Golu-Hydrogen Technologies Inc.

gölu-H_2

SBI Group of Companies

gölu-H_2

2021 gölu-H_2 **Golu Hydrogen Technologies Inc.**

To Commercialized Renewable Hydrogen Technologies

2009 **SBI BioEnergy Inc.**

To Commercialized Renewable Liquid Fuel Technologies

1998 **SBI Fine Chemicals Inc.**

Custom Advanced Molecule Development for pharmaceutical Industry

Collaborators and Partners

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Global Indigenous

EIA EDMONTON INTERNATIONAL AIRPORT

OTN Aviation

PETRON SCIENTECH INC.

teva

INSTANTON

MERCK

Frog Lake First Nation

TO VIRIDI

Pfizer

DKSH

Schering-Plough

GILEAD

KANATA

Lilly

SIGMA-ALDRICH

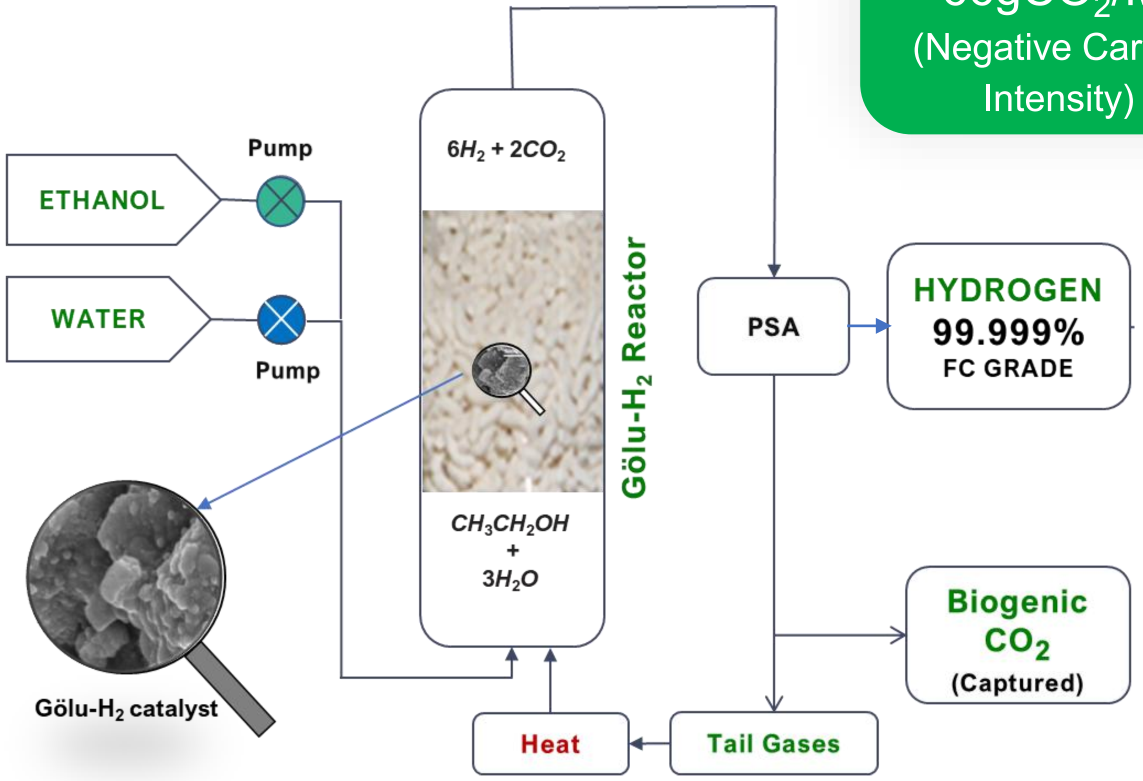
THE SOLUTION

HYDROGEN GENERATION AT THE POINT OF USE

Gölu Hydrogen Technologies Inc.

Golu-H2 Modular Hydrogen Production

- Thermo-Catalytic Process
- No external heat or energy required
- 95% less water compared to Electrolysis and SMR
- Zero carbon intensity process



REDUCE
66gCO_2/Mj
(Negative Carbon Intensity)

