



Refueling the car with hydrogen at a hydrogen fuel station

## Favorable Public Policies Drive Uptick in Patent Applications for Hydrogen Innovations

The new technologies being developed address hydrogen generation, storage, and distribution, as well as consumer products such as hydrogen-fueled vehicles and their specific components. In tandem, there has been a dramatic uptick in patent applications to protect these technologies and the considerable investments being made to create them.

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Hydrogen has emerged as a leader in the world's energy transition towards cleaner fuels. In the last five to 10 years, favorable shifts in public policy and regulations have not only encouraged significant new investments, but have also driven research and development, with large corporations, universities, government-sponsored labs, and many others focusing on developing hydrogen technologies.

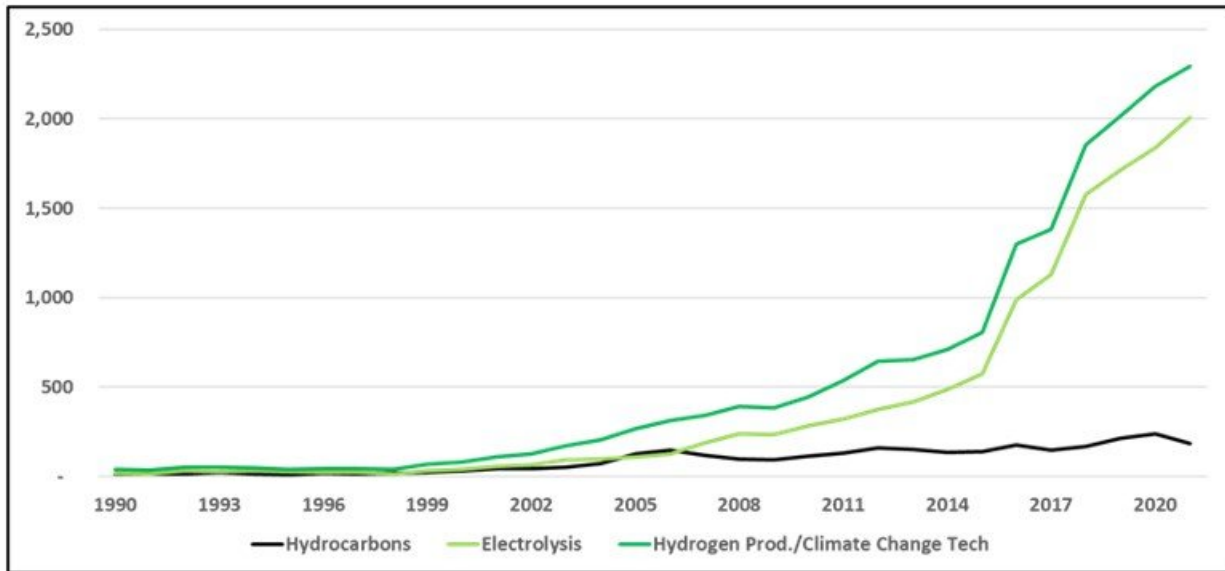
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Hydrogen Generation Patent Filings

The accompanying Chart 1, based on data from intellectual property research firm Techson IP Research (Techson), shows a sharp increase in the number of U.S. patent filings each year related to hydrogen generation from various sources. There has been a substantial increase in patent filings related to electrolysis (known as green hydrogen) and hydrogen generation using natural gas combined with advanced carbon capture technology to reduce emissions (known as blue hydrogen) in the

last 20 years as compared to traditional hydrocarbon-based (known as gray hydrogen) generation, which has remained somewhat flat.

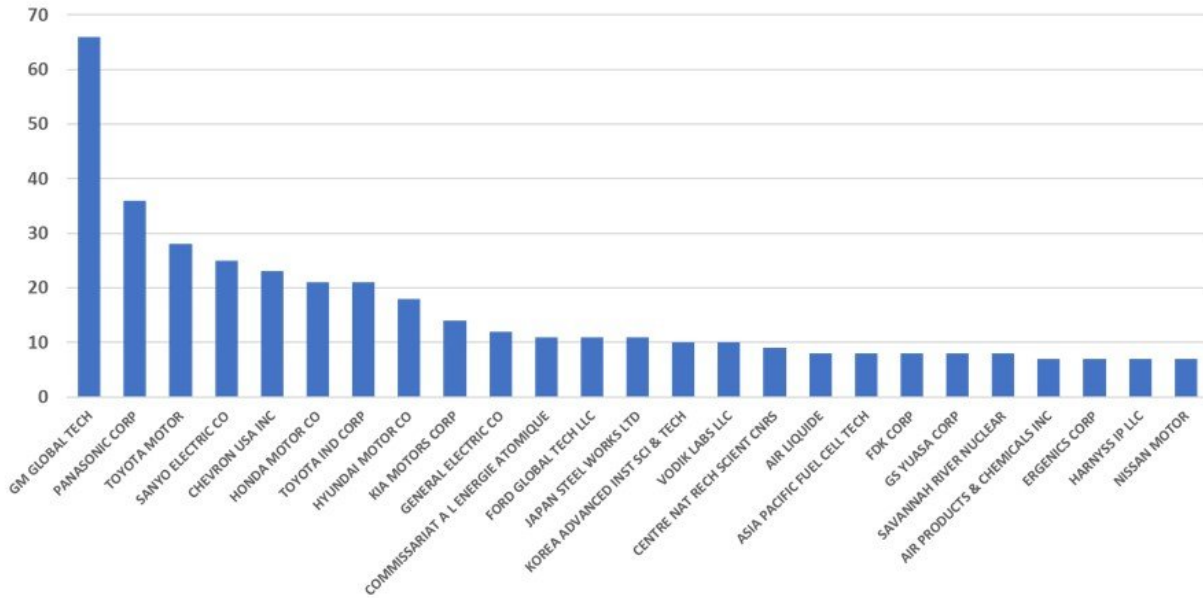
Chart 1



Besides patents for hydrogen generation, innovators are also coming up with technologies that facilitate the storage and distribution of hydrogen. This is critical, as hydrogen is difficult to store and transport, and is particularly important in the United States, where the large land area makes hydrogen storage and transportation challenging.

