CO_2 tax or fee as a single economic instrument for climate protection policy promoting Renewable Energy Sources and enhancing Energy Efficiency

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REVIEW

This paper presents the analysis of the current implementation of the policy to reduce CO_2 emissions through four practically independent processes: energy market, emission market, support for renewable energy sources through feed-in tariffs (FIT) and support scheme for enhancing energy efficiency. The conclusion is that in this system, some elements of which appear to be controversial, it is not possible to reach the goal - a radical reduction of CO_2 emissions by 80% in total and 95% in electricity production until 2050, which the EU has set as emission reduction targets for this period.

Therefore, a new system is now proposed that is based on a single objective function, CO_2 emissions. The process would be managed through taxes or fees on CO_2, while the raised revenues would be returned to projects aimed at reducing CO_2 emissions, projects for enhancing energy efficiency, renewable energy sources projects and projects reducing emissions from fossil fuels.

The paper outlines the basis of the concept of CO_2 tax or fee as a key measure to stimulate the lowering of emissions and gives an analysis of the impact of different rates of tax or fee on CO_2 emissions on the energy price. A critical analysis of the new model's impact on development of renewable energy sources and on improving energy efficiency in buildings was carried out. Also, there is an analysis of the impact of the new model on transport development.

The introduction of the new model should clear the energy market from administrative limitations and privileged positions of renewable sources and should bring all back in the frame of market economy, no matter what source of energy for production of electricity we are dealing with.

One limitation to the new model is translation of the current situation in to the new system, especially in the field of renewable energy sources and their protected position under the already concluded long-term contracts.

The paper also elaborates the basis for the model of using the revenues collected from taxes or fees on CO_2 emissions to stimulate emission reductions and the fulfilment of long-term goal of minimizing CO_2 emissions. Finally, recommendations are given for the introduction of the new model.

Key words: CO_2, climate protection, CO_2 tax, sustainable development

1. Problem definition

The policy of CO_2 emission reduction is being implemented through four almost independent policies in conditions of continuous development and upgrades of the energy market, particularly in networked commodities. These policies are:

- Energy efficiency improvement,
- Increasing utilization of RES and emission trading,
- Introduction of special charges for emissions.

Due to a lack of a common link connecting these energy policies their results are relatively modest, with continuous increases in energy costs.

The largest contribution to energy efficiency improvements has come from the development of technology, both in production and transformation of energy, as well as in its consumption. Other measures, in particular those applied in the building sector, have shown their potential only partially and their contribution to energy efficiency is yet to be fulfilled. Apart from legislative, industrial and organizational problems, the biggest issue here is funding of the reconstruction of buildings. Nevertheless, all researches point out that the renovation of buildings is the first priority in reducing the energy needs and emissions, addressing the remaining emissions at the same time.

The utilization of renewable energy sources has been boosted by introduction of Feed-in tariffs (FIT) for purchase of electricity from renewable sources at a guaranteed price, together with mandatory purchase of renewable energy. This model is simple to implement, it provides protection for investors and is discriminatory regarding the applied technologies and, if given necessary time, it can deliver the expected results. Usually, the problems encountered in its implementation have to do with too complex administrative procedures and too sluggish regulation of the property matters. This model inflates the price of electricity, because the difference between the market price and production price in certain technologies is compensated by an increase in electricity

prices for end consumers. The concept of developing and using renewable sources based on FIT model in the countries with a high penetration of renewable energy sources has caused two problems: increased cost of electricity due to support for renewables and mandatory purchase of electricity from renewable energy sources, which means serious problems in management of the power systems and market development.

Emission trade as a measure designed to contribute to reducing emissions of CO_2 and other greenhouse gases yielded some results in terms of reducing emissions, but the price paid for it proved to be too high, giving way to moving production out to the developing and emerging countries and downsizing industrial production in the EU. In order to increase the efficiency and scale of the EU emission trading system, and to avoid irregularities identified so far, amendments to the directive (2009/29/EC) that governs emissions trading system for the period from 2013 by 2020 year have been adopted.

