



2009 Joint Services Power Expo

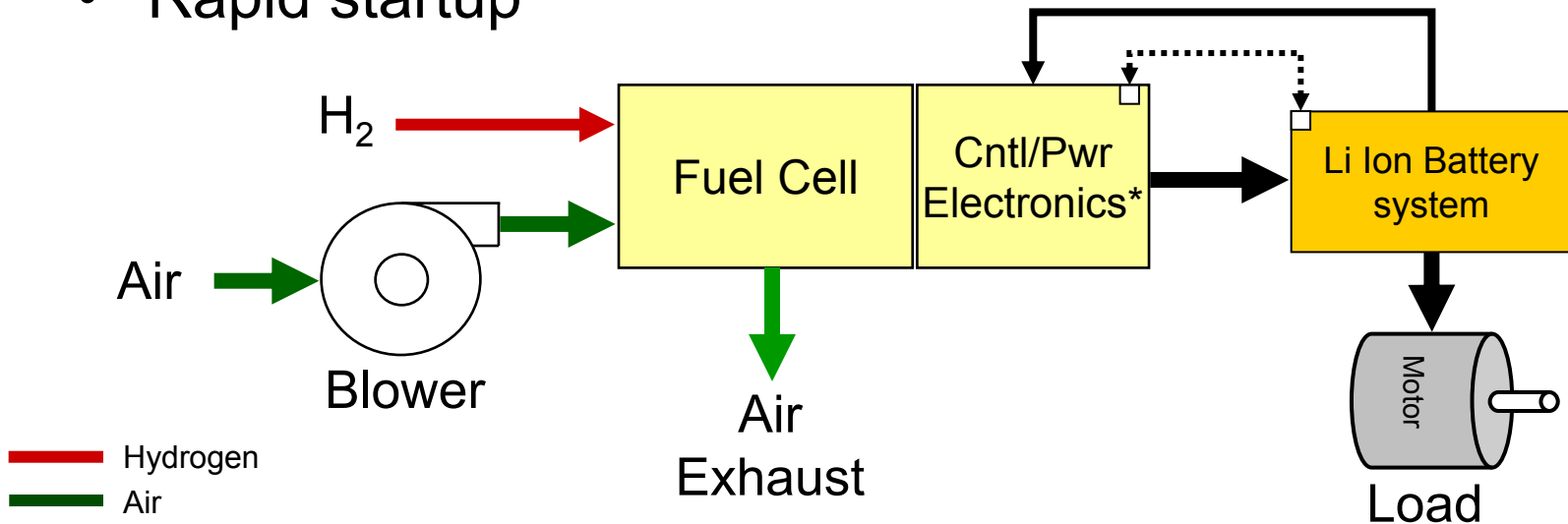
High Temperature PEM Fuel Cell/Lithium Ion Hybrid
Power Source for Ground, Air and Sea Platforms

