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С Ъ Д Ъ Р Ж А Н И Е

C O N T E N T S

HUMANITARIAN AND SOCIAL INVESTIGATIONS

ECONOMICS AND MANAGEMENT

CARBON MARKET: ENCOURAGING OF INVESTMENT IN THE ENERGY PROJECTS IN SERBIA

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ABSTRACT. Energy supply represents one of the main issues of sustainable development on a global scale, and its solution is in energy efficiency increase, plants modernization and use of renewable energy resources. The goal of this paper is to imply that investment in technologies with low carbon emissions is a profitable one, since its use allows overall decrease of greenhouse gas emissions on both local and global level. Special emphasis in paper is on CO_2 emissions prices on the carbon market which can encourage project realization focused on larger exploitation of renewable energy resources in Serbia.

Keywords: GHG emissions, CO_2 emission prices, energy projects, investment, renewable energy resources

ПАЗАРА НА ВЪГЛЕРОДНИ ЕМИСИИ: НАСЪРЧАВАНЕ НА ИНВЕСТИЦИИТЕ В ЕНЕРГИЙНИ ПРОЕКТИ В СЪРБИЯ

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РЕЗЮМЕ. Осигуряването на енергия е един от основните проблеми на устойчивото развитие на световно ниво и неговото решаване е свързано с увеличаване на енергийната ефективност, модернизирането на заводите и използването на възобновяеми източници на енергия. Целта на този доклад е да покаже, че инвестирането в технологии с ниски въглеродни емисии е изгодно, тъй като позволява цялостно намаляване на емисиите на парникови газове както на местно, така и на световно ниво. Специално внимание е обърнато на цените на въглеродните емисии на световния пазар, което може да насърчи реализирането на проекти, свързани с по-голямото използване на възобновяеми енергийни източници в Сърбия.

Ключови думи: емисии парникови газове, цени на емисиите на CO2, енергийни проекти, инвестиции, възобновяеми енергийни източници

Introduction

Climate changes have been recognized as a serious environmental problem which can violate the functioning of human civilization. energy consumption is an important component of the global climate change to reduce carbon dioxide (CO_2) emissions and ensure sustainable growth in the energy sector coincides with a looming new investment cycle in power generation in most OECD countries. In non-OECD countries, many power generation facilities are quite young, but more will be built in the coming years to meet growing energy demand. There is a window of opportunity to establish the policy framework to enable transformational change in the energy sector, including facilitating technological innovation and the creation of new markets and industries, to reduce the sector's carbon-intensity, and improve energy efficiency (OECD, 2011).

In accordance with the foregoing, energy industry has a two-fold responsibility with respect to climate change. On the one hand, it needs to be prepared for facing new risks due to the negative effects that climate change has on its business. the other hand, it can significantly help the low-carbon economy to develop by providing related products and services (e.g. services for emissions trading and financing for renewable energy technologies) (UNEP FI, 2015).

Energy company have to take into account new risks connected with carbon market products and services, therefore, it is very important to evaluate the value of power plant investment such as expansion and new construction under uncertainties of climate policy and electricity market. For one of economic analysis methods for investment projects under uncertainties, real options analysis has recently attracted growing attention (Takashima and Oda, 2012).

Energy emissions trends - global view

Carbon dioxide (CO_2) is constantly being exchanged among the atmosphere, ocean, and land surface as it is both produced and absorbed by many microorganisms, plants, and animals.

However, emissions and removal of CO_2 by these natural processes tend to balance. Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding CO_2 and other heat-trapping gases to the atmosphere. (International Monetary Fund, 2014). One indicator of the scale of the challenge to the energy sector is the fact that the total volume of global energy sector CO_2 emissions over the past 27 years matched the total level of all previous years. Fossil fuels continue to meet more than 80% of total primary energy demand and over 90% of energy-related emissions are CO_2 from fossil-fuel combustion (Fig. 1) (International Energy Agency (IEA), 2015).

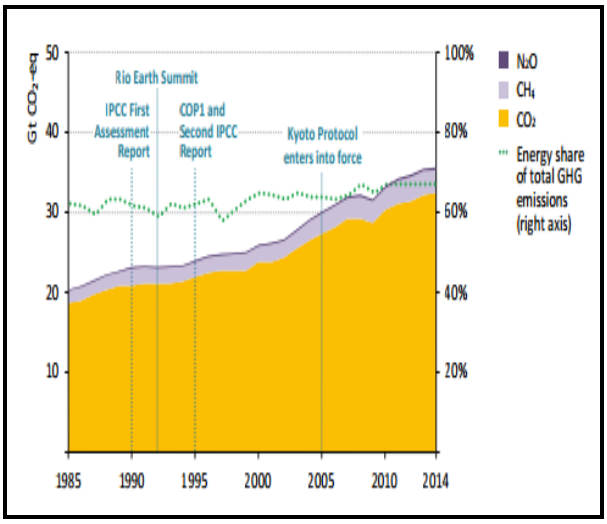

Fig. 1. Global anthropogenic energy-related greenhouse-gas emissions by type

Notes: CO_2 = carbon dioxide, CH_4 = methane, N2O = nitrous oxide. CH_4 has a global warming potential of 28 to 30 times that of CO_2, while the global warming potential of N2O is 265 higher than that of CO_2.

