

THE ECOLOGICAL AND SOCIAL VALUE OF GREEN LOGISTICS

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***Abstract:** Green Logistics is a relatively new concept, a part of Green Economy, which considers not just economical aspects but also environmental problems. Unlike classic logistics, that looks only for optimal costs, green logistics is making sure that final decisions won't have a negative effect on the environment or society. It's making sure that people working in extractions are not exploited, routes are well designed and the environment is not affected. Thanks to Green Logistics concept there were created biofuels, electric trains and were discovered so many ways of benefiting from environment without damaging it.*

***Keywords:** fuels, emissions, logistics, environment, transport.*

Contemporary economics has a different attitude towards global warming compared to 15 years ago. If previously there was skepticism about climate change, today consumer ideologies are forcing producers to draw attention to the consequences of the processes of supply, production, distribution, etc. The revision of all these stages with the aim of minimizing the negative environmental impact has drawn attention to the green economy, a concept that appeared in the 1970s, with green logistics as part of it. In 2010, the Business Council for Sustainable Development published the article Vision 2050 in which it describes the new global ideas and goals that economic agents should aim for. Similar projects have been developed by several countries individually but also by the European Union, which published Vision 2050 in 2015. The publication of these articles is a major step towards recognising the problem of waste and pollutants resulting from production and distribution processes. The new idea being propagated involves reducing the use of liquid carbohydrate fuels, reducing carbon emissions and non-reusable waste. These changes have been introduced at the legislative level, with new laws being included that support innovations that would reduce carbon emissions. Decarbonisation is an ecological concept that involves reducing carbon emissions that cause the greenhouse effect. The European Union plans to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990 and 80-95% by 2050 compared to 1990.

Green logistics is a relatively new concept that involves the distribution of goods with sustainability in mind and aims to reduce carbon emissions from the transport of goods or the production process. It takes all aspects into account and moves products through the supply chain with consideration for ethical standards (climate change impacts, pollution, waste) and social standards at minimum costs. The objectives of green logistics are to implement economical and environmentally friendly, but at the same time effective, solutions that will meet consumer needs. Green logistics is based on three pillars: economy, ecology and social impact. Conventional logistics considers the economic side, ensuring the most efficient and cost-effective flow of goods. In this context, carbon emissions from the transport process are not taken into consideration, the working conditions and health of the employees of the production or extraction centers are also ignored, the wages of the employees are taken into account, but only from a cost point of view, not from a social point of view. Classic logistics is looking for solutions that would reduce production costs, hence the outsourcing of production processes to third world countries, where unfortunately working conditions are at the lowest level and wages are extremely low. Green logistics, on the contrary, takes these issues into account, which is why a company implementing such logistics will not exploit its workforce, even if it outsources production to third world countries, but will offer adequate wages, sick leave, health insurance and other facilities. At the

same time, green logistics aims to minimize negative environmental impact, reuse waste, minimize carbon emissions from transporting goods, etc.

Transporting passengers or goods is a complex process involving several stages, boarding/loading, actual transportation, disembarkation/unloading and a multitude of processes and phenomena that may occur along the way: breakdown of means of transport and their repair, securing returns in the case of transporting goods, the need for specialized medical help in the case of transporting passengers, all of these situations are unpredictable, which prompt specialists to draw up special protocols for these exceptional situations. As far as key stages are concerned, they are all well planned and coordinated so that passengers and goods arrive on time, passengers safe and goods undamaged and without delays that could cause disruption. However, there is one shortcoming that affects people, and that is carbon emissions. Consumption of goods increases directly in proportion to the world's population, therefore the flow of transport of these goods and, of course, the flow of passenger transport increases, and as transport flows increase so do carbon emissions. Most goods are transported overland, using road transport, which releases the greatest amount of carbon dioxide, with trains as an alternative. Most people also prefer road transport and for long distances air transport.

Table 1. Share of carbon emission by transport mode

Mode of transport	Road transport	Waterborne transport	Civil aviation	Rail transport	Other
Carbon emissions share, %	71.7	14.1	13.4	0.4	0.5

Source: [3, Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

According to the European Environment Agency (EEA) report on transport and the environment in 2021, most carbon emissions are released by road transport, more than 70%, while the lowest are caused by rail transport - 0.4%. Waterborne transport is responsible for 14.1% and civil aviation for a further 13.4%.

