

# ECONOMIC-ACCOUNTING ASPECTS OF SOLVING THE PROBLEM OF CARBON EMISSION

Ivan M. Milojević, Milan B. Mihajlović and Vladan D. Vladislavljević  
University of Defence in Belgrade, Military Academy

**D**ue to economic differentiation in the world negative effects occurred at a global level. Non-global approach to the problem in rich countries caused the pollution to become a global problem because of their policies of transferring 'dirty' technologies into 'third world' countries. This is why it is necessary to introduce the solution of the global problem in economic dimension by introducing oxygen as the fifth main productive element, the others being soil, labour, capital and knowledge. In connection to this, growing consumption and feedback in production cause growing oxygen consumption through their visible forms.

*Key words: accounting, economic, global temperature growth, carbon dioxide emission*

## Introduction

**B**esides the main product, the problem of modern business operations is that they produce a great number of side products, one of which is carbon. Societies face negative consequences of growing carbon concentration in the environment at the beginning of 21st century such as global warming and related consequences, pollution of eco-system factors and many other problems. Negative effects of such consequences reflect in everyday monitoring of carbon concentration, primarily in air, but also in other elements important for environment protection. Economic dimension of the solution to this global problem can be found in accounting as a fundamental economic discipline which deals with planning, recording, control, analysis and reporting of business events. Only the correctly established global accounting – information system can stop, that is, reduce global effects in increased carbon emission.

Mathematically and economically speaking, global accounting system would reduce the number of multinational and transnational corporations to ordinary national companies, because it would incorporate national economy into a global accounting-information system. By doing this we would be able to monitor and express values of carbon emitters, the largest oxygen consumers. As market rules request, consumption has to be charged, and production paid off. In this way, payment obligation would be imposed upon the largest oxygen consumers, and the largest producers would be paid for their production. Market

management viewed in this way needs to have certain reference points, based on which the system could be established. Therefore, social consciousness of the strongest and largest participants in global social life is necessary. Unfortunately, problems of humankind, as well as everything else in the society, are solved 'at the very last moment'. Social responsibility is reflected through numerous conventions on environment protection, on harmful gases emission reduction, on millennium goals, etc. Besides thus presented elements necessary for environment protection, we cannot disregard financial dimension which imposes the need for constant profit growth. Due to constant wish to have the largest profit possible, great number of companies want to locate their production capacities on the territories where general costs (taxes and local taxes) are lower. This leads to national economies having to adjust to the overall race for fresh capital and so they reduce fiscal dues, thus reducing compensational possibilities for environment protection. By introducing oxygen and carbon into the production system as a main factor on a global level and through global accounting – information system, these problems could be overcome and a new base for arranging production relations would be created.

## World Carbon Emission

Air is a mixture of gases that form the atmosphere, and consist of approximately 80% nitrogen, 20% oxygen and very small portions of noble gases, carbon dioxide, hydrogen, ozone, water vapour and various impurities. Carbon, as a chemical element can be found everywhere: in nature, food, fat acids and proteins. Unpolluted air is a base for good health and life of people and whole ecosystem so the problem occurs when this balance is disturbed. Air pollution depends primarily on pollutant type. Polluted air has multiple effects on the entire ecosystem and people's health as well. Combustion of heating materials in individual consumption is main sources of air pollution, as well as industrial activities and traffic. The most frequent pollutants are carbon monoxide (CO), sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), soot micro particles. Air polluting substances may be, besides others, lead, cadmium, manganese, arsenic, chrome, zinc and other heavy metals and organic compounds, appearing as a result of different activities. Carbon monoxide (CO) is created at incomplete combustion of fossil fuels and it is a very poisonous gas, colourless, odourless and flavourless. Binding itself to an ozone atom, it weakens its structure and thus contributes to the reduction of its size. Emissions mainly come from traffic, thermoelectric power plants and similar. Carbon monoxide is toxic in high concentrations and indirectly contributes to global warming.