Michel Fuchs – EnerFuel
Adam Hunt – EnerDel

May 7, 2009
New Orleans, Louisiana

EnerFuel Fuel Cell/Li-Ion Hybridization

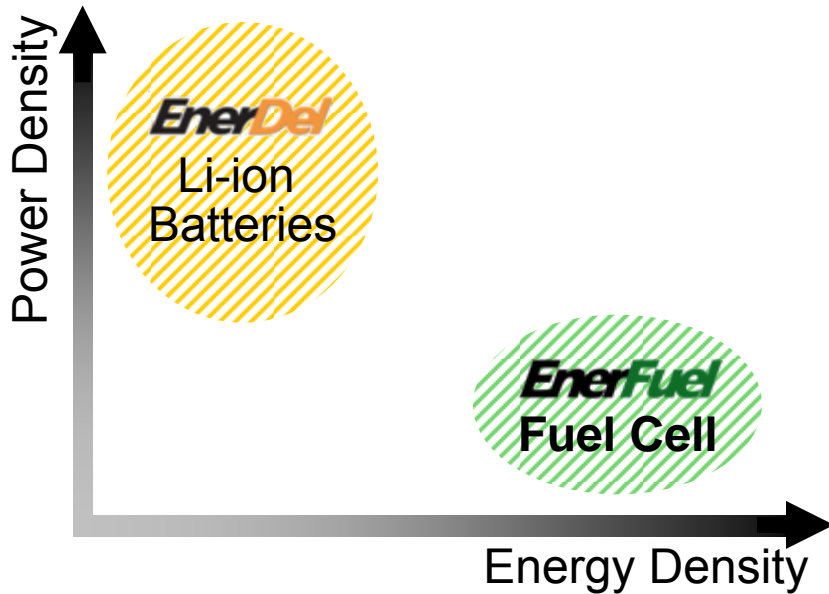
- Fuel cell sized for average power, battery for peaks
- Smaller fuel cell and battery
- Reduced fuel cell and battery cost
- Maximizes fuel cell and battery longevity
- Rapid startup



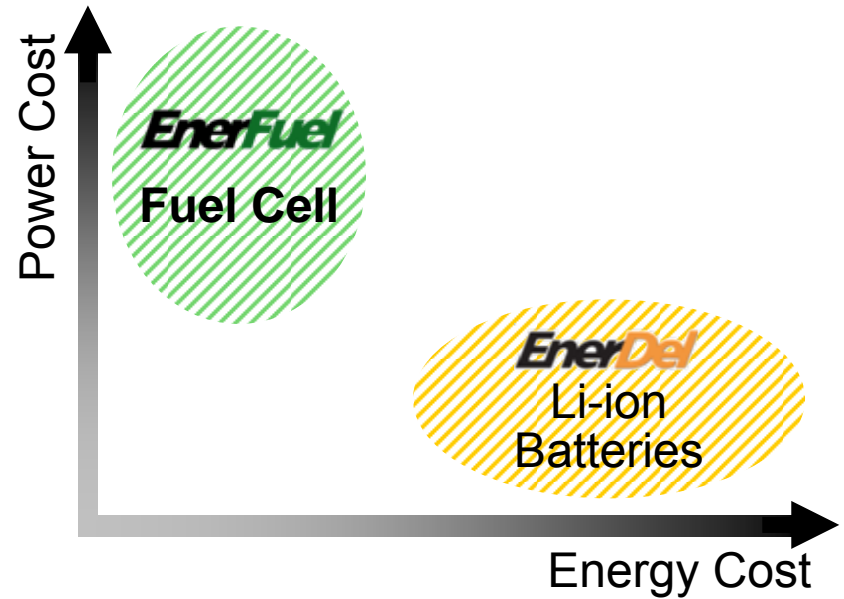
*Controls electronics, buck converter, and power conditioning

