

Oľga VÉGSÖOVÁ , Ján PINKA
Fakulta BERG, TU Košice, SR

THE FUTURE FORECAST OF CRUDE OIL AND THE ALTERNATIVE ENERGY SOURCES IN SLOVAKIA

Summary. The article deals with the possibility of alternative energy source usage. One of the possibilities of replacing the conventional sources is that of using biomass for producing liquid fuels.

PROGNOZA WYKORZYSTANIA ROPY NAFTOWEJ ORAZ ENERGII ZE ŹRÓDEŁ ODNAWIALNYCH NA SŁOWACJI

Streszczenie. W artykule przedstawiono możliwości wykorzystania alternatywnych źródeł energii na Słowacji. Wskazano, iż jedną z możliwości substytuowania konwencjonalnych źródeł energii jest wykorzystanie biomasy do produkcji paliw płynnych.

1. Introduction

Nowadays the term “alternative energy sources” is being used more and more frequently. It is generally acknowledged that there are two kinds of energy sources on our planet, namely renewable energy sources and those that cannot be renewed [1,2]. Several hundred times higher consumption of crude oil, coal or gas in the last years compared to the previous century is a threatening fact.

2. Crude oil – Conventional energy source

There are black coal, crude oil and natural gas classified as conventional energy sources. This article deals in detail with a very important exhaustible energy source, i.e. crude oil. Nowadays crude oil forms almost 37% of the gross energy consumption of the European Union. Thus crude oil is far more important source of primary power than natural gas, solid fuels and nuclear power [3,4.]. The European Commission proceeds from the fact that by 2030 the demand for crude oil will further increase, even though it will mean 0.25% increase a year only. In 2030, however crude oil will remain the most important source of primary power representing 35% of gross energy consumption.

Even though the demand in the European Union will increase slowly, it is necessary to consider much more dramatic increase in demand globally. The USA Office for Energy Information counts on the fact that the demand in 2030 will be by more than one third higher than in the year 2006. Since the supply and capacity of refineries cannot keep up with the increase in demand, the situation on the market will stay strained in the near future. Increase in crude oil prices, which the IEA (International Energy Agency) expects in the long-term horizon based on its latest report, however, will at the same time function as an obstruction for increase in demand.

The end of the crude oil age has been foreseen several times already. In connection with this peak crude oil production is being mentioned. At the same time it is necessary to take into consideration that there are a lot more reserves currently available than ever before. Even though crude oil represents an exhaustible source the past tells us that nobody can predict when exactly its exploitation starts to be limited as the result of natural source depletion and whether it will be gradual, dramatic or in several waves (Fig. 1).

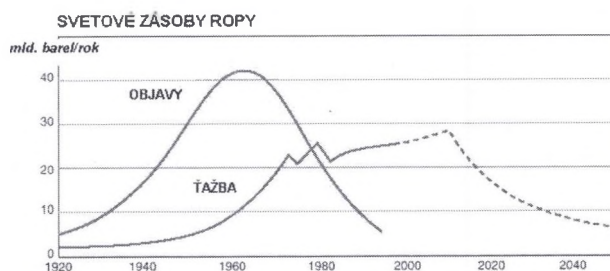


Fig. 1. Current and forecasted global crude oil reserves by 2040

Rys. 1. Aktualne i przewidywane światowe zasoby ropy do roku 2040

Limitations of crude oil exploitation are caused on one hand geologically and technologically and on the other hand the most of obstacles to its exploitation development can be found above the ground – political instability in some states, sanctions, insufficient legal protection, measures related to the environment and goal-oriented management of sources, which limit the potential exploitation.

At the same time it must be admitted that reserves represent a dynamic term. They do not depend on new oil deposit discovery only. They are also substantially dependant on technological innovations and crude oil price, since these determine economically usable part of sources. The overall crude oil sources are sufficient for the consumption of several centuries. Yet the amount of easily exploited crude oil has not increased as substantially in last years as before. Bio-fuel support is also recognized as a mean for reducing crude oil demand. It is especially diesel fuel import that can be thus reduced. In connection with that it is however necessary to see also the fact that the current effort to substantially increase the ratio of bio-fuel used in road transportation to up to 20% will lead to restructuration and unemployment in the companies affected [5, 6].

