



An Update on the Open Hydrogen Initiative and Introduction to GeoFuels

Global Syngas Technologies Conference

October 8, 2024



OHI Stakeholders

OHI Leadership



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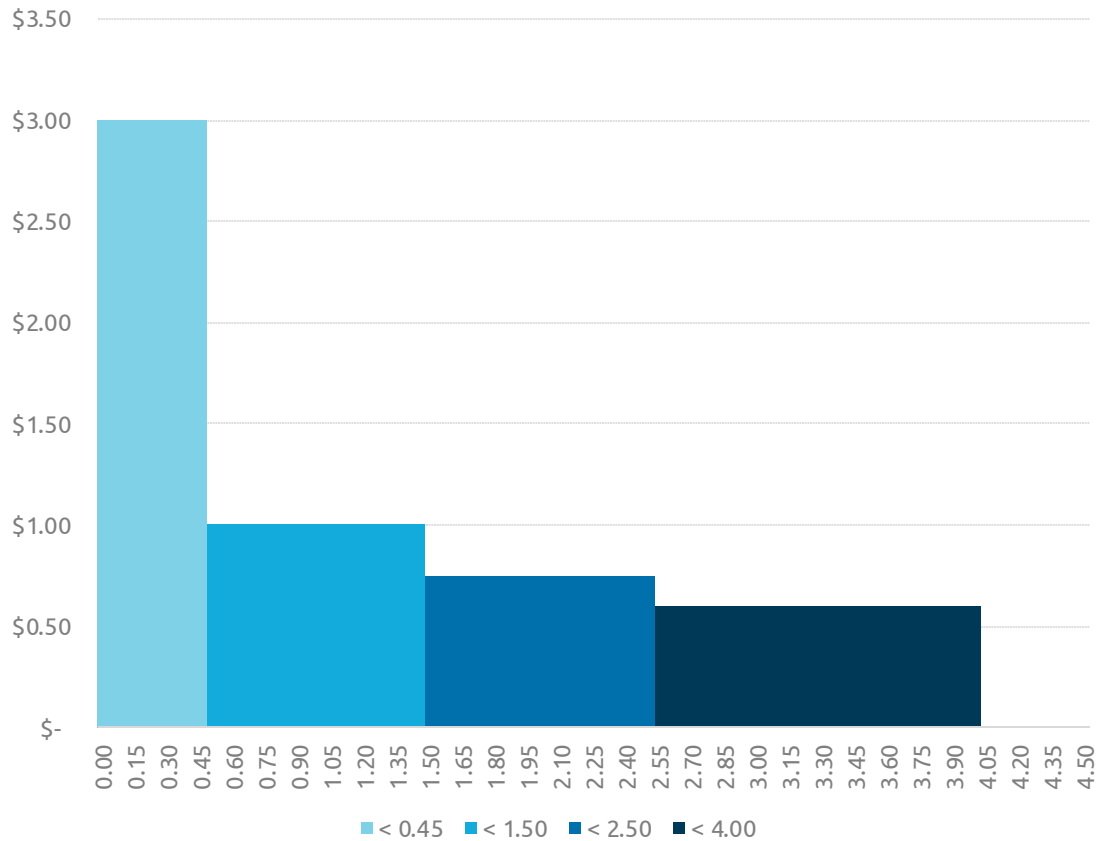


There is a lot at stake for hydrogen producers in the US

Producers can get either Section 45Q (CCUS) or 45V (Clean Hydrogen) tax credits, not both

From last year's GSTC

45V Production Tax Credits at Varying CI's



Example: Retrofit of SMR producing 100,000 Nm³/h or 9 metric tons of hydrogen per hour

CI Score	45V Tax Credit	Annual PTC
< 0.45	\$3.00/kg	\$237mn
< 1.50	\$1.00/kg	\$79mn
< 2.50	\$0.75/kg	\$59mn
< 4.00	\$0.60/kg	\$47mn

Or...
\$60 mn annually from 45Q tax credits with a 90% carbon capture rate

Part of the challenge is that the currently proposed regulatory framework does not fully capture options the producers have access to which reduces the CI of their production processes.

Problem: There is no current model that can capture carbon intensity accurately at the plant level.

