

# Metal hydride for portable applications



# Agenda

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- **Introduction**
- **About Voller Energy**
- **Portable applications**
- **Metal hydride technology**
- **Voller Energy products**
- **Ovonic canisters**
- **Availability in USA**



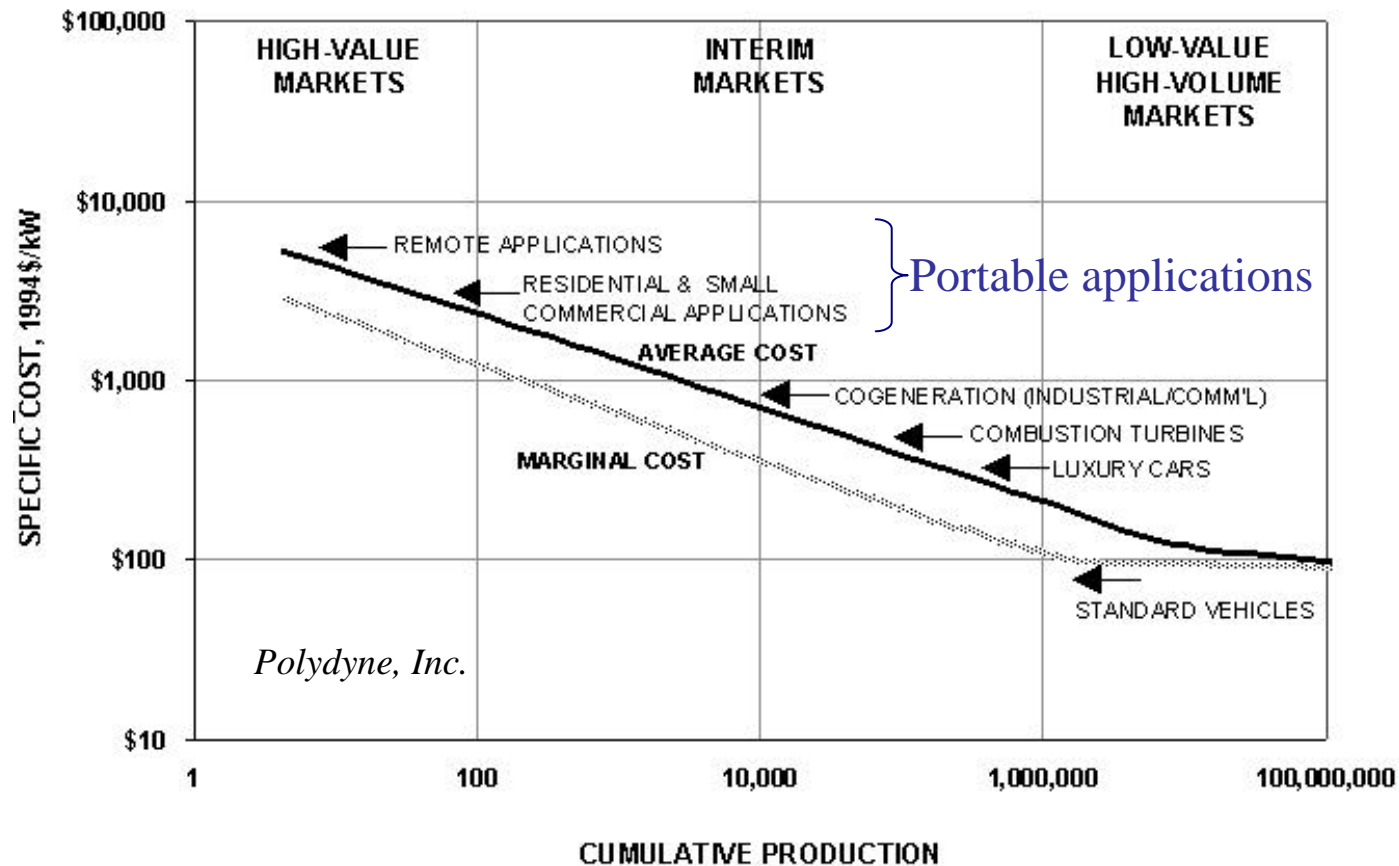
# Voller Energy Group PLC (LSE:VLR)

