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Ecology in Transport: Problems and Solutions

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Preface

Very often, the inhabitants of planet Earth in their daily lives do not realize the importance that transport takes in our lives. Nevertheless, if you do not take more distant time periods, you can compare how much time for traveler took a trip from Europe to Australia 200 years ago. It usually took several months. These days are a few hours. The reasons for this are understandable—these are the achievements of science aimed at the development of new means of transport, the related improvement of transport infrastructure, as well as the development of entire sectors of the economy that are involved in the development, production, and operation of means of transport.

Ultimately, although this is not so obvious, the development of transport affects the change in the political map of the world. An example is the creation of the most powerful state at present, which is the USA. This state was founded by immigrants from various European countries. But could they carry out this relocation, if there weren't the necessary means of transport for this?

The ambitious project of China, which was called “One Belt, One Road”¹ is currently under active discussion. The project is based on the delivery of goods using various means of transport. But in reality, the essence of this project is much wider. It implies a global change in the economies of countries that are in the zone of its implementation.

There are many more such general considerations, but it should be noted that the development of transport, with all its positive impact on the fate of mankind, also carries certain threats, the main of which is its negative impact on the environment. There are many factors that are caused by transport and which affect the environment. Various emissions to the atmosphere and water, thermal effects, noise and

¹Hofman B (2015) China's One Belt One Road Initiative: What we know thus far. URL: <http://blogs.worldbank.org/eastasiapacific/china-one-belt-one-road-initiative-what-we-know-thus-far>.

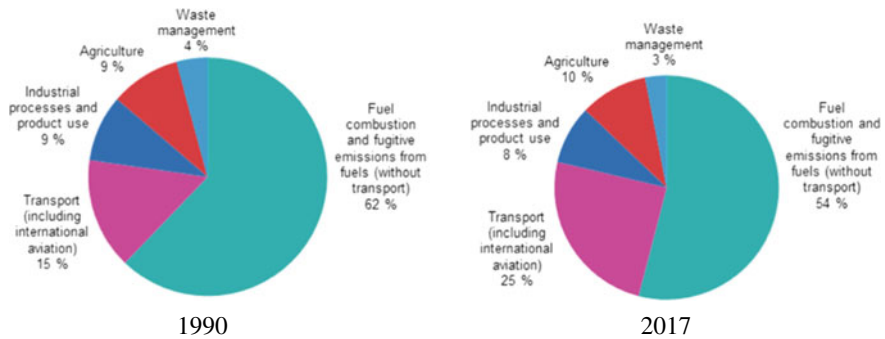


Fig. 1 Greenhouse gas emissions, by source sector, EU-28, 1990 and 2017 (percentage of total). *Source* Eurostat (env_air_gge), European Environment Agency [Greenhouse gas emission statistics—emission inventories. Statistics Explained (2019) URL: <https://ec.europa.eu/eurostat/statistics-explained/pdfscache/1180.pdf>]

vibrations, as well as a number of others can be noted. At present, one can no longer ignore the threat that the greenhouse effect poses to humanity. Residents of Europe have already quite felt the climatic changes that are a consequence of this effect. But if the consequences here are not yet catastrophic, then fires in the vast territories of Australia at the end of 2019 can be talked about as a global catastrophe.

The following greenhouse gas comparison charts show how significant the impact of transport is on this issue. At the same time, it can be clearly seen that over the past 27 years, the amount of such emissions related to transport has increased by 10%. However, these charts do not fully reflect the impact of transport, since they only take into account direct emissions. However, if the source of energy, for example, for an electric locomotive, is the current generated at a power plant, then a pure source of energy is far from always used for its production. At thermal power plants, the burning of coal, gas, or fuel oil also emits greenhouse gases, which means that ultimately the environmental impact of transport is even greater (Fig. 1).

Thus, it makes no further sense to prove that the solution of environmental problems related to transport is an urgent problem of modern science. Moreover, different countries have a significantly different environmental situation and a significantly different approach to solving environmental problems. Nevertheless, when such problems concern the whole of humanity, compromises can be found. The final document adopted at the conference (COP24) in Katowice in December 2018, which was attended by almost 14,000 delegates from 195 countries, is an example.

At this conference, special attention was paid to transport. For example, the problem of the development of e-mobility was considered. Poland and UK proposed the adoption of a joint declaration,² which was ultimately signed by representatives of 1200 leading companies from 38 countries.³

But is electric transport completely eco-friendly? After all, as mentioned above, the main issue is the source of energy necessary for the movement of the vehicle. And if the generation of primary energy is simply transferred from the combustion of fuel directly in a car running on hydrogen fuel, or in an electric locomotive that receives energy from a trolley line, to the generation of energy at a power plant, then the environmental problem is simply transferred from one place to another. Thus, the environmental problems of transport should be considered comprehensively, taking into account the experience of various countries.