Greenhouse gas emissions that occur in the EU outside the ETS sectors are also to be taxed applying the fuel tax. In order to bring the level of taxation as much as possible into line with the financial burden for the plants included in the ETS, the revision of the Directive on energy taxation (2003/96/EC) is underway. The fuel tax would depend on the CO_2 emissions and fuel energy, and the directive would define the minimum amounts required to be applied in the EU countries. Also, a relatively long deadline for implementation of the new tax, set at 2023, has been envisaged, so that industry, in the first place, can be given enough time to adjust to the new tax policy. The aim of the amendments to the directive is to encourage low-carbon development and to create conditions to reach the challenging target of reducing greenhouse gas emissions by at least 80% until 2050. However, the big question is to what extent the introduction of this tax will contribute to achieving these goals.

In Croatia, the introduction of special fees on emissions from vehicles has produced poor results when the reduction of emissions is considered. The reasons lie in the amount of the charge, non-discriminatory nature of this measure, and the purchasing power of citizens when it comes to replacing the old cars with new ones. The average age of passenger cars in Croatia is 11 years. A step forward has been made by the new Law on Special Tax on Motor Vehicles (OG 15/2013), so-called 'Eco-tax', which will link, from 1 July 2013 vehicle taxation to CO_2 emissions. The tax will be formed on the basis of cost of vehicle and its CO_2 emission, so that the cars emitting less than 120 grams of CO_2 per km will cost less, and those with CO_2 emissions above 130 grams per km will be more expensive. Although far more advanced than the current law adopted in 1997, the new law will hardly bring significant benefits in terms of reducing CO_2 emissions unless it clearly defines that at least a part of the revenues raised by this tax are allocated to measures to encourage the use of hybrid or electric vehicles, for example.

Fees on CO_2 emissions from stationary installations with emissions above 30 tons (even some school or hospital buildings, that use extra light fuel oil, generate CO_2 emission above 30 tons) also have not contributed to emission reduction. Because of corrective stimulating coefficients, in practice a unit fee of 14 HRK/tCO_2 has been replaced by much lower amounts (e.g. 3-5 HRK/tCO_2 for HEP's facilities), so that this measure also fell short of providing positive results in lowering emissions.

It can be concluded that the established system of economic measures in Croatia is ineffective and its contribution to the expected reduction in emissions is very low, while at the same time it drives the price of energy up. For example, by end 2012 the electricity prices for final customers increased by about 1% due to incentive fees for renewables and this rise is likely to be even higher in 2013. In addition, while pursing long term goals, the current economic measures could lead to problems in energy systems' operation and market development if appropriate technical, organizational and economic measures are not taken.

2. Elaboration of the concept of CO_2 tax or fee as key measure to encourage emission reductions

The analysis of the existing system of measures for encouraging the reduction of CO_2 emissions shows that the system lacks a synergistic effect, that it inflates the energy prices, and that its incomplete solutions cause major problems in the power system management.

A possible solution is the introduction of a special tax or fee on CO_2 emissions as a single economic measure. The revenues collected in this way would be returned through incentives for activities that contribute to reducing CO_2 emissions. Fees or tax on CO_2 emissions would be paid by end consumers, who use certain type of energy or transforms it into another energy form. The tax or fee should be set in such a way that for energy consumers it would pay more to switch to a new technology or to install CO_2 emissions reducing devices rather than use the current technology.

The concept could be based upon the Fund for Environmental protection which would collect the CO_2 fees / taxes and redistribute them in the form of investment support.

In return for investment support, the Fund obtains a share in the project commensurate to its financial support. In the first X years, the Fund would not participate in profits. After X years, provided the investor has not bought out the Fund's share, Fund participates in profits

Additional measures, such as imposing legal obligation of enhancing energy efficiency (especially in the building sector) and improvement of the standards and norms of thermal insulation, could be introduced.

