ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

ГОДИНА XXVI, 2017, 6

*Donka Zhelyazkova*[1]

# THE PLACE OF TRANSPORT IN THE CIRCULAR ECONOMY OF BULGARIA

*The circular economy is based on three basic principles: reduction, reuse and recycle, which can be successfully implemented with the help of transport, which is viewed as a key role in logistics. In the present paper, this idea is developed by performing a theoretical overview of the essence of the circular economy and the impact of transport on the environmental situation of Bulgaria is analysed, in order to open up opportunities for the application of advanced solutions to protect the environment. These opportunities are associated with the implementation of a circular economic model in the country and specialization in the Bulgarian economy in the sector of production of biofuels, recycling of end of life vehicles and tyres.*
*JEL: L62; N70; R40*

## Introduction

The current dimensions of the economic activity require the study of economic activities from the standpoint of environmental and reversing capabilities, which accumulate potential to reduce the footprint, left in the environment. On this basis, the perceptions for the necessity to "generate positive effects on logistics for the environment" (Blagoev et al, 2009, p. 300) are further developed. In the context of responsibilities, which the modern society assumes, the role of transport is specified as a key logistic function which ensures the flow of normal reproduction process by means of the movement of material and human flows.

The purpose of this paper is based on a theoretical overview of the nature of circular economy and an analysis of the impact of transport on its development in Bulgaria, to open up opportunities for the application of the circular pattern in some transport-related sectors of the Bulgarian economy.

In order to achieve the set objective, some key tasks should be solved:

1. Make a review of the theoretical formulations to the nature and purpose of the circular economy.

[1] *Donka Zhelyazkova is Assoc. Prof. Phd, Economics and Management of Commerce Department, Varna University of Economics, tel.: 0882/164-684; e-mail: d_zhelyazkova@ue-varna.bg.*

2. Analyse of the impact of transport on the development of the circular economy in Bulgaria
3. Reveal the role of transport in the circular economy of Bulgaria

In order to solve the formulated tasks were applied methods of summary and synthesis in theoretical plan, and in the research part the methods of a dynamic statistical analysis and graphical method are used.

The object of study is the transport of the Republic of Bulgaria and subject of the study is its role in the development of circular economy.

The information array of the research includes official statistics accumulated by Eurostat and NSI.

In the course of the analysis emerged some important restrictive conditions which affect mainly the timeliness of the statistics as they are updated in a wide periods of time and that does not allow for a maximum degree of convergence in terms of research up to this year.

Regardless of this fact, the paper addresses key issues, both from theoretical and practical application perspective and allows the author to conduct in-depth studies, based on which to formulate conclusions and recommendations.

## 1. Theoretical overview of the nature of circular economy

### *1.1. Nature and principles of the circular economy*

In the circular economy, the value of products and materials is maintained for as long as possible, the generation of waste and use of resources are minimized and the resources are kept in the economy when the product reaches the end of its life cycle and are used repeatedly to create additional value. This model may create secure jobs in Europe, to encourage innovations that provide a competitive advantage and to provide a level of protection of humans and the environment, which Europe can be proud of. This model may also provide consumers with more durable and more innovative products, through which to achieve financial savings and improved quality of life (European Commission, 2015).

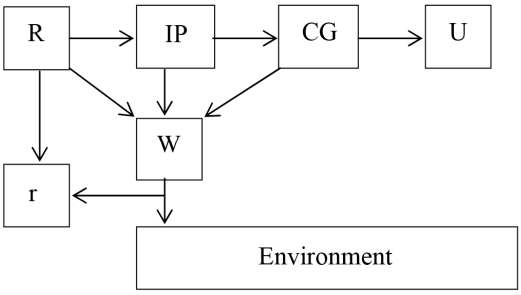
The concept of circular economy has its conceptual roots in the industrial ecology, which suggests symbiosis between many different companies, including transport and manufacturing companies (see. Fig. 1).

According to M. S. Andersen some of the waste can be converted back into resources, can be included in the manufacturing processes and thus create a new product with a new value "in use", which is to satisfy the unlimited needs with limited resources. It is namely on this basis, that the economy can be seen as circular.

According to some authors (Geng, et al., 2012, p. 216-224) the circular economy includes countless strategies that aim to achieve greater efficiency through economies based on system integration. Partnerships between businesses should be encouraged to develop the sectors of service, transport and infrastructure.

Figure 1

Simplified model of circular economy




*Legend: R – Resources; IP – Industrial Products; CG – Consumer Goods; U – Utility; W – Waste; r – recycling*

Source: Andersen, M. S., 2007, p. 134.

The circular economy has the potential to assist in raising productivity levels of resources and their environmental efficiency and to implement the reformation approach in the management of the environment and to achieve sustainable development, given the fact that is based on three main principles (3R's Principles: Reduction, Reuse and Recycle) (Ghisellini et al., 2015, p. 1-22): reduce, reuse and recycle.

The principle of "reduction", adapted to the transport sector aims to minimize the consumption of energy, raw materials and waste both at the input and output of the transport process by optimizing the technology of loading and unloading activities, stowage, transportation of compact products, application of modal transport solutions, advanced vehicles, optimal routes and so on.

The principle of "reuse" refers to any operation by which products or components that are not waste are used again for the same purpose for which they were intended. The reuse of products is very attractive principle in terms of environmental benefits, since its implementation implies less resources, less energy and less labour compared to the production of new products from new materials, their recycling and their disposal. Particularly in the field of transport the principle applies to the options provides by the spare parts for repair and maintenance of rolling stock and infrastructure.

The principle of "recycle" refers to any operation by which waste materials are reprocessed into products, materials or substances, used whether for the original or other purposes. It includes reprocessing of organic material but excludes energy recovery and the reprocessing into materials that can be used as fuels.

This principle in transport is often applied to continuous manufacturing process and the use of tyres, which leads to serious cumulative imbalance and environmental hazard.

In the transport sector, vehicle tyres that are disused, are used in building and maintaining the infrastructure needed to strengthen the banks by building barriers against erosion,

artificial reefs, breakwaters, as well as to strengthen the embankments along the roads. These tyres can also be used to reduce noise and vibration in the railway and tram routes. Added rubber powder prolongs the life of the road surface, reduces the noise from vehicles and improve traffic safety in wet conditions.

Of particular importance in the application of this principle in the field of transport are the end of live vehicles (ELV), which are manufactured by many spare parts, which are marketed and form positive economic outcome for economic agents.

Knowledge of the principles on which the circular economy is based, lets insight into its goal-setting and the design of measures to achieve the targets.

### *1.2. Main objectives of the circular economy and measures to achieve them in the context of transport*

The main objectives of the circular economy can conditionally be reduced to five and they are directly related to the principles of reduce, reuse and recycle (Table. 1).

Table 1

Main objectives of the circular economy and measures to achieve them

| Main objectives | Measures |
|---|---|
| a) Limited use of natural resources | a) Sustainable use of resources, allowing recycling of materials |
| b) A larger share of renewable and recyclable resources and energy in the total consumption | b) Repair, renew, reuse |
| c) Reduced emissions | c) Utilization of advanced technological solutions and modern equipment |
| d) Reduced material losses, preservation of the value of materials and reuse | d) Eco innovations |
| e) Sustainability of production and consumption | e) New business models |

In the context of transport, the main objectives of the circular economy can find a particular interpretation that binds them to the potential of the transport sector to respect the fundamental principles and to seek measures to achieve them, which are directly related to decisions concerning this sector.

#### *a) Objective: Limited use of natural resources*

Transport in logistics can be adapted to the environment if the transported batch loads are optimized and the running time is reduced and thus the costs and emissions decreased.

This goal can actually be achieved, since there are conditions that we associate with modal transport solutions, containerization and the promotion of groupage consignments, which are having increasingly wide application in the practice. This allows businesses to take advantage of these opportunities and to trust the multimodal operators and shippers.

Urban mobility, providing economic development of cities and quality of life of the population, can also protect the environment through an integrated approach. The objectives pursued by the project for integrated urban transport are directly related to the construction of a functioning circular economy. They can be reduced to the following major ones:

- Effective and rapid mass urban public transport (MUPT) with less energy consumption.
- More accessible secondary infrastructure of public transport networks.
- Introducing environment friendly types of urban transport.
- Increasing the attractiveness and the degree of utilization of MUPT.
- Improving the functionality of the city and population mobility.
- Reducing traffic congestions and increasing the capabilities of MUPT.
- Social inclusion and equal access of disadvantaged groups.

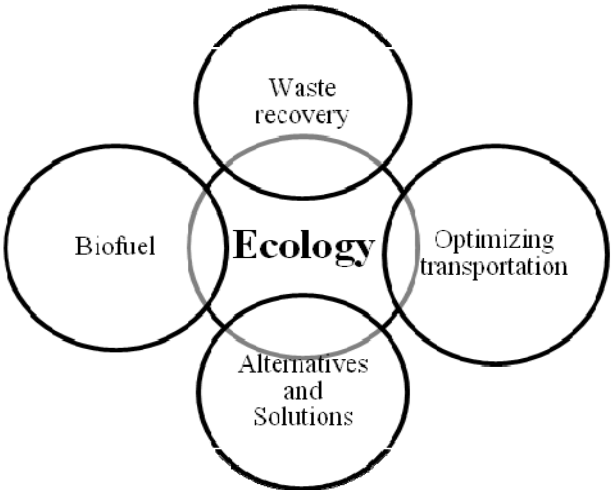
In order to achieve the set objectives actions for implementing the sustainable idea relating to the use of resources, allowing for recycling of materials should be taken.

*Measure: Sustainable use of resources, allowing recycling of materials*

Implementation of the measure "Sustainable use of resources, allowing recycling of materials" is possible with the introduction of new technologies and innovations such as the use of biofuels, alternative solutions (low-emission vehicles), waste recovery (recycling of old vehicles, tyres) and optimization of shipments (see Fig. 2).

Figure 2

Ecology at the centre of the "daisy" efficient transport




Source: Dragneva, N., 2013, p. 58.