- Founded 2002
- Clean energy solutions for a lower carbon economy
- Based Basingstoke, UK
- Floated on AIM in February 2005
- Two products that use metal hydrides – fuel cell ABC and RBC



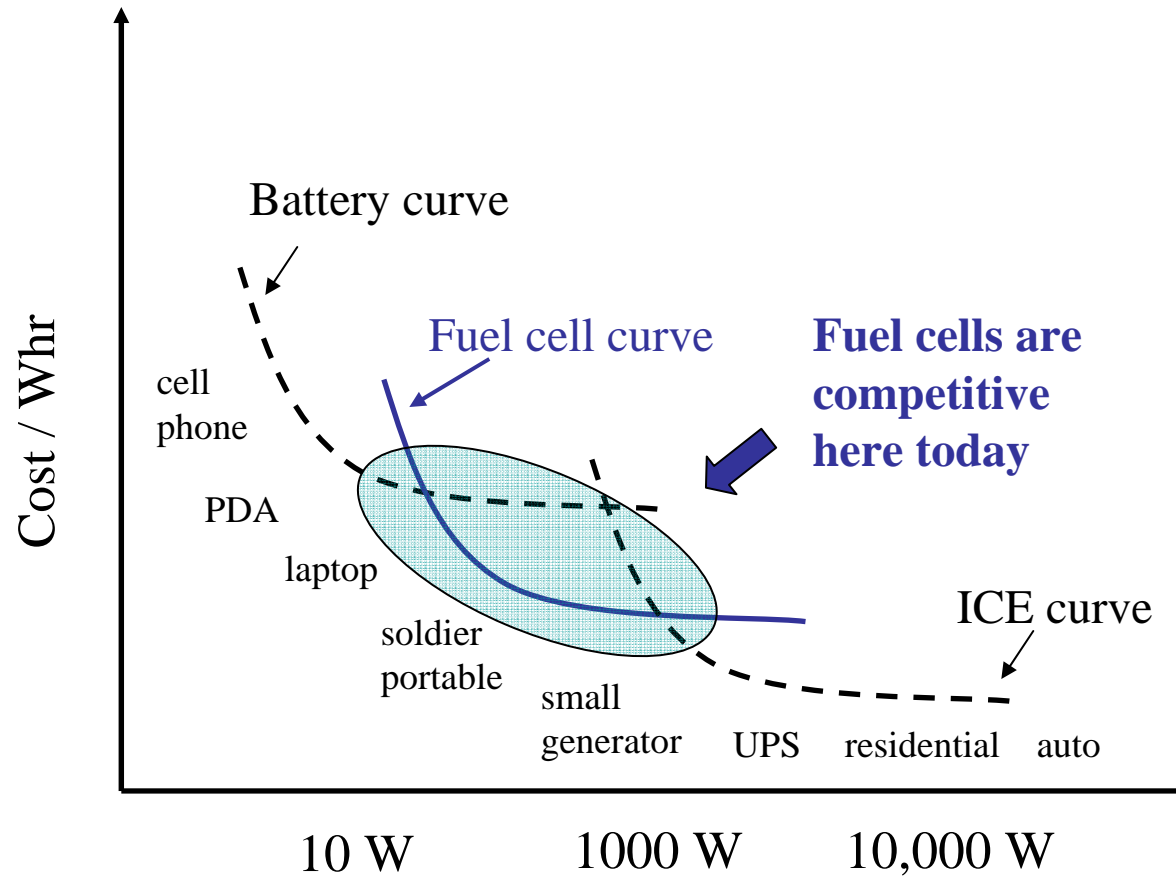


# Why portable?



Portable fuel cell products are here today!

