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# DIRECTIONS OF SUSTAINABLE TRANSPORT DEVELOPMENT COMPARED WITH ENVIRONMENTAL AND ENERGY SAFETY IN POLAND

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## KIERUNKI ZRÓWNOWAŻONEGO ROZWOJU TRANSPORTU A BEZPIECZEŃSTWO EKOLOGICZNE I ENERGETYCZNE POLSKI

SUMMARY: Artykuł jest poświęcony analizie możliwości zwiększenia poziomu bezpieczeństwa ekologicznego i energetycznego w sektorze transportu. W pierwszej części omówiono wybrane aspekty bezpieczeństwa ekologicznego i energetycznego, mające odzwierciedlenie w polityce transportowej Unii Europejskiej. Następnie dokonano oceny obecnego stanu rozwoju transportu w Polsce. Ocena konsekwencji wzrostu popytu na surowce energetyczne w transporcie pozwoliła na identyfikację czynników, które kreują określony poziom zagrożeń środowiskowych. Zwrócono szczególną uwagę na jakość powietrza i zmiany klimatu. Ponadto, określono katalog niezbędnych działań, które mogą przyczynić się do rozwoju zrównoważonego rozwoju transportu w Polsce z uwzględnieniem aspektów bezpieczeństwa ekologicznego i energetycznego.

KEYWORDS: transport, transport zrównoważony, bezpieczeństwo ekologiczne, bezpieczeństwo energetyczne

## Introduction

Transport is one of the economic sectors which is essential for the growth of competitiveness, social development and integration of the world. It provides a high level of mobility, together with ever-increasing efficiency in terms of speed, comfort, safety and availability of travel. Transport is also an essential element of logistics systems. It determines the overcoming of space, carrying out tasks related to the movement of components, materials and finished products in supply, production and distribution subsystems. The dynamic development of transport in recent decades is also a significant source of nuisance and problems. The negative effects of transport have impact on both natural environment and society. They are connected mainly with the use of fossil fuels (mainly oil), global warming, air, water and soil pollution, noise emissions and limiting the area of land on the earth. The categories of effects of the transport system's development can be analyzed through socio-economic, physical and national heritage influence[1].

The development of ecological (environmental) and energy safety is an extremely important issue in the face of today's transport threats. Environmental hazards and the possibility of unstable fuel supply are seen as strategic problems. These threats arise more and more often concerns not only among scientists, but also politicians. Aspects of ecological and energy safety are therefore reflected in the appropriate European Union (EU) transport policy, which was constructed for more than two decades. This policy was implemented in Poland via actions that are specified in transport development strategy[2].

The article focuses on the analysis of ecological and energy safety in terms of creating the sustainable development of transport in Poland, which was the main objective of the article. An overview of current state of Polish transport system was presented. The targets and key activities that are applicable for medium- and long-term development of transport in our country, in terms of ecological and energy safety, were determined, basing on the analysis of literature and applicable legal documents.

1 E. Mazur, *Gospodarka a środowisko przyrodnicze*, Szczecin 2008, s. 111.

2 Strategia rozwoju transportu do 2020 r. (z perspektywą do 2030 r.), uchwała nr 6 Rady Ministrów z dnia 22 stycznia 2013 r. (M.P. 2013 poz. 75).

## The implications of ecological and energy safety in the European Union's transport policy

One of the important barrier to the development of EU Member States in the first half of the twenty-first century is a dynamic growth in demand for energy resources. In the transport sector, this issue is of great importance. The EU Member States' energy needs in this sector are fulfilled in more than 93% by petroleum products. Basing energy demand in transport almost completely on petroleum products generates significant problems in terms of energy and environmental safety. First group of troubles relates to security of oil's and petroleum products' supply for the purpose of growing transportation needs. The second one is connected with the increased concerns about climate change, in connection with the already existing problems of pollution, congestion and noise.