Tax or fee-payers would be:

- All end customers using fossil fuels - petroleum, natural gas, coal and coke - for covering their energy needs in transport, industry and services, households and agriculture,
- All energy consumers using fossil fuels - petroleum products, natural gas and coal - to produce electricity and heat for the market,
- Imported electricity without a declaration of origin.

The specific amount of tax or fee would be uniform for all CO_2 emissions regardless of fuel type and would be expressed in HRK/ t CO_2. The total amount of tax or fee would depend on performance of the technologies used by energy customers.

The revenues collected annually would be used to support all measures aimed at reducing CO_2 emissions, to promote energy efficiency and usage of renewable energy sources. The concept of financial support would be based on supporting investments, while energy market would be free from any interference in the prices of specific energy forms. This would imply that:

- renewable energy projects can receive financial support regardless of technology they use and depending on their contribution to reducing CO_2 emissions,. This will allow for competition in the single market of electricity, without privileged position of RES,
- projects of energy efficiency in buildings, industrial buildings and transport, can obtain financial support, depending on their contribution to reducing CO_2 emissions,
- projects or transport solutions with low energy consumption and low emissions will be supported.

An important feature of this model is that renewable energy sources do not have a privileged status in the production of electricity, but have to compete with other technologies on the market. Subsidies for investments will enhance their capacity of selling their output in the electricity market.

The model does not discriminate the technologies of renewable energy sources, but by applying the least-cost criterion, encourages the technologies with potential to achieve the set targets for reducing CO_2 emissions. At the current level of technological development and investments, this model would stimulate the use of wind energy, and discourage the use of solar energy. From the point of view of the state's industrial policy there might be quantifiable reasons for supporting further technological development of solar equipment, but not in the frame of this model.

The rate of tax or fee on CO_2 emission is a regulator for carrying out the national policy in emission reduction. It should be economically stimulating, in order to make emission reduction economically appealing for consumers. It would be desirable to set a single rate of tax or fee on CO_2 emissions for the EU.

3. Analysis of the impact on energy price of different rates of tax or fee on CO_2 emissions

In the current practice of partial implementation of certain policies developed to contribute to achieving the targets of CO_2 emission reduction, the funds are being collected through fees.

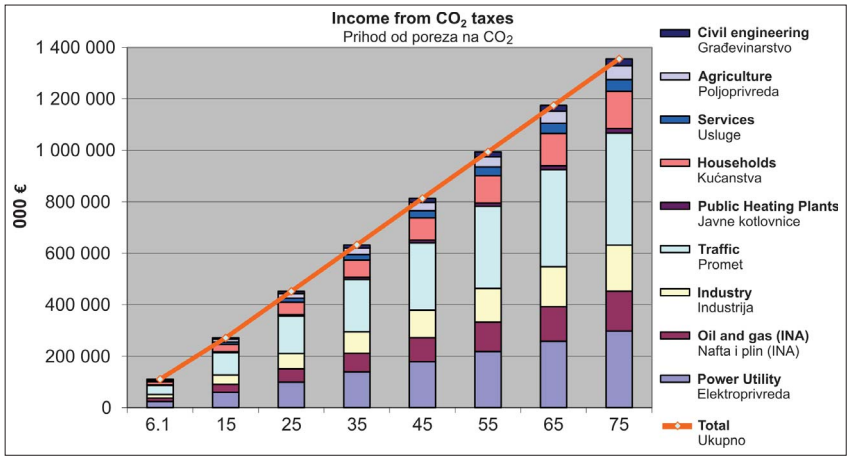
- For achieving policy goals to increase the use of renewable sources special fee of 0.005 Euros per kWh is being charged to all electricity consumers; in 2012 total amount of 12 780 000 Euros was raised in this way.
- For realization of the policy of using biofuels a total of 13 333 000 Euros was collected.
- In the frame of environmental policy realization, charges on CO_2, SO_2 and NO_2 and special tax on motor vehicles are being applied. Total revenues from this fee amounted to 41 287 000 Euros.