# Portable power range



Source: Protonex

## Portable fuel cell value proposition

- vs. Batteries
  - Compact
  - Longer runtime
  - Consistent performance
  - Hot-swappable
  - No memory effect
  - No self-discharge
  - Environmentally sound
- vs. ICE gensets
  - Compact
  - Quiet
  - Emission free

## Hydrogen storage methods

- Traditional liquid or compressed hydrogen
  - Readily available, but not particularly well suited for portable applications
- Nanotechnologies
  - Excellent laboratory results, but difficult to reproduce and certainly not yet ready for commercial marketplace
- Reversible metal hydrides
  - Proven, safe, reusable, commercially available

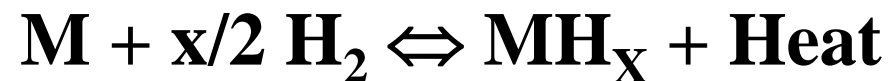
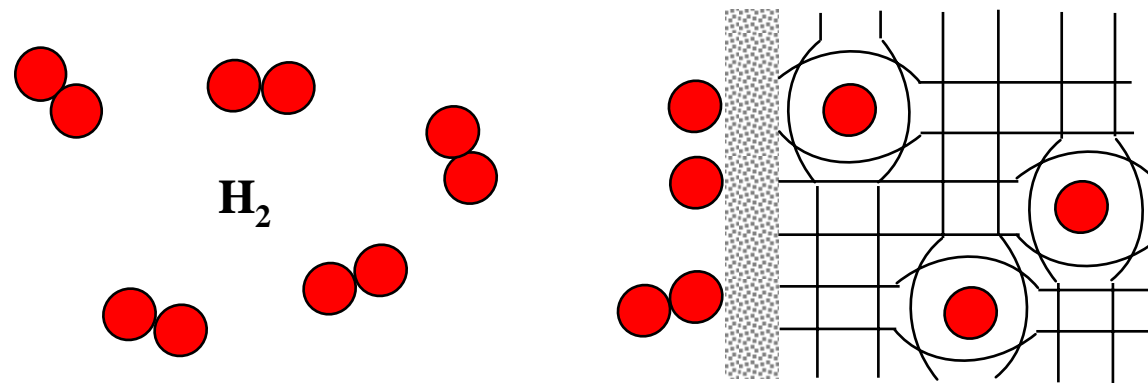
# What are metal hydrides?





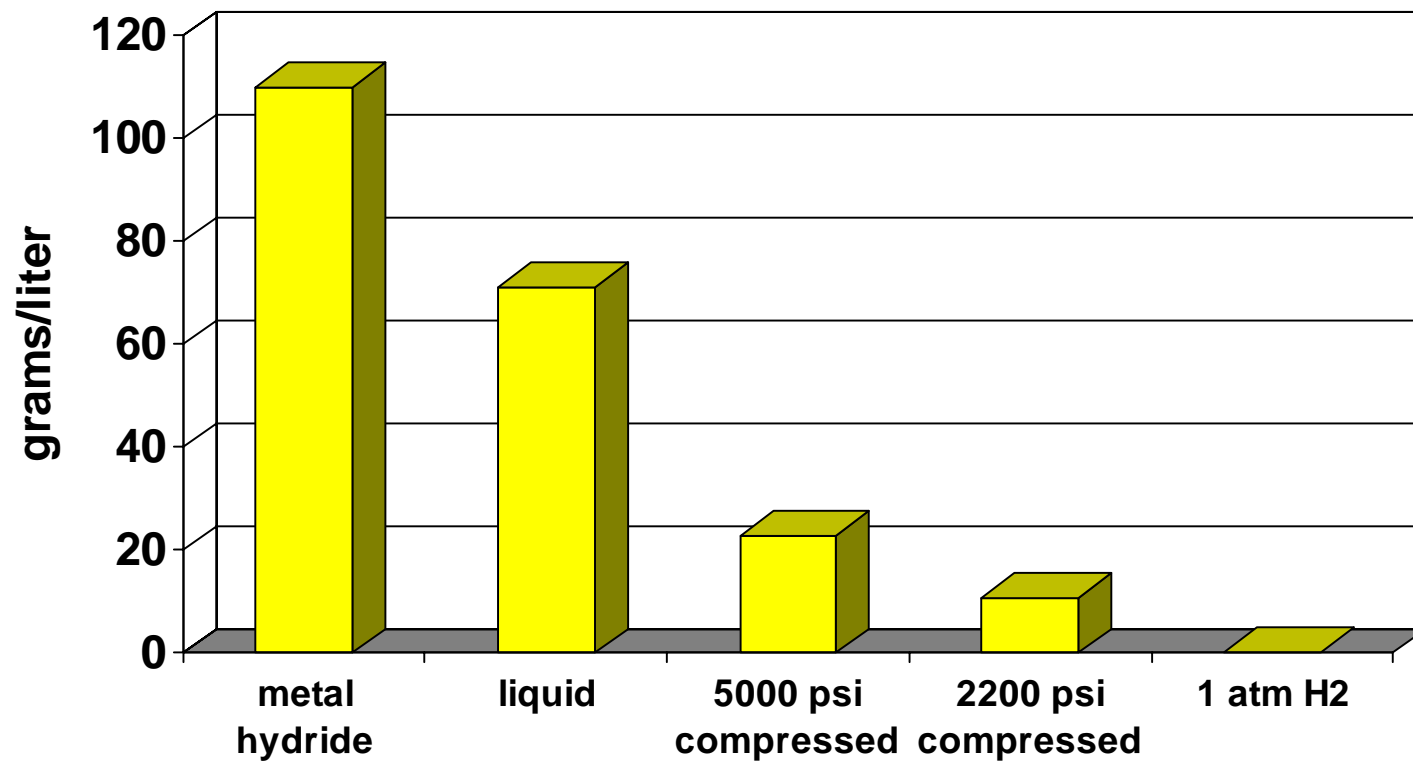
## How do metal hydrides work?

