Some methods to improve the environmental performance of wheeled vehicles

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Abstract. Road transport plays an important role in the economy of many countries, but it also has a significant anthropogenic impact on the planet's ecology, including emissions of greenhouse gases and pollutants from the exhaust gases of internal combustion engines. One way to reduce this impact is to improve the energy efficiency of wheeled vehicles.

1. Introduction
Despite the great importance of road transport in the economy of many states, the damage caused by road transport is also significant. Research carried out by JSC NIIAT showed that in the European Union, the economic damage from the operation of road transport is 6-8% of the gross domestic product, while the main damage is caused by road accidents (58%), environmental components (23%) and traffic congestion (19%) [1].

Significant anthropogenic impacts of road transport on the planet's ecology include emissions of greenhouse gases and pollutants from the exhaust gases of internal combustion engines, which make up 23% of global greenhouse gas emissions and 18% of all anthropogenic emissions in the world economy, respectively [2]. One way to reduce this negative impact is to increase energy efficiency and reduce fuel consumption of wheeled vehicles.

2. General trends in energy consumption in transport
The U.S. Department of Energy forecasts that the global volume of liquid fuels used in the transportation sector will grow from 105 quadrillion British thermal units (Btu) in 2015 to 125 quadrillion Btu in 2040. Motor gasoline will remain the largest transport fuel, but its share in total energy consumption in transport will decrease from 40% in 2015 to 36% in 2040. The transport sector will account for 60% of the total consumption of liquid fuel (this includes energy consumed when moving people and goods by road, rail, air, water and pipeline transport). Figure 1 shows a diagram of the growth of energy consumption in transport, broken down by main sources [3].

Global emissions of carbon dioxide (CO2) related to energy (which includes transport) will increase to 36.4 billion tons in 2030 and to 39.3 billion tons in 2040. Figure 2 shows a diagram of the growth of global energy-related carbon dioxide (CO2) emissions, broken down by major sources of origin [3].
Figure 1. Dynamics of energy consumption in transport by year.

Figure 2. World carbon dioxide emissions by fuel type.

Given that the share of energy consumption of road transport in the total energy consumption in the transport sector is more than 60%, improving energy efficiency and reducing fuel consumption of wheeled vehicles is one of the most important tasks of environmental policy worldwide.

The transport strategy of the Russian Federation for the period up to 2030 provides for a reduction in carbon dioxide emissions from the transport sector by 15% by 2030 compared to 2007, while the
energy efficiency of transport should reach the developed countries level. Figure 3 shows the planned dynamics of reducing fuel consumption by mode of transport in the Russian Federation [4].

![Figure 3. Average fuel consumption per unit of transport work by mode of transport (compared to 2011).](image)

### 3. Methods for improving energy efficiency and reducing fuel consumption of wheeled vehicles

Among the methods that contribute to improving energy efficiency and reducing fuel consumption of wheeled vehicles, we can distinguish methods of regulatory, economic and administrative regulation.

**Methods of regulatory legal regulation**

The methods of legal regulation can include the improvement of standards and test methods for assessing the fuel efficiency of automotive equipment, regulating the amount of fuel consumed by the vehicle per unit of distance traveled or transport work, etc.

After the world fuel crisis of 1973, the United States introduced the law on average fuel consumption – CAFE (Car Average Fuel Economy), according to which, by the mid-1980s, the fuel consumption of vehicle was halved. At the end of 2011, the average cars power reserve in the local market was approved, which should be 54.5 miles per gallon (4.32 liters/100 km) by 2025, the corresponding unit of measurement is mpg (miles per gallon). The higher the car power reserve, the more economical the car. Cars with a gross weight of up to 8,500 pounds (3,856 kg) are required to meet CAFE. They were divided into two classes: passenger cars and "light trucks" (all-terrain vehicles, pickups and minivans).

For non-compliance CAFE standards, penalties are provided: $ 5.5 for every 0.1 miles of missing mileage, multiplied by the number of cars produced by the corresponding manufacturer for the United States for the year. However, some manufacturers still prefer to pay off a fine, rather than invest in the development of more economical models.

In Europe, in 2012-2015, the maximum permissible level of CO2 limited to 130 g/km, in terms of fuel consumption, this will be 5.2-5.5 l/100 km.

**Methods of administrative regulation**

The methods of administrative regulation include the control of idle time, the prohibition of entry into certain areas vehicles that do not meet environmental performance indicators.

**Methods of economic regulation**

The methods of economic regulation include environmental, transport and energy taxes, the creation of preferences for economical and "environmentally friendly vehicles" when using transport infrastructure (parking fees, toll roads), when conducting competitive procedures for the right to execute a municipal order for passenger and cargo transportation, the adoption of targeted federal, regional and city programs to expand the use of "environmentally friendly transport", etc.

"Eco-marking" of vehicles

One of the tools that contribute to improving the energy efficiency and fuel efficiency of road transport is the creation of a system of "eco-marking" of wheeled vehicles.
The eco-labeling refers to ways to inform consumers about the level of fuel consumption of a given vehicle and its environmental class, as well as to provide other related information based on the wheeled vehicle certification system. A system for marking the fuel consumption level of cars for sale exists in many developed countries.

Somewhere this system is voluntary, as, for example, in Canada, where automakers have adopted a corresponding program, somewhere it is regulated by law, as in the countries of the European Union.

The "eco-marking" system can implement a set of measures aimed at reducing the negative impact of road transport on the environment, such as the creation of "low emission zones" in cities, restricting access of certain categories of vehicles to certain areas of cities, differentiated taxation of vehicles and payments for the use of transport infrastructure, the formation of consumer demand for environmentally friendly and energy-efficient vehicles.

First of all, eco-labeling measures are aimed at personal passenger vehicles (they consume up to 80% of gasoline and 30% of diesel fuel), while the main task is to form consumer demand.

The corresponding labels (placards, tablets, etc.) are placed in car dealerships, and the information contained in them is available on the Internet and in reference books.

Official electronic databases of eco-characteristics of models presented on the market are being formed.

As a general rule, energy efficiency labels reflect:
- data on fuel consumption in the city and outside the city;
- rating of fuel consumption and/or CO2 emissions;
- information on CO2 emissions (in the standard cycle);
- annual fuel costs (optional);
- data on emissions of pollutants.

The environmental label also includes the environmental class of the vehicle.

4. Conclusion

Emissions of greenhouse gases and pollutants from the exhaust gases of internal combustion engines directly depend on the fuel consumption of wheeled vehicles, so much attention is currently being paid around the world to improve the energy efficiency and fuel efficiency of wheeled vehicles.

One of the ways to encourage the expansion of the use of more environmentally friendly and energy-efficient vehicles is the environmental labeling of wheeled vehicles.

References
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