Fuel Cells & Batteries Enhance Each Other

Power / Energy Comparison

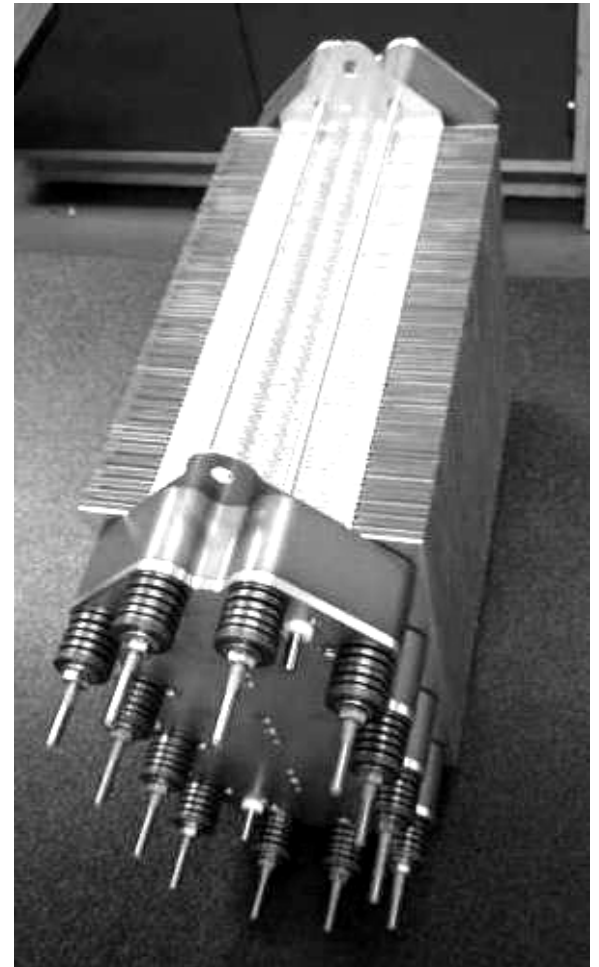


Cost Comparison

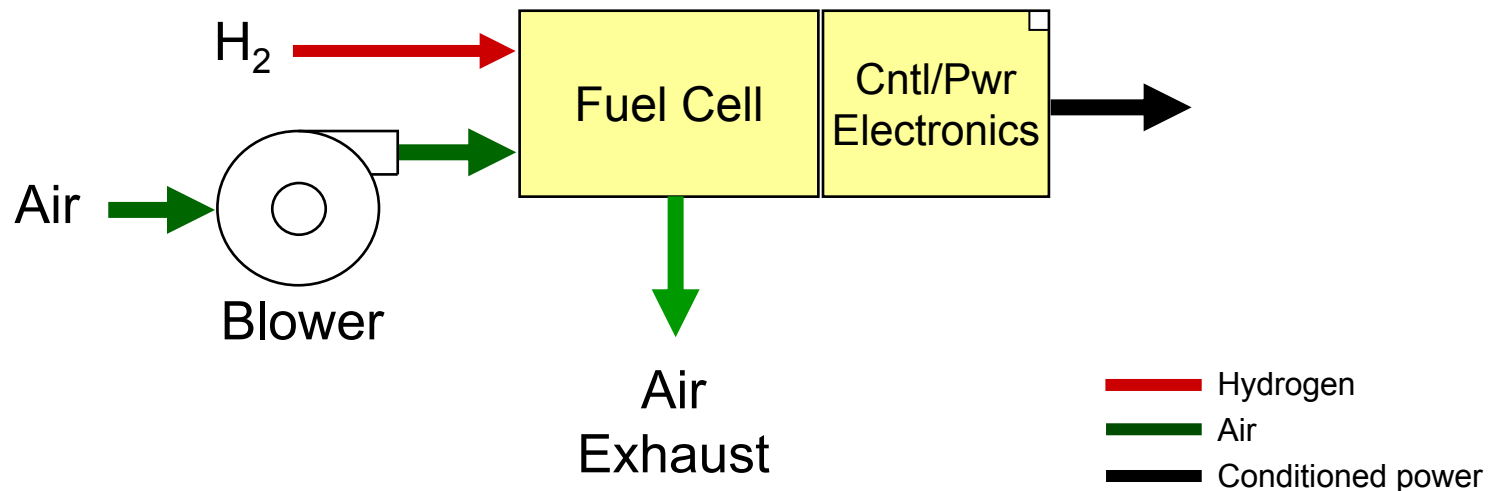


EnerFuel High Temperature PEM Fuel Cell Technology

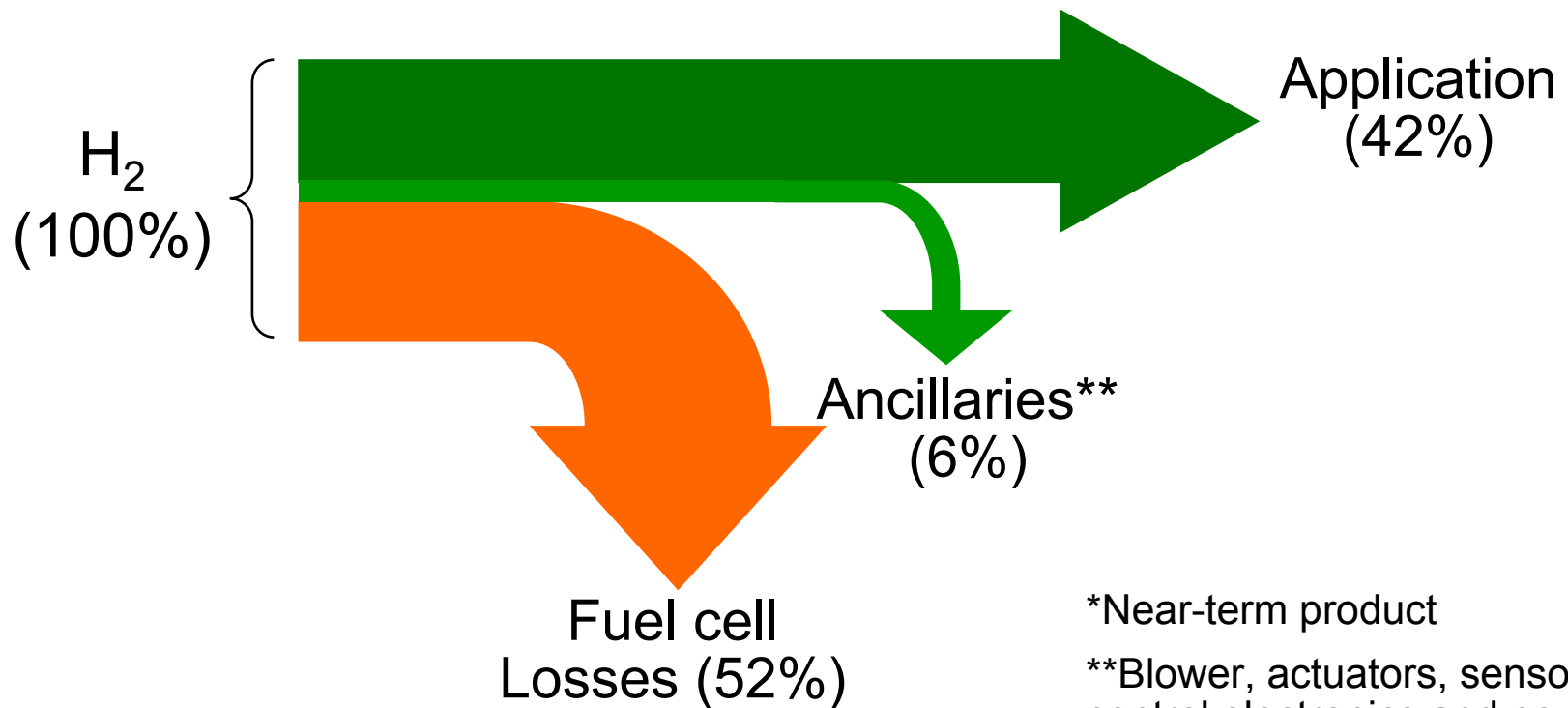
- SIMPLE
- EFFICIENT
- LIGHT WEIGHT
- FUEL FLEXIBLE
- APPLICATION FLEXIBLE



- Air cooled fuel cell stack, no radiator and liquid cooling system
- No liquid management problems
- No humidification of inlet air necessary
- Inherently suited to low cost mass production