Table 2. Share of carbon emission by road transport mode

Mode of road transport	Cars	Heavy-duty trucks and buses	Light-duty trucks	Motorcycles
Carbon emissions share, %	60.6	27.1	11	1.3

Source: [3, Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

More than half of the carbon emissions from road transport are released by cars, which are plentiful and used on a daily basis. Heavy-duty trucks and buses are responsible for 27.1% of carbon emissions from road transport. Light-duty trucks, often used by small companies, account for 11% of carbon emissions from road transport. The smallest share is accounted for by motorcycles, 1.3%, which are not usually used for transporting goods and are generally a less popular means of transport than cars. Although most of the emissions are caused by fuel cars, their numbers still prevail even as electric cars grow in popularity. Most waterborne and civil aviation transport cannot be replaced, only improved in terms of carbon emissions, while a large share of road transport can be replaced by rail. Trains themselves can be categorized by energy type into electric trains, diesel trains and mixed (diesel and electric) trains. Most carbon emissions are released by diesel trains, where fuel combustion takes place. The second most polluting are mixed trains, which get some of their energy from burning diesel and some from electric power. Electric

trains are the least harmful to the environment, as they do not directly emit carbon, but depending on how the electricity is generated, indirect emissions can vary. Another factor in favor of rail transport is its safety. In 2012, there were 28,126 road fatalities and 36 rail-related fatalities reported in the EU. Of course, regular inspections of railways and trains, as well as their maintenance, are necessary to keep rail transport safe.

The national railway network of the Republic of Moldova consists of 1045.4 km non-electrified main lines, 684.5 km secondary lines and 90 stations. More than 1000 km of main lines have a gauge of 1520 mm and just over 30 km have a gauge of 1435 mm, these being close to the border crossing points at Giurgiulesti and Ungheni. Around 40 km of the railway lines are double lines, but the number given is small, multiplying the double lines would facilitate the transport of goods on the railways and simplify the transit of foreign trains. Harnessing rail transport would allow connection to the European rail freight corridors, which would allow the export of domestic products to the West at lower costs. It is possible to connect to European freight railways through the Orient Corridor, which passes through Romania, Hungary, Austria, the Czech Republic, Slovakia, Bulgaria and Greece. These countries in turn are connected to other corridors: Scandinavian-Mediterranean (via Austria), Baltic-Adriatic (via Austria and Slovakia), Mediterranean (via Hungary). After connecting to these three corridors via the Orient corridor, it will be possible to continuously connect to the other corridors, which would allow the transport of goods all over Europe. Connecting to these corridors will reduce the cost of raw materials and imported raw materials. In order to reduce certain costs in rail transport there is the concept of double operation, when the consignee uses the container or wagon unloaded by him to load other goods. A favorable change would be the construction of new networks on the territory of the Republic of Moldova. A good example in this regard is China, which has invested considerably in its railway system, and since 2021 has already over 150,000 km of railways, of which more than 100,000 km are electrified and more than 35,000 km are high-speed. These railways would facilitate the transit of foreign trains, thus connecting northern and north-eastern Europe (Poland, Latvia, Lithuania, Estonia, Finland, Sweden, etc.) with south-eastern Europe (Bulgaria, Greece, Albania, etc.).

A downside of rail transport compared to road transport is its speed, with heavy goods vehicles reaching speeds of 50-60 km/h, sometimes 80-90 km/h, while freight trains have an average speed of 18-20 km/h, with 50 km/h recorded in some parts of the Rhine-Aplin route. A well-developed and high-performance infrastructure will allow freight trains to increase their average speed. However, trucks' speed is no guarantee of their superiority over trains. Unlike trucks, trains do not stand in queues at customs, are not weather-dependent (they are not stopped by heavy rain, snow, frost, etc.), and transport costs will increase less compared to the cost of road transport in the event of rising fuel prices.

Both trains and road transport use fuels, which can be either non-renewable or renewable resources (biofuels). The use of non-renewable resources, even if it proves to be effective, cannot continue for long, as the name of the type of fuel suggests that it is non-renewable and will eventually run out. That is precisely why alternative energy sources, such as electricity and biofuel, are viewed positively.

Table 3. Share of energy consumption by road transport by energy type

Type of fuel/energy	Diesel	Petrol	Biofuel	Liquefied petroleum gas	Natural gas	Electricity
Share, %	66.7	24.55	5.83	2.16	0.68	0.08

Source: [3 Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

According to the study conducted in 2019 by the European Environment Agency, final energy consumption of road transport is dominated by diesel, 66.7%, followed by petrol with a

share of 24.55%, biofuel has a share of 5.83% and liquefied petroleum gas and natural gas have shares of 2.16% and 0.68% respectively, the smallest share has electricity, less than 0.1%. Most of the fuels used are non-renewable, which often leads to disruptions in the fuel market and, therefore, to higher transport costs. From the listed types of fuel/energy the most environmentally friendly are electricity and biofuel. At the moment electricity is used for personal cars, most electric cars are either expensive or slower than fuel cars, hence the popularity of fuel cars.

Table 4. Share of energy consumption by road transport by biofuel type

Type of biofuel	Biodiesel	Biopetrol	Biogas
Share, %	4.77	1	0.06

Source: [3 Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

According to the same study conducted by the European Environment Agency in 2019 biodiesel held a share of 4.77%, the least used is biogas, with a share of 0.06%, even lower than the share of electricity. And yet, over 90% of fuels are non-renewable and CO₂ is released from their combustion. A large number of trains also use fuel, and the popularization of biofuel in the area of rail and road transport would reduce the consumption of non-renewable resources. On the territory of the Republic of Moldova most of the railways are ordinary, non-electric, so the use of electric or mixed trains is quite complicated, but an alternative in this situation is to modernize and adapt trains and switch them to biofuels.

