


# Elements of sustainable development in selected European Union countries

MATEUSZ CHŁAD

Czestochowa University of Technology, Faculty of Management, Chair of Logistics and International Management, ul. Armii Krajowej 19B, 42-200 Czestochowa, Poland

✉ mateusz.chlad@wz.pcz.pl

 orcid.org/0000-0002-1098-2971

## Abstract

**Motivation:** The concept of sustainable development relates in particular to the analysis of the causes of excessive environmental degradation. It defines a strategy for limiting this process in three main areas: ecological, economic and socio-cultural human activity. The survey will cover selected EU countries, including Poland, in accordance with Eurostat's sustainable development arrangements. The analysis concerns sustainable development in transport, modality of transport division, logistic efficiency and the volume of freight transport relative to GDP.

**Aim:** The purpose of the article is to present an analysis and development of sustainable transport development in selected European Union countries by using appropriate indicators in relation to the transport of goods.

**Results:** Relevant indicators regarding the transport of goods and identifying trends affecting the environment and society of transport in the EU have been analysed.

*Keywords:* sustainable development of transport; transport of goods

*JEL:* Q56; R41; R490

## 1. Introduction

The concept of sustainable development is particularly about the analysis of reasons of excessive environmental degradation. It indicates the strategy of limitations of this process in three main areas: ecological, economic and socio-cultural human activity (Fiedor & Czaja, 2010, pp. 23–24). Implementation of these changes depends on a number of factors from within the system that is sus-

tainable development. Important indicators which influence the development and level of the advancement of social awareness on the economy is an economic element and the political sphere. All of the mentioned factors undoubtedly determine the development of individual areas. It is assumed that the directions of development are determined to a large extent by a scheme of grouping indicators and measures of sustainable development. Taking into consideration all mentioned factors, the first step in a led diagnosis becomes a complex analysis of a term of a sustainable development in accordance to a law system. An important step is presenting transport indicators obligatory in EU focusing on transport policy and the natural environment. Systematic growth of the tasks carried out, both in the field of transport of goods and passenger transport, causes an increasing demand for energy (Motowidlak, 2012, pp. 211–221).

## 2. Sustainable development

Creating the idea of the sustainable development is directly connected with depletion of natural resources and significant pollution of all environmental components. The main assumption of this concept is a balance between economic, social and environmental goals. The sustainable development of transport is one of individual solution for a whole eco development. It is a key point to start the contemplations from the term sustainable development itself. This term is identical as a term of eco development but sometimes there are attempts to differentiate them. It can be said for sure that the term eco development is older but these days both of the terms are used interchangeably. We can often meet the term lasting development, which results from a more literal translation of the original name of this concept — sustainable development. All of these terms however, refer to the same, and in the Polish legislation the form of sustainable development has been adopted. The concept of sustainable development, which primarily deals with the analysis of the causes of overexploitation and destruction of the environment, defines a strategy to limit this process in three main areas: ecological, economic and socio-cultural (Krzyżaniak, 2011; Rogers et al., 2008, pp. 43–44). In each of them one can point out several fundamental problems, which are the main challenges for the economy of sustainable development (table 1).

One of the existing model of E.B. Barbier which is an extended and modified version of the B.A. model Forster (Nowosielski, 2005, p. 211). The goal of this model is to analyse paths of optimal growth of the economy, operating at the following long-term restrictions (Nowosielski, 2005, p. 211):

- the consumption of renewable resources can not be greater than the rates of their reproduction;
- in the long term, the utilization rate of renewable resources should go to zero;
- waste can not be emitted into the environment at a rate exceeding its absorption capacity.

This model assumes that at the time  $t$  the environmental degradation rate can be written as follows:

$$S = (W - A) + (R - G) + E, \quad (1)$$

where  $(W - A) = 0$  if  $W = A$ , and  $(R + E) - G = 0$  if  $(R + E) = G$  (Nowosielski, 2005, p. 211).

