Hydrogen From Nuclear Power

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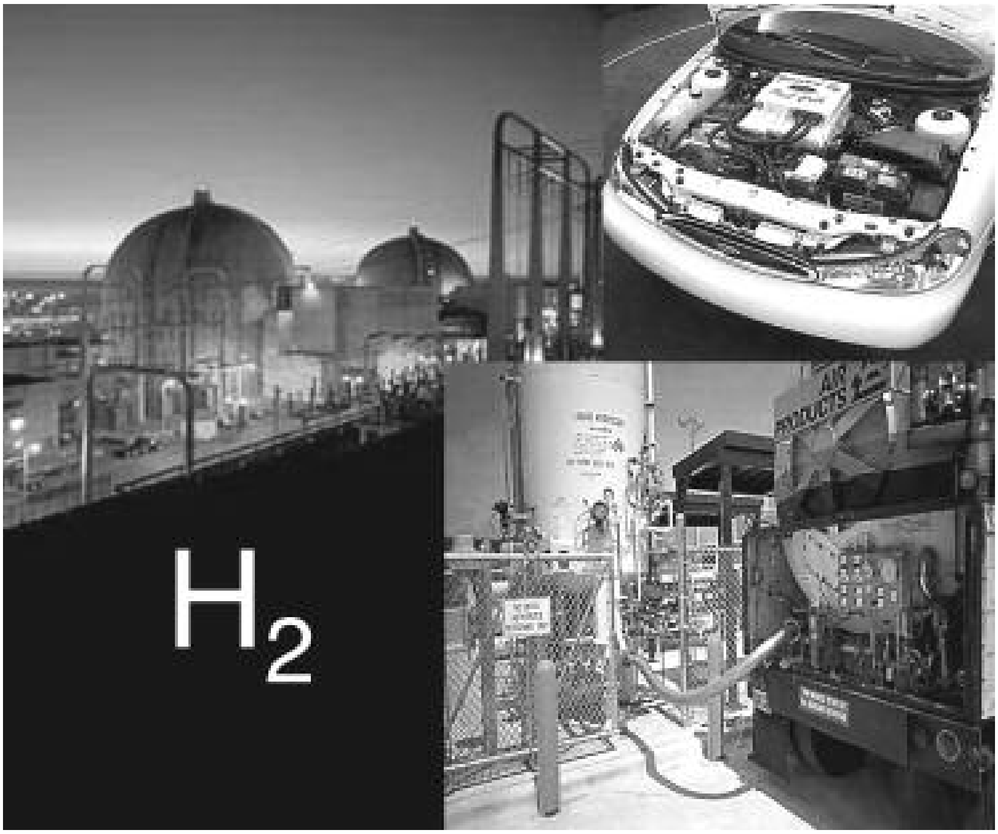

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Nuclear energy will produce the hydrogen needed for the fuel of the future. Here, a hybrid car and a hydrogen tank filling up.

The Age of Coal and Oil is giving way to the Age of Hydrogen. An international expert in nuclear technology examines the necessary role of nuclear power in ushering in this new era.

The energy sources we use for industrial and consumer purposes are called *energy carriers*. These are sources of energy which are derived from primary energy sources. Gasoline and electricity are familiar examples of energy carriers (Figure 1). After electricity, hydrogen is one of the most promising energy carriers for the future, because hydrogen is not only clean and efficient, but also storable. Essentially, water is the only emission when hydrogen is used.

The chemical energy of hydrogen can be converted to power most efficiently by a device known as a fuel cell. Combustion of hydrogen, as in an engine, could also be used for obtaining power. Hydrogen is easier to store than electricity, but hydrocarbons, especially liquid fuels, are much easier to store than hydrogen.

Hydrogen is the most abundant element in the universe. However it does not normally exist on Earth as a gas (H_2), but is rather found in the form of chemical compounds. It is most often found combined with oxygen in water (H_2O). It is also found combined with carbon in the various hydrocarbons. Examples include the gas methane (CH_4), which is the principal component of natural gas; the heavier liquid hydrocarbons which make up petroleum; and coal. To produce H_2 from compounds, it is necessary to use energy to break the chemical bonds which hold the hydrogen.

Hydrogen gas can be obtained from fossil fuels (hydrocarbons) by the steam reforming process. There are drawbacks to production processes using fossil fuels, however. Not only are resource reserves of fossil fuels limited, but as environmental regulations intensify in the future, it will be necessary to take measures, such as carbon capture and storage, or sequestration, to reduce CO_2 emissions. As for renewable energies like wind and solar, they are inherently dilute, so their hydrogen production capacity is naturally limited.

The merits of using nuclear energy for hydrogen production are that there is no CO_2 emission, a sustainable bulk supply capability, and a high energy density, facilitating energy security. These advantages also apply to using nuclear energy for electricity generation.

About one-third of the world's primary energy is converted to electricity at present. The remaining two-thirds are consumed in such non-electric applications as process-heat for industry, space heating, and transportation. Although the ratio of electricity will likely increase to about one-half at the end of the 21st Century, that still leaves one-half of the world's primary energy being used for non-electric purposes. As it is essential to reduce the global use of fossil fuels, it is important to explore the feasibility of nuclear energy replacing fossil fuels as the power source for non-electric applications. The most promising and realistic way to fulfill this need is to use nuclear energy to produce hydrogen, an excellent energy carrier.