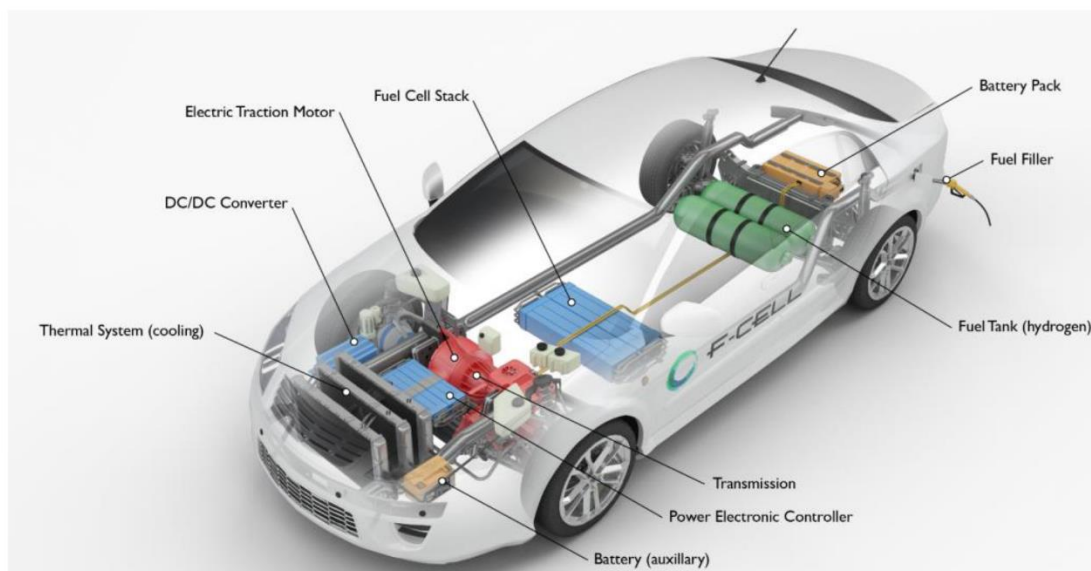


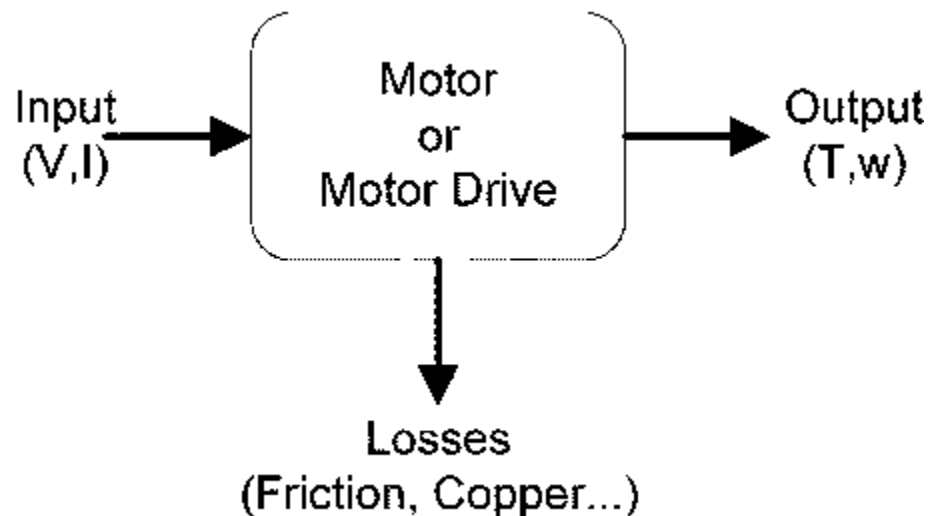
## 2.3 FUEL EFFICIENCY ANALYSIS

### 1. Introduction

At its most basic, fuel efficiency is defined as a measure of how much a car will convert energy in fuel into kinetic energy to travel. In other words, fuel efficiency shows how far your car can travel with a certain amount of fuel. In America, the concept is described as "miles per gallon" (mpg). Hybrids are the most gasoline efficient of all cars - they typically get 48 to 60 mpg (claimed). Not bad, but only about 20% to 35% better than a fuel efficient gasoline powered vehicle - like the Honda Civic, for example, that gets 36 mpg. Vehicles with better fuel efficiency tend to consume less fuel to carry out the same task. Therefore, reducing wasted fuel. Choosing a fuel efficient vehicle can bring a wide range of advantages: saving fuel costs, reducing carbon footprint, cutting our dependence on oil, etc. Let's take a quick look at why fuel efficiency is a crucial element you need to take into account, as well as the benefits it can offer you as a driver and a responsible citizen alike.



According to the data, by 2017 the number of sold hybrid cars in the world reached 10 million pcs. At this, sales dynamics has a sustainable growth tendency. The number of hybrid cars in the world car fleet in a quantitative sense increases every 5 years approximately by 3 million units. With the account of existing trends by 2020 the fleet of hybrid cars can reach 14 million pcs. While annual sales of hybrid cars reached 10% of the general number of cars sold in the world. The main factors defining the demand for hybrid cars at the market and increasing their competitiveness at the global market are the following: reliability, environmental safety, fuel efficiency. Particularly these factors facilitate the increase in the efficiency of the operation of hybrid vehicles.



