

Aluminum Gallium Company

Hydrogen-on Tap for Commercial Vehicles



BY AlGalCo

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Energy Security



Emissions

Sustainability





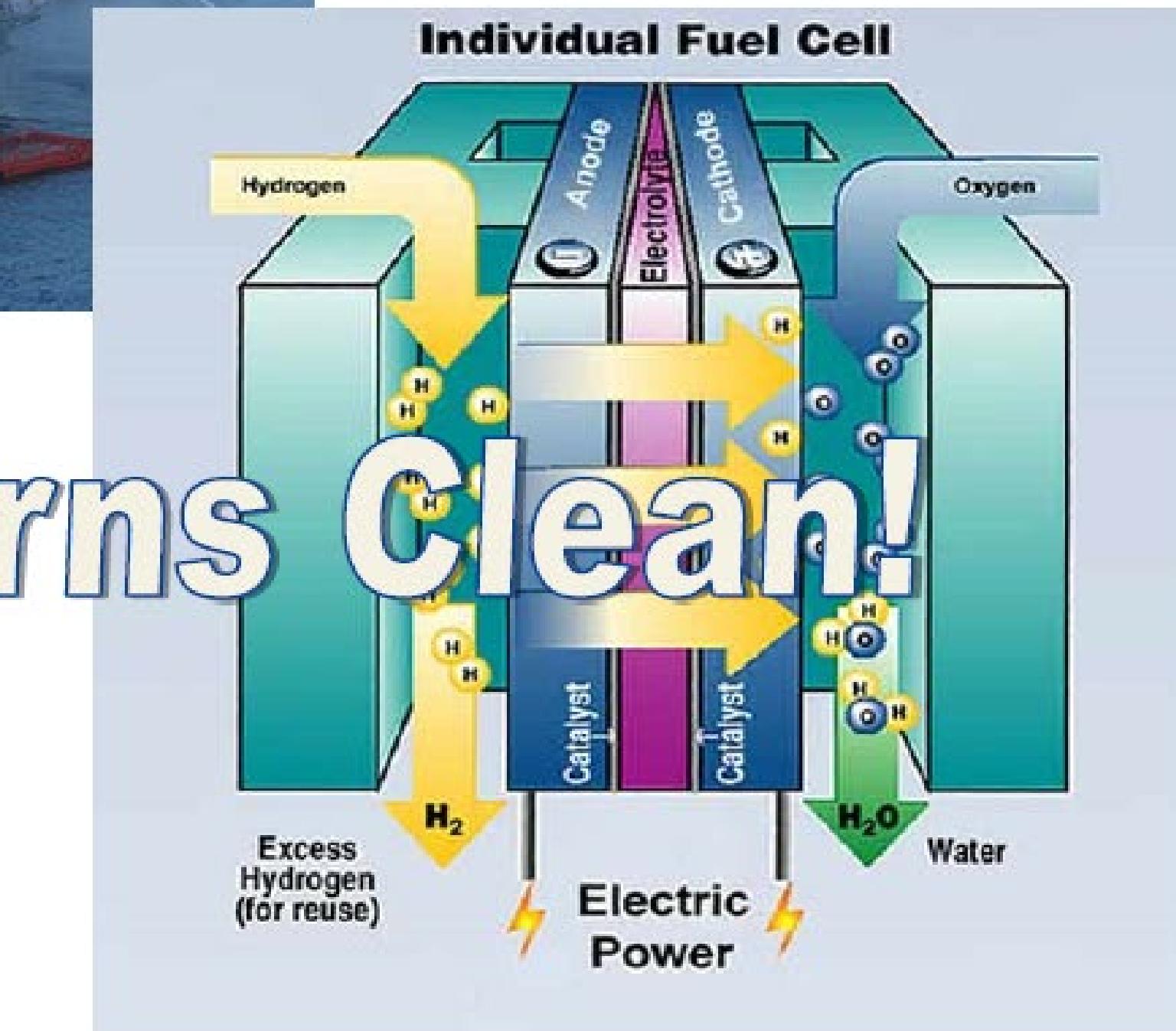
Why Hydrogen?