Fee on CO_2 emissions into the environment	7 667 000
Fee on SO_2 emissions into the environment	1 820 000
Fee on environmental emissions of NO_2	860 000
Special environmental charge on motor vehicles	30 940 000

In 2012, total collected revenue for the promotion of renewable energy sources and lowering emissions was 67 740 000 Euros, which is about 3.75 euro/tCO_2. These funds are not sufficient to meet the goals of the 20/20/20 policy, and, if the present model remains in place, they should be significantly increased.

The analysis of the impact of different levels of taxes or fees on CO_2 considers the following amounts of taxes / fees: 6.1 €/ t CO_2, 15 € / t CO_2, 25 € / t CO_2, 35 € / t CO_2, 45 €/tCO_2, 55€/tCO_2, 65€/tCO_2 and 75€/tCO_2.

Revenues from taxes or fees are shown in the following figure.



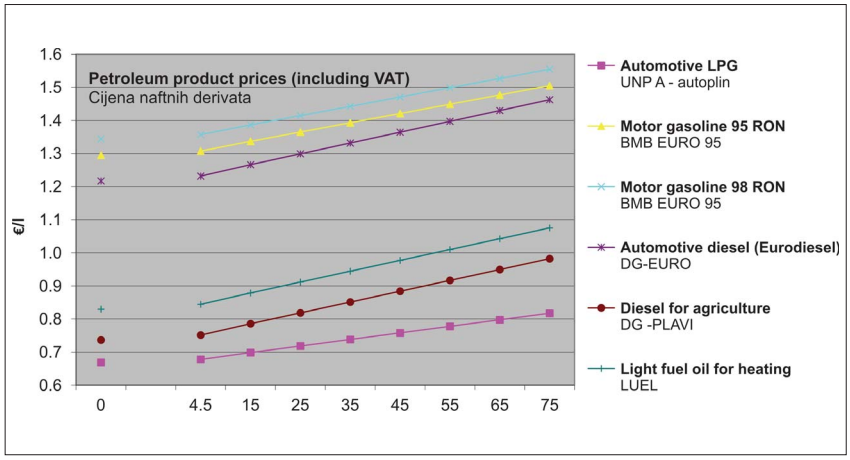
Revenues from taxes or fees are shown in thousands of Euros for the different values of taxes or fees:

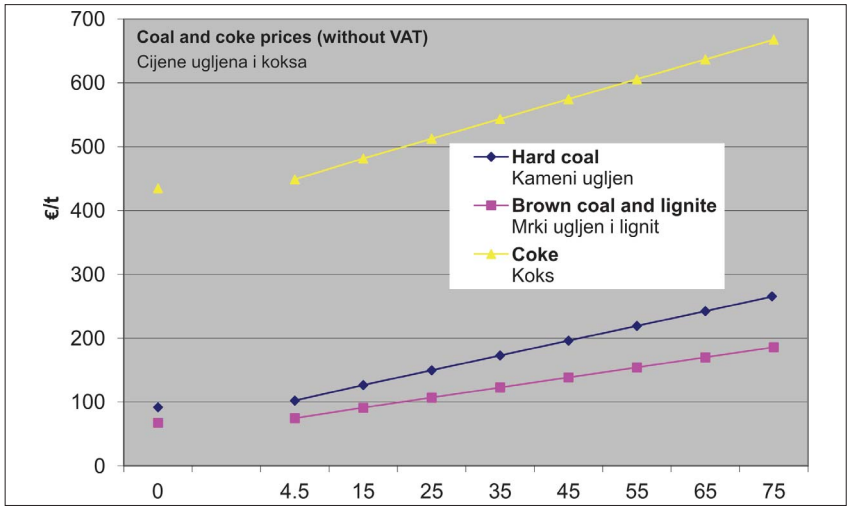
€/t CO_2	6.1	15	25	35	45	55	65	75
Electric. & district heat.	24 216	59 547	99 246	138 944	178 642	218 340	258 038	297 737
Oil and gas (INA)	12 596	30 975	51 625	72 275	92 924	113 574	134 224	154 874
Industry	14 581	35 856	59 760	83 663	107 567	131 471	155 375	179 279
Traffic	35 433	87 130	145 216	203 303	261 389	319 476	377 562	435 649
Public Heating Plants	1 422	3 498	5 829	8 161	10 493	12 825	15 156	17 488
Households	11 767	28 934	48 224	67 513	86 802	106 092	125 381	144 671
Services	3 736	9 187	15 312	21 437	27 562	33 687	39 812	45 937
Agriculture	4 370	10 747	17 912	25 076	32 241	39 406	46 571	53 735
Civil engineering	2 140	5 263	8 772	12 281	15 790	19 299	22 808	26 316
Total	110 262	271 137	451 895	632 653	813 411	994 169	1 174 927	1 355 685