Source: International Energy Agency (IEA), 2015.

Since 2000, the share of coal has increased from 38% to 44% of energy-related CO_2 emissions, the share of natural gas stayed flat at 20% and that of oil declined from 42% to 35% in 2014. While smaller in magnitude (and less long-lasting in the atmosphere, though with higher global warming potential), methane (CH4) and nitrous oxide (N2O) are other powerful greenhouse gases emitted by the energy sector. Methane accounts for around 10% of energy sector emissions and originates mainly from oil and gas extraction, transformation and distribution. Much of the remainder is nitrous oxide emissions from energy transformation, industry, transport and buildings (International Energy Agency (IEA), 2015).

GHG emissions in Serbia

The Republic of Serbia has been a member of the United Nations Framework Convention on Climate Change since 2001 and a member of the Kyoto Protocol since 2008. As a contracting state of the Kyoto Protocol, Serbia is obliged to report regularly on emissions and mitigation and adaptation measures by preparing national reports. According to the data from the First Biennial Update Report, total GHG emission in 2013, not taking into account the amounts of gas removed, is 62,520,88 Gg CO_2eq. Compared to 2010, the 2013 GHG emission was reduced by 3.5% and 25.1% in comparison to 1990 (Table 1). The Serbian energy sector consists of oil and natural gas industry, coal mines, an electric power system, a decentralized municipal district heating system and industrial energy. Activities in the energy sector include the production of domestic primary energy, the importation of primary energy (mostly oil and natural gas), the production of electric power and thermal energy, the production and the secondary processing of coal and the transport and distribution of energy and energy products to energy consumers. The vast majority of the Serbian energy infrastructure is state-owned and is operated by the public enterprises that were established by the state to manage the various domestic energy sectors (Đorđević et al., 2015)

Table 1.

GHG emissions by sources and removal by sinks, in sectors in 1990, period 2010-2013 and emissions trend

	1990	2010	2011	2012	2013	Trend 2010-2013
Emission			CO_{2eq} (Gg)			%
Energy	65.730,38	51.004,86	53.919,72	48.671,48	49.661,06	-2,6
Industrial processes	4.871,13	4.201,66	4.482,80	2.662,35	3.031,42	-27,9
Agriculture and land use	9.078,22	6.466,23	6.459,43	6.378,09	6.620,96	2,4
Waste	3.839,77	3.140,90	3.165,05	3.246,97	3.207,45	2,1
Total emissions without removal	**83.519,50**	**64.813,65**	**68.027,00**	**60.958,89**	**62.520,88**	**-3,5**
Removal			CO_{2eq} (Gg)			
Forestry	-16.855,36	-16.558,87	-16.733,17	-16.733,17	-15.737,06	-5,0
Total emissions with removal	**66.664,41**	**48.254,78**	**51.293,83**	**44.225,72**	**46.783,83**	**-3,0**

Source: Ministry of Agriculture and Environment of the Republic of Serbia, 2015.

According to the 2013 data, energy sector accounts for 79.4% of total GHG emissions, not taking into account removals by sink, and it is followed by agriculture and land use sector (10.6%), waste sector (5.1%), and sector of industrial processes and product use (4.8%). The most frequent greenhouse effect gas, expressed in CO_2 equivalent (CO_2eq) in 2013 was carbon dioxide (CO_2), which produced 78.9% of total GHG emissions, then comes methane (CH_4) (13.9%) and nitrous oxide (N2O) (7.0%), while hydro fluorocarbons (HFC), per fluorocarbons (PFC) and sulfur hexafluoride (SF_6) together comprised 0.2% of total GHG emissions. In the distribution of the above gases, energy sector contributes to CO_2 emissions with 94.4% (99.3% of which goes on fuel combustion processes) (Ministry of Agriculture and Environment of the Serbia, 2015).