Reduces dependency on oil!

Most abundant
Element in
the universe!



Burns Clean!



The Problem – Why Not Hydrogen

- **Expensive to extract**
- **Difficult to Transport**
- **Storage**

Market

- Transportation — land vehicles including over the road trucks
- Ocean going ships
- Energy storage — windmill farms
- Trillion dollar plus global markets
- Dominated by multinational oil and gas companies





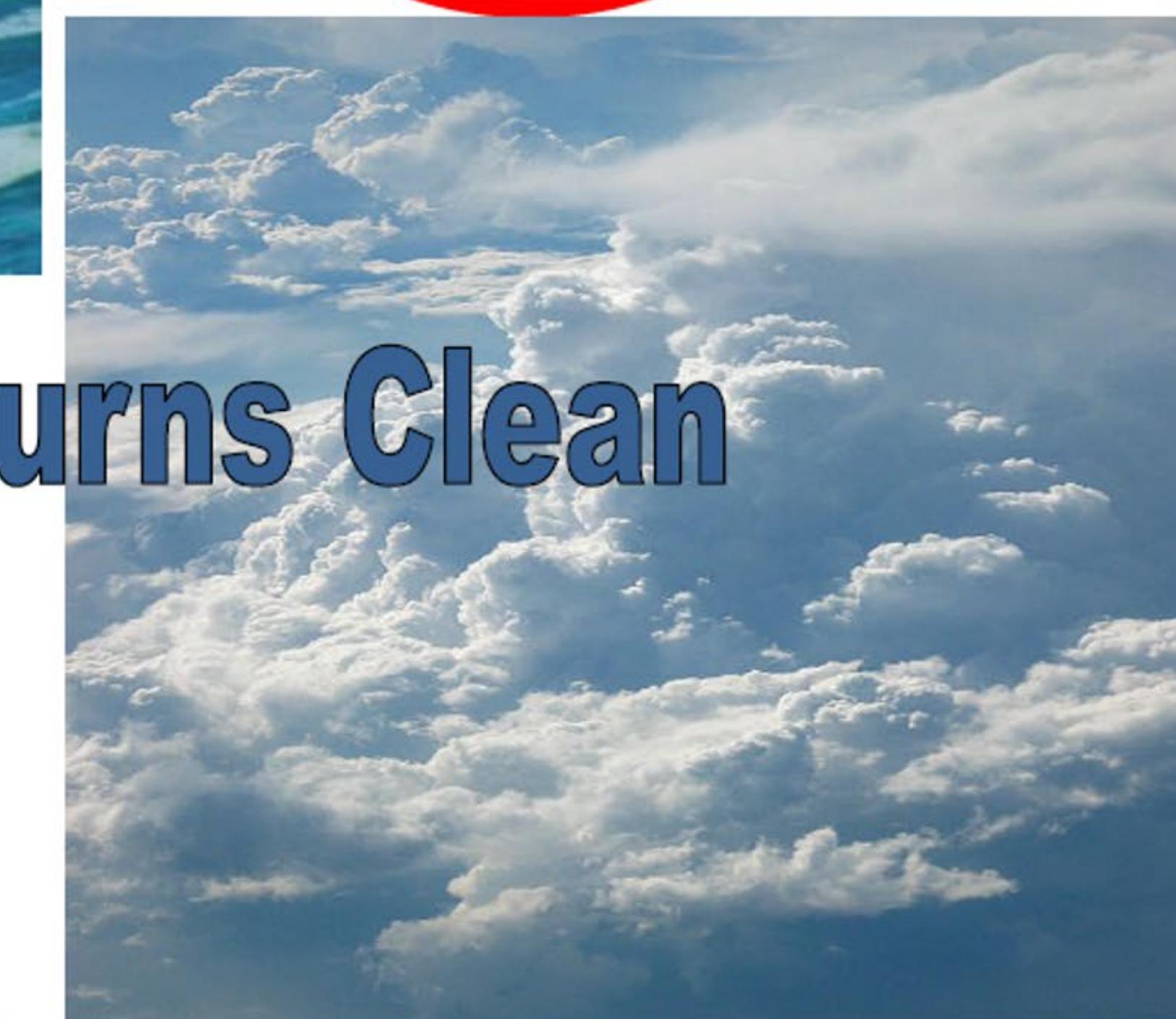
Why AlGalCo?