Gölu-H_2 City

A Carbon Neutral Off-Grid Community Concept

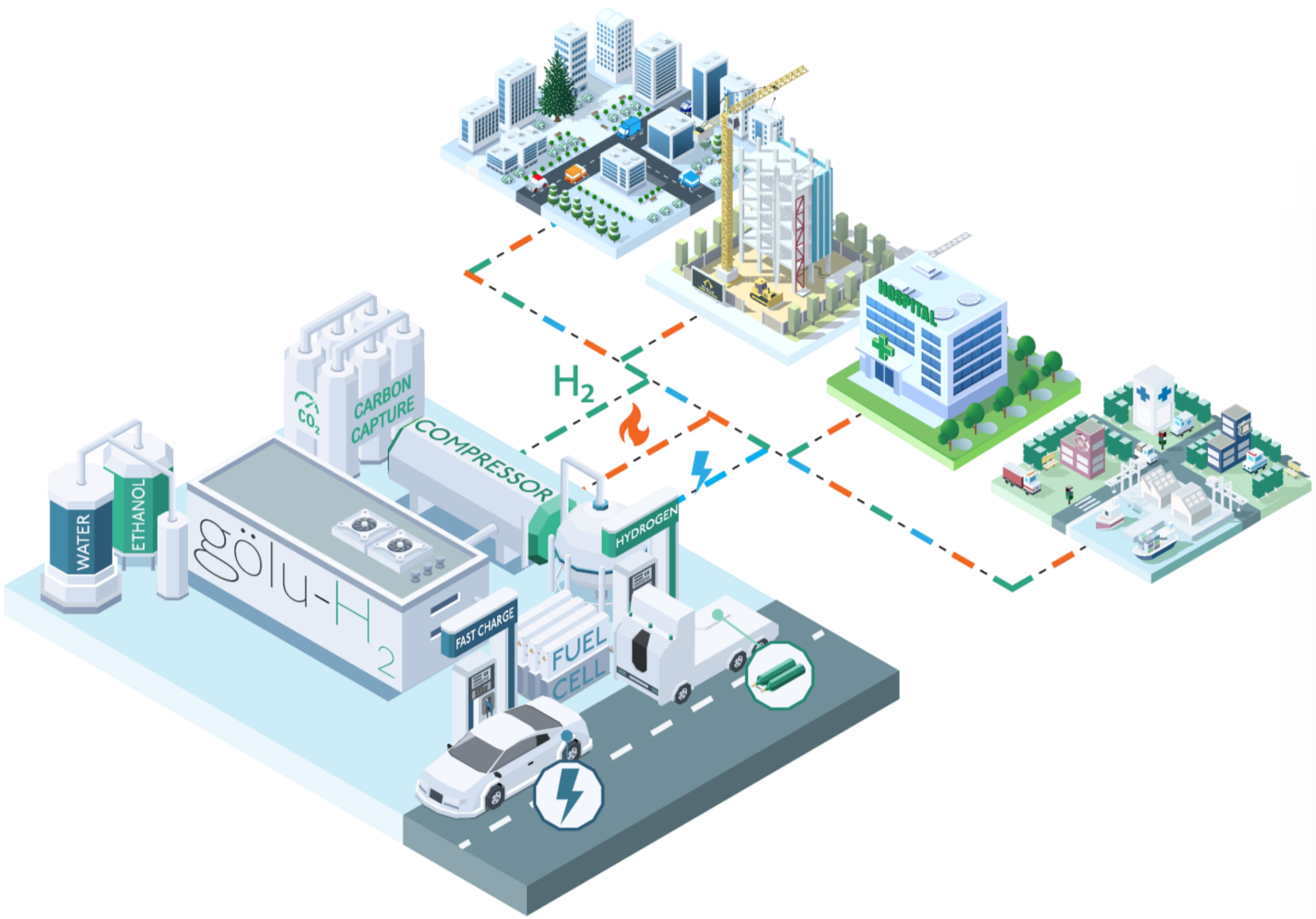
Generates On-Site:

- Green Hydrogen
- Clean Power
- Clean Heat
- Carbon Credits

Grlu-H_2 Generator
Runs on Ethanol and Water

Complete Off-Grid Solution

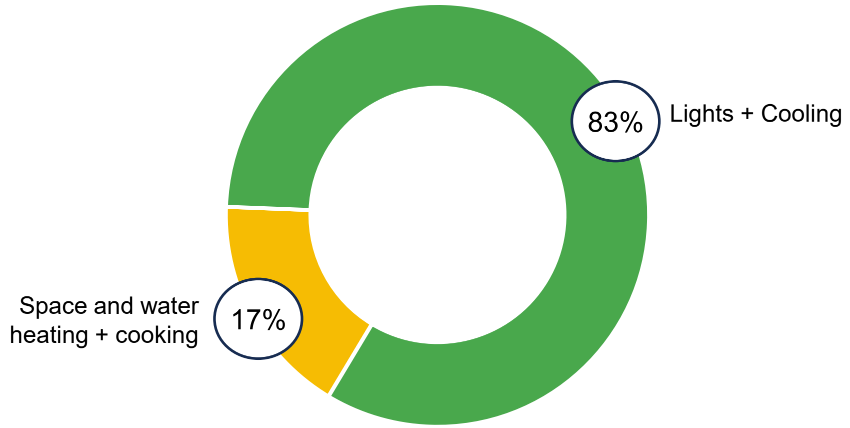
gölu-H2



One Golu-H2 Unit + 650kW Fuel Cell will support

~1000 household with their all energy needs
Support ~2,000 EV Residential Charge Points
Additional Revenues from food-grade biogenic CO2 Sales

Daily Per European Household Energy Consumption



H2 for Space and Water Heating	625 Kg
Spare heat from the process	10 MWh
H2 for Power generation	625 Kg
Power Generation Capacity	12.5 MWh

Fully-Automated Greenhouse/Microgrid

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Golu-H2 Unit kg/day	250	500	1,250
Power Generation Capacity (MWh/day)	5.25	10.5	26.25
16 hr. Lit Greenhouse Size (Acres)	1	2	5.5
CO2 Produced (T/day)	2	4	10
CO2 to produce food (T/day)	0.5	1	2.25
CO2 to sequester/sell (T/day)	1.5	3	7.75
Workers Full Time	8	16	44
Tomatoes Produced	>200 T/yr.	>400 T/yr.	>1000 T/yr.
Lettuce Produced	500 T/yr.	1000 T/yr.	2500 T/yr.

https://www.alberta.ca/commercial-greenhouse-tomato-production

https://www.mdpi.com/2073-4395/14/9/1932

Completely replace Natural Gas & Electricity
Carbon Negative Greenhouse
H_2 for Heat, Power & Food Production

