

# Management of Road and Rail Freight Transport with the View of Energy Efficiency in Serbia

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**Abstract** – This paper defines the characteristics of road and rail freight transport in Serbia in terms of energy efficiency. Energy consumption per unit of work is very unfavourable, as a result of a number of factors that indicate the irrational use of energy.

Significant possibility to boost energy efficiency of the transport sector in Serbia is in management of road and rail transport using modern technology of combined transport.

**Keywords** – energy efficiency, combined transport.

## I. INTRODUCTION

In The systematic study of energy efficiency of road and rail freight transport subsystem is done in order to get realistic assessment of the level of energy efficiency of the transportation system in Serbia. Transport participates with 26-30% in total energy consumption [5]. Analyzed the energy consumption by means of transport it is note that road transport contributes with 86%, air transport with 9%, rail transport with and 4%, and river transport with 1%.

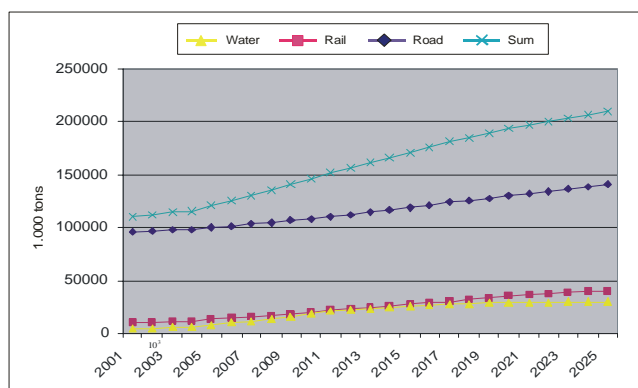


Fig. 1. Prognosis the volume transport of goods by means of transport

Over the past ten years, contribution of road transport significantly increases on the transport market in Serbia (Fig.

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1). Bearing in mind the characteristics of transport in Europe, as well as information and knowledge about participation of some forms of transport in the territory of Serbia, it is necessary in further research to focus attention on reroute of commodity flows from road to rail and water transport, more exactly applied technology of combined transport.

The aim of this research is management of road and rail freight traffic using the combined transport in the function of energy efficiency.

## II. ENERGY EFFICIENCY OF ROAD FREIGHT TRANSPORT IN SERBIA

### A. Road transport

All the indicators of road freight transport are related to the public transport, as individual transport is not recorded by the competent institutions. In the Fig. 2 it is obvious that the transport of goods by road transport has increased nearly three times in net tone kilometers.

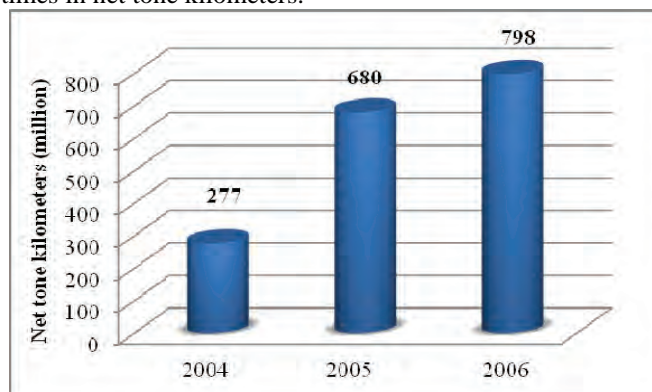


Fig. 2. The work in the road freight transport

Total energy consumption in the year 2006 increased by 48,71% if compared to the year 2004, and reduced by 10,31% if compared to the year 2005, and this can be seen in Fig. 3. [3]

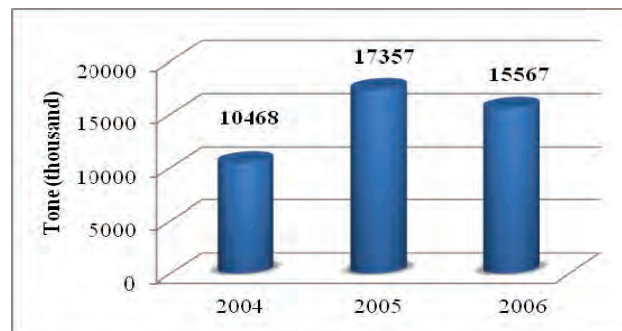


Fig. 3. Energy consumption in the road freight transport

Energy efficiency of the road freight transport in Serbia is shown in Fig. 4. Specific energy consumption per unit of work has a downward trend, which means that energy efficiency increased in the observed period. The average specific consumption in freight road transport is 0,027 kg/ntk [5].