Congress left important IRA policy details to the Department of Treasury

The GREET model is specifically referenced, but lacks the necessary adjustments for site specificity

From last year's
GSTC

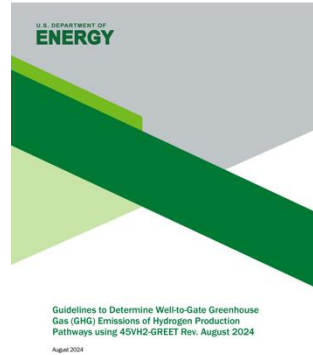
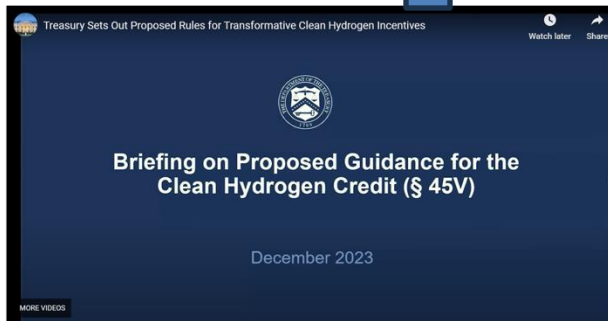
§45V(3c1B)

“GREET MODEL.—The term ‘lifecycle greenhouse gas emissions’ shall only include emissions through the point of production (well-to-gate), as determined under the most recent Greenhouse gases, Regulated Emissions, and Energy use in Transportation model (commonly referred to as the ‘GREET model’) developed by Argonne National Laboratory, **or a successor model (as determined by the Secretary [of Treasury]).**”



December 22 Notice of Proposed Rulemaking “Christmas Present”

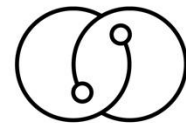
“Three Pillars” policy was announced. 45VH2-GREET announced, which still lacks the necessary adjustments for site specificity



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Verified by a third party “qualified verifier”*



OPEN **HYDROGEN** INITIATIVE



- Completed annually, retrospectively
- Many significant variables are treated as “background variables”
- Not consistent with international standards
- Provision Emissions Request (PER) can be requested, post FEED, for technologies not reflected in GREET

- Open Source, and continually updated
- Compatible with international norms and best practices: ISO, IPHE
- Not a “standard” in itself but a toolkit that uses site-specific data and ISO standards
- CI and Data Quality Index calculated at any desired frequency

*Proposed § 1.45V–5(h) would define the term “qualified verifier” to mean any individual or organization with active accreditation (i) as a validation and verification body from the American National Standards Institute National Accreditation Board; or (ii) as a verifier, lead verifier, or verification body under the California Air Resources Board Low Carbon Fuel Standard program.

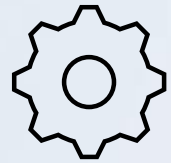
OPEN HYDROGEN INITIATIVE

Phase II Priorities: Overview



OPEN **HYDROGEN** INITIATIVE

INTEGRATION



Improved Technical Solutions

- ❖ *Ammonia, H2 Transportation, Public Comment Period, Ongoing Updates*



Market Infrastructure

- ❖ *H2 Environmental Attribute Cert. (EACs), Standardized Contracts, Pricing & Certification Support*

EDUCATION



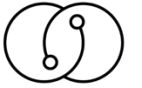
Awareness & Education

- ❖ *45V, Global Standardization, LCA-specific Policy Support, Sharing of Best Practices*



Industry Engagement

- ❖ *OHI Stakeholder Meetings, Industry Workshops, Coalition Growth, H₂Hubs*



Comparison of Selected Hydrogen Pathways using the OHI Model

	Unabated SMR		Unabated ATR		Methane Pyrolysis NG	SMR-RNG
	SMR	SMR-90%	ATR	ATR - 94%	Process Heat	
Hydrogen Production	9.92	1.09	9.33	0.52	1.47	9.92
Upstream Electricity	0.00	0.00	1.39	1.71	0.00	0.00
Upstream Natural Gas	1.59	1.75	1.65	1.65	2.11	0.00
Upstream Renewable Natural Gas	0.00	0.00	0.00	0.00	0.00	-20.75
Carbon Management	0.00	0.13	0.00	0.11	0.00	0.00
Co-product Management	-0.52	-0.02	0.00	0.00	-9.63	-0.52
Total	10.99	2.94	12.37	4.00	-6.05	-11.35

Lesson learned: The provenance of your power and your feedstock makes a huge difference.

