Human Development Report
Croatia 2008

A Climate for Change

Climate change and its impacts on society and economy in Croatia

UNDP Croatia

Executive summary

FOREWORD

Dear Reader,

I have great pleasure in presenting to you one of the first UNDP National Human Development Reports concerning the most prominent challenge of our time – climate change and its impact on our society and economy. It is a breakthrough report for Croatia and the first of its kind following the new analysis released by the International Panel on Climate Change (IPCC). More reports from other countries will follow in the coming years and will highlight the vulnerability of individual countries and the issues that the South and Central European region face because of climate change.

Climate change is not only about polar bears and glaciers and it does not happen just because somebody else is burning more fossil fuel than we are, meaning that they should act first and we can follow later. It is not only about complying with the Kyoto Protocol or new European Union targets. It has far more to do with the quality of life and with the choices of every Croatian citizen. Its impacts will be felt in Croatia even though Croatia's greenhouse gas emissions account for only about 0.1% of global emissions. The impacts of climate change bring significant risks for the future and perhaps some opportunities for each of us. We have a responsibility to do something about it, to manage that risk and to mitigate the damage in the most effective way.

It is a scientifically proven fact, recognised by a Nobel Prize last year, that the climate is changing and humans are at least in part responsible. It is obvious that the consequences of that change and of climate variability are already being felt all over the globe. Croatia is not an exception. With this Report, we have accounted for and quantified the damages in several sectors of the Croatian economy over the past several years as a result of climate variability. Agriculture, fisheries, health, hydropower, tourism and the coastal zone - the sectors we have analysed - represent 25% of the Croatian economy, employ almost half the working population and represent a total annual GDP of 9 billion Euro.

Because climate change is such a broad-based and multi-sectoral issue, the Government, business and civil society will need to be engaged in the discussion on what Croatia does to address it. Our aim is to inform those involved in this discussion, to break the silence and to illustrate the linkages between climate change and human development, ranging from health impacts to economic damage.

The potential exists to influence new thinking about adaptation and mitigation of climate effects in Croatia. First, agriculture and coastal tourism are important to the economy. Both sectors are vulnerable to climate change and low-income Croatians in these sectors would be more vulnerable to the negative effects and to the rising costs of adapting to them.

Second, the country is at a crossroads: emissions of greenhouse gases have rebounded to 1990 levels and are increasing. While Croatia is on target to meet its obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol (with its promised 5% reduction from 1990 levels), it will need to pursue emissions reductions measures in the post-Kyoto period. This is especially true given the EU-wide target of a 20% cut in emissions from 1990 levels by 2020. How the Government chooses to reduce emissions will affect the economy as a whole.

Both the Government and citizens are concerned and interested in the climate change issue. The Government is already pursuing several strategies to reduce greenhouse gas emissions, thus allowing the Human Development Report to focus on identifying key gaps and to provide specific recommendations on "climate-proofing" human development strategies. In addition, the Report can help to address public concerns: in a recent survey, 8 out of 10 Croatians felt that climate change was really happening, and of that group, 4 out of 10 thought it worse than experts were saying.

While this Report is not meant to be a comprehensive overview of all aspects of climate change, it does reflect the breadth and depth of research that has been done in many sectors to date, and it provides a link between a global phenomenon and the everyday human development issues facing Croatia. The research and analysis in this Human Development Report indicates that, while climate change is likely to pose serious threats to human development in Croatia, it also has the potential to bring several beneficial opportunities. The "climate for change" that currently exists in Croatia will provide the country with the motivation it needs to rise to the challenge.

Yuri Afanasiev

Resident Representative
UNDP Croatia

ABBREVIATIONS

DHMZ – Meteorological and Hydrological Service of Croatia

EU – European Union

GDP – Gross Domestic Product

GHG – greenhouse gas

GM – gross-margin

HDR – Human Development Report

HEP – Hrvatska Elektroprivreda

IPCC – Intergovernmental Panel on Climate Change

LULUCF – Land Use, Land Use Change and Forestry

MELE – Ministry of Economy, Labour and Entrepreneurship

MEPPPC – Ministry of Environmental Protection, Physical Planning and Construction

NGO – Non-governmental organization

NHDR – National Human Development Report

OECD – Organisation for Economic Cooperation and Development

PASETA – Projection of Economic impacts of climate change in Sectors of the European Union based on bottom-up Analysis

SME – Small and Medium Enterprise

UN – United Nations

UNDP – United Nations Development Programme

UNFCCC – United Nations Framework Convention on Climate Change

WFD – Water Framework Directive

Introduction

Climate change is one of the greatest challenges facing the world today. The 2007/2008 Global Human Development Report (HDR) demonstrated that climate change is taking place and that actions must be taken to reduce its impacts and reduce the extent of that change. Impacts from climate change – caused by increasing levels of greenhouse gases (GHGs) in the atmosphere – are expected to lead to a myriad of problems that will affect human development. Negative impacts may include damage from more frequent natural disasters and sea-level rise, strains on food production, harm to human health and many other problems. If left unaddressed, climate change in Croatia may restrict people's choices, slow down or undermine development gains and have a negative impact on human development in general.

What is Croatia's role in addressing climate change? Croatia is currently on its way to becoming a European Union (EU) member state, which will bring opportunities and challenges for human development. Croatia is globally ranked 45th in terms of UNDP's Human Development Index. As such, it is among the upper tier of middle-income countries. Within Croatia there are many economic sectors that could be very vulnerable to climate change. The agricultural sector has already shown significant vulnerability to climate variability in recent years, experiencing severe damage from drought, floods and hail. Furthermore, sectors such as fishing and mariculture, electricity production from hydropower and seaside tourism are all linked directly to climate. How might climate change affect human development in Croatia? Will there be any positive impacts?

In addition to addressing the impact of climate change, Croatia will have to reduce its own emissions as part of the global effort to prevent disastrous climate change. Croatia is not a major emitter of GHGs, with approximately 6.94 tonnes per person in 2006 (excluding land use changes). This is compared to an average of 11.5 tonnes per person in 2004, among all Organisation for Economic Co-operation and Development (OECD) countries. However, Croatia's emissions are rising, and the country's commitments under the Kyoto Protocol and those resulting from forthcoming European Union (EU) membership, may be a limiting factor in the future. The Government will have to decide the manner by which it will reduce its emissions. Can/should Croatia be part of the effort to reduce emissions by at least 20% by 2020? What would that cost Croatian citizens?

This National Human Development Report (NHDR) takes the global discussion about climate change and brings it to the local level. It is organized into three sections to give an overall picture of climate change issues and Croatia:

1. What do we know about the changing climate? - setting the stage for priority-setting by evaluating popular perceptions of climate change and the level of public interest in helping to address the problem. This section also explores the expected changes of climate in Croatia in terms of changes in temperature, precipitation and other factors.
2. What would climate change affect in Croatia? – assessing the current and potential future vulnerability of key Croatian economic sectors to climate. It also discusses the potential positive impacts that may result from climate change. This section also examines the current ability to adapt to climate impacts as related to human development. Some recommendations for adaptation measures have other key benefits regardless of climate change. They are known as "no regrets" measures.
3. What can Croatia do to change the climate? – assessing the costs of reducing emissions and the institutional capacity of Croatia to mitigate its own effect on climate change – what level of reduction can/should Croatia move towards by 2020, given the current state of emissions in Croatia and the economic and institutional realities within the country?

Overall, the Report aims to further the discussion about climate change in Croatia. It is designed to provide a concrete analysis and recommendations for policies that could help to mitigate climate change by reducing emissions and to protect Croatia against

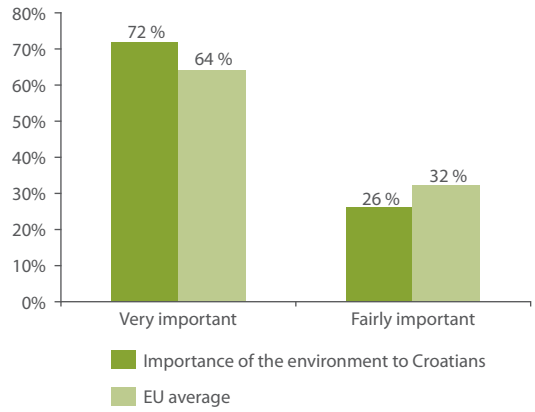
the impacts of climate change through adaptation measures. It was written to raise awareness about the often-overlooked human development aspect of climate change and to prompt a national conversation about how Croatia should best respond to the climate challenge.

Section 1: What do we know about the changing climate?

Public perceptions/knowledge about climate change

Public involvement is critical to achieving an effective response to climate change. A public that is well-informed and educated about climate-related threats, and the measures that can be taken to address them, is crucial because the process of mitigation and adaptation cannot happen without changes in individual behaviour and sufficient public support for political decisions. For the purposes of this Report, the United Nations Development Programme (UNDP) in Croatia carried out the first comprehensive national public survey on public attitudes towards climate change in Croatia.

Figure 1: Importance of the environment to Croatians and EU citizens.