The accompanying Chart 2, based on data from Techson, shows the top 25 owners of U.S. patent families related to hydrogen storage and transportation.

Chart 2



Notably, the top owner is a single U.S. corporation having nearly double the amount of patent family assignments than the next owner, and the top 25 includes several other U.S. corporations. These trends suggest that, relatively speaking, the U.S. has focused more of its development attention in storage and transportation issues, based on data from the International Renewable Energy Agency (IRENA).

Hydrogen technology developers are also focusing on the consumption front, with the best-known example of this type of technology being vehicles that use fuel cell technology. The automotive sector is heavily invested in harnessing the power of hydrogen and data from Techson shows that the top five patent owners in this area are all in the automotive industry, as are many more of the top 25.

Intellectual Property Considerations for Hydrogen-Related Technologies

**Where should patents be filed?** The best countries in which to file for a patent will depend on a corporation’s individual business operations and the details of the specific invention, but the markets with substantial

activity related to a developer's invention are a good place to start. Innovators could also consider markets with key policy action supporting hydrogen, such as Europe, the United States, and Asia-Pacific nations. Hydrogen technology developers should also look at markets where other innovators who are developing similar technologies are filing their own patents. Potential patentees should also consider filing in markets where competitors are headquartered.

**What should I do to reduce risk of infringing patents of others?**

A company that has obtained patents on its own technology could be using practices or products that infringe upon other patents owned by others that are still in force. This is especially true where, as with hydrogen, the market is rapidly expanding and cutting across multiple industrial sectors.

Companies and other players entering the hydrogen market for the first time or introducing a new product or service should consider whether or not they should perform a freedom-to-operate study. This study provides a more comprehensive look at the patent landscape surrounding products and services that may not be captured in a prior art or patentability search. Specifically, this study looks for any patent rights that may be infringed by the intended use of your own products or services.

Freedom-to-operate may depend on broad, foundational patents that may not invalidate a patent, but that would necessarily be infringed in the process of practicing the patent. For example, a company may have a patent on a new electrolysis catalyst, but that catalyst must be used in a reactor with particular material separating the cathode and anode. If another company owned a patent on that separator, then use of the novel catalyst may require a license to the patent on the separator.

In the hydrogen space, freedom-to-operate also may depend on use of patents covering technology that is tangential to a company's own patents or products. For example, a novel fuel cell for use in automobiles will almost certainly require the use of transportation and storage infrastructure before it could be commercially viable. Automobiles would need a steady supply of hydrogen accessible across the country, a means of storing sufficient hydrogen to power the automobile's fuel cell, and a means of loading the hydrogen from the distribution/storage network onto the automobile. All of these interrelated areas are likely to have patents that may be infringed in the use of even a truly novel fuel cell technology.

**Do I need to consider taking a license on patents?** Once armed with a better understanding of other patents implicated by their own patents and products, innovators must decide how to approach licensing those other patents and how they might handle licensing their own patents to others. Again, this can be a decision that depends greatly on a company's individual business needs. Freely taking and granting reasonable licenses may promote the overall growth of the industry. On the other hand, being more selective in granting and taking licenses may lead to greater profits for the company.

Even companies that are not providing the relevant technology but instead are sourcing it from others must keep these issues in mind, since the threat of patent infringement could still be an obstacle to the success of their operations and investments. In partnering with others or investing in hydrogen related technologies, companies should thoroughly investigate whether their partners have the intellectual property rights needed to provide the technology they are offering without freedom-to-operate concerns.

There do not currently appear to be any hydrogen market standards for licensing. However, using hydrogen as a reliable fuel source for vehicles, for instance, may require substantial standardization of the industry. Thus, it may be in the industry's best interest to adopt licensing systems similar to what is seen in other industries to promote the stability of the industry as a whole.

One option widely used for standardized technologies in the telecom industry has been the guarantee of a fair, reasonable, and non-discriminatory (FRAND) license to any patent deemed a "standards essential" patent. Thus, an automobile maker would be able to obtain FRAND licenses to use particular storage systems and hydrogen delivery systems that were deemed the "standard" for the industry. Another common option is the possibility of a patent pool. In a patent pool, many leading companies may reach an agreement to cross-license their patent portfolios to one another. In this manner, the companies that are able to reach an agreement are able to use each other's patents freely, while still maintaining their right to exclude those who are not willing to share their own technology.

Neither of these options, nor any other standard licensing program, has been implemented to date in the hydrogen industry. But given the possibility of these, or something similar, being adopted in the future, it is important to keep them in mind when making business decisions around licensing and patent protection. Innovators should be diligent both in protecting their own innovations and monitoring the broader patent landscape in the hydrogen space to best position themselves to benefit from (and potentially influence the creation of) these types of programs if and when they emerge in the hydrogen industry.

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