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Energy management, economics and sustainable development

KEY WORDS: management, environmental protection, energy, resources, and development

Introduction

In order to provide policy of sustainable development in The Republic of Croatia, the policy makers and the experts have the remarkable challenges in front of them. On one side are the needs of the economic development, the industrial growth and the energy consumption growth, which are closely connected to these needs. On the other side are the environmental protection requirements, which are as more and more urgent, particularly in order to integrate the Croatian economy into the European integration, which has the great importance for Croatia. The environmental protection must be implemented in all, particularly in business activities, since they cause changes in space and the environment. Within a system of thoroughly conceived economic policy instruments, all the sectors should jointly strive towards achieving sustainable development.

These facts and the development requirements impose the crucial need for fundamental industrial policy redefinition. In that process the new main goals and the new criteria have to be imposed. Also, the new methods of policy making process has to be developed, particularly in order to ensure environmental protection and public voice in policy making process.

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Industrial policy

The industrial policy development is the part of further improvements in free market economies and contemporary social and environmental incentive governmental policy, particularly connected with the sustainable development needs.

The sustainable development as the concept of contemporary growth will ensure searching for moderate growth and development policies.

Some of the experts would argue that sustainable development is a simple idea. It is about ensuring a better quality of life for everyone, now and for generation to come. Deeply embedded in the whole this concept is the prudent use of natural resources and this very much includes consideration of energy strategy, particularly to stimulate the renewable forms of energy [1]. In view of the utilisation of natural resources, use of energy, pollution of air, water and soil as well as waste emissions, the industrial sector is one of the key factors causing a deterioration of the quality of the environment in the EU. The EU policy wants for this sector to create and ensure conditions for a strong innovative development and competitiveness on the global market along with the observation of environment standards on the basis of partnership approach. Significant changes and the high growth rates are not the main task anymore. Recently, the ground goals become the environmental protection and seeking for the optimum of natural resources exploitation and the minimum of disruptions of natural world and human environment. This concept of the development policy becomes the ground scope of the sustainable development principal.

The environment issue becomes more important in industry policy, particularly in energy strategy. It means as well as in the energy strategy planning as well as in power generation.

However, the ground principle of the sustainable development is to ensure economic growth and to preserve the natural resources conservation and environmental protection or the highest possible level, in the same time. In energy it means lower level of growth in coal and oil industries, and higher gas use growth. The recent discussions about the Croatian energy strategy pushed the focus to the natural gas use as the future fuel for the Republic of Croatia [10]. These discussions are particularly focused to the future abilities of electricity produced from natural gas.

The energy consumption

In the recent few years the average rate of energy consumption growth was approximately 2.2% in the whole world, around 1.7% in Europe, 1.8% in North America and the highest growth rate of 5% was in Asia [3]. The economic difficulties during last months of 1997 and in the first half of the year 1998 are expected to slow down the growth of energy consumption in Asia.

The main sources of the primary energy consumption will remain as is, according to the majority of the recent forecast. The industry may be underestimating the size of the growth rate for oil demand over the next 10—20 years [3]. But the oil demand will increase, more or less. However, the remarkable changes or crisis are not expected. The percentage of oil product in the structure of primary energy consumption will decrease for maybe few per cents, and the percentage of natural gas will increase. The percentage of coal will increase in Asia and decrease in Europe, particularly in West Europe.

The new wave of mergers and acquisitions during the second half of the year 1998 is expected to improve the competitiveness of the major oil companies and probably will not change the general trends in oil industry market position.

Environmental liability does not tend to hit the main trends in industry so far. But for the industries like energy sector, the cost of cleaning up the old sites and further cost of environmental protection the new sites can be huge. And while there are attempts by policy makers to moderate the costs involved, the principle is clearly here to stay, at least as the future obligation.

In the aftermath of the Kyoto climate change Conference, liability for contaminated land is not the top of the environmental agenda. And yet, when the "hullabaloo about Kyoto dies down" [4], liability will remain one of the biggest issues in environment policy, particularly in the close future.

However, environmental protection erases as the issue of importance, and become more and more important issue of the energy policy. The cost generated of this particular issue will erase as one of the most important element of the development of all of the energy sectors.