3. Alternative energy sources in Slovakia

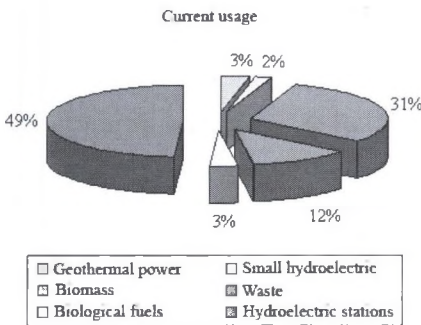


Fig. 2. Potential of energy source usage in SR
Rys. 2. Potencjalne źródła energii na Słowacji

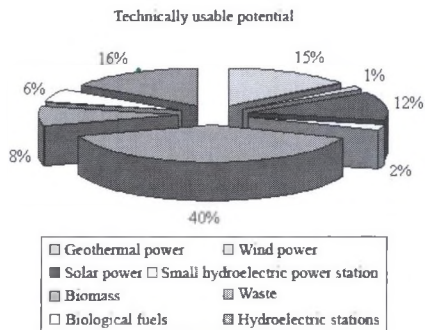


Fig. 3. Potential of usability of energy sources in SR
Rys. 3. Potencjalne wykorzystanie źródeł energii na Słowacji

Biomass can be divided based on various criteria. Based on the place of their generation we recognize agricultural, forest biomass and agricultural by-products and by-products of the manufacturing industry. Based on their state of aggregation we recognize solid, liquid and gaseous bio-fuels. The potential of energy sources usage and usability in Slovak republic is obvious from Fig. 2 and Fig. 3.

3.1. Liquid bio-fuels for running motor vehicles

Unlike solid and gaseous bio-fuels **liquid bio-fuels** are used mainly for running motor vehicles. Fuel for a motor vehicle, which can be grown, is the dream of many people and biomass is practically the only renewable source, which enables this. Liquid bio-fuels are nothing new. It is more the other way around. Biomass was an energy source even before petrol started to be used. Alcohol (methanol and ethanol) generation from biomass for technical purposes has been known since the beginning of the 20th century. **Ethanol**, **methanol** and **bio-diesel** are currently the most important fuels produced from biomass. Bio-diesel produced from colza is the only liquid bio-fuel, which is also used in our country.

From the global point of view the most common liquid bio-fuels are alcohol-based fuels, namely ethanol a methanol, which are made mainly from **grain**, **corn** and **sugar beet**. Apart from the fact that they can be grown, another advantage of the alcohol-based bio-fuels is that when burnt they create less harmful substances. It is connected with the fact that these fuels are of simpler structure than petrol or diesel fuel, they burn better and the overall process leads to smaller non-burnt waste generation. From this point of view methanol is better fuel than ethanol. Ethanol and methanol properties and their comparison with other fuels can be found in the following (Tab. 1).

Table 1
Ethanol and methanol properties and their comparison with other fuels

	Ethanol	Methanol	Benzine	Diesel
Energy value (MJ/kg)	26,9	21,3	43,7	42,7
Boil point (°C)	78,3	64,5	99,2	140 - 360
Octane number	106	105	79 - 98	-

Biomass has relatively good energy density. The fact that in terms of the energy generated 1 million tons of crude oil equals 2.3 million tons of dry biomass led to the situation when alcohol based bio-fuels started to be used in many countries as a part of their national strategy. The biggest producer of liquid bio-fuels worldwide is currently Brazil. These fuels also play an important part in the country, which is an automotive power, i.e. in the U.S.A.

3.1.1. Ethanol as a substitute for petrol

Ethanol is the substance, that can be found in the nature only sporadically and unlike methanol its usage (in small quantities) is not toxic for people. Ethanol is nowadays commonly used as **a substitute for petrol** in connection with combustion engines representing one of the oldest fuels. Ethanol however is also used for other than just transportation-based purposes. Its application in food industry is very important and it is especially this universality that represents one of its main advantages.

