

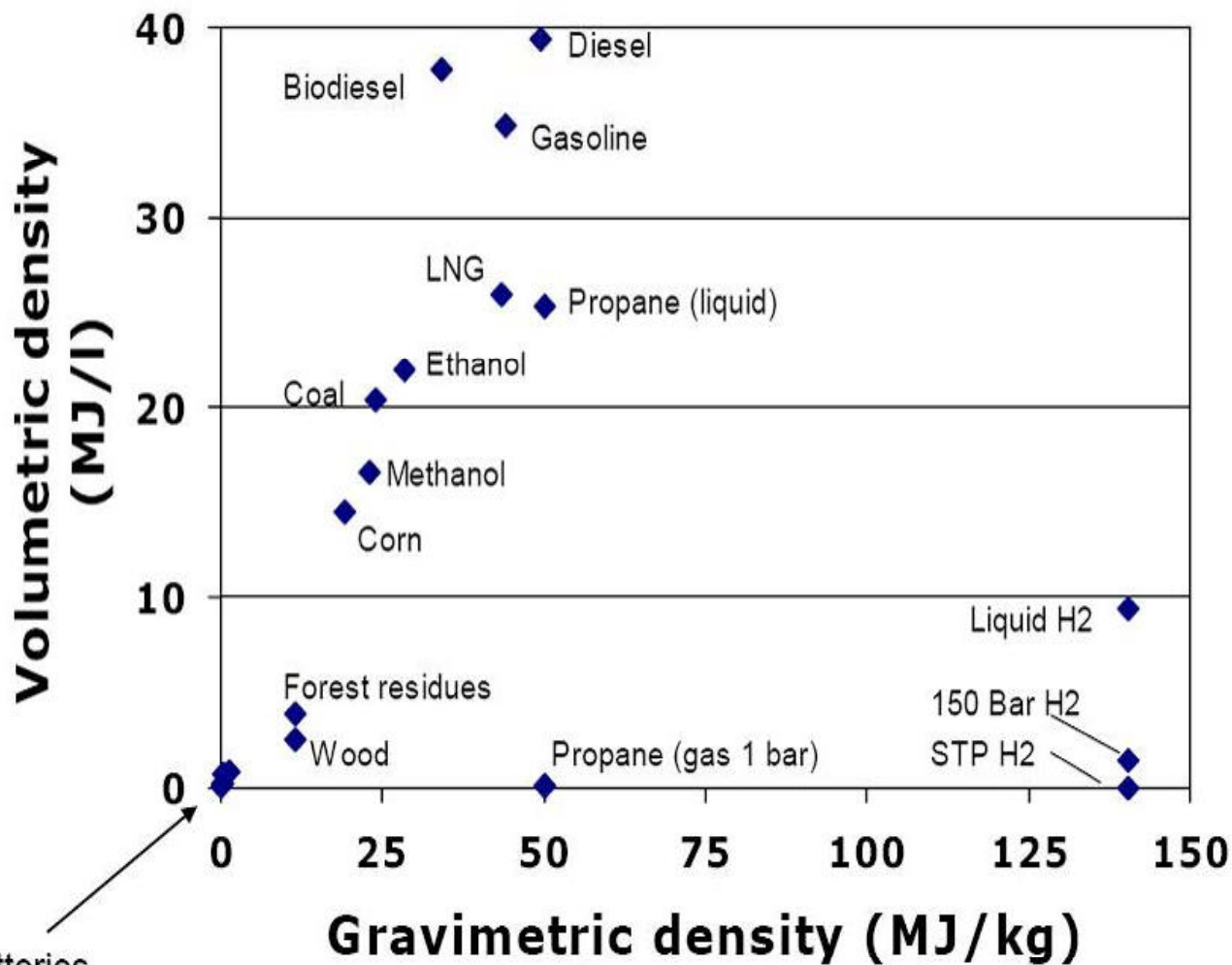


**Focus. Trust. Initiative.**

**Dantherm Power**

Energy Storage - April 2010

# Energy Density

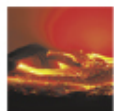


Most batteries  
Flywheel  
Compressed air  
Liquid N2

Table 1. DOE Hydrogen Storage Goals

Storage Parameter	Units	2005	2010	2015
Specific Energy	kWh/kg	1.5	2.0	3.0
	kg H2/kg System	4.5	6.0	9.0
Energy Density	kWh/l	1.2	1.5	2.7
	gm H2/l System*	36	45	81
Storage System Cost	\$/kWh	6	4	2
	\$/kg H2 capacity	200	133	67
Refueling Rate	kg H2/min	0.5	1.5	2.0
Loss of usable H2	(g/hr)/kg stored	1	0.1	0.05
Cycle Life	Cycles (1/4 to full)	500	1000	1500

\*For reference, liquid H2 density is 70 gm/l.



# Practical metal hydride storage



\$1000 per kWhre

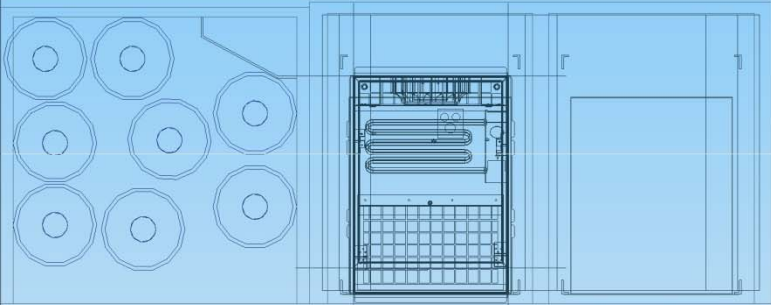


# Layout of H<sub>2</sub>



35 days  
continuous  
operation in 3m  
container

1 day  
reserve



1.7kWe  
backup  
power  
system



# Hydrogen Fuel Cells beat Diesels

## Sample Case



# Diesel Combustion



- Cell on Wheels (COW) delivered for temporary network support
  - WhisperWatt (63 dbA @23 feet) diesel genset
  - 2.2 litres per hour @ lowest power, 60 litre tank
  - Refilled every other day by diesel truck

Neighbourhood rejected site due to noise and smell.



# Zero Carbon



- Cell on Wheels (COW) delivered for temporary network support
  - Silent fuel cell generator in secure container
  - 0.3 litres per hour @ exact power, 22 tanks inside
  - Tanks replaced every week

Where you are now is louder than this Dantherm.





## Customer wins



- No noise, no pollution
- Invest in Backup power system for life of the site and all emergencies
- Use for Temporary Power until the grid is connected
- Maintain 24 hour Backup time to eliminate diesel gensets completely



# Backup power system eXtdenDed



7 days at 700We



# Extreme climate Northern remote critical



Battery free configuration reduces cost and complexity.

Eliminates need for air conditioners.

Reduces energy consumption and improves power quality.

0 ms bridge from grid power to full fuel cell backup.



# Real need for energy storage



Telecom site #1

- a) 2 kWe continuously for 16 hours
- b) 50 We for 2 months
- c) minimum temperature -25C
- d) maximum temperature +50C
- e) 10 cycles over 10 years

Less than 300kg in 20kg max unit  
Less than \$3000 capital