Under the Renewable Energy Sources Act (Renewable Energy Sources Act, 2015) the biofuels are liquid or gaseous fuel for the transport, produced from biomass [2] , including:

a) biodiesel: methyl ester, derived from vegetable or animal fats with the quality of diesel fuel, to be used pure or mixed with diesel fuels;

b) bioethanol: ethanol derived from biomass and / or the biodegradable fraction of waste, to be used pure or mixed with fuel for petrol engines;

c) ethers derived from bioethanol, oxygen-containing compounds (ethyl tertiary butyl ether, or ETBE) produced from bioethanol, where the percentage by volume bio-ETBE calculated as biofuel is 47, biodimethylether: dimethyl ether derived from biomass for use as biofuel and bio-methyl-tertiary-butyl-ether: a fuel produced on the basis of bio-methanol, where the percentage by volume of bio-methyl-tertiary-butyl-ether, calculated as biofuel is 36, intended for use in pure form or mixed with fuel for petrol engines.

These fuels are a practical alternative to conventional fuels confronting the real threat of their depletion in the world, albeit in a rather remote in time range. The dynamics of price levels of oil destabilize economies, but the most serious concern arise from the damage they cause to the environment through the emission of greenhouse gases that are released during their use and the new attitudes of society to protect the environment for life. They are adequately reflected in the strategic objectives of the Green Paper of the European Commission "Towards a European strategy for security of energy supply" and the White Paper "Energy for the future – renewable energy sources." The Green Paper sets as a key objective by 2020, 20% of the conventional fuels in the transport sector to be replaced with "new energy sources" – biofuels, natural gas, hydrogen or other alternative fuels produced in an environmentally friendly way.

Another scenario for limited use of natural resources is prepared by vehicle manufacturers, who investing in the so called low-emission vehicles based on the idea of using different propulsion systems within a vehicle infrastructure, depending on which type of energy is available in the area in which the vehicle is used.

Such solutions include:

- Vehicles fuelled with liquefied butane LPG (Liquefied Petrol Gas). When driving on LPG, $CO_2$ emissions are about 18% lower than those in the gasoline mode.
- An electric vehicle, using an entirely electricity powered engine.
- Hybrid vehicles which have engines with electrical power supply and an internal combustion engine.

The development of science gives many solutions to environmental problems in transport, but at the moment most technologies are not fully independent and are indirectly dependent

[2] "Biomass" means the biodegradable fraction of products, waste and residues with biological origin from agriculture (including plant and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and household waste (Renewable Energy Sources Act, 2015).

on natural resources. The massive entry into operation of the electric vehicle, for example, would lead to strong growth in electricity consumption, which in turn will affect carbon dioxide emissions that cause greenhouse effect, making them high.

Implementation of the measure "Sustainable use of resources, allowing recycling of materials" implies waste recovery (recycling of old vehicles, tyres). The recycling of old vehicles enables valuable raw materials to be reused in the production and thereby contribute to environmental protection. Recycling one vehicle takes place in 4 stages:

Phase 1: The recycling of the vehicle starts with its controlled transmission to an authorized location or to an authorized service for disassembly. A certificate of recycling is issued, which is necessary for the further procedure when decommission the vehicle.

Phase 2: The battery, air bags are removed and the pyrotechnic parts are rendered harmless. The actual recycling starts with draining the fluids from the vehicle to a designated location. At this point are drained, for example, the freon and brake fluid, antifreeze, motor and transmission oil, the fuel is extracted with a special device. The different fluids are sorted into appropriate containers and stored or recycled in appropriate plants.

Phase 3: During the dismantling, the parts that can be reused, are set aside. For example, disassembled engines are prepared in special locations for precise recycling. Valuable materials such as precious metals from the catalyst is recycled in a separate cycle.

Phase 4: The remaining parts of the vehicle are transported for further processing in the respective plants for scrap, where they are cut and sorted. Plastics, textiles, metals are used in other industries.

*b) Objective: A larger share of renewable and recyclable resources and energy in the total consumption.*

The automotive industry is a major consumer, which operates in the conditions of limited resources. This requires manufacturers to look for replacement materials that reduce the ecological footprint, e.g. bio-based raw materials as wood, wool, flax, soybeans and hemp.

Recycling should be considered as a key issue during the entire life cycle of a product, in this case a vehicle - from its initial concept to the end of life cycle. In accordance with this view the manufacturing companies engage in activities for as much as possible reduction of waste and recycling everything that can be reused in the phases of development, production, operation and disposal of waste. Even at the stage of design and development vehicle manufacturers concentrate on improving structural components for the purposes of recycling. If possible, easily recyclable materials are selected, materials and structural developments are re-used, increasing the amount of the used recycled materials and efforts are taken to facilitate the final dismantling of vehicles.

*Measure: Repair, renewal, reuse*

During disassembly of an automobile are formed groups of materials which may be utilized repeatedly, for example, for substitution of coal in the casting slag, for adjusting the water content of sewage sludge, some can be processed in the cement industry and so on. This

manufacturing process allows for 85% reuse of vehicles, which reduces the amount of final waste that falls in landfills.

*c) Objective Reduced emissions.*

With regard to achieving this objective most attention should be paid to road transport, given its technical and economic characteristics associated with environmental pollution.

Emissions from road transport can be classified into three main groups – emissions of flue gas emissions from wear and emissions from evaporation (magazine Ecology and infrastructure, 2016). Currently, the controlled by the legislation pollutants in flue gases from vehicles include $CO_2$ , CO, hydrocarbons, nitrogen oxides and particulate matter.

The emission standards in the EU do not yet regulate emissions from transport of: some acidic pollutants such as $NH_3$ and $SO_2$ (although the concentration of $SO_2$ is limited indirectly through the legislation on fuel quality); carcinogenic and toxic organic pollutants such as polycyclic aromatic hydrocarbons, persistent organic pollutants, dioxins and furans; heavy metals such as Pb, Cr, Hg, Ni, Se and Zn. The content of each of these contaminants in the emissions, of course, depends on the type of fuel used and the type of engine.

Emissions from wear result from the mechanical abrasion and corrosion of parts of vehicles. These emissions include only particulate matter and some heavy metals. Significant dust emissions are generated by the mechanical wear of tyres, brakes, clutch, the road surface and corrosion on the chassis of vehicles.

Emissions from evaporation are formed by vapour leaking from the fuel system. They only contain volatile organic compounds that are released into the environment, even when the vehicle is parked and the engine is off.

Taking into account the indicated groups of pollutants emitted by road transport, the measure involving the use of modern technological solutions and modern equipment should be considered, without ignoring other transport alternatives.

*Measure: Utilization of advanced technological solutions and modern equipment*

One of the measures in this direction involves the use of satellite navigation system following the program "GALILEO" (Green Paper on energy efficiency or How to do more with less, p. 30). Namely the transport sector will be the main user of this radio navigation system via satellite. Satellite navigation system will offer reliable and precise positioning systems for vehicles and will enable us to develop information systems for road users and assistance to drivers. In aviation it will assist at different stages of the flight. In seafaring will be used for marine and coastal navigation. The development of a satellite navigation system also helps sustainable transport, thanks to traffic flow optimization in road transport, aviation, maritime and rail transport. Pushing back the limits of infrastructure saturation, will diminish the exorbitant costs of traffic congestions and will help to reduce energy consumption and underpin the better protection of the environment.

*d) Objective: Reduced material losses, preservation of the value of materials and reuse.*

The idea, embedded in the modern economic processes corresponds to the objective, aimed at reducing material losses, preserving the value of materials and reuse. Regardless of whether these processes are aimed at manufacturing a product or offering a service, the shorter the time for their conduct, the more effective is the running of the operating system and more attention is paid to the environmental problems of production, waste reduction and recycling (Blagoeva, 2010, p. 132).

Particularly in the transport sector the economic functions can be grouped around the creation of conditions for carrying out the normal process of reproduction, to overcome the spatial distance between production and consumption in accordance with the economic principles for cost reduction and the time for warehousing in accordance with the basic principles embedded in the international environmental law (Rayanova, 2010, p. 117):

- principle of the common property of mankind;
- freedom of research and use of the environment;
- rational use of the environment;
- protection from environmental pollution;
- international cooperation in the field of environmental protection, and
- international responsibility in environmental protection.

Based on these principles the transport sector should exploit new technologies in its operations, which will allow it to demonstrate responsibility in the problems of modern consumer society concerning the use of obsolete goods.

*Measure: Eco innovations*

Innovations in transport are directly related to modern technologies that reveal the potential for transforming part of the solid waste into fuel. There are developed methods by which waste can be processed and turned into liquid, solid or gaseous fuels (Ecology and infrastructure, 2014).

Production of liquid fuels from waste is associated primarily with methods of thermochemical treatment of organic waste, mainly biomass. the thermochemical treatment is considered viable, environmentally and economically consistent method for obtaining power and chemicals from waste. Usually it involves the processing of waste by pyrolysis.

Solid fuel derived from waste, known as modified fuel or RDF (Refuse Derived Fuel), is produced by shredding and dehydrating solid waste through a special conversion technology. RDF is produced mainly from combustible fractions such as plastics and biodegradable waste, incl. tyres and rubber waste, residues from vehicle dismantling (automobile shredder residue) and others (Energy review, 2015).

The gas from renewable sources is a gaseous fuel produced from biomass and/or the biodegradable fraction of waste that can be purified, until reaching natural gas quality and

is intended for energy purposes, including the production of electricity, heat and energy for cooling and for use as biofuel (Renewable Energy Sources Act, 2015).

*e) Objective: Sustainability of production and consumption.*

According to the definition approved by the European Conference of Ministers of Transportation, "sustainable cause" affects the transport system and in this perusal it (ECMT, 2004): "Allows meeting and development of the needs of individuals, businesses and society to be met safely and in a manner compatible with human health and ecosystems, and promoting equity within and between successive generations. To work fairly and efficiently at affordable prices, to offers choice of transport mode and to maintain a competitive economy as well as a balanced regional development.

To limit the impact on air and water as well as noise emissions, waste and resource use.

To limit emissions and waste within the capabilities of the planet to absorb them, to use renewable resources at or below their rates of generation or use non-renewable resources at or below the rates of development of renewable substitutes while minimizing the impact on use the land and the generation of noise."