Hydrogen is absorbed into, and chemically bonded to a host metal alloy. Heat is generated in the process.

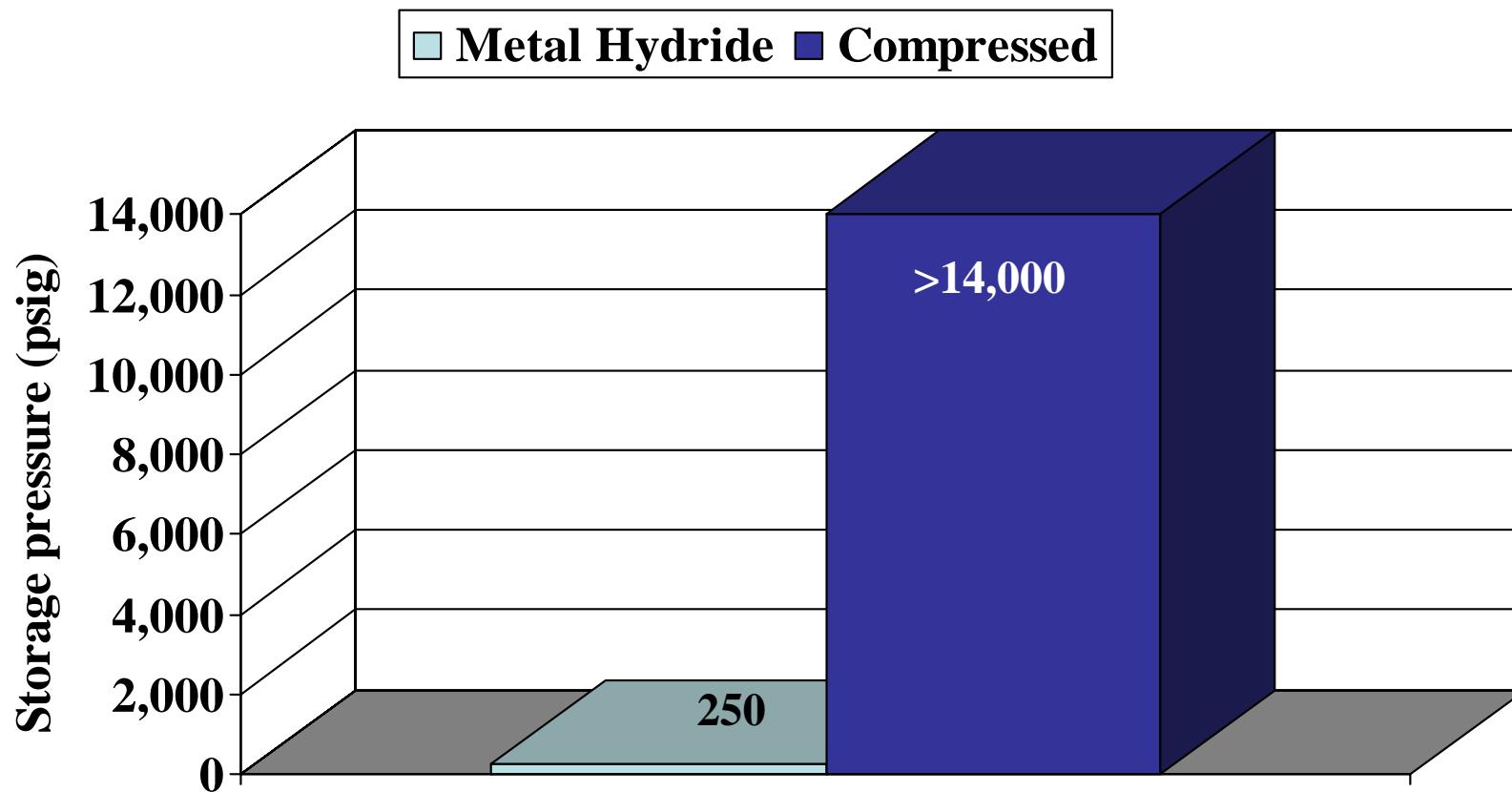


**Changes in heat or pressure can drive the reaction in either direction.**

## Metal hydrides offer a significant storage density advantage



## Pressure requirements to store similar quantities in the same size vessel



## Other advantages of metal hydrides

- Ambient temperature & pressure operation
- Ultra-high purity hydrogen delivered
- Maintenance free
- No cryogenic temperatures or “boil-off”
- Flexible packaging