A certain disadvantage related to producing ethanol from agricultural products is the fact that in the case bigger amount of traditional fuel substitution this mass production would globally compete with food production. In the time when there are globally many people starving this effort can be hardly excusable. Besides by growing monocultures forming a part of this strategy, issues related to biodiversity could occur. In the times of the current character of agricultural production it is also necessary to use large amount of fertilizers in order to grow the basic raw material. This however represents other disadvantages in the form of environmental pollution.

The above mentioned disadvantages are not related only to ethanol made of wood-based biomass, which seems to be very prospective. It also applies to ethanol production from biomass waste formed during agricultural production. The issue of ethanol production related to fermentation from cellulose is the fact that the overall process forms only small yield at relatively high cost. It is currently obvious that ethanol would probably not be able to fully replace conventional fuels. Yet, considering its reasonable production and usage this fuel can to mean partial crude oil substitution and environment improvement, mainly in cities and towns.

3.1.2. Environmental methanol utilization

Wood-based production of **methanol** (methyl alcohol) has been known for many years. Methanol however often represented a by-product related to wooden coal production. Such

production was unfortunately accompanied with very low yield percentage. The current situation is different. Wooden coal has gradually lost its importance and methanol has become an important fuel for motor vehicles. The biggest volume of methanol is currently produced in Brazil, the U.S.A. and Sweden. Methanol is poisonous for people. It is pure odourless liquid, which can be only rarely found in the nature. Moreover, methanol is also known for its high universality and it is also used as a basic raw material in many chemical processes. Methanol can be produced not only from biomass, but also from some fossil fuels such as natural gas or coal. Disadvantage of producing methanol from biomass lies in the fact that its price is roughly doubled when compared with synthetic methanol produced from natural gas. It is also interesting that even petrol can be produced from methanol. However, the whole process of production shows energy loss and therefore is not applied. In some cases though, this petrol production can be of advantage. Another fact to mention is that petrol can be produced from biomass directly without having to go through the given intermediary element, i.e. methanol production [7, 8].

The energy value of methanol is roughly a half of diesel energy value. Therefore vehicles running on methanol need basically twice as much fuel for achieving the same travel distance. The disadvantage of methanol is that its price is almost doubled than that of standard petrol. Moreover, in order to handle methanol personal safety training is required in some countries (e.g. the U.S.A.).

3.1.3. Bio-diesel – A form of vegetable oils most frequently used in transportation

Bio-diesel, under which pure vegetable oil or MERO (methyl ester of colza oil) is understood, catches up with the quality of diesel oil in terms of the energy contained in one litre of fuel and this value is higher than the energy density of other alternative fuels, which is also reported in the following (Tab. 2).

Bio-fuel generation consist of colza pressing, filtering and subsequent separation of oil (esterification) to form methyl ester (MERO – bio-fuel) and glycerol. Glycerol as its by-product is suitable for chemical industry and moulds represent valuable mash [9]. MERO is environmentally clean fuel and when compared with diesel it shows 3 to 40-times lower content of hydrocarbons in exhaust gases. It has reduced level of smoke generation; gases contain less solid particles and other hazardous materials. The usage of MERO requires however small engine modification, which will reduce its performance as well as fuel consumption by roughly 5%.

Table 2

Energy density of alternative fuels

Fuel	Energy in MJ/litre
Diesel	35,1
Vegetable oil	34,3
Biodiesel	33,1
Ethanol	21,1
Methanol	18,0
Hydrogen (liquid at -256°C)	8,5
Battery electricity	0,36

4. Conclusion

Combustion of fossil fuel (coal, crude oil, natural gas), which form the biggest part of energy consumption is not an exception but a rule in this sense [10,]. The climate changes, acid rain, and water, air and soil contamination have not only impact on our health but they will be the reality for the generations coming after us. The humankind has a yearly consumption of fossil fuels, for the generation of which the nature needed one million years. The reserves of these fuels, especially of crude oil have decreasing unbelievably fast. One of the possible solutions for replacing primary conventional sources is to be able to replace these by their alternative energy sources.

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