In this context, the sustainable aspects of the transport system are associated with main cornerstones, the first of which focuses attention on the needs of individuals, businesses and society discussed in terms of environmental performance and human health status. The second cornerstone links the objectives of a sustainable transport system with a limitation of the environmental impact and the third seeks to limit these processes to the potential for absorption of Earth in regard to "toxic emissions, greenhouse gases and water pollution from transport" (Marsden, et al., 2005, p. 7).

*Measure: New business models*

Today, businesses are looking for solutions that are economically justified and at the same time diffuse the sustainable idea, through optimal management of logistics flows, relying on new technologies and the application of scientific approaches.

The new business models are based largely on the possibilities for connecting, communicating and sharing information. The dynamics of the transport activity involves the accumulation and operation of constantly updating in real-time information on vehicles, the material and accompanying flows, which is made possible by cloud technologies that provide network access to shared resources such as: Internet networks, servers, storage arrays of data and software applications with minimal participation and management by the cloud provider (Sulova, 2013, p. 558).

Transport companies rely increasingly on science-based approaches for building their business models which ensure optimality regarding the criteria cost and time, as well as a number of other criteria such as: optimization of the time, when the incurred for the transport costs are within certain limits (Milkova, 2013, p. 104); optimize the allocation of vehicles following preliminary determined optimal routes (Milkova, 2013, p. 329); optimize the activities with relative criteria using the methods of fractional-linear

optimization, enabling performance optimization by two criteria (profitability, prime cost, relative risk, etc.) (Nikolaev, 2016, p. 10).

The actual dimensions of the environment require the economic agents to be flexible, adaptable and precise in terms of a complex of economic, social and environmental factors.

## 2. Analysis of the impact of transport on the development of circular economy in Bulgaria

### *2.1. Legal framework, related to the role of transport in the circular economy of Bulgaria*

Putting the priorities of environmental policy as a basis for the development of circular economy requires defining three sets of priorities, limited to specific programs and projects (Centre for the Study of Democracy):

A) Main priority: towards sustainability:

- possibly full integration of environmental issues in all sectoral policies, strategies and programs;
- total ecologization of the economic sectors, legally fixed by legislation, consistently brought closer to and aligned with the European norms, standards and procedures;
- consecutive introduction as leading, the shared responsibility principle, which involves both the State, local authorities and industries as well as major groups: private businesses, academia, professional classes, women, youth and children, etc.;
- measures for remodelling the social and economic behaviour of individuals, businesses and civil structures, with domination by economic and market regulators and mechanisms;
- reorientation of management activities towards horizontal measures in the process of ecologization, development of intersectoral policy and coordination between the competent state bodies and enhanced involvement of local authorities and the public.

B) Medium-term priorities:

- reduce and mitigate negative effects from diffuse, difficult to control sources of pollution and impacts in the economic sectors such as transport, agriculture, tourism, energy and specific industrial sectors;
- accelerated development of regulatory changes (limit values, environmental standards and evaluation procedures) in the process of cohesion and alignment with EU legislation, particularly in the field of consumer protection of products and goods with effects on human health and the environment;
- introducing the shared responsibility principle, along with the completion of the privatization process and the development of the private sector, which will basically carry out the country's participation in the internal market of the Union.

B) Short-term priorities:

- activities for accelerated construction of public ecological infrastructure incl. water supply and sewage systems, plants for purifying municipal wastewater, landfills and stations / plants for processing of solid waste and non-hazardous industrial waste, etc.;
- activities to reduce and eliminate the immediate environmental risks to human health, incl. ones generated in the process of manufacturing and consumption of goods / services in sectors such as energy, construction, transport, etc., as well as from the environmental components (soil, water, air, mineral and biological resources);
- activities for liquidation of past environmental damages, including nuclear industries, landfills of hazardous industrial waste (incl. of uranium production), contaminated land in the agricultural land fund, etc.;
- In order to achieve the short- and medium-term priorities is proposed the diversification and development of tools of environmental policy and environmental management through:
- internalization of the costs of environmental protection in the price of each product / service and thus generation of the necessary resources and capacity of the state, local governments and businesses to meet their environmental responsibility to the country, the market and consumers;
- development and enrichment of the economic regulators for environmental behaviour of individuals in balancing the criminal with stimulation / mitigating measures;
- diversification of sources of revenues to the budget and target funds for protection of the environment, the natural resources and the human health through direct and indirect taxes, charges for the use of resources and environmental services and so on.;
- harmonization of legislation, including alignment of the environmental procedures. incl. environmental certification of producers and technical standards and norms with those of the EU, incl. of the systems of standards ISO-9000 and ISO-14000;
- accelerated development and effective use of the active enacted harmonized legislation, especially in the part of environmental regulations and ecological standardization;
- development and strengthening of institutions and effective administrative reform, incl. in the sector of environmental protection, health and natural resources, following models and standards comparable to those of the EU;
- accelerated specialized training of management and executives in order to strengthen the capacity for immediate application of European procedures, norms and standards;

- protection of consumers from environmental and health risks generated by the manufacturing and consumption of goods/services; introduction of environmental labelling for the environmental attributes of the product (origin, processing / manufacturing, consumption) as a form of informing and protecting consumers;
- wide and objective information of citizens about the state of the environment, guaranteed to strengthen the role of civil society and major groups in society by involving them in making decisions on environmental issues.

The legal framework related to the participation of transport in the development of circular economy in Bulgaria is of particular importance given the need to regulate the obligations assumed by the state, especially in terms of European integration. The regulations concerning the transport in the context of its role in environmental protection and sustainable development of the sector are a number of laws, statutes, ordinances, regulations, directives etc., that have one common goal – to regulate the economic activity carried out in the transport sector according to European law and the active legislation of the Republic of Bulgaria.

Given the ecological footprint, which the transport sector puts in the atmosphere, it is important to define the term "air pollution". Under the meaning of Ordinance №2 from February 19, 1998 for emission limit values (concentrations in waste gases) of pollutants, released into the air from stationary sources: "Air pollution" means any entry of harmful substances in it, and "harmful substances" are those that cause changes in air quality, leading to adverse effects on the health and comfort of people, harm living resources, the soil, ecosystems and property.

The adopted in 1996 Clean Air Act, Art. 2 para. 4 declares commitment to regulate the "quality requirements for liquid fuels, including monitoring of compliance with the quality requirements for liquid fuels in their marketing and their distribution, transport and use." The legal requirements relate to: transport vehicles and other individual sources of pollution, transport activities (art. 3, para. 2, 4).

By joining the EU on 1 January 2007, Bulgaria agreed to implement Directive 2003/87/EC establishing a European scheme for trading emissions of greenhouse gases. The scheme for emissions trading is the main EU instrument for implementing the Community's obligations under the Kyoto Protocol under the UN Framework Convention on Climate Change. From 1 January 2012 the scheme for trading greenhouse gas emissions includes all flights arriving at or departing from an airport located in a Member State, for which the Treaty on the Functioning of the European Union applies. For the period from January 1, 2013 to December 31, 2020 and for each subsequent period of the European emissions trading scheme (EU ETS) from aviation activities, the quotas to be allocated to aircraft operators shall be equivalent to 95 percent of the historic aviation emissions multiplied by the number of years in the respective period (art. 37 par. 3 of the Limitation of climate change Act effective from 03.11.2014).

In view of prevention for environmental pollution was introduced the concept of "eco-tax" in the Environmental Protection Act (EPA), according to which (Art. 56a) “(1) Persons possessing motor vehicles, which through its construction, action or used fuel cause air

pollution, ozone layer depletion and climate change, shall paid one time, during the first registration of the vehicle, an eco-tax in the amount and following the procedure established by the Council of Ministers. (2) The eco-tax under para. 1 enters the Enterprise for management of environmental protection activities (EMEPA)."

Practically in Bulgaria there is no fee for motor vehicles (MV) that is associated with air pollution. The impact of motor vehicles on air quality is reflected in the tax on vehicles, which is paid annually to municipalities. It can be reduced in the event that the vehicle is equipped with catalytic devices, and corresponds to certain environmental requirements. Indirectly, vehicle users pay eco-tax when using the fuels, where such is charged.

Another type of fee accompanying the vehicles that can be mapped to eco-fee is the product fee, which is regulated by the Waste Management Act (WMA) (see Table 2).

Table 2

Comparative characteristics of the product fee from WMA and eco-fee from EPA

| Features | Product fee from WMA | Eco-fee from EPA |
|---|---|---|
| Amount and payment procedure | Ordinance for establishing the terms and amount of payment of the product fee (prom. SG., issue 30 from 12.04.2016, effective from 16.06. 2016). | Missing legislation |
| Liable persons | ~ Persons marketing vehicles (according to the WMA and the Regulation establishing the terms and amount of payment of product fee. ~ Persons who acquire for personal use motor vehicles imported or input from another Member State under the Regulation establishing the terms and the amount of the payment of product fee. | Owners of vehicles |
| Reason for introducing the fee | For manufacturers and importers of vehicles not involved in organizations for utilization and who do not perform their duties individually. | Vehicles that through their construction, action or used fuel cause air pollution, ozone layer depletion and climate change. |
| Recipients of the fee | EMEPA or OU | EMEPA |

Source: Renewable Energy Sources Act // December 18, 2015.

Unlike the eco- fee, the product fee is paid by persons marketing vehicles and applies to all motor vehicles. The product fees are paid to either the state Enterprise for management of environmental protection activities (EMEPA) or to the created by the WMA Organizations for Utilization (OU that are committed to collect, utilize and dispose of end of life vehicles (ELV).

Unlike other products (e.g. household appliances), after the use of which widespread waste is also generated and a product fee is due, but during their acquisition a separate document is not required, vehicles require documentary proof of payment to the account of EMEPA or OU (under contract for membership). Thus, with the payment of the fee, the end

customer becomes a person under a contract with OU who has to meet obligations at the vehicle's end of life. In fact, the OU members are individuals and they are, roughly equal to the number of registered vehicles.

