MEASURES TO REDUCE TRANSPORTATION GREENHOUSE GAS EMISSIONS IN ROMANIA

Vasile E., Balan M., Grabara I., Balan S.*

Abstract: The greenhouse gas emissions from transport have registered a severe increase over the years about 23% of carbon dioxide (CO2) emissions resulted from burning fossil fuels worldwide. In this context, it is observed the increasing need to shift to sustainable transport patterns for taking into consideration a wide-scale use of alternative energy sources (e.g. bio-fuels, biogas) and also, the investments in environmental technologies research and development etc. Romania has a national transport system situated on average level in terms of conventional standards of Europe's transport system. But, it was noted that the infrastructure of roads, railways, maritime and air transport is vulnerable in terms of extreme weather conditions. Considering the indirect effects of climate change, they are manifested by deteriorating road and rail infrastructure. The paper presents some of the measures adapted by Romania to reduce the greenhouse emissions produced by the transport sector. The adaptation of the Romanian transport sector to climate change impacts should take into account the use of technologies by focusing on increased safety standards, and ensuring continuity of services. In order to implement these measures it is increased the need to invest into designing vehicles that can withstand the adverse effects of climate change. The new transport infrastructure and means of transport should be designed, beginning with the design phase, in order to be resilient to the effects of the climate change.

Keywords: transport, greenhouse gas emissions, reducing emissions from transport

Introduction

Global average temperature has raised in the last century to 0.74 ° C. Scientists say this is the upward trend on the planet. Forecasts made in recent year's shows that the trend will continue and even accelerate. The most optimistic estimates indicate that the Earth could warm during the XXI century with 3 ° C.

In the last three decades, emissions of greenhouse gases have increased by an average of 1.6% CO_2 in fossil fuel use, reaching 1.9%/year. In the absence of policy action, it is expected that these patterns of emissions growth to continue.

Less than 1% of Earth's atmosphere consists of water vapor (H_2O), carbon dioxide (CO_2), ozone (O_3), methane (CH_4), nitrous oxide (N_2O) and sulfur hexafluoride (SF_6) gas known as greenhouse gas (GHG).

Environmental structural indicators' total emissions of greenhouse gases "are the quantities in tons/year of pollutants that are regulated by the Kyoto Protocol. All countries must make progress in reducing their greenhouse gas emissions.

* **PhD Emilia Vasile, PhD Mariana Balan, Drd.Dipl.Eng. Gheorghe-Stelian Balan**, "Athenaeum" University Bucharest, **PhD Iwona Grabara**, Czestochowa University of Technology, Poland
✉ corresponding author: rector@univath.ro

Analysis on the amount of CO_2 emissions in the European Union has revealed that the largest amount is from the production of electricity and heat. For example, coal based energy production in EU countries generated about 950 million tons of CO_2 emissions in 2008, representing 24% of total EU CO_2 emissions (Figure 1).

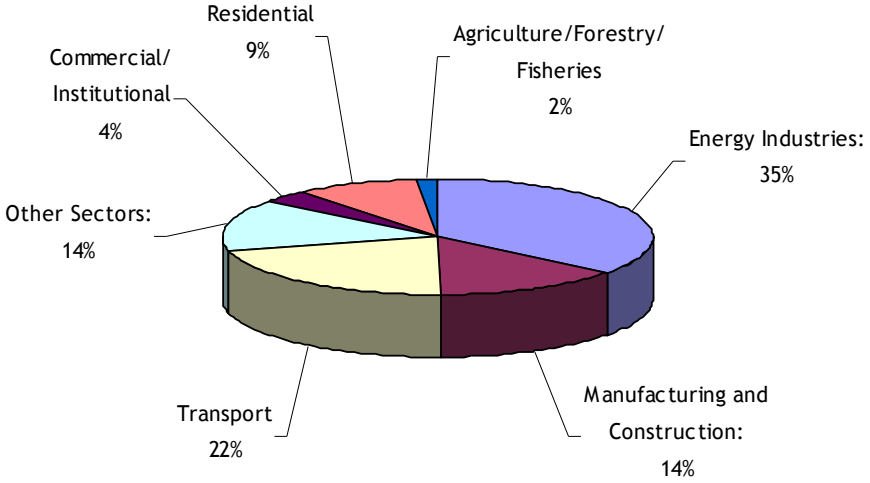

Figure 1. Share of CO_2 emissions by sector in EU countries
Source data: EU Energy in Figures 2010, CO2 Emissions by Sector, European Commission, Directorate-General for Energy and Transport (DG TREN)

Regarding Romania, CO_2 emissions from different sectors also highlights the major contribution to energy and transport sector, which means that they are areas on which are necessary to implement measures and actions to reduce CO_2 emissions (Figure 2).