The three figures on the right present the analysis of the effects of different values of taxes or fees on prices of petroleum products, natural gas, coal and coke. The prices of petroleum products and natural gas are final prices including VAT, while the prices of coal and coke are given without VAT.

Since emission lowering is a long term goal, revenues collected from taxes or fees on CO_2 emissions will also be falling gradually. If, in 2050 the targets of reducing overall emissions by 80% and emission from the power sector by 95% come to be fulfilled, the revenues from carbon taxes or fees will be reduced to minimum.

The introduction of a tax or fee on CO_2 emissions will partially increase the cost of energy. This increase will depend on the extent of price increase due to the existing system, which is presently affecting the prices through various taxes, fees or feed-in tariffs for renewable energy. It is probable that, during the period until 2050, energy prices will be growing because of introduction of increasingly expensive technologies. Of course, this overview of the period until 2050 is static, because the technological development and the market itself are expected to play their role in energy prices, so that we may as well see the decrease in energy prices in the future.



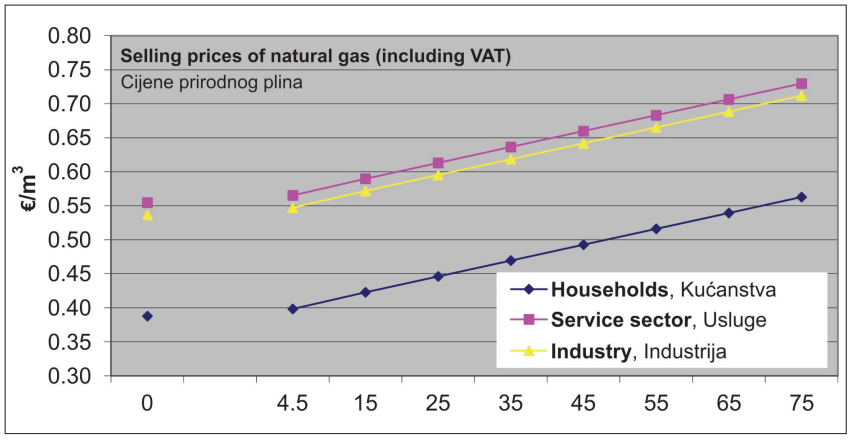


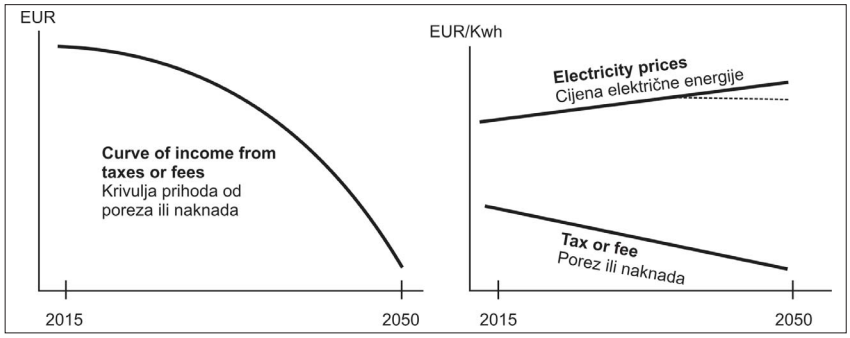
4. Analysis of the impact on the development of RES