The energy consumption in Croatia

The energy consumption in Croatia in last few years is in the process of increasing after a few years of remarkable decreasing in the years followed after the 1990. For example, the total primary energy supply in 1996 increased by 10.8 % and 21.8% according to the previous year. At the same time the gross electricity consumption increased by 4.2 %, and the energy intensity of the total primary energy supply worsened substantially in compare to the previous year's [6].

The basic derived data on energy consumption in Croatia are presented in table 1.

TABLE 1. Basic indicators for Croatia
TABELA 1. Podstawowe wskaźniki ekonomiczne Chorwacji

GENERAL DATA	1980	1990	1993	1994	1995	1996	2000
Primary energy supply PJ	326	281	281	277	283	306	373
Specific energy consumption							
a) per capita. GJ	71	80	61	59	61	68	78
b) per GDP. MJ/US \$ (1990)	12.3	15.4	17.7	16.4	15.8	16.1	17.1
GDP/capita 1000 US \$ (1990)	5.8	5.2	3.4	3.6	3.8	4.2	4.6

However, for quality rank analysis and global conclusions it is important to provide the possibility of observing the basic trends in economic transformation and technological development and their impact on energy sector.

The analysis of the above data leads to the below conclusions:

The specific energy consumption per capita namely per GDP follows the same basic trend; only the energy consumption decrease per GDP is lower which points to decline in economic efficiency in energy sector. Under such conditions the economy inevitably loses its international

competitiveness since the energy input of the product becomes too expensive regardless of low price of energy in the global market. The Croatian economy has not been technologically reconstructed. Therefore Croatia lags considerably behind the energy consumption restructuring and conservation undertaken by developed countries. In spite of that there was not any growth of economic and energetic efficiency in Croatia in the period of 1995—2000. That should be foreseen in all future economic and energetic strategies.

The energy use and sustainable development

The main problem in intensive energy development is to preserve damages of used energy to natural environment. This is particularly important in the sensitive environment, like for instance the Adriatic regions of Croatia. Furthermore, the Republic of Croatia is relatively small country; highly urban developed, full with the natural beauties and resources (national parks, parks of nature's etc.). So, the energy strategy has to be established on the basic principles of sustainable development.

On the other side, the low current level of GDP and the needs of transition of Croatian economy towards the developed market economy, and the needs for economic growth and development, would require the significant industrial development and energy consumption growth in the future.

The main principle of sustainable development, in our conditions, is to ensure reasonable economic development and to preserve the natural resources and environmental protection on the highest possible level [7]. The main task in intensive industrial development process and in energy consumption growth is to preserve the damages of industrial, particularly power plants and damages of used energy to natural environment [8].

The environmental protection become very important question itself, not only as a part of national or company strategy, but even in mergers and acquisitions and similar operations of capital restructuring and in all other changing or restructuring processes.

However, in strategy formulation and policy making process, environmental concern and protection become a legitimate part of the natural resources management. The future development and industrial policy has to be the equilibrium between development needs and needs for environmental protection.

Moreover, in strategy formulation and policy making process, environmental concern and protection become a legitimate part of the natural resources management. This concept should be developed as a broad system of information collecting, strategy formulation, policy making, public opinion and public voice in the Republic of Croatia.

The crucial purpose is to develop and to preserve the whole range of Croatian's natural resources, from beauties of nature to the industrial capacities and energy resources. The ground idea of this system should be **the equilibrium between economic needs, technological advances, environmental threats and commitments to the public welfare.**

The mission of that system is **to sustain the health, diversity and productivity of the natural resources for the public use of present and future generation.**

Greenhouse gases emissions

Fighting of climate changes and preventing of impacts causing climate changes is one of the major global tasks. The challenge 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* (CO₂). Its contribution to the greenhouse effect exceeds 65%. Carbon dioxide followed by methane (CH₄) with 20%, chloro-fluorocarbons (CFCs) with 10%, and nitrogen oxide (N₂O) with 6%. 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. Therefore, Croatia ratified the UN Framework Convention on Climate Change (UNFCCC) in 1996 and signed the Kyoto Protocol in 1999. Since Croatia is the party to the Annex I 1, it undertook to reduce the greenhouse gases emission to 95% of the base year (any year between 1985 and 1990) during the period 2008—2012.

