be improved by different methods of forest cultivation. The annual cut is a part of the forest timber stock planned for commercial harvesting for a certain period (1 year, 10 years, 20 years) expressed in timber stock (m^3, m^3/ha) or by the surface area. To satisfy the basic principles of the sustainable forest management (continuous management), the annual cut must not be larger than the increment value.

The methodology used for estimating net uptake of CO_2 follows the *Revised 1996 IPCC Guidelines*, based on annual increment of biomass in forests and wood harvest. For the period 1990-1995 total adsorption recalculated to CO_2 was 12,687 kt CO_2. For the period from 1996-2001 total adsorption recalculated to CO_2 was 14,441 kt CO_2. The total removals of CO_2 expressed in kt CO_2 for the year 2002 and 2003 are 15,373.

METHANE EMISSIONS

In Croatia, the major sources of methane are agriculture, municipal solid waste disposal on land and fugitive emission from fuel production, processing, transportation and using activities. The methods proposed by *Revised 1996 IPCC Guidelines* were used for estimating CH_4 emissions. The results of CH_4 emission estimates in the period 1990-2003 are shown in Table 2.1-4.

Table 2.1-4: CH_4 emission estimates in the period 1990-2003

Source	CH_4 emissions (kt)					
	1990	**1995**	**2000**	**2001**	**2002**	**2003**
Energy	67.8	58.4	59.2	64.5	67.0	68.4
Industrial Processes	0.8	0.4	0.3	0.3	0.3	0.3
Agriculture	75.0	48.0	43.1	43.6	42.7	46.3
Waste	37.8	41.1	51.3	52.7	54.5	56.9
Total	**181.4**	**148.0**	**153.9**	**161.1**	**164.4**	**171.9**

NITROUS OXIDE EMISSIONS

The most important sources of N_2O emission in Croatia are agriculture and nitric acid production. The other sources of N_2O emission are waste and energy sector. Emissions were calculated using the *Revised 1996 IPCC Guidelines.* The N_2O emission estimates in the period 1990-2003 are shown in Table 2.1-5.

Table 2.1-5: N_2O emission estimates in the period 1990-2003

Source	N_2O emissions (kt)					
	1990	1995	2000	2001	2002	2003
Energy	0.3	0.3	0.5	0.5	0.6	0.7
Industrial Processes	3.0	2.7	2.8	2.3	2.2	2.1
Agriculture	9.1	6.8	7.1	7.4	7.5	7.3
Waste	0.5	0.4	0.3	0.3	0.3	0.3
Total	**12.8**	**10.2**	**10.6**	**10.5**	**10.7**	**10.4**

HALOGENATED CARBONS (HFCs, PFCs) AND SF_6 EMISSIONS

PFC (CF_4 and C_2F_6) emissions are generated in the production of primary aluminium. The Croatian aluminium industry was still operational in 1990/1991, but production was stopped in 1992. Activity data (production of primary aluminium) and adequate emission factors (proposed by *Revised 1996 IPCC Guidelines*) were used to calculate emissions.

A certain amount of SF_6 is contained in electrical equipment used in the facilities of Croatian National Electricity (Hrvatska elektroprivreda). Equipment manufacturers guarantee annual leakage of less than 1 percent, so this information could be used to determine the SF_6 emissions. However, it is still not included in the inventory because input data are not reliable.

Also, some emissions are released by the handling and consumption of synthetic greenhouse gases. HFCs and PFCs are used as substitutes for cooling gases in refrigerating and air-conditioning systems that deplete the ozone layer. The survey carried out among the major agents, users and consumers of these gases and information related to import and export of HFCs in the period 1995-2003, provided by Ministry of Environmental Protection Physical Planning and Construction, was used to calculate emissions. Potential HFCs emissions (proposed by *Revised 1996 IPCC Guidelines*) were calculated by difference of import and export of these gases.

EMISSIONS OF INDIRECT GREENHOUSE GASES

Although they are not considered as greenhouse gases, photochemical active gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOCs) indirectly contribute to the greenhouse effect. These are generally referred to as indirect greenhouse gases or ozone precursors, because they effect the creation and degradation of O_3 as one of the GHGs. Sulphur dioxide (SO_2), as a precursor of sulphate and aerosols, is believed to contribute negatively to the GHG effect. The calculations of aggregate results for the emissions of indirect gases in the period 1990-2003 are given in Table 2.1-6.

Table 2.1-6: Emissions of indirect GHG in the period 1990-2003

Gas	Emissions (kt)					
	1990	1995	2000	2001	2002	2003
NO_x	91.8	65.2	76.7	76.7	77.1	73.9
CO	435.0	255.1	285.2	240.4	226.5	230.4
NMVOC	525.0	285.5	236.7	195.2	317.9	446.1
SO_2	191.6	82.0	73.5	68.8	74.6	75.7

2.2. POLICY AND MEASURES

Policies which have significant effect on the climate change issues are described below. They were developed within the framework of the Strategy of Development entitled "Croatia in the 21st Century" - Macroeconomy [4]. This development strategy consists of 19 thematic documents whose formulation was co-ordinated by the Strategic Planning Office of the Republic of Croatia.

2.2.1. ECONOMIC POLICY

Croatian economic policy supports the transition to a market economy, the reconstruction of areas destroyed during the war, privatisation, greater integration into the international economy, the restructuring and orientation of the economy towards secondary and tertiary industries, as well as increases in production and arise in employment. The high unemployment rate is the reason why the current policy is directed at finding a solution to this particular problem. Political instability in the region remains a threat and represents a principal barrier to trade, having negative effects on Croatia's vital tourist industry.

The economy development concept of the Republic of Croatia should be founded upon the increase in quality, quantity, and mobility of growth-influencing factors, on higher efficiency of market mechanisms and competition in all markets, and the increase in openness and liberalization along with preservation of macroeconomic stability and protection of nature. By implementation of the successful anti-inflationary program, the Republic of Croatia has fulfilled the prerequisites for a long-range sustainable growth.

The Republic of Croatia has economic potential that can stimulate and direct to a more rapid economic growth:

- human resources;
- favourable geographic position;
- land and preserved natural resources (forests and waters in the first place);
- relatively developed basic infrastructure.

Macroeconomic stability and more open economy are most important factors that have an impact on the economic growth. Therefore, based on Article 30, paragraph 3 of The Law on the Government of the Republic of Croatia (Official Gazette 101/98, 15/00, 17/01), on November 21st 2002 the Croatian Government adopted The Strategy of Development "Croatia in 21st Century" - Macroeconomy (further in the document as: Macroeconomic Development Strategy).

Strategy defines four main strategic objectives of the future development of Croatia, which are:

1. Accomplishment of the economic growth and high degree of welfare of all Croatian citizens along with the economic development of all regions;
2. Integration into Europe and the World;
3. Higher quality of human resources;
4. Maintenance of peace and national security.

In order to formulate and quantify specific macroeconomic policies that could be used in approaching to and achieving these objectives, the strategic objectives should be quantified as well.

The Macroeconomic Development Strategy is based on macroeconomic policies; fiscal policy, monetary policy; economic relations with foreign countries; the order of liberalization; employment and salaries; the struggle against poverty and region–economic policy. The Macroeconomic Development Strategy also gives a projection of Croatia economy grows in the period from 2001 to 2015.

2.2.2. ENERGY POLICY

In accordance with the objectives set by the Government of the Republic of Croatia, the basic strategic task of the energy sector is to provide a high quality and reliable supply of energy to customers, with necessary intensively inclusion in the international energy market. The Government's program pursues: increases in energy efficiency; the diversification of power sources and fuels; the provision of incentives for the use of renewable; the establishment of fair (market) electricity prices; the development of an energy market and corresponding entrepreneurialism; and taking care to protect the environment.

Based on Article 80 of The Constitution of the Republic of Croatia and Article 5, paragraph (3) of The Energy Act (Official Gazette 68/01), on 19 March 2002 the Croatian Parliament adopted a document of The Energy Development Strategy of the Republic of Croatia.

The Energy Development Strategy is a part of the entire strategy of economic development of the Republic of Croatia that covers a period to 2030. The strategy has the energy, economic, legislative, organizational, institutional, and educational dimension. It suggests a Croatian model of development because even the developed countries do not have their uniform solution and therefore no foreign solution could be copied and applied directly. The Strategy provides the goals of the energy policy and the measures needed to accomplish those goals. The energy development strategy is especially required because of the international obligations assumed in the field environmental protection, and adaptation of the energy sector to the energy management conditions in the European Union. The Strategy considers and elaborates three scenarios of the energy development:

Scenario S1: Conventional technologies with no active measures by the State based on the assumption of slowed down introduction of the new technologies in the energy system and insufficient involvement of the State in the reform and restructuring of the energy sector. This means the State would be less involved in institutional and organizational reform, no support would be given to increase the energy efficiency, for renewable energy sources, and for environmental protection.

Scenario S2: Implies introduction of new technologies and active measures by the State. Political and economic integration of Croatia in the European Union along with good economic effects will also have good results in transfer of technology and organization of the State. The society would relatively soon reach the level that would enable active and efficient, and socially useful intervention of the State.

Scenario S3: An explicitly environmental scenario assuming that the global problem of greenhouse effect and the concept of sustainable development at the world level will already by 2010 have a considerable impact on reorientation of the entire world industry and the economy in general by switching to energy-efficient technologies and technologies focused on renewable energy sources.

Energy Development Strategy defines goals of Croatia energy development, which are:
- Increasing the energy efficiency;
- Securing provision and supply of energy;
- Diversifying fuels and their sources;
- Using renewable energy sources;
- Achieving realistic pricing of energy and develop the energy market and entrepreneurship;
- Protecting the environment.

To increase the energy efficiency is one of the basic components of sustainable development and therefore contributes to lower environmental impact of the energy sector, higher rate of employment, and finally higher competitive ability of the entire national economy. Organized and systematic care for the energy efficiency will be implemented in Croatia by the National Energy Programmes covering vital areas of production, transmission, transport, distribution, and consumption of energy whose efficiency could be improved.

In 1997, the Croatian Government has brought a Decision on Initiation of the National Energy Programmes within the PROHES (*Croatian Energy Sector Development and Organization*) Programme. This project has been initiated in order to build the energy management system that would specifically promote cleaner technologies, gas introduction, energy efficiency, renewable energy resources and environmental protection. Realization of these projects is based on the programmes, each of which covers a specific energy management field. These programs are planned to underlie organized and systematic care of energy efficiency and exploitation of the renewable energy resources.

As a result of the Decision issued by the Government of the Republic of Croatia in March 1997, all competent ministries and other state institutions and companies signed the agreement to manage ten National Energy Programmes with the Energy Institute Hrvoje Požar:

The National Energy Programmes include:
- PLINCRO – Gas Network Development Programme
- KOGEN - Cogeneration Programme
- MIEE - Industrial Energy Efficiency Network
- MAHE - Small Hydropower Programme
- SUNEN - Solar Energy Utilisation Programme
- BIOEN - Biomass and Waste Utilisation Programme
- ENWIND - Wind Energy Use Programme
- GEOEN - Geothermal Energy Utilisation Programme
- $KUEN_{building}$ - Energy Efficiency in Buildings
- $KUEN_{cts}$ - Energy Efficiency of Centralized Thermal Systems
- TRANCRO - Energy Efficiency in Transport
- CROTOK – Island Energy Development Programme

PLINCRO - Gas Network Development Programme
Its objective is to increase use of gas in energy consumption structure as a whole as a prerequisite for gas network expanding to all until now non-gasified regions. Gas network has only been developed in north-western part of Croatia, in areas where gas has been exploited or in regions that traditionally use urban gasification. The postulates underlying the programme are: new sources of gas supply should be secure; all legal, organizational and institutional conditions should be fulfilled for the expansion of the gas network to all regions where gas has

never been used; promotional and educational activities illustrating the benefits of gas utilisation should be conducted; and a system of incentive measures for the realization of the gasification programme should be set. Currently, about 15% of Croatian households are connected to the gas pipeline system. A 40% increase in connections is expected by 2025.

KOGEN - Cogeneration Programme

There are 3 large cogeneration power plants, namely public district heating plants in Zagreb and Osijek. Cogeneration is also used in 16 large industrial power plants. These plants contribute to almost 10% of the Croatian electric energy consumption. This programme objective is to obtain all preconditions and take off all obstacles for increasing cogeneration plants construction, everywhere where heat and electricity are used in technological processes. Of course, it is necessary to assess project's economical acceptability and its cost efficiency. From the experiences of other countries, a number of barriers are known, from legal and investment security to low level of information, as well as inactivity of company's management. In programme realization, active role of government and its expert institutions in ensuring all conditions for large cogeneration plants construction is important.

MIEE - Industrial Energy Efficiency Network

The network installing programme objective is to ensure all institutional, organizational and expert prerequisites for increasing energy efficiency in industry, service sector and public sector. Model is based on experiences of developed countries, involving sector's organization in economy and public sector in order to gradually increase energy efficiency through companies own expert team and other experts work, as well as through energy balances, companies comparing, information, education and particular projects.

MAHE - Small Hydropower Programme

This programme aims to provide all conditions for a greater number of small plants constructions. Through the realisation of this programme, it is necessary to eliminate all barriers and set all incentive measures and modes of assistance for future. Formally, there are no barriers for the construction of small hydro power plants, but the reality gives a range of obstacles that could discourage prospective investors. The Croatian Power Utility Company is ready, according to a 1994 decision made by its Board of Directors, to collect all electricity produced in small hydro power plants (with installed capacity up to 5 MW), against a price which is set in relation to the average electricity sale price. Besides guaranteed buyout, for prospective future investors it is necessary to provide simple legal regulatory processes for getting location licenses and building permits. The total amount of installed power in small hydro power plants in Croatia is about 24 MW and the technical potential is estimated at around 150 MW.

SUNEN - Solar Energy Utilisation Programme

This programme's objective is to ensure all legal, incentive, promotional and other prerequisites for significant solar energy use. Solar energy has particular importance among renewable energy sources and potentially is one of the most important renewable energy sources. This type of energy gives two energy outputs: thermal energy and electricity. At present the conversion of solar into thermal energy is of particular interest. Ecologically it is a clean source of energy and, therefore, acceptable to households and service sector (tourism), especially in the Croatian islands and coastal area. At present and without incentive measures on the government side, the total potential for solar energy in Croatia is estimated at about 5 PJ in 2010 and 15 PJ in 2020. The potential of passive solar architecture is estimated at about 6430 TJ in 2020.

BIOEN - Biomass and Waste Utilisation Programme

This programme plans to use waste-wood, straw, biogas, and other waste, as well as conversions from biomass to liquid fuel (ethanol, methanol) for traffic purposes or as a base in chemical industry. Amount of energy in dry biological material is around 15 MJ/kg. Therefore, cultivation of crops for energy purposes competes with crop cultivation for food. Crop and animal wastes, as well as municipal sewage could be used as energy sources in agriculture, cattle breeding, and in urban areas. The total energy resources of biomass in Croatia are at about 50 PJ whereby 39 PJ makes technical energy resource that can be used today. It is estimated that the total energy resource of biomass in 2030 could be between 50 and 80 PJ. Until now the usage of biomass in Croatia has been at the level of 16 PJ.

ENWIND - Wind Energy Use Programme

In order to start this programme it was necessary to assess the potentials and possible locations which will, except for the economic and energy value and acceptability, bear also the environmental acceptability because of noise and visual changes in landscape. The majority of locations with good wind conditions are in the middle and southern Adriatic regions. The programme has shown that the yearly electric energy production from wind energy could be between 380 and 790 GWh on 29 locations analysed. The potential above the Adriatic Sea is between 170 and 250 GWh yearly depending on the size of the installed units. Apart from production of electric energy the wind generators can be used in water supply systems (desalination) which is very interesting for the Adriatic islands.

GEOEN - Geothermal Energy Utilisation Programme

Croatia has a centennial tradition of using geothermal energy from natural resources for therapeutic and bathing purposes. The determined geothermal gradients in the Panonic Plain are higher than the European average. At present, around 75 kg/sec of geothermal water is used for energy purposes with total installed power of 15 MW and providing an annual output of 70 TJ per year. The amount of geothermal energy resources within known deposits in Croatia are estimated to 812 MWt and 45.8 MWe. It is also possible to use this thermal potential in agriculture, hotels, residential buildings, etc. This programme should provide the framework for constructing and exploiting profitable geothermal energy sources.

$KUEN_{building}$ - Energy Efficiency in Buildings

The programme of energy efficiency in buildings emphasizes the need for changes in existing legislation and regulation in order to favour the increase in thermal insulation and the reconstruction of existing residential buildings. Through technically and economically justifiable measures, it is possible to reduce the consumption of heating energy. The essential task is to increase public awareness. This includes informing and counselling the public on potential measures in existing or planned buildings, creating an organised set of measures and activities, and setting priorities in the process of reconstruction of the existing residential capacity.

$KUEN_{cts}$ - Energy Efficiency of Centralized Thermal Systems

A large number of consumers in Zagreb and Osijek are using centralized heating systems. In the future, it will be possible to apply such systems in other Croatian cities as well. Due to the lack of individual measuring devices and general relations within the energy sector, energy efficiency is not very high and there is still room for essential improvements. The aim of the programme is to define all conditions for an increase in energy efficiency within centralised thermal systems, ranging from the measurement of thermal consumption to the improvement of the overall situation in the energy sector in terms of defined ownership and market relations.

In 2000, two new programmes were added to the existing ones. They were **TRANCRO**, the programme of energy efficiency in transport; and **CROTOK**, the programme of island energy development.

The objectives and strategy for implementation of the renewable energy resources programmes depends on specific characteristics of each renewable resource and the programme of its use, and their common characteristic is considerable increase in share of renewable resources by the year 2030, which corresponds with the general trends in EU countries.

First results of the National Energy Programmes have been presented to the public in May 1998: eleven books were published (one for each National Programme + an introductory volume) as well as a half-hour video presentation. Basic activities which were conducted for all programmes were:

- analysis of the experience in developed countries;
- analysis of energy potential and aims of the programme;
- technical and technological features of the programme;
- ecological features and benefits;
- economic and financial features;
- measures for the programme's realisation;
- organisation of the programme;
- pilot projects;
- promotion and education.

In July 2001, the Parliament passed a package of laws (Official Gazette 68/01) for the reform of the energy sectors in line with the EU legislation. They are: The Energy Act, Law on Electricity Market, Law on Gas Market, Law on Oil and Oil Derivatives, and Law on Regulation of Energy Business.

This package of energy laws will introduce market relations and allow gradual liberalization of the energy market. It will also define a transparent relation between the energy entities and the customers. The new regulations have created a legislative framework for restructuring and then for privatization of the two most important companies of the Croatian energy sector: Croatian Electricity Utility Company (HEP) and Oil Industry (INA).

The Energy Act is an umbrella law in the energy law package because it addresses elementary questions in the energy sector. The law determines the Energy Development Strategy of the Republic of Croatia and provides the basis for the energy policy and energy development plans. Based on the Development Strategy the Government of the Republic of Croatia makes an Implementation Program of the Energy Development Strategy for a period of at least three years. In line with the Strategy and the Program the national energy programs, which will ensure long-term development objectives and orientation of the energy sector as well as investments in the energy efficiency and renewable energy sources, will also be launched.

2.2.3. ENVIRONMENTAL PROTECTION POLICY

In the Republic of Croatia, environmental protection policy falls within the competence of the Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC). The State Directorate for Water is in charge of water conservation. The current body of legislation on environmental protection consists of acts, by-laws and regulations.

The Law on Environmental Protection, which was adopted in 1994, has set up a basis for the implementation of the policy in line with the concept of sustainable development. That has initiated a process of preparation the Environmental Protection Strategy. The provisions of Article 18 of the Environmental Protection Law (Official Gazettes 82/94, 128/99) prescribe adoption of the Environmental Strategy of the Republic of Croatia.

The National Environment Strategy was adopted by the Croatian Parliament on its session of 25 January 2002 ("Official Gazettes" 46/02). The National Environment Strategy is an expression of endeavour to translate the growing consciousness to protect the environment in the Republic of Croatia into a transparent, integral, and long-term concept. It's a unique document which for the first time creates and provides a structure for a comprehensive process of environmental policy-making, thus creating a new practice in the entire development of Croatia [5].

The Environmental Protection Strategy is structured as a process that should enable an integrated designation of objectives and an efficient and effective implementation of the environmental protection in Croatia. It provides directives and directions for a long-term environmental management in the economic, social and cultural development spheres and also the basis for economic, technical, scientific, educational, organizational and other measures, i.e. measures for implementation of the international obligations in the field of environmental protection.
The Strategy identifies priority topics where the topic means a unit representing an environmental problem. Priority topics include all the topics identified in the development of this strategy as priorities of environmental protection in the Republic of Croatia. The sequence of topics is determined by the national priorities, because in country some segments of the environmental protection system function better than others. The topics may be divided into two groups:

A. Top priorities

1. Waste
2. Water
3. Air quality
4. The Adriatic, islands and the coastal region
5. Soil
6. Protection of nature and biodiversity
7. Environment of urban areas

B. Other priorities

1. Chemicals
2. ***Climate change***
3. Risk management: industrial accidents
4. Risk management: nuclear accidents and radiation protection
5. Genetically modified organisms

Climate change is topic that falls into group B - Other priorities. Fighting climate change and preventing impacts causing climate change are major global tasks. The challenger is even grater for the fact that the fossil fuels will remain dominant in the energy supply for the next 50 years, resulting in considerable increase in emission of the major cause of the greenhouse effect – *carbon dioxide (CO_2)*. Its contribution to the greenhouse effect exceeds 65%. Possible consequences of greenhouse effect include global warming, increase in sea and ocean levels, change in climate zones, and ultimately natural disasters. Climate changes are particularly important for Croatia since it has large coastal area and comparatively large valleys in the north.

The protection of environment and nature in the Republic of Croatia is laid down by

- The Environmental Protection Act (Official Gazettes 82/94, 128/99),
- The Air Protection Act (Official Gazette 178/04),
- The Waste Act (Official Gazette 178/04),
- The Nature Protection Act (Official Gazette 30/94, 72/94, 162/03, 70/05),

and regulations adapted on the basis of these acts.