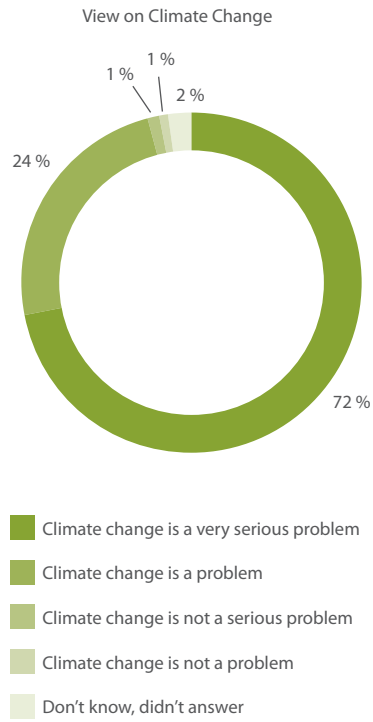


Croatians believe that climate change is a serious problem, especially in the coastal regions where it is likely to have more impact. However, in general they only regard the direct impacts of climate change as being a threat, such as the impact on health. They do not associate climate change with the indirect impacts to society, such as the potential damage to food production or changes to the energy production system due to restrictive mitigation measures or a loss of hydropower.

Furthermore, while Croatians believe they are highly knowledgeable about climate change, their actual knowledge about the causes and effects of climate change is not as high as they believe. The media – especially television – has a key role to play in informing the public about climate change issues. Most Croatians obtain information about the environment from the media, rather than from the Internet, friends and family or school/university.

Most Croatians want to protect the environment and reduce climate change risks. They are very supportive of the proactive solutions being undertaken by Croa-

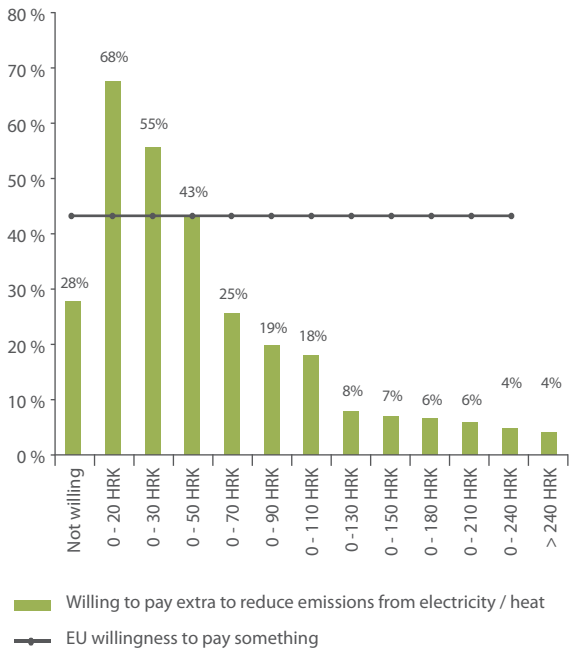
Figure 2: View of climate change among Croatians.



tian industries and the Government to reduce emissions. Over 90% believe Croatia should be doing the same, if not more, than the average EU member state to reduce emissions. At the same time, they believe that the Government and the companies that produce emissions should be most responsible for their reduction.

Additionally, a large majority of Croatians claim they already take environmentally friendly actions and are willing to take further action in the future. Many also state they are willing to pay extra to make sure the energy they use for electricity and transport comes from environmentally friendly sources. This willingness to act and to pay is higher than that found in most EU countries. Because of this, public education and programmes encouraging efficiency, environmentally responsible behaviour and environmentally responsible purchasing, can be used to motivate people to become involved in issues related to climate change.

Figure 3: Croatian willingness to pay for emissions reduction from heat and electricity at various costs and the EU average willingness to pay something



The Croatian climate

Climate is directly linked to human development and the way a society develops. Human development is, itself, affecting the climate. Three characteristics of the climate, and changes in the climate, can affect human development:

- Temperatures, which appear to be increasing
- Precipitation, which appears to be decreasing
- Extreme weather events, which may increase in frequency and intensity.

During the 20th century Croatia has shown a trend of decreasing precipitation and increasing temperatures, in most places during most seasons. It is not possible to distinguish how much of this is due to natural climate fluctuations or anthropogenic influence, but climate models for Croatia point to significant future changes in climatic conditions.

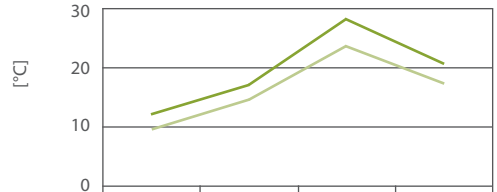
In the future, Croatia is expected to be hotter and drier, especially in the summer. Increased temperatures nationwide can be expected to have considerable impacts, including (but not limited to):

- Increases in water temperature in the sea and in inland bodies of water,
- Increases in soil temperature,
- Increases in groundwater temperature, which may lead to higher rates of evaporation and a decrease in the groundwater table,
- Decreases in lake and river levels,
- Decreases in soil moisture, leading to droughts and more heat waves that affect health.

Figure 4 and Figure 5 show the difference in projected temperature and rainfall between now and the end of the century, for both the Dalmatian Coast and the Pannonian Plain area, as examples of expected changes.

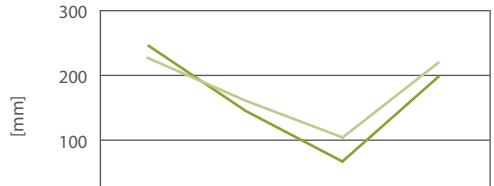
Figure 4: Potential future temperatures and precipitation on the Dalmatian Coast.

Dalmatian coastal area



	Winter (Dec - Feb)	Spring (Mar - May)	Summer (Jun - Aug)	Autumn (Sep - Nov)
Temperature Averages (1961 - 1990)	9.5	14.5	23.7	17.6
Future temperature (2080 - 2100)	12.2	17.2	28.3	20.7

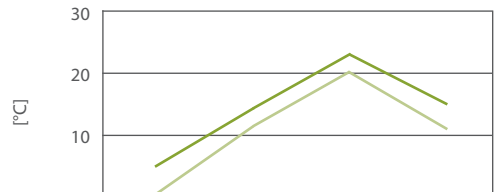
Dalmatian coastal area



	Winter (Dec - Feb)	Spring (Mar - May)	Summer (Jun - Aug)	Autumn (Sep - Nov)
Precipitation Averages (Present 1961 - 1990) (mm)	233.8	165.5	105.8	224.4
Future Averages (2080 - 2100)	252.3	151.3	66.9	202.9

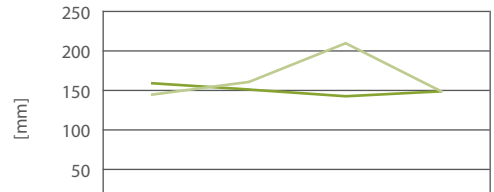
Figure 5: Potential future temperatures and precipitation in the Pannonian area.

Pannonian area



	Winter (Dec - Feb)	Spring (Mar - May)	Summer (Jun - Aug)	Autumn (Sep - Nov)
Temperature Averages (1961 - 1990)	0.4	11.3	20.3	11.1
Future temperature (2080 - 2100)	5	14.5	23.5	15.1

Pannonian area



	Winter (Dec - Feb)	Spring (Mar - May)	Summer (Jun - Aug)	Autumn (Sep - Nov)
Precipitation Averages (Present 1961 - 1990) (mm)	138.5	157.1	211.2	143.4
Future Averages (2080 - 2100)	155	146	135.6	143.5

Climate information will need to be integrated into short-term emergency preparedness, seasonal preparedness and long-term climate forecasting in Croatia. Although the State Hydro meteorological Service (DHMZ) has been developing good cooperation with the end users of its services and with its regional partners, progress is still necessary to achieve these objectives.

Section 2: What would climate change affect in Croatia?

Human development expands people's choices, enabling them to exercise greater personal control and thus enjoy long, healthy and creative lives. The impacts of climate change have the potential to restrict these choices and to force many unwanted choices on individuals and society as a whole. There are numerous examples of this. It is expected that rising temperatures and reduced rainfall will adversely affect some farmers and reduce local supplies of the freshwater needed for a wide variety of uses. Increases in the frequency and intensity of extreme events (such as heat waves and hail storms), rising sea-levels and more intense storm surges, may not only threaten lives but also individual livelihoods. These events may also force society to divert more resources towards the protection of property, lives and disaster interventions.

The physical impacts of climate change will be incredibly diverse in their basic nature, in terms of their variability across sectors and in how large they are. The impacts to specific sectors can also have wider effects on the economy as a whole. For example, the loss of income by farmers and the higher cost of food will also affect the larger economy.

There are many reasons why both the public and private sectors need information about the physical and economic impacts of climate change – why assessing vulnerability is necessary. The most general of these is simply that we need to know what is going to happen in order to plan for climate change and how to minimise its impacts through adaptation. The main problem for both the public and private sectors in Croatia now is that very little is known about how climate change will affect Croatia. In this general context, the objectives of this section of the Report are to:

1. Indicate the potential environmental and economic scale of climate change impacts using the information currently available - including information on existing impacts from climate variability that may be partly due to climate change.
2. Give some indication of the current capacity to evaluate and adapt to the threats posed by climate change.
3. Outline recommendations for future institutional/policy/technical needs including potential adaptation measures.

To accomplish these objectives this section looks at the current damages and the future vulnerability to climate change in certain key sectors. It also evaluates the capacity that exists in Croatia to project the physical impacts of climate change, place an economic value on the damages caused by these impacts, as well as the general level of adaptive capacity within each sector. The section examines six sectors for further investigation:

- Tourism
- Coastal resources – especially related to sea-level rise
- Health
- Fresh-water resources
- Agriculture
- Fisheries and mariculture.