Projections of GHG emissions until 2020 on the sectoral and overall level in Serbia have been given for three scenarios (Fig. 2):

1. ***Business as usual scenario*** implies implementation of policies and measures as it is done now, without any advancement and extension.
2. ***Scenario with measures*** implies a complete achievement of objectives from the adopted legislation and strategic documents, including

increased concrete and practical activities and measures.

3. ***Scenario with additional measures*** includes planned policies and measures, i.e. the ones which are under discussion and which stand a real chance to be adopted and realized in the forthcoming period.

In determining the measures and opportunities for reducing emissions in Serbia, it is taken into consideration that they need to be horizontally integrated into the overall economic and sectoral policies and strategies. The anticipated measures relate to the energy sector, industry, transport, construction industry, agriculture, waste collection and waste management, and forestry. As a result of the implementation of the measures by the year 2020, it is estimated that the reduction could reach 7% in the construction sector, 8% in the transport sector and, potentially, up to 57% in the energy sector. The expected opportunities to reduce GHG emissions, as well as the selection of targeted sectors, clearly indicate which way our country should choose and what should be the focus of future actions.(Bajić-Brković, 2012).

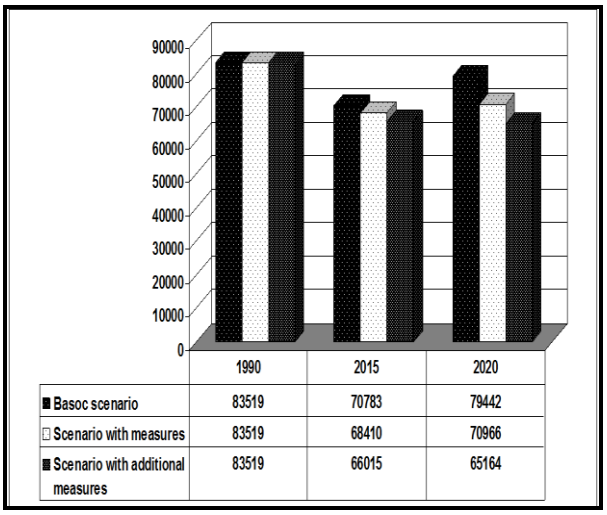

Fig. 2. Total CO_2 emissions trend and projections for period 1990-2020 for three scenarios, Gg CO_2eq

Source: Authors

The key measures with the greatest potential for GHG emissions reduction in the Republic of Serbia and worldwide are the support to renewable energy resources and improving energy efficiency. The mitigation potential due to renewable energy resources use, in the scenario with measures, amounts to 1.418 Gg CO_2eq in 2015 and 7.369 Gg CO_2eq in 2020. However, with the application of additional measures, the mitigation potential due to renewable energy resources use is as high as 2.214 Gg CO_2eq in 2015 and 9.972 Gg CO_2eq in the year of 2020. (Ministry of Agriculture and Environment of the Republic of Serbia, 2015).

Cost projections production of electricity

The environmental imperative to reduce CO_2, emissions in the energy sector coincides with a looming new investment cycle in power generation in most OECD countries. In the emerging market economies, many power generation facilities are quite recent, but many more will be built in the coming years to meet growing energy demand. As power plants and other infrastructure tend to have long operating lives, we must avoid “lock-in” of CO_2 emissions by ensuring the latest clean technologies are used. We have a narrow margin. If we do not manage to slow current rates of emissions growth, we will hit the ceiling by 2017, meaning that to keep the global increase in temperature to 2 degrees Celsius; all new infrastructure will have to be zero-emission.

A large-scale transformation of the global energy sector is possible, although it will require significant investment. Global emissions could be halved by 2050, using existing and emerging technologies, at an additional cumulative investment of USD 46 trillion, a further increase of 17% on top of baseline investments. It is vital for governments to create an enabling policy framework to catalyse private-sector investment in the transition to a lowcarbon energy sector. By acting now, long-term costs can be reduced. Every US dollar that is not spent on investment in the energy sector before 2020 will require an additional USD 4.3 to be spent after 2020 to compensate for increased greenhouse gas emissions by building zero-carbon plants and infrastructure by 2035 (OECD, 2011).

Taking into account the above, the negative impact of the energy sector on the environment, primarily on the air quality, partially can be compensated using the RES, but the most part can be compensated by implementation of measures for protecting the environment at installations for the production of energy. The basis for informing investors about the potential economic performance of energy projects is carbon price of 5 €, which is similar to today's EU-ETS price as well as the price of 30 €, which is expected in 2025. (Change partnership, 2015).

