HYDROGEN ENERGY STORAGE

FOR GRID AND TRANSPORTATION SERVICES

Electrochemically Driven

Hector A. Maza
Dir. Business Development

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GINER, Inc.

Constant innovator of PEM Technology, providing the Highest Efficiency & Lowest Costs Systems to help develop the Hydrogen Economy

Founded 41 years ago in 1973 - *Profitable every single year !*

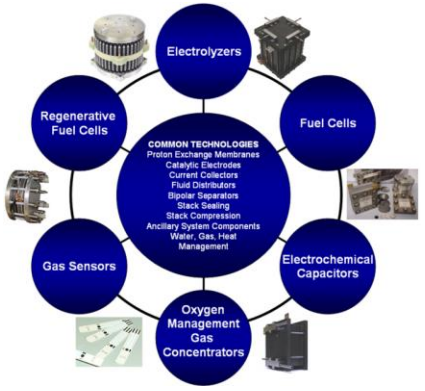
Com. Success: 15,000+ PEM electrolyzers in the field

Global leader in PEM-based electrolyzers

Markets: Military, Renewables, Energy & Storage,

Lab-Hydrogen, Backup-Power, Mobility, Sensing Devices.

PEM Technologies



Applications of Giner's PEM-Electrolyzers

Military : US Navy, NASA and DoD

Life Support Oxygen Generators

Energy Storage

Low Cap Ex → Rapid Response time

MW Stacks, 2 MW – 5 MW Systems

Industrial Hydrogen

High efficiency → Low Cap Ex

15 N →, 210 Nm^3/h

Aerospace / Space Electrolyzers

Radar Platforms; DARPA and MDA

Space Exploration; NASA

RFC Electrolyzers UUV

20 Nm^3/ Backup Power

Distributed Hydrogen

Analytical Hydrogen

Laboratory :30 -120 l / h

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What are the competitive advantages of electrolytic hydrogen storage compared to other technologies?

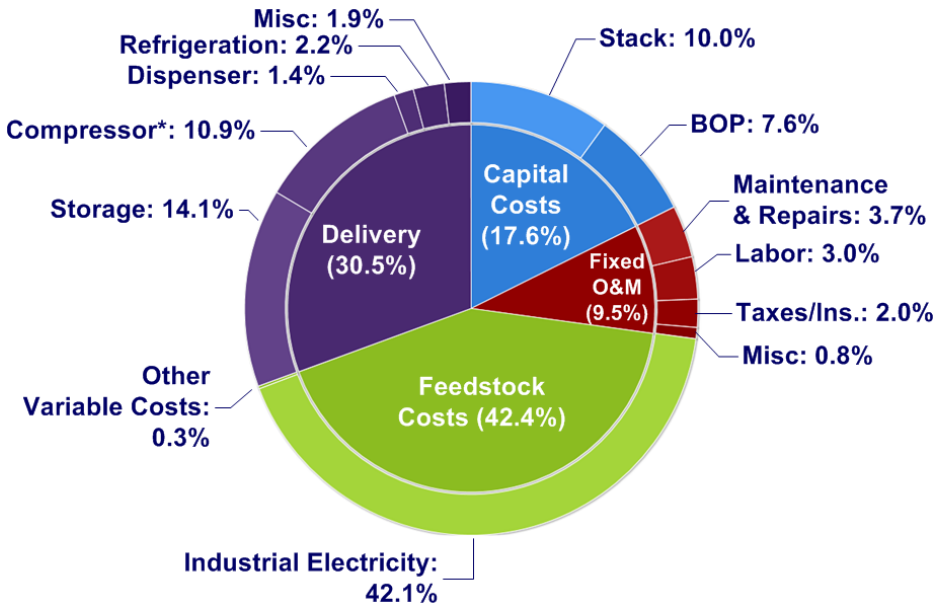
- Clean = Zero Carbon Emissions
- Immediate Response Time 0 - 100% in milliseconds
  (Tool for regulation and peak shaving)
- Flexibility in Scalability
- Small footprint
- High Efficiency – Low Energy loss while converting to H_2
- Multiple avenues to reconvert H_2 to Energy as well as potential for various uses as a reactant or heat transfer gas
- Portable equipment up to MW scale, ease to transport & deploy
- Low Maintenance
- Technology still on maturing stage potential for vast improvements to come

