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Meet the “Phi Suea House” of Chiang Mai: the world’s first residence powered entirely by hydrogen and 100% solar energy

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“Hydrogen gas” is a term that may stir up both positive and negative associations for some people. On the positive side, it is being used as an alternative energy source to reduce reliance on fossil fuels that emit greenhouse gases. On the negative side, hydrogen has been linked to disasters in the past, such as the 2019 leak and explosion of a hydrogen tank at a Nel facility in Norway, which raised concerns about hydrogen safety.

Furthermore, high costs and limited infrastructure remain issues that keep hydrogen from becoming widely adopted as an alternative energy source.

But amid these many obstacles, there is a place in Chiang Mai Province that has been pioneering the use of hydrogen for more than 10 years.

That place is "Phi Suea House" (Butterfly House), a residence that has transformed the way energy is used and proven to everyone that green hydrogen, produced from sunlight, can play an important role as a sustainable and reliable alternative energy source.

"How does 'Phi Suea House' (Butterfly House) do it, and how far can green hydrogen go as an alternative energy source for Thailand's future?"

Phi Suea House, the world's first residence powered by green hydrogen

Before talking about Phi Suea House, let's get to know green hydrogen, which is one of three main types of hydrogen. The other two are grey hydrogen and blue hydrogen. Both are produced using fossil fuels, but blue hydrogen involves a process that captures carbon and stores it underground.

The latest data reported by the International Energy Agency (IEA) shows that in 2023, less than 0.1% of all hydrogen produced was green hydrogen, which illustrates the challenges that remain in building up this clean energy source.

Phi Suea House is a residential project that began in 2015 and generates 100% of its own energy through a combination of hydrogen and solar power.

The key technology that allows green hydrogen to play a central role in powering the house is the electrolyzer. It uses excess solar energy to split water (H_2O) into hydrogen, which is then produced,

stored, and used as energy when sunlight is insufficient. This allows the house to generate its own energy and emit no carbon that harms the environment, since green hydrogen comes from solar power.

Electrolyzer for separating hydrogen from water

The system inside Phi Suea House includes a 384 kilowatt-hour (kWh) battery. When hydrogen and the battery are used together, the house can store enough energy to operate for at least 7 days during seasons with little sunlight and prolonged cloud cover.

"Phi Suea House is a concrete example of using technology to create a truly zero-carbon living environment, through the use of solar energy and hydrogen storage," said Sebastian-Justus Schmidt, owner of Phi Suea House and founder of Enapter, a manufacturer of electrolyzers.

Sebastian-Justus Schmidt, owner of Phi Suea House and founder of Enapter

However, although the Phi Suea House project is in line with Thailand's goals of achieving carbon neutrality by 2050 and net-zero greenhouse gas emissions by 2065, the widespread adoption of green hydrogen as an alternative energy source remains a challenge.

This is because production costs are still high, and the infrastructure to support it is currently limited.

Thailand's Potential for Green Hydrogen

Adopting green hydrogen as an energy source requires a large upfront investment, which may not be worthwhile from the perspective of some operators who still have access to fossil fuels or coal at significantly lower prices.

As mentioned above, green hydrogen can be produced by electrolyzers. However, the device, manufactured by Enapter, costs 400,000 baht per unit and produces 1 kilogram of hydrogen per day, which, put simply, is enough electricity to power an average home for half a day (or throughout the night).

Thanai Phothisat, Country Director for Thailand at Enapter, gave a rough cost estimate, saying that a house may need 2 electrolyzers, and including the installation of other systems, the cost would rise to around 1 million baht, which is not a small amount.

In addition, the legal framework to support this form of energy is still in its early stages. A report from the Ministry of Energy states that the short term (2020-2030) is a period of preparation, involving pilot projects, investment support, studies of new business models, import/export plans, testing of storage and transport systems, and the development of safety standards for production and use.

But in remote locations such as islands, investing in infrastructure to produce green hydrogen paired with solar power is a cost-effective option. Some islands are not connected to a power plant and must rely on oil-powered generators, which cost more than 3 times as much as green hydrogen.
As for the issue of price, although it is still expensive today, Thanai said this will not last forever. Support for clean energy is trending upward, and more efficient technology will eventually bring usage costs down.

In addition, experts and clean energy advocates who visited Phi Suea House point out that those who view fossil fuels as a cheap source of energy are overlooking the environmental and public health impacts. If the transition is not accelerated and the issue is neglected, the price of fixing the resulting problems may exceed the investment needed to shift the energy system to sustainable sources.

An estimate from the University of Oxford indicates that replacing fossil fuels with zero-emission energy could save the world as much as 12 trillion US dollars (411 trillion baht), a figure comparable to the combined value of the world's four largest companies: Apple, NVIDIA, Microsoft, and Google.
"In my view, green hydrogen is one of the energy sources of the future. Although the initial costs are high, the long-term benefits are equally high, and greater than the cost of environmental remediation that we would have to pay if we fail to adapt," Sebastian added.

As for Thailand, hydrogen experts believe that green hydrogen is something the country should prioritize urgently, and that its use should be promoted more than it is today.

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สรสิช ลีลานุกิจ. (2025, January 22). รู้จัก 'บ้านผีเสื้อ' แห่งเชียงใหม่ บ้านพักอาศัยแรกบนโลกที่หล่อเลี้ยงตัวเองด้วยไฮโดรเจนและโซลาร์ *100%* [Get to know the Butterfly House of Chiang Mai, the world's first home powered entirely by hydrogen and solar]. THE STANDARD. https://thestandard.co/wealth-in-depth-butterfly-house-chiangmai/