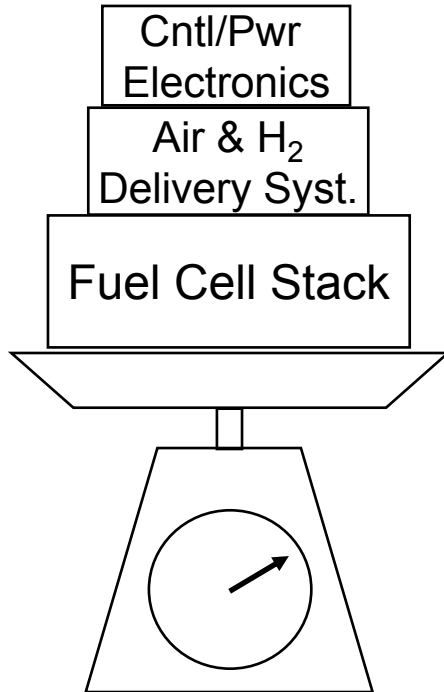
- Efficiency greater than 42% (including power conditioning)
- Startup*: 50% power in less than 1 minute
- Startup*: <280 Wh (1.0 MJ) from +20°C



*Near-term product

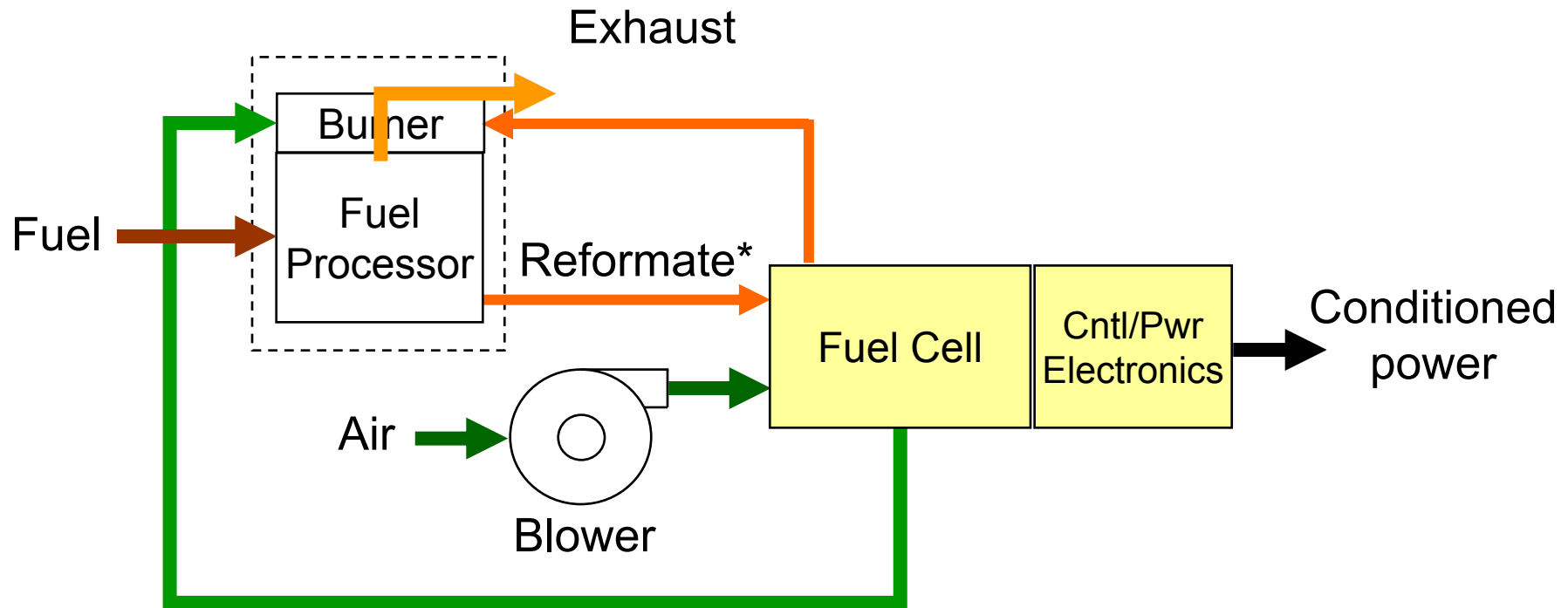
**Blower, actuators, sensors, control electronics and power conditioning