Specific environmental protection issues relating to individual environmental components are regulated by special acts (the Water Act, the Water Management Funding Act, the Maritime Code, the Technical Infrastructure Management Act, the Forests Act, the Mining Act, the Agricultural Land Act, the Marine Fishery Act, the Fresh-water Fishery Act, the Hunting Act, the Physical Planning Act, etc.) including their enforcement regulations.

The Air Protection Law is based on the principles of environmental protection stipulated by the Law of Environmental Protection and the requirements posed by the international legislation. The law determines basic issues relating to the protection and improvement of air quality and the measures, organization, implementation and surveillance of protection and improvement of air quality as a part of the environment of general weal to pursue the goal of sustainable development of Croatia. The Law sets general stipulations for protection and improvement of air quality. The Plan of Air Protection and Improvement is a detailed operational document of the Air Protection Strategy, which is an integral part of the Environmental Protection Strategy. Program for protection and improvement of air quality is an integral part of the environmental protection program.

The National Report on Air Quality is made for a four-year period and its purpose is to accomplish the objectives of the Plan and the Program, and other related documents important for the protection, improvement, and inspection of the air quality. The responsible authority for the Report is the MEPPPC and the Report itself is made by the Croatian Environmental Agency and submitted to the Government of the Republic of Croatia.

The Law determines the methods for monitoring and inspection of air quality, emissions and emission sources, measures for prevention and mitigation of air pollution, activities related to monitoring the air quality and emission to air, air quality information system, financing sources for air quality protection and improvement, economic incentives, administrative supervision, inspection and penal regulations. Article 46, paragraph (1) of The Air Protection Law defines measures for prevention and mitigation of GHG emissions:

- Monitoring of greenhouse gas emissions;
- National greenhouse gas allocation Plan;
- Emissions trading scheme;
- Joint implementation projects for mitigations of greenhouse gas emissions.

Paragraph (2), article 46 of the same Law defines that National Greenhouse Gas Allocation Plan must be based on Plan for Prevention and Mitigation of Air Pollution and on Energy Development Strategy by implementing the best available techniques.

Paragraph (3), of the same article defines establishment the Register of Greenhouse Gas Emission for implementation of National Greenhouse Gas Allocation Plan, Emissions Trading and Joint Implementation projects, which is managed by Croatian Environment Agency.

The National Environmental Action Plan (NEAP) was published on the basis of the Resolution of the Government of the Republic of Croatia dated 22 November 2001. The NEAP was drawn up in co-operation with the MEPPPC and the World Bank through the project entitled "Environmental Policy Development and Regulatory Capacity Building" in 1999.

The NEAP priorities were determined in accordance with the environmental impact assessment on health, ecosystems and socio-economic activities. In the later phase some other criteria, such as the requirements stemming from the process of approaching the EU, the level of readiness of projects, fulfilment of the international obligations that Croatia has to comply with, limited technical and personnel potentials, and similar, were also taken into consideration.

Pursuant to Article 19 of the Environmental Protection Law, the Environmental Action Plans are developed for the territories of the countries and for the City Zagreb by country assemblies or the City Zagreb assemblies.

Based on sustainable development principles and an assessment of environmental problems and priorities, the NEAP document includes strategic elements and an Action Plan in each area of concern, summarized in the Priority Activities Plan (PAP) for the highest priority actions. The PAP comprises an integrated and mutually supportive set of actions to accelerate environmental protection in Croatia over the next five years. Developed through a lengthy process of consultation and participation, it represents the best attempt at consensus between decision-makers and experts in both the public and private sectors and in the civil society. It includes actions that the Croatian Government can and will take in the immediate future with its own resources, but also a larger number of measures for which external financial support will be needed if progress is to be made while Croatia is resolving its present economic difficulties.

Actions may be of any of the following types:

- **Policies** (laws, regulations, strategies and master plans);
- **Institutional development** (strengthening of existing or establishment of new institutions, staff development and training);
- **Studies** (analytical studies of environmental problems and impacts and feasibility studies for projects);
- **Investments** (including project preparation studies).

The proposed measures are divided into three categories:

1. **Priority I** - top priorities, where action must begin as soon as possible and be completed within one to two years;
2. **Priority II** - medium priorities, where planning should begin soon and action should be completed within three to five years;
3. **Priority III** - other actions expected to be completed within ten years.

The Priority I group actions are well defined and, in many cases, preparation studies have been completed. Most Priority II actions will require further preparation over the next two years. Priority III measures are only briefly mentioned and will be fully described at a later stage.

The cost of implementing the PAP in full is estimated at just over US$ 1.0 billion or an average of $200 million per year for the five year period under consideration. While the Government is prepared to shoulder its full share of the burden, it will also need to call on its international partners to do what they can to fill the gap. If that gap cannot be filled, the program will inevitably be delayed and the expected benefits to health and wellbeing of the population and to natural ecosystems will be delayed.

Proposal of National Climate Change Mitigation Action Plan

According to UNFCCC commitment, Article 4, paragraph (b), Croatia has prepared a proposal of National Climate Change Mitigation Action Plan within its First National Communication to UNFCCC that consists of two programmes:

1. **The Capacity Building Program**
2. **The Implementation Program**

The National Climate Change Mitigation Action Plan represents proposal version of capacity building and implementation program which will set up a framework for systematic addressing of climate change issue, pursuant to the defined objectives. The Plan will be an institutional and organizational framework for partnership of all the stakeholders, governmental institutions, public institutions, local authorities and services, scientific community, private businesses, non-governmental organizations and the general population, which will contribute to the climate change mitigation. The climate issue needs to be resolved on a global level and through the international cooperation; it is specifically inter-sectorial in nature, and one that asks for a framework that will stimulate synergetic effects of all the participants.

The Capacity Building Program will establish institutional, legal, organizational and scientific capacities, enhance human resources and arise general public awareness on the issues related to the climate change mitigation. This is the main objective of the LIFE Third Countries project "Capacity Building for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol in the Republic of Croatia", which will be implemented in the period 2005-2007.

The Capacity Building Program needs to be dynamic and maximally tailored to the requirements of the Implementation Program by creation of different legal, incentive and economic tools. The objective is building of a system that will be permanently sustainable and self-supporting, in addition to its being economically effective. The main features of the Capacity Building Program are:

Emission inventory (scope of the LIFE Third Countries project "Reconstruction of National Emission Inventory System and Enforcement of its Implementation", which was finished in July 2004.)

- building the national emission inventory system, including register of sources and technologies
- improvement of methods and procedures for enhancing quality of emission inventory

Support to building, maintenance and evaluation of policy and measures (capacity building activities will be implemented in the framework of the LIFE Third Countries project "Capacity Building for Implementation of the United Nations Framework Convention on Climate Change and the Kyoto Protocol in the Republic of Croatia)

- designing and building a system for collecting information necessary for planning of the policy and measures
- setting up the systems for projects/programs planning, reporting, monitoring and evaluation
- development and implementation of methods for emission mitigation analyses, emission projections and scenarios development
- development of strategies, programs and plans on different levels
- drafting of legislation, and economic and other incentives
- assessment of capacity building needs (technology, experience and knowledge)
- removal of barriers to efficient program implementation
- studies supporting project preparation
- building of project financing mechanisms and their monitoring
- collaboration with similar programs on the national and local levels
- development and promoting of approaches, methods and knowledge for sustainable development planning
- building of incentive and other measures for implementation of demonstration and pilot projects and programs
- development of and support to the demonstration and pilot projects and programs
- setting up the system for implementation of the mechanisms for joint implementation (JI), clean development mechanism (CDM) and emission trading (ET)
- international collaboration on climate issues
- networking of institutions and programs.

Support for impact and adaptation analysis

- development and implementation of methods for assessment of impact, sensitivity and vulnerability to climate change
- development of methods and measures for adaptation to climate changes

Observation, systematic monitoring and research

- joining the Global Climate Observing System (GCOS)
- research on climate change, new technologies and solutions

Education and public awareness arising

- access to information
- education and public awareness arising
- other activities supporting the setting up of the system for implementation of policy and measures and reporting pursuant to the Convention

The Implementation Program will encompass preparation and implementation of projects, and all necessary implementation support such as regulations, manuals, facilitative services, incentives, and supervision and control of the project implementation. The Implementation Program should simplify preparation, organization of the project implementation and accelerate transfer of activities from the state and public institutions onto the private sector, businesses and civil sector.

The Program will encompass the following measures:

- use of renewable energy resources
- energy efficiency measures
- technical and other measures in the transportation sector
- fuel conversion into law-carbon energy forms
- increase removals by sink
- measures for emission reduction and sink increase in agriculture
- measures for waste management emission reduction
- measures in industry and cleaner production
- international projects based on joint implementation (JI) and clean development mechanisms (CDM) pursuant to Kyoto provisions
- integrated sustainable development projects
- other projects contributing to the climate change mitigation

The risks associated with the implementation of these Programs are numerous since there are many obstacles to be overcome. These barriers are largely connected with financing, the mentality and knowledge of participants and, to a lesser degree, with technical precursors. Special attention should be paid to education, information dissemination and the promotion of public awareness. The rights and liabilities of individual participants should be carefully regulated. Care should also be taken to safeguard the institutional capacities, values and knowledge.

Croatia applies the good practice principle, combining a number of different instruments for policy implementation: economic, fiscal, legal, voluntary, all based on information, education and research work. The prerequisite for overall program success lies in setting targets for individual sectors and including these targets and implementation mechanisms in particular sectorial strategies, plans and regulations.

In the establishment of a stimulating environment for the implementation of measures, it is crucial to increase the interest of the banking sector to stimulate investment in the projects aimed at mitigating climate change. For this to occur, the long-term objectives and state incentives provided for the successful implementation of measures should be transparent and the stability in the energy market should be assured.

Inclusive:

Policy in particular sectors, such as economy, energy and environmental protection, has significant influence on the climate change mitigation. For the effective implementation of policy objectives it is necessary to apply different instruments and implementing mechanisms in individual sectors, with including it in specific sectors strategies, plans and regulations. However, at the moment, defined objectives and measures are not adjusted completely and their implementation will be very acquiring, which is also evidenced in the practice. It indicates the emergency of better coordination between particular ministries as well as adjustment of legislation, inside and between sectors, with the aim to solve the priorities associated with the climate change.

2.3. PROJECTIONS AND THE TOTAL EFFECTS OF POLICIES AND MEASURES

A total of 39 mitigation measures for reductions in all emission sectors have been identified in the First National Communication of the Republic Croatia to the UNFCCC. The potentials identified for reductions represent target values; in some cases, these are maximum feasible values, while in some others these are realistic capabilities.

The basic criterion for the selection of priority activities, measures and the appropriate implementation instruments was the cost-effectiveness of a particular measure. In principle, priority was given to those measures that have a lower cost per unit of avoided emission.

Aside from the cost-effectiveness criteria, a number of other factors should be taken into account; they are of particular social importance that surpasses purely economic considerations. The preferences expressed during the development of First National Communication and accompanying public debates reveal that the most significant criteria at present is an increase in production and in the employment rate.

Energy sector

The measures in the energy sector relate to the increase in efficiency in the generation, transmission and distribution of electricity, the use of renewable energy sources, demand side management (DSM, energy savings), measures in transportation and a shift to fuels with lower carbon contents (natural gas). The highest reduction can be achieved in the household and electricity sectors, by the application of efficiency measures and the use of renewable energy sources. The utilisation of biomass has the greatest potential among renewable energy sources; in the electricity generation sector, in households and services and in the industrial sector.

Industrial processes

In industrial processes, the production of nitric acid, ammonia and cement account for 90 percent of the total emissions from this sector. A significant reduction could be achieved in the production of nitric acid, with the installation of catalytic devices for the reduction of N_2O emission. In the cement industry, emissions can be reduced by increasing the energy efficiency of the process using waste, instead of fossil fuels, using fuels with lower carbon content and altering the mixture of raw materials in the production of clinker. The highest reduction could be achieved by the fuel shift. However, this represents a problem in that cement works in Croatia, due to market competition, have shifted from liquid and gaseous fuel to petrol coke, threatening the implementation of this measure.

Agriculture

Measures for the agricultural sector are as following: a) improvement in application of organic and mineral fertilizers aimed at N_2O emission reduction; b) reduction in CH_4 emission by decreased fermentation; c) anaerobic fermentation related to decomposition of organic manure and biogas generation; and d) carbon storage in agricultural soil. The estimates show that, even under the most optimistic scenario of agricultural development, the emission levels will increase. At the moment, the most significant viable and potent measure is the increased utilisation of bio-waste for energy purposes, and the production of bio-diesel.

Forestry

There are two types of positive measures associated with forestry: the increase in carbon stock of biomass - removal by sinks; and the use of biomass for energy purposes as a fossil fuel substitute. Out of the several potentially workable measures, planting new forests on the available existing forestland has the best prospects. This measure has explicit environmental and social benefits, but can unfortunately generate little positive effects in the first commitment period from 2008 to 2012. A significant measure is the increased use of wood biomass as fuel, *i.e.* the utilisation of existing quantities of wood waste. This measure has by far the highest potential of all renewable energy sources.

Waste Management

A significant reduction in emissions could be realised through improved waste management, with relatively minor additional expenses and with additional benefits to environmental protection. The first measure is to avoid the unnecessary production of waste and intensify the classification and recycling of waste. The second measure covers the thermal processing of waste with energy utilisation. In this way, fossil fuels are being replaced, either by the thermal processing of solid waste or through the use of methane deposits for energy purposes. This could also be one of the possible solutions, if there are no opportunities for energy utilisation.

PROJECTIONS OF GREENHOUSE GAS EMISSIONS

The evaluation of future trends in greenhouse gas emissions and removals were made for the three scenarios [6]; “Without measures”, “With measures” and “With additional measures”, which represent different assumptions with respect to implemented, adopted or planned policies and measures:

- **“Without measures” scenario** – is based on the presumption of delayed introduction of new technologies into the business sector and insufficient support of the state to the reforms and restructuring in energy and other sectors. It implies lesser government involvement in institutional and organisational reform, lack of support for energy efficiency, renewable resources, changes in industry, agriculture and forestry, and environmental protection. However, this scenario does not represent a completely “frozen” status and an intention to continue the business-as-usual scenario. It also includes the improvements that are to happen regardless of the climate change mitigation program requirements.
- **“With measures” scenario** – the key assumptions of this scenario are equivalent to “Without measures” scenario, except one which is related to subsequent introduction of renewable energy sources and efficiency increase. The Energy Sector Development Strategy is adopted policy document and there are approximately 30 regulatory documents which support its implementation, of which five will regulate use of renewable energy and energy efficiency. This secondary regulation is currently in the process of drafting and/or adoption. Apart from Energy, other sectors do not have developed strategic or regulatory documents which address climate change mitigation measures.
- **“With additional measures” scenario** – assumes that the climate change and sustainable development concept shall cause significant change in orientation of the overall Croatian industry and economy. This scenario takes into account the highest possible potential of analysed measures for GHG emissions reduction. Considerable effects of these measures are expected beyond the year 2010.

These three above scenarios are different than those described in the First National Communication of Republic Croatia, submitted to the UNFCCC in the year 2001. Scenarios in the First National Communication have been developed on the basis of the projection vision existed in the year 1995, which has optimistic trend for years immediately after 1995. Unfortunately, economic development in the period after 1995 was slower than predicted, and expected forecast figures were moved for few years in future.

For development of abovementioned scenarios, macroeconomic parameters were taken from Macroeconomic Development Strategy. It is expected that growth of GDP will be approximately 3.9 percent in the period 2005-2010, and 4.8 percent in the period 2011-2015.

An overview of measures for GHG emission reduction in all sectors for “with measures”, “without measures” and “with additional measures” scenarios are given below.

Energy sector

Energy sector development depends on large number of significant factors among which the most important are: economic development, energy sector reform and government measures, international energy market development and international influence, technological development and global environmental protection limitations. Each of these factors has its influence dimension and the consequences will be different energy consumption levels and energy generation structures. In Energy sector three different scenarios are analysed: “With measures”, “Without measures” and “With additional measures”.

The scenario "With measures" outlines total energy demand, assuming the implementation of a variety of measures, such as the use of renewable energy resources and the implementation of energy efficiency measures. The following measures are included in "With measures" scenario:

- Wind Power Plants
- Small Hydro Power Plants
- Biomass Use in Cogeneration Plants
- Fuel Cells
- Biodiesel and Hydrogen
- Solar Energy
- Geothermal Energy
- Heat Generation Efficiency Increase

GHG emissions reduction potentials of the mentioned measures for the years 2010 and 2020 are shown in Table 2.3-1. Implementation of concerned measures is adopted through Energy Sector Development Strategy (policy document adopted by Parliament). There are approximately 30 regulatory documents which support its implementation, of which five will regulate use of renewable energy and energy efficiency. This secondary regulation is currently in the process of drafting and/or adoption.

The secondary regulation for introduction of renewable energy sources (wind, small hydro, bioenergy and geothermal) will stipulate connections of these sources to the grid by providing energy subsidies. Every power supplier will be obliged to have certain proportion of renewable energy in its portfolio, and revenue for subsidies will be collected through energy taxation.

Table 2.3-1: Potentials of GHG mitigation measures (kt CO_2-eq) in Energy sector

MITIGATION MEASURES	2010				2020			
	CO_2 (kt)	CH_4 (t)	N_2O (t)	CO_2-eq (kt)	CO_2 (kt)	CH_4 (t)	N_2O (t)	CO_2-eq (kt)
Wind Power Plants	108.9	2.1	1.3	**109.4**	285.1	3.6	3.4	**286.3**
Small Hydro Power Plants	64.2	1.2	0.8	**64.4**	125.1	1.6	1.5	**125.6**
Biomass Use in Cogeneration Plants	44.1	1.1	0.2	**44.2**	204.9	5.1	0.8	**205.2**
Fuel Cells	14.0	0.3	0.2	**14.0**	48.8	0.6	0.6	**49.0**
Biodiesel and Hydrogen	53.8	4.4	0.4	**54.1**	261.7	27.7	2.2	**263.0**
Solar Energy	311.6	15.4	3.4	**313.0**	624.8	32.7	6.0	**627.3**
Geothermal Energy	239.1	11.0	2.6	**240.1**	539.2	25.8	5.3	**541.4**
Heat Generation Efficiency Increase	33.7	2.7	0.5	**33.9**	78.6	6.5	1.2	**79.1**
Total	**869.4**	**38.2**	**9.4**	**873.1**	**2168.2**	**103.6**	**21.0**	**2176.9**

The expected increase of gross domestic product, total energy demand, electricity consumption and CO_2 emission, for “With measures” scenario, is presented in the Table 2.3-2 (data are accepted from Energy Development Strategy).

Table 2.3-2: Expected increase of main indicators, “With measures” scenario

	1990	1995	2000	2005	2010	2015	2020
GDP/capita, $/cap.	5106	3873	4669	5942	7535	9355	11521
Total energy demand, PJ	408	314	370	411	453	503	552
CO_2 emission - "With measures", Gg	20959	15082	17447	21678	24959	27674	30390
Electricity consumption, GWh	14749	11404	13836	16048	19127	22103	24865

According to expected values of main indicators for the period from 2000 to 2020, GDP will annually increase by 4.6 percent on average, total energy demand by 2.0 percent, CO_2 emissions by 2.8 percent and electricity consumption by 3.0 percent.

The scenario "Without measures" is constructed from the "With Measures" scenarios by subtracting the GHG reduction potentials of selected measures that belongs to the category of ‘Climate Change’ driven measures. Although a number of measures were simulated under the scenario "With measures", only some of them, more significant in terms of their respective potential, were selected for the creation of the scenario "Without measures" (Table 2.3-1). Therefore, the scenario "Without measures" does not represent a frozen scenario, i.e. energy demand projections based on the present state of energy technologies. In addition to the mentioned measures, a gradual improvement in energy efficiency without special incentives was also simulated. This suggests that the energy demand under the scenario “Without measures” would be slightly lower than that under the straight frozen scenario. At the same time, the GHG emission would be higher under the frozen scenario than under the analyzed scenario "Without measures".

Additional mitigation measures are analysed in official development strategy of Energy sector and First National Communication to the UNFCCC. According to abovementioned documents,

potentials of measures for Power sector and Energy consumption sectors is developed (Table 2.3-3).

Table 2.3-3: Potentials of additional GHG mitigation measures (kt CO_2-eq) in Energy sector

MITIGATION MEASURES	2010				2020			
	CO_2 (kt)	CH_4 (t)	N_2O (t)	CO_2-eq (kt)	CO_2 (kt)	CH_4 (t)	N_2O (t)	CO_2-eq (kt)
Power Generation Sector	**727.3**	**13.9**	**8.5**	**730.2**	**1225.4**	**15.3**	**14.5**	**1230.2**
Savings in power trans. and distrib.	39.6	0.8	0.5	39.8	99.2	1.2	1.2	99.6
Wind Power Plants	451.1	8.6	5.3	452.9	762.1	9.5	9.0	765.1
Small Hydro Power Plants	62.7	1.2	0.7	62.9	105.9	1.3	1.3	106.3
Biomass in Cogeneration	174.0	3.3	2.0	174.7	258.2	3.2	3.1	259.2
Industry	**258.8**	**12.6**	**3.4**	**260.1**	**795.6**	**19.0**	**12.2**	**799.8**
Motor Drives Regulation	12.2	0.2	0.2	12.3	470.7	5.9	7.4	473.1
Cogeneration Plants	52.8	0.9	0.9	53.1	150.1	2.7	2.7	151.0
Low-temp. heat gener. effic. increase	115.2	5.4	1.1	115.7	102.1	4.8	1.0	102.5
High-temp. heat gener. effic. increase	78.5	6.0	1.2	79.0	72.7	5.6	1.1	73.1
Transport	**59.4**	**4.1**	**0.5**	**59.6**	**910.2**	**70.4**	**34.5**	**922.3**
Interurban passenger transport	0.0	0.0	0.0	0.0	93.0	21.5	16.6	98.6
Urban passenger transport	0.0	0.0	0.0	0.0	77.0	15.4	11.9	81.0
Freight transport	0.0	0.0	0.0	0.0	458.5	14.4	3.7	460.0
Increase in biodiesel use	59.4	4.1	0.5	59.6	281.6	19.2	2.3	282.7
Services	**406.8**	**21.4**	**4.4**	**408.6**	**835.5**	**44.3**	**7.9**	**838.8**
DSM measures	14.4	0.3	0.2	14.5	32.1	0.4	0.4	32.2
Solar energy use increase	78.5	3.9	0.8	78.8	140.2	7.3	1.3	140.7
Geothermal energy use increase	16.4	0.8	0.2	16.4	27.9	1.3	0.3	28.0
Distr. heating and cogen.use increase	66.8	3.6	0.7	67.1	145.6	8.0	1.4	146.2
Insulation improvement	230.8	12.8	2.5	231.8	489.6	27.2	4.6	491.6
Residential	**586.8**	**22.4**	**4.4**	**588.6**	**1789.2**	**87.0**	**13.9**	**1795.3**
Solar energy use increase	28.4	1.8	0.2	28.5	286.7	21.3	1.9	287.7
DSM measures	12.4	0.2	0.1	12.5	192.3	2.4	2.3	193.0
District heating use increase	20.7	2.2	0.1	20.8	156.8	17.2	1.1	157.5
Insulation improvement	73.0	2.5	0.7	73.2	376.4	18.7	3.1	377.8
Biomass in cogen. and boiler plants	452.2	15.6	3.1	453.5	777.0	27.4	5.5	779.3
Total potential	**2039.1**	**74.3**	**21.2**	**2047.2**	**5555.8**	**236.1**	**83.1**	**5586.5**

The GHG emissions for previously mentioned scenarios of energy sector development are presented in Figure 2.3-1. The projection of fuel combustion sectors is based on Energy Sector Development Strategy. In projections, the fugitive emission from the year 2001 is used.

