

## **ECONOMIC AND ENVIRONMENTAL IMPACT OF ELECTRIC VEHICLES**

### **Introduction**

As modern culture and technology continue to develop, the growing menace of global warming and irreversible climate change draw increasing concern of the world's population.

All countries around the world are working to drastically reduce CO<sub>2</sub> emissions as well as other harmful environmental pollutants. Automobiles are amongst the most notable producers of these pollutants, as they are almost exclusively powered by internal combustion engines and exhaust unhealthy emissions.

According to various reports, cars and trucks are responsible for almost 15% of CO<sub>2</sub> emission [1].

One potential alternative to the world's dependence on standard combustion engine vehicles is EV and HEV cars. Let's try to justify this statement.

To assess the impact of electric vehicles on the environment, we need to consider several questions: exhaust gases pollution, fuel efficiency, the car efficiency, economic indicators.

#### **Electric car emissions: exhaust gases and fuel efficiency**

There is a pretty common myth that electric vehicles also pollute the environment, as well as the cars with ICE, just the pollution process is transferred to the stage of electric car production and the stage of electricity generation. This is a false judgment and it does not correspond to reality.

Electric cars significantly reduce CO<sub>2</sub> emissions since electric vehicles run on electricity and emits no exhaust gases. If one assesses only this factor, electric vehicles are much more environmentally friendly than conventional ones.

However, when evaluating the eco-friendliness of an electric vehicle, we also need to take the "well-to-wheel" emissions into account. This is an overarching term that includes greenhouse gas emissions, energy efficiency, and industrial costs [2].

When taking well-to-wheel emissions into account, every electric vehicle emits an average of around 4,450 pounds (2020 kg) of CO<sub>2</sub> equivalent each year. By comparison, conventional gasoline cars emit over twice as much annually.

#### **The car efficiency**

One more reason why electric vehicles are considered more sustainable than traditional vehicles is that efficiency of an electric car is higher.

The efficiency of the electric motor is approximately 90-95% while the efficiency of the ICE is around 20% (a diesel engine is about 25%) [3].

Let's consider an example to make it clearer. We compare the electric vehicle Tesla model 3 and the car with ICE – BMW 3 series. It is important that the cars were of one class.

So, from one liter of oil you can get from 150 to 800 milliliters of gasoline. It depends on the method of production of gasoline. BMW will run only 12.5 kilometers at the stated consumption of 6.4 liters per 100 kilometers in the combined cycle of 800 milliliters of gasoline.

With electric cars everything is more interesting. When burning 1 liter of oil at a modern thermal power plant with an efficiency of 40%, we get 3.4 kW·h of energy. The manufacturer's claimed consumption of model 3 is 500 km from the battery at 74 kW·h. This means that Tesla will travel 23 km. That is almost two times more than BMW.

In addition, we took the most efficient way to produce gasoline. If gasoline were produced by distillation, the difference would be 10 times in favor of an electric vehicle.

And there is also the fact to be taken into account that the fuel needs to be delivered to the gas station by fuel truck which uses gasoline as well.

### **Economic indicators**

The owner of Tesla Model S has posted statistics on the operation of her cars. For 5 years, she traveled 120 thousand kilometers. She drove exclusively through the city, and charged the car in the garage. She consumed almost 26 thousand kW·h of energy for which she paid a little over two thousand dollars.

If we take a similar car with an internal combustion engine, the cost of fuel would be about 10 thousand dollars.

Another reason why the EV is economical is the lack of ongoing maintenance.

Cars with ICE consist of several thousand parts many of which are subject to friction and require replacement over time. Even brake pads in electric vehicles have a greater resource due to regenerative braking. The electric motor consists of a rotor and a stator where only bearings can wear out.

The ICE resource is several hundred thousands of kilometers, and most of them require serious repairs every 150 thousand kilometers approximately. In the same time, for example, the Tesla Model 3 is guaranteed to drive 1 million 600 thousand kilometers. And it does not require repair. Moreover, nobody takes into account energy consumption and CO<sub>2</sub> emissions in the production of consumables, which are a lot.

Development of renewable energy can also be attributed to the economic component. But it also applies to the environmental component. Today, it is paid great attention. These are the state subsidies and the Paris agreement of emission reduction. For example, in North America the price of megawatts of solar power has fallen from \$ 350 to \$ 50 over the past 8 years. For now, in many countries, solar energy is cheaper than the one got from traditional thermal power plants. This price difference will increase steadily because hydrocarbon reserves are limited.

It is worth noting that, when we are talking about renewable energy sources it means not only solar power plants and wind farms but also hydroelectric power stations, geothermal and tidal power stations, as well as bioenergy. Some countries and some cities show a high percentage of generation from these sources and they are planning to switch to them completely [4].

Another important advantage of electric vehicles is the stabilization of power systems [5].

The thing is that electricity has been produced by power plants within 24 hours equally, but the load on the power grid is constantly changing. For example, at night much less energy is required during the day, but power generators continue to produce electricity. It causes dissipation of unused energy. And it's not cost-effective at all. But there are electric cars coming to help. If we connected them to the electrical grid at night, they could store electricity and then give energy back to the power grid to stabilize the energy system. This becomes possible due to an increasingly raising range of modern electric cars' run, from 300 km. Since, according to the studies, on average, cars pass only 30 km per day. Such stabilization systems are already being developed by some manufacturers, such as Nissan.

### **Conclusion**

The question of the environmental friendliness of electric cars is not easy – there are quite a few facts that speak, both in favor of one or the other. Nevertheless, already written materials, as well as studies, the results of which are not lobbied by oil companies, indicate that electric vehicles are much more environmentally friendly than fuel cars. This analysis showed that the hybrid and electric cars have advantages over the others.

And in the future, the development of the electromobile industry will only go towards minimizing environmental damage, while fuel cars today have completed evolutionary development and are simply not able to become cleaner.

### **References**

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