The fact that the Republic of Serbia has no obligation to introduce compensation for the carbon led to a plan of increasing the capacity of electricity generation from coal. However, in the process of accession to the EU power sector of Serbia will be faced with mandatory and financially burdensome costs of CO_2 emissions. Projected changes in the structure of energy sources for electricity production (significant share of RES and natural gas), the withdrawal of old and inefficient plants, commissioning of new, more efficient lignite-fired power and reduction of losses in distribution and transfer will lead to significantly lower specific GHG emissions from this sectors (Energy Strategy of the Republic of Serbia until 2025 with projections to 2030).

According to the Energy Community, Serbia has a binding target to achieve the electricity production from the RES of 27% by 2020. In order to achieve the adopted national targets, installation of the capacity for the production of electricity by using wind, biomass and solar energy is planned (Figure 3), (Strategy of Republic of Serbia up to 2025 with projections to 2030).

Starting from the fact that a high share of coal in electricity production in Serbia to demand the implementation of the

European CO_2 emissions trading scheme, in Table 2 we compare, over a 10-year period, total costs of new fossil fuel capacity against total costs of meeting that same capacity through wind or solar. As can be seen, wind is the cheapest way to cover electricity from new installations.

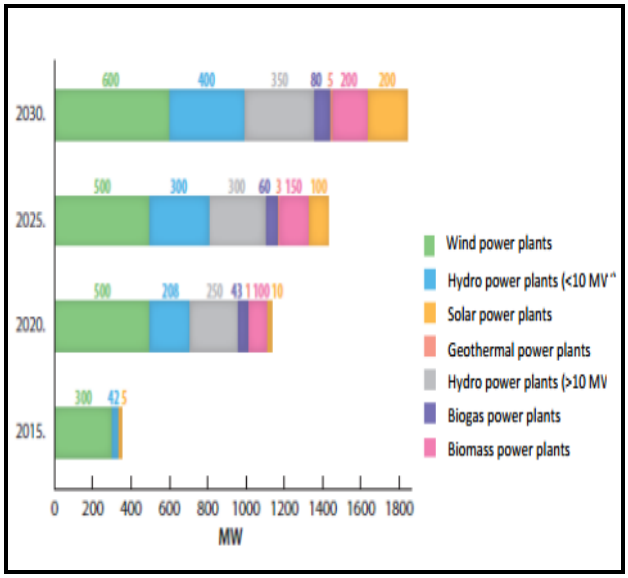

Fig. 3. Projection of new capacities for electricity production using RES
Source: Energy Strategy of the Republic of Serbia until 2025 with projections to 2030

Table 2.
Cost comparison between fossil fuels and RES of new capacity for the first 10 years of operation

Country (EnCom)	Total cost of new fossil fuel capacity in 2030 (€)*	Wind cost at current prices (€)**	Difference (%)	Solar cost at current prices (€)**
Serbia	10,144,609,000	7,561,631,605	75 %	12,851,420,455
Albania	125,290,000	213,625,245	171 %	31,0415,094
Bosnia and Herzegovina	4,012,743,000	3,371,367,417	84 %	6,436,914,894
Macedonia	1,588,215,000	1,541,010,274	97 %	2,364,856,776
Montenegro	1,401,492,000	1,008,600,000	72 %	1,890,000,000

Source: Stojanovic, Djordjevic, 2016.

Taking into account the intended obligation of payng compensation for the carbon for the new capacity using coal and gas in the future, it is estimated to be 25% cheaper to build new capacity on wind than the new capacity on fossil fuels. On the one hand, the estimated costs of building new plants using fossil fuels add up with the costs of carbon for the first 10 years of operation (2020-2030), with an expected average costs of carbon of 30 €/t amount over 10 billion €. On the other hand, despite many installed capacity to obtain the same amount of energy, equivalent wind power would cost 7.5 billion € (Centre for Ecology and Sustainable Development (STEP), 2015).

The data shown in the preceding tables show the challenges faced by member countries of the Energy Community with regard to electricity production and investment in the short and medium term. In addition to the foregoing energy projects, it becomes necessary and to consider the use of other renewable energy projects such as biogas, cogeneration biomass and geothermal energy.

Renewable energy sources - Serbia's potential

Renewable energy sources are sources that are found in nature and can fully or partially be naturaly replenished. The most important renewable energy sources are:

- Wind power,
- Solar energy,
- Bioenergy,
- Hydropower.

The issue of renewable energy sources is very current in all developed countries. There are numerous advantages to using such sources, for instance they are more environmentaly friendly than conventional sources, particularly with regard to air emissions, and emissions from renewable energy sources are much more short-lived that those from fossil-fueled plants. Namely, combustion of fossil fuels releases large quantities of CO_2 which increases the greenhouse effect. Many directives and policies have been enacted in the EU aiming at supporting renewable energy sources. The goal of the EU for 2020 is to meet the socalled "20-20" targets.