The Bulgarian legislation applies Ordinance on end-of-life vehicles (adopted by Decree № 11 of the Council of ministers from 15.01.2013, prom. SG. issue 7 from 25.01.2013). Its conditions mainly try to commit those involved in the design, manufacturing, distribution and consumption of vehicles and the persons carrying out activities with ELV to take measures to limit their harmful effects on human health and the environment. For ELVs, there are basically two scenarios – recycling or reuse. Specifically, in the Waste Management Act, "Waste recycling" is an activity for restoration or resumption of the properties as raw materials, and the "Reuse" is the use of waste as a product that has once already been used in the same form for the same purpose.

Another document that affects the environmental aspects of transportation, is Directive 2003/30/EC fixing objectives regarding the introduction of biofuels. The diversification of EU energy mix relies on multiple technologies for renewable energy (hydropower, geothermal energy, solar energy, marine energy, wind energy, energy from heat pumps, biomass, biofuels) that offer various services in the form of electricity, heating and cooling and transport solutions. Renewable energy sources (RES) together with energy efficiency and the flexible and intelligent infrastructure are options worth to be selected in each case. In the future, RES in Europe will have a larger share in energy supply, for electricity, for heating (which accounts for almost half of the total energy demand in the EU) and for cooling and for the transport sector and will reduce Europe's dependence on conventional energy sources. "Energy Roadmap 2050" involves a share of renewable energy in the energy mix in the EU by at least 30% in 2030; therefore the EU should strive to achieve even higher share for renewables for 2030, taking into account the effects arising from the interaction with other possible objectives of the policy in the fields of climate and energy, in particular in relation to the objective to reduce greenhouse gas emissions and its impact on industries in the EU, including the sector of energy production from renewable sources.

The use of and the tax benefits related to biofuels, is based on different provisions of EU legislation such as the European Directive 98/70/EC as amended by Directive 2003/17/EC dealing with the quality of fuels. This directive authorizes the addition of ethanol of up to 5%, of ethers containing five or more carbon atoms in a molecule, up to 15% in gasoline and of biodiesel – up to 5% in diesel. A larger percentage is fully compatible with today's engines.

Directive 2003/96/EC allows for partial or total removal of excise duties. In the area of biofuels, the intention is to grant favourable tax treatment and to define certain limits, with the flexible option for Member States to adopt their own policy on the issue according to their specific circumstances (26th recital of the Directive).

Thus, under Article 16 of the Directive on energy taxation, Member States, inter alia, exempt products produced from biomass from energy tax or tax them subject to reduced tax provided that the exemptions or reductions in tax must be adjusted to take into account changes in the price of raw materials in order to avoid over-compensation for additional costs associated with the production of these products.

Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania and Slovakia may apply, for the uses specified in Art. 8 and Art. 9[3], a transitional period until 1 January 2021 for the introduction of $CO_2$ emissions taxation.

In Bulgaria the legislation reflects the actual dimensions of the environmental commitments that the country assumes as a full member of the EU in regard to participation in the trading of greenhouse gas emissions, adopt the targets with regard to the introduction of biofuels, joins the provision of favourable tax taxation of biofuels. At the same time, it is noteworthy that under the national legislation no environmental tax related to pollution from motor vehicles is charged, which can be reported as an adverse circumstance, which is offset by tax payable for vehicles, which is paid annually to municipalities.

In practice it is not possible to create special environmental laws covering all the effects that human activities have on the environment, but adopting the principles of sustainable development as a normative approach, which should be reflected in specific rules relating to the ecologization of the economic sectors, including transport is objectively applicable.

### *2.2. Researching the role of transport in the development of circular economy in Bulgaria*

EU member states have set three objectives by 2020 (known as the "20-20-20"): 20% reduction in greenhouse gases of the EU compared with 1990 levels; Increase the share of renewable energy sources in EU energy consumption to 20%; Increasing the energy efficiency in the EU by 20%.

The transport sector is directly involved in achieving the operational objectives for ensuring high mobility of goods and reducing the harmful effects of transport on the environment and therefore the framework indicators for sustainable development focus mainly on energy consumption.

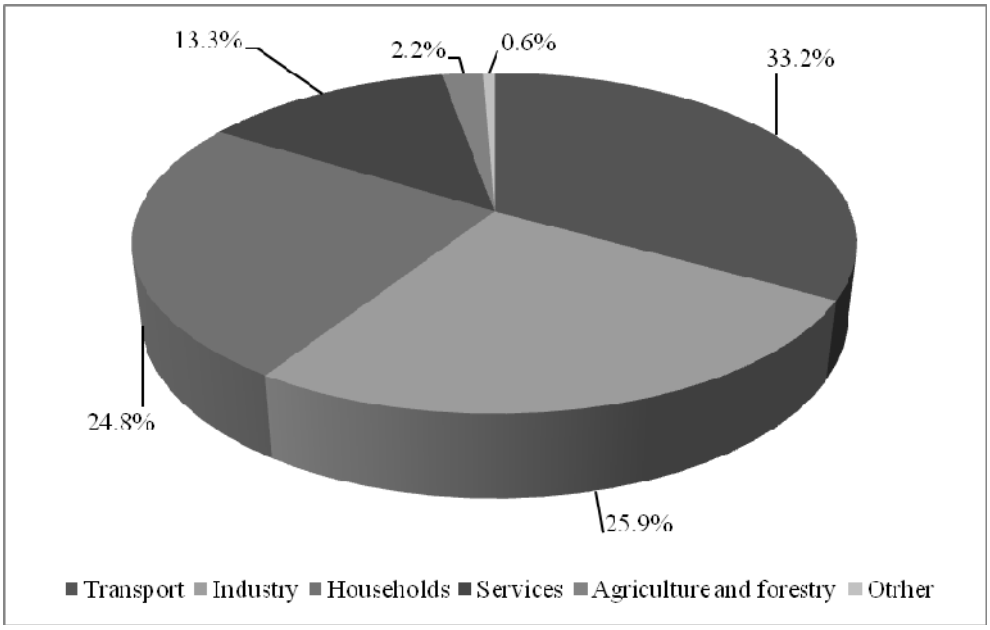
The analysis of the final energy consumption in the EU-28 in 2014, showing three dominant categories: transport (33.2%), industry (25.9%) and households (24.8%) (Fig. 3).

The total energy consumption of all types of transport in the EU-28 amounted to 353 million tons of oil equivalent in 2014. There is a significant change in the development of energy consumption for transport needs after 2007, when consumption began to decline in each year and between 2007 and 2013 energy consumption for transport in the EU-28 decreased by 9.1%. Nevertheless, in 2014 the transport sector holds the first place in final energy consumption within the Alliance.

[3] Art. 8: From 1 January 2013 the minimum levels of taxation applicable to products used as motor fuel referred to in paragraph 2 of this Article uses, shall be fixed as indicated in Annex I, Table B. Article 9: From 1 January 2013 the minimum levels of taxation applicable to heating fuels shall be fixed as indicated in Annex I, Table C.

Figure 3

Final energy consumption of the EU-28 in 2014 in %, calculated on the basis of tons of oil equivalent



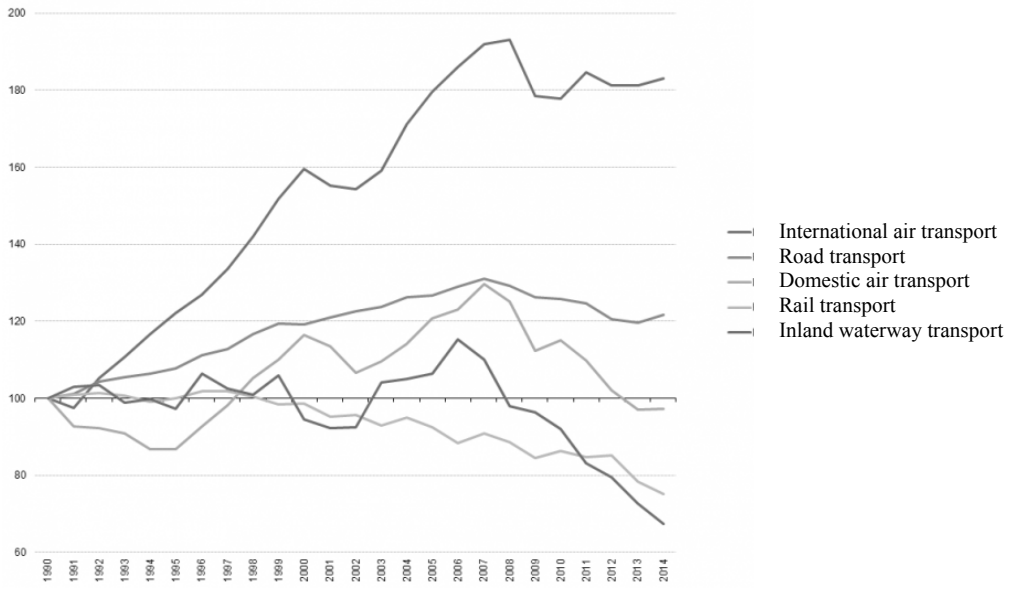

Source: Eurostat

Energy consumption among the main types of transport (air, road, rail and inland waterway) between 1990 and 2014 increases. As shown in Figure 4, the international aviation marks the highest growth in the EU-28. Road transport, which is the most exploited transport alternative worldwide, increases its energy consumption compared to the beginning of the period but also outlines a descending trend in comparison with the 2007 peak.

All other types of transport, including domestic air, rail and inland waterway, registered a decline in terms of energy consumption. This fact is not taken as a positive indicator, influenced by the application of modern transportation solutions, but is linked to the intensity of use of these transportation options from EU member states, including Bulgaria (see Table 3).