Analyzing available statistics the increasing dependence of the EU on oil and petroleum products imported from outside the EU can be observed. In 2013 this relationship in EU was 87,4%. This result is by 13,4 percentage points higher in comparison to 1995. In Poland, the level of dependence on imports of raw materials and petroleum products in 2013 was higher than the average for the EU. This relationship reached a level of 91,3%, indicating a slight decrease compared to 1995 (95,9%)[3]. In addition, it is worth mentioning that level of EU's energy dependency in terms of oil imports was the highest in 2013, in comparison to the dependencies concerning remaining energy sources. Bigger and bigger EU dependence on oil imports is therefore a threat to the development of a competitive and resource efficient European transport system. In experts' opinion, improvement of transport's competitiveness cannot be achieved without, among others, lower and stable prices of transport fuels[4]. From the consumer's and social entity's point of view, security of energy's transport can be defined as the possibility of widespread use of transport services understood in the following dimensions: the level of transport fuels' prices and guarantee of supply's reliability, while maintaining environmental protection requirements[5].

Energy needs, which determine execution of demand for transport, apart from tangible economic benefits, cause numerous negative externalities within the meaning of economic theory. The effects of transport activities are usually passed on to the whole of society, not just on the manufacturer of

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3 *EU energy in figures: Statistical pocketbook, Publications Office of the European Union*, Luxembourg 2015, s. 70.

4 *Oil market futures, A report for the European Climate Foundation*, Cambridge 2016, s. 5.

5 Ustawa z dnia 10 kwietnia 1997 r. – Prawo energetyczne (Dz. U. nr 89 poz. 625 z późn. zm.).

these effects, or transport user[6]. Direct and indirect effects of external transport services are therefore more often analyzed in terms of ecological safety.

Analyzing an overview of ecological security's definitions it can be generally assumed that it is a desirable state of the environment, free from threats affecting the balance of ecosystems and the biosphere[7]. So conceived security is recognized in two aspects, it means the negative and positive one. The negative aspect is limited to the elimination of threats to the natural environment. However, in the positive aspect it is postulated such a reorientation of the existing socio-economic relations, which do not lead to the creation of the ecological crisis[8]. The positive dimension of ecological safety accords with the idea of sustainable development.

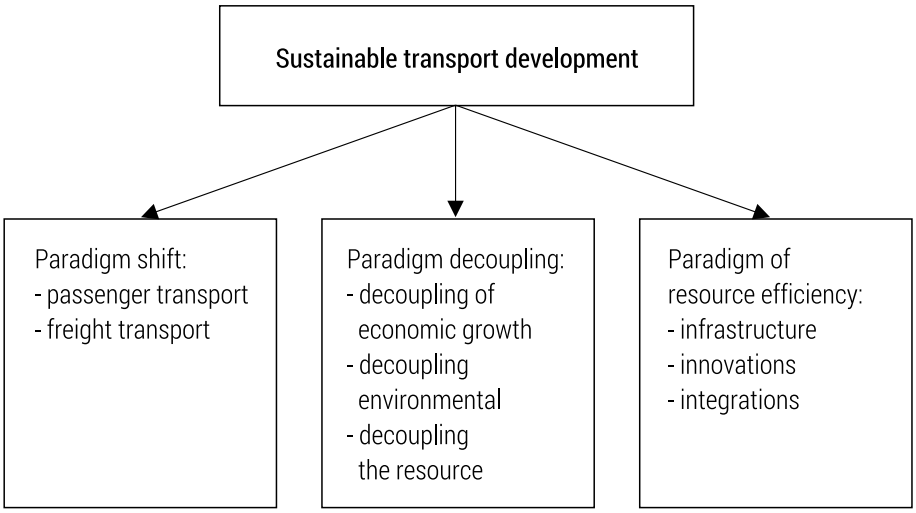


**Figure 1** Patterns of EU sustainable development of transport

Source: own study based on: K. Wojewódzka-Król, E. Załoga (red.), *Transport. Nowe wyzwania*, Warszawa 2016, s. 509-516.