The current model of supporting electricity production from renewable sources through feed-in tariffs allowed for a privileged position of RES in energy purchasing, different tariffs based on technologies, and long-term contracts that guarantee return on invested capital and an adequate profit. It seems to be the model works well for renewable energy sources, but it is certainly not so for the electricity market.

Different tariffs for different technologies are the result of technological development and achieved performance of specific technologies, and the share of specific technologies in generation is an issue with significant public interest implications. Any departure from the economic criteria should be justified by the public interest.

When the share of renewables in electricity consumption, excluding controlled renewables, increases to more than 10-15% it can have a significant im-





pact on the operation and costs of other sources and on the power system's balance. The privileged position of the renewable sources becomes a problem in running the system, which can be mitigated by means of technical and organizational measures, organization of ancillary services market, spatial diversification, pan-European energy market integration, development of smart grids, energy demand management and others measures.

In order to promote the use of renewable energy sources for heat production, incentives are envisaged for investments.

The new model envisages the incentives for using renewable energy sources at the investment side in accordance with the principle of avoided emissions. The model is non-discriminatory in terms of technologies, so it can be concluded that it would not encourage expensive technologies, such as the use of solar energy.

The new model also eliminates the privileges in placement of energy in the grid, but the placement of energy is based on the market prices. It is essential that CO_2 tax or fees are such to ensure that the production cost of electricity from fossil fuels-fired power plants is higher than the cost of electricity from renewable sources.

5. Analysis of impacts on increase of energy efficiency in buildings

Enhancing energy efficiency is a measure that contributes to the reduction of CO_2 emission, and, thus it should receive support from the funds collected from taxes or fees on CO_2 emissions. When defining policies for energy renovation of old buildings and for new constructions it is necessary to set national long-term targets for quality of the buildings expressed as energy losses in kWh/m^2, as well as the goals that will be additionally supported regardless of the age of the buildings. If a national target would be set at losses level of 50 kWh/m^2, then national policy should include the following components:

- To set the level of thermal insulation at 50 kWh/m^2 for new buildings as legal obligation,
- To set a system of support for energy renovation up to the 50 kWh/m^2 level,
- To set up a system of incentives to achieve "zero" emissions for new and old buildings.

The introduction of uniform incentives through taxes or fees on CO_2 emissions has a stimulating effect because of growing energy expenditures, rising potential for energy savings and provision of funds for supporting the projects of energy efficiency of the buildings.

6. Transport

Reduction of CO_2 emissions in the transport sector is a major challenge and the achievement of this goal will probably take a mix of various measures. The underlying basis for all measures should be a CO_2 tax or fee and such revenues should be used to fund energy efficiency improvements and utilization of new technologies.

Levying taxes and fees in accordance with amount of fuel, combined with the use of subsidies, is the best way to encourage big consumers, i.e., those who consume large quantities of fuel in low efficiency engines or by making big mileages, to look for the solutions in new technologies, biofuels or fuels with lower emissions and combining transport, together with the use of incentive funds.

In the sector of biofuel production a shift is expected to take place from the first generation biofuels based on raw materials from agriculture (oilseeds for biodiesel and starch plants for bioethanol). Their role was mainly to change the paradigm in the fuel market economy and to incite the transition from fossil fuels to biofuels. The prices of first generation biofuels have a high correlation with the oil prices because of a large portion of inputs of fossil origin in biofuel production, which is the reason for failure in reaching the main objectives of energy policy: to reduce dependence on fossil fuel, to lower greenhouse gas emissions, and to achieve sustainability. Only development of second generation biofuels produced from lignocellulose residues from agriculture and forestry sector is expected to bring about the transition from fossil sources to biofuels.

