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DEVELOPMENT DIRECTIONS OF ALTERNATIVE FUELS INFRASTRUCTURE

Abstract

An increase of the energetic efficiency of the economy is one of the priority goals of EU policy. In all the sectors of the EU-28 countries this goal has been achieved. However, in the transport sector, which is especially dependent on the supplies of crude oil, the energy consumption continues to increase. This is why, a wider use of alternative fuels is one of the ways of increasing the transport energy efficiency and decrease the dependency on crude oil. In transportation, there is a chance to increase the use of electricity and natural gas. However, the use of these energy sources in transport depends on the development of appropriate infrastructure. The requirements regarding the technical specification of the alternative fuel infrastructure and the time horizon for the construction of these facilities have been described in the European Parliament and Council Directive of 22.10.2014 on the development of alternative fuels infrastructure. In Poland, the development directions regarding the use of alternative fuels in transport and the goals of the transport infrastructure development have been set out in the year 2016 in the national framework for the policy of alternative fuels infrastructure development.

Keywords: transport, alternative fuels, infrastructure

Introduction

Among various economic resources, the energy has a strategic significance for the socio-economic growth. The provision of adequate energy resources is profoundly important for the economies of EU countries, which are highly dependent on the supplies of crude oil. This dependency is especially strong in transportation.

This is why, activities towards a wider use of alternative fuels are very important in this sector. The goal of the article is to present:

- reasons and possibilities of the use of alternative fuels in transport,
- European guidelines for the construction of appropriate alternative fuels infrastructure,
- growth directions of the alternative fuels infrastructure in Poland.

The research has been conducted on the base of literature and EU documents related to the development of alternative fuels infrastructure.

1. Reasons and possibilities of the use of alternative fuels in transport

An increase of the energetic safety is one of the leading priorities of the “Europe 2020” strategy. In the strategy a necessity to increase the efficiency of the energy use by 20% and the share of renewable energy shares in their final use to 20% have been pointed out (European Commission, 2010). Therefore, it has been assumed that by the year 2020, the use of energy should be 20% lower than its hypothetical use according to the hitherto model of production and consumption. Based on the assumption, according to the prognosis from 2007, the hypothetical use of primary energy in 2020 would have been 1842 mtoe (million tons in the crude oil equivalent) and the final energy use would have been 1347.5 mtoe. The decrease of this level by 20% means that in the year 2020:

- the use of primary energy cannot be higher than 1473.6 mtoe,
- the use of final energy cannot be higher than 1078 mtoe (Directive of 25.10.2012).

In all the sectors of the EU-28 countries this goal has almost been achieved. The use of final energy on the EU-28 counties in the year 2015 was 1082.2 mtoe (Eurostat, 2016). However, the use of final energy still increases in the transport sector. As one can observe on Figure 1, the use was equal to 358.6 mtoe in the year 2015 and was 26,2% higher than in the year 1990. In the EU-28 countries the transport sector amounts to over 33% of the final energy use (European Commission, 2016). At the same time, the transport sector is heavily dependent on the crude oil supplies. In 2014, the share of crude oil and its products in the total energy consumption in transport exceeded 95% (Figure 2).

Therefore, it is necessary for the transport system development to be targeted at the technical innovations, which are supposed to increase the energy efficiency of the vehicles in all the transport modes, e.g. by a wider use of more ecological fuels and drive systems (European Commission, 2011).

The innovations based on a wider use of alternative fuels have a particular significance in the process of the increase of energy efficiency and supply safety in the EU. The alternative fuels are “fuels and energy sources, which at least partially substitute the energy sources based on crude oil and have a potential to decarbonize transport and help to achieve the ecological transport goals” (European Parliament, 2014). The main fuels alternative to the crude oil are: electricity, hydrogen, biofuels, synthetic and paraffin fuels, natural gas, including biomethane (in the form

of compressed natural gas – CNG, liquefied natural gas – LNG or gas to liquid – GTL) and also liquefied petroleum gas (LPG). According to Table 1, the possibilities for the use of this type of fuel in transport are significant.