Congress of the United States

Washington, DC 20515

September 11, 2024

The Honorable Janet Yellen
Secretary
U.S. Department of the Treasury
1500 Pennsylvania Avenue NW
Washington, D.C. 20220

The Honorable Michael Regan
Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue NW Washington,
D.C. 20460

The Honorable Jennifer Granholm
Secretary
U.S. Department of Energy
1000 Independence Ave SW
Washington, D.C. 20585

John Podesta
Senior Advisor to the President for Clean
Energy Innovation and Implementation
The White House
1600 Pennsylvania Ave NW



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Renewable Natural Gas and Fugitive Methane Emissions

. In particular, Treasury **should not allow captured methane** to be considered greenhouse-gas-negative; such a rule would enable relatively small amounts of captured methane to offset the emissions of SMR hydrogen enough to qualify for the full \$3/kg tax credit, making it effectively free to produce. In this same vein, **book-and-claim accounting—that is, allowing methane captured in one location to be credited as an offset in another—would allow gaming of the tax ...**

- **Accurate Upstream Methane Emissions** While industry has proposed that hydrogen producers should be able to self-report user specific methane figures, there is no robust verification system in place to validate these figures. **Company-reported data from the Greenhouse Gas Reduction Program Subpart W already show significant under-reporting of methane emissions, when compared with observed satellite measurements. Producers should not be allowed to elect between using national methane emissions rates and their own site-specific rate**

Treasury's strong proposed rules demonstrated a commitment to evidence-based policy, and we urge Treasury to maintain this rigor as it finalizes the regulations. Just as we agree that it is important to get clean hydrogen right, we agree that no tax credit is worth compromising our commitment to tackling the climate crisis by pursuing scientific emissions reduction targets.

Sincerely,

 Sheldon Whitehouse United States Senator	 Jamie Raskin Member of Congress	 Emanuel Cleaver, II Member of Congress	 Mark Takano Member of Congress
 Jeffery M. Merkley United States Senator	 Donald S. Bevilacqua Member of Congress	 Mark DeSaulnier Member of Congress	 Henry C. "Tim" Johnson, II Member of Congress
 Edward J. Markey United States Senator	 Devin Munnah Member of Congress	 Shri Thanedar Member of Congress	 Rik Meek Member of Congress
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 Elissa Loomis Norton Member of Congress	 Rashida Tlaib Member of Congress	 Marcell Frawley Member of Congress	 Juan P. Lujan Member of Congress
 Sheldahl Cortez-McCormick Member of Congress	 Paul M. Gohmert Member of Congress	 Cori Bush Member of Congress	 Chris Van Hollen United States Senator
 James P. McGovern Member of Congress	 Sheila J. Lee Member of Congress	 Bonnie Wilentz Coleman Member of Congress	 Yvette D. Clarke Member of Congress
 Adriano Espaillat Member of Congress	 Alma S. Adams, Ph.D Member of Congress	 Bernard Sanders United States Senator	 Elizabeth Warren United States Senator
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 Jay Chabrowsky Member of Congress	 David J. Tracey Member of Congress	 Brittany Perdomo Member of Congress	 Cory A. Booker United States Senator
 Lloyd Doggett Member of Congress	 Sean Casten Member of Congress	 Valerie P. Foushee Member of Congress	 Ilhan Omar Member of Congress
 Kevin Mullin Member of Congress	 Suzanne Bonamici Member of Congress	 Kathy Castor Member of Congress	 Deborah K. Ross Member of Congress
 Jim Hensley Member of Congress	 Julia Brownley Member of Congress	 Becca Baltutis Member of Congress	 Bennie G. Thompson Member of Congress
 Nydia M. Velázquez Member of Congress	 Nancy Diaz Barragan Member of Congress	 Robert C. "Bobby" Latta Member of Congress	 Peter Welch United States Senator