- Excellent kinetics
- Long life
- Scaleable to virtually any size
- Tailorable to fit the requirements of a particular application



## Metal hydride myths

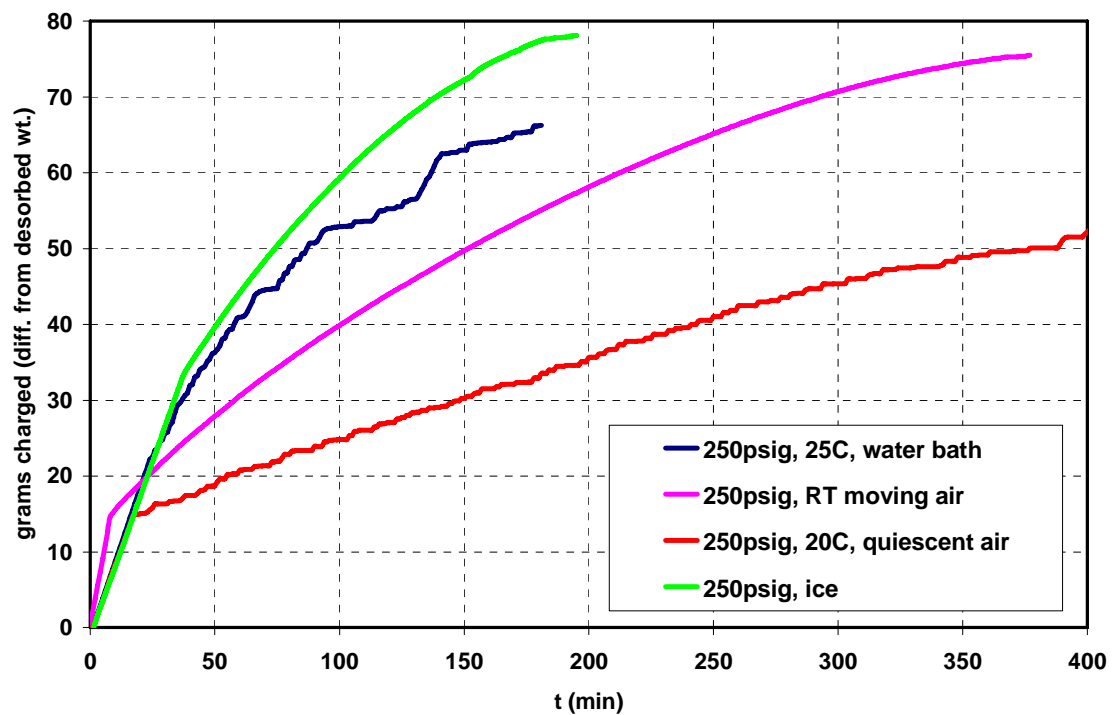
- Don't you need to add heat to release hydrogen?
  - No. The storage alloy used in Ovonic portable canisters is specially formulated to absorb and desorb hydrogen under ambient conditions.
- Isn't refilling a complex process?
  - No. The canister used in the Voller ABC can be recharged in about 2 hours, simply by providing hydrogen at a pressure of 250psig.