The concept of sustainable development and the need to adapt to the strategy of development of transport in the EU is presented in the white papers for transport for more than two decades. The idea of sustainable

6 B. Pawłowska, *Zrównoważony rozwój transportu na tle współczesnych procesów społeczno-gospodarczych*, Gdańsk 2013, s. 288.

7 P. Szyja, *Wymiar ekonomiczny i społeczny bezpieczeństwa ekologicznego w Polsce*, w: A. Czyżewski, B. Klepacki (red.), *Problemy rozwoju rolnictwa i gospodarki żywnościowej w pierwszej dekadzie członkostwa Polski w Unii Europejskiej*, Warszawa 2015, s. 457.

8 M. Ciszek, *Bezpieczeństwo ekologiczne i zrównoważony rozwój*, „Studia Ecologiae et Bioethicae" 2012 nr 1(10), s. 30.

transport is also the subject of many scientific analyzes of the global and national levels. The results of these analyzes are presented in scientific works, among others R. Constanza, H. Daly, R.K. Turner, H. Rogall, T. Litman, D. Pearce, T. Borys, B. Fiedor, J. Wronka, K. Wojewódzka-Król, E. Załoga, B. Pawłowska and A. Przybyłowski.

Inseparable recognition of ecological and energy safety with the postulate of sustainable transport development supports the paradigm's shift in EU transport policy (figure 1). The pressure of transport, especially road transport, on the environment, human life and health is an important factor in relation to the phenomenon of sustainable development of transport. Limitations inherent in the environment caused a change in the approach to transport development.

Launched in the 90s of the twentieth century, the evolution of transport policy has led to the formation of three distinct paradigms, i.e. shift, decoupling and efficient use of resources (figure 1). The first one is based on shifts of branch in passenger and goods transport. The purpose of these changes is the need to reduce the role of road transport. In the second paradigm special role was assigned to two categories. The first category concerns the economic growth. The second one, means reducing transport needs at the same time. Balancing the development of transport, resulting from the paradigm of decoupling has led to rebuild relations between economy-society-environment. As a result third paradigm was introduced. According to White Paper from 2011, the development of competitive transportation was subordinated to the efficient use of resources[9].

The sustainable development of transport systems is now inextricably linked to the security aspects of environmental and energy (table 1). The needs in terms of mobility and accessibility should be implemented, taking into account the forecasted decreasing availability of energy resources and environmental constraints.

Activities presented in table 1 are expected to contribute to the reduction of $CO_2$ emission of EU transport by 60% by 2050, compared to 1990. Simultaneously, reduction of oil consumption in the assumed perspective is expected to reach approx. 70% compared to 2008. These activities, both directly and indirectly, positively affect the ecological and energy safety of transport. At the same time these measures may be accompanied by negative effects. Potential range of negative environmental impacts relates primarily to investments in infrastructure. The carrying out of any investment in the field of transport infrastructure is closely connected with the transformation of

9 K. Wojewódzka-Król, E. Załoga (red.), op. cit., s. 516.

the environment, the impact of investment on people, plants and animals[10]. In terms of ecological and energy safety, applied solutions should fulfill not only technical requirements and be economically viable, but also ensure adequate environmental effectiveness and energy efficiency.

**Table 1** Increase in EU environmental and energy sustainable transport system

| Area | Activities |
|---|---|
| Infrastructure | The development of eco-efficient transport corridors<br>Development of infrastructure and new propulsion technologies<br>Increasing the network of low-carbon freight and passenger transport<br>Interoperability of charging infrastructure for eco-vehicles |
| Innovations | The introduction of land and water transport management systems<br>Increase in the usage of alternative fuels<br>Implementation of sustainable mobility concepts<br>Promotion of European ecological and energy safety standards in the world<br>The increased interest in green public procurements<br>The use of standards for emissions and noise<br>The development of non-conventional goods distribution systems<br>Promoting a new mobility culture |
| Integrations | Optimization of multi-modular logistic chains<br>The synergy of innovation for transport and power industry<br>Full interoperability between communication and informational systems in transport |

Source: own study based on the: *White Paper. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*, COM (2011) 144 final, s. 23-143.