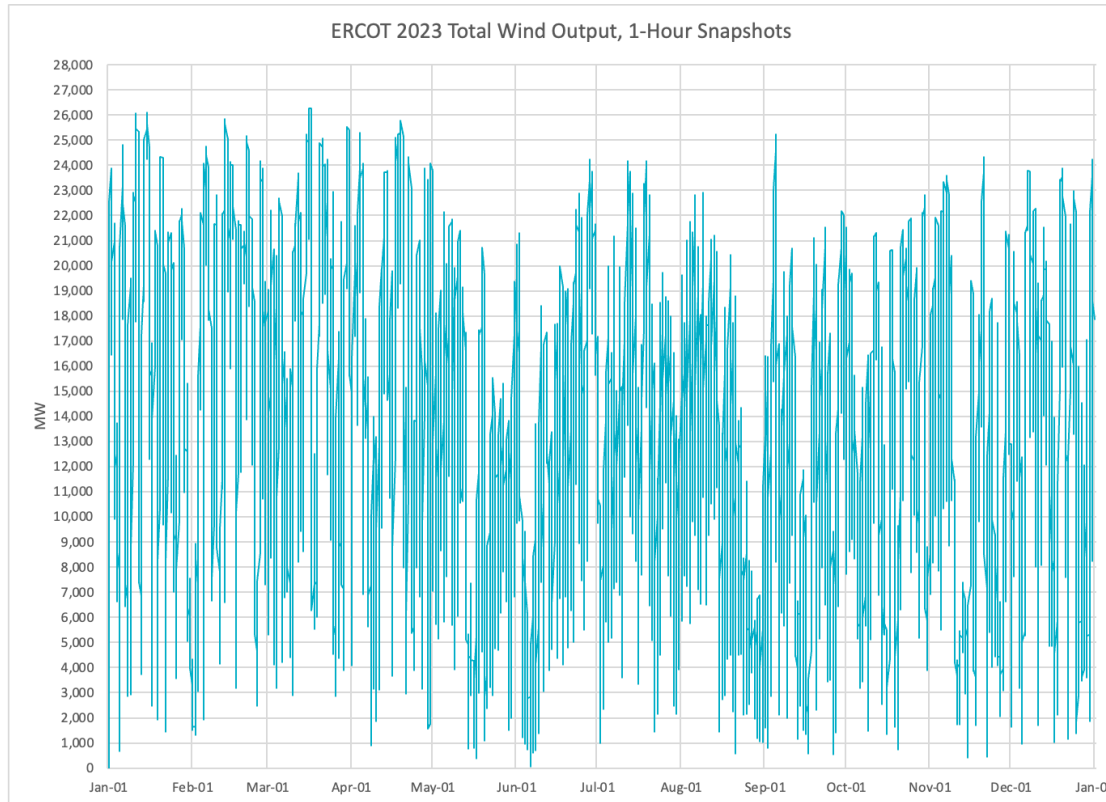
Introducing a
new concept in
clean energy

geofuels

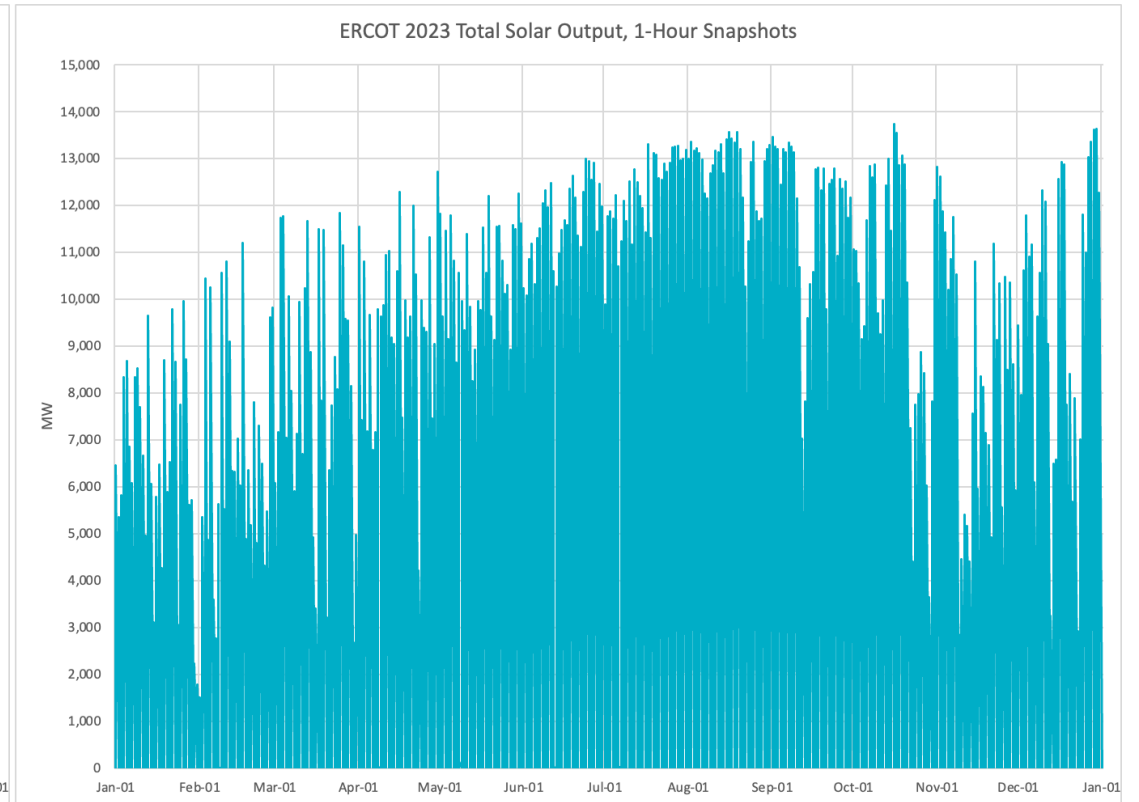
leveraging geothermal energy
to create sustainable fuels

