Low-Cost Manufacturable Microchannel Systems for Passive PEM Water Management IIPS Number 16910

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Battelle

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Project objective: Create a low cost and passive PEM water management system

Specific Targets Addressed for 3.4.2 Automotive-Scale: 80 kWe Integrated Transportation Fuel Cell Power Systems Operating on Direct Hydrogen

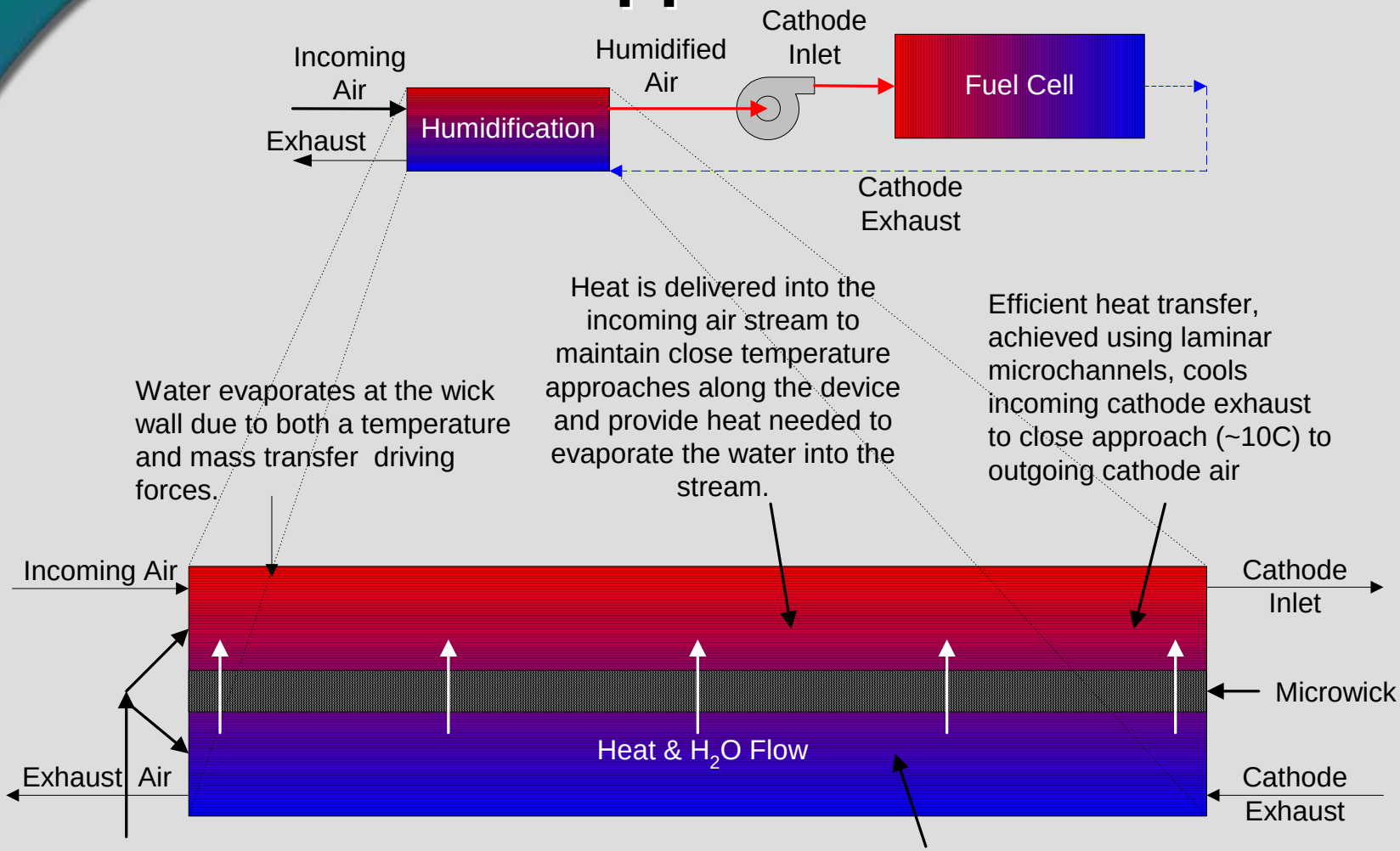
Target addressed	Target	80 kWe System Objective	% of System for Water Mgmt
Power Density	650 W/L	123 L	2 – 7%
Specific Power	650 W/kg	123 kg	2 - 9%
Cost	$30/kWe	$2400	< 7%

Project objective: Create a low cost and passive PEM water management system

Specific Barriers Addressed:

- **B: Cost:** *Balance-of-plant components specifically designed* for use in fuel cell systems need development in order to achieve cost targets. *Low-cost, high-volume manufacturing* processes are also necessary.
- **E: System Thermal and Water Management:** *Improved* heat utilization, cooling and *humidification* techniques are needed.

