Advanced Core for Energetics, Hiroshima University Vol. 87

HU-ACE NEWS LETTER

Advanced Core for Energetics, Hiroshima University

Vol. 87
2024.3

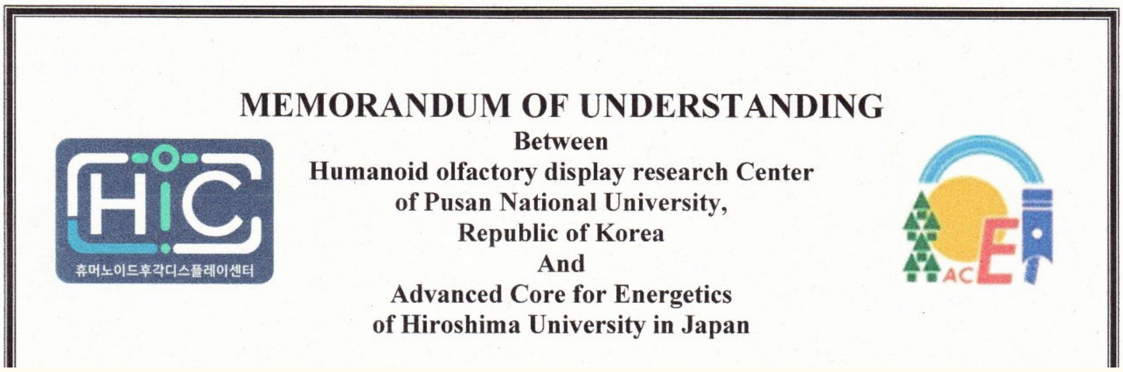
Activities of the Core

Mar. 7, 2024	The 28th Hiroshima University Biomass Project Center Symposium (co-organized by HU-ACE)
Mar. 11, 2024	The 13th Hiroshima University Biomass Premium Evening Seminar (co-organized by HU-ACE)
Mar. 14, 2024	The 89th HU-ACE Steering Committee Meeting

HU-ACE Signs MOU with Humanoid Olfactory Display Research Center, Pusan National University, Republic of Korea.

On February 28, 2024, the Advanced Core for Energetics, Hiroshima University (HU-ACE), signed an MOU on research activities between our center and the Humanoid Olfactory Display Research Center of Pusan National University.

Pusan University's Humanoid Olfactory Display Research Center has been conducting advanced research on olfactory display technology development, and this MOU was realized after discussing an inter-center agreement to further develop research on issues such as the development of new sensors in the energy field. We are looking forward to further research and educational exchanges in the future.



MEMORANDUM OF UNDERSTANDING
Between
Humanoid olfactory display research Center
of Pusan National University,
Republic of Korea
And
Advanced Core for Energetics
of Hiroshima University in Japan

Related Events

The 8th International Symposium on Fuels and Energy (ISFE2024) is scheduled on July 1-2, 2024.
Details can be found here. https://symposium2024.isfe.hiroshima-u.ac.jp/

We have constructed a roadmap for the development of energy utilization technologies leading up to 2050 and an integration scenario called the "Hiroshima Scenario". Please feel free to share your thoughts with us.
https://hu-ace.hiroshima-u.ac.jp/wp/wp-content/uploads/2022/10/220921-brochure.pdf

Research consultation and joint research are welcome.

Issued by Advanced Core for Energetics, Hiroshima University
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Research Topics

No. 50

Techno-Economic Assessment for an Energy System to Achieve a Balance between Producing Less Expensive CO2-Free Hydrogen and Positioning Renewable Energy as the Main Power Source

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Research fields: Energy Policy, Social Science
Keywords: Hydrogen, Carbon-Recycling, TEA (Techno-Economic Assessment)

Abstract

Background

In order to realize a decarbonized society, the expectation for “CO2-free” hydrogen has been growing. Hydrogen is promising in the transportation sector as well as the power generation sector, industrial sector, and household sector. In the process of carbon-recycling, hydrogen is necessary to produce chemicals and fuels.

To realize the target production cost of CO2-free hydrogen indicated by the state, which is ¥20-30 /Nm3 (¥170 as of today), we analyzed how to achieve both the productin of such hydrogen in a less expensive way as well as putting renewable energy as the main power source.

Methods

We propose cutting-off the power from photovoltaics at a certain level and dividing it into “High-Value Power(HVP)” and “Low-Value Power (LVP)”. The former means stable, available power at a high probability for purchasers (i.e., grid operators), and at the same time, it mitigates the burden of capacity of varying the output of thermal power generators to respond to power demand.

The latter means fluctuant, uncertain power, making it difficult for purchasers to balance power supply-demand. Then we sell the former at a high price and use provide the latter to produce hydrogen by smoothing such fluctuant output by battery as shown in Fig. 1.

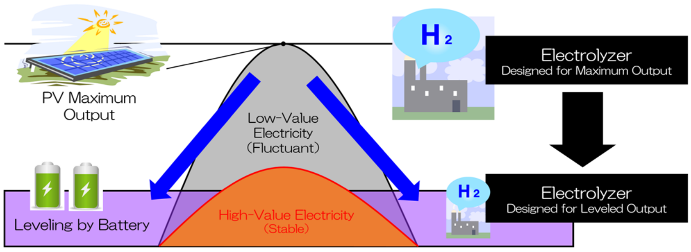

Fig.1 High-Value Power and Low-Value Power (Conception)

Results

We simulated using solar radiation data in Higashi-Hiroshima City, Japan, under the model comprised of PV and power-leveling by battery. If we cut off at 25% of the peak generation every month, we could obtain high-value power 50.6% among the total PV generation in a year. Meanwhile, the capacity factor of the electrolyzer raised from 25.0% to 73.0%, tripled the amount of H2, and reduced the production cost of H2 to ¥24.2/Nm3 under the assumption LVP and HVP are ¥7/kWh and ¥12/kWh, respectively. This cost would accomplish the target price during for 2030-50 set by the Japanese government, and meanwhile, showed the prospect of how to put renewable energy as the main power source, avoiding high dependence on the adjustment of the utility grid.

Cutoff Level			25%	20%	15%
Allocation of electricity		High-value electricity (kWh)	652.1	547.7	432.1
		Low-value electricity (kWh)	637.3	741.7	857.4
		Ratio of Low-value electricity	49.4%	57.5%	66.5%
Installed Capacity		Electrolyzer (kW)	0.073	0.085	0.098
		Battery (kWh)	1.746	2.032	2.349
Cost (per year)		Electrolyzer (Yen)	181.9	211.7	244.7
		Battery (Yen)	873.1	1,016.1	1,174.5
H2 production	Without battery	Electricity for electrolyzer (kWh)	159.0	210.3	268.6
		Capacity factor of electrolyzer	25.0%	28.3%	31.3%
		Amount of H2 production(Nm3)	31.8	42.1	53.7
		Cost of H2 (Yen/Nm3)	**43.5**	**63.4**	**76.0**
	With battery	Electricity for electrolyzer (kWh)	465.1	559.8	666.1
		Capacity factor of electrolyzer	73.0%	75.5%	77.7%
		Amount of H2 production(Nm3)	93.0	112.0	133.2
		Cost of H2 (Yen/Nm3)	**24.2**	**32.9**	**39.5**

Table 1 Calculation for H2 production cost