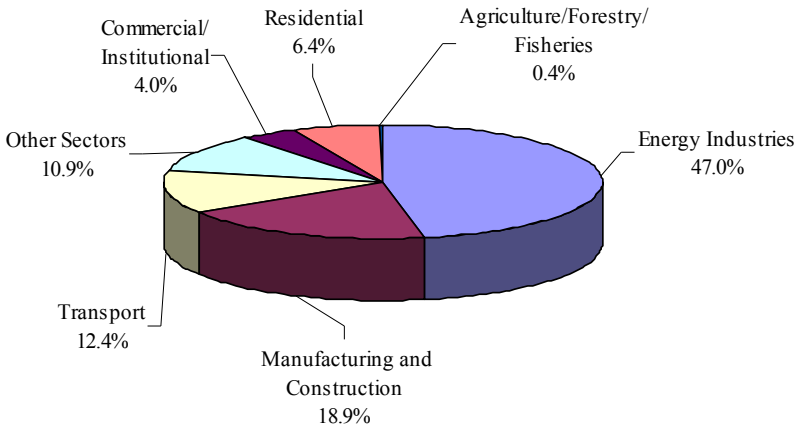

Figure 2. Share of CO_2 emissions by sector in Romania
Source data: EU Energy in Figures 2010, CO2 Emissions by Sector, European Commission, Directorate-General for Energy and Transport (DG TREN)

Climate change is already having a significant impact on some regions, especially the developing countries and on the ecosystems. This will prevent developing countries to fulfill the Millennium Development Goals (MDGs). In this sense, a role it is aimed at climate change policies. National action programs are an option for the least developed countries, offering a rigorous assessment of urgent adaptation needs. Their goal is to expand the capacity of communities to adapt.

National legislative framework on climate change mitigation and promoting renewable energy use

Romania signed the 1992 Summit in Rio de Janeiro, United Nations Framework Convention on Climate Change (UNFCCC), ratified by Law no. 24/1994. The main objective of this Convention is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
From January to May 2005 was Romania's National Strategy on Climate Change (NSCC) and National Action Plan on Climate Change (NAPCC) Romanian policy making on international obligations under United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol and Romania's national priorities in climate change.
As EU member state, Romania sought national legislation transposing the European Commission Directives on the environment.
Ministry of Economy, Trade and Business Environment (MECMA) is responsible for implementing policies on renewable energy and bio-energy. Requesting assistance from the Dutch Ministry of Economic Affairs, completed in 2010 MECMA project "Biomass Master Plan for Romania" whose beneficiaries are Romanian General Directorate of Energy, Oil and Gas and Infrastructure Department and Environmental Quality, both being part of MRCMA.
Electricity Law no. 13/2007 establishes the regulatory framework for activities in the electricity and heat produced in cogeneration, the optimal use of primary energy resources in terms of accessibility, availability and affordability and safety compliance, quality and protection environment.

Environmental impact of transport

Transport activity plays a key role in economic and social development of society. In transport, Romania has a key position at the eastern border of the enlarged EU as a transit area, both east-west direction (link to Asia via the Black Sea) and north-south (from the Baltic to Mediterranean). Three of the TEN-T axes across Romania.
Existing transportation systems in Romania are freight and passenger transport. In these systems operate systems of road, rail (inland waterways, sea), air, and special non-motorized (power transmission pipeline and air).