- Near-term commercial product: 133 W/kg
- With aggressive weight reduction: >150 W/kg



$$= 30 \text{ kg} \rightarrow 4\text{kW} @ 30 \text{ kg} = 133 \text{ W/kg}$$

- Can accommodate low quality reformat (CO \leq 3%)
- Can use low cost reformer w/ minimal cleanup stage
- Possible fuel choices: methanol, NG, diesel, JP8



*H₂ rich gas

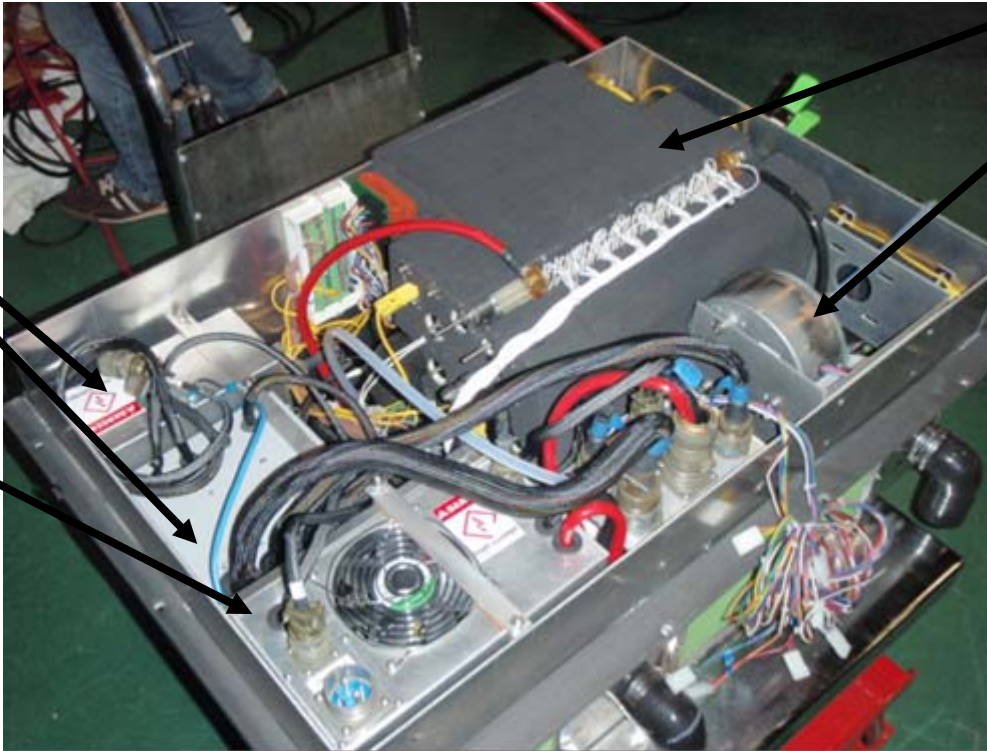
- APU, backup power, primary power
- Tolerate wide range of environmental temperatures
- Less susceptibility to freezing
- Low thermal & acoustic signature



Transition to Commercialization

Control electronics

Power electronics



Fuel cell stack with manifolding

Blower

Specifications

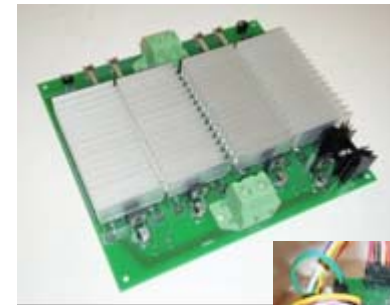
- TRL-6 equivalent
- 57 kg
- >40% efficient
- \$80k

3kWnet TRL-6, HT-PEMFC system prototype

- Weight & Cost
 - Consolidate control/power electronics into single module
 - Stack material replacement and component reduction
 - Projected weight of: 30kg
 - Projected fuel cell cost: \$9k*
- Timeline
 - Commercial ready product by end of 2011