Tourism

Tourism has long played a central role in Croatia. In 2007 alone, tourists stayed for a total of more than 56 million overnights in Croatia. Tourism generates about 20% of Gross Domestic Product (GDP) and 28.7% of total employment. By 2018, one-third of total employment is expected to occur in the tourism sector.

In addition to those directly working in the tourist industry, there are many people working in related industries that are directly impacted by tourism. Tens of thousands of families rely on tourism income in the grey economy as a way to supplement their income (unregistered apartment rentals, unregistered sales of agricultural, aquaculture or fishery products, etc.). The value of unregistered accommodation alone is equal to almost 1% of the entire country's GDP.

Figure 6: GDP and tourism share in GDP 2001-2007.

Most projections of tourism in the EU show that by the end of the century, hotter daytime temperatures along the Adriatic coast will cause many beach tourists to avoid these destinations in favour of cooler locations to the north. This could have serious adverse consequences on many local communities and, given the important role of beach tourism, the national economy. Alternatively, climate change may benefit the tourism sector by lengthening the tourist season or creating two seasons for visitors – the spring and the autumn.

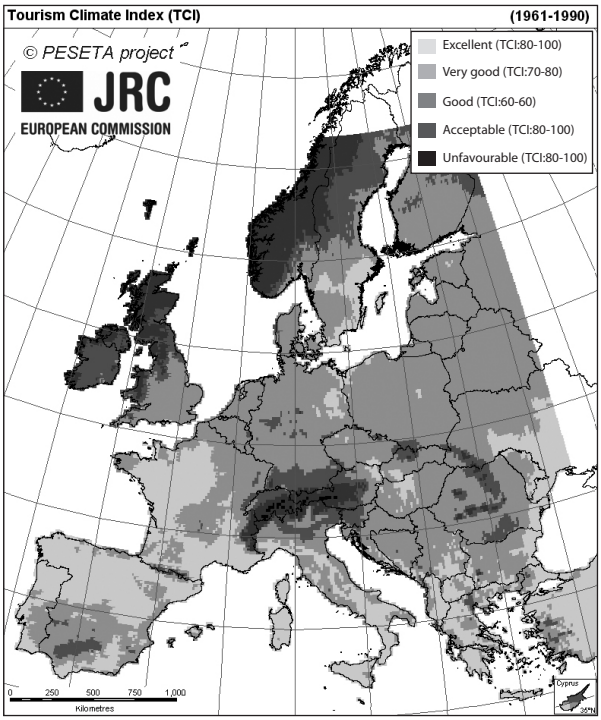
Hotter, drier summers with more extreme weather events combined with rising sea level may put human and economic development gains at risk. Additionally, specific natural sites may be at risk due to climate change, though further studies will be required to evaluate the probable physical impacts on specific areas. Because of the lack of knowledge about the actual physical impacts on specific tourist sites as well as the probable changes in tourism trends, recommendations for adaptation are currently limited. However, the following "no regrets" steps can be taken in order to address climate change and human development in the tourism sector:

- Continue to focus on "climate-proofing" tourism in Croatia – including expanding the tourist season and enhancing the service capacities and products offered within the industry.
- Encourage measures to increase energy efficiency and improve the ability to keep hotels and buildings cool during the hottest months. This will also have an impact on emissions reductions.
- Ensure that information on the tourism industry, provided by Government-funded research, is user-friendly and can be easily accessed by the public and stakeholders, in particular.

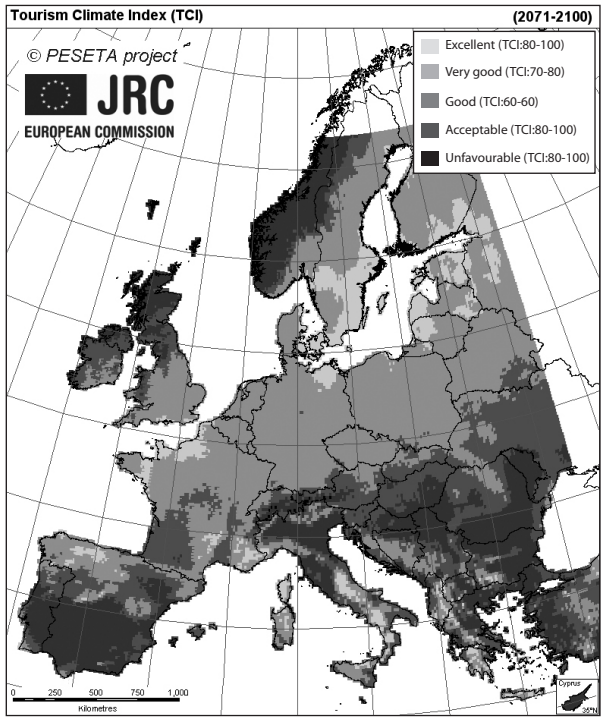
In addition to "no regrets" options, other steps can be taken to address vulnerability in the tourism industry.

- Develop better information for decision-makers (including Government and investors) about future climate change and its likely effect on the natural systems that impact the tourism sector. This is already taking place to some extent through work with the DHMZ and as a part of university research. However, these activities must be coordinated.
- Develop the capacity to simulate the impacts of climate change on tourism and assess the impacts on the local and national economies.

Figure 7: Climate conditions for summer tourism in Europe for 1961-1990 and simulated climate conditions for summer tourism in Europe for 2071-2100 according to a high-emission scenario (IPCC A2).



Source: PESETA project 2007.



Source: PESETA project 2007.

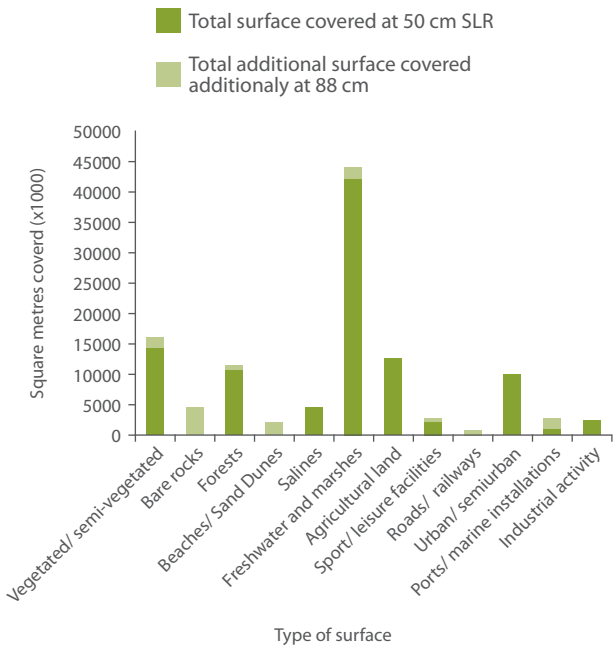
Coastal zone and sea-level rise

The Adriatic is important for Croatians – not only those living on the coast, but also those living inland. Maritime transport, offshore gas production, shipbuilding, agriculture and fishing and mariculture are all important economic activities occurring either on or near the coast. Croatian coastal areas are also important because of the diversity of natural ecosystems. Economic development is currently putting pressure on these natural ecosystems. This constitutes a significant risk especially for biodiversity.

Global sea level is expected to rise between 9 and 88 cm by 2100. However, this estimate only represents the rise resulting from the warming of the seawater. It does not consider the impact of ice melt, ice sheet flow or the uncertainties in climate-carbon cycle feedbacks. Croatia may face significant vulnerability to sea-level rise. In particular, the Neretva Delta, the Krka River, Vrana Lake near Biograd, the island of Krapanj, and numerous other locations may face significant challenges in the middle to late part of this century if sea level rises more than 50 centimetres.

According to the rudimentary analysis in this Report, a total of over 100 million square metres of land would be submerged with a sea-level rise of 50 cm and over 112 million square metres with a sea-level rise of 88 cm. This would lead to a loss in land value of EUR 2.8-6.5 billion and EUR 3.2-7.2 billion for 88 cm respectively. While these are very rough estimates, they point to the potential for significant losses as a result of sea-level rise.

Figure 8: Types of land which would be covered by 50 cm of sea-level rise and additionally by 88 cm.



The basic options for coping with sea-level rise are either to protect vulnerable areas or to retreat from them. Sea-level rise is expected to occur gradually and the actual rates of sea-level rise are still uncertain. As such, there is still time to develop the best methods for coping with the problem at each specific location. The role of the national and local governments in adapting to sea-level rise is currently unclear and should be defined. Many laws and regulations address the protection and management of Croatia's coastal resources, but the existing body of law is largely a patchwork of legislation that is sometimes inconsistent and does not address the management of the coastal areas in a comprehensive and consistent manner.

The first step for Croatia in this area is to improve the country's institutional capacity to comprehensively plan and manage coastal resources in a consistent manner. This is a "no regrets" measure. The second step is for coastal planners, managers and developers in the public and private sectors to take into account future changes in sea levels when developing coastal

Figure 9: Flood affected area of the Neretva river valley after 0.50m (light grey) and 0.88m (dark grey) sea-level rise (mesh indicates urban settlements).

Source: OIKON d.o.o.

land use regulations, disaster risk management, and when planning major infrastructure projects – such as sewerage – with planning horizons of 50 or even 100 years into the future.