What are the most important drivers which should influence R&D priorities? Efficiency and Scale vis a vis Cost of H_2 Production

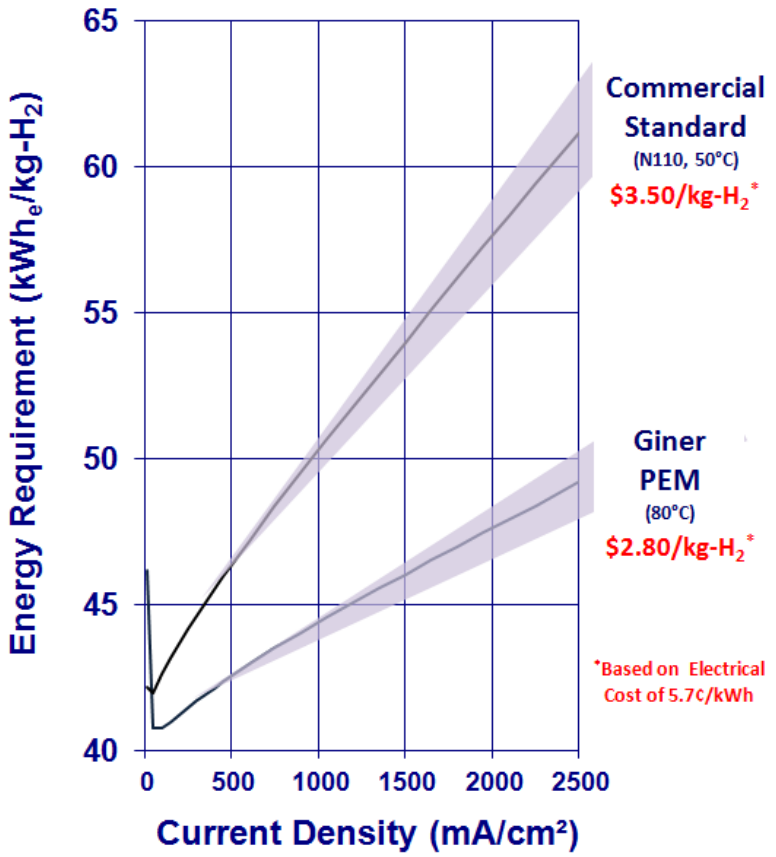
Cost (Current Density, Differential Pressure & Scale)

- Hydrogen production cost dominated by feedstock
- Efficiency is key to cost competitiveness (~30% red)
- MW Stack reduces Capex by 45%

H_2 Production Cost Breakdown



At high Current Density 3A/cm^2 & Pressure Diff it has an impact on cost of approx ~30%



H_2 Total Cost = CapEx System + OpEx

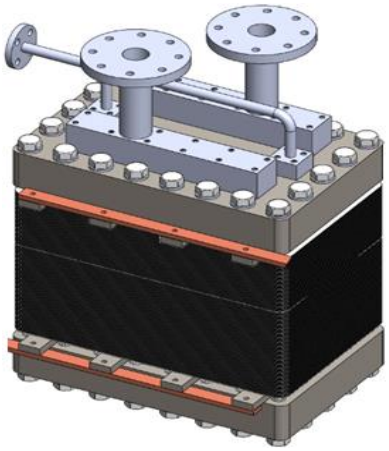
$/kg of H_2 = (<$1.4) + (<$2.6) = < $4.00/kg * DoE Target 2020

What are the R&D priorities necessary to ensure market success ?

- Increase Scale
- Reduce Total Cost

} MW Scale Stack

- Increase Differential Pressure (DSM™) to reduce overall system Capex

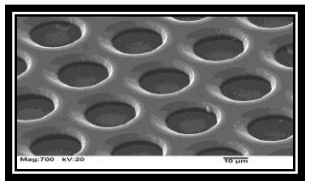


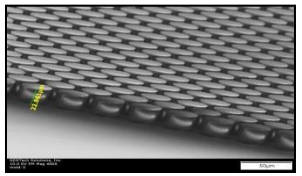
210 Nm^3/h Electrolyzer Stack

Today's R&D focus ?

a) MW Scale Stacks

b) **Dimensionally Stable Membranes (DSM™)**
High-strength, High-efficiency membranes





- Superior Mechanical Properties than regular PEM
- No x-y-z dimensional changes upon wet/dry or freeze-thaw cycling
- Stronger Resistance to tear propagation than PEM
- Superior to PTFE based supports, 10x stronger base properties
- ➢ Enabling technology for high pressure applications
- ➢ Commercial viability in 2015

R&D funded U.S. Department of Energy

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Under what conditions and where will electrolytic based hydrogen energy storage projects succeed in N. America?

