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The 10th IEEJ/APERC International Energy Symposium
-Ideals and Reality in the Global Energy Landscape under Growing Uncertainties-

Session 2 “Strategies to Bridge the Gap between Ideals and Reality”

Where do we place our ideal goal and how do we bridge the gap with it?

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● Basic Hydrogen Strategy (2023)

●Volume as a Target

- 2030: 3Mil ton-H2/y
- 2040: 12Mil ton-H2/y
- 2050: 20Mil ton-H2/y

- 1$=140Yen
- 1kg-H2=11.2Nm3-H2
- 1Yen/kg-H2=1/11.2 Yen/Nm3-H2
  =0.089Yen/Nm3-H2
- 10.89MJ/Nm3-H2(LHV)
- 14.17MJ/Nm3-NH3(LHV)

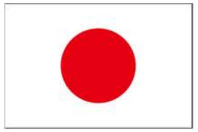
●Cost as a Target

- 2030: 30Yen/Nm3-H2 (336Yen/kg-H2, 2.4$/kg-H2)
- 2050: 20Yen/Nm3-H2 (224Yen/kg-H2, 1.6$/kg-H2)

- 2030: 23Yen/Nm3-NH3 (18Yen/Nm3-H2) (＊)e.g. : LHV base, “in the upper 10yen range”

Source: METI(2023) https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/pdf/20230606_3.pdf
Source: METI(2023) https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/pdf/20230606_5.pdf

Reality as Fact (1)



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- **Volume as Fact**
  Domestic supply(including NH3): 2Mil ton-H2/year (2023)
- **Cost as Fact**
  100Yen/Nm3-H2@Hydrogen Station (1,120 Yen/kg-H2, 8.0$/kg-H2)

Source METI(2023) https://www.meti.go.jp/shingikai/enecho/shoene_shinene/suiso_seisaku/pdf/20230104_1.pdf

(*2)METI-HP(2024) xxx

Reality as Fact (2)

Green Hydrogen Trial Transactions Publication of Bidding Results Prices

(1)Unit price bid by supply side

Bidding Category	Number of Bidders	Bid Unit Price
Common for each course	1 bidder	300Yen/Nm3-H2 (3,360Yen/kg-H2, 24$/kg-H2)

(2)Unit price bid by user side

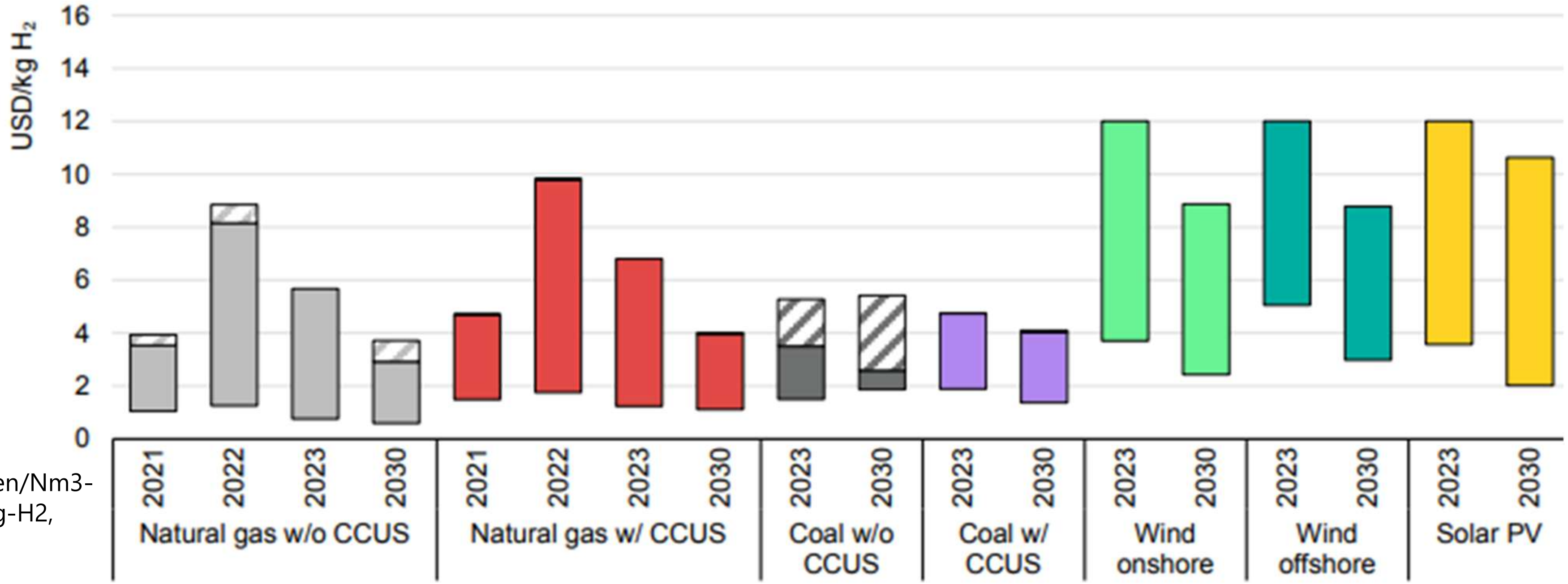
Bidding Category	Number of Bidders	Bid Unit Price
1) Trailer Transportation course	2 parties	89Yen/Nm3-H2 (996.8Yen/kg-H2, 7.1$/kg-H2)
2) Cardle transportation course	2 parties	230Yen/Nm3-H2 (2,576Yen/kg-H2, 18.4 $/kg-H2)