The third step would be to actively develop the capacity to formulate policies, measures and projects for adapting to potential sea-level rise. Assessing the benefits and costs of these options should be undertaken on an ongoing basis, as better information becomes available about the future rates of rise. More comprehensive and detailed mapping of Croatia's coastlines, their physical characteristics, land use patterns and economic activities will be needed to achieve this.

Croatia should co-operate with existing agencies, institutions and research centres that are currently developing global and regional databases, as well as models for forecasting sea-level rise, physical and economic damage and the benefits and costs of alternative adaptation options. Participating in the development of these databases and tools will make it possible for Croatia to improve its forecasting of the physical and economic damage caused by sea-level rise and the benefits and costs of avoiding this damage. This will be essential for the development of a comprehensive Croatian policy on adaptation to sea-level rise, which either facilitates private action, promotes State action, or is a mixture of the two.

Health

Climate change is likely to affect human health in Croatia and this was identified as a major concern among respondents to the public opinion poll. Climate-related events such as heat waves, which may increase in frequency due to future climate change, have already had an impact on the health of Croatians. It is estimated that the 2003 heat wave caused 185 additional Croatian deaths - a 4.3% increase in mortality. The health risks caused by climate change in Croatia are not fully understood but are likely to include cardiovascular risks from heat waves, increases in allergic reactions resulting from changing pollen counts and distribution periods, and increased heat stroke and other acute impacts from hot daytime temperatures.

Health impacts, such as an increase in the vector-borne illnesses carried by mosquitoes (malaria), birds (West Nile fever) and other organisms; water borne diseases; and increased bacteria growth in food may also occur. However, climate change may also have some positive impacts in Croatia, including decreased death rates during winter months, as the temperatures will not be as cold.

While potential health benefits due to climate change do exist, Croatia will have to adapt to the health risks. Existing risks, primarily from heat waves, must be dealt with now, and the priority among public health institutions and actors should be to minimise illness and death due to the changing climate, especially among vulnerable populations, such as the elderly and those with heart conditions.

Water resources

Water is a critical resource for the environment and human development. It is used in many processes including for drinking water, agriculture, wetlands services and the production of hydroelectric energy. Croatian fresh water resources are abundant; indeed they are among the richest in Europe. Therefore, water resources are not currently considered a limiting factor for development in Croatia.

However, while there is no shortage of water per se in Croatia, problems do exist.

- First, a large amount of water is wasted due to leakages in pipes, which leads to a revenue loss of up to EUR 286 million (0.9% of GDP) and increased emissions resulting from the additional use of electricity for pumping.
- Second, farmers often face water shortages at certain critical times of the year and, in general, the soil lacks moisture.

Croatia uses a small fraction of its available water resources (about 1%). However, climate change may stress some of the systems that depend upon freshwater resources. This may be especially important in terms of wetlands services and hydroelectric generation. Wetlands services include nutrient and pollutant removal from water, the provision of habitats for biodiversity, timber and hunting areas.

One of the most important ways in which water contributes to human development is in the production of hydropower. During 2000-2007, 50% of all Croatian electricity was produced from this source. The Croatian energy sector is potentially vulnerable if climate change results in reduced river flows, which is expected. Reductions in hydroelectric generating capacity would reduce the nation's level of energy security.

During the severe droughts of 2003 and 2007, the amount of hydroelectric power produced dropped significantly from the average outputs of 2001 and 2005. Decreases in hydroelectric production due to reduced runoff and river flows may require lost production to be offset by domestic or imported electricity, which is more costly.

Figure 11: Differences in amount and estimated cost of electricity production in drought years versus the average from 2000-2007.

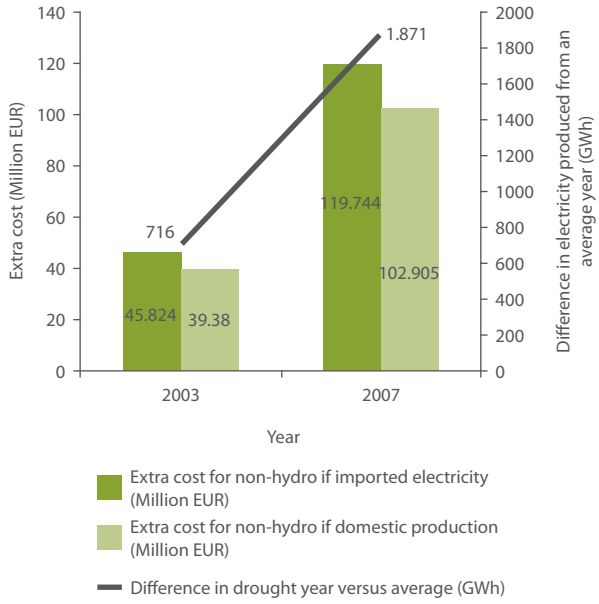
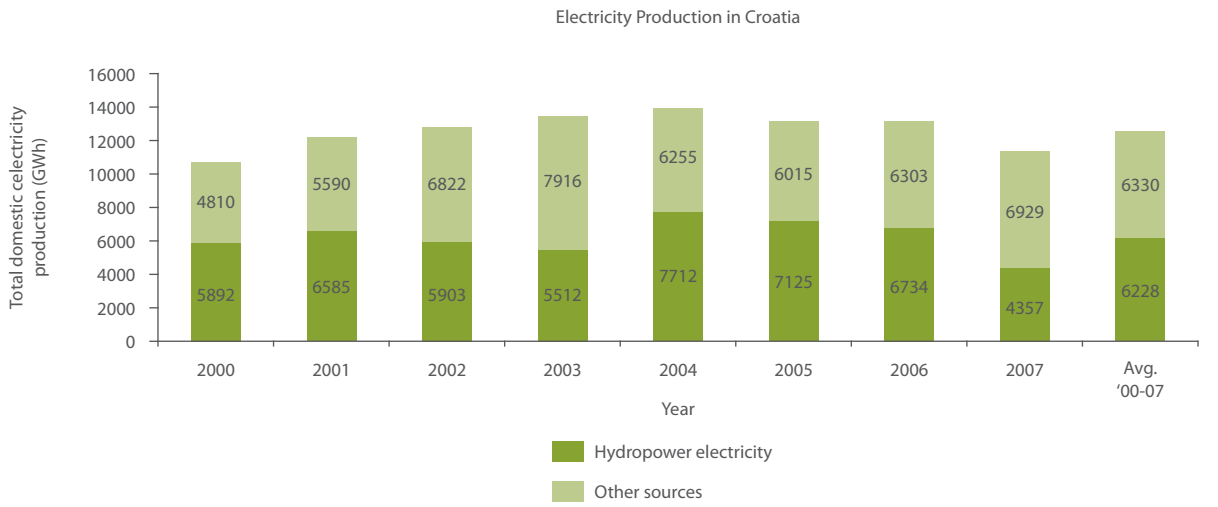


Figure 10: Annual (2000-07) share of hydropower in electricity production.



Source: after CBS 2007 and HEP 2008b

Climate change may significantly impact the water cycle in Croatia. This could result in more droughts, affecting agriculture and natural environments, especially wetlands. It could also result in decreased river flows, and perhaps lower levels of the groundwater used for drinking. The initial analysis shows that the projected impacts may result in a loss of EUR 17-86 million per year in direct losses from hydropower alone, with multiplier effects throughout the economy.

Croatian authorities have yet to take climate change into account when planning for the management of water resources. Croatia's current efforts in the water sector are mostly focused on aligning national legislation with that of the EU – especially the Water Framework Directive (WFD). The EU WFD is potentially a powerful implementation tool for climate change adaptation policy. While the WFD does not explicitly mention that climate change impacts need to be recognised, the approach of the WFD will serve as an important adaptation tool. In addition to river-based management, Hrvatska Elektroprivreda (HEP) representatives are well aware that drought and runoff impact energy production and the overall economic situation. However, since the probable impacts from climate change have not been conclusively studied, they have not been included into future energy planning scenarios.

Flood severity and drinking water quality/quantity may also be affected by climate change, though more research is necessary to investigate these possibilities. While sufficient information is not yet available to plan adaptation projects, there are a number of steps that should be taken:

- Water management planners should begin incorporating climate change into planning. This will require the use of further information, such as regional climate models, which can be incorporated into planning for flood protection, ground water recharge and river flows.
- HEP and the Ministry of Economy, Labour and Entrepreneurship (MELE) should also include climate change impacts into projections of energy supplies in Croatia beyond 2020. The initial analysis shows that the projected impacts may result in a loss of EUR 16-82 million per year in direct losses, with multiplier effects throughout the economy.
- More research should be carried out to look at the probable physical impacts of climate change on wetlands. Similar research should be carried out regarding flood risks and any adaptation that may be necessary.
- Finally, Croatia should undertake measures to improve the efficiency of the public water supply. The current loss is immense and may lead to problems if water resources become scarcer.

Table 1: Estimated GVA loss in the electricity sector in case of 10-50% lower inflow.

		Anticipated reduction of hydropower-generated electricityinflow								
	Unit	**10%**	**15%**	**20%**	**25%**	**30%**	**35%**	**40%**	**45%**	**50%**
Lost GVA in the electricity sector	Million EUR	17	26	34	43	52	60	69	77	86
	%	4	6	8	10	12	14	15	17	19
Lost GDP	%	0.06	0.10	0.13	0.16	0.19	0.23	0.26	0.29	0.32

Agriculture

Agriculture is expected to suffer the most severe impacts from climate change. Precipitation, temperature, weather extremes and evaporation rates, all impact production. Agriculture is very important to the economy of Croatia due to its overall value and its impact on food security, vulnerable populations and the employment it generates. In 2001, 92% of Croatia was classified as rural with 48% of the Croatian population living there. Generally, rural households are more vulnerable than households in urban areas, due to poorer access to basic infrastructure and poorer housing conditions.

