A Rebrand Breathes Life Into Cold Fusion Research in Japan

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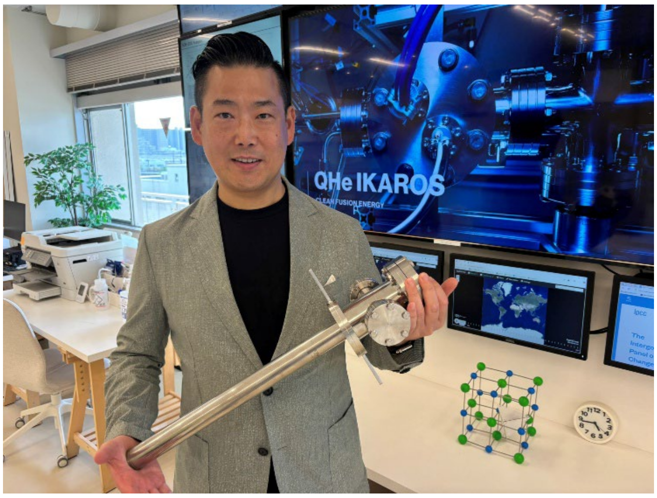
The massive earthquake and nuclear disaster that struck Japan in March 2011 had profound implications for the island nation, kickstarting the country's investment in renewables, raising questions about the future of nuclear energy and thrusting energy security into the spotlight. The seismic shift proved both personal and life-altering to Hideki Yoshino.

For Yoshino, the founder and former chairman of English language school Gaba Corp., the Fukushima disaster proved a fulcrum, spurring his interest in pioneering new sources of clean energy.

Fukushima would lead Yoshino back to Japan after several years abroad and down the path of cold fusion, a science considered fringe by some but one that still sparks research interest and funding. The US Department of Energy, for example, announced $10 million for eight cold fusion projects in 2023, one of which is based at the Massachusetts Institute of Technology.

"I felt I couldn't just sit back and wait for other people to make things happen," Yoshino said in an interview with BloombergNEF. "That's when I came home and started to get reconnected with friends. I felt clean energy was what was really needed."



Hideki Yoshino, chief executive officer of Clean Planet Inc., in a photo taken from the startup's Kawasaki labs.

The story of cold fusion, re-labeled in recent times as Low Energy Nuclear Reactions or LENR, is fraught. Cold fusion refers to a type of nuclear reaction able to take place at or near room temperature. The term burst into the spotlight in 1989 when University of Utah electrochemists Martin Fleishmann and Stanley Pons reported that they had produced excess heat from a tabletop experiment involving the electrolysis of heavy water on the surface of a palladium electrode. Moreover, they said, their experiment produced the byproducts of a nuclear reaction.

A media frenzy followed, fueled by excitement around the prospect that an abundant, clean and cheap source of energy was at hand. Scientists around the world rushed to reproduce the results, but failed. Since that first burst of enthusiasm and subsequent disappointment, cold fusion research largely lay dormant, though a small cadre of researchers around the world has continued to investigate the potential.

Hokkaido focus

In Japan, enthusiasm seems highest in Hokkaido, mostly through the work of Tadahiko Mizuno, a former professor at Hokkaido National University's Department of Nuclear Engineering and author of Nuclear Transmutation: The Reality of Cold Fusion. It was Mizuno's research, and especially his book, that inspired Yoshino to dive deeper into the field.

Following Fukushima, Yoshino had returned to Japan, intent on reconnecting with his network of friends and business associates in hopes of tapping a larger braintrust who shared his deep concern about the future — and the potential of clean energy.

Already, Yoshino had a general awareness and understanding of cold fusion through Star Scientific, an Australian company in which he had become an investor after his sale of Gaba. It was through Star Scientific that Yoshino was introduced to Mizuno's work.

Inspired, Yoshino says he decided to dive deeper into the technology. At the same time, he was meeting almost nightly with his network in Japan. The goal: crack the problem of clean, sustainable and cheap energy.

“We got together almost every night after work over dinner discussing how we could turn the situation around,” Yoshino said. “We felt we had to visit some scientists to ask about the situation, especially about cold fusion. I already knew that the technology existed and that it had been discredited and forgotten.”

What followed was a dance of sorts, with Yoshino courting Mizuno, eventually convincing the professor to work with him. Momentum built, with Yoshino's efforts attracting the attention of other scientists from Tohoku University and eventually from corporate interests like Mitsubishi Heavy Industries Inc. In 2012, in the early post-Fukushima days, Yoshino formed Clean Planet Inc. with the aim of developing a CO_2-free fusion energy source.

A lab worker monitors a reactor operating in a clean room at Clean Planet's Kawasaki location.

Conventional fusion versus cold fusion

Though similar in name, cold fusion or LENR and what's generally considered to be fusion energy research differ in key respects. Conventional research into fusion is focused on replicating the intense heat and fusing of two light atomic nuclei like hydrogen that occurs inside a star — but on Earth. That kind of fusion, dominated by heavily government-funded research projects and a profusion in recent years of private research, revolves around the development of huge fusion reactors.

Cold fusion is altogether different. Most researchers theorize that cold fusion produces heat by way of a nuclear process involving the fusing together of deuterium nuclei that have been absorbed into a metal lattice like palladium. The fusing of the deuterium nuclei, so the theory goes, converts some of the mass of the nuclei into energy.