We can also save the rate of environmental degradation in a different formula (Nowosielski, 2005, p. 212):

$$S = [W(C) + R(C) + E(C)] - [A(X) + G(X)] = N(C) - Q(X). \quad (2)$$

Theoretical analysis of this model lead to the conclusion that that at the initial low quality of the environment, unsustainable economic growth may be an optimal strategy, because then, with increased consumption, the current environmental degradation will occur. It is necessary to show the negative impact of transport operations on the functioning of logistics systems (Nowakowska-Grunt & Strzelczyk, 2016, p. 419). It is not the most optimistic conclusion because it shows that a choice between balanced and unsustainable growth is not always obvious and it is possible to consciously strive for imbalance. Sustainable development is about maximizing the net benefits of economic development while ensuring the recovery of usability and quality of natural resources in the long run. Then economic development must mean not so much increase in income, but also improvement of other elements of social well-being (Woś, 1995, p. 105). The term of prosperity is not unequivocal and can be interpret very widely. For example, a prosperity in in GDP reporting is limited to the consumption of goods and services via the market, and it is known that there are goods and services drawn directly from the natural environment (Żylicz, 2010, p. 76). Prosperity concerns possibilities of satisfying non-material needs that have an impact on increasing the quality of life, it is difficult to precisely determine which goods are material and which are not (Nowosielski, 2005, p. 213). What is more, some psychological factors, e.g. subjective sense of justice or social cohesion (Żylicz, 2010, p. 76) have an impact on the prosperity. These determinants reflect the concept of utility, emphasized by economists as the essence of satisfying human needs. Bearing in mind that the transport system is a comprehensive service of the transport needs of the economy and society of a given region or country, a number of factors should be taken into account when shaping it, including its impact on the environment (Zielaskiewicz & Nowak, 2010, p. 21). During last year's more and more interest in the phenomenon of sustainability and its implications for the planning and operation of the transport system is observed worldwide (Litman & Burwell, 2003, p. 331). The prosperity is not the only present element which defines constant development that goes beyond what is included in statistical analyzes, mostly based on gross domestic product. It also covers other phenomena that can not be market valued (Żylicz, 2010, p. 76). While analysing indicators of sustainable development we have to put our attention on three basic spheres of human life

where a balance should occur in order to talk about a sustainable development. There are (Skrobicki, 2011, p. 300):

- economic sphere,
- social sphere,
- natural environment.

More deeply Piontek (2002, p. 27) in her book isolated the components of development. She assumed that development would be permanent and articulating a high quality of life, if the economies of individual countries would strive for harmonious development in areas such as:

- management of economic resources,
- human resource management.

Education of consciousness in relation to the scale of values and the choice of the model of life:

- management of natural resources;
- spatial management;
- institutional solutions conditioning the course of development processes;
- a moral sphere based on a stable, i.e. non-relativistic scale of values and axioms.

The scale of measurability of features is very differential in particular spheres. The biggest number of measurers was created to material sphere in particular for economic capital. If it comes to non-material factors for example social, spiritual or moral sphere, they have not been subjected to a quantified description (Stachera-Włodarczyk, 2012, pp. 158–161). The factors of sustainable development allow for the diagnosis of the condition of the balance of the economy, provide important information to help identify problems and unfavourable trends. So far, the most often used measurer of prosperity was Gross National Product (GNP). It is a measure of the current monetary value of all final goods and services generated in a given economy over a specific period of time (Piontek, 2002, p. 47). It takes into consideration net income from work or property abroad. Because GNP refers to a particular period of time, the most often — a year, it occurs in two shapes: in nominal and real terms. Nominal GNP is a measure of production at current prices, real GNP at constant prices. If we deduct net income from work or property from GNP from GNP, we will get GDP — gross domestic product (Piontek, 2002, p. 49). In order to receive more detailed information about individual rate of living, the GNP (or GDP) per capita index is used (Piontek, 2002, pp. 27–49). We get it by dividing GNP and GDP by the number of inhabitants of a given country. It has to be underlined that the increase in this indicator will not always be caused by an increase in prosperity, and it may be caused by the decrease in the number of people (European Commission, 2009). It was previously mentioned that GDP does not actually define broadly-conceived prosperity, but only the material part of the market for goods and services. This does not mean, however, that the GDP indicator should be replaced with alternative indicators. GDP is independent of arbitrary valuations, which is its significant advantage. Prices are established by market

and physical quantities are included in statistics, which does not allow arbitrary manipulation of size by researchers (Żylicz, 2010, p. 76).