Existing climate variability has already had a significant impact on agriculture. Extreme weather events have resulted in average losses of EUR 176 million per year from 2000-2007, representing 0.6% of the national GDP, or 9.3% of the GVA generated by the agriculture, forestry and fisheries sectors.

Looking at the future effects of climate change on maize alone, lost revenue would be EUR 6-16 million in 2050 and EUR 31-43 million in 2100. This corresponds to 0.8-5.7% of all revenue from arable crop sales in Croatia in 2005. This would mean an increase in the vulnerability of rural populations, which are already among the most vulnerable.

Because of the negative effects of extreme weather conditions and climate variability in Croatia, policymakers and farmers must begin regarding climate as a more important factor of production. However, little information is available to assess the consequences of farm practices and climate variables. Few crop models or agricultural sector economic models exist to help the sector understand the current levels of vulnerability or future vulnerability due to climate change. Furthermore, basic economic information about the sector and about the gross margins of crops is not

Figure13: Revenue from maize sales obtained in 2005 and projected for 2050 and 2100.

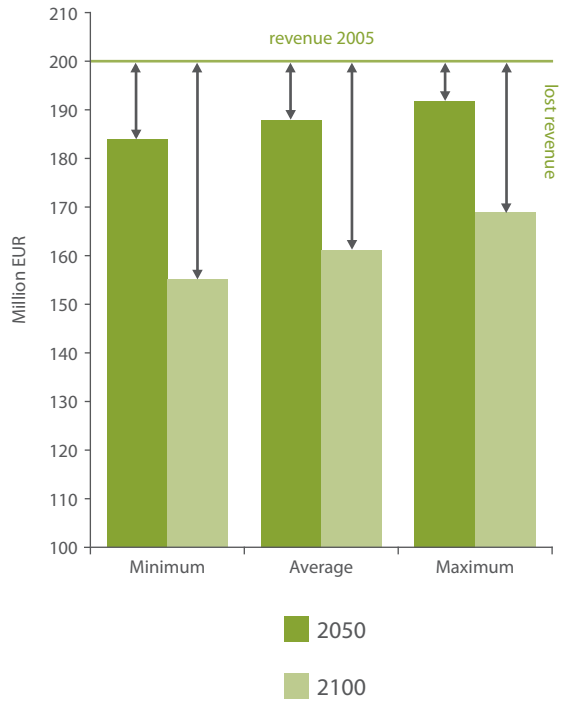
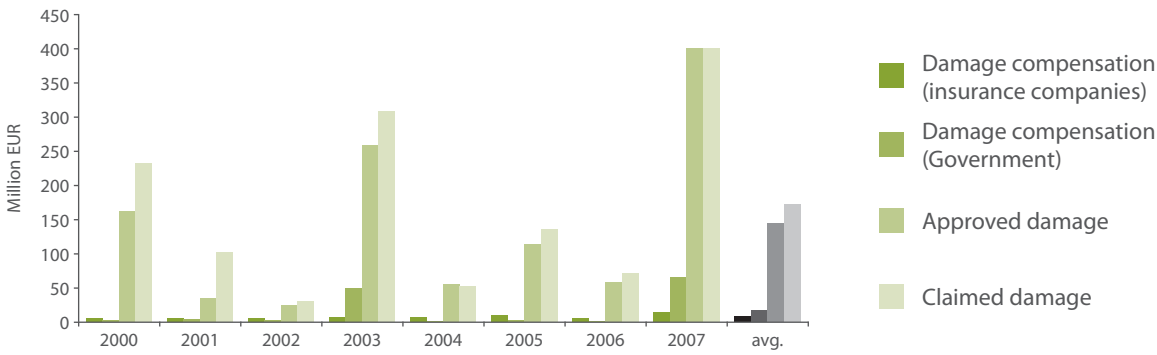


Figure 12: Claimed, approved and compensated damage to the agricultural sector in the period 2000-2007.



Source: after MF 2008 and Hanfa 2008.

available. Thus, while climate change may be a risk in the future, there are a number of actions that could be taken now to address the current vulnerability to climate.

Models to simulate the effects of climate (including climate change) on crops need to be calibrated for Croatian conditions to understand how the country should adapt. This research may also identify ways Croatia can benefit from climate change. Furthermore, the Government should conduct an overhaul of its existing systems for collecting data on agricultural production, prices and accounting for farm revenues/costs, in order to produce information which reflects the reality of the situation on the ground.

A multi-crop, multi-region agricultural sector model should be developed to assist the public sector to develop strategies and measures for coping with existing economic development, pressures to preserve the quality of the environment, climate variability and finally climate change. This would also assist farmers in implementing best management practices and would support national agricultural development and marketing strategies. More work also needs to be done to assess the economic impacts of the agricultural sector on the larger economy.

While significant resources exist to help farmers – including the provision of aid following damage from severe weather – insufficient knowledge is available about the impact of climate on crops, the economic circumstances within the agricultural sector and the likely impact of climate change. Adaptation options can only be evaluated once a basic understanding of the interaction between climate, agricultural production and the economy is developed. This should include a comprehensive cost-benefit analysis of the Government's current irrigation programme as well as other programmes, such as increasing the carbon content in soils, changing tilling methods or organic farming, as possibilities for addressing water shortages.

Fishing and mariculture

Croatia has a long history of both fishing and mariculture and a coastline that is suitable for developing a modern industry. The fishery and mariculture sector in Croatia accounts for a relatively small portion of the national Gross Value Added (GVA) – an average of 0.25% or around EUR 56 million in 2003 and 2004. However, it is culturally important and provides many economic opportunities in areas where these opportunities are limited. Climate change and increasing temperatures may impact this sector in the near future, which will further challenge the industry.

The abundance of marine fish populations is already showing significant fluctuation. These populations are also changing their behaviour and migration patterns in the Adriatic, which has implications for fish catches. The relationship between these fluctuations and large-scale climate change is of great concern. In the previous 10-20 years, warm-water fish species have been moving northward and many new species in the northern parts of the Adriatic Sea have been recorded over the last thirty years.

Climate change is likely to have a positive impact on several species currently under mariculture in the Eastern Adriatic, as the growing season will lengthen and the rearing cycles will shorten. Tuna is the most important economic product within the fishery and mariculture sector and is a warm-water species. As such, tuna farming in the Eastern Adriatic will probably benefit from climate change. The situation with two other species – sea bass and the european oyster – is however different, as they generally prefer colder water.

The arrival of new species in the Adriatic Sea has resulted in both positive and negative impacts economically. However, it is highly troubling from an environmental standpoint, as the indigenous species are now under significant threat. Two potentially poisonous

fish species have also been recorded in the Adriatic Sea – the oceanic puffer fish and the blunthead puffer fish. Although still rare in the Adriatic, the public – especially subsistence fishermen – should be educated about the potential dangers of these fish.

Changes in the distribution of species in the Adriatic will result in changes in revenue for the fishery sector, and benefits and losses may not be distributed equally. In order to develop adaptive fishery management and adequate measures to prevent losses and to promote the benefits of the potential impact of climate change on Croatia's fishery and mariculture sectors, more funding must be provided for research. The available technological options for adaptation can be found in neighbouring countries already affected by warmer climates – especially Turkey and Greece. Their experiences in mariculture management and fishing techniques – specifically regarding invasive species – should be applied to local conditions. Their experiences in culturing sea bass and sea bream under warmer conditions should be used to prevent similar problems occurring in Croatia's mariculture of these two species.

Vulnerable groups

While climate change is a global problem, it does not affect all global citizens equally. Just as global climate-related impacts continue to be distributed unequally and disproportionately among the poor, impacts at the national level also mirror this trend. Vulnerabilities to climate change depend greatly on geographic, sectoral and social contexts.

Poor communities can be especially vulnerable to climate change, in particular those concentrated in relatively high-risk areas. They tend to have more limited adaptive capacities and are more dependent on climate-sensitive resources such as local water and food supplies. There is clear evidence that regional differences between counties are already profound in terms of income, employment, quality of life and opportunities for development. Thus special attention needs to be given to regions that are already disadvantaged and could be in an even worse situation due to climate change.

Two considerations might be useful for further research. First, it would be useful to ascertain the importance of weather-dependent economic activities in the poorest counties and among the poorest people. Second, it would be helpful to explore the phenomenon of additional vulnerability where weather-dependent industries form the predominant job source in certain regions (fishing/tourism on the coast, farming in rural areas).