The impact of these types of transport on the environment is manifested in all the environmental factors: congestion and accidents - in case of road transport, air pollution, the effect of emissions, noise and vibration - the major intersections, along road, near railway junctions and airports, water and soil pollution by dumping of petroleum products; occupation of land in built areas for parking, changing eco-urban landscape, generation of solid waste (tires, batteries, etc.).
Among the effects that transport has on human health the most important are those related harm exhaust gas containing NOx, CO, SO_2, CO_2, VOCs, particulates loaded with heavy metals (lead, cadmium, copper, chromium, nickel , selenium, zinc), pollutants, dust involved with the road, can cause acute and chronic respiratory problems and other diseases worse. Heavy traffic is generating high levels of noise and vibration, which determines the occurrence of stress conditions, sometimes with major implications on health.
In terms of environmental impact, there is a wide range of factors influencing growth of CO_2 emissions from road transport, such as supply and demand for cars, individual mobility needs, availability / lack of availability of alternative public transport services common and associated costs of having a private car.
Although the energy efficiency of vehicles was and is still growing, this is offset by increased average length of travel, the increase of the fleet, and other variables, such as driving style, traffic jams etc.., which translates into an increase in the intensity of emissions of greenhouse gases.
Regarding transport, the Sustainable Development Strategy of the European Union, stated "that transport systems meet current economic needs, social and environmental, while minimizing unwanted effects on the economy, society and environment". For CO2 emissions from light commercial vehicles, it is recommended that their mean value, corresponding to the new car fleet should achieve the target of 120 g / km in 2012.
In Romania, transport policy aims to align the national transport system continues to Community Transport Policy principles defined in the Transport White Paper (with corresponding updates) and the requirements of sustainable development of Romania.
Medium term priorities set by the Government Program 2009 - 2012, and other public policy documents and institutional commitments (sectorial strategies, national development plans, development programs) are mainly: i) modernization and development of transport ii) development and modernization of transport means and facilities to improve service quality, traffic safety, security, environmental quality and ensuring interoperability of transport, iii) strengthening social and territorial cohesion at national and regional level by providing links between cities and growth the accessibility of population to public transport, including in areas with low population density and / or dispersed iv) competitiveness in transport, internal transport market liberalization, v) improving transport behavior in relation to the environment, mitigating impacts global

transport (climate change) and vi) reducing environmental quality degradation in natural and urban environment.

Noise from traffic affects individuals in different ways: causing both discomfort and health problems. Physical effects include a higher heart rate (and therefore a higher risk of cardiovascular disease), psychiatric disorders and high levels of stress, sleep disturbances, cognitive problems, understanding and concentration in children, and at very high noise, hearing problems.

Gases emitted from traffic contributes to the increase of atmospheric acidity, and the formation of tropospheric ozone, direct effects and / or indirect effects on all environmental components (vegetation, fauna, soil, water). Heavy metals in the exhaust gas and water affect soil quality, the health of flora and fauna. It also produces different soil pollution with waste (particularly parking), petroleum products from some damage to vehicles, and various substances from road accidents.

Actions Taken to Reduce Emissions of Transport

To reduce emissions from transport were organized numerous activities throughout the country, of which can be listed:

- **in road transport**, the Romanian Auto Registry representatives conducted traffic inspection to verify emissions and the technical condition of vehicles.
- to reduce emissions from transport, used vehicles equipped with EURO III and EURO IV, EURO III and EURO IV diesel by European standards, catalytic convectors.
- by Archimedes project, ongoing, aims to implement a pilot route, means of transport (by providing facilities for 30 buses LPG) and construction of bicycle lanes;
- local public transport Suceava projects were developed SMILE CIVITAS II: "Alternatives for ecological sustainable development of European cities", and MIDAS: "Measures for influencing transport demand for sustainable development", which had led to improve the quality of life and the urban environment, modernization of public transport, extending the concept of low emission zone, development of pedestrian facilities, improving existing pedestrian infrastructure, upgrading parks, central area, promoting alternative fuels, attracting citizens in a participatory and co-decision, consultation and information.
- to streamline automotive traffic and increase participation in traffic safety, in Constanta county, was started implementation of an integrated traffic management in the city.
- increased road capacity and infrastructure in Cluj County (in 2009), by putting into circulation the 42 km portion of Gilau and Turda, on section 2B of the Transylvania Motorway, opening the bypass of the city Gherla (5 km), making the 2.6 kilometers of road bypass of Cluj, rehabilitation and modernization, in 2009, important county roads that facilitate access to areas with high tourism

potential: the road Răchiţele - Prislop - IcPonor Valley road yesterday - Caps, go Agarbiciu - Rasca.

- In Bucharest there is a transport network consisting of public transport operators: SC Metrorex S.A. - Responsible for operating the underground network, coordinated by the Ministry of Transport, Constructions and Tourism and Transport Autonomous Bucharest - urban transport, responsible for managing the surface transportation system. R.A.T.B. is subordinated to the Bucharest General City Hall. Autonomous Transportation Bucharest participate in project COMMERCE (Creating Optimal Mobility Measures to Enable Reduced Commuter Emissions) which is funded by the European Commission under the "Intelligent Energy - Europe" and its partner cities London, Paris, Budapest, Kaunas, Plovdiv and Bucharest. COMMERCE objective is to work with EU companies to reduce harmful effects on the environment due to wasteful use of car travel to / from work.