## Selected trends in transport development in Poland concerning environment and energy industry

Issues of development and creating transport system in Poland in the national and international systems have become particularly important because of progressing process of globalization. These processes are particularly important taking into consideration energy and environmental aspects (table 2). This is due to the relationship between the size and structure of demand for transport and energy consumption and environmental pressures.

[10] A. Przybyłowski, *Inwestycje transportowe jako czynnik zrównoważonego rozwoju regionów w Polsce*, Gdynia 2013, s. 24.

Table 2 Evaluation of transport development in Poland in terms of ecological and energy safety

| Strengths | Weaknesses |
|---|---|
| Increase in requirements for reduction emission units;<br>Reducing the unit consumption of fuel; Growth of expectations concerning reduction of the transport's share in the main emission's sources structure;<br>Gradual implementation of new technical solutions for drive vehicles;<br>Decreasing the level of noise;<br>Increase in the length of the network of roads and highways;<br>Implementation of the principle „user pays" in the network infrastructure. | Increase in total energy consumption by transport;<br>Strong dominance of road transport in the consumption of transport fuels;<br>Preferences for individual motorization;<br>Nuisance of numerous transport network's elements to environment;<br>Increase in ozone concentration;<br>Local deterioration of acoustic climate;<br>Growing phenomenon of congestion;<br>Fragmentation of space and stimulation of unwanted suburbanisation processes;<br>Low competitiveness of rail transport;<br>Lack of a coherent network of expressways and highways;<br>Low awareness of the maintaining of new patterns concerning mobility. |
| **Chances** | **Threats** |
| Development of transport infrastructure, especially road and rail, to a level that meets the modernity standards;<br>Elimination of missing links in the regional and local network;<br>Development of innovative technologies to support efficient use of resources;<br>Improving accessibility in the field of public transport services;<br>Deepening intermodal coherence in transport;<br>Increase in public support for measures to reduce the negative impact of transport on the environment;<br>Implementation of the internalisation of external transport costs;<br>Development of a sustainable demand on public transport. | Problems with achieving emission standards; No plans for protecting Nature 2000 areas; Difficulties in the implementation investments for transport infrastructure in the Nature 2000 areas;<br>Chaos regarding situation planning; Unordered expansion of the local road infrastructure network;<br>Forecasted increase in energy demand for transport services for passengers and freight; Forecasted increase in emissions and transport pollutions;<br>Maintaining unfavorable parameters of air quality in cities;<br>Deterioration of acoustic climate in the centers of large cities;<br>Occupying new areas;<br>Threats of natural disasters;<br>No effectiveness in the change of fixed behaviour in relation to transport. |

Source: own study based on: Podsumowanie strategicznej oceny oddziaływania na środowisko Strategii rozwoju transportu, Załącznik nr 1, Ministerstwo Transportu, Budownictwa i Gospodarki Morskiej, Warszawa 2013, s. 2-6.

Over the last twenty years Poland has made considerable progress in the development of infrastructure and transport markets. Among the strengths of transport development in Poland, in the context of energy and environmental, clear progress in reducing specific energy consumption and $CO_2$ emissions can be indicated. The sources of these positive developments include among others the gradual development of infrastructure and new

technological improvements. At the same time a strong asymmetry of the transport sector, concerning passenger transport and cargo in Poland, determines the number of negative effects of transport development. Statistics indicate that transport dominated the cargo handling in transport on land in years 1995-2014, increasing its share in the transport of 43% to over 81%[11]. However, in the land passenger transport more than 88% of transport in 2014 was served by individual transport. Analysis of the economic, energy and environmental results regarding performance of the transport system in Poland indicates the low efficiency of the shaped structure modal balance. Transport of passengers and freight are carried out in conditions of greater congestion routes. These processes are accompanied very often by use of trucks with a lower capacity while at the same time engine's power of passenger cars increased. The validity of these issues increases according to the forecasts confirming the absence of significant changes in the structure of passenger and freight transport, which was considered one of the main threats to energy and ecological safety of transport in Poland until 2030.