Technical Approach: Humidifer

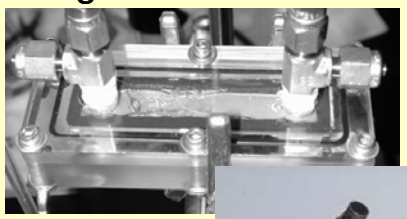


Advantages of Microwick Approach

- Passive operation
- Low pressure drop in device (operation with blower)
- Orientation independent
- Self recovery during process upsets

Relevant Prior Work: Microwick Technologies

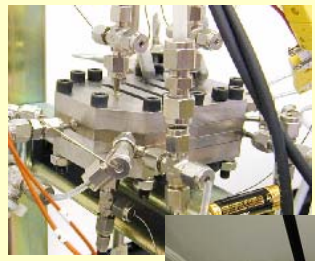
Single channel



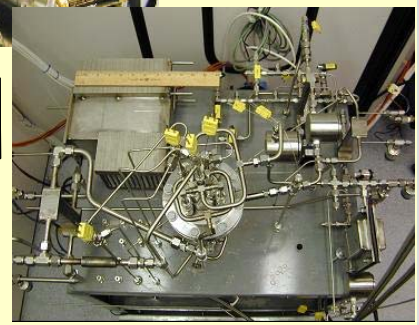
Phase separation

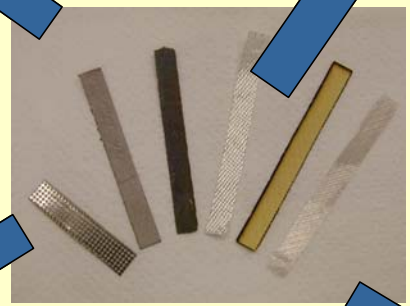
