Is hydrogen fuel efficient enough to replace fossil fuels in the near future?

Business

To cope with the current energy crisis, scientists are working vigorously to find alternative energy sources to supply current needs. As technology advances, the demands for energy continue to rise. Energy alternatives become increasingly important over time. However, to introduce an alternative source as a dominant energy supplier, that alternative source must be able to compete commercially with contemporary fossil fuels. One of the potential solutions for the energy crisis is burning hydrogen atoms to create thermochemical reactions that yield to a net output of electricity.

However, hydrogen fuel is not efficient enough to replace fossil fuels in the near fuel due to costly production methods, dangerous transportation, and installation difficulties. Since the introduction of hydrogen fuel as a potential solution for the world’s energy shortage, scientists have been trying to improve this technology in many ways. Many people support the hydrogen alternative because of its cleanliness. Its cycle is complete within itself; nothing is created or disposed. The result is simply a flow of electrons creating electricity (Crabtree and Dresselhaus 423).

However, according to the Government Accountability Office, in order to implement hydrogen fuel as a dominant energy source, billions of dollars must be spent to continue research and development to perfect this technology (Stoffer). One of the reasons that hydrogen fuel has made little progress over the last several years is that lawmakers voted to distribute the funds for the initiative to their home states’ universities and colleges instead of using the funds to construct a major project that concentrates on hydrogen fuel (Stoffer). Because the effort is diverged, not as much has been done. Even though the US Energy Department has declared that it will exert appropriate effort to make hydrogen-powered cars available commercially by 2015, this date has been postponed (Stoffer). With the current difficulties confronting the establishment of hydrogen fuel as a dominant energy supplier, its potential of replacing fossil fuels in the near future becomes very feeble.

Many of the prominent problems with hydrogen fuel come from the different methods of hydrogen extraction. The US Department of Energy (DOE) states that there are still major advances to be achieved to perfect the technology of hydrogen production and storage (Hydrogen 14). The Department reports that they need to be able to obtain hydrogen to be used as fuel with a cost equivalent to fossil fuels'. They also need to be able to develop technologies that could be used to help carry hydrogen fuels on vehicles through a distance of at least 482. 8 km (Hydrogen 14). There are different methods to produce hydrogen atoms for usage.

However, each method presents drawbacks that prevent hydrogen fuel from becoming commercially consumed. Producing hydrogen from natural gas is not beneficial because such processes will result in similar environmental impacts as the use of fossil fuels (Hydrogen 17). Extracting hydrogen from natural gas would be detrimental because such isolation would result in CO2 emission (Zyga). The only methods to produce hydrogen without CO2 emissions are to use renewable energy sources, at least until scientists succeed in encapsulating CO2 from the fossil fuels in the process of hydrogen extraction (Sanders). The challenges in hydrogen production require major scientific breakthroughs to overcome, resulting in the delay of its market. The efficiency of hydrogen production truly limits its popularity in the global market.

Ulf Bossel, an expert on alternative fuels, states that the process of hydrogen production, storage, delivery, and actual operation allows the final energy output of around ? of the energy input (Zyga). Not only does the process of hydrogen extractions require energy, the hydrogen fuel produced has to, in turn, complete with that energy commercially (Zyga). In comparison, the cost for electricity from hydrogen fuel is much higher than from contemporary sources. For instance, every kWh produced by a phosphoric acid fuel cell costs about 19 cents while the same amount of electricity could be obtained for only about 12 cents from current fossil fuel sources (Welander 61-62). Another problem encountering the production of hydrogen fuel is the impurity in the fuel, which can disrupt the operational capabilities of fuel cells (Hydrogen 20).

Even though extracting hydrogen using non-fossil fuels seems promising, this technology requires major improvements to the cells' catalyst to reduce energy loss and cost (Crabtree and Dresselhaus 421). It is impossible to get back the energy put in through hydrogen fuel (Crabtree and Dresselhaus 423). Therefore, the future of hydrogen fuel majorly rests upon the improvements made on its efficiency. Another major concern about hydrogen fuel is its dangerous transportation. The transportation of hydrogen is dangerous because leakage can easily occur due to the diffusion nature of hydrogen at the gaseous state (Hydrogen 19). Leakages are difficult to detect due to the properties of hydrogen (Behar 114).

To make hydrogen fuel commercially available, its delivery must be as convenient and secure as gasoline's (Hydrogen 19). DOE officials have reported that current methods of storage will not meet the demands of a hydrogen economy (Hydrogen 18). In order for hydrogen fuel to replace fossil fuels, vehicles must be able to carry enough fuel to power them through the range of at least 482. 8 km. However, such advances must not replace passenger's room and cargo (Hydrogen 17).