Carbon dioxide is besides carbon monoxide an even more important pollutant. Quantities of carbon dioxide emitted into the atmosphere at the beginning of world economic crisis in 2008 were reducing, but in 2009 and 2010, the pollution tempo returned to its previous level. 36.4 billion tons of carbon dioxide was emitted into the atmosphere in 2010, which is an increase of 45% compared to 1990.[1]

An estimate of sulphur dioxide emission (SO<sub>2</sub>) in Europe is of 39 M-tons annually. Sulphur dioxide is created through fossil fuel combustion and occurs in the form of winter smog, most intensively and most frequently in central, south and southeast Europe. Because of this the authorities in countries of these regions initiated the campaign for traffic reduction in central urban areas. [2]

Industrial development imposes the need to monitor and measure the factors created as side products of industrial plants operations. Carbon dioxide (CO<sub>2</sub>), as a combustion product, has been largely increasing globally with the industrial development, and it is necessary to find the way which makes quantification of its release possible, in order to enable monitoring and influencing its growth. That could be achieved by a formula expression which could be used to calculate the quantity of carbon dioxide created by combustion of certain fuel. Emission coefficient for carbon dioxide (ECCO<sub>2</sub>) shows the quantity of carbon dioxide released from combustion of certain type of fuel per unit of such obtained heat quantity. Mathematical formula is expressed in the following way [3]:

$$CE_{co_2} = 3,67 \frac{fc}{H}$$

Where:

- *fc* stands for carbon in fuel (non-dimensional number in units [kg/kg] or [t/t],
- *H* stands for thermal fuel power (can be high or low thermal power) in units [MJ/kg or GJ/t],
- 3.67 stand for coefficient of stoichiometric equation of carbon combustion.

The formula shows that the carbon dioxide emission coefficient is expressed in units [kg/MJ] or [t/GJ]. Since both high and low thermal power values can be used in calculation, when presenting the value *CE*<sub>CO<sub>2</sub></sub>, it must be pointed out which one is used.

Quantity of CO<sub>2</sub> emitted at some fuel combustion, directly depends on quantity of consumed fuel, carbon content in that fuel and thoroughness of carbon combustion.

Thus calculated coefficient takes into consideration only the so-called direct emission of CO<sub>2</sub>, that is, the one from the combustion process, disregarding emission from the production process. The coefficient calculated in this way may differ significantly, which is particularly important for biofuels. It should be mentioned that in such combustion, carbon binding oxygen is used and as such represents the base of our presumption for introduction into reproduction process.

Table 1 – Carbon dioxide emission coefficient for different fuels

Fuel	Emission, kgCO <sub>2</sub> /GJ
Biomass	109,60
Peat	106,00
Stone coal	101,20
Brown coal	97,09
Lignite	96,43
Diesel	77,40
Crude oil	74,10
Kerosene	73,30
Petrol	71,50
Liquid oil gas	63,10
Natural gas	56,10

(Source: Besermenji, S. (2007). Pollution of air in Serbia, Collection of Papers of Geographic Institute "Jovan Cvijic", SANU, (57), 495-501)

We can suppose, based on the data obtained in the above table [4], that the most favourable fuel from ecological and economical point of view is a natural gas. It has the lowest carbon dioxide emission coefficient, i.e. the lowest quantity of oxygen consumption for the same realized thermal effect which comes from its composition where methane is definitely most present and then other, lower hydrocarbons.

Natural gas has such composition that it has the least participation of carbon related to other fossil fuels (fc), which is why combustion, besides carbon dioxide, also emits a significant quantity of water vapour. Contrary to natural gas, biomass represents renewable source of energy and is considered CO<sub>2</sub> neutral. During its combustion, the same quantity of carbon dioxide that a plant can bind during photosynthesis when growing is released which is, of course, economically relevant in the conditions of equivalent consumption and production.

There isn't a catastrophe in our past or future that could cause such a disastrous effect on civilization and the life on our planet as can be caused by global warming, based on the report of the National Health Academy of U.S.A. Such consideration of this phenomenon demands realistic connections with the theory of limited resources and closed system. So far, the most relevant study on this issue is considered to be the study published after the end of the Intergovernmental Panel on Climate Changes held in 2001 within the United Nations (IPCH), which anticipates that the temperature on the Earth surface could rise from 1.4 to 5.8°C by 2100. This study foresees that such growth of temperature could cause iceberg and Arctic polar ice caps melting, sea level rise, storm occurrence, animal habitats destabilization and animal migrating north, drinking water salinization, forest massive destruction, accelerated disappearance of plant species and major draught. [5]

If we consider that, due to man's activity, the quantity of CO<sub>2</sub> emitted into the atmosphere in this century will be doubled, the circumstances for sudden climate change at a global level could mature, perhaps in the interval of a few years.