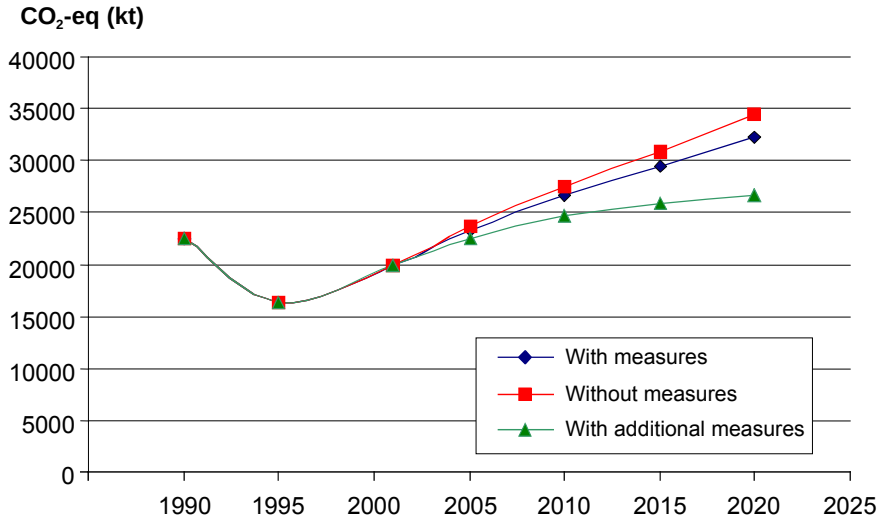

Figure 2.3-1: GHG emissions projections for Energy sector

According to all analysed scenarios, the increase of GHG emissions will occur. For scenario "With additional measures" in 2010, the GHG emissions will be 10.5 percent larger than emissions in 1990, while for the scenario "Without measures" even 22.5 percent. In scenario "With additional measures", about 300 MW installed capacity in renewable power plants (wind power plants, small hydro plants and biomass cogeneration plants) is involved.

Industrial processes

The projections of emissions from industrial processes assume that Croatia is not going to install additional capacities of the energy-intensive industry, and that there will be no revival of iron and primary aluminium production which were closed down in 1991. The industrial processes analyzed here (production of cement, ammonia and nitric acid) have the major share in the total sector emission (around 92 percent) and have prepared medium or long-term business strategies. The projections does not encompass the closed down processes and ones for which there are no developed medium or long-term business plans/strategies as well as those that have negligible contribution to total emission from this sector.

There are no currently implemented and adopted policies and mitigation measures in industrial processes in Croatia, and therefore "Without measures" and "With measures" scenarios are identical.

The "Without measures" and "With measures" projections of emissions from industrial processes assumes that production of selected processes (cement, ammonia and nitric acid) in the period 2005-2020 will reach its planned capacities, and that no measure for reduction of greenhouse gases will be implemented. For other less important industrial processes frozen GHG emissions were purposed and scenario projection assumes that the emission will be at the 2001 level.

The only mitigation measure in industrial processes which is considered as "additional measure" in this analysis is installation of NSCR (Non-Selective Catalytic Reduction) in the nitric acid production plant. This measure is included in manufacturer's business strategy as medium term

objective or to achieve allocated greenhouse gas emission limit according to national emission allocation scheme (still not developed). For this purpose it is assumed that this measure will be implemented in 2010, and that NSCR has 85 percent efficiency.

GHG emissions reduction potentials of the mentioned measure for the period 2005-2020 are shown in Table 2.3-4.

Table 2.3-4: Potentials of additional GHG mitigation measures (kt CO_2-eq) in Industrial processes

Industrial processes	1990	1995	2001	2005	2010	2015	2020
Without/With measures	3892.4	2020.7	2785.0	3026.9	3118.5	3118.5	3118.5
With add. measures	3892.4	2020.7	2785.0	3026.9	2300.1	2300.1	2300.1
Mitigation	**0**	**0**	**0**	**0**	**818.4**	**818.4**	**818.4**

The GHG emission projections for analysed scenarios are shown in Figure 2.3-2.

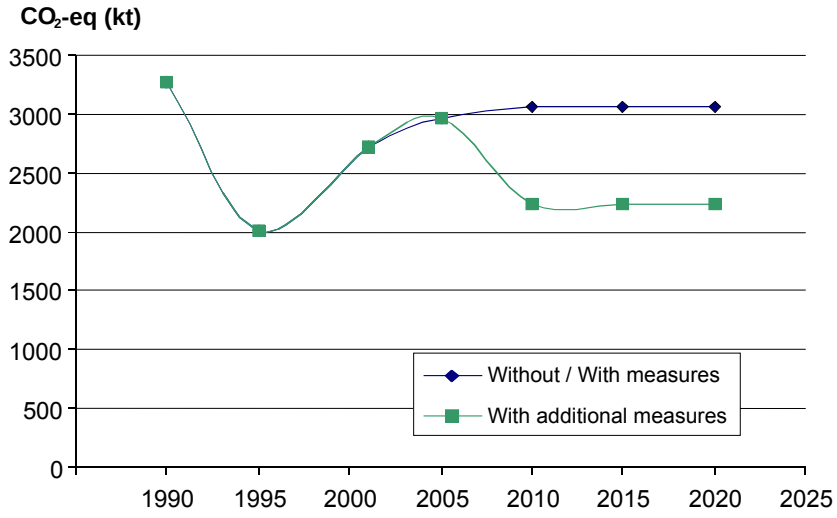

Figure 2.3-2: GHG emissions projections for Industrial processes

Agriculture

In Agriculture is not possible to recognize implemented and adopted measures, accordingly “Without measures” and “With measures” scenarios are the same. The production is oriented towards meeting of the lower demand level, which will be reached under the conditions of the slower increase in purchasing power and a particularly slow development of agriculture. A 25-38 percent lower technical advancement is planned measured by the plant production yield. The animal husbandry production rate, measured by the live weight gain, is about 30 percent lower. The milk production per head is relatively high, since considerable increase is assumed in larger farms share without any additional incentives (2672 kg/year in 2020 on average).

Accordingly “With additional measures", a significant consolidation of farm land is planned, application of modern technology on 70-85 percent of arable land and over 50 percent participation of large farms in animal husbandry are predicted. As said, the increase in plant production yield is also anticipated. In animal husbandry, an expected average increase in

milkiness to about 3,360 kg milk a year from about 55 percent of milking cows on larger farms. An average increase in animal breeding productivity measured by the live weight gain is about 30 percent (pork, beef and eggs production). With such structure, a well-organized production could meet a maximum domestic demand (increased by tourist demand). All major agricultural projects (plantations, farms, processing facilities) will be highly environmentally oriented, with considerable use of sound practices for removal of the potentially harmful substances.

The most probable agricultural production development is based on realization of 60-70 percent of presumptions from the economically efficient case. The production is focused on meeting a moderate demand to be achieved under the conditions of the slower increase in purchasing power and medium agricultural development efficiency. A 12-23 percent lower technical advancement is planned, measured by the plant production yield, animal husbandry productivity measured by the live weight gain and milk production per head (2,704 kg/year in 2020 on average).

GHG emissions reduction potentials of the mentioned measure for the period 2005-2020 are shown in Table 2.3-5.

Table 2.3.5: Potentials of additional GHG mitigation measures (kt CO_2-eq) in Agriculture

Agriculture	**1990**	**1995**	**2001**	**2005**	**2010**	**2015**	**2020**
Without/With measures	4320.6	2890.7	3035.6	3579.2	3920.3	3909.7	3899.0
With add. measures	4320.6	2890.7	3035.6	3218.5	3197.8	3236.9	3281.1
Mitigation	**0.0**	**0.0**	**0.0**	**360.7**	**722.5**	**672.8**	**617.9**

The GHG emissions projections for analysed scenarios are shown in Figure 2.3-3.

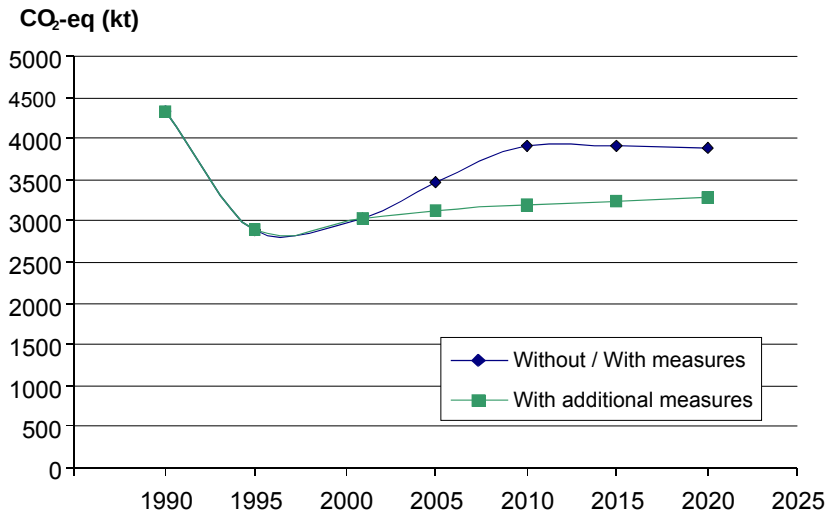

Figure 2.3-3: GHG emissions projections for Agriculture

Land use change and forestry

Measures for increase of carbon sequestration with forest biomass with the highest contribution are reforestation and better use of biomass in power generation. Reforestation does not bring short-term results and the procedure for determination of the GHG emissions and sinks is very complex if the entire cycle is to be covered. That is the reason that within the Convention this issue is still undergoing the methodological analyses and discussion. For better understanding of the problem, Croatia has for a number of years participated in the international IEA program Bioenergy – Task 38 "GHG Emission Balances of Bioenergy Systems".

No significant effects of the measures are expected in this sector until the year 2010. The reforestation of the free forestland on the surface area of 331000 ha could result in an increase in the annual increment of 2.2 million m^3, which means the emission sink increase by 2 million tons.

Waste management

The projections of emissions from waste sector includes only municipal solid waste disposal on land since there are no realistic plans for anaerobic wastewater treatment and waste incineration without energy recovery in Croatia in the future period.

There are no currently implemented and adopted policies and mitigation measures in waste sector in Croatia, and therefore "Without measures" and "With measures" scenarios are identical.

The "Without measures" and "With measures" projections of emissions from solid waste disposal assume continuous increase of municipal solid waste caused by increase in the standard of living and size of population, and subsequent decrease with time due to waste avoidance/minimization and recycling measures. In the period 1990-2000, the estimated annual waste increase was 2.7 percent. The estimated increase for the period 2001-2010 is in the range of 1.5 to 2.5 percent, and for the period 2011-2020 from 1.0 to 2.0 percent.

The "With additional measures" projections include implementation of "waste-to-energy" plants for municipal solid waste instead of waste disposal to land. According to actual plans for building of the first waste incineration plant it is assumed that approximately 20 percent of total municipal solid waste generated in Croatia will be incinerated in 2010 and 40 percent in 2020.

GHG emissions reduction potentials of the mentioned measure for the period 2005-2020 are shown in Table 2.3-6.

Table 2.3-6: Potentials of additional GHG mitigation measures (kt CO_2-eq) in Waste management

Waste	**1990**	**1995**	**2001**	**2005**	**2010**	**2015**	**2020**
Without/With measures	932.9	994.6	1163.2	1399.3	1553.0	1458.1	1294.3
With add. measures	932.9	994.6	1163.2	1224.8	1205.9	973.4	741.5
Mitigation	**0.0**	**0.0**	**0.0**	**174.5**	**347.1**	**484.7**	**552.8**

The GHG emissions projections for analysed scenarios are shown in Figure 2.3-4.

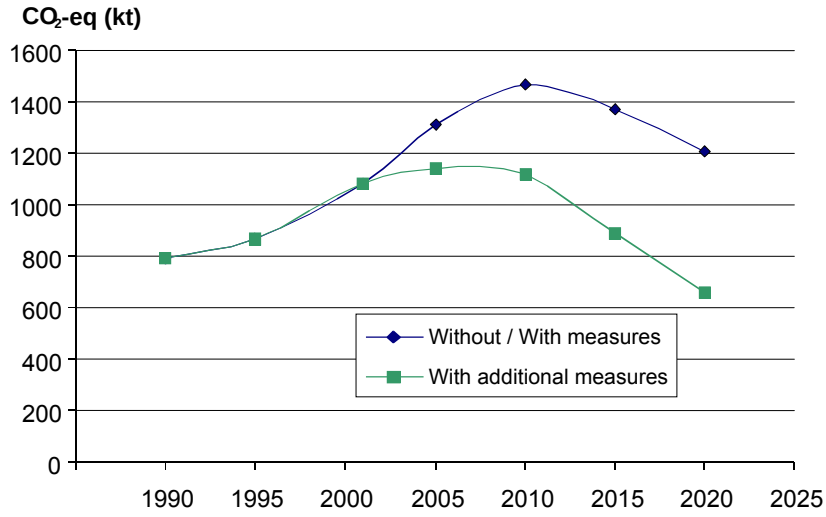

Figure 2.3-4: GHG emissions projections for Waste

Summary of scenarios

Total GHG emissions projections for "Without measures", "With measures" and "With additional measures" scenarios are shown in Figure 2.3-5. Kyoto protocol target presented on this figure is on the level which does not involve Proposal of the Croatian under article 4.6 (7.4 million of tons of CO_2-eq above standard approach for defining base year emission).

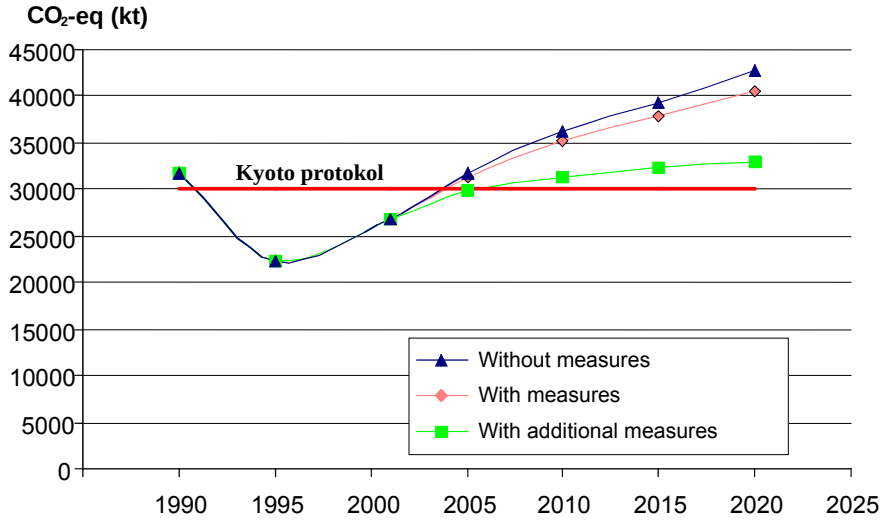

Figure 2.3-5: Greenhouse gases emissions projections for Croatia

Figure 2.3-5 shows that even with implementation of all additional measures Croatia is not able to achieve the GHG emissions stabilisation on the level of the base year emission and Kyoto

target. It should be emphasised that “With additional measures” scenario could be hardly achieved. This scenario assumes full utilisation of reduction potentials, presently estimated on aggregated analysis and data, with an approach which usually gives more optimistic figures than the collection of individual project potentials by bottom-up approach.
Scenario “With additional measures” exceeds Kyoto emission target by 1.3 million tons CO_2-eq. This scenario assumes reduction of emission by 4.8 million tons comparing to “Without measures” scenario in the year 2010, in 2020 reduction needs to be 10 million tons.

Even according to the “Without measures” scenario Croatia will have per capita GHG emissions among the lowest in EU and EIT countries. Feasible scenario “With measures” gives 5.2 million tons of CO_2-eq above the Kyoto Protocol target. Including forest sink (976.000 t CO_2) which is 15 percent of total removal of forestry management activities, the emissions of Croatia in the year 2010 will be 4.2 million tons above Kyoto target.

GHG Emissions Reduction Costs

The marginal costs are calculated as the difference between the equivalent annual costs of the reference scenario (“Without measures” scenario) and the mitigation scenario (“With additional measures” scenario) [7]. The marginal costs of the emissions reduction in energy sector were taken from the First National Communication. The costs should be taken as given for orientation only, since the calculation have not been based on actual data of the GHG mitigation projects implemented in Croatia. Recalculation of marginal costs will be performed within preparation of the Second National Communication.

The curve of marginal costs of emissions reduction in energy sector is shown in Figure 2.3-6.

The installation of Non-Selective Catalytic Reduction in the nitric acid production plant is the only mitigation measure in industrial processes which is considered as “additional measure”. The marginal cost of implementation of this measure can be evaluated to 1 US$/t$CO_2$-eq, which makes this measure very attractive.

The cost estimate for measures included in scenarios for the methane emission reduction in the waste management sector shows that the costs of the emissions reduction scenarios range from 11 to 18 US$/t$CO_2$-eq, considering only reduction of the methane emission from the landfills. If the resulting reduction of the fossil fuel emissions caused by use of waste is also considered, the cost of 7 to 11 US$/t CO_2-eq puts this solution among very attractive measures.

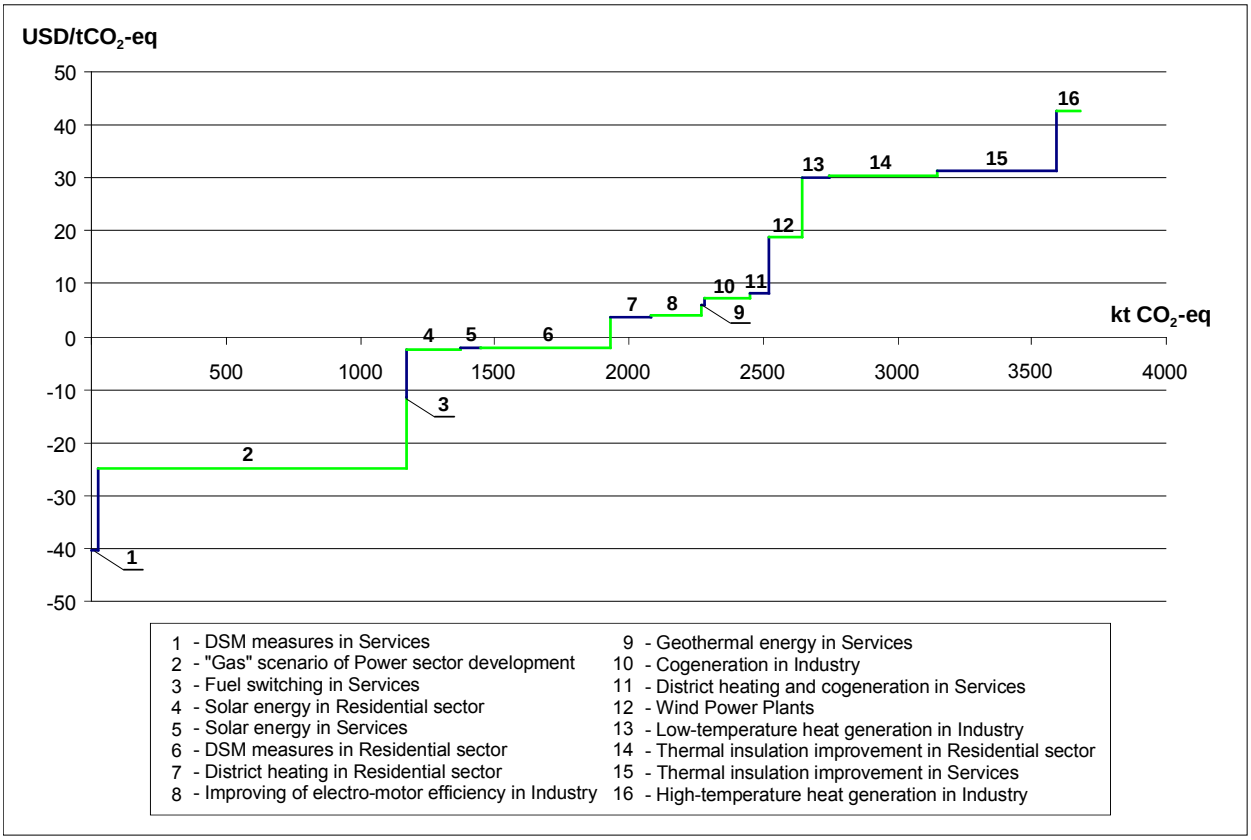

Figure 2.3-6. The curve of marginal costs of emissions reduction in energy sector

2.4. OVERVIEW OF EXISTING GEF PROJECTS ADDRESSING CLIMATE CHANGE

The Republic of Croatia has three Full Size Projects in the focal area ″climate change″ that are funded by The Global Environment Facility (GEF).