# Canister refilling

- 250 psig regulated hydrogen supply
- Active cooling is optional



85G250B canister refilling at 250psig



# Fuel cell ABC – Automatic Battery Charger

- Self contained fuel cell system
- Metal hydride canister slots into side of unit
- Mains inverter built in – 110v AC just like regular wall socket
- Also has 12v DC output, automobile cigar lighter

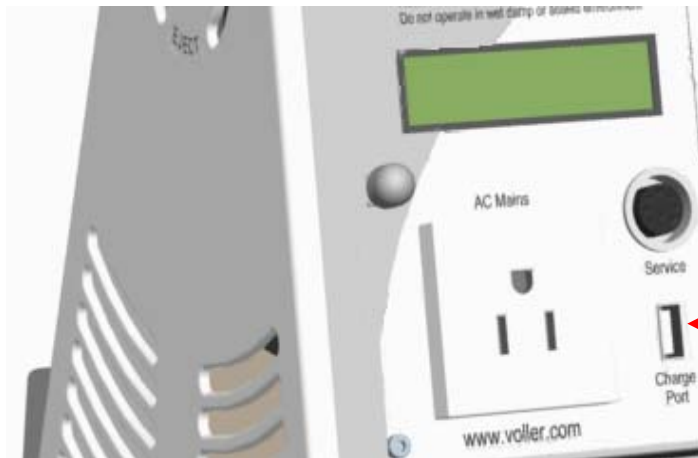


# ABC USB charging port



## USB Charging Socket

Below the serial port on the front panel, we have added a USB charging socket, which is rated at 300mA maximum. This can be used to charge MP3 players, iPods, or similar low power equipment.

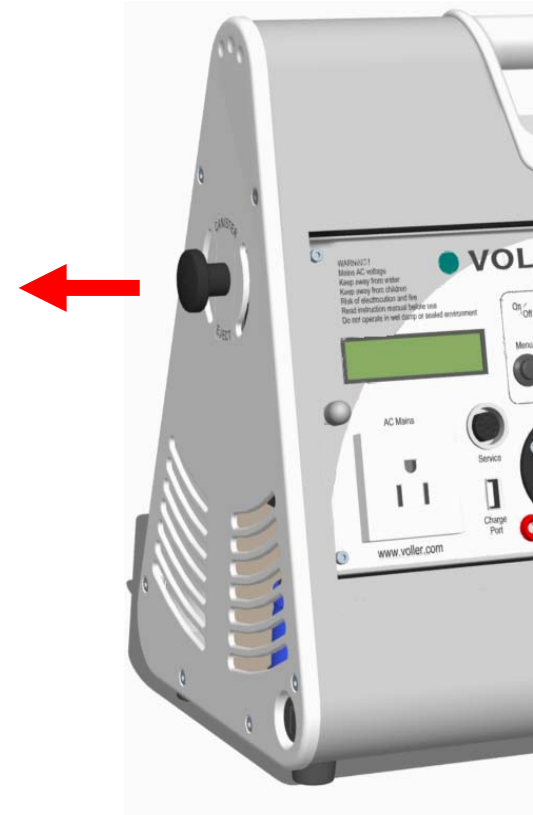




# ABC Canister ejection

## Improved Canister Ejection

We have redesigned the mechanism that releases the canister. We have also relocated the ejection lever to the side of the unit. It is bigger than the previous model and therefore is easier to pull.



