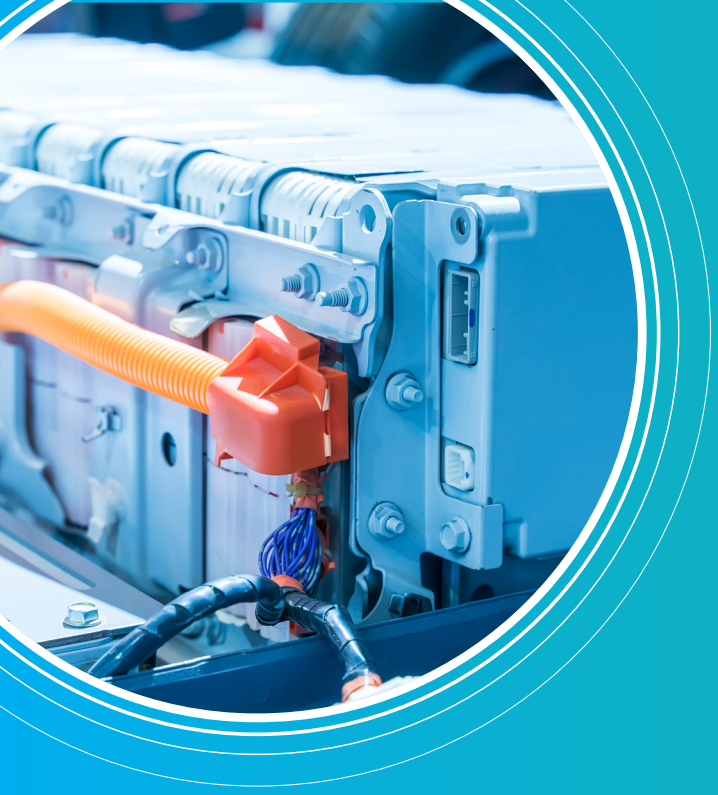


MOBILITY ECOSYSTEM: FUEL CELLS

DEFINITION

Fuel cells convert the chemical energy of reactants (hydrogen, air) into water and exhaust heat, thus providing clean energy generation for both stationary and transport uses. In transportation, fuel cells are particularly useful for long-haul heavy-duty vehicles thanks to the shorter re-fuel times and longer autonomy compared with battery-powered vehicles. However, the commercialisation of fuel cell electric vehicles is not yet widespread.
The EU promotes the adoption of heat pumps as part of its broader strategies like the REPowerEU plan and the European Green Deal.