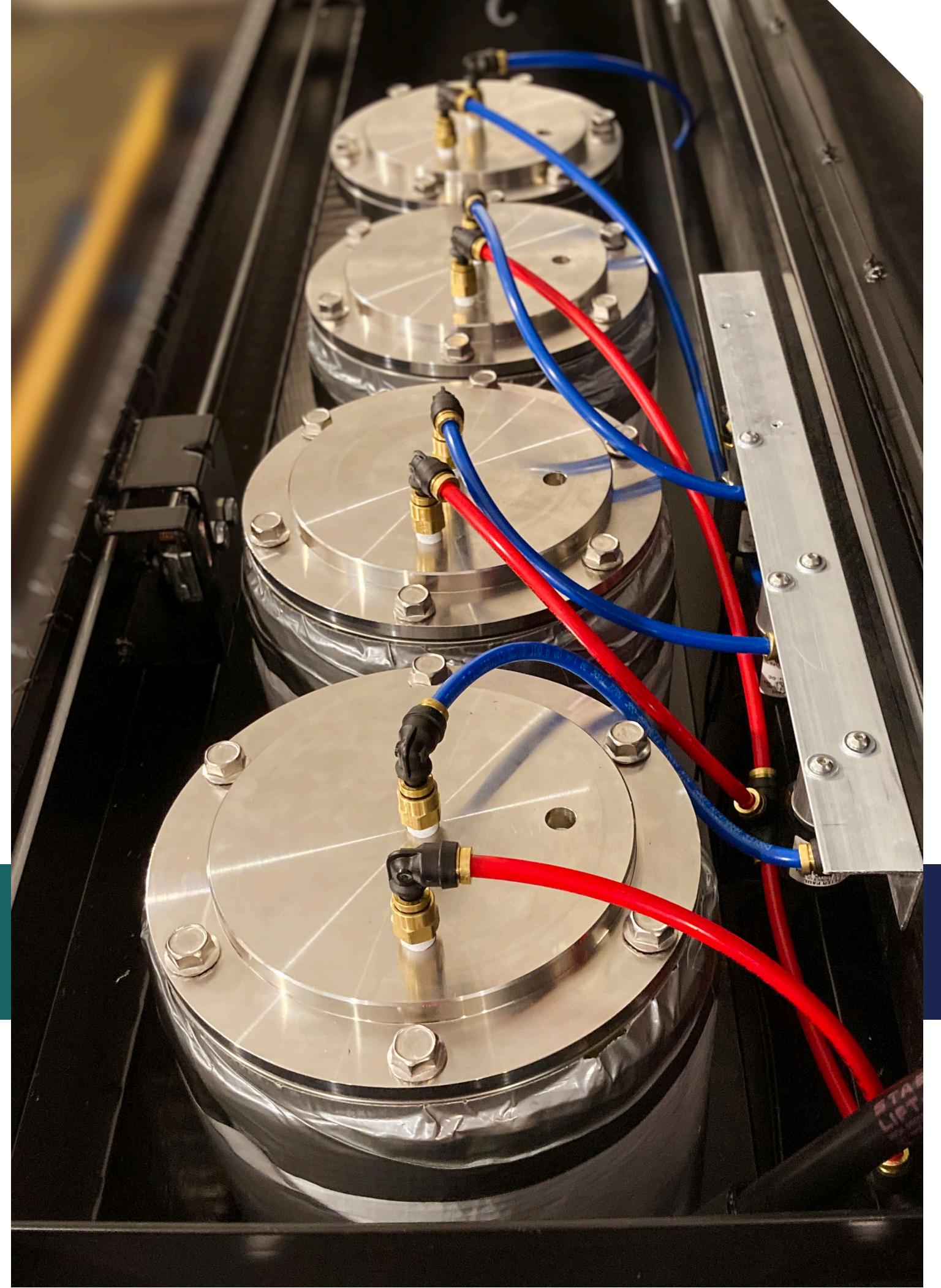
Aluminum-based



Burns Clean



Introducing Hydrogen on Tap (HOT)