The projected increase in energy demand for transport services concerning passengers and cargo and the accompanying increase in emissions and pollutions, coming from transport, was also an important causative factor for the development of new drive technologies and organizational improvements. Another important issue of strengthening the sustainable development of transport in Poland is the gradual increase in public support for measures to reduce the negative environmental impact of transport. This fact was confirmed by, among others, results of the survey regarding public acceptance of modern communication solutions in Lodz agglomeration.

The study of communication behavior was the survey conducted electronically and via paper questionnaires. The time range of study covered the period from March to April 2016[12]. The survey results indicate that there is an increasing importance of using public transport in order to reduce car traffic in the city center. Also the positive trend of integration public transport services with other transport modes can be observed. The alternative services, which are aimed at reducing traffic problems, has become increasingly important, e.g. Park & Ride and Kiss & Ride. It is worth noting that the above listed actions increase energy and ecological security of transport and promote the development of sustainable transport.

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11 www.ec.europa.eu [15-05-2016].

12 Detailed results of the study were presented in the paper: U. Motowidlak, *Analyse der sozialen Akceptanz der modernen Kommunikationslösungen*, XIII Międzynarodowa konferencja EURO-TRANS, Szczecin 2016.

Monitoring of the improvement of ecological and energy safety in the Polish transport system

The time until 2030 is years of enormous challenges for the transport sector in Poland in terms of increasing ecological and energy safety. This is not only due to the above outlined main threats for the development of sustainable transport, but also the multidimensional determinants, to which this sector is susceptible. The conditions are the result of EU transport policy objectives, as well as the impact of external factors. Moreover, the source of these conditions are both regulations on climate protection, development of renewable energy sources and improvement of energy efficiency, as well as limited energy resources and volatility of transport fuels prices. This creates necessity to take strategic decisions for the development of a competitive and resource efficient transport and their consistent implementation by a dozen of years or even a few decades (figure 2).