The key difference between conventional fusion and cold fusion is that the latter occurs near room temperature.

With a plethora of cold fusion research in hand — and the support of academics like Mizuno and, later, Tohoku University emeritus professor Jirohta Kasagi — and building off the various theories of why the technology produces excess heat, Yoshino and his team set to work examining the different permutations of metals and structures that were able to produce heat.

The 1989 announcement by Fleischmann and Pons on cold fusion was a strong influence on the direction of research undertaken by Kasagi, who is now part of the engineering leaders team at Clean Planet and has focused his career on understanding the principles behind low-energy nuclear reactions.

“The importance of clean energy has provided another push to do the kinds of experiments that we’ve been doing,” says Kasagi.

For Clean Planet, the result is a tube-like reactor of sorts that runs on something the company calls quantum hydrogen energy (QHE), Yoshino says.

Quantum hydrogen energy

QHE, Yoshino says, works by placing a nano-sized nickel-based composite material in a chamber infused with hydrogen. A vacuum is created inside the chamber and heat is passed through the nano material. An excess amount of heat is eventually generated by way of a mechanism that the company now terms solid state fusion. Once the reaction is started, the heat used to power the initial reaction can be turned off. Excess heat can be stored and used to power the startup of other reactors.

At the moment, Clean Planet has been able to stack 22 sheets of the nickel-based composite into a narrow tube, Yoshino says. It is this tube that is infused with the hydrogen and in which the vacuum is created.

The company currently has 119 patents granted in 23 countries. According to fusion patent ranking, it is number one in solid state fusion, Clean Planet says.

A Clean Planet reactor module.

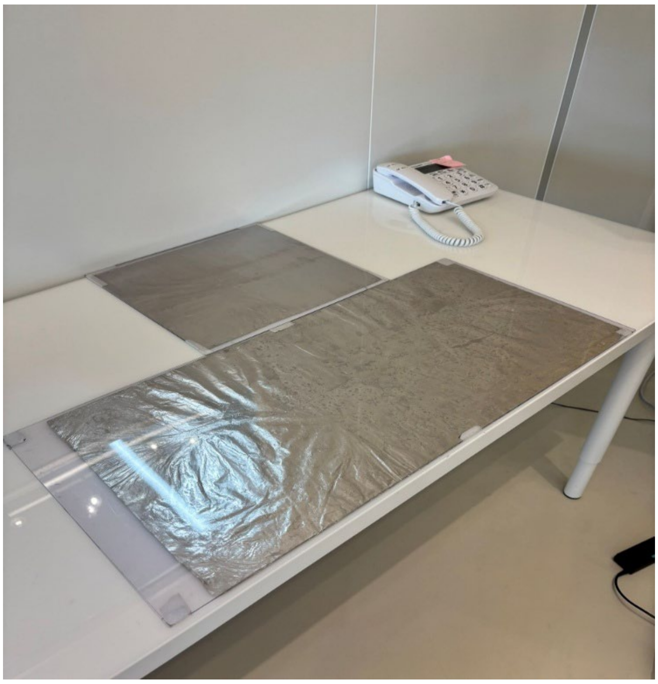
The goal is to stock 900 sheets in a reactor much bigger than what has already been achieved. Theoretically, Yoshino says, as many as 10,000 sheets could be stacked. Eventually, Clean Planet wants to develop heat modules for the industrial, commecial, transportation and residential sectors.

“The limit would be that if it gets too hot, it will break some of the parts (of the reactor) and other things like gaskets and the heater itself so we try not to exceed 1,400 structures. That’s where the nickel would start to melt.”

Thus far, Clean Planet says it has completed the basic research phase, showing that its technology can generate heat. How much heat is the key. Clean Planet says QHE’s heat density per gram of fuel is much higher than that of chemical reactions such as methane and hydrogen combustion.

Partnerships with several major companies have followed, including with Mitsubishi Estate and Miura Co., a manufacturer of industrial boilers. Earlier this year, Clean Planet received a 1 billon yen ($6.7 million) grant from the Tokyo Metropolitan Government to commercialize its low-temperature nuclear fusion technology.

“If proven commercially viable, QHe-based heat modules could disrupt large-scale industries,” Umer Sadiq, a Tokyo-based analyst with BNEF, said, though LENR remains a largely unverified field as significant hurdles remain before commercialization. The development is, nonethless, worth monitoring as part of the wider fusion and alternative clean energy ecosystem, Sadiq said.



Clean Planet uses a nickel copper composite material infused in the reactor with hydrogen.

On a recent visit to Clean Planet’s lab in Kawasaki City, Yoshino displayed a reactor a little less than a meter long. In one experiment described on its website, Clean Planet says that excess heat had been observed for almost 600 days, with hydrogen saturation needed only at the beginning of the experiment.

“It takes about half an hour to get the system going and less than an hour before it stabilizes,” Yoshino said.

The goal, Clean Planet says, is to produce a commercial product in the next few years. The grant from the Tokyo Metropolitan Government will be used to build a production line to help boost production of the nickel-based material used in the company’s reactors.

“There are so many people who are trying to legitimize cold fusion but we need to go beyond that and make it available for people, otherwise it’s of no use,” Yoshino says. “We’d like to attract potential manufacturing partners but before we can do that we have to convince them to make an investment.”

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