Such assumptions are acceptable if the oxygen resources at a global level are not increased.

## The Role of Economy in Carbon Emission Reduction

The phenomenon of globalization at the level of entire humanity as a global village is an unstoppable process. It is built on sound and modern basis and it is necessary for several reasons. Some of them can be found both in realization and maximization of exploitation of resources that are limited, which evolves from the very title. Each social system consists of two parts: commercial and non-commercial. Within so differentiated parts we can observe four sectors: external, monetary, real and public sector. In order for the society to develop, it is necessary to harmonize relations of these sectors filled with three types of subjects: workers, business subjects (here we think of an enterprise in its economic sense) and state. Business subjects have interest to obtain larger profit, exploiting resources as cheaply as possible. This principle applies to workers, while it goes for state, too, but in modified form. In economic theory and practice so far, the differentiated production factors are: labour, capital, land and know-how.

A new production factor is missing in this sequence, and it is oxygen. The question is why oxygen. Oxygen is an integral part of ozone which is the Earth's safety fuse, and therefore, mankind's refuge. Carbon is an integral part of all organic compounds on Earth, used to produce energy. Humanity shall exist on planet Earth as long as there is

oxygen and possibility for energy production. It is impossible, at an existing level of technological development, to search for a way out in discovering a new solution for life existence in the form of ozone protection by technical means only. This is not only a wrong course but also a wrong direction for solving the humanity crisis.

In our research, we have found assumptions for solving planetary crisis in monitoring oxygen consumption. Contrary to taxing solution, our solution is directed towards oxygen purchase and selling.

## Accounting Aspects of Carbon Emission

It is impossible to change anything which cannot be recorded using accounting methods. Accounting – information system finds the role in solving this problem in its base. We will explain further the proposal reproduction system functioning, viewed in this way. By performing their functions, workers and business subjects realize a certain profit, which is a base for the functioning of the whole society. State, as an arbiter in economic relations, regulates redistribution of domestic product and thus enables satisfaction of life needs of the whole society (public expenditures). By performing its function in society, state has become its integral part, and as globalization process accelerated, it strengthened its apparatus. With globalization process acceleration, state assumes its role of a service, just like a car repair service, business subjects and workers being taken as cars.

Such state acting is enabled by existence of non-designated public revenue (tax), which for business subjects and workers means contributions, which, translated to accounting and technical sense can be identified with payment of some obligation without a bill. Such state acting complicates the process of harmonization of international conduct norms and makes reproduction process more complex. Contributions for environment protection are insufficient, since they are not system-solved. It is only system solution which can stop environment destruction. When this problem is observed from different aspects, environment protection aspects are not sufficiently protected in accounting and technical sense. This problem becomes more complex with exhaustion of resources that can be found on the planet Earth. Endangered existential conditions oblige man to look for a new place for living, and so new celestial bodies beyond Solar system are discovered, which indicates that social elite has lost hope of survival on the planet Earth. Solution of this very complex problem can be found only in: designating all public revenues (public revenues represent monetary assets that a state accumulates in order to cover public expenditures, they increase state net property at all levels of power and are characterized by: collecting cash, collection regularity, not risking property at making payments and covering costs of general character), introduction of life factors (primarily oxygen) in reproduction process in the form of production factor (production factors regulate material which needs to be input in the process of creating values) and accounting treatment[6] (accounting treatment is primarily linked to accounting aspect of possibility to make quantification records of economic events, and to other accounting aspects of planning, control and analysis of global economic processes) of these processes.

Designation of public revenues gives space to competition, which represent main precondition of mankind survival. Contesting with marketing means, business subjects

will exercise influence on resource exploitation reduction and repeated research in the technology field. Population has to know final destination of all their contributions, which is conditioned by technical development. As can be seen, there would be constant upgrade of production forces and production relations, alternately, in this sense. Tax contributions prevent the man to follow his money up to a final spending. This kind of attitude would be inevitable at a low level of technique and technology development when it was impossible to designate almost all public revenues.