### 3. A modal division of freight transport in selected European Union countries

A transport policy in EU is a highly important element in building and functioning of a common market. Its influence on transport system in particular member country should be analyzed with other important sectors and horizontal community policies. The biggest and the most direct relationships and forms of interactions take place between cohesion policy and transport policy. The logistic efficiency indicators and the volume of freight transport in relation to GDP will serve to analyze the modality of the transport split.

Table 1 shows the ratio of transport to GDP in per cent for 28 European Union countries and for Poland, the Netherlands, Spain, Belgium, the Czech Republic and Germany in 2011–2016. These indicators are computed by adopting the ratio between freight transport efficiency (in ton kilometres) and gross domestic product (GDP) (chain-linked volumes, according to the 2005 exchange rates) and indexing in one reference year (2005) (Eurostat, 2018).

Effectiveness of a freight transport is a collection of transport means such as: land, railway and inland. Results of transport (in ton kilometers) should be reported by countries according to the principle of territoriality. It means that only the results of transport in the territory of a country should be considered. Road transport is collected according to every movements of vehicles registered in the reporting country, and therefore further methodological changes and calculations are needed to estimate road transport in accordance with the ‘principle of territoriality’. The current version of the indicator is based on inland transport only. But, the statistics of air and maritime transport are well developed taking into consideration their international character, there are some conceptual difficulties in dealing with these types of transport in a manner consistent with modes of land transport (roads, railways and inland waterways). Indicators are indices from the base period of 2005. The units used to measure transport efficiency are ton kilometers (tkm) for freight transport. A ton kilometer means the movement of one tone for a distance of one kilometer (Eurostat, 2018). The next analyzed indicator is a modal division of transport. chart 1 will show the values of this indicator for Poland from 2012 to 2016. This indicator is the percentage of each inland mode in the total capacity of freight transport measured in ton kilometers. Inland transport consists of road, railway and inland waterways transport. Next, charts will show trends in other countries referring to table 2 over these years. This indicator presents us with the quantitative values of consumption between states, because not only the area, but also the population of a given country has to be taken into account.

In Poland in years 2012–2016 the modal division of transport is increasing in particular through road transport. This indicator is focused to monitor

dependences on the transport of goods from individual modes. The indicator is the percentage of road, rail and inland waterway transport in the total transport of inland goods in ton kilometers. In case of road transport, modality is the effect of the intensity's increasing of this movement. National air transport and inland sailing have negligible share in transport, therefore their consumption is also minimal. Especially, the inland transport in Poland is low because it is unprofitable due to the small area of the country, a network of specialized infrastructure. In order to compare the potential of the whole transport branch, we can look at the index illustrating the modality in the Netherlands as shown in chart 2.

On the chart 3 we can see that in case of the Netherlands mobility in three areas is at a very high level, as it was the case in Poland. It is mostly because of the fact that road transport has grown up which is the most energy-intensive mode of transport. The inland transport is included in the modal transport indicator, the energy consumption of this means of transport shows us that it occupies a significant place in the transport of the Netherlands. Apart of the fact that it is commonly known and what will show the modality coefficient, the share of shipping in this country in freight transport is enormous, however, the energy consumption of this mode of transport is incomparably small. What is more, it shows the decreasing tendency, so it can be assumed that the technological development makes it even more economical.