Figure 4

Energy consumption by types of transport in the EU-28 for the period 1990-2014 (1990 = 100, based on tons of oil equivalent)




Source: Eurostat

Table 3

Relative share of goods transported and work performed by road and other transport in Bulgaria for the period 2000-2015 (%)

| *Indicators* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* |
|---|---|---|---|---|---|---|---|---|
| Goods carried by road transport | 38.289 | 41.225 | 51.293 | 51.156 | 49.676 | 51.013 | 52.476 | 53.515 |
| Transport performance by road transport | 4.683 | 6.618 | 8.649 | 9.103 | 10.293 | 12.989 | 12.569 | 12.939 |
| Goods carried by other transport | 61.711 | 58.775 | 48.707 | 48.844 | 50.324 | 48.987 | 47.524 | 46.485 |
| Transport performance by other transport | 95.317 | 93.382 | 91.351 | 90.897 | 89.707 | 87.011 | 87.431 | 87.061 |
| *Indicators* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* | *2015* |
| Goods carried by road transport | 52.675 | 56.366 | 54.97 | 58.107 | 60.906 | 65.877 | 66.11 | 67.916 |
| Transport performance by road transport | 11.634 | 20.819 | 31.931 | 40.335 | 51.836 | 65.064 | 73.657 | 76.058 |
| Goods carried by other transport | 47.325 | 43.634 | 45.03 | 41.893 | 39.094 | 34.123 | 33.89 | 32.084 |
| Transport performance by other transport | 88.366 | 79.181 | 68.069 | 59.665 | 48.164 | 34.936 | 26.343 | 23.942 |

A database of National Statistical Institute.

The data in the table shows the road transport as the most preferred by the transport operators in Bulgaria in the recent years, which was not typical for the sector at the beginning of the study period. Gradually over the years, can be observed, increasingly higher relative shares that are accumulated by road transport both in terms of transported goods and the work performed. To a large extent this trend of development is seen as unfavourable because it is the result of the growing interest of carriers to transport of goods by road, which is not a consequence of the economic boom in the country, but is the result of decreased levels of operational activity of other modes of transport and, in particular, rail and water, which can be defined as a form of cannibalism in the transport sector.

The main reason to prioritize road freight transport is a consequence of the limited volumes of business of the enterprises, which does not allow them to benefit from the main advantage of rail transport, associated with a lower cost per unit load transport. On the other hand, the reasons for the observed decline in the activity of the railways can be connected with the narrow relation and with the poor state of the infrastructure and rolling stock, with which the companies in the transport sector operate. On this basis it can be concluded that the "revitalizing the railways" is yet to be seen in Bulgaria as set out by the European Commission in the so called White Paper.

Particularly in water transport the lack of economic interest in this transport option is related to the general state of the Bulgarian economy, regarding the impact of key sectors whose products are subject to import or export, such as:

- oil processing industry (import of oil and export of oil products)
- metallurgy (import of ore, coke and other products of the metallurgical industry and export of the metallurgical industry and scrap);
- energy (coal import);
- construction (cement export, domestic shipments and export of inert materials, import and export of building materials and structures);
- agriculture (export and import of grain and fodder); chemical industry (export and less import of fertilizers);
- light industry and others sectors of industry (import and export of various general and containerized cargo).

The lack of basic raw materials in the country is a precondition for the preservation of existing or close to them volumes of imports from Russia and Ukraine. The partial recovery of the positions of Bulgarian products on the Russian market is expected to have a positive impact on transportation, but from March 2014 EU gradually imposes restrictive measures in response to the illegal annexation of Crimea and the deliberate destabilization of Ukraine.

The high degree of use of road transport, which is characterized by unfavourable influence on the ecological parameters of the environment requires a comparative tracing of the shares of emissions of harmful substances, defined by a calculated method based on the following indicators: consumed fuel, calorific properties, quantity of manufactured

production and input raw materials and emission factors for the respective pollutants emitted into the atmosphere of Bulgaria by road and other transport (see Table 4).

Table 4

Share of emissions of harmful substances into the atmosphere of Bulgaria from Road transport (RT) and Other mobile sources (OMS) for the period 2000-2014[4] (%)

| *Emissions* | *2000* | *2001* | *2002* | *2003* | *2004* | *2005* | *2006* | *2007* |
|---|---|---|---|---|---|---|---|---|
| Sulphur oxides (SOx) RT | 95.791 | 96.265 | 95.998 | 96.342 | 92.332 | 89.922 | 73.651 | 60.271 |
| Sulphur oxides (SOx) OMS | 4.209 | 3.735 | 4.002 | 3.658 | 7.668 | 10.078 | 26.349 | 39.729 |
| Nitrogen oxides (Nox) RT | 94.910 | 95.556 | 95.597 | 96.108 | 95.425 | 95.277 | 94.722 | 94.060 |
| Nitrogen oxides (Nox) OMS | 5.090 | 4.444 | 4.403 | 3.892 | 4.575 | 4.723 | 5.278 | 5.940 |
| Non-methane volatile organic compounds (NMVOC) RT | 99.384 | 99.408 | 99.448 | 99.495 | 99.324 | 99.303 | 99.234 | 99.272 |
| Non-methane volatile organic compounds (NMVOC) OMS | 0.616 | 0.592 | 0.552 | 0.505 | 0.676 | 0.697 | 0.766 | 0.728 |
| Methane ($CH_4$) RT | 99.528 | 99.558 | 99.603 | 99.641 | 99.593 | 99.617 | 99.636 | 99.673 |
| Methane ($CH_4$) OMS | 0.472 | 0.442 | 0.397 | 0.359 | 0.407 | 0.383 | 0.364 | 0.327 |
| Carbon oxide (CO) RT | 99.617 | 99.621 | 99.636 | 99.638 | 99.496 | 99.437 | 99.375 | 99.281 |
| Carbon oxide (CO) OMS | 0.383 | 0.379 | 0.364 | 0.362 | 0.504 | 0.563 | 0.625 | 0.719 |
| Carbon dioxide ($CO_2$) RT | 97.653 | 98.022 | 98.239 | 98.593 | 98.635 | 98.733 | 98.814 | 98.927 |
| Carbon dioxide ($CO_2$) OMS | 2.347 | 1.978 | 1.761 | 1.407 | 1.365 | 1.267 | 1.186 | 1.073 |
| Dinitrogen oxide ($N_2O$) RT | 88.731 | 89.461 | 91.003 | 92.163 | 85.617 | 86.102 | 87.219 | 88.522 |
| Dinitrogen oxide ($N_2O$) OMS | 11.269 | 10.539 | 8.997 | 7.837 | 14.383 | 13.898 | 12.781 | 11.478 |
| Ammonia ($NH_3$) RT | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 |
| Ammonia ($NH_3$) OMS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| *Emissions* | *2008* | *2009* | *2010* | *2011* | *2012* | *2013* | *2014* | *2015* |
| Sulphur oxides (SOx) RT | 71.131 | 74.851 | 55.805 | 47.734 | 49.327 | 43.575 | 44.811 | : |
| Sulphur oxides (SOx) OMS | 28.869 | 25.149 | 44.195 | 52.266 | 50.673 | 56.425 | 55.189 | : |
| Nitrogen oxides (Nox) RT | 93.507 | 93.964 | 94.487 | 93.286 | 93.379 | 93.140 | 93.421 | : |
| Nitrogen oxides (Nox) OMS | 6.493 | 6.036 | 5.513 | 6.714 | 6.621 | 6.860 | 6.579 | : |
| Non-methane volatile organic compounds (NMVOC) RT | 99.051 | 99.354 | 99.304 | 99.305 | 99.191 | 99.319 | 99.423 | : |
| Non-methane volatile organic compounds (NMVOC) OMS | 0.949 | 0.646 | 0.696 | 0.695 | 0.809 | 0.681 | 0.577 | : |
| Methane ($CH_4$) RT | 99.563 | 99.736 | 99.733 | 99.726 | 99.652 | 99.744 | 99.815 | : |
| Methane ($CH_4$) OMS | 0.437 | 0.264 | 0.267 | 0.274 | 0.348 | 0.256 | 0.185 | : |
| Carbon oxide (CO) RT | 99.155 | 99.265 | 99.299 | 99.069 | 98.976 | 98.930 | 99.049 | : |
| Carbon oxide (CO) OMS | 0.845 | 0.735 | 0.701 | 0.931 | 1.024 | 1.070 | 0.951 | : |
| Carbon dioxide ($CO_2$) RT | 98.711 | 99.187 | 99.163 | 99.250 | 99.120 | 99.324 | 99.532 | : |
| Carbon dioxide ($CO_2$) OMS | 1.289 | 0.813 | 0.837 | 0.750 | 0.880 | 0.676 | 0.468 | : |
| Dinitrogen oxide ($N_2O$) RT | 86.505 | 90.029 | 89.891 | 90.743 | 89.327 | 91.806 | 94.144 | : |
| Dinitrogen oxide ($N_2O$) OMS | 13.495 | 9.971 | 10.109 | 9.257 | 10.673 | 8.194 | 5.856 | : |
| Ammonia ($NH_3$) RT | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | : |
| Ammonia ($NH_3$) OMS | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | : |

*Legend: ":"missing data.*

Source: Database of National Statistical Institute.

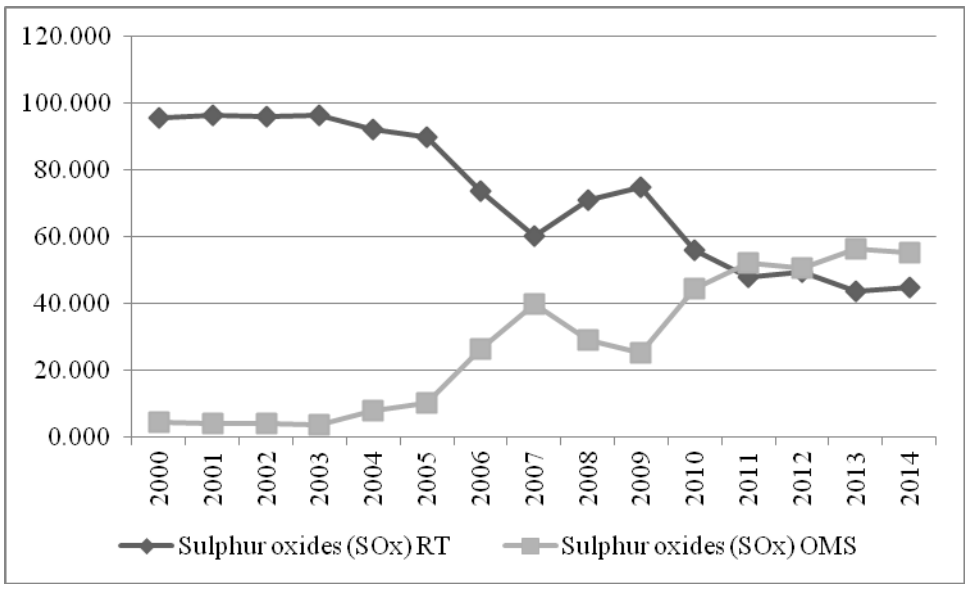
[4] The emissions are calculated according to the latest edition of the methodic CORINAIR.