SME SIGNIFICANCE

NUMBER OF SMEs IN THE EU27 VALUE CHAIN

ca. **80** fuel cell sub-component and system manufacturers

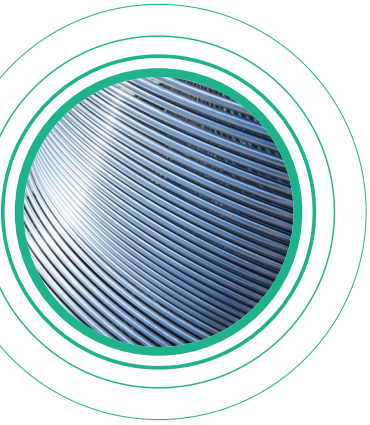
SHARE OF SMEs OVER TOTAL

72%

ADDED VALUE OF SMEs OVER TOTAL

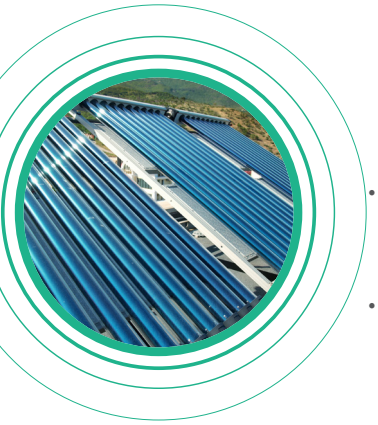
40%

FUEL CELLS EU VALUE CHAIN



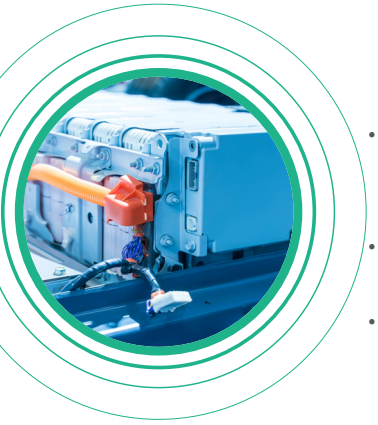
PHASE 1
RAW AND PROCESSED MATERIALS

- PGMs are among the most important material for fuel cells. The EU mines less than 3% of the raw materials necessary for fuel cells, although it is able to produce around 18% of the processed or specialised materials.
- EU production of PGMs is almost completely concentrated in Finland (99.4%), with Poland covering the rest.
- Recycled PGMs from catalytic converters and jewellery have the exact same properties as when they are first mined, meaning that primary and secondary platinum are completely interchangeable and can be reused repeatedly in new stacks.



PHASE 2
SUB-COMPONENT AND SUB-SYSTEM MANUFACTURING

- Many of the efforts in this phase are still dedicated to R&D and first industrial deployment operations rather than mass production and commercialisation.
- SMEs are widespread in this phase of the value chain and contribute in several ways:
  - SMEs are often involved in R&D operations, with 24% of unique participants from 176 fuel cell EU-funded projects under the Horizon Programmes being SMEs.
  - SMEs provide services for pilot tests on a small scale, which are pivotal in the pre-commercialisation stage of this technology.
- SMEs operate in niche markets, which allows them to pioneer novel uses of fuel cell technologies, including construction, aviation and space exploration.



PHASE 3
SYSTEM INTEGRATION

- In 2022, there were around 5,600 fuel cell electric vehicles in Europe, constituting less than 8% of the world total, while Korea is home to over half of the global stock.
- Vehicle manufacturers foresee that 50,000 hydrogen-powered fuel cell heavy-duty vehicles will enter operation in Europe by 2030.
- Other applications for fuel cells include maritime navigation, rail and aviation. Stationary applications involve heating for houses and energy storage.

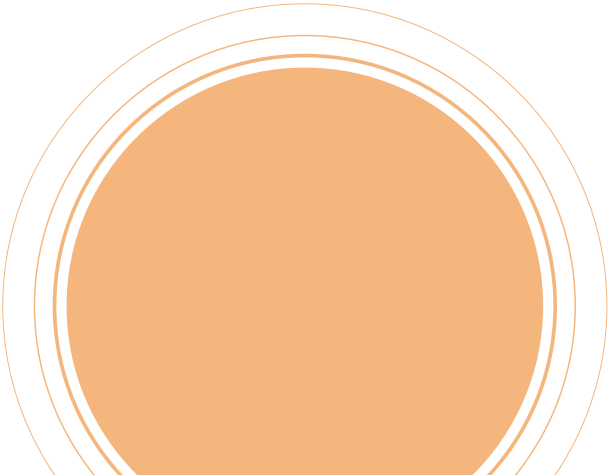
STRENGTHS AND VULNERABILITIES

EU STRENGTHS

- The **Clean Hydrogen Partnership** provides substantial support for R&D operations and awareness campaigns on hydrogen technologies, including fuel cells.
- Thanks to this embeddedness within the Partnership, fuel cell manufacturers have participated in three IPCEIs (**Important Projects of Common European Interest**), which have made available over EUR 17 billion in state support for the development of hydrogen technologies.
- EU companies are at the **forefront of R&D** in fuel cell technology, which has allowed some European SMEs to be recognised internationally and receive substantial investment from global players in the sector.

EU VULNERABILITIES

- The widespread application of fuel cell technologies is constrained by the inclusion of **expensive and rare materials**, especially PGMs, to which European companies do not always have easy access.
- Fuel cell technologies are **not yet commercially mature** and EU companies are lagging behind Asian competitors, with only the Japanese Toyota and the Korean Hyundai having commercially viable fuel cell electric vehicles to date.
- Fuel cell-powered **vehicles are still very expensive** to manufacture and maintain. Without enough demand for fuel cell technologies (which in the EU is still very low), there is little flexibility to increase the stock of spare parts necessary for the maintenance of these vehicles.
- Because the technology is novel, there is **no harmonised framework** for the approval of on-the-road testing, which slows down the capacity for further production development and commercialisation of fuel cell vehicles.
- The **certification process** for fuel cell vehicles is very time-consuming and a source of delay in the execution of pilot projects and commercialisation.
- As long as fuel cell technologies remain high-cost, mobility-as-a-service firms (e.g. bus companies) will flock to the **cheaper alternatives**, such as electric buses.
- **Lack of workers** with the necessary skills and preparation to contribute to hydrogen technologies.