## 2. Problem of fuel efficiency of hybrid vehicles

The problem of actual fuel consumption rate defining is quite relevant. The owners of hybrid vehicles provide ambiguous data on the average fuel consumption rate in the process of their operation. The research is directed at the identification of phenomena causing the difference in average fuel consumption rates of hybrid vehicles stated by the manufacturer and the actual values of such consumption provided by the vehicle owners. In this connection the purpose of

the paper consists in studying the reasons of the discrepancy of the actual average fuel consumption values of hybrid vehicles with those stated by manufacturers.

### **3. Research methods**

All the information about the hybrid vehicle data was collected in automotive clubs of Vladivostok by means of car drivers' interrogating. The information was analyzed in the conditions of the urban cycle. More than 1,000 car owners took part in the poll. The presented vehicles had various mileages in the territory of Russia. The obtained data are compared with the manufacturer's parameters of Japanese car producers. It gives the manufacturer's technical characteristics of hybrid cars operated in the Russian Federation. Manufacturer's technical characteristics of hybrid cars operated in the Russian Federation.

According to the car owners, during real operation the average costs for such hybrid cars are 3040% higher than the expected ones (based on the manufacturer's statements). The reasons of such higher real values of the average fuel consumption rate in hybrid cars relate to multiple factors. The International Environmental Transport Council has published the report on 2018. According to the report, in 2018 a record-breaking discrepancy between the indicators of the stated and real fuel consumption rate of cars was registered, in particular, the real consumption rates were by 42% higher. For vehicle owners it means additional costs of 400 euro per year, as it is reported by the periodical of the media groups "Funke" with the reference to the available results of the poll conducted by an independent organization ICCT (International Council on Clean Transportation). There is a number of factors having the impact on the average fuel consumption rate of hybrid vehicles. The important factors are the fuel quality, climatic and road conditions. The fuel quality significantly affects the fuel consumption rate of a hybrid car. Regardless of the hybrid drive configuration, such fuel use causes

consumption growth. The deviation of quality indicators causes serious faults in the engine operation. During the winter period to heat the engine and all car systems, one needs fuel using. A running heater and snow tires have an impact on the increase of the fuel consumption rate. In summer the fuel consumption rate increases due to the operation of air conditioning and related systems because of increased environment humidity. Road conditions can include the quality of road carpet, road carpet type, mountainous area, location of the road above the sea level. Road carpet quality directly impacts the car economic efficiency, continuous dynamic loads cause fatigue fractures, fixture unfastening, loosening, excessive wear of a driving gear. In the mountainous areas the load on the electrical part increases, engine generators, power inverters and accumulators emit heat more intensively, the cooling system is subject to a higher load. The research are based on the data provided by car clubs of Vladivostok. The data were gathered by means of interrogating drivers in the period of 2017-2018. The base created included the following data: – vehicle make; – vehicle manufacture date; – vehicle mileage; – average velocity of a vehicle during fuel consumption measurement.

#### **4. Obtained results**

At the first stage the authors set the task to define an average fuel consumption rate of hybrid cars Honda and Toyota. To do this, the whole data package was divided into groups in compliance with their makes and manufacture dates. Fuel consumption rate depending on the Honda cars year of manufacture. The curve showing the dependence of the fuel consumption rate on the year of manufacture makes it obvious that the highest ratio for Honda Insight can be 8.7 l /100 km while the lowest, i.e. the most profitable ratio in terms of fuel consumption for a hybrid car Honda Fit, is 6 l /100 km. The data present an

average value for this car make provided by the vehicle owners. The difference in the indicators of these makes is explained by different liter capacity of a vehicle.

2.The curve showing the dependence of the fuel consumption rate on a Toyota mileage presents an average mileage value for this model. The models Toyota Prius PHV and Toyota Sai are the most profitable hybrid cars while the cars Toyota Aqua and Toyota Prius are less cost-effective.

3.At the third research stage the authors determined the ratio between fuel consumption and the average velocity of hybrid cars Honda and Toyota. For hybrid vehicles one should use the indicator of the distance covered at one fuel liter. Fig. 6 shows the curve of the distance covered at 1 fuel liter in relation to the velocity of hybrid cars Honda depending on their mileage.

4.The curve showing the ratio “fuel consumption rate - average Honda velocity” makes it obvious that in case the velocity rate is normal, the fuel consumption rate can be rather low as well. The curve shows that at various velocities the fuel consumption rate is virtually the same which is explained by various engine liter capacities.

The curve of the distance covered at one fuel liter in relation to a Toyota average velocity shows that most cars have the difference of only 2-3 km at one 1 liter. It is mostly connected with vehicle liter capacity as it varies significantly.

## **5. Conclusion**

Therefore, the authors made the following conclusions on the research outcomes: Firstly, the fuel consumption rate depends of the year of manufacture: for Honda cars - starting from 3 l /100 km for Toyota cars - up to 7.2 l /100 km. Secondly, depending on the mileage after 120,000 km the consumption rate increases by

3.7 l/100 km of the stated 3.3 l/100 km for Honda; up to 40% Toyota cars at the mileage from 85,000 km to 150,000 km inclusive. Finally, depending on the average velocity the fuel consumption rate of Honda and Toyota cars increased by 40% of the stated technical specifications. In addition, the fuel consumption rate of hybrid vehicles depends on fuel quality, climatic and road conditions but the latter are not covered in the poll organized in Vladivostok car clubs.