Source Tokyo Met Gov(2024) https://www.metro.tokyo.lg.jp/information/press/2024/12/2024122316

Reality as Fact (3)

- **Production Cost : Hydrogen (2023)**

Figure 3.11 Hydrogen production cost by pathway, 2023, and in the Net Zero Emissions by 2050 Scenario, 2030



Ref 2030: 30Yen/Nm3-H2 (336Yen/kg-H2, **2.4$/kg-H2**)

Source IEA(2024) https://www.iea.org/reports/global-hydrogen-review-2024

Gaps compared to 2030 are the current targets

- **Gap as volume: 1Mil ton-H2**

⇒ to create opportunities/projects for more 1Mil ton-H2

- **Gap as price: -70 Yen/Nm3-H2 (-784Yen/kg-H2, -5.6 $/kg-H2)**

⇒ to reduce CAPEX and OPEX in the range of -70Yen/m3-H2

- **Gap as production method from renewable energy: -2～-1$/kg-H2**

⇒ to reduce CAPEX and OPEX by 1-2$/kg-H2 for solar and wind case

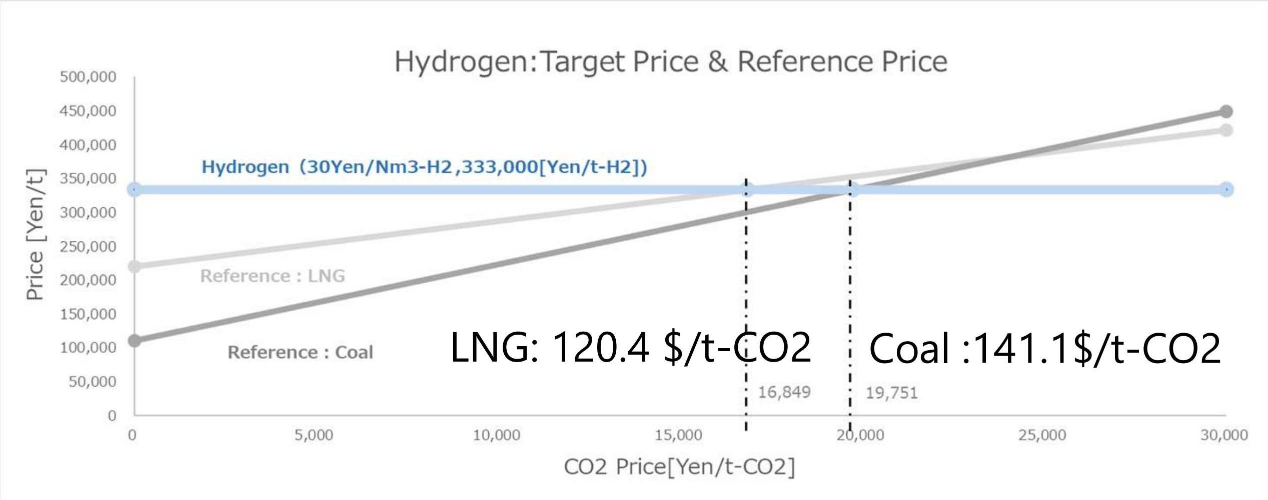
Ref:2030: 30Yen/Nm3-H2 (336Yen/kg-H2, **2.4$/kg-H2**)