This task was undertaken by the editor of this publication, inviting colleagues from different countries to share their experience in developing means of transport and transport infrastructure in order to solve environmental problems for each specific region. The team of authors of this monothematic monograph consists of scientists from Lithuania, Poland, Ukraine, Bulgaria, Slovakia, Russia, and Latvia. The order of countries in this list is related to the topics of the respective chapters, which were written by representatives of these countries.

The first chapter of the book was written by Lithuanian scientists who concentrated their research on the use of fuels, which, when burned, emit less CO₂. Alternative fuels, biofuels, and fuels based on various gases are considered, and comparisons are made with electric vehicles. It also considers the use of hydrogen as an additive to various gaseous or liquid fuels, as well as the use of pure hydrogen.

The next chapter of Polish scientists considers more specific gas mixtures: hydrogen (H₂), hydrogen–methane mixtures (HCNG), and dimethyl ether (DME). It also discusses the more efficient use of gaseous fuels in order to increase their efficiency and reduce harmful emissions.

The use of biofuels as an energy source for vehicles is considered in the third chapter of Ukrainian and Polish scientists. At the same time, all interrelated processes are considered, starting from the production of this type of fuel, taking into account environmental aspects at all stages.

In the fourth chapter, Bulgarian scientists concentrated on analyzing the operation of electric cars or hybrid cars. As an energy source can be used electric batteries, gas fuel, including hydrogen or traditional fuels. The use of bicycles with an electric motor is also considered. The comparison of greenhouse gas emissions for the countries of the European Union is described.

²Driving Change Together—Katowice Partnership for E-Mobility (2018) URL: https://cop24.gov.pl/fileadmin/user_upload/files/Driving_Change_Together_Partnership.pdf.

³Thirty-eight Countries, 1200 Companies Join E-Mobility Partnership, COP Presidency Announces Just Transition Declaration (2018) URL: <https://sdg.iisd.org/news/38-countries-1200-companies-join-e-mobility-partnership-cop-presidency-announces-just-transition-declaration/>.

The next chapter, despite the fact that it was written by scientists from another country (Slovakia), could be called a natural continuation of the previous chapter, since it considers the legal aspects of European environmental policy aimed at reducing harmful emissions from the use of vehicles and primarily greenhouse gases. The chapter discusses aspects of the impact of European standards on environmental protection.

If the previous chapters were primarily aimed at solving the environmental problem for an individual vehicle, this chapter, written by scientists from Russia and Poland, considers the problem more broadly, studying the supply chain of goods taking into account environmental problems. It is not surprising, therefore, that the term “green logistics,” which has recently become generally accepted, is widely used by the authors.

The environmental problems associated with the use of transport are primarily felt by residents of large agglomerations. At the same time, the use of new solutions for the development of transport networks can help improve the situation. The Polish authors of this chapter, based on surveys of a large number of specialists, analyze the environmental problems of implementing the concept of a “smart city.”

The eighth chapter, co-written by scientists from Bulgaria and Poland, examines the various environmental problems of the urban economy. Their solution can be the use of both new means of transport, including those developed by students, or river ships using solar energy, and the development of optimal routes for urban transport.

The last chapter, presented by Latvian experts, is somewhat different from the previous ones, since it considers a slightly different type of environmental pollution. Such pollution is noise and vibrations that are generated by the movement of vehicles. The authors analyzed the movement of rail transport from the point of view of the possibility of applying the EU method of noise measuring for local railways.

Obviously, in the brief summaries given above, far from all the aspects described in the corresponding chapters of this monograph are described. I would also like to note that Springer Publishing House pays great attention to scientific research in the field of transport. This monograph, published under my editorship, is the fifth edition that is published in this publishing house. Environmental aspects related to transport, albeit to a lesser extent, have already been considered in previous books, some of which can also be recommended to readers interested in environmental issues in transport.^{4, 5, 6}

⁴Śładkowski A (ed.) (2017) Rail transport—systems approach. Studies in systems, decision and control 87. Cham: Springer. ISBN 978-3-319-51502-1.

⁵Śładkowski A (ed.) (2018) Transport systems and delivery of cargo on East—West routes. Studies in systems, decision and control 155. Cham: Springer. 2018. ISBN 978-3-319-78294-2.

⁶Śładkowski A (ed.) (2020) Modelling of the interaction of the different vehicles and various transport modes. Lecture notes in intelligent transportation and infrastructure. Cham: Springer Nature Switzerland AG. ISBN 978-3-030-11511-1.

In conclusion, I would like to wish for readers, who are interested in environmental issues, to receive new useful information that may be useful for practical use in the field of designing vehicles, developing transport systems, creating transport infrastructure, logistics for delivering goods, and providing other transport services. Obviously, scientists, teachers, and students can and should be readers of this book. But despite the scientific nature of the book and its rather specialized orientation, it can also be recommended for a wider circle of readers who are interested in environmental aspects in the transport industry and the achievements of modern science in various countries.

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