Subsequent research could address the following issues:

- An assessment of weather-dependent industries, their employment structures and their regional distribution, to provide a better understanding of potential climate impacts.
- An understanding of the impact of weather-dependent industries on income and relative access to benefits
- A better understanding of direct health effects and protection measures from climate extremes for vulnerable groups, such as the elderly
- Gender implications in industry, health and among the elderly

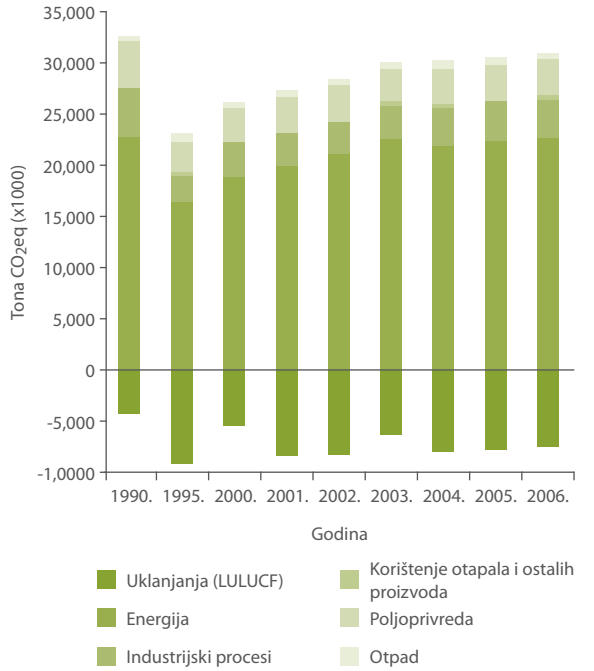
Table 2: Different systems and their climate impact – current variability and potential due to future change.

Sector	Total GDP/ GVA value per year (million Euros)	% of Croatia's Economy	Number of People Employed	Source of Impact (positive + or negative -)	Total economic impact (EUR per year)	Time period
Agriculture	1750	5.80%	272,000	(-) Existing extreme weather	176 million in damage	2000-2007
				(-) Changes in average temperatures, seasons, etc. in the future causing decreases in maize yields	a. 6-16 million in damage b. 31-43 million in damage	a. 2050
				(+)Lengthened growing season and higher carbon concentrations helping in crop production	Unknown	
Fresh Water	164.4	0.62%		(-) Decreased Hydro-power due to previous drought conditions	63-96 million	2003 drought - estimated
				(-) Decreased Hydro-power in the longer term future	16-82 million	By 2070
	238	0.90%		(-) Loss of wetlands	Unknown	
	Not measured			(-) Floods in agriculture and cities	9 million - mostly in agriculture	2001-2007
	317.7	0.85%		(-) Problems with drinking water	Unknown	
Tourism	6700	17.91%	336,000	(-) Tourists not coming to Croatia because of poor climate	Unknown	
				(-) Damage to infrastructure and image due to extreme weather events	Unknown	
				(+) Potential benefit from lengthened tourist season	Unknown	
				(+) Potential benefit from less rain during the peak tourist season (better for tourist enjoyment)	Unknown	
				(-) damage to unique ecosystems and natural attractions	Unknown	
Sea-Level Rise	Not measured			(-)Sea-level rise covering urban coastal areas/ marinas/ beaches with economic value according to value per square metre covered	30.4 million - 78.1 million annual average with sea-level rise 0.50 - 0.88 metres	by 2100
				(-)Contamination of freshwater/ brackish resources near coast (Neretva Valley, Vrana Lake)	Unknown	
Fisheries/ Mariculture	56	0.25%	20,000	(+)/ (-) Invasive species	Unknown	
				(-)Problems with sea water temperature causing fishing and mariculture losses	Unknown	
				(+) Increased productivity and production from fisheries and mariculture	Unknown	
Health	Not measured			(-) Heat waves causing respiratory failure, allergy changes, ground level ozone causing breathing problems	Unknown	
				(+) Milder winters decreasing health problems due to cold weather	Unknown	
Totals	9226.1	24.67%	628,000			

Section 3: What can Croatia do to change the climate?

In order to avoid disastrous climate change, global GHG emissions must be cut by 50-85% by 2050. The EU has committed to reducing emissions by 20% by 2020. Croatia's level of emissions per person is somewhere in between the levels of the "developed" and "developing" countries. As such, Croatia should constitute part of the solution. Croatia has already committed to reducing emissions by 5% from the baseline level of 36 million tonnes by 2012 under the Kyoto Protocol. Beyond that, it will form part of the EU commitment, by attaining some level of reduction by 2020 – though perhaps not as high as 20%. The expected emissions levels for 2020, if Croatia continues on the "Business as Usual" path, would be approximately 42 million tonnes of GHG emissions. This section of the Report analyses the costs/benefits and institutional conditions necessary for Croatia to drastically reduce its emissions. How much can/should Croatia commit to reducing? What would that cost? What institutional changes are necessary for Croatia to reduce emissions and what is the current situation?

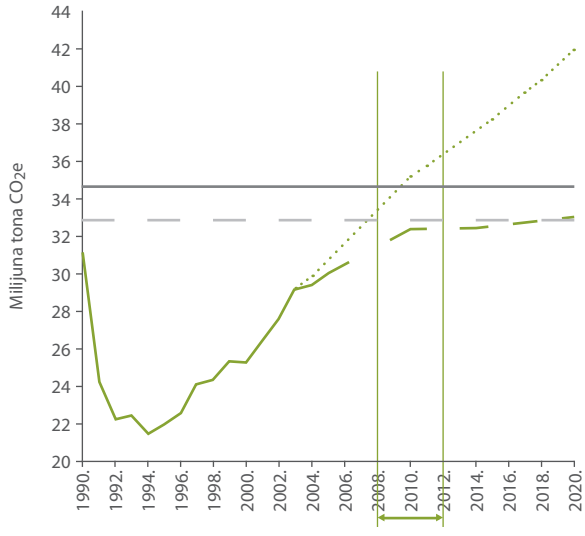
Figure 14: GHG emissions from various sectors in Croatia.



Izvor: MZOPUG 2008b

Figure 15: Likely emissions scenario for Croatia until 2020. 2008 to 2012 is the period for the Kyoto Protocol.

The dotted line represents the current projections of emmissions under BAU scenario. The dark striped line represents the projections of emmissions if Croatia introduces measures to reduce emmissions and stabilise them by 2020.



Izvor: MZOPUG 2007: 73.

The Costs/ Benefits of Mitigation

Energy

The energy sector is the largest source of GHG emissions in Croatia (73% in 2006). The emissions come from all activities, including fossil fuel consumption and fugitive emissions from fossil fuel production, transport, processing, storage and distribution. Many potential measures exist to reduce emissions from the energy sector by 2020:

- Improved energy efficiency – approximately 1% of national GDP is currently wasted as a result of low energy efficiency. Croatia must move forward with energy efficiency measures that will actually save money.

- Emissions reduction from electricity production - achieved by using geothermal, small hydropower, wind and solar power, increasing the efficiency of conversion and transmission, and – more controversially – moving to more nuclear power and electricity generated from burning waste. Croatia has also committed to producing at least 5.8% of all electricity from renewable energy sources, other than hydropower plants, by the end of 2010.
- Introducing measures to change the way energy is produced or to increase efficiency in industry. Most of these measures are either cost neutral or would actually have a positive impact on the balance sheets of industries.
- Introducing energy saving measures to reduce household and service industry emissions. A reduction of almost 2 million tonnes by 2020 is possible and would result in a net economic benefit.

The use of more fuel-efficient vehicles, changing to less carbon intensive fuels, using biodiesel or other biofuels, or reducing car travel in general through better urban planning, public transportation and better traffic systems, would result in reduced emissions from transport.

Agriculture

The agricultural sector accounts for almost the same amount of emissions as industry (11% of 2006 emissions) – including from livestock, manure management and soil management. Agriculture can play a role in climate change mitigation by:

1. Reducing GHG emissions from agricultural soils, livestock and manure management (e.g. reduced or more efficient use of fertilisers, prevention of nitrogen leaching from soil, improved manure management, reduction or replacement of ruminants with other livestock, a less nitrogen-rich diet for livestock, less burning of crop residues, etc.).
2. Reducing indirect emissions, notably those arising from fertiliser production, its transportation and application.

Industrial processes

Industrial processes were responsible for approximately 13% of Croatia's emissions in 2006. Most of those emissions were from either cement production, lime production, ammonia production (for fertilizers), or nitric acid production. Emissions reductions can be achieved by:

- Reducing the amount of clinker in cement to EU standards;
- Changing the industrial process that produces nitric acid.
- Although no data is available regarding reduction potential in fertilizer and lime production, these are also important sources of emissions. The Petrokemija fertiliser manufacturer alone accounts for 30% of Croatia's natural gas consumption and 5% of Croatia's anthropogenic GHG emissions.

Indirect emissions reduction measures related to cement production include:

- Preventing emissions at waste collection sites, by burning waste materials and reducing emissions from the waste lying in the waste storage site.
- Building concrete rather than asphalt roads, which uses less energy and results in energy savings for the vehicles using them. In some EU countries (Germany, Belgium, and Austria) almost 25% of roads are built of concrete.

Waste management

The waste management sector was responsible for a little under 2% of total emissions in 2006. These emissions are primarily from the escape of methane gas from waste sites after the decomposition of waste material. Emissions can be reduced in the waste management sector by burning methane at the waste sites.

Land use changes

A major "carbon sink" in Croatia has been created from changes in land use, as significant portions of land have become forested. In 2006, land use changes amounted to an estimated net reduction of 7.5 million tonnes - almost a quarter of Croatia's emissions. Enhancing carbon storing management practices can also remove carbon from the atmosphere and deposit it in agricultural land. This can be done through the inclusion of grassland crops in arable rotation, reduced soil disturbance, avoiding bare soil, etc. This change must be officially recognized for Croatia to gain credits for this reduction. However, the mitigation possibilities through this measure are tremendous.