GEF helps developing countries fund projects and programs that protect the global environment. GEF grants support projects in six focal areas: biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. As the financial mechanism for the UNFCCC, GEF receives guidance from the COP on policy, program priorities, and eligibility criteria related to the Convention. Climate change projects are designed to reduce the risks of global climate change while providing energy for sustainable development.

GEF climate change projects are organized into four areas:
1. removing barriers to energy efficiency and energy conservation;
2. promoting the adoption of renewable energy by removing barriers and reducing implementation costs;
3. reducing the long-term costs of low greenhouse gas emitting energy technologies;
4. supporting the development of sustainable transport.

Croatian Climate change Full Size Projects are:
- Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors
- Energy Efficiency Project
- Renewable Energy Resources Project

Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors

Background

In 1998, the United Nations Development Programme (UNDP) approved to the Republic of Croatia funds through the Global Environment Facility's (GEF) Project Development Facility Block B for the development of a project idea for improving energy efficiency and an increase in the utilisation of renewable energy sources. The agreement between the Governments of the Republic of Croatia, represented through its Ministry of Economy and UNDP/GEF was signed on July 22nd 1998. The Republic of Croatia had at its disposal US$ 200.880,00 for developing the project. The United Nations Office for Project Services (UNOPS) was nominated as the executing agency, while it was agreed that the Energy Institute Hrvoje Požar be nominated as the Government Implementing Agency.

After elaborating the project idea and preparing a Project Brief, UNDP/GEF was presented with a project concept titled "Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors". The Brief was endorsed by the Croatian Ministry of Environmental Protection and Spatial Planning in the vests of the GEF Focal Point on June 21st 2000. The endorsement was given in collaboration with the Ministry of Economy of the Republic of Croatia. Based on the Project Brief, the GEF Council approved the elaboration of the full project documentation and allocated a tentative grant of US$ 4.591 million to the project "Croatia – Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors".

UNDP was suggested as the GEF Implementing Agency for the project, while the Croatian Ministry of Economy was suggested as the National Executing Agency.

Scope of the project

The main scope of the project is to reduce the emissions of greenhouse gases by applying energy saving and demand side management measures in households and the service sector with a special emphasis on tourism. A reduction in energy consumption in these sectors would result in lower energy demand in the Republic of Croatia. Taking into consideration the average mix of energy sources used for energy generation in Croatia, the project has an estimated potential for reducing 2.0 Mt CO_2 until 2020.

The Republic of Croatia is a party to the UNFCCC. In 2001, Croatia produced its First National Communication to the UNFCCC and the National Environmental Action Plan (NEAP). The Plan identifies the project "Croatia – Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors" as a national priority toward meeting Croatia's goals and obligations in relation to the Convention. The projected effects of the project have also been illustrated in the National Communication which has been accepted by the relevant bodies of the Convention.

Activities

The project "Croatia – Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors" is essentially composed of two sub-projects coordinated by the Energy Institute Hrvoje Požar:

- Improvement of energy efficiency in households and the service sector through the application of Demand Side Management (DSM) measures in the Republic of Croatia;
- Creation of preconditions for an increase in energy efficiency in the sector of tourism.

<u>Improving energy efficiency through the application of Demand Side Management (DSM) Measures in the Republic of Croatia</u>

The DSM measures which would be applied under the umbrella of the project include Compact Fluorescent Lamps (CFLs). A CFLs distribution campaign shall be organised. It will target households and the service sector. After the campaign is over, and depending on its results, a campaign which facilitates the purchase of energy efficient refrigerators and freezers may also be organised.

Geographically, the CFLs distribution campaign would encompass the entire territory of the Republic of Croatia. There would be a pilot phase which would be conducted in Istrian country. Only if the pilot phase would yield positive results would the campaign be extended to cover the entire Croatian territory.

The campaign would include two week CFLs distribution cycles which would cover different Croatian counties. Experience from other countries has shown the best results may be achieved when distribution campaigns are concentrated to one or two weeks. The majority of interested consumers are covered in this timeframe. Only about 20 percent more of the total volume of CFLs sold during the campaign can be sold during the remainder of the year which means that it is not feasible to extend the campaign over long periods of time. The CFLs could be

distributed through the customer service departments of the local power utilities or through the postal network of the Croatian Post in order to avoid high retail margins.
The financial institutions involved in this sub-project would be the GEF with its grant and the CFLs producers with their financial institutions.

Creation of preconditions for an increase in energy efficiency in the tourist sector

Preconditions for an increase in energy efficiency in the tourist sector would be achieved through financial instruments which would encourage tourist companies and small and medium tourist enterprises to invest in efficient energy utilisation. The UNDP in conjunction with the World Bank (WB) which is developing a similar project targeting different client groups are developing a new guarantee program to support financing of energy efficiency (EE) projects by domestic financial institutions in Croatia. This program will be funded with two grants from UNDP's and the World Bank's Global Environment Facility. The Croatian Bank for Reconstruction and Development (HBOR) will serve as the local Guarantor and manager for the guarantee program. Budgets for the UNDP/GEF and the WB/GEF EE guarantee program are US$ 2.0 million and US$ 1.2 million, respectively. As manager of the guarantee program, HBOR would use the GEF funds as reserves against loan guarantee liabilities.

The main objectives of UNDP/GEF and WB/GEF for undertaking an EE finance guarantee program are to: (i) directly support financing of EE projects by addressing credit risk and transaction structuring barriers to EE finance, (ii) engage and build capacities of commercial financial institutions to provide financing for EE projects on a commercially sustainable basis.

The Guarantee Program's benefits for the Economy are:
- Generate employment;
- Provide stimulus for small and medium enterprises in the energy service sector.

For the potential End-Users of the facility:
- Use savings-based cash flows as payments for the EE investment;
- Improve affordability of energy services, including for the poor;
- Improve local and global environment.

For the Banking Community:
- Introduce banks to market mechanisms for lending funds to an untapped industry;
- Introduce banks to the concept of another party handling technical risk so banks can focus on credit risk only;
- Build capacity of domestic banks to provide project-based debt financing for EE projects in a variety of market segments and with SME sponsors.

For HBOR:
- Introduce new financing products to entice domestic banks to capture untapped EE market opportunities;
- Achieve its institutional development objectives by: (i) mobilizing debt and equity financing of EE projects, (ii) supporting the Government's effort to remove barriers to energy efficiency, and (iii) reducing pressure on end-users, incl. the poor, tariff reforms by exploiting savings opportunities in the utility bills.

Status of the Project

The project development phase has been successfully completed. The project was assessed by both the UNDP/GEF and Croatian sides. The GEF Council approved the project and signed the project document in September 2004. The Croatian Minister of Economy, Labour and Entrepreneurship signed the project document on behalf of the Croatian Government in December 2004. The project will move into implementation in 2005. The duration of the project is 4 years.

Energy Efficiency Project

Background

National Environmental Strategy with National Environmental Action Plan (NEAP), completed in 2001, calls for incorporating environmental protection costs in energy prices, encouraging the use of environmentally friendly fuels in thermal and electrical energy generation, and investing in energy efficiency.

The project is consistent with the objectives of GEF Operational Program 5: includes support for activities that remove barriers to achieve local, national, and global benefits.

The proposed World Bank project and the UNDP "Removing Barriers to Improving Energy Efficiency of the Residential and Service Sectors" project have both received GEF approval for barrier reduction activities in Croatia's energy efficiency sector. The UNDP project focuses on overcoming barriers to implementing efficient energy management systems in hotels and compact fluorescent lighting for residential use in Istria and Rijeka. It will contribute to building up a pipeline of projects for implementation by HEP ESCO and other energy service companies, since it supports potential customers to develop energy efficiency projects, but does not provide a mechanism for investment financing.

The Government of Croatia invited USAID, under the South-East European Energy Efficiency Program to support local energy efficiency efforts and help local authorities fulfil their new mandate by preparing model tender documentation for the provision of energy management services for public buildings (including hospitals). This effort will in fact contribute to a pipeline of potential projects for implementation by HEP ESCO and others.

Hrvatska Elektroprivreda (HEP, the Croatian Electricity Utility) for the IBRD loan, GEF contingent grant, and GEF technical assistance; an independent financial intermediary for the GEF guarantee were nominated as the executing agency. The World Bank was nominated as Implementing Agency. The Ministry of Finance will be represented in HEP ESCO's Supervisory Board, to oversee the execution of the GEF grant during and after implementation.

The total project investment cost is US$ 30.4 million, including funding for ESCO and the market at large. The total cost of the GEF project, including initial costs for Technical Assistance, the contingent grant and guarantee fund operation is US $7 million. Base case energy efficiency market investments leads to maximum of 195,000 tons CO_2 reductions. Investments of US$ 35.4 million in energy efficiency will yield over 1.156 million tons CO_2 reductions. The project will produce incremental global benefits of 960,000 tons of avoided CO_2.

Scope of the project

The project's global environment objective is to reduce greenhouse gas emissions. The objective of the proposed project is to increase the demand for and supply of energy efficiency projects and services.

Primary objectives:

- saving electricity and heating energy by financing the reconstruction and modernization of facilities and by financing projects aimed at improving production and use of energy;
- development of a market for goods and services needed for the implementation of energy efficiency projects;
- reduction of the emission of greenhouse gases as a contribution of the Republic of Croatia to the sustainable development at the local and the global level.

Secondary objectives:

- reduction of energy imports;
- reduction of state expenses by saving energy and rationalizing the use of energy, particularly in the public sector;
- reduction of the burden of tariff reforms in the energy sector on consumers by lower electricity and heating bills;
- increase in competitiveness of domestic manufacturers through the reduction of manufacturing costs by means of energy saving;
- promotion of SMEs in the energy services sector through the development of a market for energy efficiency projects;
- creation of new jobs;
- introduction of a new concept based on commercial banks focusing only on the credit risk and specialized agencies of the energy services sector dealing with technical issues.

Activities

The project supports two of the objectives laid out in the Bank's Country Assistance Strategy for Croatia. The first is making the institutional changes and investments needed to ensure an efficient energy supply in an environmentally sustainable manner at realistic but socially acceptable prices. The second is achieving financial sustainability and efficient operations for public enterprises. The project will support both objectives by addressing market and institutional failures to promote the development and financing of energy efficiency projects and protect the environment. This will be achieved by:

- Establishing a utility-based energy service company (HEP ESCO) to develop the market for energy efficiency projects, finance their implementation, and create business opportunities for private providers of energy efficiency goods and services as partners to HEP ESCO;
- Maximizing local co-financing of energy efficiency projects by using innovative financing mechanisms that reduce some of the perceived high risks of those projects and mitigate the rigid collateral requirements imposed on these projects by local financiers;
- Creating a framework for other emerging service providers to capture some of the energy efficiency market potential.

The project will focus on reducing two barriers to commercially sustainable energy efficiency projects and services: a lack of funding, due to perceived risks among lenders and investors, and a lack of know-how among key stakeholders. The project will address these barriers

through a World Bank (IBRD) Loan and a blend of grant and nongrant financing from the Global Environment Facility (GEF).

The direct benefits of the project are realized energy savings which will (a) lower energy costs for end users, (b) renew aging equipment, (c) improve comfort within buildings, (d) reduce local and global air pollution, and (e) improve quality, affordability, and competitiveness of energy delivery systems in key markets. Indirect benefits of the project are the creation of awareness and capacity within local businesses and banks that will extend beyond project implementation period.

Project beneficiaries include users of thermal and electric energy, project partners such as energy auditors and engineers, small energy service providers, equipment manufacturers and installers, local and national banks, regional and municipal authorities, and the country as a whole.

Status of the Project

The project implementation period is 6 years (2003-2008), and expected closing date is 06/30/2010. The cost and benefits of the project were assessed over a 20 year period. Project started with Japanese US$ 187.994 donation and GEF founds of US$ 84.000.

Renewable Energy Resources Project

Background

The use of renewable energy sources was set at priority level by the National Environmental Strategy and by the National Environmental Action Plan (NEAP).

The project is consistent with the objectives of GEF Operational Program 6: promotion of renewable energy by removing barriers and reducing implementation costs. The barriers include: (i) lack of enabling framework; (ii) lack of development capital and equity financing; and (iii) lack of resource assessment, capacity and knowledge.

Based on the Project Brief, the GEF Council approved the elaboration of the full project documentation and allocated a tentative grant of US$ 6.350 million to the project "Croatia – Renewable Energy Resource". The World Bank (IBRD) was set as the implementing agency. Ministry of Finance, Croatian Bank for Reconstruction and Development (HBOR) and Hrvatska Elektropriveda (HEP) were set as the executing agencies. Operational focal point organization is Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC).

A US$ 1.6 million GEF grant for technical assistance will support policy development and implementation, training, resource assessments, development planning and capacity building. A US$ 1.4 million GEF contingent grant will cover development costs for investments. A US$ 3.0 million GEF grant will provide seed capital for equity co-financing of projects. The project is expected to attract associated investment co-financing of US$ 1.50 million in equity from HBOR, US$ 14.38 million in commercial bank loans and US$ 5.55 million in private equity. Total funding for the project is estimated to be US$ 27.780 million.

A preliminary estimate of the cost effectiveness of the GEF financing (excluding replication potential) is about US$ 10 per ton of carbon. It is on the high range because Croatia has a large hydro generation (40-60% of energy supply) and therefore lower carbon intensity. The total potential for carbon emissions reductions resulting from sustainable renewable energy project development in the country is roughly estimated at 3.4 million tonnes over ten years.

Scope of the project

The project's global environment objective is to reduce greenhouse gas emissions on a continuous basis by overcoming barriers to implementation of renewable energy. Performance indicators for the global objective include:

- Reductions in CO_2 emissions at the national and project levels;
- Development of renewable energy products and services that deliver a growing range of renewable technologies and applications.

The objective of the proposed project is to help develop an economically and environmentally sustainable market for renewable energy resources in Croatia. Development of this market will make Croatia's economy less reliant on imported electricity and fossil fuels as well as reduce overall emissions.

Primary objective:

- to develop an economically and ecologically sustainable market of renewable sources of energy in the Republic of Croatia;

Secondary objectives:

- to reduce the dependence of the Croatian economy on the imports of electricity and fossil fuels;
- to reduce the emission of CO_2;
- to create conditions for attracting private investments in renewable energy sources;
- to promote the development of industry at the local level;
- to promote employment.

The project will overcome several policies, financial and technical barriers to implementing renewable energy projects. It will do so by supporting the implementation of a national policy framework that would legally require a minimum share of energy supply to be met from renewable resource, catalyzing investments through creation of critical financial mechanisms, and building knowledge and implementation capacity.

The project goal is to create a more favourable environment for the implementation of renewable energy projects in Croatia. The global environmental objective of the project is to stimulate the development of Croatia's significant renewable resources and reduce greenhouse gas emissions.

Activities

The project will contribute to the sustainability of renewable energy supply in Croatia by: (i) assisting the Government in achieving its policy objective to renewable energy; (ii) supporting the creation of the enabling legislation and its implementation; (iii) providing knowledge and building capacity among decision-makers and market participants for a better understanding and acceptance of renewable energy; (iv) supporting the creation of an attractive climate for

private investment as well as the financing mechanisms and structure that will entice multiple market participants to seek business opportunities in renewable energy and implement the demonstration and follow-on projects.

Project benefits include the following:

- Increased energy security through reduced imports of electricity and fossil fuel;
- Reduced CO_2, SO_2 and NO_x emissions;
- Assistance to Croatian Government in complying with Kyoto Protocol and EU Directives on renewable energy;
- Minimal impact on the environment through smaller project size;
- Development of new industries and businesses, including:
  - Project developers/investors;
  - Engineers and consultants;
  - Manufacturing/assembly of equipment;
- Improved environmental image, which could impact the tourism industry;
- Increased foreign direct investment and lending through removal of barriers.

Domestic Benefit:

- Some continued development and implementation of renewable energy, mostly small hydro and wind; slightly lower GHG emissions are detected as base project domestic benefit;
- Project Alternative: Immediate implementation of three projects, creation of capacity within industry and government to implement additional projects; more widespread;
- Increment: Greatly enhanced ability and capacity to implement renewable energy projects; greatly reduced local emissions; creation of new industry.

Global Environment Benefit:

- Baseline: Slow implementation of renewable energy projects; about 34 kt CO_2 reduction over 10 years;
- Project Alternative: Total reduction of approximately 191 kt CO_2, through financing and implementation of 18.9 MW;
- Incremental reduction of 157 kt CO_2.

Status of the Project

The GEF Council approved the project and signed the project document in May 2002. The duration of the project is 6 years.

3. TECHNOLOGY NEEDS ASSESSMENT

3.1. TECHNOLOGY TRANSFER FRAMEWORK

The UNFCCC identifies TNA as one of the five elements of technology transfer framework[1]. The elements of the technology transfer framework are as follows:

- Technology needs and needs assessment
- Technology information
- Enabling environments
- Capacity building
- Mechanisms for technology transfer

Key stages in the technology transfer process include identification of needs, choice of technology, assessment of conditions of transfer, agreement, implementation, evaluation and adjustment to local conditions and replication. For each of these stages or implementation steps, the stakeholders, technology transfer pathways, and barriers to technology transfer encountered will vary.

Successful technology transfer programs have included variations of the following five initial steps: (i) establishment of collaborative partnerships between key stakeholders with the common purpose of enhancing technology transfer; (ii) implementation of technology transfer needs assessments (including both evaluation of alternative technologies and definition of technology transfer priorities); (iii) design and implementation of technology transfer plans and specific actions, (iv) evaluation and refinement of the actions and plans (an ongoing process); (v) dissemination of technology information.

TNA as a component of the technology transfer process is an important tool for the identification of technology needs, the development of sector specific technology transfer strategies and facilitator of environmentally sound technology acquisition and transfer.

TNA should identify measures and practices that might be implemented in different sectors of a country to reduce GHG emissions and vulnerability to climate change and to contribute to overall goals. It provides multiple benefits at the country level, including the identification and removing of policy gaps leading to improvement of enabling environments, increasing the capacity of local institutions and experts, and raising public awareness of climate change issues.

TNA involves a common set of organising activities that should be closely linked to other relevant national development processes. TNA process should reflect national response to climate change technology needs that is informed by the private sector, the general public, and other stakeholders.

Three types of activity are required for effective TNA: (i) institutional arrangements and stakeholder engagement; (ii) description of TNA processes and activities; (iii) implementation actions.

[1] The framework is confirmed in decision FCCC/CP/2001/13/Add.1, adopted at COP7.

Overview of the types of activity involved in TNA process, proposed by UNDP/GEF Handbook on Methodologies for Technology Needs Assessment [8], is presented in Figure 3.1-1.

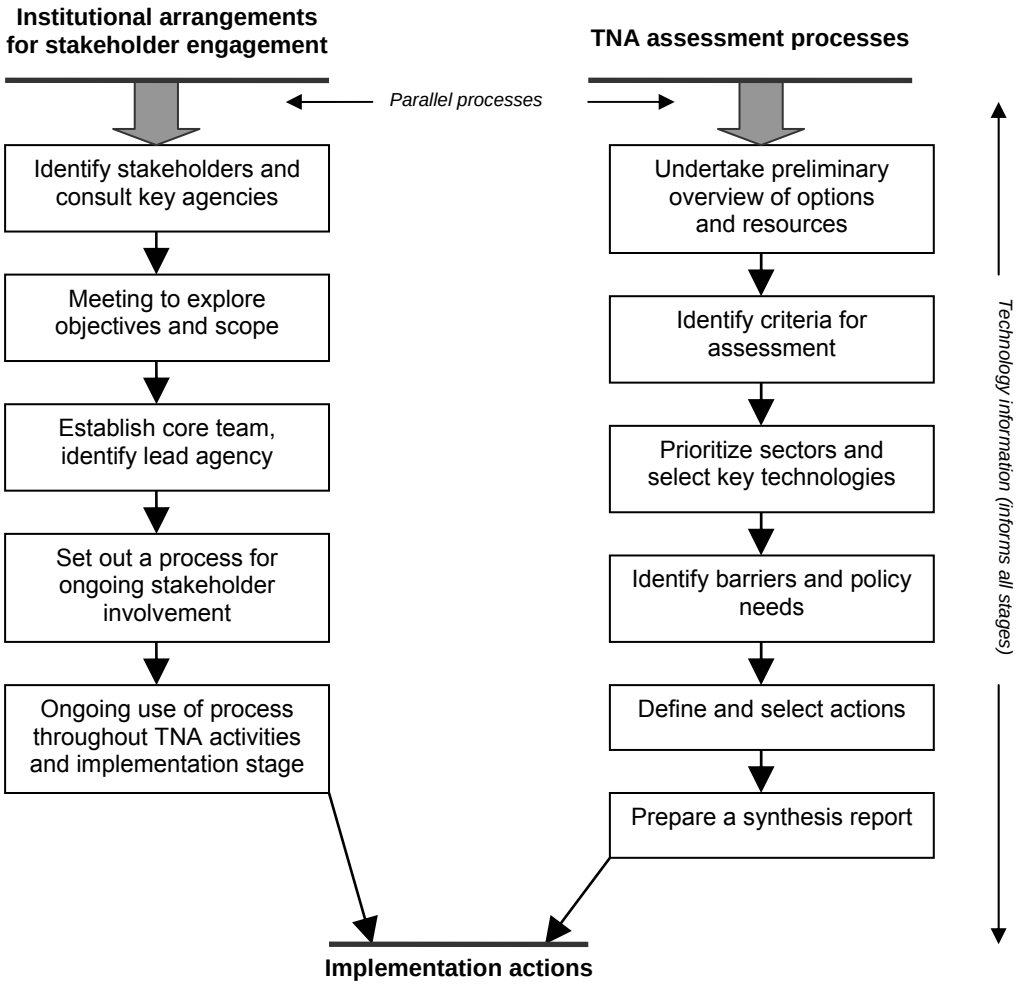

Figure 3.1-1: Overview of the types of activity involved in TNA

To conduct TNA in Croatia, one initial and three thematic workshops were organized. Following thematic areas were included: (i) energy efficiency and renewables; (ii) agriculture; (iii) waste management. The aim of these workshops was to find common framework for identifying the highest priority measures and technology transfer activities and identification of the main barriers in technology transfer process.