EXAMPLES OF POLICY MEASURES INTRODUCED TO ENHANCE OPEN STRATEGIC AUTONOMY

EU

- Three **IPCEIs on hydrogen** involving 35, 29 and 32 companies from 15, 13 and seven Member States, respectively, for a total funding of EUR 17.5 billion. Fuel cell companies are particularly involved in the first IPCEI (Hy2Tech) aimed at increasing efficiency and reducing costs of fuel cell stacks, adapting system behaviour for stationary and mobility applications, and testing and validation for different use cases aimed at scaling up production.
- 176 fuel cell EU-funded projects under the **Horizon programme** are SMEs (200 out of 848 participants), which participate in projects accounting for around 25% of the EU net contribution for fuel cell-related projects (EUR 215 million out of EUR 866 million).
- SMEs are involved in these projects particularly in two ways: contribution to R&D operations, and provisions of services for pilot tests on a small scale.

MEMBERS STATES

- 17 Member States offer **purchase subsidies** for fuel cell electric vehicles, whereas six more offer either tax or other **financial benefits**.

EXTRA-EU

- **South Korea**: the country has a 30+ year-old national strategy for the pursuit of fuel cell vehicle development, which has recently dove-tailed with the goal of reducing greenhouse gases emission by 40% by 2030, compared to 2018 levels. In early 2023, the South Korean government initiated a subsidy programme to stimulate demand. It will subsidise up to 16,000 new fuel cell vehicles (95% will be for personal transportation), for an estimated cost of around USD 300 million.
- **Japan**: in June 2023, the Japanese Ministry of Economy, Trade and Industry (METI) announced a revised hydrogen strategy that particularly to expand into overseas markets other than just developing the domestic market, thanks to a budget of around EUR 20 billion. Japan aims to promote fuel cell initiatives based on three pillars: (1) the industrialisation of the fuel cell business through support of business and the creation of demand clusters; (2) the establishment of strategies from a global perspective; and (3) the increase of demand in Japan in both the mobility and power segment and in the consumer sector (fuel cells for households).
- **USA** (federal level only): fuel cell vehicles are included in the tax credits for green vehicles within the scope of the Inflation Reduction Act (IRA), including battery electric vehicles.

POLICY RECOMMENDATIONS TO MAXIMISE SME OPPORTUNITIES AND REDUCE RISKS IN OPEN STRATEGIC AUTONOMY

National governments could provide **forums of networking** or create **production clusters** to help create synergies and reduce some of the high costs required for fuel cell stacking. This would in particular offer a protective shield against more vulnerable SMEs facing non-EU competition.

Local authorities could enter in **private-public partnerships** to help procure goods and services complementary to fuel cell technologies (e.g. refuelling stations, spare parts) in order to stimulate demand in those geographical areas that would be particularly apt to the diffusion of fuel cell technologies.

Highly skilled SMEs could provide **services for the certification** of fuel cells ensuring the quality of the technology and preventing the EU market from being flooded from cheaper non-EU products.

Highly innovative SMEs could also exploit the flexibility offered by fuel cell technologies to **explore alternative uses**, such as in construction and space exploration. National and local governments would help in these efforts by providing the necessary market intelligence and facilitating the networking of companies operating in different sectors.

Data sources:
Data on mining and refining capacity comes from the Raw Material Information System (https://rmis.jrc.ec.europa.eu/) and the 2023 JRC Report "Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study": https://publications.jrc.ec.europa.eu/repository/handle/JRC132889.
Data on the number and share of SMEs in the sector comes from Milda: https://milda.ai/
Data on fuel cell vehicles and Member State policies come from the European Hydrogen Observatory: https://observatory.clean-hydrogen.europa.eu/index.php/homepage
Data on fuel cell-related projects under the Horizon Programme come from: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/d58f3864-d519-4f9f-855e-c34f9860acdd/sheet/KVdtQ/state/analysis

Authors of the study: CSIL, IDEA Consult, PPMI, LSE Consulting – Trade Policy Hub.

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