Table 5. Share of feedstocks for bioethanol

Raw material	Maize	Wheat	Sugars	Other cereals	Lignocellulosic material
Share, %	38	30	21	7	4

Source: [3 Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

Table 6. Share of feedstocks for biodiesel

Raw material	Rapeseed oil	Palm oil	Used cooking oil	Animal fats	Soybean oil	Sunflower oil
Share, %	53	19	18	4	4	2

Source: [3 Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

Table 7. Share of feedstocks for hydrogenated vegetable oil

Raw material	Rapeseed oil	Palm oil	Used cooking oil	Animal fats	Soybean oil	Sunflower oil
Share, %	18	43	25	10	3	1

Source: [3 Transport and environment report 2021, Decarbonising road transport – the role of vehicles, fuels and transport demand]

Following the analysis of the data in the tables above, biofuels are obtained from agricultural products: rapeseed, wheat, maize, vegetable oils, etc. Rapeseed is known as an easily cultivated plant, also widespread in the north of the Republic of Moldova. Growing rapeseed for the purpose of creating biodiesel or HVO (Hydrogenated Vegetable Oil) to fuel trains and trucks would reduce the consumption of petroleum products. However, it would be necessary to grow rapeseed on huge acreages or to import it. Used cooking oils could also be used to make biodiesel

and HVO, therefore a system for collecting used oils from the Horeca sector would be welcomed. This kind of a system would require extremely detailed management and the final quantities would be too small, such a system would involve far too high costs and the impact would be insignificant.

Trains based on alternative energy sources are an underdeveloped topic, they already use electricity. Electric railways need to constantly be kept under voltage, they can be powered by solar or wind energy, which produces less CO₂ emissions than thermal energy, which in turn involves burning fuels. However, the problem of electrifying the railways is more complicated than it seems. Because of the requirement to keep them under constant voltage, there arises the need to limit access of people and even animals near electrified railways to avoid potential accidents. All these processes of adapting railways involve additional financial costs.

Around 65% of the carbohydrates extracted in the EU are used to produce fuels that will later power means of transport (petrol, diesel, kerosene, liquefied gas, etc.), 10% are used to obtain petrochemical products (artificial flavors, synthetic dyes, etc.) and 25% for other purposes (fuel oil, oils, liquefied gasses, etc.). The 65% of carbohydrates converted into fuel burns, powering means of transport: trains, cars, planes, trucks, etc., hence the extremely high demand for petroleum products and the rise in prices at the slightest inconvenience to the supplier. These price increases are also reflected on transport costs, which in turn cause an increase in the final price of the product or service. In the current energy crisis, reviewing green logistics not only brings social but also economic benefits, although some alternative resources may be more expensive, they are more stable and less prone to turbulence due to the lack of monopoly. Fuel-free trains help reduce greenhouse gas emissions. To reduce this indicator, several measures have been taken to lower emissions, including the upgrading of trains and railways.

Concluding remarks

Green logistics is emerging at the intersection of economic, environmental and social values. Its implementation requires detailed planning and assessment of all variables capable of disruption. Actions taken in favor of a greener environment are welcomed and appreciated by the general public as well as by partners, investors and other economic agents. Improving the rail system would reduce transport costs, which would lower the price of the finished product, which would have a positive effect for the consumer, whilst the high transport capacity and low energy consumption would result in low CO₂ emissions per product. However, in order to achieve such a result, investments are needed in the railway system of the Republic of Moldova, namely, the electrification of the railways, the construction of more double lines, and more 1435 mm gauge lines and their gradual renewal according to the European gauge, the development of the biofuel industry and the support of international financial organizations in this initiative. Electrification of the railways will reduce the dependence of transport costs on fuel prices, a sensitive factor in the context of the energy crisis. The difference in gauge consumes a lot of time at customs crossing points, the 1435 gauge was intentionally created by the Soviets to be 8.5 cm smaller than the European one to minimize contact with the West and avoid the refuge of citizens from the USSR, the time spent by the train at the border was in favor of this policy, whereas since the Republic of Moldova gained independence the aim is to export to the West. Thus, the difference in gauge is against the trade policy and its renewal would solve the given problem. The construction of double lines will allow an increase in the quantity transported by rail. A well-developed system will facilitate foreign trade and help domestic producers penetrate foreign markets more easily. Switching trains to biofuel would reduce their contribution to the resulting pollution from the extractive industry. Northern Moldova is well known for growing rapeseed, and rapeseed oil is one of the main biodiesel feedstocks. Likewise, sunflower, a plant widely grown in Ukraine and the Republic of Moldova, is used to obtain biofuel. Currently, the main export markets are Romania and Russia, followed by Turkey, Italy and Germany, with trucks as the main means of transport. A well-organized railway system will also favor the transit of foreign trains.

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