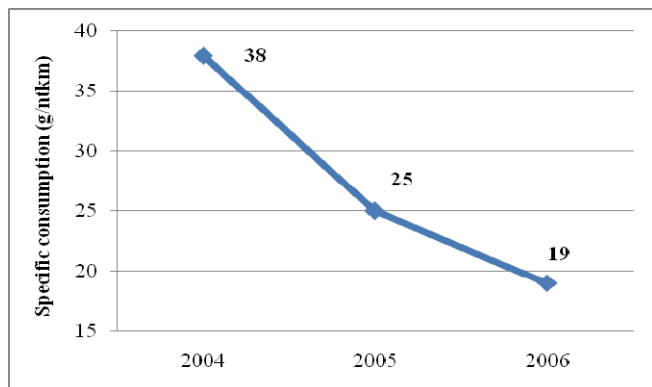


Fig. 4. Energy efficiency of the road freight transport

### B. Rail freight transport

Volume of the transport of goods in the Serbian Railways increased in the period since 2004 to 2006 by 33,8% in net tone kilometers (Fig. 5).

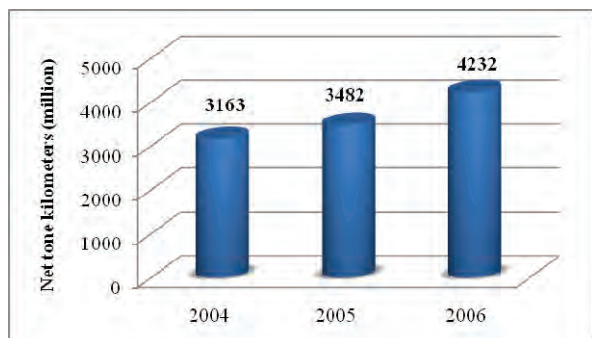


Fig. 5. Energy efficiency of the road freight transport

Energy consumption in freight rail transport consists of the consumption of diesel fuel for diesel traction, and electricity consumption for electric traction.

The specific consumption of diesel traction ranges from 8,84 to 9,42 g/ntk (Table I).

TABLE I: THE SPECIFIC CONSUMPTION OF THE DIESEL TRACTION

Year	Consumption liquid fuel ( $10^3$ g)	Work achieved (ntkm)	Specific consumption (g/ntkm)
2004	6 404 660	706 402 912	9,07
2005	7 083 143	801 274 629	8,84
2006	8 676 078	921 078 411	9,42

In the Table II we can see that the specific consumption of electric traction is in the range of 3,77 to 4,25 g/ntk. The specific fuel consumption in 2006 decreased by 11,29% compared to 2004.

TABLE II: THE SPECIFIC CONSUMPTION OF THE ELECTRIC TRACTION

Year	Energy consumption (kWh)	Work achieved (ntkm)	Specific consumption (kWh/ntkm)	Specific consumption (g/ntkm)
2004	121 979 559	2 456 724 005	0,0496	4,25
2005	131 826 121	2 679 392 721	0,0492	4,21
2006	146 141 860	3 309 875 670	0,0441	3,77

The specific energy consumption per unit of work in the railway transport has a trend of reduction in the electric traction, while the diesel traction increases. The increase of energy efficiency of the electric traction has influenced the greater degree of utilization of freight cars for cargo transport [5].

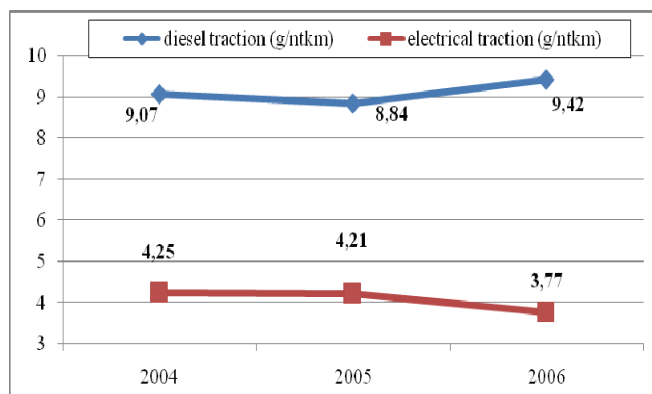


Image 5: Energy efficiency of the railway freight transport

Image 5 shows that the electrical traction energy is more efficient than the diesel traction, and that the specific consumption per unit of transport work is more than twice smaller. One of the basic problems of energy efficiency of the railway transport is that only 32% of the total railway network in Serbia (4.347 km) is electrified. Therefore, one of the priority measures would be to increase the number of the electrified railways.

### III. IMPROVING THE ENERGY EFFICIENCY OF TRANSPORT USING THE COMBINED TRANSPORT IN SERBIA

Energy consumption in Serbia is much higher than in developed countries so there are significant opportunities to reduce it.