#### 4. Sustainable transport of goods

Freight transport functions in connection with business entities and institutions obliged in its area. The supply of industrial, commercial and service enterprises generates the biggest amount of these transportations. In addition, the institutions, offices and bureaus are provided with the equipment and materials needed to function. We can not, however, omit transportation in the distribution system of the supply chain channel initiated by these entities (Krzyżaniak, 2011, pp. 43–44). It is about exporting goods outside the country to external customers, because internal distribution transports are identical to the supply of enterprises located in a given area. The needs of modern carriers create the growth of the share of high-value cargo in the total sum of shipments and customer requirements. The largest share in the transport is car transport. This is, of course, a consequence of the dispersion of consumers and shippers, transport infrastructure and the flexibility of road transport in case of other transport means (Borys, 2009, p. 172). Transport of cargo is mainly in coordinate because it is realized by units which function independently and which take care about own needs while not considering the needs of others, i.e. those competing links. It is possible to distinguish at such stage the effects and needs that will result in better coordination of goods flows as presented in table 3 regarding total freight transport in selected European Union countries.

Presented data in homogeneous way shows us that the level of yearly freight transport according to the operation and type of transport in selected countries are on a parallel level. Differences between years are little. The upward tendency is visible for Poland. The analyzed data show the growth of the transported goods, which is caused by the larger share of our transport in the transport of goods in Europe.

Realization of goods' delivery to the places of destination which are within the country faces many difficulties if it relates to the transport environment. The intensity of city traffic tends to predict the extended delivery time of the relevant batches of goods. Transports taking place in strong traffic are characterized by much lower flexibility. The general requirement for the availability of goods is combined with the proper planning and organization of loading zones (European Commission, 2006). These zones taking into consideration the necessity to keep constantly shortened service time in which unloading and loading should be done efficiently. It concerns the principle of freight availability in a particular place and in a particular number meeting the requirements of potential buyers (Kauf & Tluczak, 2014, pp. 110–112). In ensuring the competitiveness of areas, it is important to pay attention to environmental protection requirements related to the flow of goods and services. Residents do not complain about the multitude of material goods available, but about the problems caused by the vehicles carrying those goods. Smooth protection of material needs through proper organization of deliveries and freight shipments are very important for users, co-decides not only about the quality of life, but also testifies to the authorities' ability to deal with current problems typically caused by lorries and trucks. The flow of cargo which influences the environment may create problems with:

- time of delivery,
- availability of loads,
- removal of used packaging,
- loading and unloading,
- opportunities for cooperation between various entities in order to systematize the process of cargo transport.

Freight transport has the influence not only on the environment but also on security and smoothness in motion. In conditions of road congestion is the ability to choose other means of transport to execute customer orders. Increased demand for services provided by delivery vans and lorries causes traffic congestion, slow driving, as well as overtaking or turning manoeuvres. It makes impediments in motion for other roads' users. A big danger may be because of performing steering manoeuvres by the vehicles. Safety in motion also reduces the transport of dangerous and sometimes oversized materials. In a whole truck traffic must also take into account the fact that heavy goods vehicles, due to their mass, affect the condition of road infrastructure to a much greater extent than personal vehicles. When calculating the pressure on one axle of a truck, it can be assumed that the degradation of roads is many times greater than that of passenger cars. The solution in this case is to weight vehicles more often in or-



der to eliminate the limitation of truck traffic on hot days and implementation of road construction from more durable materials (Pressl & Reiter, 2003, p. 33). The basic condition of effective and rational implementation of solutions supporting the management of transport of goods is conducting an in-depth analysis measuring, situations and the state of a given system and identifying problems occurring in a given process. Each problem in realization of goods flow is individual and implementation of changes and realization of assumptions should be adapted to the relevant factors affecting the tested systems. The impact of changes in the assumptions has dynamism, which in its complexity affects the participants, restrictions on movement of goods and services, as well as the expectations of the individual (Moterski, 2008, pp. 89–91).

Apart of listed solutions many other projects are implemented which can contribute directly or indirectly to improve the implementation of distribution processes in their areas. The vast majority of them are projects co-financed from the European Union assistance funds. Many are focused on the modernization of transport infrastructure and the implementation of intelligent transport systems.