CAPEX, OPEX & Maintenance covered ($0/kWh) at $600/T CO_2 sales

Circular Data Center Solution

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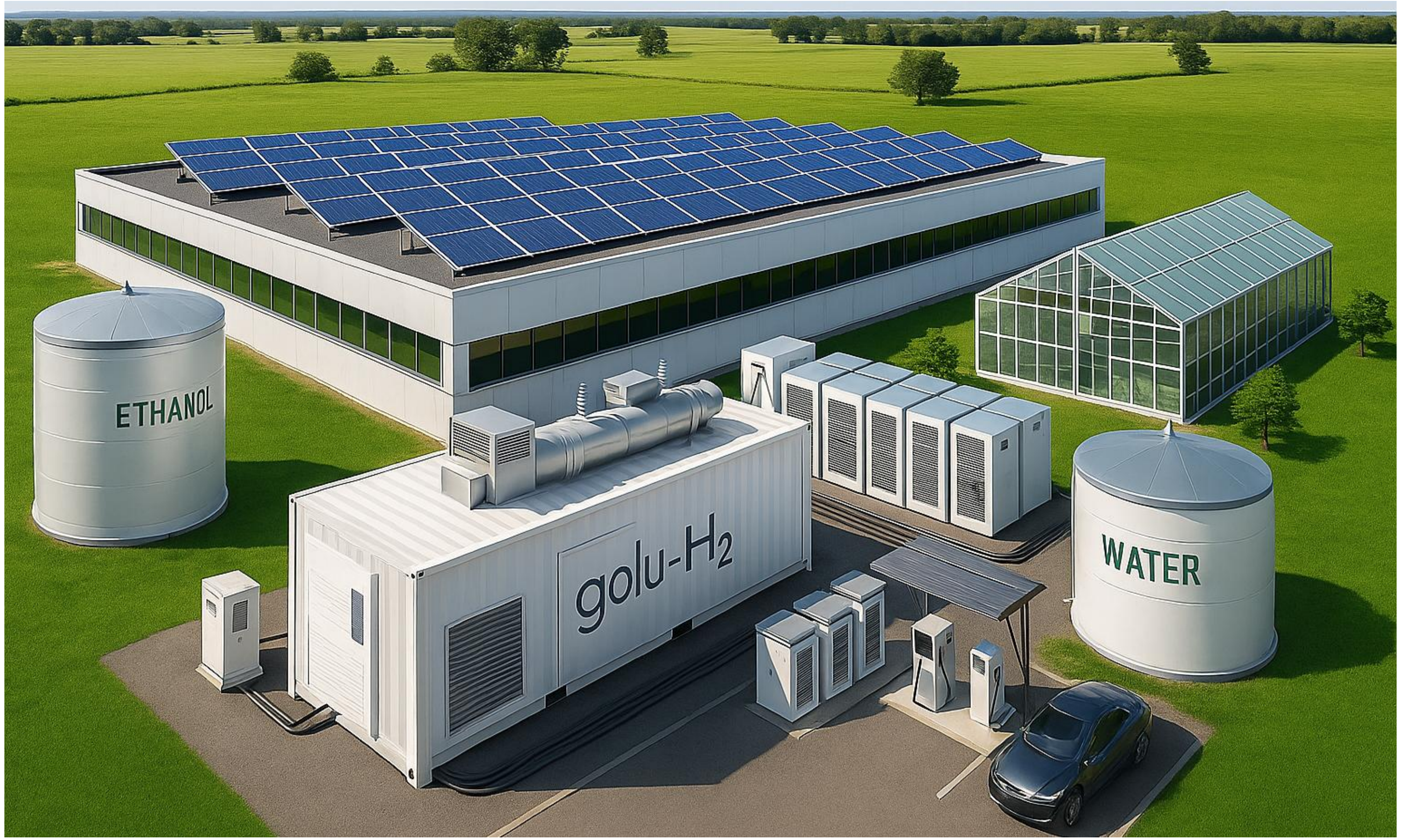


