

# **HYDROGEN FUEL CELL VEHICLES**

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## **ABSTRACT**

The article presents hydrogen fuel cell vehicles. More and more car manufacturers are seriously developing and producing hydrogen fuel cell vehicles. Electric cars powered by hydrogen will become more and more common in the future. Hydrogen vehicles are powered by fuel cells containing hydrogen. Hydrogen and oxygen in the fuel cell of a hydrogen car produce electrical energy. This energy is fed into the electric motor and/or battery as needed. Hydrogen fuel cell cars run on an electric motor and are therefore considered electric cars. Short for FCEV, which stands for “Fuel Cell Electric Vehicle”. The difference between hydrogen fuel cell cars and electric vehicles is that hydrogen cars generate their own electricity, so there is no need to charge the battery from an external source.

## **KEY WORDS**

hydrogen cars, hydrogen fuel cell vehicles, electrical energy, battery, fuel cell electric vehicle

## **CLASSIFICATION**

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## INTRODUCTION

The article presents the hydrogen cars. More and more car manufacturers are seriously developing and producing hydrogen fuel cell vehicles. Electric cars powered by hydrogen will become more and more common in the future. Hydrogen cars are powered by fuel cells containing hydrogen [1-10].

Hydrogen and oxygen in the fuel cell of a hydrogen car produce electrical energy. This energy is fed into the electric motor and/or battery as needed.

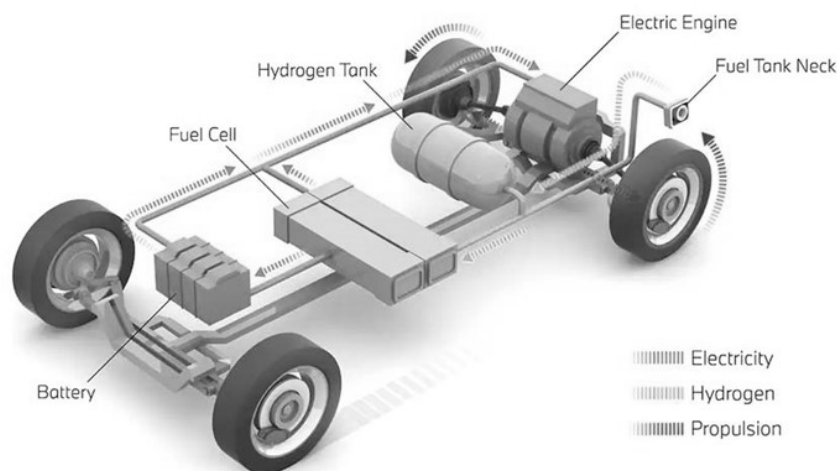
Hydrogen fuel cell cars run on an electric motor and are therefore considered electric cars. Short for FCEV, which stands for “Fuel Cell Electric Vehicle”.

The difference between hydrogen fuel cell cars and electric vehicles is that hydrogen cars generate their own electricity, so there is no need to charge the battery from an external source.

The first section is the introduction, the second section presents the hydrogen fuel cell cars, the third section presents the advantages and disadvantages of hydrogen cars, the fourth section presents the hydrogen car commercially available in 2025, the fifth section presents the Self-Driving Hydrogen Cars – the future of driving and the sixth section summarises the results of the research [11-17].

## HYDROGEN FUEL CELL CARS

Hydrogen cars have their own efficient power source on board: the fuel cell. So, it does not get its energy from a built-in battery that can be charged from an external power source, as in the case of electric or plug-in hybrid vehicles, Figure 1.



**Figure 1.** Hydrogen fuel cell car.

The hydrogen in the fuel cell reacts with oxygen from the surrounding air, resulting in electrical energy, heat and water, which is released as water vapour through the exhaust.

The electricity produced in the fuel cell of a hydrogen engine can be used in two ways:

- either it flows into the electric motor and directly powers the hydrogen car,
- or it charges a battery, which stores the energy and is significantly smaller and lighter than the battery of an all-electric car because it is continuously charged by the fuel cell.

Like other electric cars, hydrogen cars can recover braking energy, converting the kinetic energy of the car back into electrical energy and feeding it into the battery [18, 19].

## **ADVANTAGES AND DISADVANTAGES OF HYDROGEN CARS**

There are advantages and disadvantages of hydrogen cars.