## 5. Conclusion

The progressing globalization process changes the needs and expectations of society and business entities that are users of services offered on the transport market. The effect of economic and social changes is the increase in demand for transport, which on one hand is a factor favourable to globalization, while on the other hand it is also subject to globalization. Well-chosen indicators lead to monitor successfully the progress of goals and assumptions realization, they help to identify trends, anticipate problems and prevent them. Integrated planning of sustainable transport needs the set of indicators which reflect relevant economic, social and environmental goals and effects. Their selection for the analysis of sustainable development is a key step in the process of planning and implementing the principles of sustainable development.

## References

- Borys, T. (2009). Pomiar zrównoważonego rozwoju transportu. In D. Kielcewski, & B. Dobrzyńska (Eds.), *Ekologiczne problemy zrównoważonego rozwoju*. Białystok: WSE w Białymstoku.
- European Commission. (2006). *Communication from the Commission to the Council and the European Parliament: Keep Europe moving: sustainable mobility for our continent: mid-term review of the European Commission's 2001 Transport White Paper* (COM/2006/314).
- European Commission. (2009). *Communication from the Commission: a sustainable future for transport: towards an integrated, technology-led and user friendly system* (COM/2009/279).



- Eurostat. (2018). Retrieved 02.01.2020 from <https://ec.europa.eu>.
- Fiedor, B., & Czaja, S. (2010). Ekonomia środowiska i ekologiczna jako filary ekonomii zrównoważonego rozwoju. In B. Poskrobko (Ed.), *Ekonomia zrównoważonego rozwoju: materiały do studiowania*. Białystok: WSE.
- Kauf, S., & Tłuczak, A. (2014). *Logistyka miasta i regionu: metody ilościowe w decyzjach przestrzennych*. Warszawa: Difin.
- Krzyżaniak, S. (2011). Najlepsze praktyki w logistyce i zarządzaniu łańcuchami dostaw szansą wzrostu konkurencyjności przedsiębiorstw i wsparcia zrównoważonego rozwoju. *Logistyka*, 6.
- Litman, T., & Burwell, D. (2003). Issues in sustainable transportation. *International Journal of Global Environmental Issues*, 6(4). doi:10.1504/IJGENVI.2006.010889.
- Moterski, F. (2008). Praktyczne wykorzystanie elementów logistyki w gospodarce miejskiej. In Z. Przygodzki, & M.E. Sokołowicz (Eds.), *Nowoczesne miasto: badania, instrumenty, analizy*. Łódź: Uniwersytet Łódzki.
- Motowidlak, U. (2012). Wybrane aspekty transportu zrównoważonego. *Logistyka*, 2.
- Nowakowska-Grunt, J., & Strzelczyk, M. (2016). Problem of air pollution and road freight in European Union. *Transportation Research Procedia*, 16. doi:10.1016/j.trpro.2016.11.039.
- Nowosielski, R. (2005). Definicja i model rozwoju zrównoważonego. In A. Wasiaś, & G. Dobrzański (Eds.), *Zrównoważony rozwój w przedsiębiorstwie i jego otoczeniu*. Białystok: Politechnika Białostocka.
- Piontek, B. (2002). *Rozwój zrównoważony i trwały w miernikach oraz w systemach sprawozdawczości*. Bytom: Wyższa Szkoła Ekonomii i Administracji.
- Pressl, R., & Reiter, K. (2003). *Zarządzanie zachowaniami komunikacyjnymi i świadomość transportowa*. Retrieved 02.01.2020 from <https://www.yumpu.com>.
- Rogall, H. (2010). *Ekonomia zrównoważonego rozwoju: teoria i praktyka*. Poznań: Zys i s-ka.
- Rogers, P., Jalal, K., & Boyd, J. (2008). *An introduction to sustainable development*. London: Earthscan.
- Skrobacz, Z. (2011). Od ogólnej idei zrównoważonego rozwoju do zasad zrównoważonego rozwoju transportu. *Autobusy: Technika, Eksploatacja, Systemy Transportowe*, 12.
- Stachera-Włodarczyk, S. (2012). Wybrane aspekty zarządzania zrównoważonym rozwojem w bankach komercyjnych. In I. Krawczyk-Sokołowska (Ed.), *Zarządzanie przedsiębiorstwem w kontekście zrównoważonego rozwoju*. Częstochowa: Sekcja Wydawnictw Wydziału Zarządzania Politechniki Częstochowskiej.
- Woś, A. (1995). *Ekonomika odnawialnych zasobów naturalnych*. Warszawa: PWN.
- Zielaskiewicz, H., & Nowak, I. (2010). Kształtowanie sieci transportowej z uwzględnieniem zasad internalizacji. *Logistyka*, 1.