This kind of designation would be conditioned by globalization process, role of state in global society, as well as by technical capacities. When we speak about globalization process, we have to say that conditions for humanity survival are connected with international integrations which are inevitable. At a global plan, it is necessary to set standards which would be binding for all, on the condition that their definition is linked to logically just and feasible factors. State will have to renounce its strong role at an international plan and thus enable the business subjects to adjust and come closer, aiming at optimization of natural resource exploitation. Such role of state shall be necessary for mankind functioning in the future, as it will turn into a business subject which will perform necessary functions, but in the form of business subject. Technical potentials are the base for introducing current accounts, electronic signature, global accounting system, internet, etc. Production factors upgrade in the form of oxygen implementation in a reproduction process as a production factor builds up a new aspect of modern society development. [7]

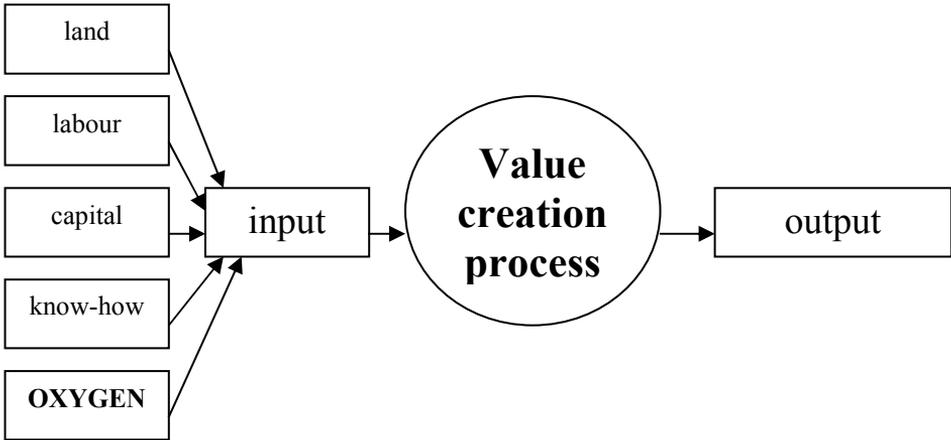


Figure 1 – Production factors in global reproduction process

Oxygen, as an integral part of ozone will be, in a global reproduction system one of production factors (global reproduction system represents a system of value creation at a level of global village, which entails a new social system administration, international business standards (one of them being International Accounting Standards), full mobility of production factors, etc.). Oxygen considered in this way, would implement the existence of a value system which would have functional effects on environment, taken at a global plan.

This production factor would require numerous technical and technological solutions, which would primarily reflect on: its measurability, its ownership, purchasing methods, etc. Measurability is conditioned by technical characteristics which can be achieved by measuring scales and measuring gas units. In the previous part, we brought up a formula for carbon monoxide calculation, which can be used to calculate oxygen, too.

Ownership is, in fact, a motive for its introduction to a reproduction process. Production will be rewarded, while consumption will be paid for, which will create conditions for the possibility of just globalization. For example: if an industrialist produces steel and consumes oxygen quantity  $H$  in a steel plant, maximum permitted oxygen quantity for consumption is  $Y$  (such observed value of maximum permitted oxygen quantity consumed at a level of business subjects would represent an equivalent of today non-taxable profit), whereas the amount paid above this maximum would be designated unlike tax which is not designated), difference  $H - Y$  is represented by value  $\Omega$  which represents the total amount of oxygen consumption. This consumption multiplied with price  $\alpha$  gives the amount of oxygen consumption  $\delta$ .

To this process, we should add the quantity of carbon emitted. For each quantity of produced steel, certain quantity of carbon is released, generated during combustion of fuel needed for production. Now, besides steel as a final product, we have a by-product which pollutes environment. Here we arrive to global challenge which is related to the fact that wherever a producer consumes oxygen (which is present everywhere in the world, its quality is everywhere the same), while the impact of carbon release and related climate changes on the environment is not the same everywhere. Its influence on the environment has increased so much during the last hundred years, so that the differences in carbon effects on different parts of the world have been largely reduced.