Croatia's TNA process is mainly guided by the following methodological guidelines:

- IPCC Special Report: Methodological and Technological Issues in Technology Transfer
- UNDP/GEF Handbook on Methodologies for Technology Needs Assessment
- Methods for Climate Change Technology Transfer Needs Assessments and Implementing Activities: Experiences of Developing and Transition Countries [9]

Croatia's TNA exercise has been conducted through the following activities:

1. Preliminary overview of options and resources
2. Institutional arrangements and stakeholder engagement
3. Establishing criteria for selecting mitigation measures priorities
4. Defining priority sectors and sub-sectors
5. Selecting priority measures and sectors
6. In-depth measure and barrier assessment and stakeholder consultation
7. Selection of high priority actions for further development and implementation
8. Needs assessment report preparation

3.2. PRELIMINARY OVERVIEW OF OPTIONS AND RESOURCES

Preliminary overview of the current status of sectors and measures are presented in Chapter 2. It includes an overview of current circumstances of key sectors (GHG emissions, measures in use) and potentials to reduce GHG emissions.

3.3. INSTITUTIONAL ARRANGEMENTS AND STAKEHOLDER ENGAGEMENT

One of the most important steps in the technology transfer process is creating a team which provides a foundation for needs assessments and all other aspects of technology transfer activities. Following steps in forming institutional arrangements have been performed:

- convene meeting to explore objectives and scope
- identify relevant stakeholders and consult key agencies
- establish core team and identify lead agency, lead technical institution, other participants
- define process for ongoing, involvement of all stakeholders

Successful technology cooperation requires cooperation at many different levels. Successful model for developing and enhancing cooperation among relevant stakeholders are the establishment of a technology transfer team. The role and responsibility of the technology transfer team are designing and implementing technology transfer activities. Key members of a technology transfer collaborative team include climate change government officials; businesses and business associations; non-government organizations and community organizations; technical institutions with expertise in technology assessments, technology implementation, market analysis and business project development and financing for each sector of interest and representatives from donor agencies.

A national technology transfer team represent a broad range of interests. Government plays a key role in facilitating partnerships. In particular, effective stakeholders cooperation can help maximize synergies between various programs.

Core project team has been established with leading agency and technical institutions. Partnerships between different stakeholders build upon their common interests and create an important pathway for successful technology transfer.

Institutions responsible for project enforcement are as follows:

- Ministry of Environmental Protection, Physical Planning and Construction (MEPPPC)
- EKONERG - Energy Research and Environmental Protection Institute (EKONERG)
- Energy Institute Hrvoje Požar (EIHP)

Overall roles and responsibilities of leading institutions in the project

MEPPPC – according to National Execution Modalities, acting as National Executing Agency, MEPPPC is responsible for achieving project objectives and accountability to UNDP for the use of project resources. The Ministry has controlling and regulatory authority that is needed for implementation of technology transfer actions and integrates the work of the team with key climate change issues.

EKONERG – acting as Implementing Agency in the project based on its leading role in the Enabling Activity Phase I, and its technical capacities in the field of strategy planning and concrete experience in design, engineering and maintenance of the energy related facilities and installations.

EIHP – work on tasks related to energy efficiency and renewables, which is the field of their full competence, particularly in national energy policy development.

Project Steering Committee (PSC) is responsible for evaluation of project execution according to proposed timetable and outcomes of the project. In this project National Climate Change Committee, which was established during Phase I, will act as PSC in the Phase II.

PSC is consisted of:

- Ministry of Environmental Protection, Physical Planning and Construction
- Ministry of Foreign Affairs
- Ministry of Science and Technology
- Ministry of Economy
- Ministry of Transport
- Ministry of Agriculture and Forestry
- Croatia Academy of Science and Arts
- Croatian Chamber of Commerce
- Meteorological and Hydrological Service of Croatia (HMSC)
- Energy Institute Hrvoje Požar
- INA (Oil industry)
- Hrvatska elektroprivreda (Electricity Utility Company)
- NGO Green Action
- UNDP Country office
- Independent experts

Within Project enforcement, initiation workshop was organized, with participation of stakeholders from government, private sectors, interested parties from different sectors (energy, industry, waste management, agriculture, and forestry), institutes, universities and NGO-s.

The workshop was focused on presentation objectives of the project "Climate Change Enabling Activity Phase II" and overview of current status of sectors and activities needed for transfer and implementation of GHG mitigation measures.

There was concluded that one of the important tool for introducing activities for transfer of mitigation measures is assurance of legal and institutional framework and supporting policy. There is no such an approach that could be considered best for implementation of these measures, since it mostly depends on the national situation. The "good practice", which is recommended by international community, integrates a number of different instruments for the policy implementation. The instruments can be economic, fiscal, legislative, voluntary, all based on information, education and research.

3.4. ESTABLISHING CRITERIA FOR SELECTING MITIGATION MEASURES PRIORITIES

Well defined criteria for selecting priority measures create a common framework for identification of the highest priority measures and future technology transfer activities. This process also requires an understanding of impacts of these measures to overall environmental, social and development goals in different sectors. There are many analytical approaches which could be applied to assess measures but it is of greatest importance that implemented approach takes into account country's circumstances.

For establishment and weighting of criteria, a technique of **multi-criteria analysis (MCA)** was performed. Criteria were identified through a hierarchical approach [10]. AHP is especially suitable for complex decision-making process which involves the comparison of decision elements which are difficult to quantify.

Four steps have been conducted for criteria establishment and weighting:

1. Definition of three basic criteria and their goals
2. Preparation of extended list of sub-criteria associated with each basic criterion
3. Assessment and final selection of criteria and sub-criteria
4. Weighting the criteria

During the initial workshop a survey was carried out to establish criteria for selecting priorities among 39 GHG mitigation measures in all sectors. The basic criteria and their goals are:

1. **Development benefits** – defines climate change mitigation and adaptation technologies which offer the greatest value to the country in meeting its current national development priorities.

2. **Implementation potential** – defines scale of implementation and diffusion of the technology which can be realistically achieved if key barriers are overcame.

3. **Contribution to climate change response goals** – defines technologies which will make the biggest contributions to the country's efforts for mitigating greenhouse gas emissions and for facilitating adaptation to climate change.

An extended list of sub-criteria were prepared and evaluated according to the scale of their contribution and significance. The final list of criteria and sub-criteria has been proposed for the selection of high priority mitigation measures:

I Development benefits

1. job creation
2. capacity building (production, know-how)
3. economic structure change according to Croatia export orientation
4. agriculture security

II Implementation potential

1. marginal cost
2. commercial readiness
3. technology availability
4. measure applicability

III Contribution to climate change response goals

1. GHG emission reduction potential / enhancement of CO_2 sinks
2. indirect effect on the other air pollutants emission reduction
3. conservation of energy

Desirable qualities of criteria include:

- comprehensiveness - requires that basic criteria is comprehensively described by its underlying sub-criteria;
- decomposability - each sub-criterion represents a distinct portion or segment of the criterion;
- selectivity - possibility to select localised portions of the hierarchy and resolve that component of the problem;
- non-redundancy - avoiding of double counting and duplication of information in a set of criteria;
- minimum size - the fewest possibility to provide comprehensive representation of the basic-criteria;
- operationality - measurable criteria are operational and provide the greater extent of quantification.

For better understanding and application for the selection of high priority mitigation measures, description of each sub-criterion is proposed below:

Development benefits

- ***job creation***
  Introduction of the measure creates possibility for employment increase.
- ***capacity building (production, know-how)***
  Introduction of the measure encourages building of new and extension of existing production capacity and increases the knowledge, practice and ability of employees.
- ***economic structure change according to Croatia export orientation***
  Efficiency and effectiveness of measure provides competitive advantages and possibility of export.
- ***agriculture security***
  Introduction of measure directly affects the utilization and purpose of agriculture land (sustainable usage of land, safety food supply).

Implementation potential

- ***marginal cost***
  Marginal cost represents the sum of measure implementation cost by unit of emission reduction (USD/tCO_2-eq). Higher marginal cost causes minor market implementation potential opportunity.
- ***commercial readiness***
  Defines openness, flexibility, capacity and adjustment of market for measure implementation.
- ***measure availability***
  Indicates level of measure availability on the market.
- ***measure applicability***
  Indicates measure applicability in different environmental conditions (e.g. geographical, socio-economic and cultural).

Contribution to climate change response goals

- ***GHG emission reduction potential / enhancement of CO_2 sinks***
  GHG emission reduction and respectively the enhancement of CO_2 sinks with regard to baseline scenario are provided by measure implementation.
- ***indirect effect on the emissions of other air pollutants***
  Emission reduction or enhancement of the other air pollutants (e.g. SO_2, NO_x, and particulate matters) is achieved by measure implementation.
- ***conservation of energy***
  Introduction of the measure encourages rational energy consumption, energy savings and substitution of traditional resources of energy with renewables.

3.4.1. CRITERIA WEIGHTING

For criteria weighting, MCA method was performed. MCA is defined as any technique, or combination of techniques, used to rank the desirability of a set of alternatives. It involves a process for weighting the criteria and a process for ranking the alternatives [11].

MCA methods could be classified under two major groups: (1) continuous and (2) discrete methods. Continuous MCA methods are aimed at identifying an optimal quantity in a decision problem. Discrete MCA methods are aimed at identifying the most desirable alternative i.e. measure from a finite set of alternatives.

In our case, discrete MCA is defined as a decision support technique that has:

- a finite number of GHG mitigation measures;
- a set of objectives and criteria by which GHG mitigation measures are to be judged;
- a method for ranking GHG mitigation measures based on how well they satisfy the objectives and criteria.

Weighting of the criteria could be appreciated as the major phase of the MCA process. In this stage qualitative or quantitative information is obtained to assess the relative importance of criteria. Direct and indirect estimation of weights could be used for obtaining weights information. Direct methods require an explicit statement of the relative importance of each criterion. Indirect weighting methods estimated weights based on simulated or real decision behaviours. The purpose of an MCA weighting method is to attach a set of cardinal or ordinal values to a set of criteria to indicate their relative importance.

Rating technique was used for the weighting of the criteria by which mitigation measures were judged. The rating technique obtains a score to represent the importance of each sub-criterion. It is similar to scales used on a Likert scale questionnaire. Numbers 1-9 are used to indicate importance of criteria. According to the 9 point scale, there is following ratings:

1 - weakly important
3 - less important
5 - moderately important
7 - more important
9 - extremely important

Point scale includes all point from 1 to 9 (2, 4, 6, 8 are inter-values). Equal assessments might be given to the more criteria.

Determining the importance of each of sub-criteria was performed by survey technique Delphi method. The Delphi technique is a common approach for having a panel of experts provides quantitative measurements where scientific data is unavailable. Quality of decision depends on the number of experts. In effect, the best result (minor error) could be achieved by 9 to 17 experts. Method is conducted using an anonymous staged survey approach. In the first survey a group of experts are asked to indicate a value for an unknown quantity that researchers are attempting to estimate. The experts are asked also to provide a brief explanation as to why they gave a particular value. This information is then processed by the researcher and the scores are sent back to all experts in the next survey showing values indicated by all other experts and their explanations. Each expert is then given the opportunity to adjust their score in light of the other scores.

The process is repeated until no single expert is willing to further change its score. At all stages of the process the identity of each expert remains anonymous. The variability in responses, which can be measured with the standard deviation (or the other statistical indicator), decreases at each repetition. This means that greater confidence be placed in the mean value at each repetition. Delphi technique effectively built consensus as evidenced by the reduction in the variability of responses at each survey stage [11].

The process of criteria weighting is presented in Annex 1. Seventeen experts were involved in the process of criteria weighting which was performed in the two stages. Median and quartile (first and third) as well as standard deviation were used to give statistical information for the each expert. Weighting factors, which were determined for each sub-criterion, reflect their relative importance.

Three categories of criteria were formed after the weighting process. The first category includes the most important criteria, which can be quantified. The second and third categories include relative less important criteria, which can be qualitatively determined.

The result of criteria weighting is presented in Table 3.4-1.

Table 3.4-1: Result of criteria weighting

	CRITERIA/CATEGORIES	RELATIVE WEIGHTS (%)
	I CATEGORY	
1	GHG emissions reduction potential/enhancement of CO_2 sinks	13
2	conservation of energy	12
3	indirect effect on the other air pollutants emission reduction	11
4	marginal cost	10
	II CATEGORY	
1	commercial readiness	9
2	measure availability	8
3	measure applicability	8
	III CATEGORY	
1	capacity building (production, know-how)	8
2	job creation	8
3	agriculture security	7
4	economic structure change according to Croatia export orientation	6
	TOTAL	**100**

3.5. IDENTIFICATION OF PRIORITY SECTORS AND MITIGATION MEASURES

MCA model which was used for evaluation of mitigation measures is comprised of a set of evaluated criteria and a set of feature indicating the performance of each measure against each criterion. Important part of this process of evaluation is accuracy of algorithms applied to identify and rank the best measure and sensitivity analysis which involves systematic variation of data values used in the MCA model to determine the robustness of the results.

3.5.1. MITIGATION MEASURES EVALUATION

Measures were evaluated using the data from preliminary assessment process which includes summary of the sectors with potential to benefit from measure development and transfer, available measure options and resources and supporting policies for adoption of the identified measures. Collecting of additional information about the priority sectors leads to better understanding of measure options and the decision-making process.

Following three steps in the analysis have been performed:
1. Identification of priority sectors
2. Identification of key mitigation measures for each sector
3. Assessment of key mitigation measures

Selection and prioritisation of measures has focused on following sectors: Energy sector, Waste Management, Industrial processes, Agriculture and Forestry. Measures which have been evaluated are presented below.

ENERGY SECTOR

a) Power Generation Sector

1. Savings in Power Transport and Distribution
2. Wind Power Plants
3. Small Hydro Power Plants
4. Biomass in Cogeneration Plants

b) Industry

1. Motor Drives Regulation
2. Cogeneration Plants
3. Low-Temperature Heat Generation Efficiency Increase
4. High-Temperature Heat Generation Efficiency Increase

c) Transport

1. Interurban Passenger Transport
2. Urban Passenger Transport
3. Freight Transport
4. Increase in Biodiesel Use

d) Services and Residential

1. Demand Side Management (DSM) Measures
2. Solar Energy Use Increase
3. Geothermal Energy Use Increase
4. District Heating and Cogeneration Use Increase
5. Insulation Improvement and Energy Efficiency in Buildings and Construction
6. Biomass in Heating Plants

WASTE

1. Thermal Processing of Waste with Energy Utilization

INDUSTRIAL PROCESSES

a) Nitric Acid Production

1. Non-Selective Catalytic Reduction

b) Cement Production

1. Increase in Energy Efficiency of the Clinker Production Process
2. Switching to Fuel with Lower Carbon Content
3. Decrease of Clinker Percentage in Cement
4. Use of Waste as Alternative Fuel

AGRICULTURE

1. Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction
2. Reduction in CH_4 Emission by Decreased Fermentation
3. Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation
4. Carbon Storage in Agricultural Soil

FORESTRY

1. Reforestation of Productive Bare Forestland
2. Increase in Forestland Surface to be Cared by Thinning
3. Including of Complete Second Age Class Forests (all the forests 20-40 years of age) into the Thinning
4. Planting Pioneer Wood Species on the Degraded Forests
5. Improvement in Wood Utilization Efficiency and Increase in Harvesting

Evaluation and selection of priority mitigation measures was performed by expert team according to criteria previously established and based on the compiled information. Broad stakeholder participation has been essential to ensure that there is broad support for these priorities and that they reflect the best opportunities for accelerated implementation.

The type of method that is selected for measures ranking depends on whether quantitative or qualitative data is available and which method of weighting was used. Discrete MCA methods were used to rank measures. Combination of quantitative and qualitative techniques of measures evaluation was performed.

In the process of selecting priority measures a ranking matrix has been used to ensure each measure is assessed against each established criterion. An example of a measures ranking matrix is provided in Table 3.5-1. For each sector under assessment key measures have assessed.

Table 3.5-1: Ranking matrix for selection of priority measures

MEASURE	CRITERIA / CATEGORIES										
	I				II			III			
	I1	I2	I3	I4	II1	II2	II3	III1	III2	III3	III4
M1											
M2											
…											
Mn											

Measures were evaluated by following MCA techniques:

- scoring is used for measures evaluation against first (I) criteria category;
- AHP is used for measures evaluation against second (II) and third (III) criteria categories.

Quantitative classes are determined for each criterion of first (I) category. For each criterion of second (II) and third (III) categories qualitative classes are determined. Evaluations from 1 to 5 are assigned to each class.

To determine the final scores under each criterion, the measures scores were multiplied by the relative weight of criterion. Description of measures evaluation and results of measures scoring are illustrated in Annex 2.

A ranking process of the scored measures in each sector has been followed and priority measures have been selected. The final selection is presented in Table 3.5-2.

Table 3.5-2: Measures ranking matrix for selection of priority measures

	SECTOR / MEASURE	TOTAL
ENERGY SECTOR		
a) Power Generation Sector		
1	Savings in Power Transport and Distribution	2.00
2	Wind Power Plants	3.75
3	Small Hydro Power Plants	2.67
4	Biomass in Cogeneration Plants	3.38
b) Industry		
1	Motor Drives Regulation	2.23
2	Cogeneration Plants	2.73
3	Low-Temperature Heat Generation Efficiency Increase	2.63
4	High-Temperature Heat Generation Efficiency Increase	2.27
c) Transport		
1	Interurban Passenger Transport	2.00
2	Urban Passenger Transport	1.97
3	Freight Transport	2.11
4	Increase in Biodiesel Use	3.37
d) Services and Residential		
1	Demand Side Management (DSM) Measures	2.60
2	Solar Energy Use Increase	3.00
3	Geothermal Energy Use Increase	2.00
4	District Heating and Cogeneration Use Increase	2.77
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.42
6	Biomass in Heating Plants	3.53
WASTE		
1	Thermal Processing of Waste with Energy Utilization	3.16
INDUSTRIAL PROCESSES		
a) Nitric Acid Production		
1	Non-Selective Catalytic Reduction	3.14
b) Cement Production		
1	Increase in Energy Efficiency of the Clinker Production Process	2.90
2	Switching to Fuel with Lower Carbon Content	2.70
3	Decrease of Clinker Percentage in Cement	2.54
4	Use of Waste as Alternative Fuel	2.95
AGRICULTURE		
1	Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction	2.93
2	Reduction in CH_4 Emission by Decreased Fermentation	2.29
3	Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation	2.96
4	Carbon Storage in Agricultural Soil	2.59
FORESTRY		
1	Reforestation of Productive Bare Forestland	2.99
2	Increase in Forestland Surface to be Cared by Thinning	2.68
3	Including of Complete Second Age Class Forests (all the forests 20-40 years of age) into the Thinning	2.68
4	Planting Pioneer Wood Species on the Degraded Forests	2.48
5	Improvement in Wood Utilization Efficiency and Increase in Harvesting	2.61

3.5.2. SELECTION OF PRIORITY GHG MITIGATION MEASURES

From the results of measures assessment it is evident that the most significant measures that need to be addressed and implemented are from Energy sector. Priority measures for mitigating GHG emissions are presented in Table 3.5-3:

Table 3.5-3: Priority measures for mitigation GHG emissions

MEASURE
Wind Power Plants
Biomass in Heating Plants
Insulation Improvement and Energy Efficiency in Buildings and Construction
Biomass in Cogeneration Plants
Increase in Biodiesel Use

Wind Power Plants

Wind Power Plants estimated to be key measure with first priority. Wind energy is a considerable potential as energy source, uniformly widespread in every corner of the earth. According to the research work, 29 locations were identified in Croatia as most suitable for utilization of wind energy – these are the locations characterized by wind speeds exceeding 5.5-6 m/s, 25 m from the ground. All locations are on the Adriatic. Wind energy potential is not used in the overall Croatia's potential territory so far.

According to last analysed data, 576 GWh of electricity from wind turbines in the year 2010 could be produced. It must be noted that this optimistic potentials are based on very limited data, since no detailed mapping of the Adriatic was made for harnessing of the wind potential, which is one of the research priorities. Further, the environmental impact studies point to the impact on birds and aesthetic pollution for which some of the technically feasible sites are questionable for use. The cost estimates show that the emission reduction by implementation of this measure is relatively more expensive than implementation of most other measures, so its launching would demand considerable incentives. Finaly, using wind-electricity, appropriate fossil fuels consumption will be reduced, because of decrease of thermal power electricity production. Consequently, 453 kt of equivalent CO_2 emission would be reduced.

Wind Power Plants measure should be realised within the national renewable energy program ENWIND. The ENWIND program will ensure a number of conditions necessary for cost-efficient harnessing of wind in power generation, by using the wind turbines of new generation. The wind energy, an environmentally sound and accessible local resource, is a completely undeveloped energy resource that might contribute to satisfying the energy demand in Croatia.

Biomass in Cogeneration Plants; Biomass in Heating Plants

Biomass in Cogeneration is estimated to be measure with second priority**.** The Republic of Croatia, as a country with big forestry and agricultural potential (44% continent forestry area), and numerous wood-processing units, has significant amount of biomass from different origin for disposal. The biomass is a renewable energy source, because use of the biomass as a fuel does not produce the greenhouse gases emission if the entire cycle is taken into consideration: wood stock increment, burning of the biomass and assimilation of CO_2. The wood carbon

content is about 50 percent, and it is released during burning as CO_2, which is again fixed in the biomass. The biomass can be of wooden, non-wooden or animal origin. The biomass needs to be pretreated for its use in power generation, which includes the biomass collecting, preparation for transport and utilization. The biomass use has significant socio-economic and environmental consequences, which should be accounted for in the potential assessment. Today, the agricultural waste use is not practiced. Estimated total usable biomass potential, in 2010, from forestry and agriculture is 6 PJ. This potential may be used in households, small boiler houses, industrial boiler plants or cogeneration plants. It is also assumed that 40 percent of biomass potential will be used for cogeneration plants and 60 percent in small heating plants. The biomass-fired cogeneration plants should contribute to reduction of 314 kt CO_2-eq emission in 2010, while biomass-fired small boilers should reduce for additional 314 kt CO_2-eq emission.