7. Analysis of the development of the energy market

If the current model, in which the share of renewable energy sources is increasing daily while the market is shrinking, continues to be in place, it will bring into question the existence of the market and open a possibility that the market disappears, thus, leaving the space to total regulation. This is probably not a sustainable option for the future relations in the energy market.

The new model eliminates the privilege of renewable energy sources and puts them in a position to compete with other electricity production technologies. It is expected that this will stimulate further development of technologies for electricity production and systems of planning and operation of renewable energy sources. The fee or tax rate is a tool for managing the processes toward the targeted reduction of CO_2 emissions.

8. Analysis of the impact of the change in RES financing on previously concluded contracts

Replacing the financing model should not have a negative impact on the use of renewables. On the contrary, a new model should be rather stimulating because it is expected that increasing use of renewables will enable significant reduction of emissions. Particularly is highlighted the problem of solar energy technology, where significant improvements and upgrades in efficiency and competitiveness with other renewable energy sources are expected.

The problem of the existing contracts is primarily a legal issue and can be resolved in several ways:

- By retaining contractual rights until contract expiration; after that the parties would participate in the market at equal terms as any new producer,
- By retaining the model till return of capital, followed by participating in the market,

- By termination of the contracts, with compensation for lost profits.

A thorough analysis should be conducted and each solution should be evaluated. The situation of each country is different, because it depends on specific shares of renewables, nature of the contracts and, of course, on the applicable legislation.

9. Model of energy sector development and economic relations

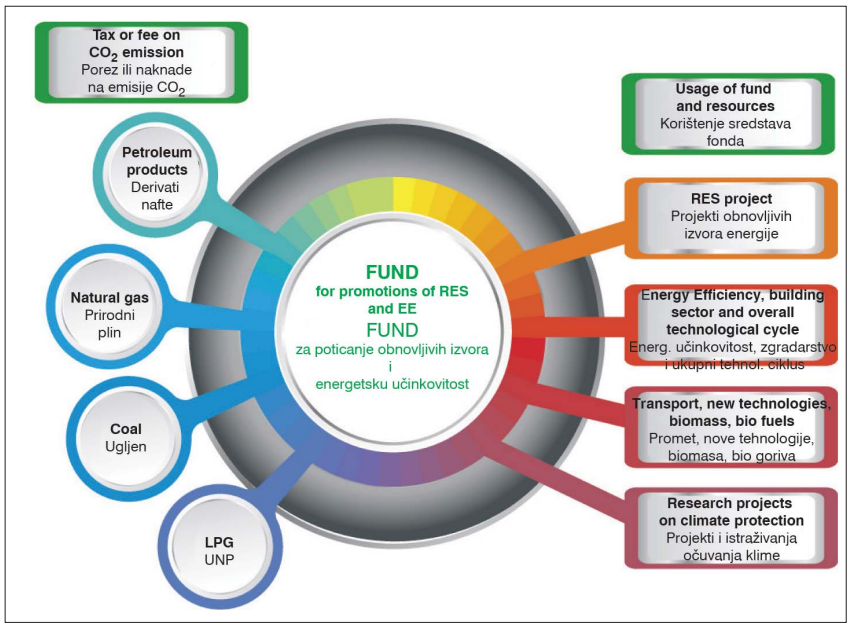
The model of the energy sector development should be based on economic criteria of cost optimization while satisfying the goals of reducing CO_2 emissions. Taxes or fees are an economic regulator for stimulating the introduction of new technologies in order to reduce CO_2 emissions, and the revenues collected from taxes and fees are the financial accelerator for achieving policies of energy efficiency enhancing, usage of renewable energy sources and new technologies.