➢ **in rail transport**, tracking the impact of such transport on the environment, regional elections rail transport out their monitoring programs, analyzes were conducted in laboratories specialized environment.

According to national commitments, to reduce emissions of greenhouse gases and increase energy from renewable sources by 30% by 2020, CFR committed to the aim of reducing CO2 emissions. In order to reduce CO2 emissions was a program of measures to reduce consumption of electricity and fuels. Thus, in 2009 adopted the following measures for reducing environmental pollution:

- reducing CO2 emissions: i) the replacement of seven facilities in stations CED large installations that, with a reduction in energy consumption of about 1 GWh per year (Deva, Simeria, Alba Iulia, Sighisoara, West Ploiesti, Ploiesti Triage, Craiova),
  ii) replacement of track circuits in two sequences with TC C4 - 64 or similar about 7 railway stations, iii) the introduction of savers LEC (Lighting Energy Controller) for exterior lighting installations - pillars, the five stations large yard, with a reduction in energy consumption of approximately 0.3 GWh per year; iii) replacing incandescent lighting to 645 EC and ECD facilities, lighting lamps with low power consumption - 100 lamps per year, with a reduction energy consumption of approximately 0.01 GWh per year; iv) replacing incandescent lighting with fluorescent lighting, with a lower power in all-purpose office space owned by CNCF CFR SA, the Palace building CFR;
- the impact of rail transport on air quality through emissions of air pollutants: i) modernization of diesel electric locomotives and diesel hydraulic ii) purchase of new rolling stock with low energy and low emissions, iii) transfer thermal plants operating with natural gas replacing light fuel oil, iv) modernization of heating by installing equipment to reduce exhaust emission, v) extractor device equipped with filters to retain pollutants and absorbing hood systems in workshops and battery room;

- impact of rail transport on water quality is monitored by analysis of wastewater and groundwater tests taken at observation wells. Efforts to prevent sewage pollution have included work on: rehabilitation facilities and collection systems, drainage and tailings/ waste oil separation, cleaning and upgrading clarifiers and separators; Installation of the rain water collection and pre-treatment, works to ensure the systems drainage of rainwater and providing means to prevent leakage, purchase and installation of waste oil collection;
- impact of the operation and maintenance of rolling stock units held on the premises involving fuel management and storage of lubricants is tracked and measured by soil analysis, carried out in specialized laboratories will monitor the indicator substances particularly oil. In recent years, the greening works have made the soil contaminated with oil, scraping surface soil contaminated with petroleum deposits, ecology railways.

It has also been upgraded existing rolling stock fleet, cars were equipped with low noise brakes and was purchased new rolling stock performance, in line with EU environmental requirements.

- **in the air**, *"National Action Plan on reducing greenhouse gas emissions in civil aviation for the period 2011 - 2020"*, is to: i) improve aviation fuel efficiency by 2% / year, ii) performance of strategic commitment assumed by European Union to reduce greenhouse gas emissions by at least 20% by 2020 compared with 1990 emissions levels by the end of an international agreement for the period post - 2012, iii) informing the airline operators on new technologies promoted internationally and their participation in the mechanisms of emission trading in order to create the necessary conditions that, since 2020, to proceed to next stage gradual reduction CO_2 emissions due to aviation activities.
- environmental impact of **transport on waterways**, is given the increasing risks of accidents by leakage of hydrocarbons in the Danube and the port aquatory during loading and unloading operations, transshipment, handling and transportation of petroleum and petrochemical products as well as maneuvers refueling the ship. This requires provision of machinery and equipment for environmental protection and remediation in case of accidental pollution.

  Also, the repair of vessels may impact on the environment through emissions of particulate air (blasting powder, powder grit used, VOC solvent) and generated waste (packaging of paints, clay and welding electrodes scrap, zinc ash, used oil).

Summary

An efficient and flexible transport system is essential for the economy and quality of life. The main objective of transport policy in Romania is the restructuring of the transport system and ensuring its functioning in order to achieve a homogeneous transport system, connected in terms of structure at national and European transport networks.