The objectives and strategy for implementation of the biomass in cogeneration technology programs depends on specific characteristics of that renewable resource and the program of its use. This technology should be realised within the national renewable energy program BIOEN. The BIOEN program is focused on energy generation from biomass and waste and it indicates that such production could cover minimum 15 percent of total primary energy demand by the year 2020. The objective is to be realized by initiation of the demonstration projects, creation of market and conditions for increased use of biomass energy, by attracting industry and businesses, education, and stimulation of research and international collaboration.

Insulation Improvement and Energy Efficiency in Buildings and Construction

The total floor area of premises in the services sector is estimated to around 25 million m^2. Until 2030, it is estimated that the floor area will be doubled. Here, it should be kept in mind that the specific heat consumption by m^2 in newly built floor area is much lower than in the existing premises. It means that the improvements of thermal insulation in the services sector relate to the already existing floor areas. The scenario with measures envisages the thermal insulation improvement in the existing premises by about 10 percent in relation to the initial status by the end of the planning period (2030). The scenario with aditional measures foresees an additional improvement of about 20 percent until the end of the planning period. Comparatively high marginal costs of this measure are the result of high investment costs compared to the achieved energy savings.

In order to assess the potential of reducing greenhouse gases emission by improved insulation in households in Croatia, we should start from the fact that the housing stock of Croatia is rather old. Out of 1.6 million apartments 26 percent is over 50 years old, while almost 30 percent is 30 to 50 years old. On the other hand, it should be kept in mind that less than half of floor area in these apartments has quality heating. In the future, it can be expected that floor area in old apartments with quality heating will increase so, knowing that about 60 percent of useful heat used by households is consumed for space heating, it can be estimated how much useful heat will be consumed in the next thirty years. Based on various studies, the potential for insulation improvements in old apartments is estimated, given the assumption that new apartments will be built using the latest technologies with modern and efficient insulation, so the insulation improvement refers only to old housing stock. The analysis of thermal energy demand has shown that by 2030 the heat required for apartment heating will grow almost twofold compared to 2000. The scenario with measure envisages the insulation improvement of 10 percent what equals 4,4 PJ of decreasing in useful heat demand. So, the additional improvement in the

scenario with aditional measures refers to the additional 10 percent of insulation improvement, which makes the total useful thermal energy for space heating lower by about 8 PJ in relation to the scenario without measures.

Increase in Biodiesel Use

To increase biodiesel use in transport is selected as fifth GHG mitigation measure. Gradual supplementation of motor fuels with biodiesel is expected beyond 2005 according to both the mitigation and baseline scenario. The mitigation scenario envisages faster rate for introduction of these fuels in the motor fuels market, so the increase in use of 0.8 PJ for biodiesel is expected in the year 2010 in comparison with the baseline scenario, and total increase by 3.8 PJ is expected by the year 2020. Increased use of this fuel decreases the demand for motor oil and diesel fuel, and results in CO_2 emission reduction (about 280 kt of CO_2-eq in 2020).

Introduction of biodiesel is covered by the BIOEN and TRANSCRO national energy program. The TRANCRO program is aimed at permanent care for energy efficiency and environmental protection in transportation sector. The program encompasses long-term forecast of energy consumption increase in the transportation sector in the Republic of Croatia and determination of its environmental impact, along with the model analysis of economically viable measures that could result in energy efficient and environmentally sound development of the transportation system.

Detailed assessment for each priority measure include identification of the specific applications for the measure, estimation of the scale of implementation and market penetration, analysis of the costs and development benefits, identification of in-country business and investment organizations, government agencies, technical institutions, donor, international institutions and other stakeholders involved in technology transfer. These activities will be done in some future projects. The purpose of the assessments is also to support decisions on the actions that will be pursued to overcome key technology transfer and diffusion barriers.

3.5.3. SENSITIVITY ANALYSIS

Sensitivity analysis is the systematic variation of data and decision rules used to rank measures to determine the reliability or 'robustness' of final ranking. It allows to the determination of credibility of the results of MCA. A ranking of measures which either does not change or changes minimally can be considered robust and reliable. On the other hand, a ranking of measures that changes significantly when key elements of MCA model are varied is unreliable. In this case MCA is unable to provide a clear solution to the decision problem [11].

There are three main components to sensitivity analysis including (i) systematic variation of weights information; (ii) systematic variation of performance measures; (iii) systematic variation of MCA methods for weighting the criteria and/or ranking the measures.

Sensitivity analysis was performed in two ways: (1) by criteria, and (2) by experts.

Sensitivity analysis by each individual criterion (I1, I2, I3, I4, II1, II2, II3, III1, III2, III3 and III4), each criteria category (I, II and III) and both qualitative criteria categories (II+III) were conducted. It was performed in the way that expert judgment final scores of observed criterion or criteria category were excluded. In that way each criterion/criteria category was able to show its influence on the priority of measures (Table 3.5-4). The priority (numbers in Table 3.5-4) is a result of measure's dependence on criterion/criteria category.

Sensitivity analysis by each of seventeen experts was also conducted. With respect to that, individual expert's judgment results were analyzed. The sum of experts who evaluated priority five measures are presented in Table 3.5-5.

List of measures abbreviations is presented in Table 3.5-6.

Table 3.5-4: Sensitivity analysis by criteria

CRITERION/ CRITERIA CATEGORY	MEASURE							
	M1	M2	M3	M4	M5	M6	M7	M8
I1	1	2	4	5	3	-	-	-
I2	1	3	5	4	2	-	-	-
I3	1	2	5	3	4	-	-	-
I4	1	3	2	4	5	-	-	-
II1	1	2	5	3	4	-	-	-
II2	1	2	3	5	4	-	-	-
II3	1	2	4	3	5	-	-	-
III1	1	2	3	4	5	-	-	-
III2	1	2	3	4	5	-	-	-
III3	1	2	3	4	5	-	-	-
III4	1	2	4	3	5	-	-	-
I	-	2	3	4	1	5	-	-
II	1	2	5	3	4	-	-	-
III	1	3	4	5	-	-	2	-
II+III	1	3	4	5	-	-	2	5

Table 3.5-5: Sensitivity analysis by experts

MEASURE	EXPERTS
M1	16
M2	13
M3	13
M4	14
M5	6
M6	-
M7	5
M8	5
M9	5
M10	2
M11	2
M12	2
M13	1
M14	1

Table 3.5-6: List of measures abbreviations

ABBREVIATION	MEASURE
M1	Wind Power Plants
M2	Biomass in Heating Plants
M3	Insulation Improvement and Energy Efficiency in Buildings and Construction
M4	Biomass in Cogeneration Plants
M5	Increase in Biodiesel Use
M6	Small Hydro Power Plants
M7	Non-Selective Catalytic Reduction
M8	Thermal Processing of Waste with Energy Utilization
M9	Solar Energy Use Increase
M10	Use of Waste as Alternative Fuel
M11	Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation
M12	Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction
M13	Reforestation of Productive Bare Forestland
M14	Switching to Fuel with Lower Carbon Content

If one compares results obtained by sensitivity analysis it is obvious that criteria I1, I2, I3, I4, II1, II2, II3, III1, III2, III3 and III4 did not influence on selection of priority measures, but that criteria influenced on measures rank. Nevertheless, measure **Wind Power Plants** remains in the first place in all cases. It can be concluded that each individual criterion is not sensitive in degree that must be additionally analyzed.

First (I) and third (III) criteria category has significant influence on selection of priority measures, while second (II) criteria category has not influence on measure selection.

First (I) criteria category, which is the most important category, has the greatest influence on the measure **Wind Power Plants**. At the same time, third (III) criteria category and both qualitative

criteria categories (II+III) have the greatest influence on the measure **Increase in Biodiesel Use.** Sensitivity analysis according to criteria category (I and III) and both qualitative criteria categories (II+III) defines three new measures which appear in priority order: Small Hydro Power Plants; Non-Selective Catalytic Reduction of N_2O in nitric acid production and Thermal Processing of Waste with Energy Utilization.

Sensitivity analysis by experts show that five priority measures; Wind Power Plants, Biomass in Heating Plants, Insulation Improvement and Energy Efficiency in Buildings and Construction, Biomass in Cogeneration Plants and Increase in Biodiesel Use are priority measures obtained by all experts judgment. According to analysis, measure M1 is ***priority 1*** measure, because majority of experts evaluated this measure as top five priority measure. Measure M4 is ***priority 2*** measure and measures M2 and M3 are ***priority 3*** and ***priority 4*** measures. Measure M5 is ***priority 5*** measure because minority of experts evaluated this measure as top five priority measure (Table 3.5-5). Analysis show that, for most measures, expert's judgment doesn't vary significantly.

Influence of individual criterion/criteria category and expert's judgment on the measures priority is presented in Annex 3.

3.6. TECHNOLOGY TRANSFER BARRIERS ASSESSMENT

Identification, analysis and removal of specific barriers (e.g. policy, regulatory, information, financing, capacity building, etc.) increase deployment of new measures by sector and enable achieving of full implementation potential [12]. Analysis of barriers might define the primary reasons why the measure is not currently in widespread use and why the private and public sectors have not made greater investments in the measure. It could consider whether there exist any critical policy or other barriers stages in companies decision-making process that prevent them from implementing investment actions.

A number of barriers in each sector have identified through a broad consultative process with key stakeholders. Three workshops with following thematic areas were organized: (1) energy efficiency and renewable; (2) agriculture; (3) waste management.

Based on the experience of the other countries and proposed guidelines for determination of technology transfer barriers [12, 13], the final list of barriers has been synthesized and barriers assessment conducted at thematic workshops. The aim of these workshops was to identify key barriers and to find common framework for identifying the highest priority measures and technology transfer activities. At the workshops surveys were carried out to identify main barriers for technology transfer in defined areas. Barriers identified as relevant for mitigation measures transferring are presented in Table 3.6-1. The results of surveys are illustrated in Annex 4.

According to the survey's result, barriers which are identified as the most significant in all selected sectors are as follows:

- legal, institutional and organisational;
- social;
- financial.

Table 3.6-1: Main barriers for mitigation measures transferring

CATEGORY OF BARRIER	DESCRIPTION
FINANCIAL	High cost of new technologies, unsuitability to host conditions
	Lack of investment capital
	Lack of financing instruments
LEGAL INSTITUTIONAL ORGANISATIONAL	Lack of legal and regulatory framework
	Weak connection among different stakeholders
	Limited institutional capacity, management and organisational experience
TECHNOLOGICAL	Low technical capabilities and lack of technology knowledge base, inability to assess, select and adapt appropriate technologies
	Lack of infrastructure
	Lack of technological standards and institutions for supporting the standards
ECONOMIC	Inflation
	Economic instability
	Disturbed or non-transparent markets
POLITICAL	Corruption
	Political instability
	Interventions in domestic market (subsidies, encouragements, fees)
INFORMATION	Lack of technical information
	Lack of demonstrated track record for many EST
	Lack of financial information
SOCIAL	Lack of awareness and social acceptance, insufficient understanding of the advantage of new technologies, social biases
	Lack of confidence in the economic, commercial and technical viability of technologies
	Consumer preferences

Barrier avoiding requires a range of carefully tailored policy measures and there is no single policy that can tackle all barriers and market failures. Important measures to overcome barriers include assessment of technology needs, adaptation of technology to local conditions, building capacity to understand and operate the technology transferred, connection with the local institutions, research and development institutions and universities.

Legal, institutional and organizational barriers are considered as the most significant among all identified barriers. Lack of legal and regulatory framework, weak connection among different stakeholders, limited institutional capacity, management and organisational experience were identified as the most important barriers to effective needs assessments.

The laws which have brought within Development Strategy of Macroeconomy, Energy Development Strategy and Environmental Protection Strategy, have the aim to reform and adjust sector's development in line with the EU legislation. Transposition of the EU legislation and integration of translated legislation into the national constitutional and legal system will be a very complex and time-consuming job because there is a number of standards and restrictions that should be included into the applicable constitutional and legal system. The process will simultaneously run in many areas so setting up legal coordination is one of the priorities. The process of harmonization with EU legislation needs an establishment of legal coordination between priority categories. In the long run, it is necessary to complete the existing system of environmental protection and adapt it to the systems applicable in the EU countries. It is also essential to establish non-discriminatory cooperation of all protagonists in environmental protection and encourage the raise of consciousness of the environment importance and general participation in its protection.

There is also need for improving and implementing institutional support and training for assessing, developing and managing new technologies and pursuing collaborative networks among all involved stakeholders (government, private sectors and interested parties from different sectors, institutes, universities and NGO-s). Government play a key role in facilitating partnerships and play an essential role in creating favourable conditions for the participation of these stakeholders. In particular, effective stakeholders cooperation can help maximize synergies between various programs. For private sector participation is essential to establish a stable institutional setting with sound economic and regulatory framework and transparent regulatory and judicial system.

Lack of awareness and social acceptance, insufficient understanding of the advantage of new technologies, social biases and the other social barriers represent significant barriers to technology transfer and poses a major challenge in assessing technology needs. Limited awareness on the benefits of new environment sound technologies perform important problem in local communities. An information system for avoiding limited access to technological information should be also established. Establishment of awareness raising campaign will contribute in information transfer among governmental structure, private companies and public.

The implementation of new technologies requires great financial resources. Limited funding and inability of national institutions to provide the necessary support require additional international supporting of mitigation transfer technologies. Therefore funding is significant barrier that can be overcome by grants or loans provided by domestic and international donors. Consequently, the international assistance from multilateral, bilateral and other sources, including technical and financial assistance will be essential in this process.

A condition underlying successful implementation of the climate mitigation technologies is stipulation of objectives as per sectors and incorporation of those objectives and implementation mechanisms into the sector strategies, plans and legislation. To establish a favourable environment for implementation of these technologies, it is important to establish continuous education, informing and public awareness arising and increase the interest of the banking sector to invest into the climate change mitigation projects. This will only be possible if the long-term objectives and state incentives are transparent and the energy market stability ensured.

4. PRIORITY IMPLEMENTATION ACTIONS FOR TECHNOLOGY TRANSFER

As a result of technology needs assessment, TNA expert team conclusions are:

1. **Technology needs assessment was conducted according to methodology recommended by the UNFCCC adjusted to country circumstances in terms of the availability of required information and other resources (human and financial);**

2. **A straightforward approach to technology needs assessment was made in order to ensure transparency, consistency and comparability of this Report;**

3. **Mitigation measures (technologies) which were identified as priorities, with implementation potential at 2010, are: Wind Power Plants, Biomass in Construction, Biomass in Cogeneration Plants and Increase in Biodiesel Use;**

4. **According to the results of sensitivity analysis, Non-Selective Catalytic Reduction of N_2O in nitric acid production and Thermal Processing of Waste with Energy Utilization are two additional mitigation measures which should also be considered in technology transfer process;**

5. **Measures such as Biomass in Heating Plants, Biomass in Cogeneration Plants and Increase in Biodiesel Use, according to the view of the TNA expert team, are cross-cutting energy and agriculture sectors and future technology transfer implementation actions should address this issue;**

6. **Particular attention has been given to identification and rating of key barriers including legal, institutional, social, political and financial which need to be overcome by the stakeholders in order to enhance technology transfer process;**

7. **TNA assessment process is based on multi-criteria analysis and expert judgement when empirical or quantitative data are lacking, and in such cases conclusions or decisions are made from information presented to or available to the expert. This approach entails uncertainties associated with quality of information, activity data and biases in expert judgement. In the view of TNA expert team these uncertainties should be addressed to help prioritise efforts to improve the accuracy and confidence in the results of technology needs assessment. Nevertheless, TNA expert team believes that priority GHG mitigation measures were selected by means of the best available estimates as a combination of the available empirical data and expert judgement and as such are reasonably accurate.**

8. **In order to reduce uncertainties related to selection of priority mitigation measures TNA expert team recommends usage of relevant technical-economic models, such as MARKAL and/or MESSAGE as first step in future implementation activities primarily to review priority measures in terms of their cost-effectiveness and alignment with overall energy policy goals on national level.**

9. **Policy in particular sectors, such as economy, energy and environmental protection, has significant influence on the climate change mitigation. For the effective implementation of policy objectives it is necessary to apply different instruments and implementing mechanisms in individual sectors, with including it in specific sectors strategies, plans and regulations. However, at the moment, defined objectives and measures are not adjusted completely and their implementation will be very acquiring, which is also evidenced in the practice. It indicates the emergency of better coordination between particular ministries as well as adjustment of legislation, inside and between sectors, with the aim to solve the priorities associated with the climate change.**

TNA expert team recognize as a first further step preparation of **Technology Transfer Action Plan** which will address key elements in technology transfer process which include:

Technology information system, which defines the means, including hardware, software and networking, to facilitate the flow of information between the different stakeholders to enhance the development and transfer of environmentally sound technologies. This component of technology transfer framework provides information on technical parameters, economic and environmental aspects of environmentally sound technologies and opportunities for technology transfer. The technology transfer process requires a comprehensive and consistent set of information for different technologies. Such a set of data is broad and complex and includes a number of data compiled and stored in TT:CLEAR databases, which include Technology Transfer Projects (TTProjects), Environmental Sound Technologies (ESTs) and Technology Needs (TTNeeds).

The technology information system complements and works with existing web sites/clearing houses of other relevant international organizations and national/regional technology information centres (e.g. State Intellectual Property Office of the Republic of Croatia). It has the potential to act as a gateway for fast access to up-to-date information on the latest technology transfer projects, environmentally sound technologies and know-how, and organizations and experts involved in the development and transfer of technologies. It includes a search engine which enables users to access distributed sources of information such as UNFCCC, OECD, IEA and UNEP databases, performs conversions between different classifications used by these sources, and presents integrated results. The system can be used to access information on ongoing technology cooperation projects by countries, sectors of activity or technology type, to browse technical characteristics, economic performance and environmental parameters of different technologies, to locate possible partners or to locate experts to provide support. They may also perform side-by-side comparisons of different technologies stored in the database.

Enabling environment for technology transfer includes macroeconomic conditions, the involvement of social organisations, national institutions for technology innovation, human and institutional capacities for selecting and managing technologies, the underpinnings of sustainable markets for environmentally sound technologies, national legal institutions that reduce risk and protect intellectual property rights, codes and standards, research and technology development, and the means for addressing equity issues and respecting existing property rights.

The enabling environment component of the framework focuses on government actions, such as fair trade policies, removal of technical, legal and administrative barriers to technology

transfer, sound economic policy, regulatory frameworks and transparency. The purpose of the enabling environments component of the framework is to improve the effectiveness of the transfer of environmentally sound technologies.

The enabling environment for the transfer of environmentally sound technologies could be improved through the identification and removal of barriers, including strengthening environmental regulatory frameworks, enhancing legal systems, ensuring fair trade policies, utilizing tax preferences, protecting intellectual property rights and improving access to publicly funded technologies and other programmes. Joint research and development programmes and implementation of facilitative measures (e.g. export credit programmes and tax preferences, and regulations) promote the transfer of these technologies. Objectives of technology transfer need to be integrated into national policies, including environmental, research and development policies and programmes.

Capacity building will focus on building human, organizational and information capacity.

Human resource capacity building will focus on training and human resource development, keeping informed of relevant technical literature; forming links with other enterprises, professional and trade organizations, and research institutions; learning by doing-operational experience (twinning arrangements with other firms and institutions).

Organizational capacity building will focus on developing firms for publishing and provision of communication, access to and transfer of information (Internet services); encouragement of industry associations, professional associations and user/consumer organizations; participatory approaches to enable private actors, public agencies and NGO's to engage at all levels of environmental policy-making and project formulation; decentralization of governmental decision making and authority.

Information capacity will focus on developing improved indicators and collecting data on availability, quality and flows of ESTs; developing technology performance benchmarks for ESTs; improving information systems and linking them to international or regional networks.

Mechanisms for technology transfer are National Systems of Innovation (NSI), Official Development Assistance (ODA), The Global Environment Facility (GEF), The Multilateral Development Banks (MDB), The Kyoto Protocol mechanisms and EU Technical Assistance Programmes (e.g. CARDS, ISPA, LIFE).

NSI activities include targeted capacity building, information access and training for public and private stakeholders and support for project preparation; strengthening scientific and technical educational institutions in the context of technology needs; collection and assessment of specific technical, commercial, financial and legal information; identification and development of solutions to technical, financial, legal, policy and other barriers to wide deployment of ESTs; technology assessment, promotion of prototypes, demonstration projects and extension services through linkages between manufacturers, producers and end users; innovative financial mechanisms such as public/private sector partnerships and specialised credit facilities; local and regional partnerships between different stakeholders for the transfer, evaluation and adaptation to local conditions of ESTs; market intermediary organisations, such as Energy Service Companies.

ODA is focus on bilateral aid provided by donor governments to address a sound policy environment, strong investment in human capital, well functioning institutions and governance systems and environmental sustainability.

GEF has leveraged financing through loans and other resources from governments, other donor agencies, the private sector, and the three GEF project-implementing agencies: UN Development Programme, UN Environment Programme and World Bank Group.

MDB (The World Bank (WB), The European Bank for Reconstruction and Development (EBRD) can help to mobilise private capital to help meet the needs of sustainable development and the environment, and use financial innovation to encourage environmental projects and initiatives.

The Kyoto Protocol Mechanisms will affect the transfer of ESTs. The Clean Development Mechanism (CDM) and Joint Implementation (JI) can provide financial incentives for ESTs and influence technology choice.

EU Technical Assistance Programmes are pre-accession instruments financed by the European Union to assist the applicant countries of Central and Eastern Europe in their preparations for joining the European Union.