### **ADVANTAGES**

- enables environmentally friendly and sustainable mobility,
- hydrogen cars are safe, hydrogen is stored in liquid form in thick-walled tanks,
- hydrogen cars have a longer range than pure electric cars,
- the range of hydrogen does not depend on the outside temperature, so it does not decrease in cold weather,
- the hydrogen car's fuel cell can be recharged in a shorter time than the battery of an electric car,
- hydrogen cars could be the zero-emission technology for urban and road transport, thus contributing to climate change mitigation.
- crash tests have shown that hydrogen tanks are not damaged in collisions and therefore do not release hydrogen, driving a hydrogen car requires no special skills and is easy to refuel and maintain.

### **DISADVANTAGES**

- the running costs per kilometre of hydrogen cars are currently higher than those of battery vehicles charged from external sources,
- the main shortcoming of hydrogen cars is currently the scarcity of refuelling options. There are still few refuelling stations for hydrogen cars in the world,
- the current high purchase price of hydrogen cars.

## **HYDROGEN CAR COMMERCIALY AVAILABLE IN 2025**

Toyota, in terms of hydrogen cars, is the leading car manufacturer in the world. The Toyota Mirai has a total capacity of 5,6 kg of hydrogen in its tank, takes 5 minutes to fill up and has a range of 650 km.

A 2028 BMW hydrogen fuel cell production car is coming. BMW and Toyota will collaborate on the powertrain for a BMW hydrogen fuel cell vehicle coming in 2028.

## **SELF-DRIVING HYDROGEN CARS – THE FUTURE OF DRIVING**

Let us explain what autonomous vehicles really are. An autonomous vehicle permits the vehicle to manage certain driving points which in a normal car would be controlled by a driver. For example: steering, braking and acceleration, checking and monitoring the driving environment. To perform all these actions autonomous cars, must have certain equipment such as a combination of sensors, controllers, onboard computers, actuators, algorithms, and advanced software. Autonomous cars form and maintain a map of their surrounding with the help of various sensors embedded in the different parts of the vehicle. Sensors pay attention to the nearby vehicles while video cameras detect traffic lights, road signs, pedestrians and track other vehicles on the road.

The advantages of autonomous cars are various. For instance, human drivers tend to cause accidents due to different reasons. Many people use their mobile phones while driving, some drive for long distances and get tired, others over-speed because they are in a hurry and some of them just do not respect the traffic and road safety rules.

These limitations do not fall under autonomous cars. These cars can detect obstacles and thus avoiding them. Sensitive sensors can notice the obstacle much earlier than the human driver

would, especially in the dark roads. Furthermore, autonomous cars can recognize the presence of other cars on the road and estimate the size and speed of the oncoming car so any collision would be less likely. Since self-driving cars are operating on software and connectivity, they are pretty much vulnerable to the hackers. Autonomous cars are still at their early stages of development and need a lot of improvements especially in terms of security. They require protection. To accomplish this some efforts have already been made.

Autonomous vehicles are still pretty much a novelty and require further developments in particularly in the field of cyber security. In previous years cyber security was something yet to be understood but nowadays it is quickly. Autonomous vehicles have modernized the mobility of people, which means that people no longer have to come to the vehicle but the vehicle comes to them and are able to share transportation and thus lowering the traffic congestion and cost [20].

In our opinion hydrogen fuel cell propulsion will dominate in Self-Driving Cars. These vehicles will reduce pollution and save the environment, they will reduce CO<sub>2</sub> emission. Considering all the facts, fuel cells autonomous vehicles represent the future of transportation and hopefully will soon become common in the streets.

## CONCLUSIONS

The article presented hydrogen cars. More and more car manufacturers are seriously developing and producing hydrogen fuel cell vehicles.

Electric cars powered by hydrogen will become more and more common in the future. Hydrogen cars are powered by fuel cells containing hydrogen.

The difference between hydrogen fuel cell cars and electric vehicles is that hydrogen cars generate their own electricity, so there is no need to charge the battery from an external source. Hydrogen cars could be the zero-emission technology for urban and road transport, thus contributing to climate change mitigation.

The article presented the advantages and disadvantages of hydrogen cars, commercially available in 2025 the Toyota Mirai and the future of driving: Self Driving Hydrogen Cars.

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