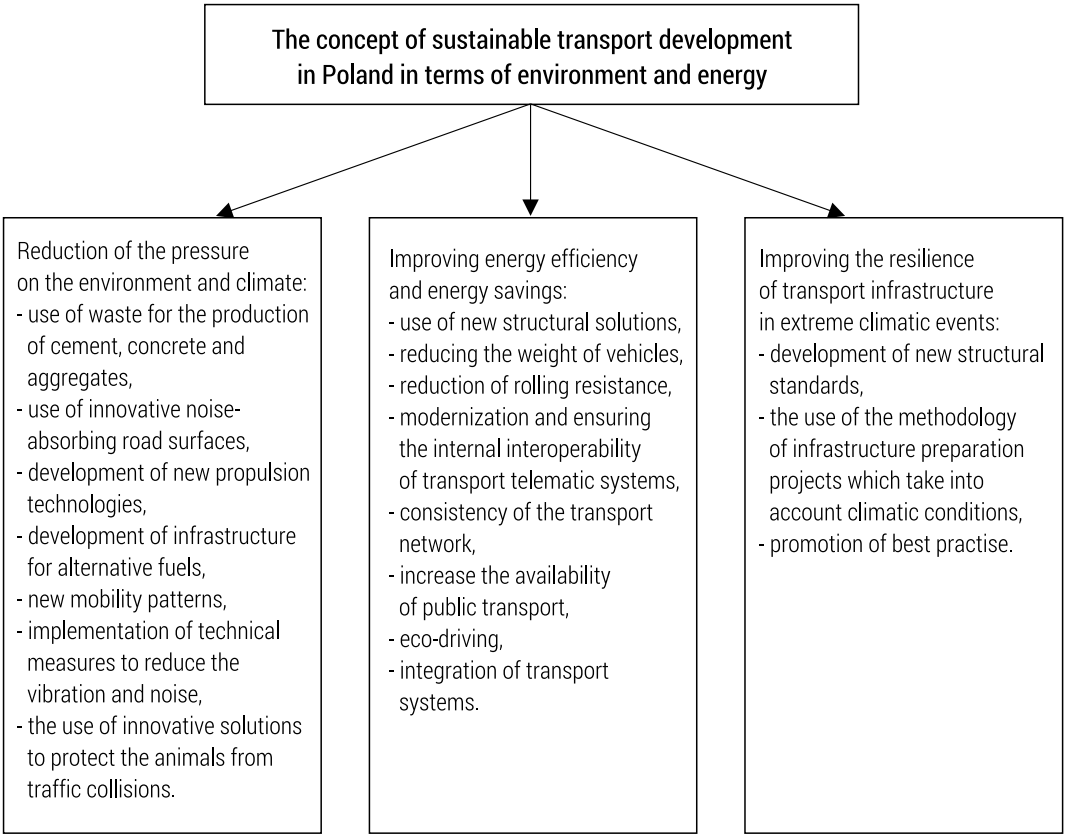


**Figure 2** Directions to improve ecological and energy safety of transport in Poland

Source; own study based on the: Strategia rozwoju transportu do 2020 roku ..., s. 83-84.

Strategic directions of transport policy in Poland indicate a need to reduce the negative impact of transport on the environment and climate, to improve its energy efficiency and mitigating the negative effects of climate change affecting the infrastructure and transport activities. Shown in figure 2 most important aspects of environment and energy industry determine the steps to ensure implementation of the two trends. The first one concerns meeting the growing transportation needs, while ensuring the efficiency and reliability of transport services. The second one aims to reduce pressure on the environment.

Not without significance for compliance with environmental requirements and improvement of the resource-use efficiency is the monitoring of sustainable transport (table 3).

Table 3 Selected indicators characterizing the development of sustainable transport in Poland in terms of ecological and energy safety

| Indicator | Base year | Level for | |
|---|---|---|---|
| | | Base year | 2020 |
| Volume of greenhouse gas emissions from transport (thous. tonnes): | | | |
| – $CO_2$ emissions | 2009 | 43 771,00 | 45 455,00 |
| – $CH_4$ | 2009 | 5,52 | 5,91 |
| – $N_2O$ | 2009 | 1,78 | 4,05 |
| Annual consumption of final energy the transport sector (Mtoe) | 2010 | 15,50 | 18,70 |
| The number of passenger transport services per capita in urban areas in Poland | 2008 | 174,50 | 226,80 |
| Number of fatalities in road accidents | 2010 | 3 907,00 | 2 000,00 |
| Length of highways (km) | 2010 | 857,00 | 2 000,00 |
| Length of expressways (km) | 2010 | 675,00 | 2 800,00 |
| Connection of provincial cities with express roads or motorways | 2008 | 6/18 | 18/18 |
| Share of freight's mass of intermodal transport in the total mass of transported freight by rail (in%) | 2010 | 2,03 | 5-6 |

Source: Informacja o realizacji Strategii rozwoju transportu do 2020 roku (z perspektywą do 2030 roku) w roku 2014, Ministerstwo Infrastruktury i Rozwoju, Warszawa 2015, s. 61-62.

Monitoring the general condition of the environment, resulting from the implementation of the Transport Development Strategy until 2020 (with the prospect of 2030) is based on the existing system of indicators[13]. This system

13 Strategia rozwoju transportu do 2020 roku ..., s. 86.

is supplemented with selected indicators which refer to the improvement of ecological and energy safety of transport in Poland. Creating a coherent, sustainable transport system is conducive to increase the availability of transport and at the same time it improves ecological and energy safety of transport.

## Conclusions

The transport sector, in particular road transport, occupies a high position in the category of the dominant sources which put pressure on the environment. The primary source of interaction in transport area is the dependence on fossil fuels. Conducting investment activities and use of transport infrastructure plays also a very significant role in terms of ecological and energy safety. Intensification of passenger transport, in particular individual transport and cargos, causes a range of direct and indirect causalities. These connections form a kind of chain including relationships and interactions between the issues of ecological and energy safety and sustainable transport strategy. This was reflected in EU transport policy and strategy for transport development in Poland.

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