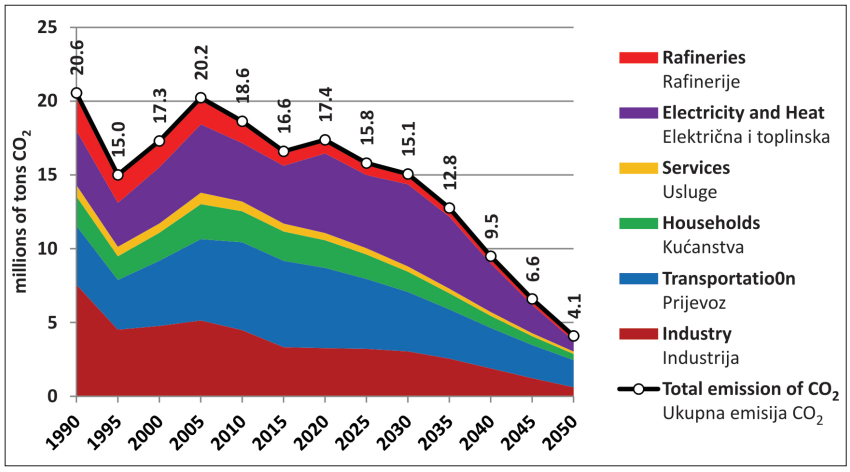
Economic relations in the energy sector are exclusively market based and without administrative positioning and protection of any source.

10. Elaboration of models for using revenues raised through CO_2 taxes or fees

The main purpose of the revenues from taxes or fees on CO_2 emissions is to reduce the emissions of greenhouse gases. It is necessary to set targets of emission reduction in all sectors and, following the largest impact requirement, give priority to those measures which most contribute most to emission lowering. The support includes:

- Improving energy efficiency throughout entire technological process, particularly in the building sector (to increase energy efficiency in all sectors of final energy consumption, as well as in the energy transformation sector)
- Increasing the use of renewable energy sources,
- Reducing transport emissions, by promoting new technologies, use of biofuels, adopting low emission transport and public transport,
- Environmentally safe capture and geological storage of carbon dioxide, particularly from fossil fuel-fired power plants and certain industrial sectors and subsectors
- Funding research aimed at mitigating climate change and adapting to climate change, including in the areas of aeronautics and air transport,





- Funding research and development in energy efficiency and clean technologies,
- funding research and development in the field of reporting on greenhouse gas emissions.

11. Analysis of the energy sector with a CO_2 tax, while ensuring the goals of reducing CO_2 emissions by 2050

The analysis of the energy sector in Croatia shows that it is possible to achieve the targets set for reduction of CO_2 by 2050: reduction of total emissions by 80% and by 95% in the production of electricity respectively, all in relation to 1990.

This will prompt major changes in the energy sector. Great technological changes and improvements are also expected.

Main structural changes:

- Significant increase in energy efficiency in all technological processes and achieving average losses in buildings of 30 kWh/m^2,
- Significant increase of RES,
- Use of CCS technology in power generation and industry,
- Use of biomass in households and DH systems,
- Use of over 50% of cars running on electricity, biofuels, CNG and electric traction.

The introduction of carbon taxation is expected to raise energy prices, but at the same time there will be reduction in energy consumption due to increased energy efficiency, especially in the heat consumption, so that the overall growth in energy costs in long term will be lower than the rise in level of taxation.

12. Conclusions and recommendations

a) The concept of developing an energy sector with almost no CO_2 emissions will deeply change the sector, from the production and choice of primary energy to the transmission / transport, distribution and consumption of energy,

b) From the technological point of view, it is possible to reduce CO_2 emissions until 2050, by 80% in the energy sector and by 95% in the production of electricity, from 1990 levels,

c) Requirements for achieving these goals:

- Establishing a unified and global approach to the problem of emission reductions,
- Establishing a uniform economic measure in order to stimulate emissions reductions by evaluating contributions to reducing CO_2 emissions; introducing taxes or fees on CO_2 emissions and using the collected revenues for promotion of emission lowering measures,
- Developing a single energy market at the European level regardless of the type of technologies for energy production; the abolition of privileged position of renewable energy sources.

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