In the table 2 and 3 analyses carbon dioxide (CO₂) emissions from fossil fuel combustion between 1990—1999. Globally, CO₂ emissions increase 7.6% between 1990 and 1990. OECD CO₂ emissions from fossil fuel combustion increase 10.8%. Developing countries aggregate CO₂ emissions increase 34.3%. Emissions by the EITs decrease 35.8% in the some time, reflecting economic turbulence and restructuring during the 1990s. Table 3 summarises the CO₂ emissions performances of the main industrialised countries. In North America and Canada emissions increase 12.4%, over the period 1990 to 1990, in Australia 15.4% and Japan 13.6%. The European Union in aggregate contained its emissions during the 1990s to only 0.4% above 1990 levels in 1990. However, this outcome masks a wide dispersion of individual Member State performance. For members of the EU 15, the individual Member States have a negotiated target under the total EU 15 “bubble” target of 8% reduction in first commitment period (2008—2012) over the 1990 GHG emission level (Kyoto Climate Change agreement in 1997). Portugal and Greece can increase emissions by 25% or more; Denmark, Germany and Luxembourg must reduce emission by over 20%; Croatia must reduce emission approximately 5%, etc [11]. This analysis reports the 1990 outcome on an CO₂-only basis and shows a growing difference from the Kyoto targets negotiated for most countries and regions in the world.

TABLE 2. CO₂ emissions by industrialised countries, economies in transition and developing countries
[MtC]

TABELA 2. Emisja CO₂ w krajach uprzemysłowionych, o gospodarkach w transformacji oraz
krajach rozwijających się [MtC]

	1990	1995	1996	1997	1998	1999	% Change 1999/1990
OECD	3 013	3 164	3 224	3 236	3 374	3 338	+10.8
Economies in Transition (EIT)	1 311	925	890	876	854	841	-35.8
Developing Countries (DC)	1 774	2 225	2 381	2 421	2 393	2 383	+34.3

TABLE 3. CO₂ emissions by USA, Canada, EU-15, Japan and Australia [MtC]TABELA 3. Emisja CO₂ w USA, Kanadzie, EU-15, Japonii i Australii [MtC]

	1990	1995	1996	1997	1998	1999	% Change 1999/1990
USA	1 490	1 569	1 620	1 643	1 650	1 679	+12.7
Canada	128	132	136	138	138	143	+12.4
EU – 15 Member States	928	914	934	922	935	932	+0.4
Japan	315	355	361	358	349	359	+13.6
Australia	80	85	89	91	93	92	+15.4

Greenhouse gases emissions in Croatia

Croatia's energy sector contributes with 99.1% to the total emission of SO₂, with 96.7% of nitrogen oxides (NO_x) and 90.8% of carbon monoxide (CO). The SO₂ emission in 1996 amounted to 57,000 tons, coming mainly from combustion processes (85.9%) and to a lesser extent from traffic.

The highest share in NO_x emissions is traffic-related (65.5%) and the minor relate to emissions from combustion plants (34.5%). The CO₂ emissions come mainly from combustion processes (74.1%), with some 16.8% emitted from the thermal power plants. As a party to the United Nations Framework Convention on Climate Change (UNFCCC) Croatia has assumed the obligation to keep the CO₂ emissions at their 1990 level until the year 2000. Pursuant to the Kyoto Protocol Croatia is bound to reduce the greenhouse gas emissions in the period from 2008 to 2012 to 95% in relation to the base year, which can be any year between 1985 and 1990. Over the several last years there is an evident positive trend towards the reduction of the influence of energy sector on water pollution caused mainly by discharge of cooling water into watercourses.

For Croatia it is a problem to define the base year emissions, because in that period power produced outside its present territory was used, but that amount of emissions is not attributed to Croatia although that portion of energy, i.e. "corresponding emissions" should be included in the reference balance.

There are three possible scenarios of energetic development in Croatia till 2030 [13]:

- ◆ S-421 it anticipate the use of classic technology, without active State measures in energy sector with slow introduction of new technologies,
- ◆ S-422 introduction of new technologies with Active State measures,
- ◆ S-423 expressive ecological scenario that takes in consideration:
 - global emissions of greenhouse gases,
 - sustainable development,
 - energy efficiency of new technologies,
 - greater consumption of renewable energy sources and
 - education, information and consulting service, including the development of public relations.