Carbon Negative Power & Fuel

24/7 Renewable Electricity

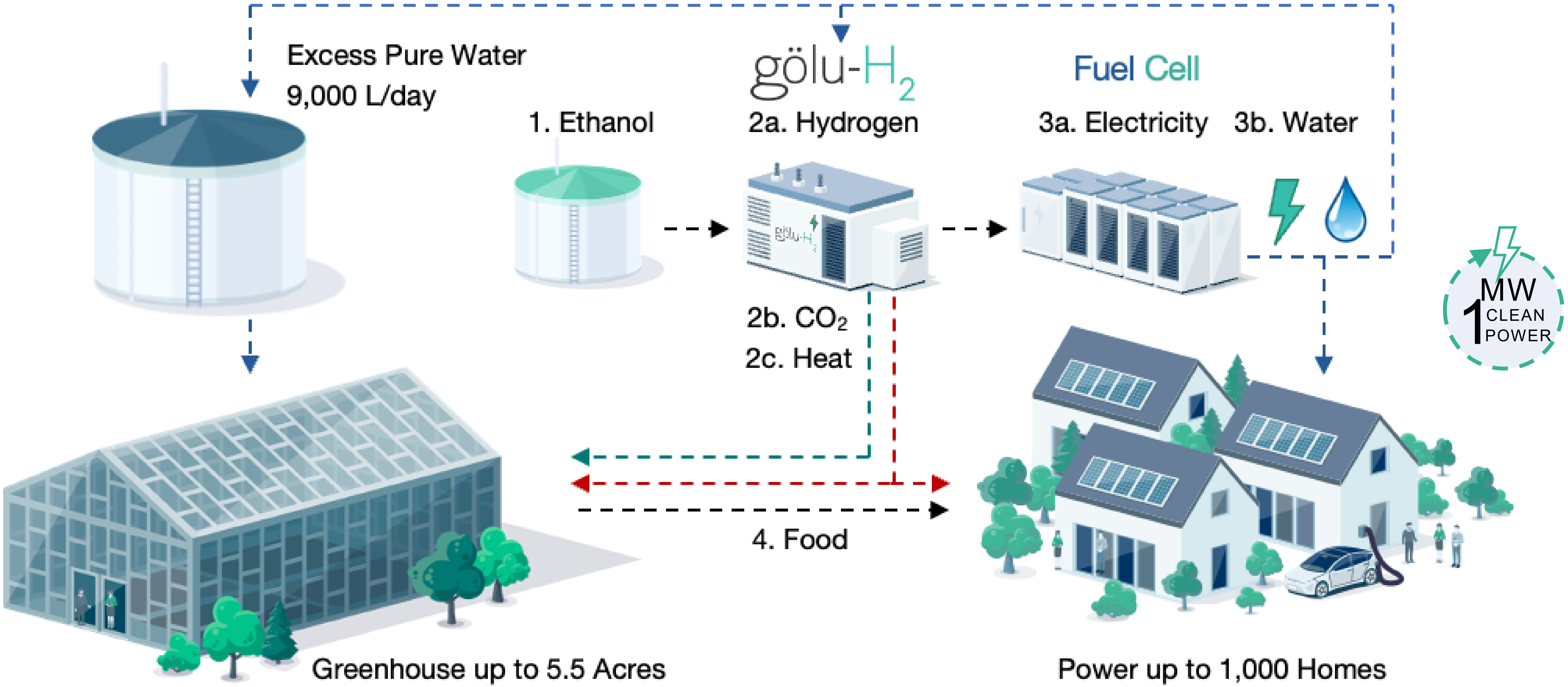
Off-Grid

Highest Renewable Energy Efficiency

Generate Power & Capture Atmospheric CO_2

Excess Elemental POTABLE Water Generated

Independent Circular Solution



Gölu 1st Commercial Deployment 2026

gölu-H_2

can provide power to a 150,000 Sq ft. bldg.

COMMERCIAL DEPLOYMENT

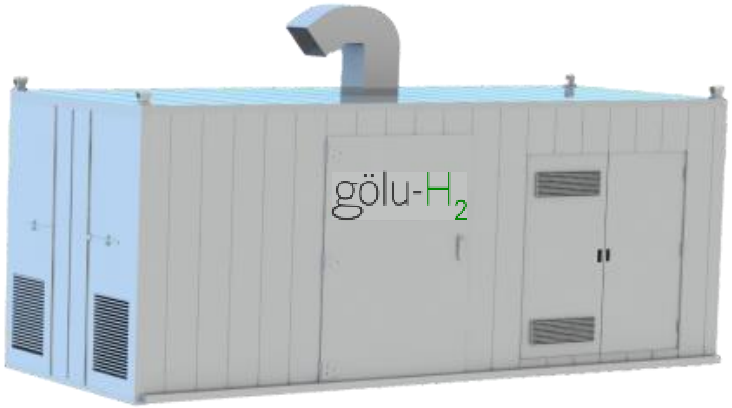
Produce 250 kg Fuel Cell Grade Hydrogen per day

Generate 5 MWh/day of Carbon Negative Power

Capture 2 Tons Biogenic CO_2/day

Fully automated with remote monitoring

Modular unit design with Standardized Interchangeable Parts



250kg/day unit

CO_2 Capture via Photosynthesis vs. DAC

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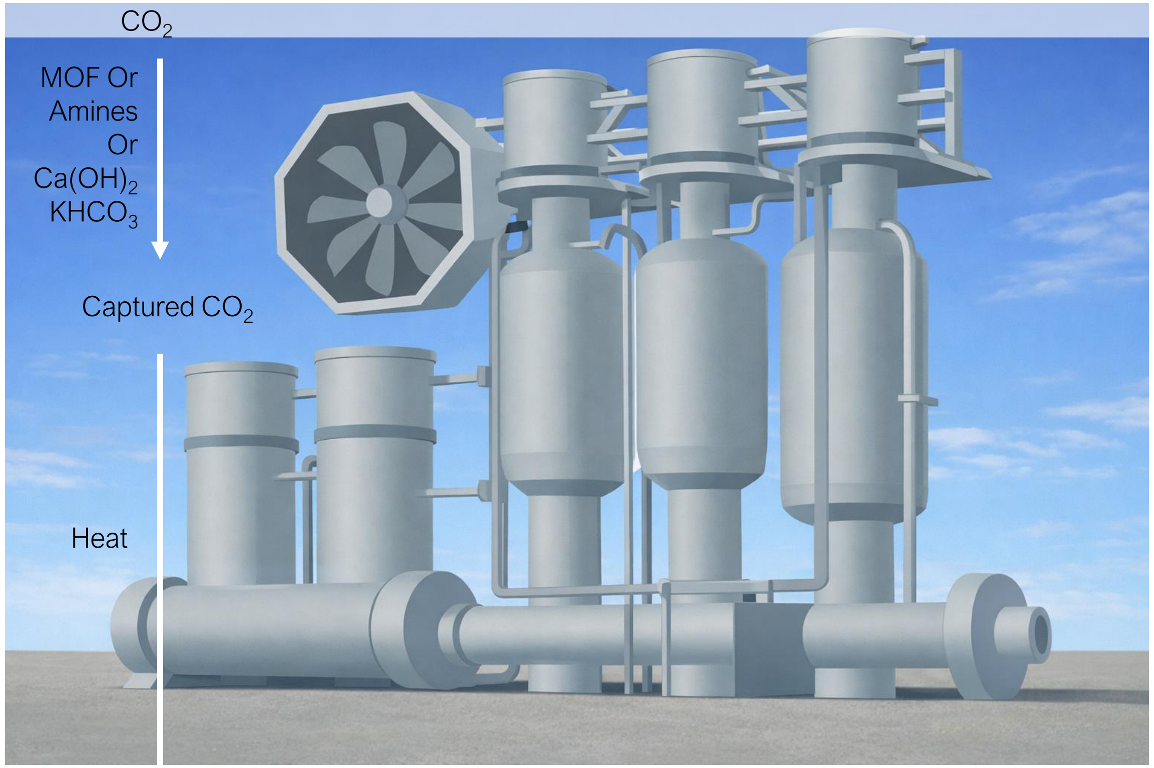
DAC by Golu-H_2 with Clean H_2 Production & BECCS

DAC by MOF or Amines



BECCS CO_2 Capture & Storage

DAC vs Gölu-H_2

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DAC with MOF or Amines

15 MWh Power to Capture 10 Tons CO_2

- Use electricity to capture CO_2
- 1-2 MWh energy per ton of CO_2 Captured
- High MOF or Amine loses
- No H_2 is Generated
- No PTC Credits generated
- Create CCUS Credits