To increase energy efficiency in transport, it is necessary to perform the integration of some forms of transport, diversion of commodity flows to the energy efficient forms of transport such as rail or water. Application of combined transport requires development and production of new means of transport, use of alternative fuels, introduction of information technology in managing and monitoring transport vehicles and etc.

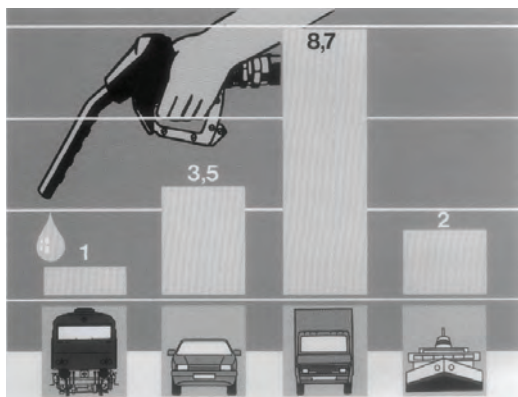


Image 1. Energy consumption some mood of transport [1]

Conducted research and the best European experience have shown that the specific energy consumption in the current transportation system with introduction of technology designed for optimal combined transport can be reduced by 5.8% [2]. This is even more important if we bear in mind that the reduction in specific energy consumption, as a rule, means the reduction of air pollution.

Combined transport in Serbia until 2005. participated in the overall transport with about 0.5%, and at the European Union it participated with 6 to 9% [2]. Given the size of the countries in the region and the limited potential for this type of transport, it is very important to cooperate with neighbouring countries, as strategic, based on regional and bilateral initiatives for the combined transport, as well as operational by operator for the combined transport. With the recovery of the economy in the region and international transport processes the importance and role of combined transport has increased.

The study found that the use of modern technology of combined transport in Serbia, on the whole, is insignificant and it is primarily related to intercontinental transport of container. There are only three terminals, which have a certain capacity for handling transport units of the combined transport: ŽIT -Belgrade railway terminal, Container terminal in the Port of Belgrade and the Container terminal at the port of Pančevo. Presence of other technologies for combined transport (Hucke-pack, Ro-Ro and etc.) at the total commodity flow is negligibly small, primarily because of the lack of appropriate infrastructure elements of the transportation system (the terminals for the handling and transportation unit for combined transport) [3].

Terminal capacity should be developed gradually, according to market demands. It is necessary to ensure that the terminals, according to the needs, except for transfer Container are also capable for handling other units of

combined transport (for example exchange transport vessels and semi-trailers), as well as complete road vehicles.

Special attention should be pay on the environmental aspects of combined transport. In fact, this technology of transport should contribute significantly reduction of the harmful effects of transport on the environment.

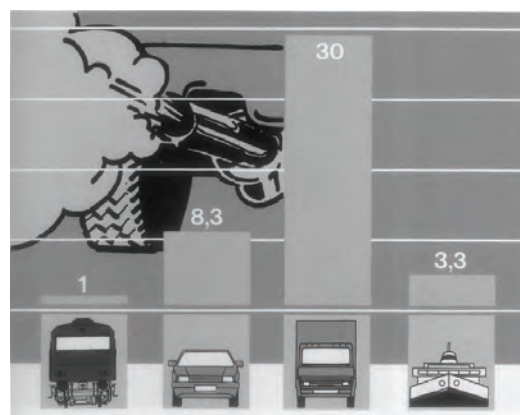


Image 2. Impact some mood of transport in emissions of exhaust gases [1]

Rail traffic is able to use electricity as a fuel and thereby make a huge transport work. Electrical energy is the cleanest fuel and there is no necessary to stored it, also it can be obtained from renewable natural resources. It least from all other sources of energy threatens the natural environment, which provides to railway undoubted advantages over all other forms of transport, especially road transport.

#### IV. CONCLUSION

Energy efficiency of road and rail transport in Serbia is very unfavourable, as a result of a number of factors that point to the irrational use of energy. The main causes of low energy efficiency of road transport are outdated road network, lack of bypass, obsolete technology traffic management, traffic congestion, unfavourable age structure of vehicles, inadequate vehicle capacity utilization, etc. The causes of lower energy efficiency of rail transport are outdated infrastructure, low capacity of railway lines, old vehicles and low capacity utilization.

Combined transport, as a transport of the wider public interest, is environmentally acceptable, economically justified and safe. Bearing in mind the current state of the energy consumption of the traffic system in Serbia, it is necessary for the government to conduct "aggressive" policy of application of combined transport in order to increase the energy efficiency of transportation. The intensity of activity in the combined transport in particular it will be increase with formation of institutions in this area, removing bottlenecks in the corridors, construction of terminals and logistics centres, improving the organization of all participants in the combined transport chain and the implementation of stimulating measures by the government.

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