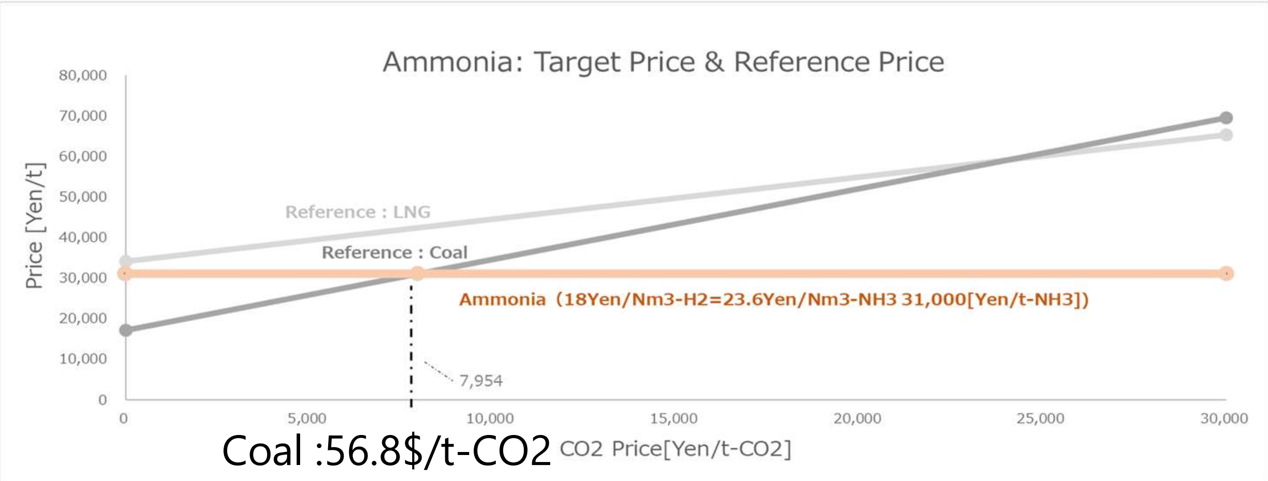
What is the solution?

Gap	Potential Solution
1.Volume	● Demand creation(in particular, development in the HtA sector) ● J-CfD ● Regulation (for example, aviation, shipping) ● (Large volume) Effective use of low carbon hydrogen/ammonia
2.Price	● Subsidy (short term) ● J-CfD ● Regulation (carbon price/tax) ● Effective use of low carbon hydrogen/ammonia ● Technology Development
3.Production method	● Infrastructure development (transmission and distribution system considering renewable energy derived electricity) ● Technology Development

What is the impact of introducing a carbon price?

Calculated using the respective CIF prices and CO2 emission factors for LNG and coal.





Estimated conditions :
H2 30Yen/Nm3(2030): 333,000Yen/t-H2 (2,379$/t-H2)
NH3 23Yen/Nm3(2030):31,000Yen/t-NH3(221.4$/t-NH3)
LNG CIF(2024):91,186Yen/t-LNG (651.3$/t-LNG)
Coal CIF(2024):22,800Yen/t-Coal (162.9$/t-Coal)
CO2 Emission Factor of LNG: 2.79t-CO2/t-LNG
CO2 Emission Factor of Coal: 2.33t-CO2/t-Coal

How does the impact of carbon price look from the power plant?

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Comparison of 1 GW power plants

Fuel	Efficiency(%)	Required Calorific Value (GWh)	Required Fuel(ton)	Fuel Cost($)	CO2 Emission(ton)	CO2 Price ($/t-CO2)
Coal	40	20,000	2,903,226	472,811,060	6,764,516	119
LNG(CCGT)	50	16,000	1,156,627	808,197,452	3,226,988	146
H2(gas turbine)	45	17,778	533,333	1,280,000,000	0	-
NH3(100%)	38	21,053	4,074,703	902,255,639	0	-

- Target Price of H2 :30Yen/m3-H3 (2.4$/t-H2)(2030)
- CO2 Price of Coal : 16,660Yen/t-CO2 (119$/t-CO2) (2024)
- CO2 Price of LNG : 20,440Yen/t-CO2 (146 $/t-CO2) (2024)

My message

At present, the gap is three points as follows.

- **Gap as volume: 1Mil ton-H2**

⇒ to create opportunities/projects for more 1Mil ton-H2

- **Gap as price: -70 Yen/Nm3-H2 (-784Yen/kg-H2, -5.6 $/kg-H2)**

⇒ to reduce CAPEX and OPEX in the range of -70Yen/m3-H2

- **Gap as production method from renewable energy: -2～-1$/kg-H2**

⇒ to reduce CAPEX and OPEX by 1-2$/kg-H2 for solar and wind case

Solutions to these are as follows.

- **Demand Creation(Subsidy, J-CfD)**
- **Effective use of low carbon hydrogen/ammonia**
- **Technology Development**
- **Regulation (for example, carbon tax/price)**