Wind and Solar are Great Resources, but not for H2 Production

There are significant intraday and seasonal variations in output



Wind: Annual **33%** Capacity Factor



Solar: Annual **22%** Capacity Factor

“Green” electrolytic hydrogen producers using renewables must build a combination **~3.5-4x the capacity of their electrolyzers** to be balanced on an annual basis. Hourly matching will require newer electrolysis technologies or storage

LevelTen Energy's Market-Averaged Continental Index (Q2 2024)



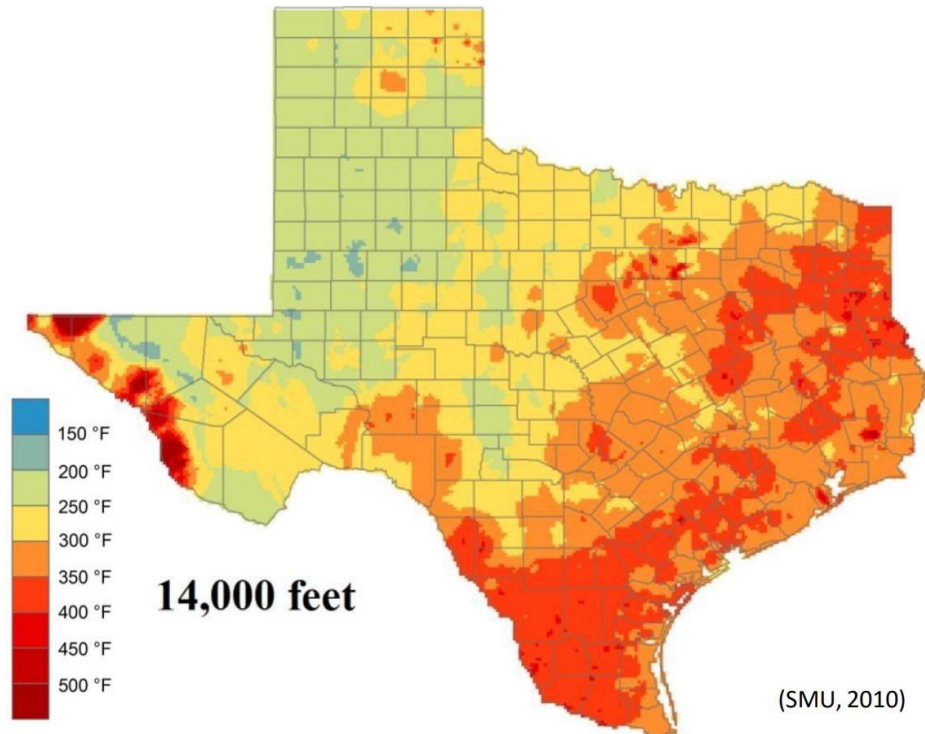
Between 2010-2020 the cost of renewable energy dropped significantly.

Post 2020, costs have increased due to:

- Supply chain disruptions
- Raw material costs
- Labor costs
- Inflation
- Interest rates
- Increased demand

The Gulf Coast is well-positioned to utilize sedimentary geothermal energy

This provides an opportunity for inside the fence power development of baseload renewable energy



A skid-mounted Turboden 20MW organic rankine cycle generator. Founded in 1980, Turboden has been part of Mitsubishi Heavy Industries since 2013. The company is headquartered in Brescia, Italy, and operates additional facilities in Germany, Russia, and Turkey.