P2M™ - Power to Mobility ***(...next 3 years)***

Move to Multi-MW Solution(s) with DoE Constituents

Who ? - DoE to influence & coordinate

- Utility Companies - Wind Operators, Electric & Gas (PG&E,SDG&E,…)
- Auto Manufacturers - FCEV (Ford, Honda, Hyundai, Toyota…)
- Equipment Manufacturers (PEM MW Stacks)
- Regulators (Lawmakers supporting with Tax Incentives)

Where ? – California, USA

What & How ?

- Coordinating partners to develop 10+ MW H_2 Gen/Store Site from Renewables (Wind / Solar) to be coupled with Mobility users
- Infrastructure to speed Renewable Energy Generation & Storage using H_2 as carrier, development & adoption

Result:

- 80% Cost Reduction of H_2 for Mobility from recent Awards May 1st, 2014

Huge Value creation “synergy” by combining the 2 largest Markets

What would this 10MW+ DoE led “P2M partnership” look like ?

- ($$$) & Ideal Location site
- Wind / Solar Farm

- Equipment & Labor @ Cost Share (in-kind)

Utility Co.

Electrolysis Manufacturer + Engineering Construction Firm

Legislator Body

Auto Manufacturer

- Tax Incentive for all above IRS, CFB.

Cash $ to enable Infrastructure Acceleration

Near Term Market Opportunities – Current bids

1) Mobility 1,000 HRS H_2 Refueling Stations – 100 CA + 400 Germany

Committed 50% @ $100 M + €350 M : Total ~ $1Bn market next 10yr

Product Solution: (50 – 200 Nm^3/h) : $750K – $2.2M /ea

2) Energy Storage from renewables - Wind, Solar, Bio-Gas

Identified 23+ Systems, Total ~$100M market

Product Solution: (400 – 1,000 Nm^3/h → 2 - 5 MW) @ $3.5M – $6.5M /ea

3) Backup Power : Regenerative FC

Market size $65M, Product Solution: 5 – 10 kW @ < $50K/ea

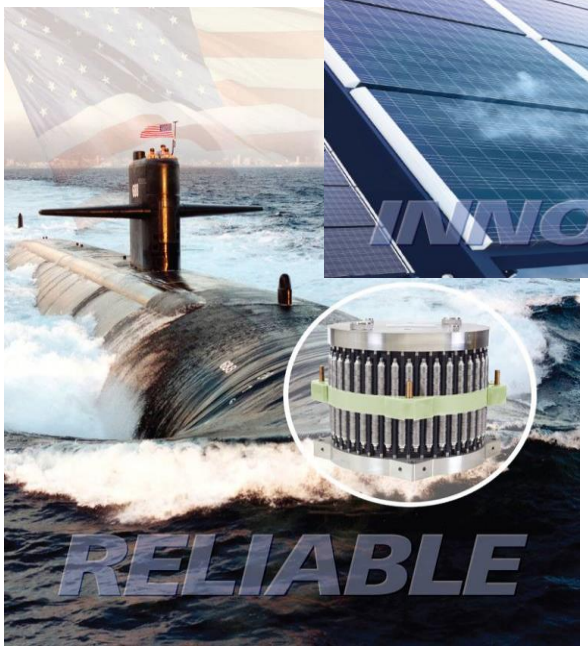
4) Industrial Applications where "No Reforming" option available

Market Size $65M, Product Solution: 30 – 1,000 Nm^3/h @ $500K – $6.5M /ea

5) Cooling Applications

Market Size $22M, Product Solution: 10 – 30 Nm^3/h @ $200K – $500K /ea

Q & A …



Hector A Maza
Dir. Bus Development
hmaza@ginerinc.com
(408)761-6276