Categories according to cost

No regrets measures beneficial to the economy

Some of the measures that can be taken to reduce emissions would actually have a net cost benefit. If fully implemented, these measures would account for a little over 3.5 million tonnes of emissions reduction in 2020, saving EUR 170-241 million in costs for that year, when compared to business as usual. It should be noted that the reductions resulting from changing 25% of ruminant livestock (cattle) to non-ruminant livestock (which represents almost half of these savings) may not be fully achieved, but even a partial introduction of this measure could reduce emissions and increase economic gains. Furthermore, many of these measures depend upon the active involvement of citizens. While public education may help in this area, the introduction of regulations and altering the prices for energy and energy efficient products will probably have a greater impact.

Measures with a net cost close to zero

A second set of measures that can be introduced cost almost nothing or, at least, cost less than the probable price of carbon for 2020. Not all of these measures will be eligible for carbon credits, for example building new nuclear power facilities. But those that are eligible can be profitable for businesses if sold on the carbon market, such as the burning of methane from landfills or changes in the production of nitric acid. In total, these measures could reduce emissions by 7.4 million tonnes of CO2e in 2020, for between a net benefit of EUR 96.1 million and a net cost of EUR 96.6 million for the year. However, it should be noted that the majority of these reductions (5.5 million tonnes) result from the building of new nuclear facilities, which is problematic in terms of environmental sustainability as well as political feasibility.

Measures with a net cost of less than EUR 25 per tonne

A third set of measures could be economically justifiable if the price of carbon is EUR 25 per tonne. If these measures are introduced, emissions could be reduced by an additional 880 thousand tonnes in 2020, for a cost of EUR 8.57 – 24.77 million for that year.

More expensive, but probably more popular measures

A fourth set of emissions reduction measures, which are likely to be more expensive than the market price of carbon, may still be worth implementing. In total, these measures could account for an additional 5.06 million tonnes of reduction – though at the significant cost of EUR 444 – 585 million for 2020. Nevertheless, it may still be sensible to implement these measures for the following reasons:

1. They are a requirement for meeting EU obligations – such as the use of biodiesel and bio ethanol and the implementation of Best Available Technologies in agriculture;
2. They are more acceptable to the public – such as solar power; or
3. They have alternative benefits to the sectors that implement the measures. For example, increasing the carbon content in soil would not only be a mitigation measure, but would also help the agricultural sector to reduce the problem of the lack of moisture in soil.

Measures for which cost estimates are unknown

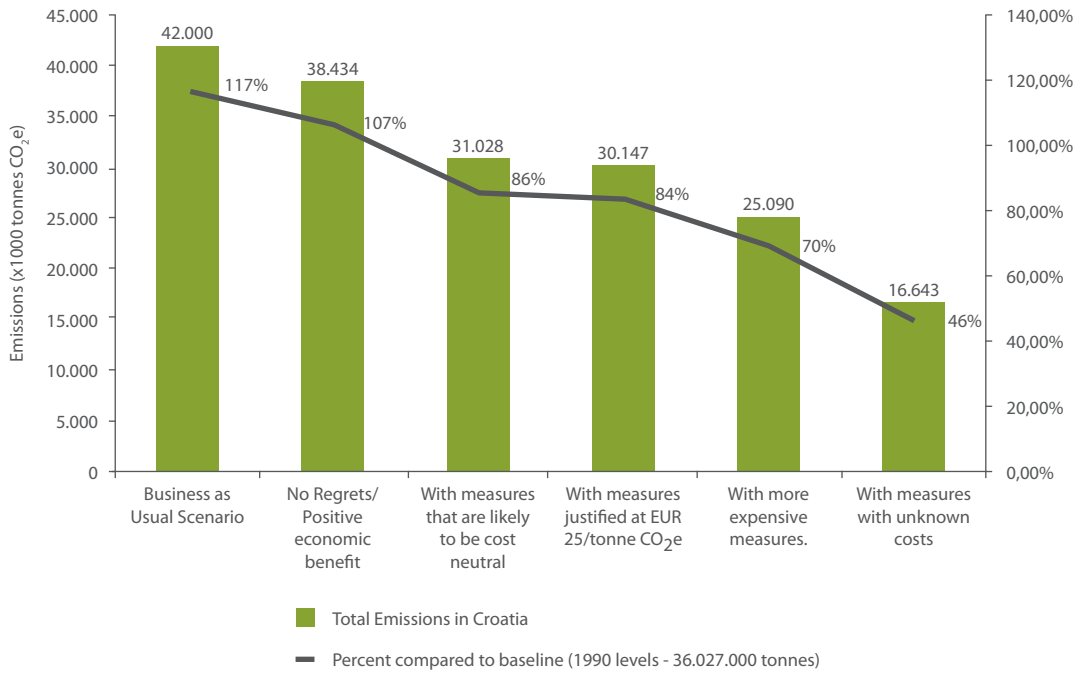
The fifth and final set of emissions reduction measures are those for which data is currently unavailable, in terms of emissions reduction cost per tonne. Some of these measures may not be politically popular, such as building a waste incinerator plant. Some measures will require significant cross-sector cooperation and public involvement, such as measures to increase public transportation and decrease transportation emissions. Others will require a better understanding of the technology (such as pumping carbon underground in oil and gas production) or improved methodology for measuring emissions reductions. These measures will then require acceptance by the international community – such as credit for land-use changes. In total, the potential exists to reduce CO2e emissions for 2020 by a tremendous 8.45 million tonnes. Despite the fact that most of this reduction comes from continuing the reductions associated with forest cover and the growth of forests – which is unlikely to be confirmed in international negotiations at such a high level - it demonstrates that there is enormous potential in increasing forest cover in Croatia.

Total annual net cost

The first three sets of measures - which could be economically justified with the price of carbon set at EUR 25 per tonne - would result in reductions totalling 12 million tonnes of CO2e. If subtracted from the projected emissions of 42 million tonnes, this leads to an emissions total of 30 million tonnes – which would mean a significant reduction (16%) from the baseline emission level of 36 million tonnes. However, much of this reduction (5.5 million tonnes) would result from nuclear power production, which may not be a viable measure for environmental and/or social acceptability reasons.

If all the measures are fully implemented, including those that are costly but popular, the total emissions reduction for Croatia for 2020 would be approximately 17 million tonnes which, when deducted from the projected 42 million tonnes, results in 25 million tonnes of emissions (a 30% decrease from the baseline level of 36 million tonnes). The economic consequences for reaching such a reduction would be significant – costing between EUR 115-536 million for 2020.

Figure 16: Reductions for 2020 and level of emissions sorted by level of costs of the measures.



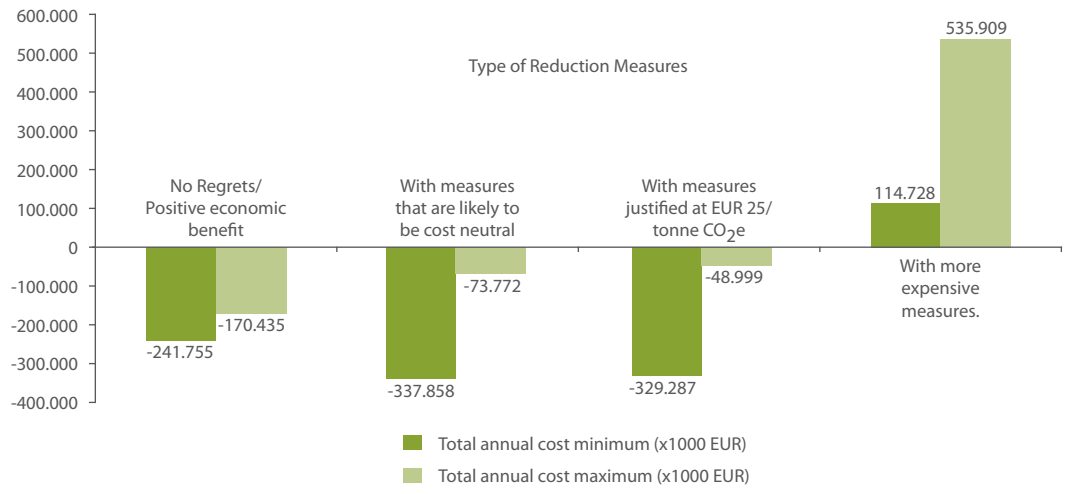
Although it is unlikely that the final set of measures (incorporating land use changes into the total, pumping CO2 underground, etc.) would be implemented and that Croatia would receive credit for those reductions in international negotiations, it is still important to note that the total emissions reduction potential would be approximately 25.4 million tonnes. This would mean that in 2020 from a total of 42 million, the total net emissions from Croatia would be a little over 16.6 million tonnes – or approximately 3.80 tonnes per person per year, if the population reduced to 4.37 million. To put this into perspective, this would represent over a 29% cut from 2006 emissions levels in Croatia.

Conclusions from the mitigation cost analysis

Whilst the initial calculations presented here need further analysis, they indicate that major reductions are possible with economically acceptable costs, especially if the price of GHGs is set at EUR 25. However, while the potential exists and seems achievable at a relatively moderate cost, the actual capacity of the various actors involved in the implementation of these measures is much less certain. There are many political, institutional, technical and justice considerations that must be taken into account before moving forward. Numerous measures have been identified as no-regrets measures and these can have a significant impact. As mentioned earlier, they are primarily oriented towards:

- Improving energy efficiency in the households and services sector,
- Increasing efficiency and decreasing emissions in industrial processes,
- Switching to the use of waste as a fuel in industrial processes instead of coal,
- Burning methane from landfills for energy,
- Encouraging organic farming,
- Continuing land use changes that promote the sequestration of carbon in forests – with better monitoring and acceptance of methodology within the international community,
- Increasing the efficiency of transport systems, including the fuel efficiency of cars, the efficiency of traffic flows, and alternative transportation (walking, biking, carpooling, public transport).