Żylicz, T. (2010). Wskaźniki trwałego rozwoju. In J. Kronenberg, & T. Bergier (Eds.), *Wyzwania zrównoważonego rozwoju w Polsce*. Kraków: Fundacja Sendzimira.

## Acknowledgements

**Author contributions:** author has given an approval to the final version of the article.

**Funding:** this research was funded by the Czestochowa University of Technology, Faculty of Management statutory sources.

**Note:** the results of this study were presented at *10th International Conference on Applied Economics Contemporary Issues in Economy* (June 27–28, 2019, Torun, Poland).

## Appendix

**Table 1**  
**Challenges for the economy of sustainable development**

Ecological dimension	Economic dimension	Socio-cultural dimension
climate warming	lack of stability of the national economy, e.g. insufficient employment offer	inadequate implementation of the principles of democracy and the rule of law
destruction of ecosystems	insufficient satisfaction of basic needs, high prices	poverty, lack of social security, demographic problems, e.g. population growth
exhaustion of non-renewable resources	inflation, a high degree of concentration and economic power	inequality, e.g. gender
excessive exploitation of renewable resources	non-economic imbalance, dependence on raw materials supply, underdevelopment	lack of internal and external security, resolving conflicts through violence, competition for benefits
threat to human health, harmful substances, radiation, noise	state indebtedness, insufficient equipment for collective rights and unfair distribution of income	burdens on health and quality of life

Source: Own preparation based on Rogall (2010, p. 37).

**Table 2.**  
**The volume of freight transport relative to GDP in 2011–2016 (in %)**

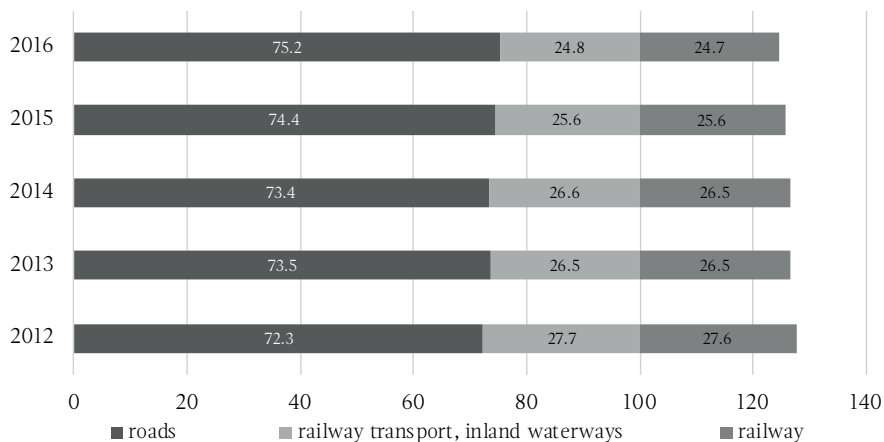
Country	2011	2012	2013	2014	2015	2016
EU–28 countries	97.8	89.7	90.6	89.4	88.9	90.4
Poland	98.8	95.8	102.6	97.6	98.6	99.1
Belgium	90.2	91.6	93.7	93.2	91.2	93.0
Czech Republic	87.7	87.0	92.3	93.9	99.9	99.5
Spain	81.6	79.6	79.3	79.1	81.4	82.3
Netherlands	96.2	96.0	101.0	100.8	97.6	99.9
Germany	100.2	98.2	99.8	99.5	97.9	99.1

Source: Own preparation based on Eurostat (2018).