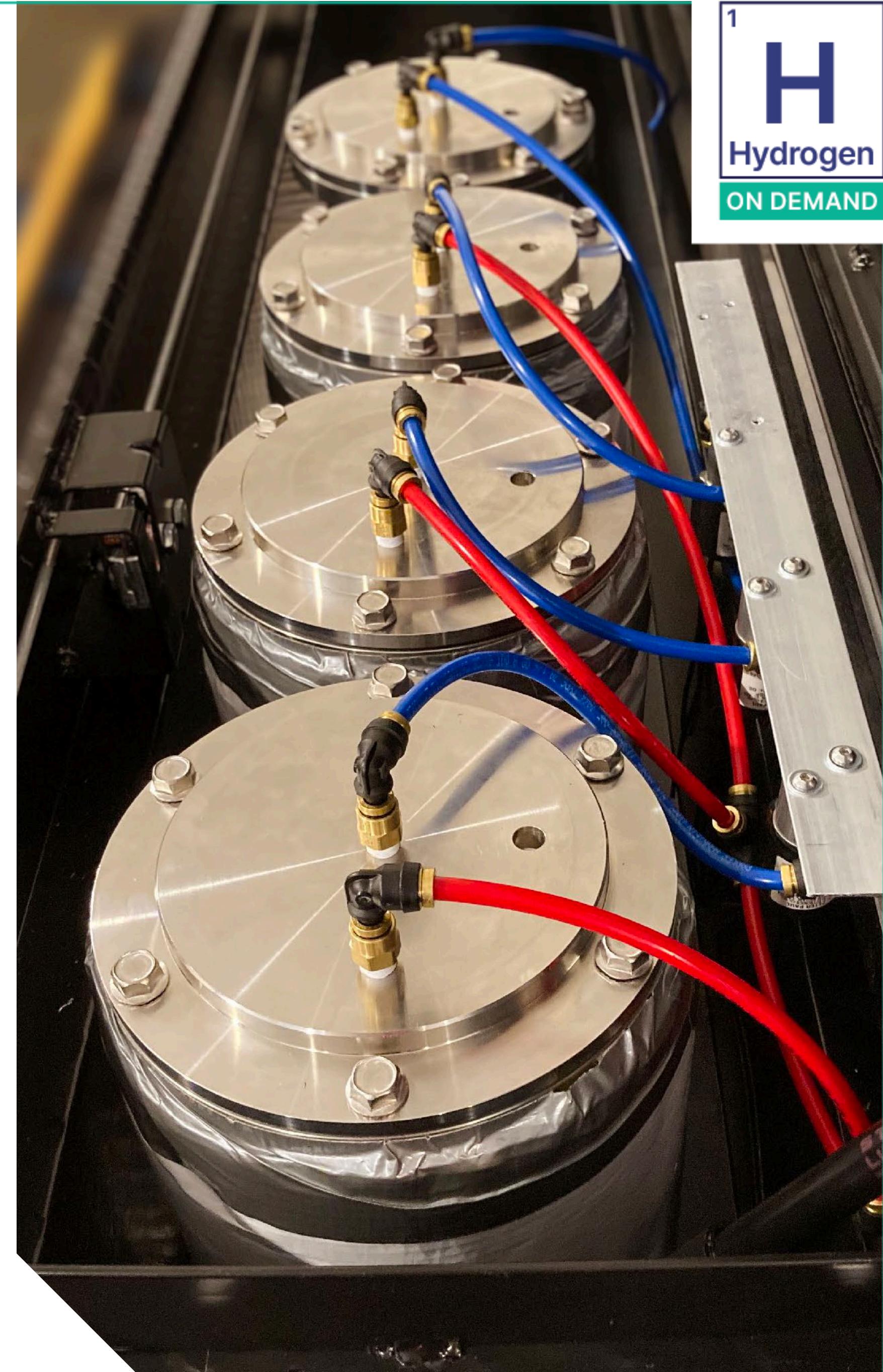


SYSTEM 5.0

Technology

- Issued Patents – Material Science
- Proprietary Technology – Actual Operation

Patented Technology

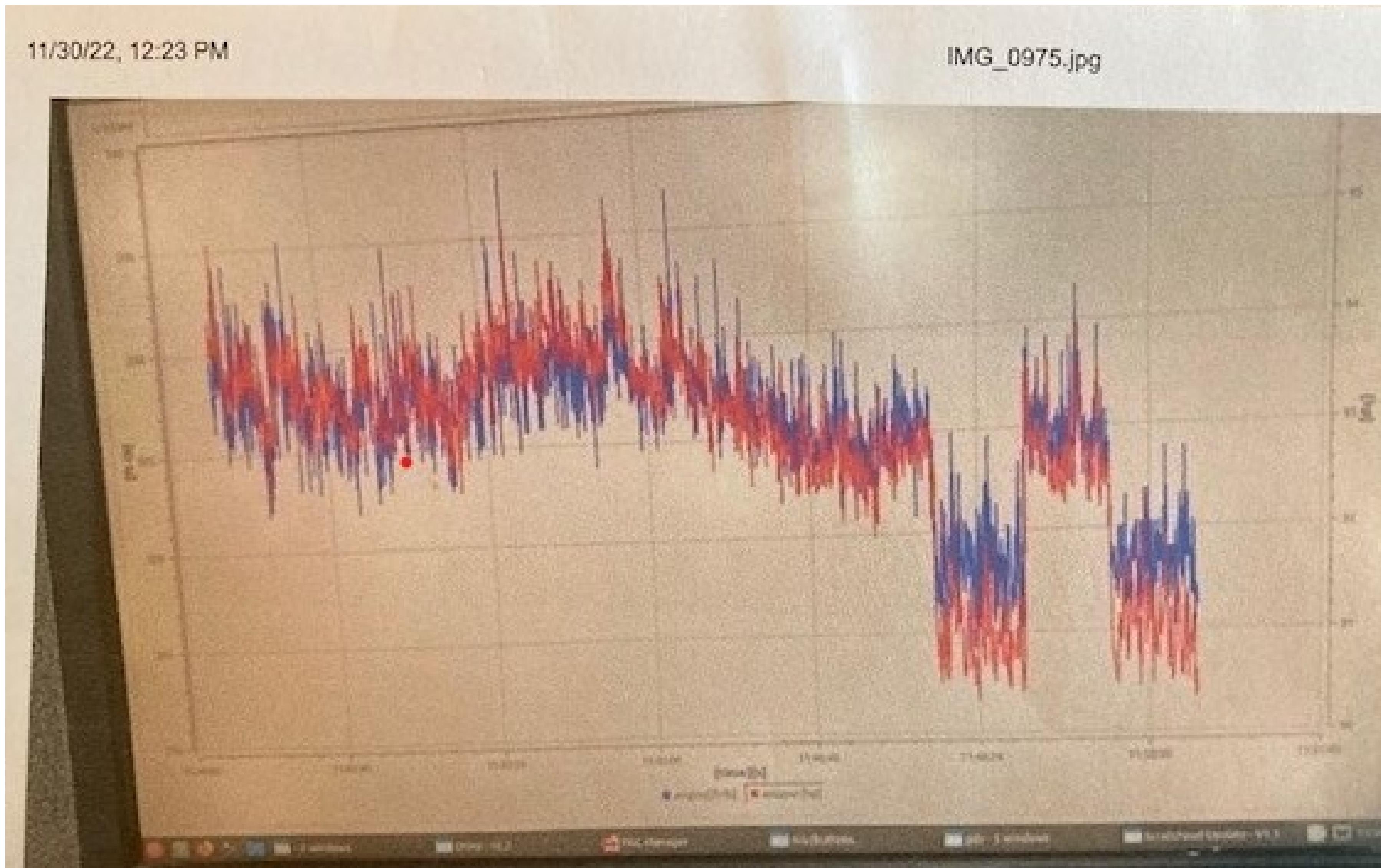


Test Results

Reference	Test conditions			Performance		Emissions					Comments
	Load	EGT	H ₂ supply	BTU	SMC	PM	HC	NOx	CO	CO ₂	
Verde and Frame (37)	62%, 100%	No	14% - 17%	Green	White	Green	Red	Red	White	Green	1,800rpm
Ueki et al. (38)	25%, 75%	0 - 13%	2.5% - 15%	White	White	Red	Red	Red	White	White	3,600rpm
Saravanan and Nagarajan (33)	25%, 100%	No	9.4% - 37%	Green	White	Red	Red	Red	White	White	
Saravanan and Nagarajan (34,35)	50%, 75%	No	9.4% - 37%	Green	White	Green	Red	Red	White	White	
