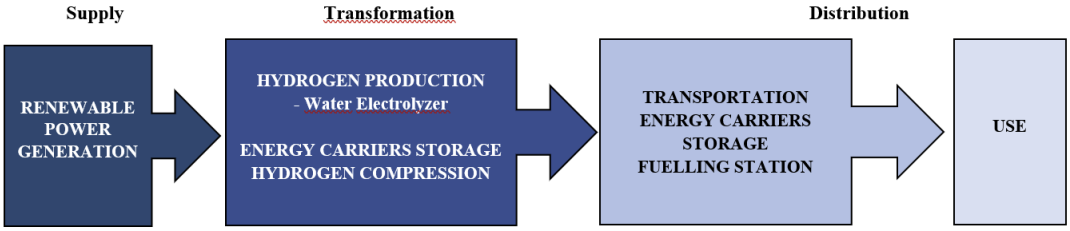
Hydrogen Distribution and Infrastructure Development Research Division

About

Hydrogen supply chains can have a different structure depending on the purpose of their operation. They have a significant impact on the sustainable development of energy systems. The hydrogen supply chain stabilizing the points of obtaining renewable energy, in which hydrogen is converted into fuel and distributed to the end user.



When talking about hydrogen supply chains, we think about the supply chain of hazardous materials, which requires a special approach, including compliance with regulations and social pressure related to the location of nodes. Hydrogen is perceived by society as one of the most dangerous fuels. Contrary to appearances, it is less flammable than gasoline or other fossil fuels. Like any other fuel, hazards arise when stored and transported improperly. These risks can be minimized by using appropriate control systems. These include:

- leakage prevention by highly accurate tank tightness testing,
- installing multiple shutoff valves,
- designing devices resistant to shock, vibration and high temperatures,
- use of hydrogen sensors for leak detection,
- prevention of ignition by locating all hazards that create an electric spark,
- separation of fuel cells from other electrical devices.

Due to safety problems, the most commonly referred to as hydrogen fuel supply chains with centralized production, at an appropriate distance from inhabited places. However, hydrogen can be produced in a distributed system close to collection points. In the case of hydrogen refueling stations, hydrogen can even be produced at the station . In such a case, the production costs will be higher, but they will reduce the costs related to transport. The cost of producing hydrogen depends strongly on the technology used and using the technology of centralized production of hydrogen using SMR technology, the cost of producing 1 kg of this gas is estimated at EUR 2 and is strongly dependent on the price of natural gas. In the case of distributed production, the cost is estimated at EUR 4 without taking into account the cost of CO2 emissions. In the case of hydrogen production from water in the EC process, the cost of centralized production is € 6 / kg, and in the case of distributed production, the cost is estimated at € 8 / kg . Many different transportation modes can be used to deliver hydrogen from production facilities to storage sites and finally to the fuelling stations. Hydrogen can be transported by cylinders, road tankers, pipelines, bulk ships or ferry. Each of these solutions entails additional risks related to transport safety as well as social and environmental effects, such as air pollution or the land consumption of

infrastructure. Establishing hydrogen as a fuel for transportation requires also a detailed cost analysis of the entire supply chain. This includes how hydrogen is to be produced, its large-scale storage that takes the seasonal intermittency of renewable power generation into account, its transportation and distribution from a central production plant to fuelling stations as well as the fuelling stations themselves. Numerous studies investigate the most costefficient supply structure between production and transportation. Yang and Ogden investigate a method for comparing the different transport possibilities of tube or liquid trailer truck vs. pipeline delivery. They show that each technology has a maximally cost-efficient niche and there is no single perfect solution for the entire system. Another studies develop an Excel tool for calculating the cost of hydrogen supply while varying different input parameters like FCEV market penetration, refuelling station capacity, transmission mode or production volume for different delivery scenarios. Although, hydrogen production is not calculated inside either model and is instead assumed to be an input. As such, the influence of hydrogen production on storage demand was not investigated. Crucial for the design of the supply chain has a hydrogen fuel station location and distance from their places of production and storage. The key factors in the installation of fuelling stations are characterizing the required demand and the form of product to dispense. These two factors will determine the size and type of fuelling stations . The costs of building hydrogen stations are high and the return on investment is negligible due to the low popularity of such vehicles. Meanwhile, sales of hydrogen-powered cars are negligible, mainly due to high purchase costs and the lack of a charging network. It is easier for electric cars to win the market. Because even without an extensive network of chargers, they can still be charged from a home socket. There is no way to deal with the problem of the lack of infrastructure with hydrogen cars.