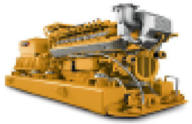
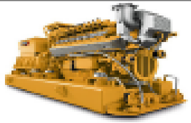
DAC + Clean Hydrogen: Golu-H_2

Generate 25MWh + Capture 10 Tons of CO_2

- Plants use photosynthesis to capture CO_2 naturally
- Golu-H2 purifies CO_2 without using external heat
- 0.1 MW per ton CO_2 Captured
- No MOF or Amines used
- 1,25 tons of fuel cell grade H_2 produced
- Generate PTC & BECCS Credits,

More Renewable Energy Delivered

gölu-H_2

Delivery Method	Fuel Qty.		Total Electricity*	Cost/MWh	CO_2 **IMPACT**	TOTAL$/MWh[1]
Ethanol	14,000 gal		163 MWh	$146	110 T Credits	$31
Ethanol	14,000 gal		154 MWh	$155	104 T Credits	$40
Diesel	14,000 gal		227 MWh	$276	143 T Penalty	$383
Liquid Ammonia	4,700 kg		99 MWh	$369	80 T Penalty	$506
Compressed Nat. Gas	350 GJ	 small genset	42 MWh	$142	19 T Penalty	$219

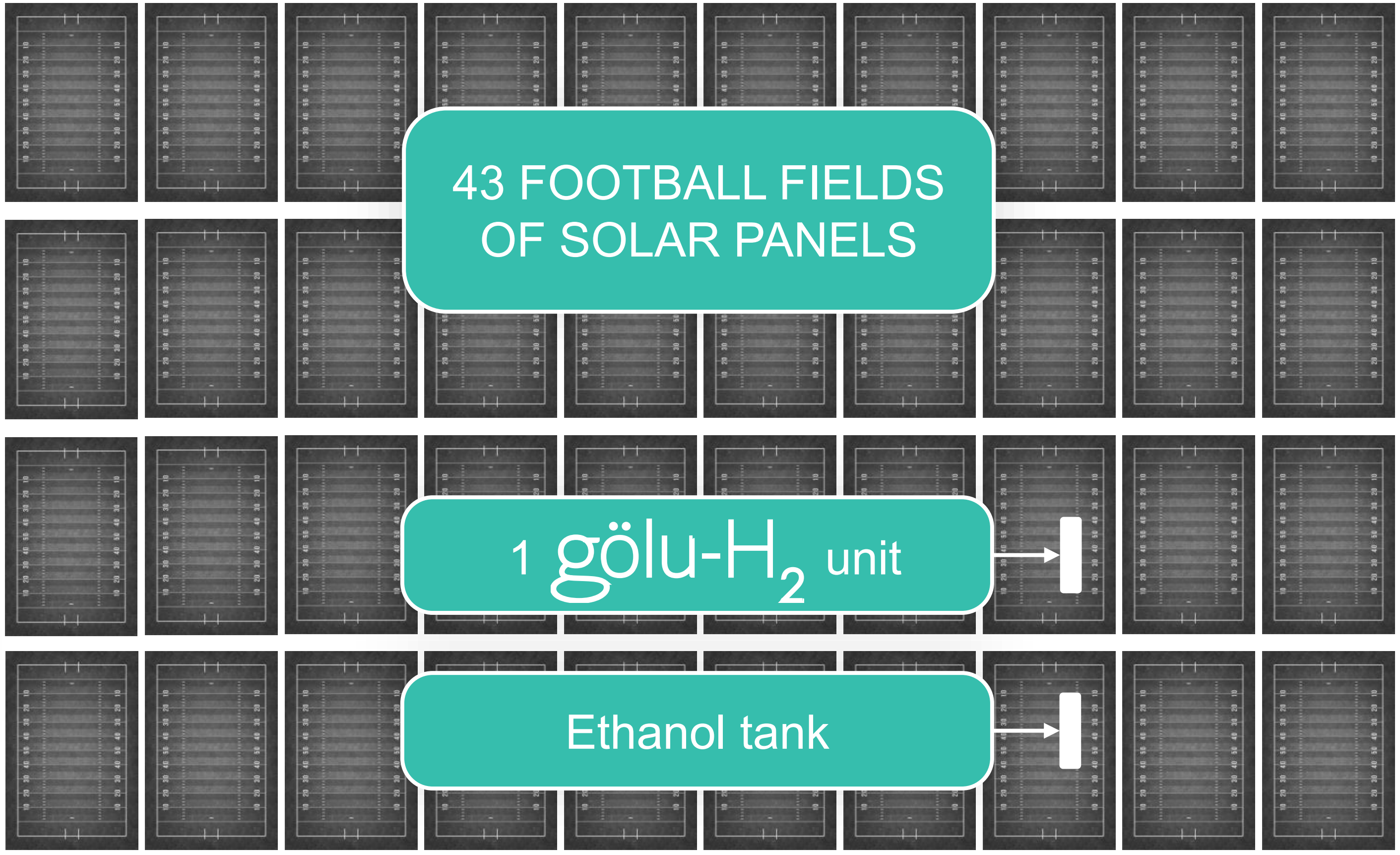
*based on various published data, [1]with $170/Ton CO2 Carbon Tax

Footprint Comparison

57 acre Solar Farm

1.5 acre Electrolyzer

40’ x 8’ 1,250 kg/day



Generating 1250 kg/day of hydrogen through solar power necessitates an area of 57 acres covered with solar cells, which is equivalent to 43 football fields. Additionally, an extra 1.5 acres is needed for the footprint of the electrolyzer

