

Japan Reaches Goal of Zero Reliance on Fossil and Nuclear Fuels

January 1, 2055. The world celebrated today when Japan, one of the world's largest economic powers, announced they had achieved their goal of zero reliance on fossil fuels or nuclear energy. It proved that even a country as densely populated as Japan could attain energy independence from using such fuels. The move toward independence from these energy sources was due to the recognition, and determined efforts, of industries and governments that this accomplishment would meet a trifecta of economic, environmental, and political goals. Without reliance on fuels being delivered by others, industries became unlinked from rises or changes in prices or abundances of fuels, making their products economically more consistently competitive. In the absence of the use of fossil fuels, net carbon dioxide emissions could be avoided, and thus, Japan would no longer be a contributor to climate change. With independence from nuclear fuels, Japan avoided the need for handling nuclear fuels or finding safe disposal sites for nuclear waste, and thus, they were assured that accidents such as the one that occurred at the Fukushima Daiichi nuclear power plant in 2011 (that contaminated soil and water in that area for generations) would never occur again. International politics were also easier as there was no longer the need to consider impacts on energy in discussions with nations previously supplying these fuels.

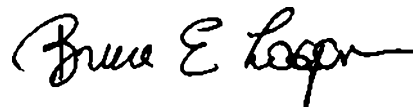
Research and technologies for renewable energy have been highly supported for decades in Japan, leading to unprecedented advances in methods for energy production, conversion, storage, and transport. The development of solar panels based on inexpensive perovskites (materials with a CaTiO_3 crystal structure) meant that every building, car, and surface facing the sun could contribute in some way to energy production. Solar energy became efficiently stored in supercapacitors during the day and released for use at night. New technologies were developed to convert waste heat from industrial processes into electricity. The sea was used to generate power using off-shore tidal, wind, and solar farms. The energy produced at these sites was captured as either electrical power or hydrogen gas. The advantage of generating hydrogen gas was that it could be transported over long distances and then used at high energy conversion efficiencies. Compressed gas was conveyed to the islands through pipelines buried in the ocean, which permitted safe transmission over the long distances needed to get the fuel from the sources to consumers.

While technological developments were important, it was social and political factors that finally allowed energy independence. The most important step in this process was government insurance of renewable energy capital expenses, as it allowed companies make large capital investments in technologies that had a long payback period. Such government support had successfully launched new energy technologies before, motivating Japan to try this for renewable energy technologies. For example, the early growth and success of the nuclear industries in the United States was largely due to government insurance against nuclear accidents. Such guarantees, as well as governmental assistance in dealing with nuclear waste (which to this day is not solved), were key factors in moving that industry

forward. In Japan, the key was governmental guarantees on loans for companies that installed solar systems in homes, so that these sites could generate electricity where it was needed, rather than at centralized facilities. Homeowners bought the electricity, but they did not have to individually purchase, own, and maintain their units as the company (via government support) assumed responsibility and financial risks for the equipment.

The development of a hydrogen economy in Japan was stimulated by industrial investments, such as the production of automobiles capable of efficiently running on hydrogen fuels. Back in 2015, Toyota released the first commercial hydrogen vehicle for purchase by consumers. While the price for the car was initially about double that of a gas-fueled vehicle, it had a range comparable to that of combustion fuel vehicles, and it could be refueled in minutes compared to the hours required for electric vehicles. Japan created corridors of refueling stations that allowed these vehicles to be easily refueled in major metropolitan areas, which eventually led to their expansion into all parts of the country. While the rewards of a hydrogen economy had been known for decades even back in 2015, no other country had been willing to insure companies that constructed the distribution pipelines and fueling stations. In a time when payback on industrial investment was needed within 3 years, the hydrogen economy was always at least 5–10 years away from making a profit, and therefore, it was considered to be an unsafe investment. The financial guarantee of the Japanese government in their 10-year H_2 Plan allowed a successful transition that required decades for replacement of existing combustion engine vehicles with fuel cell vehicles. Other countries are following Japan's lead, with China allowing only fuel cell vehicles in their major cities, such as Beijing and Shanghai, leading to visible improvements in air quality.

Japan created something that other countries still only dream about: energy independence. We have to wonder why no other countries had the foresight to invest and develop these renewable energy technologies and build this type of energy infrastructure. Other nations have now lost an enormous business opportunity in selling energy technologies, as Japan is clearly the market leader in sustainable and renewable energy technologies that are the only viable choice for a carbon-neutral energy future.



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Notes

Views expressed in this editorial are those of the author and not necessarily the views of the ACS.

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