From the data in the table is established that over 90% of the nitrogen oxides, non-methane volatile organic compounds, methane, carbon monoxide, carbon dioxide and ammonia are emitted from the road transport and only with nitrous oxide were observed years, in which the levels are lower, but they also gravitate within 85.617% (2004) and 94.144% (2014), while with sulphur oxides seems to be present a downward trend in road transport from 95.791% (2000) to 44.811% (2014) and growth in other modes of transport, respectively from 4.209% (2000) to 55.189% (2014).

Emissions of SOx in the exhaust gas of internal combustion engines result from oxidation of the sulphur contained in the fuel during the combustion process. Therefore, the amount of sulphur oxides in the flue gas depends entirely on the sulphur content of the fuel used. In this connection, the complete penetration of petrol and diesel with a maximum sulphur content of 10 mg / kg contributes to reducing SOx emissions after 01.01.2009 in the EU, which is laid down in Directive 2003/17/EC of the European Parliament and the Council from 3 March 2003 amending Directive 98/70/EC on quality of petrol and diesel fuels (see Fig. 5).

Figure 5

Dynamics in relative share of emissions of harmful substances into the atmosphere of Bulgaria from Road transport (RT) and Other mobile sources (OMS) for the period 2000-2014




In other modes of transport measures to reduce emissions are also taken, e.g. in maritime transport, the parties to the International Maritime Organisation (IMO) have negotiated significant revision of Annex VI of MARPOL at the end of 2008 (COM/2011/0441 final). This review recommended a phased reduction to 0.50 % from 2020, of the sulphur content

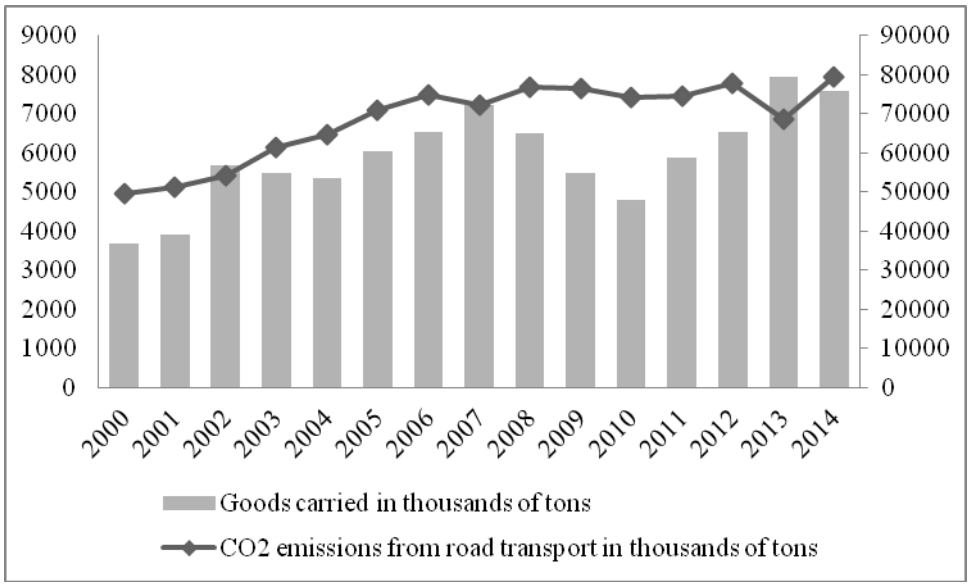
of fuels used in all seas to 0.10% in the SECA[5] from January 2015. The provisions to achieve compliance with regulations are technologically neutral and can be met through alternative methods of emissions reduction, such as systems for cleaning the exhaust gases or the use of alternative clean fuels such as liquefied natural gas.

In regards to the carbon dioxide, requirements on the quality of petrol and diesel fuels are introduced by Directive 2003/17/EC of the European Parliament and of the Council of 3 March 2003 amending Directive 98/70/EC and the reported progress towards the goal of the Community is 120 g/km for the average emissions of $CO_2$ per vehicle.

In this regard, in Fig. 6 is reported the dynamics in the development of $CO_2$ emissions in the atmosphere of Bulgaria and the goods carried by road transport (RT) for the period 2000 – 2014. A decline in the amount of separated carbon dioxide per unit of transported cargo is observed. The data show that for the period under study, $CO_2$ per 1 ton transported cargo from 0.135 tons reaches levels of 0.105 tons., with the lowest values achieved in 2013 – 0.086 tons. $CO_2$ per 1 ton of transported cargo. At the same time, we should also take into account the fact that the average distance travelled increases by 210.629 km., calculated at the end of the period compared to the beginning of 2000, which means that the quantities of harmful $CO_2$ emissions, emitted for the distance of one kilometre travel are reduced.

Figure 6

Dynamics in the $CO_2$ emissions in the atmosphere of Bulgaria and the goods carried by road transport (RT) for the period 2000-2014




[5] Due to the particular contribution of shipping emissions to acidification problems in northern Europe, MMO has designated the Baltic Sea, North Sea and the English Channel SECA in the EU.

It can be objectively argued that the measures taken by the EU to reduce the negative impacts of transport activities in the Community have reflection on the current picture of the emissions of harmful gases within Bulgaria.

The consumption of biodiesel in road transport in the country develops in this positive direction. Regarding biofuels, with the entered into force on 04.01.2013 Regulation on sustainability criteria for biofuels and liquid fuels from biomass, Bulgaria reports growing consumption of energy from renewable sources in the "Transport" sector in 2013 and 2014 compared to previous years (see Table 5).

Table 5

Share of biodiesel in the total consumption of diesel (thousand tons) in road transport for the period 2006-2014

| Years | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| Share in % | 0.63 | 0.30 | 0.27 | 0.42 | 1.59 | 1.27 | 5.69 | 7.17 | 6.38 |

Source: Database of National Statistical Institute.

In 2013 and 2014 the consumed quantities of biofuels in the sector "Transport" meeting the sustainability criteria according to NSI data, are respectively 104 thousand tons of oil equivalent and 111 thousand tons of oil equivalent, of which for 2013 : biodiesel – 105 435 tons (96 thousand tons of oil equivalent) and bioethanol – 12 568 tons (8 thousand tons oil equivalent) and for 2014 biodiesel – 106 321 tons (96 thousand tons of oil equivalent) and bioethanol – 22 824 tons (15 thousand tons of oil equivalent).

Although the fixed 10% use of biofuels in the transport sector by 2020 are not reached, there is an indication of a certain potential in this area and the state should motivate the production and consumption of these fuels.

An important aspect of the development of the transport sector in Bulgaria in the context of circular economy is the waste generation from end-of-life vehicles (see Table 6).

Table 6

Waste generated by end-of-life vehicles in th. tons for the period 2006-2014, in EU-28 countries

| Country/Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 | : | : | : | : | : | : | 6240.000 | 6450.000 | 6350.000 |
| Bulgaria | 45.127 | 23.433 | 38.600 | 63.027 | 74.422 | 65.428 | 59.191 | 62.723 | 82.258 |
| Czech Republic | 48.094 | 62.000 | 132.533 | 147.217 | 135.479 | 118.147 | 114.800 | 114.833 | 122.450 |
| Estonia | 10.637 | 12.334 | 13.716 | 7.712 | 7.679 | 12.123 | 14.056 | 16.391 | 16.617 |
| Croatia | : | : | : | : | : | : | 33.221 | 29.017 | 22.584 |
| Latvia | 5.659 | 10.979 | 10.578 | 8.946 | 9.650 | 10.115 | 10.435 | 9.037 | 8.983 |
| Lithuania | 14.057 | 17.207 | 19.426 | 19.014 | 22.885 | 27.823 | 26.187 | 31.037 | 33.265 |
| Hungary | 16.380 | 30.207 | 28.287 | 27.419 | 15.589 | 14.959 | 14.388 | 14.865 | 13.887 |
| Poland | 124.173 | 150.063 | 170.100 | 192.281 | 217.636 | 284.307 | 340.212 | 401.639 | 462.202 |
| Romania | 17.624 | 32.007 | 44.031 | 48.424 | 162.276 | 110.035 | 50.732 | 34.566 | 38.137 |
| Slovenia | 7.810 | 6.041 | 4.790 | 5.428 | 5.305 | 5.703 | 4.528 | : | : |
| Slovakia | 11.907 | 23.414 | 29.885 | 54.051 | 27.396 | 30.341 | 26.373 | 29.678 | 24.710 |

*Legend: ":"missing data.*

Source: Eurostat.

It is noted that in most countries of Eastern Europe, including Bulgaria over the years the generated waste from end of life vehicles is increasing, except for Hungary and to some extent Croatia, which joined the EU on 01.07.2013. The outlined trends are logically influenced by the growth of the operation of road transport for freight and people. As a whole the fleet of vehicles in Bulgaria increases and only for five years in 2014, there is a growth of 493 569 in the number of available vehicles, according to Eurostat data, which logically leads to the decommissioning of some of the vehicles. Moreover, it must be borne in mind that Bulgarians are among the biggest consumers of used vehicles. Used are generated are a prerequisite to saturate the environment with large amounts of pollutants from different categories, they are a real threat to life and health of people, given the manipulation of measuring instruments and general technical condition of road vehicles and create prerequisites for the development of new business activities.

Therefore, in Bulgaria there is a marked economic interest in the market niche for recycling and reuse of vehicle regulated by the legislature. The data for reused and recycled vehicles for Bulgaria shows that in the country there is a well-developed market segment for recycling and reuse of motor vehicles and share growth was observed in 2014 compared to 2006 (see Table 7).