# Fuel cell RBC – Remote Battery Charger

- Industrial version
- Designed to fit in standard 19" telecoms rack
- 12v DC output as standard
- Metal hydride canister can be internal or external



# ABC Features Explained

## Automatic Battery Charging

This mode can be selected via the front panel using the menu and select buttons. The system will automatically monitor the level of the internal battery and any load being applied to it and when that level drops below a preset voltage, the system will switch itself on and top up the battery to its optimum level. The user has the advantage of now being able to set the voltage levels where the unit begins and stops charging.



# ABC frost sensor



## Frost Sensor

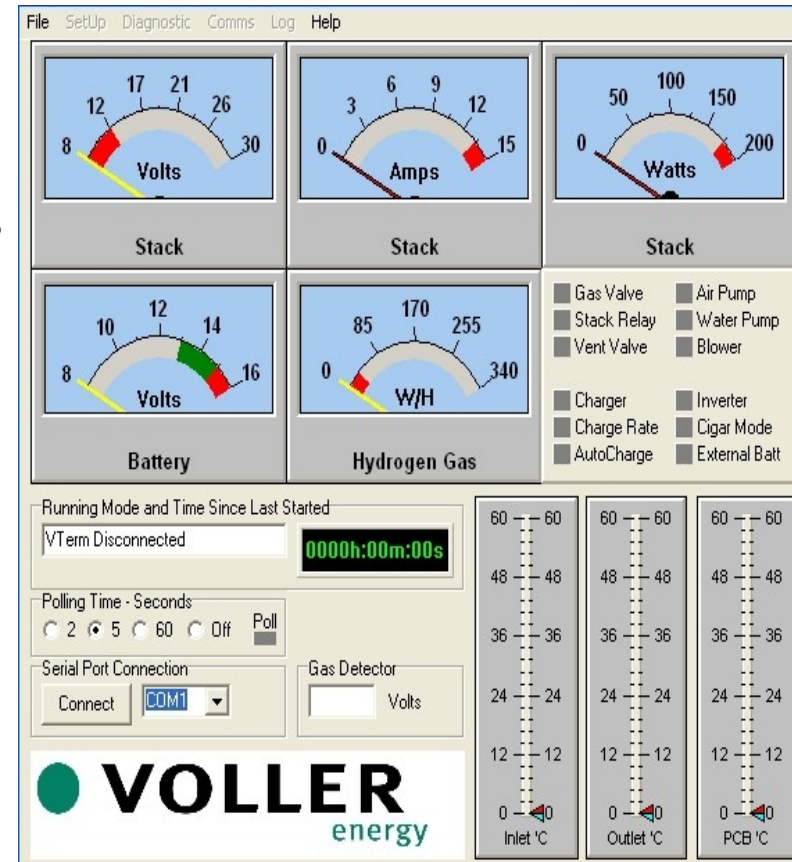
The ABC now has a frost sensor built in which works when the system is in automatic mode.

When the temperature drops to  $+2^{\circ}\text{C}$ , the system will automatically switch on and remain on until the temperature has reached  $+7^{\circ}\text{C}$ . It will then switch off again. It will continue to do this automatically.



# ABC, RBC Control Capabilities

- External diagnostic programme via GSM dial-in.
- Access to all parameters and controls
- Connection via front panel
  - Remote connection via modem
- Data logging for fault finding
- Ability to modify control parameters
- Monitor fuel consumption remotely



## Available in US from

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# Ovonic metal hydride canisters

- 3000 units in field
- 4 models available
  - up to 900 liter size
  - custom products available
- All meet requirements of DOT-SP13280 allowing transport with hydrogen



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