Green hydrogen to combat climate change: Opportunities and challenges of a hydrogen economy

Hydrogen to be used to achieve European climate protection targets

The growing challenges arising from the climate crisis have sparked interest in green hydrogen and the technologies based on it as another step in combating climate change. Hydrogen (H_2) can be used as a basic material, as fuel, as an energy carrier and as energy storage. In the context of sector coupling, hydrogen facilitates the decarbonisation of those industrial processes and economic sectors in which CO_2 emissions can either not be reduced at all by electrification or only at considerable cost. The development of an extensive hydrogen economy is key to the achievement of German and European climate protection targets. With the German government's national hydrogen strategy and the EU Commission's hydrogen strategy, a framework was created in 2020 to develop and promote a hydrogen economy in Germany and Europe. The German federal government will provide up to 9 billion euros by 2040 to implement its national targets and to build international partnerships. The EU Commission expects cumulative investment in hydrogen in Europe of up to 480 billion euros by 2050.

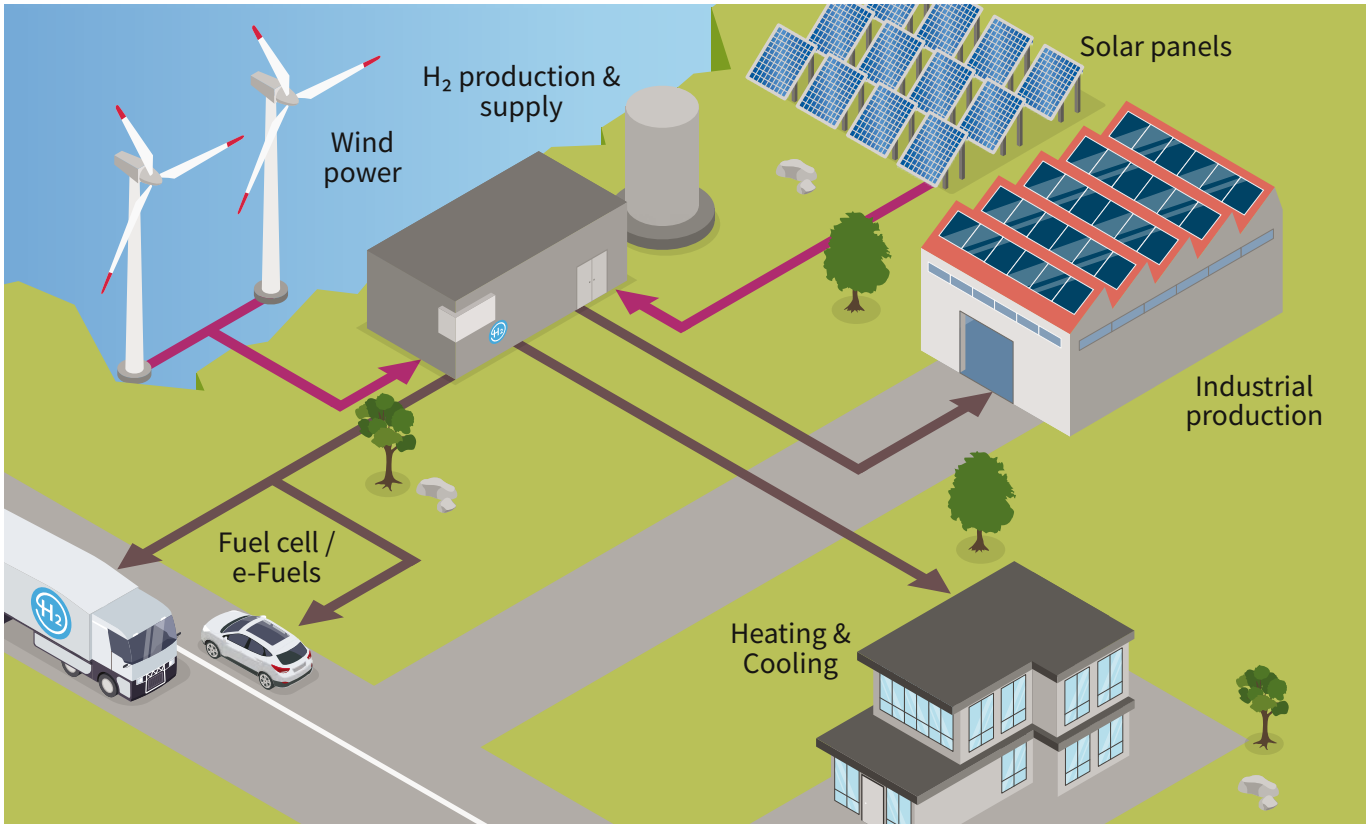
Hydrogen can accelerate the decarbonisation of CO_2-intensive sectors

Hydrogen can contribute to reducing CO_2 emissions in a number of ways. Green hydrogen can, for example, replace hydrogen derived from fossil fuels as a basic material in the chemical and steel industries. In certain mobility applications, such as heavy goods transport, public transport, logistics and inland navigation, fuel cells and hydrogen-based synthetic fuels can contribute in the medium term to a lower carbon footprint in the transport sector.
In the long term, it is conceivable that hydrogen-based synthetic fuels will also be used in shipping and aviation.