Table 7

Total recycled and reused end-of-life vehicles, in % of waste generated by end-of-life vehicles for the period 2006-2014, in EU-28 countries

| Country/Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| EU-28 | : | : | : | : | : | : | 84.5 | 85.3 | 85.7 |
| Bulgaria | 82.4 | 89.5 | 81.0 | 82.7 | 88.9 | 90.0 | 89.5 | 93.2 | 94.1 |
| Czech Republic | 79.0 | 79.0 | 80.0 | 80.3 | 80.3 | 80.3 | 80.3 | 80.3 | 80.3 |
| Estonia | 82.5 | 82.2 | 92.4 | 87.2 | 77.3 | 76.1 | 80.9 | 77.7 | 87.0 |
| Croatia | : | : | : | : | : | : | 97.2 | 100 | 89.5 |
| Latvia | 86.0 | 88.0 | 87.0 | 85.0 | 85.7 | 85.4 | 97.6 | 92.4 | 92.2 |
| Lithuania | 88.0 | 86.4 | 85.0 | 86.0 | 88.1 | 87.2 | 89.2 | 92.1 | 93.5 |
| Hungary | 81.2 | 81.6 | 83.0 | 84.4 | 82.1 | 84.4 | 84.4 | 90.7 | 90.3 |
| Poland | 84.7 | 72.8 | 79.5 | 87.1 | 88.8 | 89.5 | 90.4 | 88.6 | 85.5 |
| Romania | 77.1 | 83.7 | 83.7 | 80.1 | 80.9 | 82.9 | 84.0 | 83.8 | 84.1 |
| Slovenia | 76.8 | 87.2 | 87.6 | 84.1 | 88.6 | 86.1 | 100 | : | : |
| Slovakia | 82.8 | 88.0 | 88.4 | 88.8 | 88.4 | 93.1 | 89.9 | 92.5 | 94.8 |

*Legend: ":"missing data.*

Source: Eurostat

In fact, after joining the EU only in 2008 and 2009, when is the peak of the global economic crisis, we report a slight decline, but in other years the processes take place upstream in this sector, which can be associated with the perceived overall environmental EU policy, with legislative changes, but to a great extent also with the potential market for final processing of secondary raw materials in the country, determined by the age structure of the fleet.

It is noteworthy that in the last three years of the study period Bulgaria is ahead of recycled and reused vehicles out of use, total EU-wide and with increasing pace. Of the countries

that were part of the socialist block until 1989, only Slovakia is positioned in front of Bulgaria with a minimum of 0.7 points.

Virtually every vehicle has a complex structure and includes a number of components that can be recycled and reused:

- The batteries are a source of plastics and lead. In Bulgaria they are recycled from "Monbat" AD, town of Montana, "KCM" AD, town of Plovdiv, "EL BAT" AD, Dolna Banya municipality.
- The glass is 100% recyclable and is commonly used to make new glass products. One of the businesses that use in the manufacture of new products, cleaned of impurities cullet is "Druzbha Glassworks" AD, town of Sofia.
- Fluids (brake fluid, oil, freon, antifreeze). In Bulgaria the collected waste oils are recycled by two companies – "Lubrica" EOOD, town of Ruse and the workshop on "Polychim - SS" EOOD in the town of Lukovit. The enterprises use a technology where a base oil is produced, which can be used for production of new oils for the automotive industry and the industry as a whole.
- End of life tyres can be used in construction to strengthen banks – barriers against erosion, artificial reefs, breakwaters; to strengthen the embankments along the roads. New technologies allow their implementation in manufacturing: safety flooring, safety, sports and anti-shock mats, artificial grass cover, paving blocks and materials for building roofs, waste bins, carts and so on. The largest importers of tyres in Bulgaria – "Medina med" AD, town of Stara Zagora and "Diana" OOD, Sofia built in Stara Zagora a factory for recycling of discarded tyres – "Ecomediana Recycling" OOD.
- Automotive plastics are used to manufacture products from recycled plastic, but it can reasonably be burned to produce energy. In Bulgaria this market is operated by a number of small and medium enterprises, but one of the leaders is "Ecoinvest" EOOD,. Pazardzhik – the company produces plastic pellets and PET (polyethylene terephthalate) flakes (scales) for reuse. PET flakes are used as raw material for the production of packaging materials, bottles and packing containers for a wide range of food products and other consumer goods.
- Ferrous (steel) and non-ferrous (aluminium, copper, etc.). metals. "Steel Industry" AD, town of Pernik is a major consumer of ferrous metals in Bulgaria, which are a major part of the mass of a motor vehicle.
- Other materials: textiles, catalysts, oil filters, hazardous waste.

Based on the analyses the following main conclusions on the participation of transport in the circular economy of Bulgaria can be systematized:

1. Road transport is the preferred by the transport operators in Bulgaria and it is characterized by an unfavourable influence on the ecological parameters of the environment and this requires the proportion of emissions of harmful substances into the atmosphere of Bulgaria to be examined.

2. Over 90% of nitrogen oxides, non-methane volatile organic compounds, methane, carbon monoxide, carbon dioxide and ammonia are liberated from road transport. based on the performed analysis, it can be objectively argued that the measures taken by the EU to reduce the negative impacts of transport activities in the Community have reflection on the current picture of the emissions of harmful gases within Bulgaria.
3. The fixed 10% use of biofuels in the transport sector by 2020 is not reached, but a positive trend is reported after the entry into force of the Regulation on sustainability criteria for biofuels and liquid fuels from biomass.
4. It is noted that in most countries of Eastern Europe, including Bulgaria over the years the generated waste from end of life vehicles is increasing, except for Hungary and to some extent Croatia.
5. The processes related to recycling and reuse of vehicles in Bulgaria, are taking place upstream in the sector, which can be associated with the perceived overall environmental policy of the EU, the legislative changes, but also to a great extent by the potential market for final processing of secondary raw materials in the country determined by the age structure of the fleet.

Transport plays a key role in the construction and development of circular economy in the country, but from all transport alternatives the biggest part is played by road transport. In this respect it should be concluded that in the Bulgarian economy operate in a competitive environment business entities, who on the basis of a synchronised with the European legislation legal basis are engaged with the issues of environmental protection and the application of the basic principles associated with reuse and recycling.

## 3. Possibilities to apply the model of the circular economy in the transport sector of Bulgaria

The Bulgarian state must develop a clear program for the transition from linear model to circular economy, because circular economy creates conditions for more efficient use of raw materials and hence accumulate effects for businesses, citizens and governments, especially in the long term. Thus, the circular economy will create more jobs, reduce dependence on countries, supplying raw materials and will help avoid climate change. The actual implementation of this model is important for Bulgaria because of the limited resource base available, which makes the country dependent on a number of international suppliers. Therefore, if our country adheres to the linear economy, the final consumption will be defined by raw materials prices, costs and profits.

The basic principle which the development of this model must use as a foundation step is connected with the idea that in the circular economy there are almost no waste products and materials as they are reused. Nevertheless, there is a need to provide new resources, but they must be extracted in a sustainable way in order to avoid negative consequences for the environment.

In this circular economic model, a particular place should be given to certain sectors related to transport and in particular to the production of biofuels, recycling and recovery of end of life vehicles and tyres.

In the presence of a free and competitive market, each country has the opportunity to specialize in a production, in which it has a natural or acquired competitive advantage (Zhelyazkova, Grozdeva and Stoyanov, 2010, p. 97). In this regard, some of the possible effects that the state may pursue in the applied by it policies, are stimulating the economic growth through exploitation of such production and service sectors that focus on specialization in waste recovery and recycling of old products, manufacturing of biofuels, etc. whilst taking into account the negative influence of these proceedings. For example, the different biofuels increase the effect of greenhouse gases that contribute to global warming of the planet, because these gases are emitted during the entire production cycle - during the manufacturing of the fertilizers, pesticides, the fuel used during the processing of agricultural land, transport and distribution, and during the actual combustion (Staikova, Baikov, 2012, p. 174).

Biomass is essential to reduce carbon emissions and reduce dependence on fossil fuels such as petrol, diesel and gas. Through the deployment of more biomass, the government will build a greener economy and it will be possible to talk about bioproductive economy.

Unlike other renewable energy sources, biomass can be converted directly into liquid fuels for transportation needs. The two most common biofuels are ethanol and biodiesel. Ethanol, which is alcohol, is obtained by fermentation of any biomass high carbohydrates, such as corn. It is mostly used as a fuel additive to reduce the carbon monoxide from the vehicle and other emissions that cause smog. Biodiesel, which is an ester, is obtained from vegetable oils, animal fats, algae and recycled cooking greases. It can be used as a diesel additive to reduce vehicle emissions or as a fuel in its pure form.

Bulgaria could exploit the market niche of biofuels and specialize in their production, with which it will solve the problems of dependence on external suppliers of fuels and will export the finished production on one hand, and on the other will utilize part of the accumulated waste.

Like all business entities involved in the economic life of Bulgaria, the companies associated with transport should make a commitment to implement the concept of circular economy in the country. For this purpose, they should develop and implement strategies and tactics focused on environment friendly practices in their business.

An advanced concept that gives impetus to modern production cycles is the so called. "foretold death of the products", which is directly related to the initial design phase of the product when its useful life is determined, which is precisely reduced to minimum levels. This option offers the potential for the formation of needs of new production volumes and thus provides a relative intensity of the production processes.

In the automotive industry this concept also finds its practical application, which concerns both ELVs and individual components such as tyres.

Vehicle manufacturers are already facing many regulations on emissions, safety and recycling of their products. The greatest environmental impact is caused by vehicles during the stages of production and use, so the focus is much more directed at the harmful emissions and to energy efficiency measures in production than the use of the materials at the end of life cycle product.

The commitments for recycling of ELVs and their parts must be an envisaged option for the use of the product after its designated exploitation.

At present such an idea in Bulgarian legislation is discovered in Art. 13 of the Waste Management Act, Section II, entitled "Extended Responsibility of the Manufacturer" which regulates product requirements, after which use is generated widespread waste, the procedure and methods for separate collection, reuse, recycling and/or recovery, including the targets for separate collection, reuse, recycling and/or recovery.