The increase of energy efficiency is one of the fundamental requirements for sustainable development. Within Croatia's energy sector development strategy it comprises the following programs [14]:

KUEN: Program of energy efficiency of buildings,

MIEE: Network of industrial energy efficiency,

KOGEN: Cogeneration program,

KUENcts: Energy efficiency in a centralised thermal system program,

TRANCRO: Transport energy efficiency program.

Based on anticipate energy consumption and measures that will be undertaken for environmental protection and reduce of greenhouse gases, projective emission SO₂, NO_x will be in limits expected by Second SO₂ protocol and Second NO_x protocol.

The emission of SO₂ is decreased of 180000 ton in 1990. to 78000 ton in 2000 (obligations of Second SO₂ protocol are 117000 ton). Projection for 2020. is 25000 ton.

The emission of NO_x in 1990. was 83000 ton (obligations to Second NO_x protocol for 1990. are 84000 ton). It is expected that in 2020. will be 11—17% less than in 1990.

The emission of CO₂ will be considerable over that, prescribed by Kyoto protocol. Estimate of CO₂ emission for various scenarios in Croatia is showed in table 4.

TABLE 4. Estimate of CO₂ emission for various scenarios in Croatia (1000 ton)

TABELA 4. Oszacowanie emisji CO₂ w Chorwacji dla różnych scenariuszy (1000 ton)

	1990	1995	2000	2010	2020	2030
S-421	23 000	15 000	20 000	30 000	35 000	44 000
S-422	23 000	15 000	20 000	27 500	31 000	37 000
S-423	23 000	15 000	20 000	25 500	29 000	33 000
Kyoto protocol	23 000	23 000	23 000	23 000	23 000	23 000

Source [13]

Against all scenarios the emission of CO₂ in 2010 will be increased between 11 to 24% in relation to demanded in Kyoto protocol (fig. 1)

National environmental strategy and economic instruments

The Strategy should offer guidelines and directions for long-term environmental management, while fully observing the economic, social and cultural development and including the basic conditions for the harmonisation of economic, technical, scientific, educational, organisational and other measures, as well as the measures for fulfilling the international commitments made in the environmental protection field.

The environmental protection must be implemented in all, particularly in business activities, since they cause changes in space and the environment. Within a system of thoroughly conceived economic policy instruments, all the sectors should jointly strive towards achieving sustainable development. The objective of well-defined environmental policy is integration of all sector

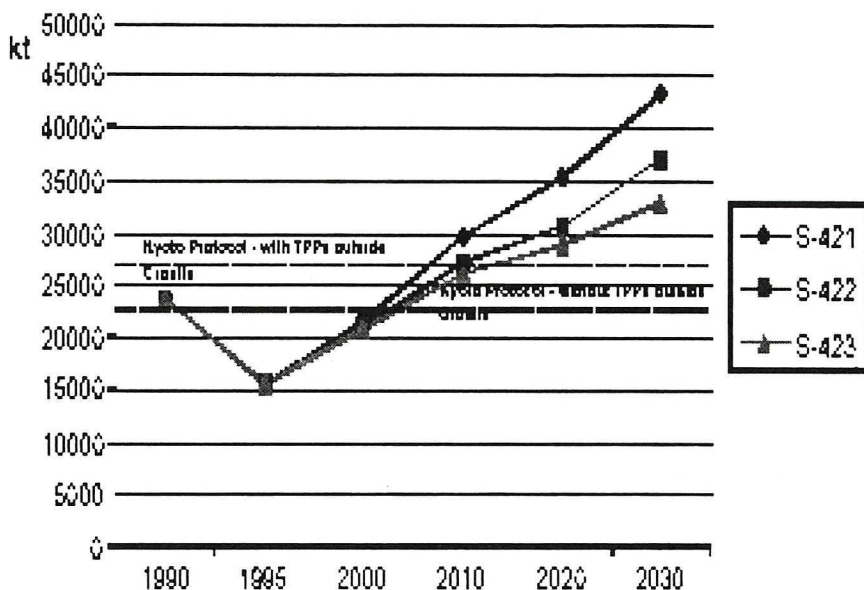


Fig. 1. CO₂ emission projection

Rys. 1. Prognoza emisji CO₂

policies. The economic instruments are considered as a particularly effective tool for realization of the set objective since they can correct the market imperfections. The environmental economic instruments may be defined as instruments affecting costs and benefits of the activities that might have environmental impact. They must encourage the business and other sectors to change their behaviour towards environmentally sound practices. The economic instruments are often used along with other environmental policy measures.