The purpose of **TT Action Plan** is to serve as a key policy document in stepping out from initial technology needs assessment phase towards concrete implementation of activities in technology transfer framework. From the perspective of Croatian commitments to Kyoto Protocol and planned economic growth, transfer of GHG mitigation technologies will play a crucial role in meeting Kyoto target. In that respect it is necessary that TT Action Plan defines all elements which are important for this process in terms of objectives, actions, responsibilities, indicators of success and expected results. It is also important to effectively integrate implementation of technology transfer activities with other relevant climate change mitigation programmes and stakeholder activities, particularly those which were identified in National Environment Action Plan (NEAP) and Priority Activities Plan (PAP). Overview of Projects related to Air and Climate Change are presented in Annex 5. Finally, to ensure continuation of activities related to technology transfer it is necessary to secure technical and financial support both from foreign donor organizations and domestic institutions.

Provisional Terms of Reference for TT Action Plan includes:

- *objectives and targets*, related to implementation of each priority mitigation measure in a form of specific, measurable, achievable and realistic goals;

- *scope of the actions*, that will be undertaken to achieve goals; it is important to indicate dependency of these actions in order to minimize redundancy;

- *participant's responsibilities*, should clearly define roles and responsibilities of each institutions which will be involved in technology transfer taking into account their available resources;

- *barriers*, identified in the TNA report should be further analyzed and solutions to overcome them have to be proposed;

- *duration of activities*, should define realistic timeframe of activities, completion date as well as milestones in their execution;

- *cost of actions*, an estimate of costs for implementation activities have to be presented;

- *progress indicators*, are monitoring tools which will provide evidence that objectives and targets are achieved and/or accomplished;

- *awaited results*, quantifiable outputs/deliverables of activities which are expected after activities are finished.

5. REFERENCESS

[1] Ministry of Environmental Protection and Physical Planning (2001) *The First National Communication of the Republic of Croatia to the United Nations Framework Convention on Climate Change (UNFCCC)*, Zagreb

[2] IPCC (2000) *IPCC Special Report: Methodological and Technological Issues in Technology Transfer*

[3] EKONERG (2005) National Inventory Report; *Inventory of Anthropogenic Emission by Sources and Removals by Sinks of All Greenhouse Gases not Controlled by Montreal Protocol*, Zagreb

[4] http://www.hrvatska21.hr/index.htm, *Development strategy project "Croatia in the 21st Century"*

[5] Ministry of Environmental Protection and Physical Planning (2002) *National Environmental Strategy; National Environmental Action Plan*, Zagreb

[6] EKONERG (2003) *Projections of Greenhouse Gas Emissions*, Zagreb

[7] EIHP (2001) *Energy related measures to greenhouse gas emission reduction*, Final Report, Zagreb

[8] UNDP/GEF (2003) *Handbook on Methodologies for Technology Needs Assessment*

[9] CTI (2002) *Methods for Climate Change Technology Transfer Needs Assessments and Implementing Activities: Experiences of Developing and Transition Countries*

[10] T.L. Saaty (2001) *Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World*, Third Edition, Pittsburgh

[11] CSIRO 2000, *Supporting Decision, Understanding Natural Resource Management Assessment Techniques*

[12] IPCC, Climate Change 2001, Working Group III: Mitigation; *Barriers, Opportunities, and Market Potential of Technologies and Practices*

[13] FCCC/TP/1998/1, *Barriers and Opportunities Related to the Transfer of Technology*

ANNEX 1 - Criteria Assessment

Table A1-1: Criteria rating

CRITERIA/CATEGORY		EXPERT																	M	Q1	Q3
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
I	**Development benefits**	3	3	5	5	7	7	-	8	7	5	4	-	6	-	9	9	5	5.5	5	7
II	**Implementation potential**	5	5	7	9	8	6	-	7	6	7	9	-	8	-	7	7	7	7	6	7
III	**Contribution to climate change response goals**	8	7	9	7	9	7	-	9	9	9	5	-	9	-	3	7	3	7.5	7	9
TOTAL		16	15	21	21	24	20	0	24	22	21	18	0	23	0	19	23	15			
I	**Development benefits**																				
1	Job creation	7	7	7	3	5	7	5	7	7	5	4	3	3	5	7	9	2	5	4	7
2	Capacity building (production, know-how)	6	8	6	3	7	7	6	5	6	5	4	5	5	5	7	7	7	6	5	7
3	Economic structure change according to Croatia export orientation	5	2	5	5	6	6	4	6	6	5	1	5	3	3	7	9	1	5	3	6
4	Agriculture security	3	5	5	1	5	6	3	9	7	3	3	7	7	3	9	3	3	5	3	7
TOTAL		21	22	23	12	23	26	18	27	26	18	12	20	18	16	30	28	13			
II	**Implementation potential**																				
1	Marginal cost	8	9	8	7	8	7	8	7	8	9	8	9	9	9	5	3	7	8	7	9
2	Commercial readiness	5	6	7	9	9	6	7	6	7	7	6	3	8	7	5	5	7	7	6	7
3	Technology availability	5	7	6	3	7	7	7	8	6	7	7	5	6	7	3	5	7	7	5	8
4	Measure applicability	4	5	5	3	6	9	7	8	6	8	9	7	8	7	3	3	5	6	5	8
TOTAL		22	27	26	22	30	29	29	29	27	31	30	24	31	30	16	16	26			
III	**Contribution to climate change response goals**																				
1	GHG emission reduction potential / enhancement of CO_2 sinks	9	9	9	9	8	9	9	9	9	9	5	9	9	9	7	9	3	9	9	9
2	Indirect effect on the other air pollutants emission reduction	7	5	7	7	7	8	8	9	8	8	5	3	8	7	5	9	3	7	5	8
3	Conservation of energy	6	7	8	7	8	9	8	9	9	9	5	9	9	7	5	7	5	8	7	9
TOTAL		22	21	24	23	23	26	25	27	26	26	15	21	26	23	17	25	11			

M – Median
Q1 – First quartile
Q3 – Third quartile

Table A1-2: Relative importance of criteria (%)

CRITERIA/CATEGORY		EXPERT																	A	N	M	Q1	Q3
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17					
I	**Development benefits**	19	20	24	24	29	35	-	33	32	24	22	-	26	-	47	39	33	29	29	28	24	33
II	**Implementation potential**	31	33	33	43	33	30	-	29	27	33	50	-	35	-	37	30	47	35	35	33	30	36
III	**Contribution to climate change response goals**	50	47	43	33	38	35	-	38	41	43	28	-	39	-	16	30	20	36	36	38	30	42
TOTAL		100	100	100	100	100	100	100	0	100	100	100	100	0	100	0	100	100	100	100			
I	**Development benefits**																						
1	Job creation	33	32	30	25	22	27	28	26	27	28	33	15	17	31	23	32	15	26	8	27	23	31
2	Capacity building (production, know-how)	29	36	26	25	30	27	33	19	23	28	33	25	28	31	23	25	54	29	8	28	25	31
3	Economic structure change according to Croatia export orientation	24	9	22	42	26	23	22	22	23	28	8	25	17	19	23	32	8	22	6	23	19	25
4	Agriculture security	14	23	22	8	22	23	17	33	27	17	25	35	39	19	30	11	23	23	7	23	17	27
TOTAL		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	29			
II	**Implementation potential**																						
1	Marginal cost	36	33	31	32	27	24	28	24	30	29	27	38	29	30	31	19	27	29	10	29	27	31
2	Commercial readiness	23	22	27	41	30	21	24	21	26	23	20	13	26	23	31	31	27	25	9	24	22	27
3	Technology availability	23	26	23	14	23	24	24	28	22	23	23	21	19	23	19	31	27	23	8	23	22	24
4	Measure applicability	18	19	19	14	20	31	24	28	22	26	30	29	26	23	19	19	19	23	8	22	19	26
TOTAL		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	35			
III	**Contribution to climate change response goals**																						
1	GHG emission reduction potential / enhancement of CO_2 sinks	41	43	38	39	35	35	36	33	35	35	33	43	35	39	41	36	27	37	13	36	35	39
2	Indirect effect on the other air pollutants emission reduction	32	24	29	30	30	31	32	33	31	31	33	14	31	30	29	36	27	30	11	31	29	32
3	Conservation of energy	27	33	33	30	35	35	32	33	35	35	33	43	35	30	29	28	45	34	12	33	30	35
TOTAL		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	36			

A (%) – Average importance
N (%) – Normalization
M (%) – Median
Q1 (%) – First quartile
Q3 (%) – Third quartile

ANNEX 2 - Evaluation Matrix

Table A2-1: Evaluation matrix

MEASURE		CRITERIA											
		I category				II category			III category				TOTAL
		I1	I2	I3	I4	II1	II2	II3	III1	III2	III3	III4	
ENERGY SECTOR													
a) Power Generation Sector													
1	Savings in Power Transport and Distribution	1	1	2	1	3	4	4	2	2	2	1	2.00
2	Wind Power Plants	5	5	5	3	3	5	3	3	3	2	2	3.75
3	Small Hydro Power Plants	2	1	2	3	3	5	3	4	3	2.5	2	2.67
4	Biomass in Cogeneration Plants	4	3	3	3	3	5	3	4	3	4	2	3.38
b) Industry													
1	Motor Drives Regulation	1	1	1	3	3	4.5	4	2.5	2	2	2	2.23
2	Cogeneration Plants	2	1	2	4	3	5	4	3	3	2	2	2.73
3	Low-Temp. Heat Generation Efficiency Increase	2	2	4	2	3	3.5	3.5	2.5	2	2.5	2	2.63
4	High-Temp. Heat Generation Efficiency Increase	2	2	2	1	3	3.5	3.5	2.5	2	2	2	2.27
c) Transport													
1	Interurban Passenger Transport	1	1	1	3	2	4	4	2	2	2	1	2.00
2	Urban Passenger Transport	1	1	1	3	2.5	4	3	2	2	2	1	1.97
3	Freight Transport	1	1	1	3	2	5	4	2	2	2	1.5	2.11
4	Increase in Biodiesel Use	3	2	3	3	3	4.5	4	4	4	4	4	3.37
d) Services and Residential													
1	Demand Side Management (DSM) Measures	1	1	1	5	4	4.5	4.5	3	2	2	2	2.60
2	Solar Energy Use Increase	2	2	3	5	3	4	3	3.5	3	2	3	3.00
3	Geothermal Energy Use Increase	1	1	1	4	2	3	2	3	2	2	2	2.00
4	District Heating and Cogeneration Use Increase	2	2	2	4	3	5	3	3	3	2	2	2.77
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	4	4	4	1	4	4	4	4	3	2	3	3.42
6	Biomass in Heating Plants	4	4	3	3	3	5	3	4	3	3.5	3	3.53
WASTE													
1	Thermal Processing of Waste with Energy Utilization	4	3	3	3	3	4	3	4	3	2	2	3.16
INDUSTRIAL PROCESSES													
a) Nitric Acid Production													
1	Non-Selective Catalytic Reduction	5	3	3	4	2	4	4	2	2	2	2	3.14
b) Cement Production													
1	Increase in Energy Efficiency of the Clinker Production Process	2	3	3	3	3	5	4	3	2	2	2	2.90
2	Switching to Fuel with Lower Carbon Content	3	3	3	3	2	5	3	2	1	2	2	2.70
3	Decrease of Clinker Percentage in Cement	3	3	3	3	2	3	3	2	1	2	2	2.54
4	Use of Waste as Alternative Fuel	3	3	3	3	3	4	4	3	2	2	2	2.95
AGRICULTURE													
1	Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction	3	3	3	3	3	3	3	3	2	4	2	2.93
2	Reduction in CH_4 Emission by Decreased Fermentation	2	2	1	3	2	3	3	2	2	4	2	2.29
3	Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation	3	4	3	3	2	3	3	3	2	4	2	2.96
4	Carbon Storage in Agricultural Soil	4	2	2	4	1	2	2	3	2	4	2	2.59
FORESTRY													
1	Reforestation of Productive Bare Forestland	4	2	1	4	3	5	4	3	2	3	2	2.99
2	Increase in Forestland Surface to be Cared by Thinning	3	2	1	3	3	5	4	2	2	3	2	2.68
3	Including of Complete Second Age Class Forests (all the forests 20-40 years of age) into the Thinning	3	2	1	3	3	5	4	2	2	3	2	2.68
4	Planting Pioneer Wood Species on the Degraded Forests	2	2	1	3	4	4	3	2	2	3	2	2.48
5	Improvement in Wood Utilization Efficiency and Increase in Harvesting	3	2	1	3	3	4	4	3	2	2	2	2.61

Table A2-2: Quantitative classes for first (I) criteria category

CRITERION	I1	I2	I3	I3	I4
SCORE	**CO_2-eq (kt)**	**FUEL SAVINGS (PJ)**	**SO_2 EMISSION REDUCTION (t)**	**NO_x EMISSION REDUCTION (t)**	**MARGINAL COST (US$/t$CO_2$)**
1	< 50.0	<1.0	< 100.0	< 50.0	>30.0
2	50.0-150.0	1.0-2.0	100.0-300.0	50.0-150.0	20.0-30.0
3	150.0-250.0	2.0-3.0	300.0-600.0	150.0-300.0	10.0-20.0
4	250.0-350.0	3.0-4.0	600.0-1000.0	300.0-500.0	0-10.0
5	>350.0	>4.0	>1000.0	>500.0	negative

Table A2-3: Qualitative classes for second (II) and third (III) criteria categories

SCORE	II / III criteria categories
1	without / extremely weak performance
2	poor performance
3	good performance
4	very good performance
5	clearly outstanding performance

ANNEX 3 - Sensitivity Analysis

Table A3-1: Influence of criterion I1 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.10
2	Biomass in Heating Plants	3.01
3	Increase in Biodiesel Use	2.98
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	2.90
5	Biomass in Cogeneration Plants	2.86

Table A3-2: Influence of criterion I2 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.15
2	Increase in Biodiesel Use	3.13
3	Biomass in Heating Plants	3.05
4	Biomass in Cogeneration Plants	3.02
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	2.94

Table A3-3: Influence of criterion I3 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants*	3.20
2	Biomass in Heating Plants	3.20
3	Biomass in Cogeneration Plants	3.05
4	Increase in Biodiesel Use	3.04
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	2.98

Table A3-4: Influence of criterion I4 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.45
2	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.32
3	Biomass in Heating Plants	3.23
4	Biomass in Cogeneration Plants	3.08
5	Increase in Biodiesel Use	3.07

Table A3-5: Influence of criterion II1 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.48
2	Biomass in Heating Plants	3.26
3	Biomass in Cogeneration Plants	3.11
4	Increase in Biodiesel Use	3.10
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.06

Table A3-6: Influence of criterion II2 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.35
2	Biomass in Heating Plants	3.13
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.10
4	Increase in Biodiesel Use	3.01
5	Biomass in Cogeneration Plants	2.98

Table A3-7: Influence of criterion II3 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.51
2	Biomass in Heating Plants	3.29
3	Biomass in Cogeneration Plants	3.14
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.10
5	Increase in Biodiesel Use	3.05

Table A3-8: Influence of criterion III1 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.51
2	Biomass in Heating Plants	3.21
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.10
4	Biomass in Cogeneration Plants	3.06
5	Increase in Biodiesel Use	3.05

Table A3-9: Influence of criterion III2 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.51
2	Biomass in Heating Plants	3.29
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.18
4	Biomass in Cogeneration Plants	3.14
5	Increase in Biodiesel Use	3.05

Table A3-10: Influence of criterion III3 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.61
2	Biomass in Heating Plants *	3.28
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.28
4	Biomass in Cogeneration Plants	3.10
5	Increase in Biodiesel Use	3.09

Table A3-11: Influence of criterion III4 on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.63
2	Biomass in Heating Plants	3.35
3	Biomass in Cogeneration Plants	3.26
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.24
5	Increase in Biodiesel Use	3.13

Table A3-12: Influence of I criteria category on the measure priority

RANK	MEASURE	FINAL SCORE
1	Increase in Biodiesel Use	2.11
2	Biomass in Heating Plants	1.90
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	1.88
4	Biomass in Cogeneration Plants	1.87
5	Small Hydro Power Plants	1.77

Table A3-13: Influence of II criteria category on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	2.84
2	Biomass in Heating Plants	2.62
3	Biomass in Cogeneration Plants	2.47
4	Increase in Biodiesel Use *	2.42
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	2.42

Table A3-14: Influence of III criteria category on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.01
2	Non-selective Catalytic Reduction	2.56
3	Biomass in Heating Plants*	2.54
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	2.54
5	Biomass in Cogeneration Plants	2.42

Table A3-15: Influence of II + III criteria categories on the measure priority

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	2.10
2	Non-selective Catalytic Reduction	1.74
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	1.54
3	Biomass in Heating Plants	1.63
5	Thermal processing of waste with energy utilization and Biomass in Cogeneration Plants	1.51

Table A3-16: Priority five measures by Expert 01

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.80
2	Biomass in Heating Plants	3.47
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.40
4	Biomass in Cogeneration Plants	3.29
5	Non-selective Catalytic Reduction	3.13

Table A3-17: Priority five measures by Expert 02

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.64
2	Increase in Biodiesel Use	3.61
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.51
4	Biomass in Cogeneration Plants	3.34
5	Solar energy use Increase	3.31

Table A3-18: Priority five measures by Expert 03

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.84
2	Non-Selective Catalytic Reduction	3.41
3	Biomass in Heating Plants	3.30
4	Biomass in Cogeneration Plants	3.18
5	Use of Waste as Alternative Fuel	3.15

Table A3-19: Priority five measures by Expert 04

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.66
2	Non-Selective Catalytic Reduction	3.42
3	Insulation Improvement and Energy Efficiency in Buildings and Construction *	3.30
4	Biomass in Cogeneration Plants *	3.30
5	Biomass in Heating Plants	3.30

Table A3-21: Priority five measures by Expert 05

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.80
2	Biomass in Heating Plants	3.47
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.40
4	Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction	3.33
5	Biomass in Cogeneration Plants	3.29

Table A3-22: Priority five measures by Expert 06

RANK	MEASURE	FINAL SCORE
1	Non-selective Catalytic Reduction	3.55
2	Increase in Biodiesel Use	3.54
3	Biomass in Cogeneration Plants	3.52
4	Biomass in Heating Plants	3.48
5	Reforestation of Productive Bare Forestland	3.39

Table A3-20: Priority five measures by Expert 07

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.99
4	Biomass in Cogeneration Plants	3.36
5	Solar Energy Use Increase	3.34
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.56
2	Biomass in Heating Plants	3.64

Table A3-23: Priority five measures by Expert 08

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.66
2	Thermal Processing of Waste with Energy Utilization	3.64
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.52
4	Biomass in Heating Plants	3.44
5	Solar Energy Use Increase	3.31

Table A3-24: Priority five measures by Expert 09

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.54
2	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.30
3	Non-Selective Catalytic Reduction	2.91
4	Switching to Fuel with Lower Carbon Content	2.89
5	Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation	2.89

Table A3-25: Priority five measures by Expert 10

RANK	MEASURE	FINAL SCORE
1	Biomass in Heating Plants	3.61
2	Wind Power Plants	3.54
3	Biomass in Cogeneration Plants	3.51
4	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.18
5	Thermal Processing of Waste with Energy Utilization	3.17

Table A3-26: Priority five measures by Expert 11

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	4.34
2	Biomass in Cogeneration Plants	3.96
3	Biomass in Heating Plants	3.94
4	Thermal Processing of Waste with Energy Utilization	3.60
5	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.49

Table A3-27: Priority five measures by Expert 12

RANK	MEASURE	FINAL SCORE
1	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.67
2	Wind Power Plants	3.66
3	Biomass in Cogeneration Plants	3.64
4	Increase in Biodiesel Use *	3.54
5	Improvement in Application of Organic and Mineral Fertilizers Aimed at N_2O Emission Reduction	3.54

Table A3-28: Priority five measures by Expert 13

RANK	MEASURE	FINAL SCORE
1	Wind Power Plants	3.59
2	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.35
3	Increase in Biodiesel Use *	3.22
4	Thermal processing of waste with energy utilization	3.22
5	Biomass in Cogeneration Plants	3.11

Table A3-29: Priority five measures by Expert 14

RANK	MEASURE	FINAL SCORE
1	Biomass in Cogeneration	3.46
2	Biomass in Heating Plants	3.44
3	Wind Power Plants	3.42
4	Use of Waste as Alternative Fuel	3.27
5	Thermal Processing of Waste with Energy Utilization	3.25

Table A3-30: Priority five measures by Expert 15

RANK	MEASURE	FINAL SCORE
1	Biomass in Heating Plants	3.83
2	Wind Power Plants	3.82
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.44
4	Increase in Biodiesel Use	3.34
5	Biomass in Cogeneration Plants	3.29

Table A3-31: Priority five measures by Expert 16

RANK	MEASURE	FINAL SCORE
1	Biomass in Heating Plants	3.98
2	Wind Power Plants	3.90
3	Insulation Improvement and Energy Efficiency in Buildings and Construction	3.82
4	Solar Energy Use Increase	3.75
5	Biomass in Cogeneration Plants	3.48

Table A3-32: Priority five measures by Expert 17

RANK	MEASURE	FINAL SCORE
1	Biomass in Heating Plants	3.82
2	Anaerobic Fermentation Related to Decomposition of Organic Manure and Biogas Generation	3.69
3	Wind Power Plants	3.50
4	Increase in Biodiesel Use	3.45
5	Solar Energy Use Increase	3.43

* Measure with more number of highest final score.