Measures taken to reduce greenhouse emissions in Romanian transport can be listed:

- Remove from use of those vehicles, especially those of heavy-duty engines not equipped with retention of pollutants - action begun in 2005, but with cars older than 12 years;
- Lack of parking and poor location of garages, which determine the use of green spaces as parking spaces. Local government in urban development plans must have regard to the parking arrangement so that should not affect the green and have the ability to serve the population of the area;
- Acoustic protection measures, with green curtains to protect the built road and rail would be likely to help reduce the discomfort of urban noise, and at improving air quality;
- One of the most effective measures to reduce pollution is to develop the railway, an environmental transport, and with which it can bring positive results both in the short and medium term.

The main objective of transport policy, according to the National Action Plan for Environmental Protection, is the restructuring of the national transmission system and ensuring its functioning in order to achieve a homogeneous transport system, connected in terms of structure the pan-European corridors.

Reference:

[1]. County reports on the State of Environment in Romania in 2010 – County agencies for environment protection, www. mmediu.ro
[2]. Eurostat database, - www.ec.europa.eu/eurostat
[3]. Garstecki A., Pozorski Z. Studziński R., Optimal design of sandwich panels with a soft core, Journal of Theoretical and Applied Mechanics, 47, 3, 2009.
[4]. Reducing Transport Greenhouse Gas Emissions Trends & Data 2010, The International Transport Forum, OECD, www. internationaltransportforum.org
[5]. Romanian Statistical Yearbook , 2011- National Institute of Statistics
[6]. The database of The National Institute of Statistics, www.insse.ro

BADANIA W CELU ZMNIEJSZENIA EMISJI GAZÓW CIEPLARNIANYCH TRANSPORTU W RUMUNII

Streszczenie: Emisje gazów cieplarnianych pochodzących z transportu odnotowały silny wzrost w ciągu roku, wzrost dwutlenku węgla (CO2)o 23% wynikał ze spalania paliw kopalnych na całym świecie.W tym kontekście należy zauważyć rosnącą potrzebę przejścia do zrównoważonych modeli transportu dla uwzględnienia na szeroką skalę wykorzystania alternatywnych źródeł energii (np. biopaliwa, biogaz), a także inwestycji w zakresie badań środowiska, technologii i rozwoju itp. Rumunia posiada krajowy system transportowy który znajduję się na średnim poziomie w zakresie konwencjonalnych standardów europejskiego systemu transportu. Ale zauważono, że infrastruktura dróg, linii kolejowych, transportu morskiego i lotniczego jest podatna na działania ekstremalnych warunków pogodowych.

Biorąc pod uwagę pośrednie skutki zmian klimatu, manifestują się one drogą pogarszającej i infrastruktury kolejowej.Przedstawiono niektóre z działań dostosowanych przez Rumunię do zmniejszenia emisji gazów cieplarnianych pochodzących z sektora transportu. Dostosowanie sektora transportowego do rumuńskiego skutków zmian klimatu powinny uwzględniać wykorzystanie technologii poprzez skupienie się na zwiększenie standardów bezpieczeństwa i zapewnienia ciągłości usług.W celu wykonania tych środków jest zwiększona konieczność inwestowania w projektowanie pojazdów, które mogą wytrzymać niekorzystne skutki zmian klimatycznych. Nowa infrastruktura transportowa i środki transportu powinny być zaprojektowane, począwszy od fazy projektowania, aby być odporne na skutki zmian klimatycznych.

在羅馬尼亞措施，以減少溫室氣體排放的交通

抽象:運輸的溫室氣體排放量已經註冊了嚴重的逐年提高，約23%的二氧化碳 CO2）排放導致燃料燃燒化石全球。在這種情況下，它是觀察需要轉移，考慮到大範圍地使用替代能源（如生物燃料，沼氣），並增加可持續發展的交通模式，投資環境技術的研究和開發等。羅馬尼亞位於歐洲的交通運輸系統的常規標準的平均水平在全國的交通系統。但是，有人指出，在極端天氣條件下的基礎設施，公路，鐵路，海運和空運是脆弱的。考慮到氣候變化的間接影響，他們的表現日益惡化的道路和鐵路基礎設施。提出了一些適用於羅馬尼亞的措施，以減少由交通部門產生的溫室氣體排放量。羅馬尼亞運輸部門的適應氣候變化的影響也應該考慮使用的技術，專注於提高安全標準，並確保服務的連續性。為了落實這些措施，這是增加的需要，投入到設計車輛可以承受氣候變化的不利影響。新的交通基礎設施和交通方式的設計，從設計階段開始，為了適應氣候變化的影響。