The manner of sale and purchase of this production factor is a process which is tied to a state as a business subject, unlike the other production factors. State would represent a sale and purchase service for this production factor – it would redistribute global gross product to the producers of this factor and its consumers. Oxygen included this way would realize equal starting position in globalization process of technically developed and naturally rich countries. Accounting treatment of these processes represents the most complex and procedurally hardest part for realization. In the global system of financial transaction system accounting treatment, it would be necessary to establish: business records, book keeping documents and accounting procedures. Within thus established global accounting system, it would be necessary to establish an account of these resources, and the concept of a global layout of chart of accounts, as well as an account for treatment of externalities, which would contain all contributions of business subject related to harmful effects to the environment (noise, various waste material, etc.). Some factors have local influence (noise, waste), some have global impact (ultraviolet radiation), so, from this aspect, it is necessary to include them in the subject evaluation process. Global oxygen account would be treated by consumers as oxygen cost, and by producer as a global product account. Global externalities account would represent an account of non-material values for business subjects which would, according to automatism principle, reflect their value. Accounting and information system of this kind would solve problems of resource allocation, establish possibility for centralized monitoring of ecosystem sustainability, define the base for reporting fair values of business subject and create possibility for extending human existence on the planet Earth.

## National Solutions for Reduction of Carbon Emission in Some Countries

Carbon dioxide is a gas that is transparent for shortwave Sun radiation and absorbs long-wave Earth radiation, and the temperature in lower atmosphere layers is because of its presence higher than if it was not there. In the last century, the quantity of carbon dioxide in atmosphere increased for about 25%. Carbon dioxide effect is joined lately by some other gas influence (chlorofluorocarbon, or Freon, methane, nitrogen oxide and ozone in troposphere) artificially emitted in atmosphere.

The global goal of reducing carbon emissions has significant contributions by some of the most industrially developed countries. An example can be taken of China, which has plans to obtain 30% of its electrical energy production from renewable resources by the year 2020. In 2005, it adopted the Law on Renewable Energy Support. We can find such legal foothold in Germany, too, which also adopted the Renewable Energy Law (EEG).

For example, Australia applies the Law which obliges around 300 largest pollution producers to pay 24\$ per ton of greenhouse gas produced. Tax on carbon dioxide emission is necessary for fulfilment of obligations imposed in order to prevent climate changes. In the developed world, Australia is a country with largest gas emission per capita, but due to relatively low population, contributes with 1.5% of gas emission at a global level. Tax on gas emission in the European Union countries varies between 8.7 – 12.6\$ per carbon dioxide ton, and it affects most mine industry, air companies, steel plants and energy companies. [5]

With the development of dynamic industrial progress, collecting taxes on gas emission polluting the environment has developed as well. Its beginnings can be found in the need of legislator to tax in some way something that endangers the environment, and the money thus collected can be used for new scientific projects which would help to find new and clean industrial capacities, whose work would provide the same productivity but less harmful gases. Global approach is missing to all this, as gases circulate throughout Earth atmosphere, from one continent to another, and not only around those states which tax harmful gases. It should be added that besides industry, harmful effects are released into the atmosphere by animals, too, which caused even cow taxing in Australia.

## Financial Dimension of Economy Based on Carbon Dioxide Emission

Modern developed companies are owned through different types of ownerships. They are linked to business subjects through their accounting and legal connections and represent the base for their operations. We will process two main types of property for our research, private and state property, which will contribute to methodological distinctness of research subject statement. In the observed global financial and accounting system, regulation of ownership over production factors is one of the most important issues. Ownership at a global level should be approximated to a micro level, on the condition that its elements contain main characteristics of modern ownership, such as inviolability. In accordance with thus observed ownership characteristics, existing forms of business subjects, such as: entrepreneurs, proprietorships and partnerships, and corporations

would require its evolutionary character. This evolutionary character would mean, in the first sense, the respect of ownership rights.

An example of this can be illustrated on the change of public into private property. This example shows the role of state which represents transmission mechanism in this process. Business subjects which were born in the form of shareholding companies with social property (shareholding company can have different forms of share ownership, which can appear in the form of: private, state, public, etc. share property).

They have found their accumulation of capital primarily in labour, which is in compliance with the labour value theory, which gave rise to public property. Such share capital accumulation in thus defined shareholding company had public character (public share character is a type of ownership where the ownership is dematerialized, and beneficial ownership dispersed to several parties) which was to be changed into private property. State as a mediator in this case conducts transmission of ownership without assuming ownership, which is in fact needed in order to materialize shares in a shareholding company such as this one, which turns group beneficial ownership into individual one. A frequent example for this kind of ownership change can be found in the term privatization, which cannot be essentially identified with change of ownership of business subjects. Establishing ownership over this new production factor will represent serious problem, unless essential process is implemented into a formal problem of future global reproduction system. The first thing to consider is a model of ownership definition which we presented, where private property will be dominant compared to all others. Private property and accounting statement of business subject value will enable rationalization of production factor consumption which will imply environment protection.