ANNEX 4 - Barriers Assessment

Table A4-1: Barriers assessment

BARRIERS		SECTORAL AVERAGE ASSESSMENT			TOTAL AVERAGE
		ENERGY EFFICIENCY	AGRICULTURE FORESTRY	WASTE MANAGEMENT	
FINANCIAL	High cost of new technologies, unsuitability to host conditions	2.75	3.90	3.65	3.43
	Lack of investment capital	2.75	3.60	3.69	3.35
	Lack of financing instruments	3.00	3.25	3.77	3.34
LEGAL INSTITUTIONAL ORGANISATIONAL	Lack of legal and regulatory framework	4.44	4.55	4.31	4.43
	Weak connection among different stakeholders	4.44	3.90	3.65	4.00
	Limited institutional capacity, management and organisational experience	4.11	3.80	3.88	3.93
TECHNOLOGICAL	Low technical capabilities and lack of technology knowledge base, inability to assess, select and adapt appropriate technologies	3.13	3.72	3.27	3.37
	Lack of infrastructure	2.25	3.84	3.46	3.18
	Lack of technological standards and institutions for supporting the standards	2.63	3.47	3.42	3.17
ECONOMIC	Inflation	3.22	3.43	3.06	3.24
	Economic instability	2.38	3.40	3.37	3.05
	Disturbed or non-transparent markets	1.38	2.94	2.44	2.25
POLITICAL	Corruption	3.57	3.10	3.50	3.39
	Political instability	2.63	3.40	3.31	3.11
	Interventions in domestic market (subsidies, encouragements, fees)	2.25	3.60	3.13	2.99
INFORMATION	Lack of technical information	2.75	4.11	3.27	3.37
	Lack of demonstrated track record for many EST	2.63	3.68	3.65	3.32
	Lack of financial information	2.25	3.37	3.15	2.92
SOCIAL	Lack of awareness and social acceptance, insufficient understanding of the advantage of new technologies, social biases	3.75	3.95	3.94	3.88
	Lack of confidence in the economic, commercial and technical viability of technologies	3.33	3.30	3.56	3.40
	Consumer preferences	2.86	3.65	3.33	3.28

ANNEX 5 - Projects Related to Air and Climate Changes

PAP No.:22
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: I
PROJECT TITLE**: DEVELOPMENT OF THE NATIONAL AIR QUALITY PROTECTION STRATEGY AND ACTION PLAN**
Responsible institution: Ministry of Environmental Protection and Physical Planning
Project status: Project has not been started
Estimated cost: US $430 000
Estimated duration: 2 years
Possible sources of financing: State budget, International funds
Description /What is requested from donors: Determination of measures, method of organizing and implementing air quality protection. The international obligations and domestic legal obligations require an urgent drafting of the air protection strategy, which should, starting from the social objectives and requirements and taking into considerations the economic, environmental, cultural and other values, establish and elaborate action plans by specific sectors (climate changes, acidification, euthrophication, ground-level ozone, air quality in the populated and unpopulated areas). The technical and financial assistance in drafting the strategy and action plan is requested from donors.
Contact : Andelka Bedrica, MoEPPP (a.bedrica@mzopu.hr, tel.+385 1 610 6556)

PAP No.:23
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: I
PROJECT TITLE**: DEVELOPMENT OF THE NEEDED CAPACITIES FOR THE IMPLEMENTATION OF THE CLIMATE PROGRAMME**
Responsible institution: Ministry of Environmental Protection and Physical Planning
Project status: Project is in preparation
Estimated cost: US $2 290 000
Estimated duration: 2-3 years
Possible sources of financing: International funds, State budget
Description /What is requested from donors: Development of the capacities needed for establishment and implementation of the climate program in accordance with the national report on the climate change in order to meet the obligations which Croatia has under the Kyoto Protocol.
- Development of national system for emission calculation (500,000-LIFE Third Countries application under project titled
"Reconstruction of national emission inventory system and inforcement of its implementation")
- Emission register (50,000-UNDP/GEF Regional project on capacity building of emission inventory improvement.)
- Evaluation study for the needed capacity and climate program feasibility (50,000- UNDP/GEF expedite financing under Enabling Activity 40-50,000)
- Technical background for the preparation of laws, guidebooks, normative acts (100,000)
- Climate program operation plan (50,000)
- Detailed capacity estimation and mapping (biomass, wind, small hydropower plants, energy efficiency, waste) (400,000)
- Development of background material for projects with the most promising measures (project identification, selection of sites, emission measurements, conceptual designs, environmental impact studies, feasibility studies, socio-economic analyses) (500,000)
- Database of potential projects and projects in realization, information on technologies (40,000)
- Public awareness campaigns development (150,000)

- Planning policy and measures (expert training, technical assistance visits, planning models, climate impact models, climate scenario, monitoring system) (300,000)
- Support in preparation of the project documentation (100,000) Technical and financial assistance for the development of capacities and providing a stimulus for the development of projects and starting a demonstration and pilot facilities is requested from donors. Necessary funding for project preparation and design - US $90 000

Activities: For some activities international financing is expected:
- Development of national system for emission calculation
- Emission register
- Evaluation study for the needed capacity and climate program feasibility

Contact : MoEPPP (tel.+385 1 3782 444, fax. +385 1 3772 822)

PRIORITY ACTION PLAN PROJECTS January, 2002

Cornelis Klein, UNDP/GEF, UNDP Resident Office, Ilica 207 (tel. +385 1 3712 635)

COMPONENT 1: 23a

PROJECT TITLE: RECONSTRUCTION OF NATIONAL EMISSION INVENTORY SYSTEM AND ENFORCEMENT OF ITS IMPLEMENTATION (LIFE THIRD COUNTRIES APPLICATION)

Responsible institution: Ekonerg holding, Ministry of Environmental Protection and Physical Planning

Project status: Project has started

Estimated cost: 575 000 EUR

Estimated duration: 30 months

Possible sources of financing: International financing, State budget

Description /What is requested from donors: National Emission Inventory System will facilitate development of the sustainable environmental policy on national, sectorial and local levels. It will help Croatia's efforts to be in compliance with international commitments, particularly to UNECE and UNFCCC convention. It will also enhance capabilities for stockholders involvement in the process of creating environmental policy, by disseminating knowledge and providing adequate and on-time information on environmental pressures.

Donor (interested institution): European Commission; DG Environment – LIFE Third Countries

Implementing institution: Ekonerg holdnig

Amount (requested / approved): Approved LIFE contribution: 398 000 EUR

Contact : Ekonerg holding, Ulica grada Vukovara 37 (00385 1 6717 289)

COMPONENT 2: 23b

PROJECT TITLE**: CAPACITY BUILDING FOR IMPROVING THE QUALITY OF GREENHOUSE GAS INVENTORIES (EUROPE/CIS REGION)**

Responsible institution: Ekonerg holding, Ministry of Environmental Protection and Physical Planning

Project status: Project has started

Estimated cost: US $3 257 100 (whole region)

Estimated duration: 3 years

Description /What is requested from donors: Regional. The project will initiate a regional programmatic approach developed to build capacity for improving the quality of data inputs to national greenhouse gas inventories, using the good practice guidance of the Intergovernmental Panel for Climate Change for cost-effectiveness. The project will build on the expertise gained during the preparation of the initial National Communications. By strengthening institutional capacity to prepare inventories and establishing a trained, sustainable inventory team, the project will help countries to reduce uncertainties and improve the quality of inventories for Second National Communications.

Donor (interested institution): GEF / UNDP

Implementing institution: UNOPS

Amount (requested / approved): Regional program. For Croatia: 345 000 + 100 000 (top up) -Enabling Activity, 85 000 – Inventory

Contact: Ekonerg holding, Ulica grada Vukovara 37 (00385 1 6717 289)

PAP No.: 24
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: I
PROJECT TITLE**: MODELS OF BIO-DIESEL FUEL PRODUCTION – PILOT PROJECT**
Responsible institution: Ministry of Agriculture and Forestry (project management – Agricultural College, University of Zagreb)
Project status: Feasibility study has been completed
Estimated cost: US $3 032 000
Estimated duration: 2 years
Possible sources of financing: State budget, International financing, Local financing
Description /What is requested from donors: The fulfillment of obligations ensuing from the international agreements requires a considerable decrease in transport emissions and a gradual introduction of the environmentally acceptable fuels such as BIO-DIESEL. The feasibility study on starting a bio-diesel production in Croatia is being drafted. There is also the interest of Croatian Oil Company INA to start producing bio-diesel. It is necessary to draft documentation for the entire bio-diesel production chain and the establishment of the system of economic, financial, technical, administrative and other measures in the state. The expert, technical and financial assistance for evaluation of feasibility, preparation of documents and the establishment of the demonstration plant for production of bio-diesel fuel is requested from donors.
Activities: Biodiesel Production Feasibility Study has been elaborated. Following step – construction of the demonstration plant for the production of biodiesel fuel at the co-operative farm of Osatina-Semeljci, Osjecko-baranjska County
Contact: Ms.Tajana Kricka, Agricultural College, Department for Agricultural Technology, Storing and Transporting (tel.+385 2393 813)

PAP No.: 25
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: II
PROJECT TITLE**: INCENTIVE MEASURES FOR THE REALISATION OF NATIONAL ENERGY PROGRAMMES: SUEN, BIOEN, ENWIND, GEOEN AND MAHE**
Responsible institution: Ministry of Economy, Ministry of Environmental Protection and Physical Planning
Project status: Project applied for funding
Estimated cost: US $1 000 000 per program
Estimated duration: 2 years per program
Possible sources of financing: International financing
Description/What is requested from donors: The fulfillment of obligations ensuing from the international agreements requests a considerable decrease in emissions from the energy sector and a gradual introduction of renewable energy resources. Croatia has great possibilities for the production of energy from different renewable resources, but also certain obstacles in increasing that share, i.e. economic, legislative, development, financial, institutional, organizational and technical problems. A drafting of complete documentation and the establishment of system of economic, financial, technical, administrative and other measures is needed. The expert, technical and financial assistance for starting the demonstration pilot projects to introduce certain types of renewable resources in the country is requested from donors.
Activities: The projects have been submitted to the GEF within the "Renewable Energy Resources Projects". The project is in preparation for application to GEF PDF-B fund.
Contact: Energy Institute „Hrvoje Požar“, Savska 163, Zagreb (tel. +385 1 6326 100)

PAP No.:26
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: II
PROJECT TITLE**: INCENTIVE MEASURES FOR THE IMPROVEMENT OF ENERGY EFFICIENCY IN SERVICES AND HOUSEHOLDS: CONSUMERS SAVING MEASURES, INSULATION IMPROVEMENT, CONSTRUCTION, CENTRALISED HEATING SYSTEMS (ENERGY PROGRAMS: KUENZGRADA, KUEN CTS)**
Responsible institution: Ministry of Economy; Ministry of Environmental Protection and Physical Planning
Project status: Technical documentation for project implementation is in preparation
Estimated cost: US $ 7 800 000
Estimated duration: 4 years
Possible sources of financing: HEP (Hrvatska Elektroprivreda), International financing
Description/What is requested from donors: There is a lack of adequate legislation, financing measures and technical capacity for energy efficiency program implementation.
It is necessary to eliminate obstacles for chosen economically most appropriate energy efficiency measures for households and services in Croatia with the aim of consumption reduction and greenhouse gas emission reduction. Expert, technical and financial assistance for implementation of the project for which Rijeka and Istria will be taken as pilot sites is requested from donors.
Donor (interested institution): GEF
Implementing institution: Energy Institute „Hrvoje Požar“
Amount (requested / approved): Approved - US $4 400 000
Activities: The project has been approved by GEF (4,4 m USD). Technical documentation for project implementation financed by UNDPGEF is being prepared. Follow up of the project and its expansion to other areas is expected in the frame of WB-GEF "Energy Efficiency of Croatia".
Contact: Energy Institute „Hrvoje Požar“, Savska 163, Zagreb (tel. +385 1 6326 100)

PAP No.: 27
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: II
PROJECT TITLE**: STIMULATION OF CO-GENERATION DEVELOPMENT, GASIFICATION AND ENERGY EFFICIENCY IMPROVEMENT IN INDUSTRY (NATIONAL ENERGY PROGRAMS: KOGEN, PLINCRO, MIEE)**
Responsible institution: Ministry of Economy
Project status: Project applied for funding
Estimated cost: US $1 000 000
Estimated duration: 5 years
Possible sources of financing: International financing
Description /What is requested from donors:T he lack of adequate legislation and a cost policy are basic obstacles in the implementation of this incitement measure. The regulations that will enable the increased construction of the co-generation facilities in all the plants where heat or electric energy is used in the technological process or the process of heating and cooling, a feasibility study and a study on the implementation of incentive measures need to be drafted and adopted. The expert, technical and financial assistance in starting a demonstration pilot project in a settlement and in the construction of new cogeneration facilities is requested from donors.
Donor (interested institution): GEF (“Renewable Energy Resources Projects”)
Implementing institution: Energy Institute „Hrvoje Požar“
Activities: The projects have been submitted to the GEF within the "Renewable Energy Resources Projects".
Contact: Energy Institute „Hrvoje Požar“, Savska 163, Zagreb (tel. +385 1 6326 100)

PAP No.:28Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: II
PROJECT TITLE**: REDUCTION OF PARTICLES EMISSIONS IN FUEL OIL FIRED THERMAL POWER PLANTS BY**
INSTALLATION OF ELECTROSTATIC PRECIPITATORS
Responsible institution: HEP (Hrvatska Elektroprivreda)
Project status: Project is in preparation
Estimated cost: US $96 700 000
Estimated duration: Until 2004
Possible sources of financing: HEP, International financing
Description /What is requested from donors: The installation of electrostatic precipitatiors for the reducion of particles emissions in thermal power plants EL-T, TE-TO, TPP Sisak and TE-TO Osijek with the efficiency rate of at least 95 percent. Emission measurements show that the particles emission limit values have been exceeded in thermal power plants EL-TO, TE-TO, TPP Sisak and TE-TO Osijek. The installation of electrostatic precipitators will reduce particle emissions to the level significantly lower than the stipulated one, thus reducing significant heavy metals emissions. Expert, technical and financial aid is required for project implementation.
Donor (interested institution): "Japan Environmental Consultants" Ltd. and TEPSCO (Tokyo Electric Power Services Ltd.)
Activities: The Study on the Estimated Potential for Emission Reduction with Rough Cost Estimate has been prepared. Representatives of the "Japan Environmental Consultants" Ltd. and TEPSCO (Tokyo Electric Power Services Ltd.) undertook a preliminary survey in October/'01 on the possibility for the improvement in power generation efficiency and reduction in emissions at several power plants of HEP and recommended the following projects to be proposed as Feasibility Study to JBIC (Japan Bank for International Cooperation) or Ministry of Economic and Industry in next year: (Feasibility Study on Velika Gorica Combined Cycle Cogeneration Project, Feasibility Study on Block 3 Combined Cycle Power Plant Project at TE Sisak and Feasibility Study on TE Sisak and TE Rijeka for improving operations and lessening emissions of SO2, Nox and particles according to new air protection legislation.
Contact: Zoran Stanic, HEP-Development Department (tel.+385 1 6322 857, zoran.stanic@hep.hr)
Note / link: Link PAP 29

PAP No.: 29
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: II
PROJECT TITLE**: REDUCTION OF NOX EMISSIONS IN FUEL OIL FIRED THERMAL POWER PLANTS BY PRIMARY TECHNICAL MEASURES**
Responsible institution: HEP (Hrvatska elektroprivreda)
Project status: Project is in preparation
Estimated cost: US $19 100 000
Estimated duration: Until 2004
Possible sources of financing: HEP, International financing
Description /What is requested from donors: The reconstruction and upgrading of firing systes in fuel oil fired thermal power plants TPP Rijeka (310 MW) and on the K3 boiler in TE-TO Zagreb (120 MW) aimed at NOx reduction by 30 to 40 percent. The measurements show that at the rated capacity of TPP Rijeka limit emission values are being exceeded by 40 percent, and at the boiler 3 in the TE-TO Zagreb by 11 percent. Emission control will be achieved by the application of, so called, primary measures such as low NOx burners, OFA combustion, phased combustion, air re-circulation and other by 30 to 40 percent. Expert, technical and financial aid is required for project implementation.

Donor (interested institution): "Japan Environmental Consultants" Ltd. and TEPSCO (Tokyo Electric Power Services Ltd.)
Activities: The Study on the Estimated Potential for Emission Reduction with Rough Cost Estimate has been prepared. Representatives of the "Japan Environmental Consultants" Ltd. and TEPSCO (Tokyo Electric Power Services Ltd.) undertook a preliminary survey in October/'01 on the possibility for the improvement in power generation efficiency and reduction in emissions at several power plants of HEP and recommended the following projects to be proposed as Feasibility Study to JBIC (Japan Bank for International Cooperation) or Ministry of Economic and Industry in next year: (Feasibility Study on Velika Gorica Combined Cycle Cogeneration Project, Feasibility Study on Block 3 Combined Cycle Power Plant Project at TE Sisak and Feasibility Study on TE Sisak and TE Rijeka for improving operations and lessening emissions of SO2, Nox and particles according to new air protection legislation.
Contact: Zoran Stanic, HEP-Development Department (tel.+385 1 6322 857, zoran.stanic@hep.hr)
Note / link: Link PAP 28

PAP No.:30
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: I
PROJECT TITLE**: HYDROTREATING OF ATMOSPHERIC HEAVY GAS OIL / VACUUM GAS OIL, ATMOSPHERIC LIGHT GAS OIL AND DIESEL FUEL**
Responsible institution: INA – Refinery Sisak
Project status: Project has not started
Estimated cost (mil/US$): US $42 500 000
Estimated duration: Until 2004
Possible sources of financing: INA, State budget, International financing
Description /What is requested from donors: With an aim of complying with the national and the EU standards on the content of sulphur in fuels, those already in force and those that will be in force in 2000, and with the purpose of reducing the air pollution and within the overall modernization of facilities, the INA Refinery Sisak would like to realize the project of construction of treatment facility for hydrogen products, atmospheric light and heavy gas oils, vacuum gas oil and diesel fuel in order to remove sulphur, nitrogen and nonsaturated hydrocarbons.
Technical assistance and co-financing will be necessary in al Project phases.
Contact: Boris Cavrak, INA-Refinery Sisak (boris.cavrak@ina.hr, tel.+385 44 534 554

PAP No.:31
Area: Air and Climate Changes
Type: Legislative / institutional / organizational
Priority category: I
PROJECT TITLE**: REVAMP OF THE EXISTING HDS/MHC UNIT (BASED ON THE INA 2001 – 2010 DEVELOPMENT STRATEGY)**
Responsible institution**:** INA – Rijeka Oil Refinery
Project status**: Project is in preparation**
Estimated cost: US $173 000 000
Estimated duration: Until 2005
Possible sources of financing: INA, State budget, International financing
Description/What is requested from donors: Due to increasing severity of the fuel sulphur level requirements and enhanced demand for low sulphur fuels, the Rijeka Oil Refinery is already facing difficulties for the insufficient capacity of the hydrodesulphurization unit. Project objective is to meet both national and EU 2000 fuel sulphur

content standards in effect as well as those to be in-place by 2005. The first stage of the project would involve revamp of the existing HDS/MHC unit. The second stage foresees construction of and additional MHC unit. The project will enable Croatia and INA, as the Croatian national oil company; to meet the EU standards on the fluid oil fuels quality and hazardous emissions to the environment. Technical and financial assistance is required for reconstruction of the HDS/MHC unit, elaboration of technical documents for new MHC, hydrogen plant and sulphur production unit as well as for equipment procurement and plant construction. Necessary funds can not be made available from INA's own business operation, which necessitates involvement of international financial institution investments.

Activities: ABB Lummus Shevron Global Company is preparing an investment study "Modernization of the Rijeka and Sisak Refineries until 2005" including which the HDS/MHC will be covered. The investment study is necessary for ensuring of financial means for the construction of the MHC unit.

Contact: INA-Industrija nafte d.d. Zagreb, Av.Veceslava Holjevca , Zagreb
N.Marcec-Rahelic, Rafinerija nafte Rijeka, 51221 Kostrena, tel. +385 1 203 802)

PAP No.: 32

Area: Air and Climate Changes

Type: Legislative / institutional / organizational

Priority category: I

PROJECT TITLE**: RECONSTRUCTION OF THE EXISTING AND CONSTRUCTION OF NEW PROCESS UNITS FORUNLEADED GASOLINE MANUFACTURE ACCORDING TO THE QUALITY REQUIREMENTS IN 2005**

Responsible institution: INA – The Sisak Refinery

Project status: Project has not been started

Estimated cost: US $61 500 000

Estimated duration: 2001-2005

Possible sources of financing: State budget, International financing

Description/What is requested from donors: In order to comply with the EU standards, INA will have to adjust the fuel production as to reduce the content of sulphur in fuel to 50 ppm, lead to 0,0 g/l, and aromatic carbohydrates to maximum content of 30 - 35 % v/v. Even greater restrictions with regard to the content of the above-mentioned components in NLP can be expected by 2010. The realization of this project through the removal of sulphur, non-saturated carbohydrates, reduction of content of benzenes and complete range of aromatic carbohydrates would help attain the European quality of NLP and contribute to a decrease in emissions and an increase of air quality. Professional assistance and co-financing are necessary through all project stages.

Contact: Boris Cavrak, INA-Refinery Sisak (boris.cavrak@ina.hr, tel.+385 44 534 554

PAP No.:33

Area: Air and Climate Changes

Type: Legislative / institutional / organizational

Priority category: I

PROJECT TITLE**: ESTABLISHMENT OF THE NATIONAL NETWORK FOR PERMANENT AIR QUALITY MONITORING**
IN THE REPUBLIC OF CROATIA

Responsible institution: Ministry of Environmental Protection and Physical Planning, Meteorological an Hydrological Service

Project status: Project applied for technical cooperation

Estimated cost: US $ 3 036 000 (total costs envisaged for 22 stations)

Estimated duration: 5-10 years

Possible sources of financing: State budget, International financing

Description/What is requested from donors: The establishment of a network for permanent monitoring of air quality is a precondition for the establishment of an integral system of monitoring and management of air quality on the national level. The categorization of country regions with regard to the air quality will be possible on the basis of relevant indicators of air quality measured at the national network stations. The impossibility to adequately categorize areas of the country can result in different negative consequences related to the management, use and protection of environment. The establishment of the national network will also contribute to the fulfilling of certain international obligations of the Republic of Croatia related to the data exchange on air quality. Expert assistance in evaluation of technical equipment of certain stations, logistics related to the data exchange, preparation of tender documentation and choice of equipment, i.e. manufacturers, is expected. Furthermore, assistance in providing additional funds for equipping the stations is required.
Donor (interested institution): Government of Japan - JICA (Japan International Cooperation Agency)
Amount (requested / approved): Requested: technical assistance (Expert, equipment, training) for 2 stations
Activities: Decision on the acceptance of the project is expected in March 2002.
Contact : Andelka Bedrica, MoEPPP (a.bedrica@mzopu.hr, tel.+385 1 610 6556)