In the private sector, fuel cells may be used in combined heat and power (CHP) plants to supply buildings with electricity and heat. In addition, hydrogen can be used as energy storage to improve the total yield from renewable energy, allowing energy generation surpluses to be stored and fed into the grid as required.

The hydrogen economy faces various technical challenges

While hydrogen, from a technological point of view, can be used for diverse applications, the development of a climate-friendly hydrogen economy is controversial from an economic perspective, because major challenges are presented by the production, storage and transport of hydrogen. A crucial element of a sustainable hydrogen economy is cost-efficient production of green hydrogen. In an electrochemical process (electrolysis), electrical energy is used to separate water into hydrogen and oxygen. If the electricity used comes from renewable energy sources, the result is hydrogen which is CO_2-free and therefore known as green hydrogen. Currently, only 5 percent of hydrogen worldwide is produced using electrolysis. Most hydrogen (over 70 percent) is obtained from natural gas. In comparison with electrolysis, the gas-based process (steam reforming) requires half as much water and significantly less energy. As this process is more cost-effective, natural gas will remain the predominant energy source for hydrogen production for the time being. Moreover, the storage and transport of hydrogen present particular technical challenges: H_2 is usually cooled to minus 253 °C or stored under very high pressure. Possible alternatives which make it easier to transport and store hydrogen include conversion to ammonia, binding to liquid organic hydrogen carriers (LOHC) and the production of renewable fuels such as methanol in Power-to-X processes. However, the conversion and reconversion processes result in energy losses and some of these processes are not currently ready for the market on the industrial scale that would be required.



Infineon delivers solutions for the development of a green hydrogen economy

To benefit fully from the potential of hydrogen, solutions must be found to the challenges posed by its production, storage, transport and use. Infineon is the leading supplier of power semiconductors in the fields of renewable energy and electromobility. Infineon's semiconductor solutions can also provide valuable support for the development of a sustainable hydrogen economy along the value chain.

Industry: Power semiconductors make the production of green hydrogen possible

Very high direct currents (DC) are required in the electrolysis process for the production of green hydrogen. The alternating current (AC) supplied by the power grid must therefore first be converted into DC, a process known as rectification or AC-DC conversion. High-power semiconductors made by Infineon are designed for this conversion. Several synchronized high-power switches allow for a high combined system performance (> 50 megawatts). As a leading manufacturer of power semiconductors for wind power and photovoltaic inverters, Infineon is also driving forward electricity generation from renewables. When the electrolysis process is based on power generated from solar panels (which produce DC), the only adjustment required is to the DC voltage. The combination of renewable energy and Infineon's efficient power semiconductors provides significant leverage for the large-scale production of green hydrogen.

Clean mobility: H_2 sensors control, monitor and ensure the safety of fuel cell systems

The future will see increasing use of fuel cell-based commercial vehicles, which are virtually emission-free, for medium to heavy loads and for medium to long distances. As is the case with other fuels, hydrogen must not escape uncontrolled into the environment. To ensure the safety of fuel-cell drives and to increase their acceptance, Infineon is working on the development of highly reliable hydrogen sensors. These help to detect leaks and to control and monitor the production, storage and operation of fuel-cell systems. This is a significant contribution towards increasing efficiency through intelligent control along the entire value chain and towards ensuring safety.

Measures required for a competitive and sustainable hydrogen economy in Europe:

- Promotion of microelectronics and power electronics as enablers of a future-oriented hydrogen economy in Germany and in Europe
- Massive acceleration of renewable energy generation, so that it is possible to produce green hydrogen at the same time as proceeding with electrification through sector coupling
- Implementation of new hydrogen-based solutions in the areas of energy storage and mobility using green hydrogen
- Prioritisation of the local production and use of hydrogen, in order to avoid long transport routes and losses arising from conversion processes
- Provision of the necessary infrastructure and creation of economic incentives for the use of hydrogen-based technologies