Smart Load Management / Peak Shaving

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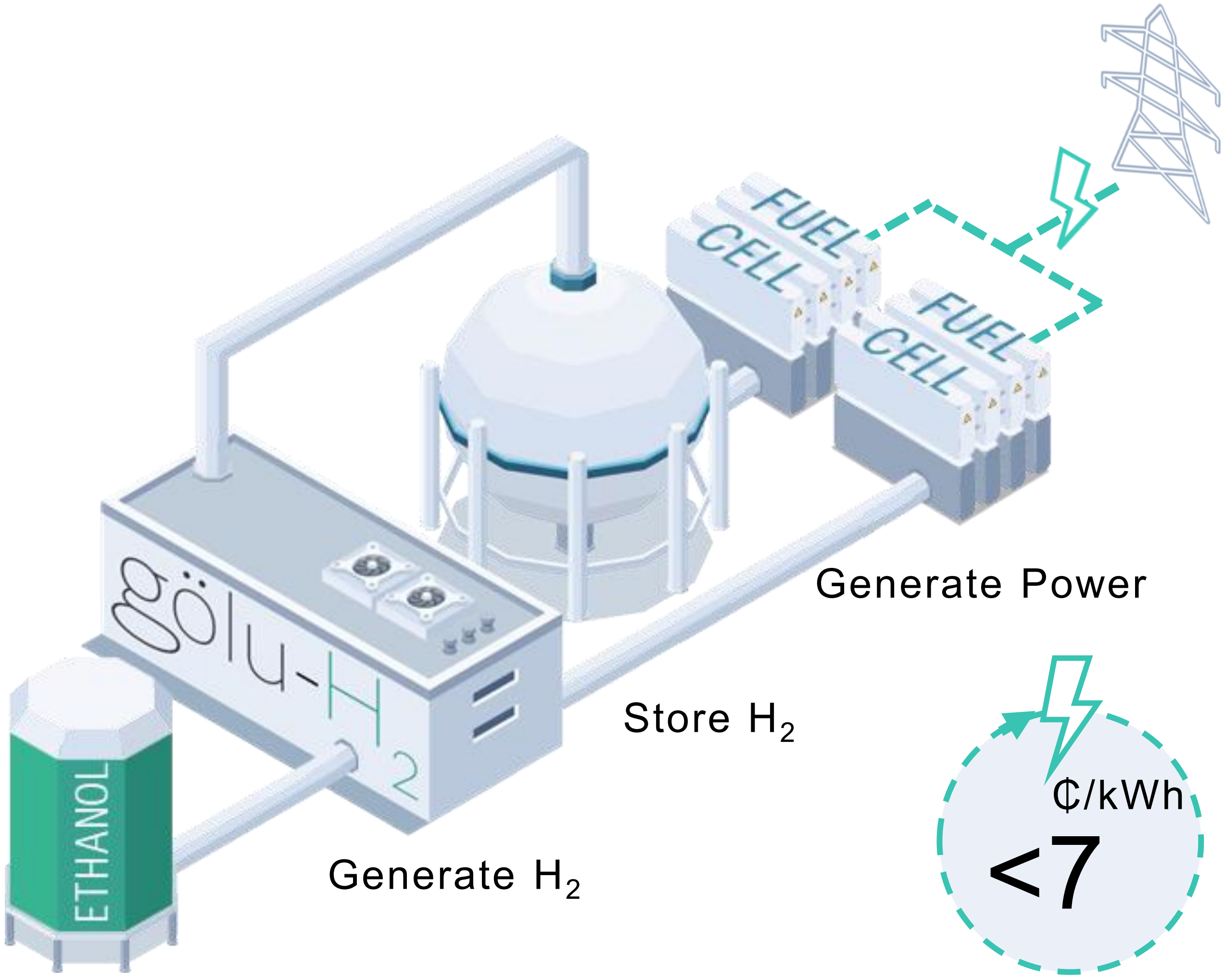
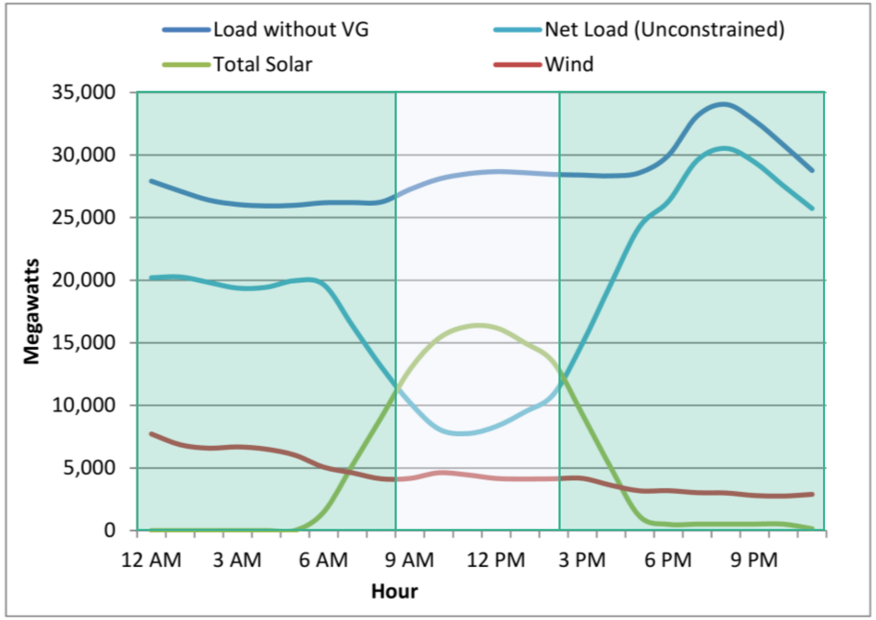


California grids rely on Solar and Wind

Golu-H2 generates and stores Hydrogen

Generate power through Fuel Cells

California Load Generation



Load, Solar and wind profiles for California on March 29 in a scenario with 11% annual wind and annual solar assuming no curtailment