This includes ELV, but unlike other ordinary waste (paper, batteries, appliances, etc.) in vehicles, the marketing of components is sufficient to achieve the economic objectives and in practice the principle on which the system functions, is self-financing. The vehicle is one of the most sophisticated consumer products. Vehicles are composed of a huge amount of raw materials and a large number of suppliers. Also, vehicles have a longer life and impact on the environment throughout their entire life, both during production and during use.

On this basis it can be argued that one introduced in Bulgaria product fee could be waived, as is the practice in many countries, leaders in the recycling of ELV by Austria, Germany, France, Spain, the UK and Italy.

Especially important commitment concerning the transport sector and reflected in the development of circular economy of Bulgaria, are end of life tyres (ELT). For this purpose, in 2011, the Bulgarian state adopted the Regulation on the treatment of end of life tyres under the Waste Management Act, which created a legal base, which regulates the duties and responsibilities of the companies engaged in manufacturing and commercial activities with tyres. The state thus stimulates the development of a market niche, utilizing end of life tyres.

According to this Regulation, the persons who market tyres are responsible for the collection, storage, transport, recovery or disposal of end of life tyres, as the salvaging is performed in one of the following methods:

- through regeneration;
- through recycling;
- through their incorporation as a material in construction, including the addition of whole and sliced tyres as a material in the construction of landfills;
- by incineration with energy recovery.

The persons, marketing tyres are responsible for meeting the following objectives:

- not less than 65 per cent of the amount (in tons) tyres, marketed by them in the Republic of Bulgaria during the current year to be utilized;

- not less than 50 per cent of the amount (in tons) tyres, marketed by them in the Republic of Bulgaria during the current year to be regenerated and/or recycled. The introduced targets for recycling and regeneration of ELT are achieved incrementally by 2020 and come into force on January 1, 2013.

Key objectives for the activities of ELT in Bulgaria for the period 2014-2020 are planned as outlined in the National Plan for Waste Management 2014-2020 (see Table 8).

Table 8

Key objectives for the activities of ELT in Bulgaria for the period 2014-2020

| Waste streams | Year | Target | |
|---|---|---|---|
| | | Utilization | Recycling |
| Tyres | | Utilization of not less than: | Regeneration and / or recycling of not less than: |
| | 2014 | 65% of the quantities (tons) of tyres, marketed during the current year. | 20% of the quantities of tyres, marketed during the current year. |
| | 2015 | 65% of the quantities (tons) of tyres, marketed during the current year. | 25% of the quantities of tyres, marketed during the current year. |
| | 2016 | 65% of the quantities (tons) of tyres, marketed during the current year. | 30% of the quantities of tyres, marketed during the current year. |
| | 2017 | 65% of the quantities (tons) of tyres, marketed during the current year. | 35% of the quantities of tyres, marketed during the current year. |
| | 2018 | 65% of the quantities (tons) of tyres, marketed during the current year. | 40% of the quantities of tyres, marketed during the current year. |
| | 2019 | 65% of the quantities (tons) of tyres, marketed during the current year. | 45% of the quantities of tyres, marketed during the current year. |
| | 2020 | 65% of the quantities (tons) of tyres, marketed during the current year. | 50% of the quantities of tyres, marketed during the current year. |

Source: Ministry of Environment and Water. National Plan for Waste Management 2014-2020, p. 152.

The development of circular economic model, in the conditions of the Bulgarian economic realities may be applied by a relatively narrow specialization in certain sectors, related to transport such as manufacturing of biofuels, recycling and utilization of end of life vehicles and tyres.

## Conclusion

The multiple set of challenges posed in front of the modern society impose taking commitments that are directly related to long-term economic, environmental and social goals. Adequate models applicable at various levels, covering the perimeter of corporate activity and the state responsibility for sustainable development are being more and more actively developed.

One option that corresponds directly with the public and corporate interests in this direction is the implementation of a circular economic model. It is based on three basic principles: reduce, reuse and recycle. In practice, the idea is to close, as far as possible, the economic cycle and for it to allow for maximum utilization of the scarce resources to meet the unlimited needs.

In a circular economic model, the role of transport is especially important and in particular the related production of biofuels, recycling and utilization of end of life vehicles and tyres.

In Bulgaria this model can find its application, because the state is relatively poorly provided for with raw materials and has untapped potential for specialization in the production of biofuels. The favourable conditions for the formation of biomass as raw material for biofuel production give reason to believe that the country can develop in this direction. Thus the Bulgarian economy can obtain some independence from fuel supplies from other countries and can export the finished product.

Modern concepts for business development are directly or indirectly focused on environment friendly practices in doing business. One such concept that gives impetus to modern production cycles is the so called "foretold death of products" which is applied in vehicle manufacturing and directly binds planning the vehicle with the stage after its operational use.

Particularly important in this respect are the processes involved in recycling and utilization of end of life vehicles and tyres. Bulgaria strictly adheres to the regulations of the European Union but could initiate some changes which to contribute to the development of this sector. In particular, the author refers to removing the product fee for motor vehicles, given the opportunities provided by the vehicle as a product that can find market realisation as spare parts and thus form a positive economic results.

The studies outlined in the guidelines are extremely comprehensive and current and create the basis for the development of the subject in future scientific papers.

## References

Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. – Sustain Sci, pp. 133-140.

Blagoev, Bl. et. al. (2009). Business Logistics. Varna: Science and Economics.

Blagoeva, S. (2010). Operating system and competitive advantages of the company. – Economic Research Academy of Sciences, N 3, pp. 130-168.

Center for the Study of Democracy, Bulgaria and the European Union: institutional infrastructure. Environmental legislation and environmental policy. Available at: <http://www.csd.bg/artShow.php?id=12968> [30.12.2016].

Clean Air Act. July 26, 2016.

COM/2011/0441 Final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the review of the implementation of Directive 1999/32 / EC as regards the sulfur content of certain liquid fuels and further reduce pollutant emissions from maritime transport. Available at: <http://eur-lex.europa.eu/legal-content/BG/ALL/?uri=CELEX%3A52011DC0441> [28.12.2016].

Directive 2003/87/EC establishing a European scheme for trading emissions of greenhouse gases.

Directive 98/70/EC as amended by Directive 2003/17/EC dealing with the quality of fuels.

Directive 2003/30/EC fixing objectives regarding the introduction of biofuels.
Directive 2003/96/EC for partial or total removal of excise duties.
Dragneva, N. (2013). Use of "green technologies" in transport. Proceedings of the scientific conference with international participation BSU, pp. 57-63.
ECMT. (2004). Assessment and Decision Making for Sustainable Transport. European Conference of Ministers of Transportation, Organization of Economic Coordination and Development. Available at: <http://www.keepeek.com/Digital-Asset-Management/oecd/transport/ assessment-and-decision-making-for-sustainable-transport_9789282113134-en#page1> [30.12.2016].
Emissions from transport – measuring progress in reducing their – part I. (2016). – Ecology and infrastructure, N2.
Environmental Protection Act. October 14, 2016.
European Commission – Information document. Package circular economy: Questions and Answers. Brussels, December 2, 2015. Available at: <http://europa.eu/rapid/press-release_MEMO-15-6204_bg.htm>. [13.11.2016].
Fuels from solid waste. (2014). Ecology and infrastructure, N 1.
Geng, Y., Fu, J., Sarkis, J., Xue, B. (2012). Towards a national circular economy indicator system in China: an evaluation and critical analysis. – Journal of Cleaner Production, 23, pp. 216-224.
Ghisellini, P., et al. (2015). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. – Journal of Cleaner Production, pp. 1-22.
Green Paper on energy efficiency or How to do more with less.
Limitation of climate change Act effective. June 21, 2016.
Marsden, Gr. et al. (2005). Appraisal of Sustainability: Environmental Indicators. Institute for Transport Studies, University of Leeds, pp. 1-18. Available at: <http://www.its.leeds.ac.uk/projects/sustainability/resources/Appraisal%20of%20Sustainability%20in%20Transport%20-%20Environment%20Indicators.pdf> [30.12.2016].
Mechanical-biological treatment of waste to produce RDF fuel. (2015). Energy review, N 6.
Milkova, T. (2013). Opportunities to optimize routes for transportation in the supply chain. Proceedings of the University of Economics in Varna, 2/2013, Varna: Science and Economics, pp. 103-114.
Milkova, T. (2013). Optimal attachment of users to the provider taking into account the load capacity of vehicles. Proceedings of the International Conference "Prospects for the industrial business", Varna: Iko-Consult, pp. 329-333.
Ministry of Environment and Water. (2014). National Plan for Waste Management 2014-2020.
Nikolaev, R. (2016). Optimizing production and transport planning now to relative criteria. Monograph. Library "Prof. Tsani Kalyandzhiev", Varna: Science and Economics.
Ordinance establishing the terms and amount of payment of a product fee. June 16, 2016.
Ordinance N 2 from February 19, 1998 for emission limit values (concentrations in waste gases) of pollutants, released into the air from stationary sources.
Ordinance on end-of-life vehicles. January 25, 2013.
Rayanova, Kr. (2010). Principles of international environmental law. – Scientific University of Rousse, Volume 49, Series 7, pp. 117-123.
Regulation on sustainability criteria for biofuels and liquid fuels from biomass. January 4, 2013.
Regulation on the treatment of end of life tires. September 25, 2012.
Renewable Energy Sources Act. December 18, 2015.
Staikova, Yu., B. Baikova. (2012). Environmental assessment of production of various renewable energy sources. Climate impacts in the production of biogas and biodiesel. Proceedings of the Fourth Annual International Conference "Greening 2012" Sofia: NBU, pp. 170-179.
Sulova, Sn. (2013). Some aspects of the use of cloud services in e-commerce. Proceedings of the Jubilee International Conference on "Regional and global dimensions of trade", Varna: Science and Economics, pp. 557-564.
Waste Management Act Waste Management Act. February 20, 2015.
Zhelyazkova, D., Grozdeva, D., Stoyanov, M. (2010). Key driving forces for the development of commercial business in Bulgaria. – Economic Research Academy of Sciences, N 1, p. 90-131.