Figure17: Projections for total costs for various types of measures for 2020.



Current activities to mitigate climate change – institutional analysis

To reduce GHG emissions without undermining human development goals, Croatia must involve various actors and ensure that they work together effectively. Institutions that must be involved in the effort include government institutions, businesses, research institutions, non-governmental organizations (NGOs) and the donor community. Croatia can address barriers to the implementation of mitigation measures if it has the proper regulatory environment, provides the necessary information for people and institutions, and identifies sufficient funding to pursue emission-reducing technologies and practices.

- Croatia has made significant strides towards an institutional framework that could lead to emissions reductions and foster human development, though more work is still necessary.
- The regulatory framework set out by the Government has sent a clear message that energy efficiency, renewable energy and reduced emissions are important.
- A fair amount of technological capacity and knowledge exists to address climate change mitigation demands and to ensure that human development is enhanced, not undermined.
- Finally, opportunities for financing emissions reductions exist and are increasing. This capacity is likely to continue to grow as Croatia moves towards EU accession.

Several specific recommendations can be made to ensure that mitigation efforts aid human development rather than hinder it.

- The Government should form an inter-ministerial working group on climate change coordinated by MEPPPC. This group should involve technical and political representatives who can work together to ensure improved communication and coordination among Governmental actors. This coordination could prevent the waste of public resources and ensure that ministerial strategies/ plans take climate change into account in development planning. The mandate of the group could be more general and address adaptation as well as mitigation.
- Data development and best practice measures should be made more publicly available when funded by the Government.
- Progress currently being made in promoting energy efficiency in the Governmental sector should also be encouraged in the industrial and small and medium enterprise (SME) sectors.
- It may be necessary to develop the stakeholder process further and to involve business representatives in discussions regarding the implementation of new policies.
- Revenue from carbon fees should be used either for emissions reductions programmes or for tax reductions for fee-payers.
- Businesses and technical consultancies may have a competitive advantage in promoting regional mitigation measures. Croatian companies should investigate the possibilities for marketing mitigation measures in other countries. These services can also be considered part of Croatia's official development assistance if executed by the Government.

Recommendations: Research Needs

- **Data requirements for the current situation:** In order to address current climate variability, regardless of future climate change, specific data is required to improve the management of specific sectors. In agriculture, better data on crop yields and the economics of individual farms would help decision-makers decide how to spend resources. Additional economic data about the actual gross margins and the impact of various economic factors on agriculture, such as the price of fertilizers, water inputs, labour and market prices, would also be helpful. Continued and improved cooperation among Croatian authorities, as well as among the hydro-meteorological services in various countries in the region, could help, by formulating improved, coordinated responses to major natural disasters (such as storms, heat waves and forest fires), in order to limit the damages to human development. Within all sectors, a more open data sharing structure would benefit the research community and actors, both within and outside the Government, whose plans may depend upon data from other institutions. Research funded by public money must be made available to public institutions and the general public.
- **Modelling needs:** To address current needs – especially in agriculture - crop models that simulate responses to changes in existing climate or inputs would aid Governmental decision-making regarding subsidies and rescue packages. Furthermore, a macro-economic model of the agricultural sector and the entire Croatian economy would help the Government to better understand the impacts of current changes in prices on the economy, employment and poverty levels. In looking at future climate change, efforts to downscale global climate models to regional climate models will be helpful in a variety of sectors. Models can then project changes in agriculture, precipitation patterns that may lead to changes in river flow (thus reducing hydro-electric power), and physical impacts on popular and lucrative tourist destinations, such as Plitvice Lakes National Park, wetlands and fisheries. Physical impact studies coupled with economic analyses could then provide the basis for developing adaptation measures to avoid damages from climate change. Finally, additional analysis related to mitigation is necessary and more stakeholders, beyond the energy and industrial sector, should be engaged in efforts to mitigate the effects of climate change to ensure that emissions reduction measures support the human development process.
- **Understanding causal relationships:** In addition to having the modelling ability to project the impact of climate change on Croatia and an understanding of the economics behind potential adaptation measures, a direct linkage needs to be made between climate and human development in Croatia. The sectors analysed in this Report have a dramatic impact on poverty alleviation, livelihoods and economic development. Climate-related risks – though not necessarily attributable to climate change – are already apparent in the agricultural sector and to some extent within the health, fisheries, power and even tourism sectors (forest fires and droughts). Policy-makers and planners must incorporate current climate variability and future climate change into their long-term planning processes.
- **Applied policy analysis:** For particular coastal areas that may be vulnerable to sea-level rise, more detailed analysis is advisable in planning any major infrastructure investments. For the agricultural sector, a detailed cost-benefit analysis should be carried out to address current problems related to soil moisture. For the water sector, additional analysis related to the high water losses from leakage and a cost-benefit analysis of measures to reduce leaks would be useful.

Policies and Institutions

To address both vulnerability and mitigation effectively, Croatia must improve coordination among the different actors involved. A high–level, inter-ministerial committee on climate change should be established. This committee could facilitate discussions within the Government and then collaborate with important stakeholders, such as businesses, civil society and the general public. Tremendous opportunities exist to improve human development in Croatia, through energy efficiency measures, which save public money, and by reducing risks from climate-related disasters. More high-level support will be needed to integrate climate issues into decision-making.

- **Integration:** Because climate change is such a broad-based and multi-sectoral issue, many Government agencies/ ministries, as well as private entities/ firms, will need to be engaged in the discussion on what Croatia does to address the issue. The Ministry of Agriculture, Fisheries and Rural Development will need to be involved in decisions related to both adaptation and mitigation measures. Croatian Waters, which is developing plans for the next 20-30 years, should take climate change into account. HEP will need to think about the impact river flows may have on electricity production, in addition to the potential increased energy needs for air conditioning in the summer months – especially from tourists. The tourism sector is already beginning to address reducing emissions from tourism activities, but more work is necessary to understand the potential impacts of climate change on coastal and inland tourism in Croatia. The Ministry of the Sea, Transport and Infrastructure, along with spatial planners, should incorporate issues related to the mitigation of emissions from transport into its decisions. While climate change mitigation is already listed in many strategic documents, massive effort will be required by Croatia to reduce its emissions. Many of the steps to reduce emissions can actually save money, but they will require forward thinking and a strategic effort to become effective.
- **A national position for post-2012 mitigation issues:** This Report cannot recommend the level of emissions the Republic of Croatia should be willing to commit to under any post-2012 climate change regime. However, emissions reductions from Land Use, Land Use Change and Forestry (LULUCF) seem to have massive potential for carbon removal in Croatia. This includes sequestration in forests as well sequestration in soils, which may also improve soil moisture. Croatia has the potential to move towards a lower carbon economy, but it will take significant political will and organisational capacity, in addition to bankable energy efficiency projects, public action and continued advocacy from the Government, regarding Croatia's role in the global solution to climate change.
- **An inclusive position:** Because of the broad-based nature of mitigation and adaptation, it is critical that lines of communication with stakeholders are open, including opportunities for stakeholder involvement in planning processes. Many opportunities to forward human development may become apparent, as a consequence of either reducing emissions or by making a sector less vulnerable to climate variability and/or climate change. Future adaptation or mitigation measures must also take into account the needs of stakeholders and Croatia's technological and economic capacity for change.
- **A proactive position towards public involvement:** Though the public seldom see themselves as responsible for climate change, public involvement and an understanding of climate change is absolutely critical to ensuring that emissions are reduced in a cost-effective way and that current and future climate risks are addressed. More education and fact-based public discussion is needed to educate Croatians of all ages on the effects of climate change and the steps the Government is taking now and in the future. The mass media is the best avenue for this, though the education system should also include topics related to climate change.

As a country that has emerged from the turbulent decade of the 1990s with very bright economic and social prospects and with a strong concern for the environment, Croatia is prepared to move forward as a regional leader in addressing future climate change, by reducing emissions and minimizing climate-related risks to human development. The Croatian public is both concerned and willing to act. Croatian institutions have the political will to avoid the worst damages from climate change by taking on the responsibility of reducing emissions. The Croatian scientific and research community has the potential to be a regional leader in understanding and addressing climate risks. The next several decades are critical for the development of methodologies, which will help alleviate the dire impacts of global climate change and also protect Croatia from climate-related damages. Croatia is ready to take on this challenge.

Human Development Report - Croatia 2008

A Climate for Change:

Climate change and its impacts on society and economy in Croatia

Climate change is one of the greatest challenges facing the world today. Its impacts can already be seen across the globe. Croatia may already be facing impacts from climate change and will inevitably see those impacts in the future. The 2007/2008 Global Human Development Report demonstrated that climate change is happening and that actions must be taken to reduce its impacts and reduce the extent of that change. Impacts from climate change - caused by increasing levels of greenhouse gases (GHGs) in the atmosphere - are expected to lead to a myriad of problems that affect human development. Negative impacts may include damages from more frequent natural disasters and sea level rise, strains on food production, harm to human health, and many others. If not addressed, climate change in Croatia can restrict people's choices, slow down and undermine development gains, and have a negative impact on human development in general.

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