SOURCE: NREL

Storage Cost Comparison: 1 GWH Power

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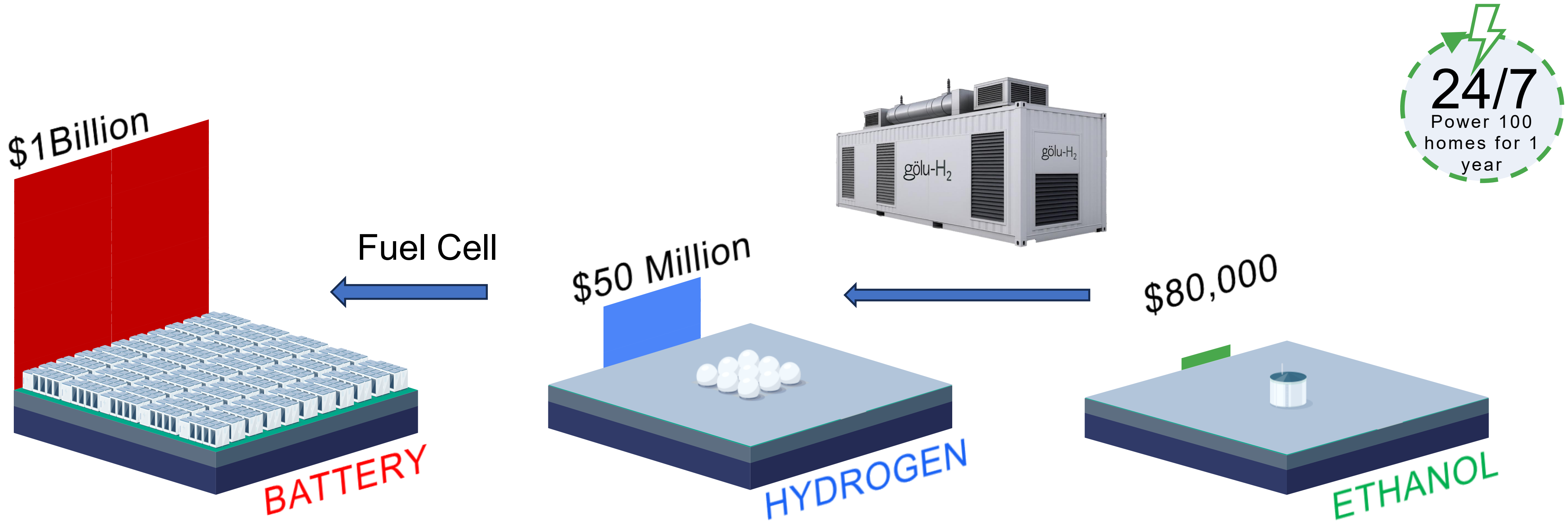

	Batteries
Capacity	~20 Acres
Cost	~ $1Bn. USD

	Hydrogen Tanks
Capacity	50 Tons
Cost	~ $50Million USD

	Ethanol Tank
Capacity	90,000 gal.
Cost	~ $80,000 USD

More Hydrogen Per Delivery

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Delivery Method	Total Hydrogen	Advantage/Disadvantage
Ethanol	7,700 kg	Existing infrastructure
Liquid Ammonia	4,700 kg	Toxic, needs Cryogenic carrier
Liquid Hydrogen	3,000 kg	Needs Cryogenic form
Compressed H_2	800 kg	High Pressure Cylinders

Fuel Cost Comparison 100,000 miles/yr.

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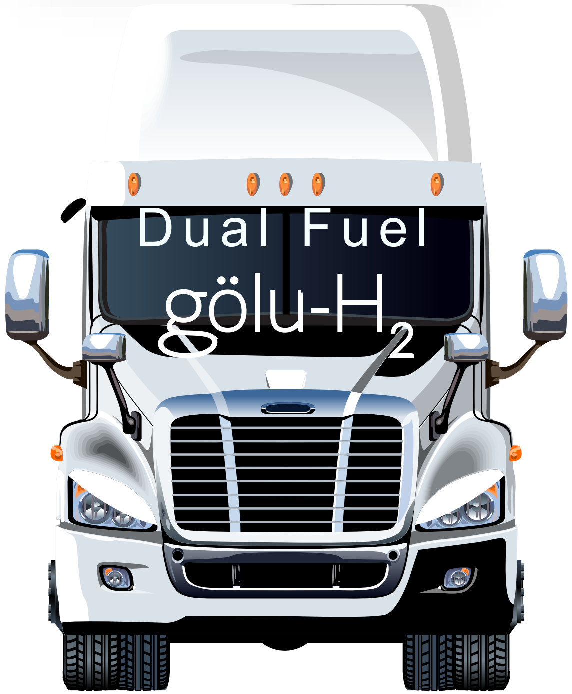
Diesel @ $5/gal.

Fuel Cost
$100,000/yr.

High Emissions

Ethanol @ $ 2.16/gal



Fuel Cost
$86,600/yr.

Net-Zero Emissions
60% Diesel / 40% H2

Ethanol @ $ 2.16/gal

Fuel Cost
$30,600/yr.

Carbon Negative

H_2 @ $36/Kg

Fuel Cost
$450,000/yr.

Reduced Emissions

cost based on ethanol, H_2 pricing 02/2023

Fuel Cost Comparison 60,000 miles/yr.

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Diesel @ $5/gal.

Fuel Cost
$86,000/yr.
High Emissions

Ethanol @ $ 2.16/gal

Fuel Cost
$51,960/yr.
Net-Zero Emissions
60% Diesel / 40% H2

Ethanol @ $ 2.16/gal

Fuel Cost
$18,360/yr.
Carbon Negative

H_2 @ $36/Kg

Fuel Cost
$258,000/yr.
Reduced Emissions

*cost based on ethanol, H2 pricing 02/2023

Flex Energy Station

Hydrogen Fueling

1,250 kg/day

Up to

>250 Toyota Mirai cars (5kg)

>25 Class 8 Trucks (50kg)

EV Charging

25 MWh/day

Up to

>300 Model 3 Sedans

>500 PHEV

>30 Class 8 Trucks

Hurdles with Conventional Hydrogen

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C

CARBON FOOTPRINT

High emissions if produced from fossil fuels.