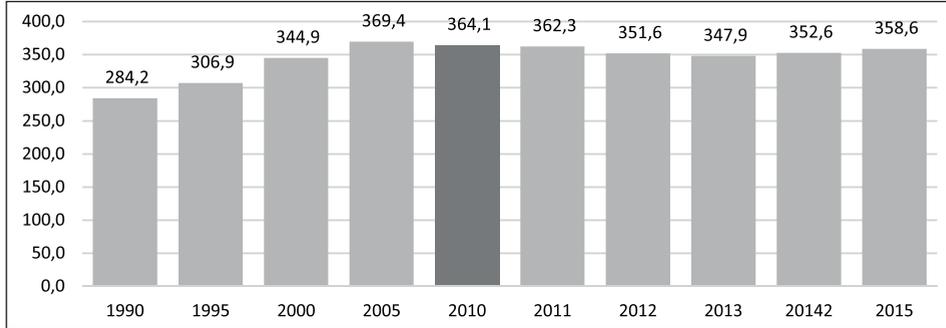


Figure 1. The use of final energy in transport in the EU-28 countries (years 1990–2015, mtoe)
Source: (own elaboration based on data available at: Eurostat, 2016)

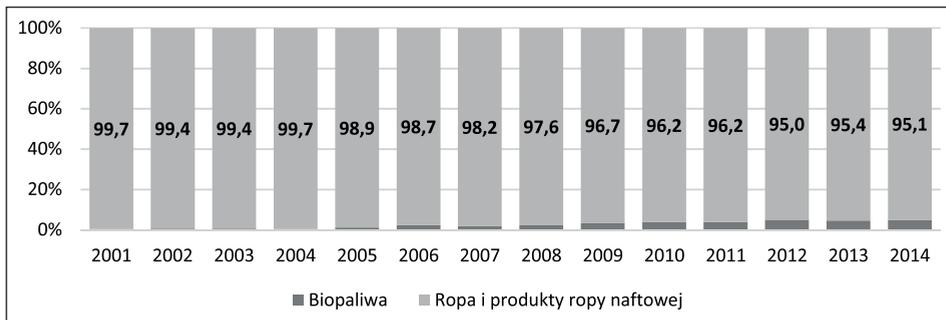


Figure 2. The share of crude oil and crude oil products in the total energy consumption in transport of the EU-28 countries [%]

Source: (own elaboration based on data available at: European Commission, 2013)

Table 1. The possibilities for the use of alternative fuels in modes of transport

Specification	Road passenger transport			Road cargo transport			Air transport	Rail transport	Inland waterways transport	Sea transport	
	Near	Mid	Far	Near	Mid	Far				Near	Far
LPG											
Natural gas	LNG										
	CNG										
Electricity											
Biofuels											
Hydrogen											

Source: (European Commission, 2013)

2. European guidelines for the construction of appropriate alternative fuels infrastructure

A wider of fuels such as electricity, natural gas (LNG, CNG) and hydrogen in transport requires an appropriate infrastructure, which allows to supply the means of transport with alternative fuels. The development process of this infrastructure must comply with the technical specifications of the EU, the safety specifications regarding the safety of LNG and CNG refueling points and the safety specifications regarding the introduction of biomethane into the natural gas network.

Within their national policy, the Member States have to provide an appropriate distribution of public charging points by the end of 2020 (Table 2) so as to enable the use of electric vehicles at least in the urban and suburban areas as well as other densely populated areas. The approximated number of electric vehicles should be the basis for the distribution of these points. Generally, it is assumed that there should be at least one charging point for every 10 vehicles. An appropriate number of public charging points should be installed, in particular, next to public transport points such as: port passenger terminals, airports and railway stations. It is also vital to provide proper access to charging points in parking lots, next to blocks of flats, office buildings and industrial plants.

Table 2. Time horizon for the development of alternative fuel infrastructure

Type of alternative fuel infrastructure	Time horizon for the construction of infrastructure objects
Charging points for electric cars	31.12.2020
Facilities for charging ship with electricity	31.12.2025
CNG Refuelling points – TEN-T basic road network	31.12.2025
CNG Refuelling stations – agglomerations	31.12.2020
LNG Refuelling points – TEN-T basic road network	31.12.2025
LNG Refuelling points – TEN-T basic marine ports	31.12.2025
LNG Refuelling points – TEN-T basic inland waterway transport ports	31.12.2030
Hydrogen Refuelling points (depending on country's interest)	31.12.2025

Source: (Directive of 22.10.2014)

Electricity can also be used auxiliary to power marine or inland ships during their stay in ports. Particular Member States should consider the possibility to power the ships from land, within the national policy. In economically justifiable cases, the facilities used to power the ships with electricity should be installed in the ports of TEN-T core network and other ports before the 31st of December 2025 as a matter of priority.

Significant energetic and ecological benefits can be achieved in the passenger and cargo car transport as a result of using CNG alternative fuel. So as to enable the flow of vehicles driven by CNG across the EU, the Member States should construct an adequate number of publically accessible CNG refueling points by the end of year 2025, at least within the current TEN-T core network. As a priority,

the CNG stations should be constructed in the urban and suburban areas as well as other densely populated areas, by the end of year 2020. Similarly, the Member States, should create an adequate amount of LNG refueling points, at least within the current TEN-T core network.