In addition, the transportation of hydrogen will release more CO2 emissions. For instance, the release of CO2 from hydrogen production from natural gas is even more than the current rate of emission (Behar 113). The risks associated with hydrogen transportation are detrimental to hydrogen fuel because they accumulate more cost to the overall process to create electricity, making it unappealing to the public. As an attempt to overcome the difficulties with hydrogen transportation, scientists introduced alternative approaches to safely carry transportation between two locations, but these solutions come with a price too high to compromise. For instance, scientists of DOE also suggest trapping hydrogen atoms in compounds and releasing them for usage as a method of storage.

However, such method requires the development of nanotechnology centers to perform the adsorption and release when necessary (Hydrogen 19). When comparing mass, hydrogen is three times more efficient than gasoline, but when comparing volume, its efficiency is only a quarter of gasoline's (Hydrogen 17). Liquefying hydrogen allows more hydrogen to be stored per volume. However, such a method presents the risk of losing hydrogen because of evaporation (Hydrogen 18). The current level of possible hydrogen compression is barely half the amount of hydrogen needed to establish a hydrogen economy (Hydrogen 18). For safety purposes, compressed hydrogen liquid must be allowed to evaporate in storage thus result in a net loss of about ? of the fuel in 14 days (Zyga).

Future methods of hydrogen storage must not apply high pressures and temperatures (Hydrogen 18). Another transportation option is using pipelines. Even though transporting hydrogen using pipelines is more efficient, this method is dangerous because variation in temperatures can cause damage to the pipes resulting in leakage (Hydrogen 20). In addition, when transporting hydrogen fuel, it becomes necessary to construct delivery and pumping facilities. The delivery centers for hydrogen fuel require a complete operation to process hydrogen from production to delivery (Hydrogen 19). The Department of Energy has to introduce hydrogen fuel pump stations for travelers to refill their hydrogen fuel.

However, currently, scientists are not even close to such developments (Hydrogen 17). Not until scientists can introduce a successful transportation method that does not require additional costs will hydrogen fuel become more attractive commercially. The future of hydrogen fuel is even more unsound when one considers the slow developments in the last few decades. Currently, the realization of using hydrogen fuel to replace fossil fuel is still in the realm of science fiction because hydrogen fuel technologies still require major improvements (Welander 60-61). An official of the Department of Energy, Jerry Hinkle, states that the Bush Administration has cut spending on hydrogen research and development to focus on the war effort. The budget on hydrogen research for 2009 is only about ? of the money allowed by the 2005 legislation (Stoffer).

By 2030, an amount of 600 Megatons per year of hydrogen would become necessary to run all cars and small trucks globally. However, only about 8% of that is currently produced (Crabtree and Dresselhaus 422). Furthermore, 50% of the bases of hydrogen fuel installations are in North America. These bases could produce about 100 MW. However, one coal-fired plant could produce 6 times more than that (Welander 62). According to Bossel, the energy one can obtain from hydrogen is no more than 30% of what is put in, while efficient batteries can have an output of more than 80% (Zyga).

To reduce greenhouse gases, scientists need to concentrate on developments that could reduce CO2 emissions from power plants instead of from cars (Sanders). Also, mass production of cars will not reduce cost, according to Patrick Davis, former official of the Department of Energy (Behar 116). Therefore, speculating from past progress, it seems very unlikely that hydrogen fuel will obtain a firm marketing foundation in the near future. The last stage of the process to produce electricity from hydrogen requires installation of fuel cells. Yet, this stage of the process presents more problems.

One of the many disadvantages of hydrogen fuel cell is that once the processes are fully shut off, it could take more than a couple hours to restart them again (Welander 62). Many types of fuel cell have drawbacks. For instance, even though phosphoric acid fuel cells are capable of starting quickly, they are the least efficient type of fuel cells. Meanwhile, molten carbonate fuel cells are more efficient, but they do not last very long because of high operating temperatures (Welander 63). On the other hand, solid oxide fuel cells require special shielding to maintain the performance at about 1000oC (Welander 63).

Contemporary fuel cells cost about 100 times more than fossil fuel engines. Even with significant improvements, the cost would only fall down to approximately 90 times (Crabtree and Dresselhaus 421). Consequently, these problems further decrease the potentiality of hydrogen fuel. Major problems associated with hydrogen fuel restrict its capability to replace fossil fuels. Hydrogen production is inefficient, expensive, and potentially hazardous.

Storage is a major weakness of hydrogen fuel because little amounts of fuel occupy large storage rooms. In order to store hydrogen safely, scientists can only, however, compress it to a certain degree. Yet, the compression limit is not enough for hydrogen fuel to compete in the global market. In addition, hydrogen transportation is dangerous because leakage could easily occur. Besides the danger associated with transportation, facilities to deliver and pump hydrogen fuel must be built, requiring an additional major cost. Therefore, with major difficulties, the establishment of hydrogen fuel as a dominant energy source is far away in the future.

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