Saravanan & Nagarajan (34,36)	25%	No	2 - 9.5rpm	Green	White	Green	Red	Red	White	White	
Saravanan & Nagarajan (34,36)	50%, 75%	No	2 - 9.5rpm	Green	White	Green	Red	Red	White	White	
Saravanan & Nagarajan (34,36)	50%	No	2 - 9.5rpm	Green	White	Green	Red	Red	White	White	
Zhou et al. (41)	10%	No	10% - 40%	Red	Red	Red	Red	Red	White	White	
Zhou et al. (41)	30%	No	10% - 40%	Red	Red	Red	Red	Red	White	White	
Zhou et al. (41)	50%	No	10% - 40%	Red	Red	Red	Red	Red	White	White	
Zhou et al. (41)	70%, 90%	No	10% - 40%	Red	Red	Red	Red	Red	White	White	
Sandakki and Karagiannis (43)	100%	No	0 - 45%	Red	Red	Red	Red	Red	White	White	
Manzoor and Mehmood (47)	20% - 100%	No	10% - 100%	Green	White	Green	Red	Red	White	White	Variation of injection timing
Saravanan et al. (48)	100%	No	0 - 38.6%	Green	White	Green	Red	Red	White	White	NOx reduced for H ₂ to 30%
Saravanan and Nagarajan (49)	0 - 100%	No	0 - 100%	Green	White	Green	Red	Red	White	White	NOx increase for high loads
Tsujimura and Suzuki (50)	3 - 9bar IMEP	No	0 - 90%	Red	Red	Red	Red	Red	White	White	
Suzuki and Tsujimura (51)	Partial	0 - 35%	50% - 70%	Red	Red	Red	Red	Red	White	White	
Suzuki et al. (52)	4.2 - 10.5bar IMEP	0 - 25%	0 - 83%	Green	White	Red	Red	Red	White	White	

- Supplemental Hydrogen in ICE proven technology
- AlGalCo Hydrogen actual operations results