In the domain of oxygen ownership, there are consequences that are identical to those with public property in socialist countries. That is why a precise and clear establishment of beneficial owner over oxygen has to be carried out in the domain of finance, as some consume (use) oxygen, which is a general good of all people on the planet, for their own interests, without giving any compensation to the others.

## *Conclusion*

Industry development, resource mobilization and their modern exploitation require a new overall approach in consideration, monitoring carbon emission as a by-product which affects the environment. Over the past decades carbon concentration has rapidly increased, through knowledge mastering and objectification, increased investment in science and education, expansion of the need for a higher quality life style.

World carbon emission primarily depends on the type of pollution producer it comes from. Whether pollution comes from thermal power plants, traffic, various impurities or chemical industry, it is necessary to express it with mathematical formula in order to be able to express it quantitatively and monitor it. Carbon dioxide emission coefficient represents that very indicator, but its disadvantage is that it shows carbon dioxide obtained from combustion process, neglecting emission from production process. The least emission coefficient is obtained from natural gas combustion due to methane content, while biomass represents a renewable energy resource and is CO<sub>2</sub> neutral. Economic globalization as a

motor of climate changes enforced itself as a higher stadium of economic integrations. Today, countries are connected into a network of financial, social connections, which resulted in productivity increase within certain branches of national economy. This exposure brought improvement in other branches within national economy. However, a by-effect may occur, which is that those branches simply cannot sustain the tempo of accepting new technologies and work principles. Direct foreign investments go to those branches where there is a domestic factor of competitiveness, which domestic enterprises cannot support.

Economy finds the way in rationalization and maximization of global resources exploitation, which results in social system consisting of commercial and non-commercial part. Society development depends on harmonization of relations among workers, companies and state. Taxing carbon dioxide emitters is a new approach to the solution of climate changes aiming at using accumulated funds for researches in the field of environment protection, development of clean types of industry and its capacities. Europe and Australia are only ones of several global factors, which devoted themselves to this kind of solving and controlling carbon dioxide emission.

Accounting and information system basically finds the role in solving this problem. Contributions to environment protection are insufficient. Only system oriented solution may stop environment destruction. This problem may be observed also from another aspect, the aspect of environment protection which is not, in accounting and technical sense, protected enough. This problem is becoming more complex with wearing off resources that can be found on Earth. Endangered existential conditions compel mankind to search for the new place of living. Destination of public revenues provides space for competition, which represents the main precondition for man's survival. Fighting with marketing instruments, business subjects affect the resource consumption reduction, and repeated research in technical field. Population has to know the final destination of their contributions, which is conditioned by technical development. Technical potentials create base for introduction of current accounts, global accounting system, internet, etc. Upgrade of all production factors in the form of introducing oxygen and carbon into reproduction process as a production factor, creates a new aspect of shaping modern society.

## Literature

[1] Valent, V. & Krgovic, V., & Kršikapa, M., & Nikolić, S. (2008.) Energy potentials in the world and their significance in cellulose-paper industry, *Chemical Industry* 62(4), p. 223-232

[2] Milojković, J. V., Stojanović, M. D., & Grubišić, M. S. (2009). Greenhouse gases with high global warming potential value - GWP. *Ecologica*, 16(54), p. 197-204.

[3] Živković, M., & Ivezić, D. (2009). Contribution to definition of natural gas carbon dioxide emission coefficient, *Ecologica*, 16(56), p. 610-616

[4] Besermenji, S. (2007). Pollution of air in Serbia, *Collection of Papers of Geographic Institute "Jovan Cvijić"*, SANU, (57), p. 495-501

[5] Lambić, M. (2009, jun) Energy Technologies – Contribution in Environment Pollution Reduction, *Paper presented at the meeting of Ecological safety in post-modern environment*, Banja Luka, BiH.

[6] Milojević, I. (2011). *Accounting*, Beograd, Republic of Serbia, Center for Economic and Financial Research, Belgrade.

[7] Milojević, I., & Cvijanović, D., & Cvijanović, G. (2012) Economics aspect of global ecological problems solving, *TTEM*, BiH, 7(3) 8/9