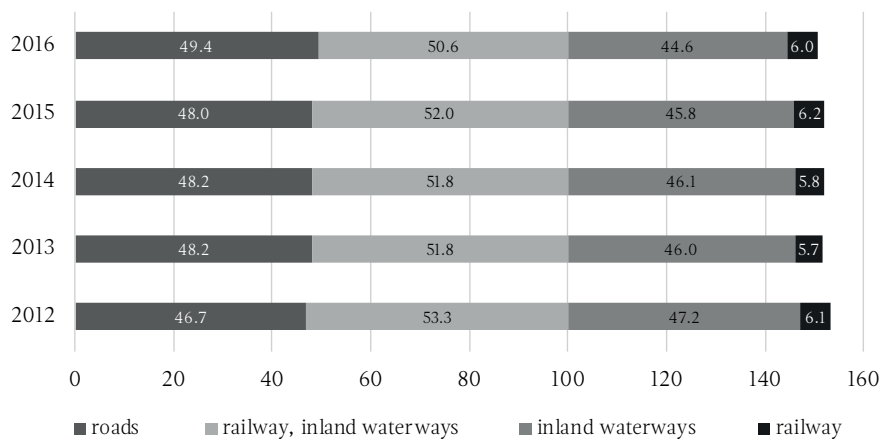
**Table 3**  
**Summary of the annual road freight transport by type of operation and mode of transport in selected EU countries in 2012–2017 (adopted unit of measure for millions of tonne-kilometers, TKM)**

Country	2012	2013	2014	2015	2016	2017
EU–28 countries	1 687 098	–	–	1 684 213	–	1 685 314
Poland	222 332	247 594	250 931	260 713	290 749	335 220
Belgium	32 105	32 796	31 808	36 078	35 192	34 220
Czech Republic	51 228	54 983	54 092	58 715	50 315	–
Netherlands	70 085	72 081	72 338	68 900	67 779	67 533
Spain	199 209	192 597	–	–	216 997	–
Germany	307 009	305 744	310 142	314 816	315 774	313 149

Source: Own preparation based on Eurostat (2018).

**Chart 1.****Modal division of transport in Poland in 2012–2016 (in %)**

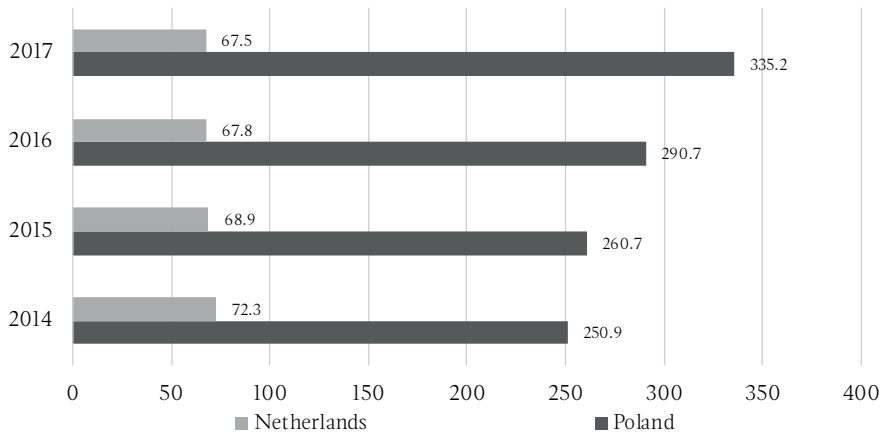
Source: Own preparation based on Eurostat (2018).

**Chart 2.****Modal transport of goods in the Netherlands in 2012–2016 (in %)**

Source: Own preparation based on Eurostat (2018).

**Chart 3.**

Summary of the annual road freight transport by type of operation and mode of transport in Poland and the Netherlands in 2014–2017 (adopted unit of measure for millions of tonne-kilometers, TKM)



Source: Own preparation based on Eurostat (2018).