There are large possibilities of using LNG in marine and inland transport. It is assumed that an appropriate number of LNG refueling points will be created in the European marine ports by 31st December 2025 so as to allow the movement of marine and inland ships. An appropriate number of LNG refueling points will be created in the European inland ports by 31st December 2030.

These provisions apply mostly to the locations of bunkering points within the TEN-T core network (Directive, 22.10.2014). Due to the fact that large inland vessels are more predestined to use the LNG engines, it is expected that inland routes with high technical parameters will be equipped with the refueling stations. This mostly applies to routes of Rhein, Danube and Elbe. The growth of bunkering stations onto other waterways will be dependent on the further development of the network of inland waterways and also the economic possibility to use the LNG engines in smaller vessels (Wurster et al., 2014).

The hydrogen is an important alternative to the fossil fuels. Across the world, the hydrogen fuel cells are used in personal cars, buses and light commercial vehicles. There is also a possibility to use the hydrogen drive in trains instead of the Diesel engines, small ships and in big ships as an auxiliary energy source whilst anchoring. The hydrogen technology is currently the alternative fuel which is the least developed in the transport sector. On estimate, there are only 82 hydrogen refueling stations (The Ministry of Energy, 2016) and only a few of the Member States plan to expand their network of hydrogen refueling. This is why, the countries which assume the development of the hydrogen drive as part of their strategies should grant access to an adequate number of hydrogen refueling points by the end of year 2025 as part of their national strategies.

3. Growth directions of the alternative fuels infrastructure in Poland

Taking into considerations the experience of the use of alternative fuels in Poland so far, a special attention should be paid to the development of infrastructure regarding:

- electricity charging points and stations,
- LNG and CNG refueling points and stations

so as to support the dependence of transport on the conventional fossil fuels.

Currently in Poland, both the electric cars market and network of charging points and stations is barely developed. In 2014, only 1.29% of newly registered personal cars were electric cars. On estimate, there are 305 public charging points in Poland (the number of private points is unknown). They are mostly located in Warsaw, Kraków, Poznań and Gdańsk (The Ministry of Energy, 2016).

An observable growth in this matter is determined by a proper development of the vehicle charging infrastructure. Given the current stage of technological progress, it is assumed that the technology will be mostly used in urban transport. In 2020, on estimate there will be 54 thousand electric vehicles in the 32 agglomerations in Poland (not counting the buses), whereas there will be 6859 charging points: 1367 in Warsaw, 523 in Kraków, 431 in Łódź and 320 in Gdańsk.

As mentioned above, the electricity may also be used to power ships. Based on analysis, there is not enough demand to justify equipping all the sea ports within the TEN-T network with charging points (stations). In Poland, the appropriate installations might be constructed in Szczecin and Świnoujście ports.

The use liquefied natural gas and compressed natural gas is an attractive possibility of the alternative fuel use in transport. In Poland, there is a relatively small number of natural gas vehicles and refueling points (stations). In 2011 there were 32 such stations and the number has consistently decreased. On estimate, currently there are 26 such stations and 3600 vehicles powered by natural gas are used.

The use of CNG, mostly due to the range of up to 300 km is especially popular in urban buses, commercial vehicles and taxis. In Polish agglomerations 72 refueling points are supposed to be created by 2020, including 6 in the Warsaw agglomeration, 3 in the Cracow and Wrocław agglomerations and 2 each in the remaining agglomerations. What is more, by the end of 2025, across the core corridors within the core network 32 CNG refueling points and 14 LNG refueling points are supposed to be created.

As mentioned before, hydrogen is an important alternative to the conventional fossil fuels. However, the introduction of hydrogen energy is connected with significant difficulties, in particular creating:

- a quick and cheap method of hydrogen production (current technologies are based on thermo-chemical processes, which are based on limited non-renewable fuels);
- methods for safe and cheap transport and storage of hydrogen;
- engine, cell or battery with the highest possible energy efficiency.

Currently in Poland there are no infrastructure objects for hydrogen refueling, moreover there are reasons to develop them (The Ministry of Energy, 2016).

Conclusions

The transport sector is particularly dependent on the supplies of crude oil. This is why the use of alternative fuels has a high significance in the process of decreasing this dependency. This, however, depends on the progress of infrastructure development. Without such enterprises all the other activity towards the use of alternative fuels will remain futile. Also, it is important for the process of development of alternative fuel infrastructure to be carried out according to identical technical specifications. The use of universal solutions is the basic condition for the development of alternative fuel markets and the increase of significance of these fuels in the European transport market. The national objectives of the policy for

the growth of alternative fuel infrastructure mean that the support of the use of alternative fuels in the urban car transport plays a key role in the process of decreasing the dependency on the traditional fossil fuels.

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