Selection of a particular environmental policy economic instrument should be based on the following criteria:

- ◆ environmental efficiency,
- ◆ economic efficiency,
- ◆ stimulating pollution abatement and new technologies,
- ◆ administrative acceptability.

Conclusions

It is not possible to achieve sustainable development on a global level unless it has been attained on the local level. The local level is the one on which most of the environmental concerns are identified and the level on which general public has the highest impact on their resolving. The local level is actually the key factor in the process of creating conditions for changing the behaviour, production, consumption and use of space.

The future industrial and energy policy of the Republic of Croatia should be developed as the **new industrial deal**. This should be an authentically part of the Croatian industrial policy. The main task is to establish the equilibrium between the needs of economic and technological development and the emerging requirements for efficient system of the environmental protection.

Future development in order to ensure sufficient and efficient natural resources use should be established. Special importance has energy use. Moreover, the efficient energy use will push the structure of primary energy supply towards increasing of natural gas use.

The entire effort must be viewed as a transitional process over several years, not a singular event lasting a few months or only a year. The new natural resource management as the new industrial policy should be managed through a multidisciplinary deal that can address all relevant issues both before and after the basic principles of the new industrial deal is closed. However, all relevant subjects should be involve: the policymakers, the experts and the public as well.

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Abstract

The main problem of the contemporary policy of the economic development is equilibrium between industrial growth, particularly energy consumption growth and imperative of environmental protection. Moreover, the sustainable development strategy has to have conservation, not only natural resources exploitation, as it's main objective. It provides the best framework for understanding how social, economic and environment factors combine in their net influence on the future of our planet.

In the proposed article the basic principles of the natural resources management strategy is analysed as one of the ground aspect of the future industrial policy for Croatia. In our circumstance the fundamental assumption is to preserve the natural resources for the industrial development, particularly to ensure the stable and secure energy consumption growth. But even more important is to ensure the environmental protection. Such equilibrium of contradictions could be established only through the policy of natural resources management. The public opinion is particularly imported in the technology development and future industrial and energy plants planning.

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Gospodarka energetyczna, ekonomika i zrównoważony rozwój

SŁOWA KLUCZOWE: zarządzanie, ochrona środowiska, energia, zasoby, rozwój

Streszczenie

Głównym problemem współczesnej polityki w zakresie rozwoju ekonomicznego jest zachowanie równowagi pomiędzy wzrostem gospodarczym, w szczególności wzrostem konsumpcji energii, a koniecznością ochrony środowiska. Ponadto strategia zrównoważonego rozwoju za główny swój cel uważa nie tylko eksploatację surowców, lecz również ich oszczędność. Daje to najlepsze ramy pozwalające na zrozumienie, jak czynniki socjalne, ekonomiczne i środowiskowe wspólnie wpływają na przyszłość naszej planety.

W artykule przeanalizowano główne zasady zarządzania strategicznego surowcami naturalnymi w aspekcie przyszłej polityki przemysłowej Chorwacji. W warunkach Chorwacji podstawowym założeniem jest ochrona zasobów naturalnych w celu umożliwienia rozwoju gospodarczego, w szczególności dla zapewnienia bezpiecznego wzrostu konsumpcji energii. Jeszcze ważniejsze jednak jest zapewnienie ochrony środowiska przyrodniczego. Równowaga między tymi sprzecznymi celami może zostać ustanowiona wyłącznie poprzez właściwe gospodarowanie surowcami naturalnymi. To stwierdzenie ma szczególne znaczenie zwłaszcza dla rozwoju technologii oraz planowania przyszłych zakładów przemysłowych i energetycznych.