+ There are significant levels of **associated methane and CO2** in the brine as well

Methane pyrolysis beats electrolysis when natural gas is available



Alkaline Electrolysis	Methane Pyrolysis
Power: 53 kwh/kg	Power: 9.2 kwh/kg
Hight purity water: 17 kg/kg H2	Methane: 4.1 kg/kg
\$3.19/kg H2	\$0.98/kg H2
Assumptions: renewable power is \$60/MWh, free water, no variable O&M, Natural gas = \$2.00/MMBTU, no carbon co-product value	

Carbon Co-Products make a difference to project economics

 ModernHydrogen



low-CO2 paving materials

menolith



Carbon black

hycamite

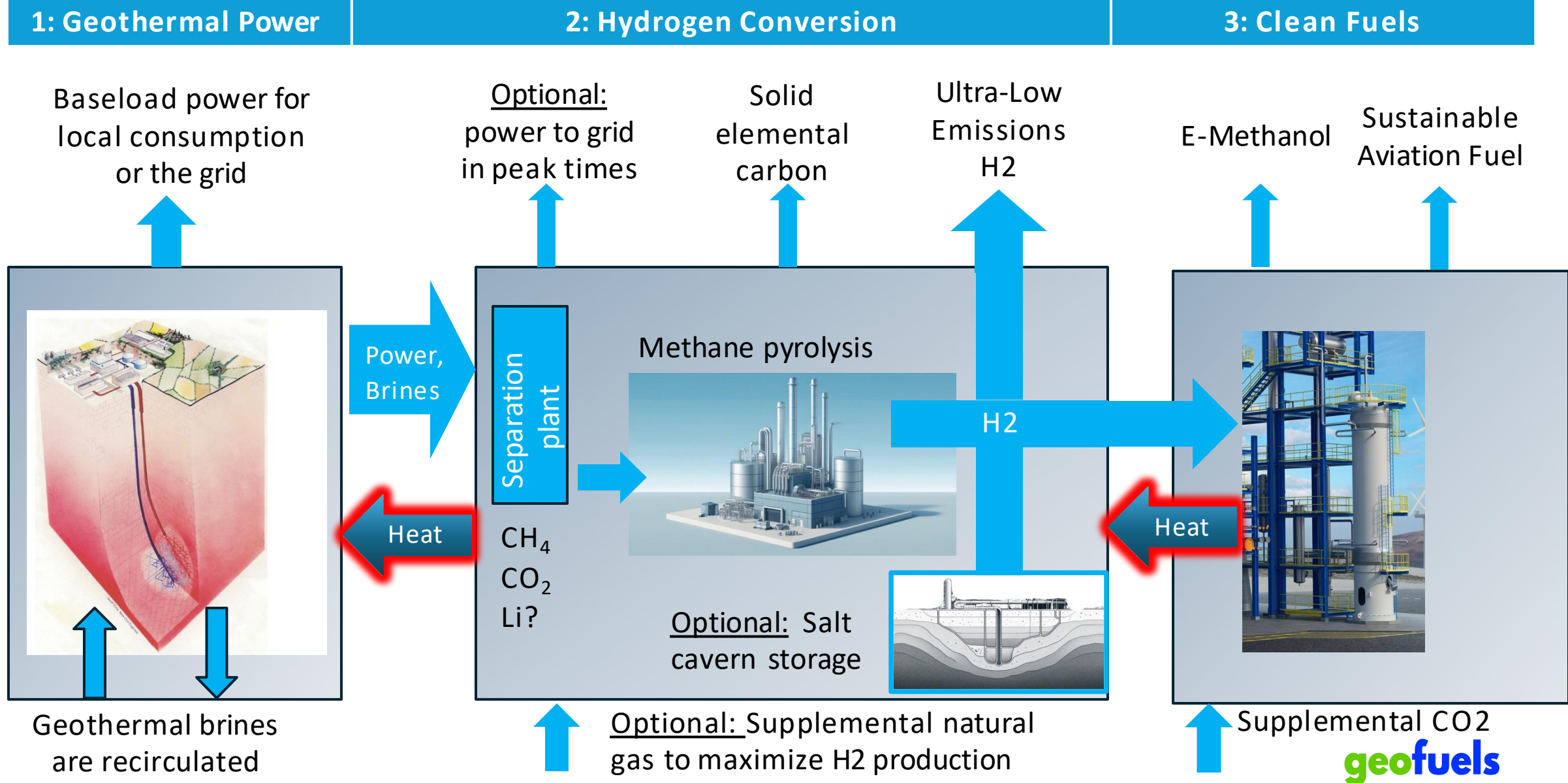


Graphite for lithium batteries

Hycamite Opened Customer Sampling Facility on Sep 5th in Kokkola, Finland



By vertically integrating across the value chain, we maximize the value of this energy by sending it to the markets that value it the most





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