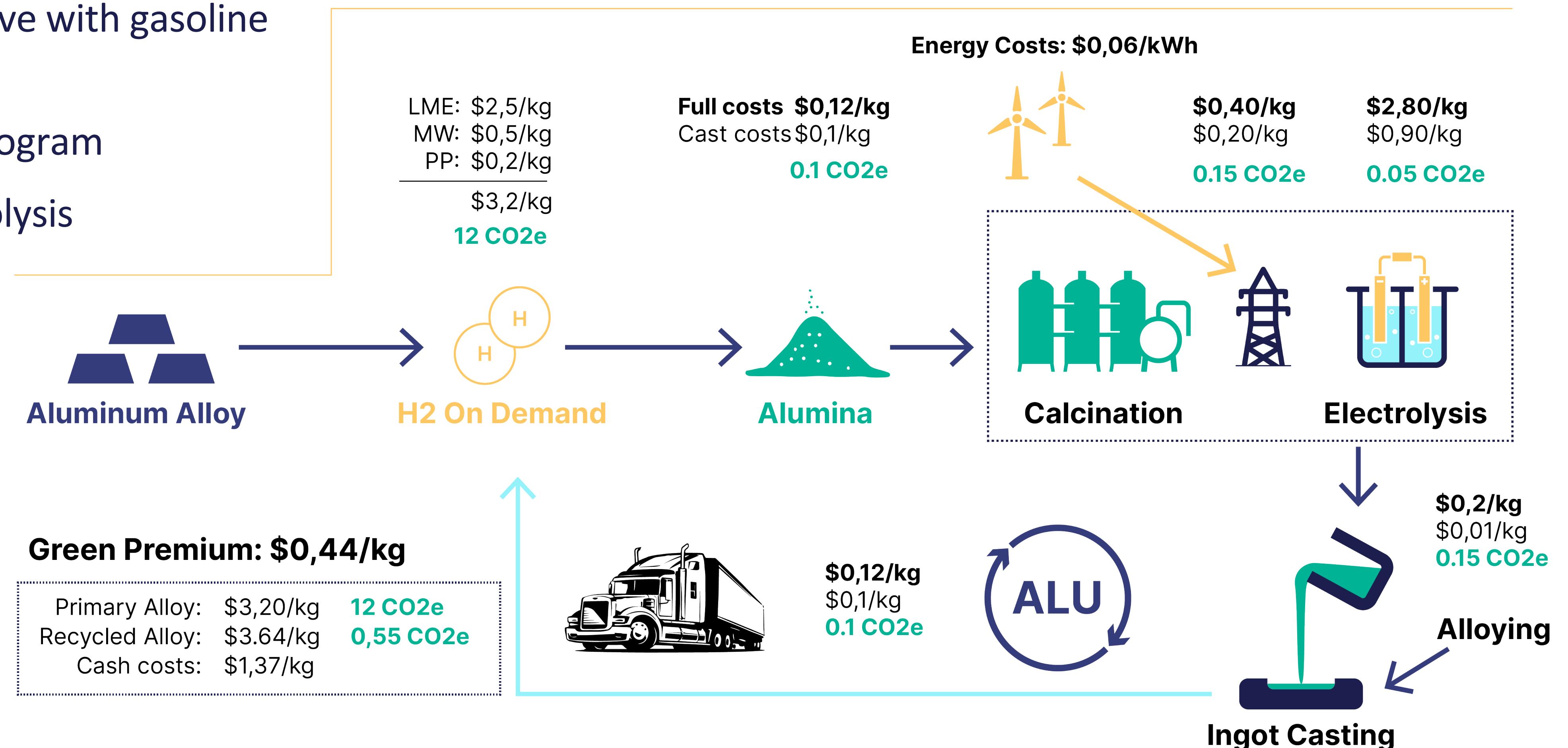
Test on 15L Diesel Engines



- Lower emissions
- Increased fuel efficiency

Closed Loop Recycling Hydrogen On Tap Aluminum Alloy Industrialization

- Cost competitive with gasoline and diesel
- Inert anode program
- Molten electrolysis



For cost reduction of the Hydrogen

Mid-size engines generate 1kg/truck/week

Class 8 diesel engines generate 150kg/truck/week

Class 8 trucks	7,800	Kg/y	
NA market	4,000,000	Trucks	
# of trucks			Market
10	78	MT/y	0.00025%
100	780	MT/y	0.0025%
1,000	7,800	MT/y	0.025%
10,000	78,000	MT/y	0.25%
100,000	780,000	MT/y	2.5%
1,000,000	7,800,000	MT/y	25%