Fuel cell stack with manifolding

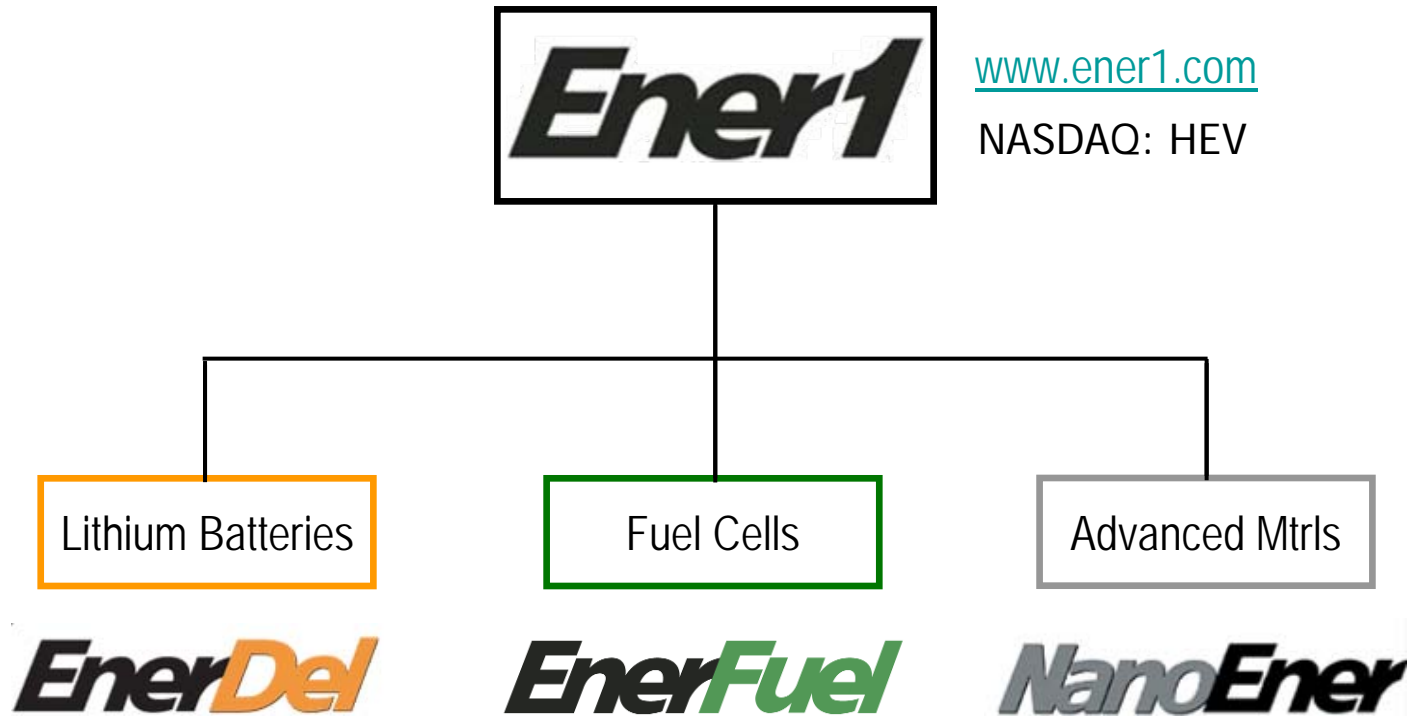


In-house power and control electronics hardware



* Minus margin, battery, or reformer

Company Overview



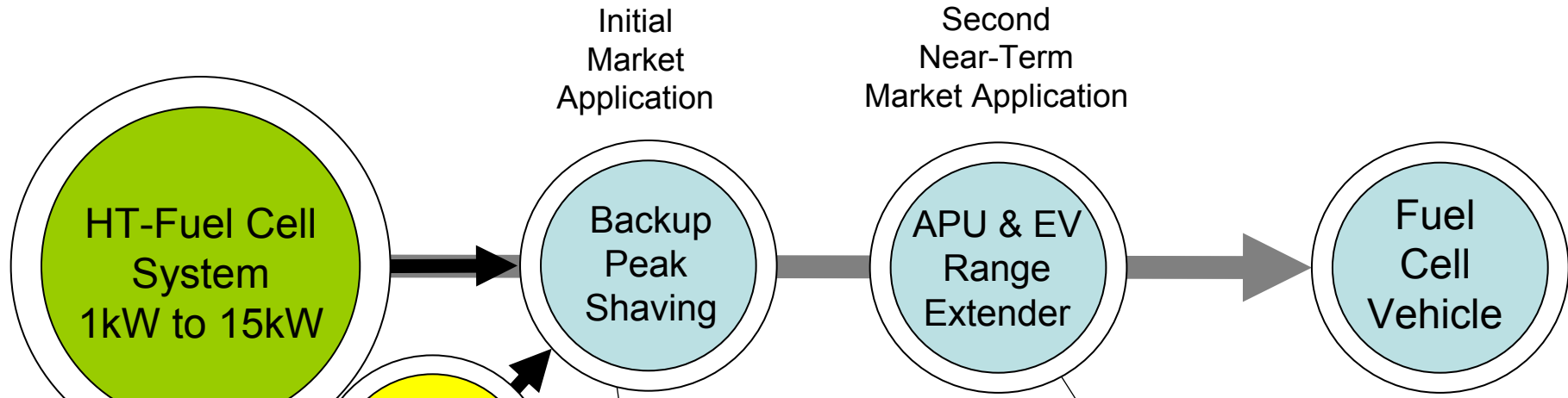
- Senior staff of 10 with an average fuel cell experience of 12 yrs
- Majority of senior staff legacy of  *energy partners*

- Staff composition:

- Mechanical Engineers
- Systems Engineers
- Electrical Engineers
- Material Scientists
- Computer Scientist
- Chemical Engineer
- Industrial Designer
- Chemist
- Technicians with close to 20 years individual fuel cell experience
- Business professionals



Product Roadmap

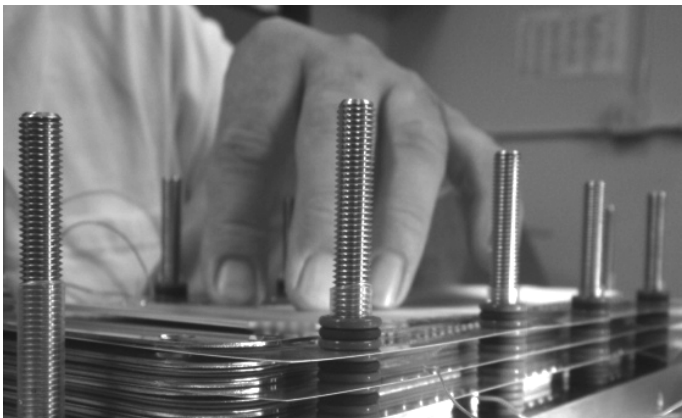


Core EnerFuel Technology

NG or LPG Reformer

Initial Market Application

Second Near-Term Market Application



Fuel cell stack assembly

Provides Point of Use Energy storage and Backup for the Electric Grid

- Increases grid efficiency
- Increase grid reliability
- Reduces carbon emissions

Commercialization Timeline:

First Article Test – 2010
 Product Qualification – 2011
 Market Introduction – 2012

Key to Mass Market EV

- Increases driving range
- Reduces vehicle cost

Commercialization

Timeline:

Proof of Concept - 2008
 First Article Test – 2010
 Product Qualification – 2012
 Incorporation into OEM vehicle - 2013

Prototype Vehicle Range Extender Specifications

EnerFuel Fuel Cell PHEV

- 3 kW fuel cell system
- 20 kWh net capacity
- 60 to 80 mile range extension



Q&A

**Please Visit Booth 111 for
Additional Information**

mfuchs@enerfuel.com
ahunt@enerdel.com