The key objectives of these targets are a 20% increase in use of renewable sources and a 20% decrease in emission of greenhouse gases. In order to reach these objectives, EU countries are introducing various economic instruments to stimulate investing in renewable energy sources, such as feed-in tariffs, quota systems and green bonus. The Serbian Government has adopted several regulations under Directive 2009/28/EC from November 2009, including establishing a system of "incentive tariffs" within which the Serbian Government will subsidize the cost of renewable electricity.

Renewable energy sources are the focal point of Serbia's energy independence in the future. This is supported by the fact that the total potential of energy from renewable sources can meet a quarter of Serbia's annual demand; add to that the enormous potential for energy savings across all sectors, and the general impression is that Serbia has good renewable energy souces: some estimates of wind power indicate 10.000 MW, while the potential for small hydropower plants is estimated at no less than 500 MW. Although renewable energy sources are particularly important for Serbia because of its accession to the EU, the use of renewable sources in production of electricity has not yet reached greater proportions, which is unacceptable given the huge potential for their use (the overall technical potential of energy from renewable sources is around 160 PJ per year).

Namely, the large potential for use of solar energy is evident from the fact that the number of sunny hours in Serbia exceeds 2000, while the solar energy emitted in one year on 1 m2 of roof of one house equals the energy generated from the combustion of 130 liters of oil. Areas with a large number of sunny hours and annual ratio of actual radiation and overall possibility cover aproximately 50% of Serbia's territory. Finally,

it is important to note that the energy potential of solar radiation in Serbia is one third (about 40%) higher than in Central Europe, making it very attractive to investors (Janković et al., 2015).

Most important points carbon market development in Republic of Serbia

Keeping in mind global effects of climate changes, as well as growing number of ecological catastrophes all around the world, the Kyoto protocol question becomes more and more significant. The necessity of implementing this document is quite obvious. Republic of Serbia signed Kyoto protocol on January 17th 2008. Even though Serbia's position is mainly defined by causes and consequences of transition to EU membership, certain experiences of some countries might be of importance for understanding global tendencies and defining one's position. This particularly refers to tendencies related to negotiations on future activities of international community regarding climate changes and taking over commitments which are (not) in accordance with economic and social abilities. (Todić and Grbić, 2014).

Considering former analyses and projections, crucial points of emission market growth would be the following: (Djordjevic et al. 2016):

1. A price signal on current greenhouse gas emissions;
2. Planned new fossil fuel capacity; Implementation of the Industrial Emissions Directive;
3. Renewable energy;
4. Energy efficiency:

Using carbon markets to improve the energy efficiency of a country may have some positive implications such as:

- attracting new technologies,
- encouraging economic innovation,
- improving the competitiveness of the economy and
- fostering long-term economic growth.

Pursuant to the above mentioned, investing in projects of utilization of renewable energy is very important for several reasons (Rakic, 2009):

- Renewable energy sources have a very important role in reducing CO_2 emissions into the atmosphere and reducing emissions is the goal of European Union policy;
- increase the share of renewable energy increases the sustainability of the system (reducing dependence on imports of raw material and electricity);
- expected that the OIE become economically competitive with conventional energy sources.

Bearing in mind the global effects of climate change on the health of the population in the Serbia, as well as the increasing number of environmental disasters around the world, the issue of the Kyoto Protocol, and to invest in projects of utilization of renewable energy is becoming increasingly important (Stojanovic and Popovic, 2016).

Conclusion

Globalization affects the way of life in all the countries, including the Serbia, so that the further development of the energy sector is increasingly conditioned by generally accepted international rules. At the global carbon market, the Republic of Serbia can turn its energy inefficiency in comparative advantage. Charging emissions will inevitably focus the producers on using of cleaner technologies. However, improving the efficiency of energy consumption is not just presuming the application of certain technical solutions. In fact, any technology, no matter how effective, lose that feature if not used in the most efficient manner. If the Serbia wishes to become a full member of the EU it is necessary to adopt rules for protecting the environment and reducing climate change.

When it comes to power generation, investment projects in this area are primarily directed on funding the capacity building for the use of RES such as wind, solar and hydropower. Investing in projects of utilization of RES is primarily a matter of people's consciousness and their will to change long-established habits and adoption of energy-efficient solutions. That is the reason because it is necessary to consider consumer habits first and direct them toward more conscientious choices before making recommendations for improving the energy efficiency of certain country. Accordingly, deciding about their application will be done on the basis of their cost-effectiveness, which will increase energy as well as economic efficiency.

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Recommended for publication by Editorial board.