128,205 trucks generate 1,000,000MT of “grey powder” = 3.2% market penetration

Recycling and Expansion

Recycling



Aluminum smelters



Energy storage

Expansion



Transportation applications



Marine diesel engine
emissions reductions

Value Proposition

Reduces demand for gasoline and diesel

On Demand, so **NO** high pressure storage or refueling

Reduces harmful emissions

Completely renewable aluminum-based feedstock

No new refueling infrastructure

Cost-competitive with gasoline and diesel

No modifications of vehicle engine

EPA compliant

Meets or Exceeds GREEN Fleet Initiative Metrics

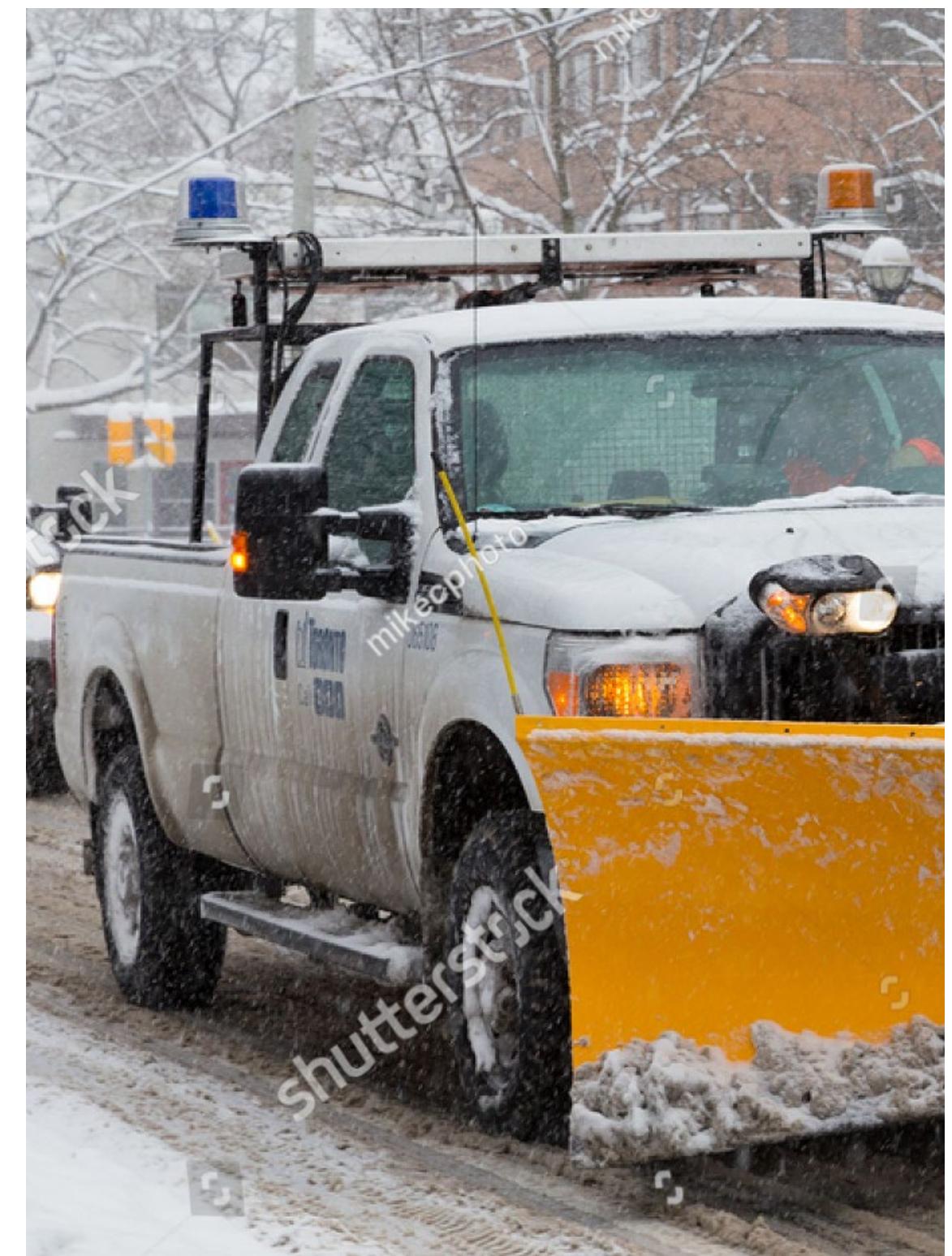
Scalable



PORTABLE
GENERATORS



FUEL
CELLS



5.4 LITER V-8
GAS POWERED FLEET
VEHICLES



15 LITER
OVER THE ROAD
DIESEL TRUCKS

Competition

Benefits	AlGalCo	Natural Gas	Water Electrolysis
Recyclable	Yes	No	Yes
Storage	Yes	No	No
Fuel Cells	Yes	Yes	No
Infrastructure	Yes	No	No

Advantages to Energy EcoSystem

- Fleet service providers
- Commercial Fleets
- OEMs
- The aluminum industry
- Windmill Farms
- Utilities

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