O

ON-SITE INFRASTRUCTURE COST

Expensive to build and maintain.

S

SAFETY

Flammability and handling risks.

T

TRANSPORT

Low energy density, requiring specialized storage and distribution methods.

Competitors and Competitive Advantages

Competing Technologies

Direct competitors for Golu-H2 technology include:

1. Methane Steam Methane Reforming (SMR): This is the most common method for hydrogen production, using natural gas as a feedstock. Although it is widely used, it is more carbon-intensive compared to Golu-H2.
2. Electrolysis: This method uses electricity to split water into hydrogen and oxygen. When powered by renewable energy sources, it produces green hydrogen. Companies like Nel Hydrogen and ITM Power are key players in this space.
3. Proton Exchange Membrane (PEM) Electrolysis: This is a specific type of electrolysis that is efficient and suitable for variable renewable energy sources. Companies such as Plug Power and Cummins are notable competitors.
4. Solid Oxide Electrolysis Cells (SOEC): This technology operates at high temperatures and can achieve higher efficiencies. Companies like Sunfire are developing SOEC technology for hydrogen production.
5. Biomass Gasification: This process converts organic materials into hydrogen and other products. Companies like SGH2 Energy are working on commercializing this technology.

These technologies have their own advantages and challenges with the competition in the green hydrogen market driving innovation and improvements across the board.

Comparative Analysis for Technologies

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Technology	Advantages	Disadvantages
Golu-H2 Technology	1. Low Carbon Intensity: Produces hydrogen with up to -66g/MJ CO2e Carbon Intensity score compared to traditional methods that struggle to get to carbon neutrality. 2. Decentralized Production: Suitable for on-site hydrogen generation, eliminating transportation and storage costs. 3. Renewable Feedstock: Uses bioethanol, a fuel additive, already used as Carbon Intensity mitigator in gasoline globally. Bioethanol production is increasing globally and is facing risk of reduced consumption due to rapid adoption of non-combustion fuel engine vehicles. It is largely derived from renewable sources like non-food corn, cellulosic biomass and sugar cane. 4. Sustainability: Global bioethanol production is projected over 50Bn gallons (https://www.statista.com/aboutus/our-research-commitment) that can be transformed with Gölu-H2 into over 25 million MT of hydrogen that would be roughly half of the projected hydrogen consumption by 2030. 5. Scalability: Can be scaled to meet various demands, from small on-site generation to industrial size refineries. 6. Multiple Applications: for transportation and microgrids uses	1. Feedstock Availability: Dependent on the availability of bioethanol, which can be influenced by agricultural yields and market prices. 2. Initial Adoption Risk: Being first of its kind and a new technology, initial adaptors may see it as a financial risk.
Methane Steam Methane Reforming (SMR)	1. Established Technology: Widely used and well-understood process. 2. Cost-Effective: Generally cheaper to produce hydrogen compared to newer technologies.	1. High Carbon Emissions: Significant greenhouse gas emissions, making it less environmentally friendly. 2. Fossil Fuel Dependency: Relies on natural gas, a non-renewable resource. 3. High Water Consumption: Requires significant amount of high purity water.
Electrolysis	1. Green Hydrogen: When powered by renewable energy, it produces zero emissions. 2. Versatility: Can be used in various scales, from small units to large industrial plants.	1. Energy Intensive: Requires a significant amount of electricity, which can be costly if not sourced from renewables. 2. High Water Consumption: Requires significant amount of high purity water. 3. Infrastructure: Requires substantial infrastructure for large-scale deployment.
Proton Exchange Membrane (PEM) Electrolysis	1. Efficiency: High efficiency and suitable for variable renewable energy sources. 2. Compact Design: Smaller footprint compared to other electrolysis methods. 3. Water Production: by product is potable grade water.	1. Cost: Higher capital costs due to the use of expensive materials like platinum. 2. Durability: Membranes can degrade over time, requiring maintenance.
Solid Oxide Electrolysis Cells (SOEC)	1. High Efficiency: Operates at high temperatures, achieving higher efficiencies. 2. Integration: Can be integrated with industrial processes that produce waste heat.	1. Complexity: More complex and expensive to build and maintain. 2. Operating Costs: relatively high. 3. Material Challenges: High operating temperatures can lead to material degradation.
Biomass Gasification	1. Renewable Source: Uses organic materials, making it a renewable method. 2. Waste Utilization: Can utilize agricultural and forestry waste.	1. Feedstock Variability: Quality and availability of biomass can vary. 2. Operating Costs: Cost of collection can impact the project viability. 3. Complex Process: Requires complex processing and purification steps.

International Awards

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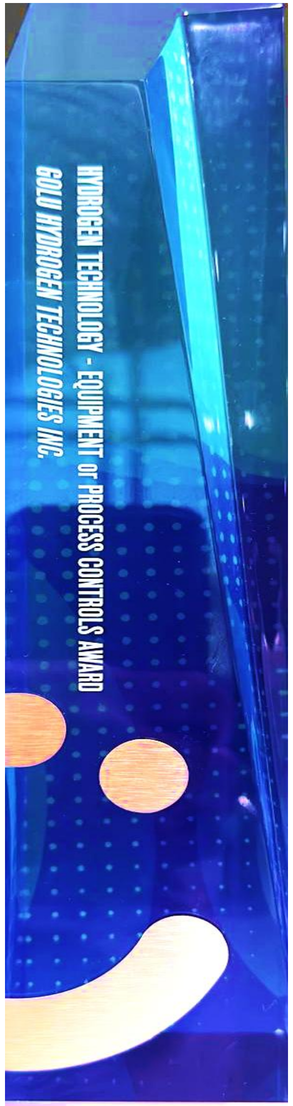

SBI BIOENERGY INC.

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THANK YOU

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