Multichannel

Absorption & Desorption

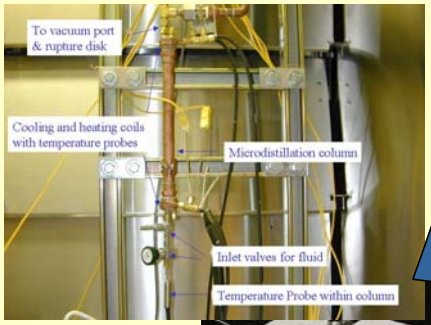


Integrated heat pump

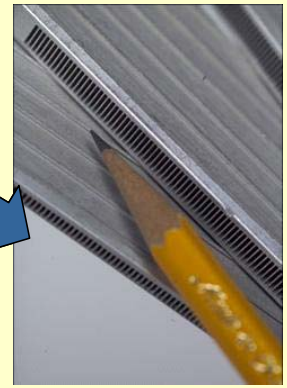




Microwicks allow two phase flow

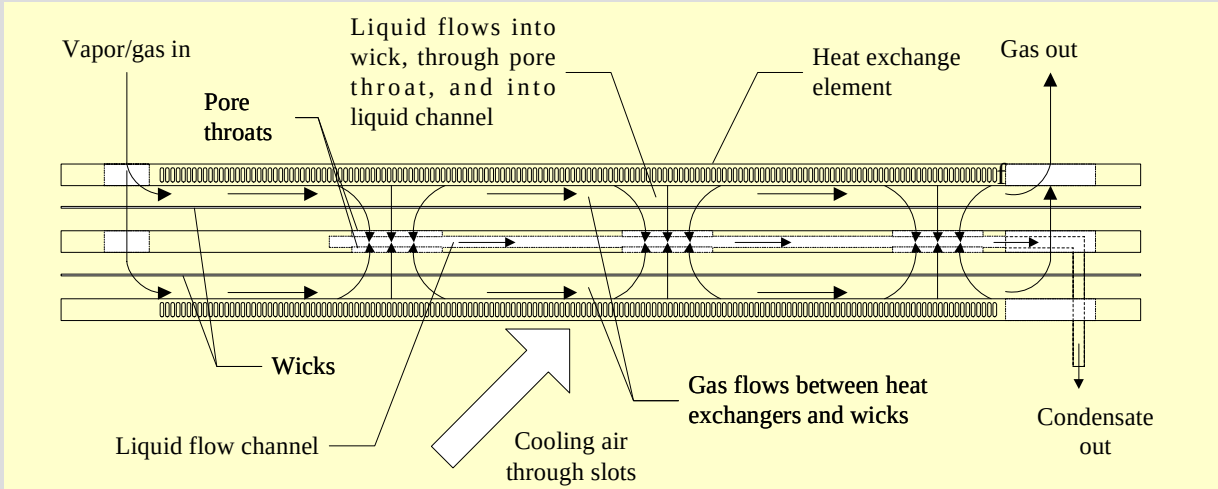


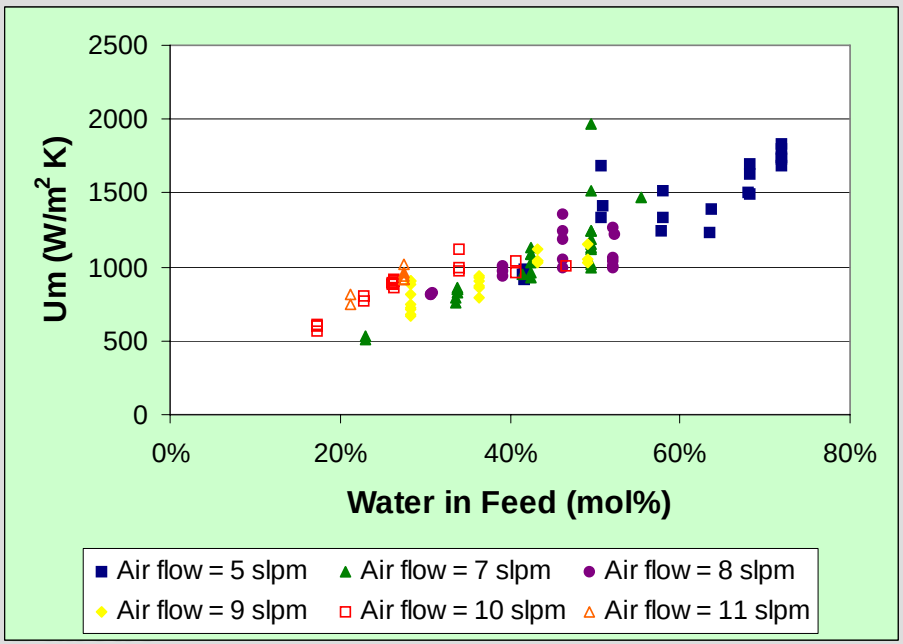
Distillation

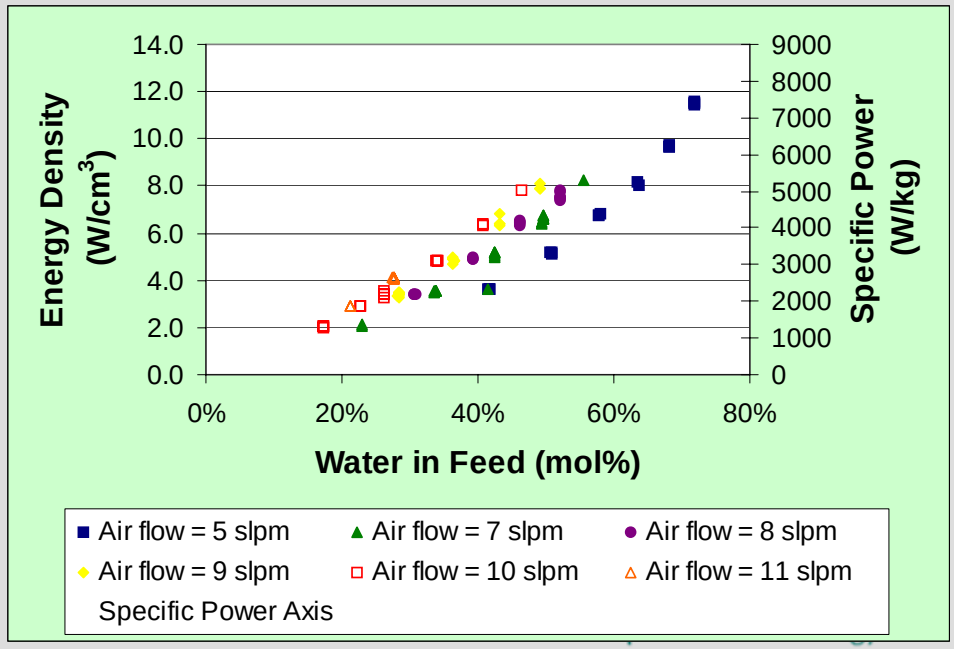


Phase separation with partial condensation

Performance for Phase Separation with Partial Condensation







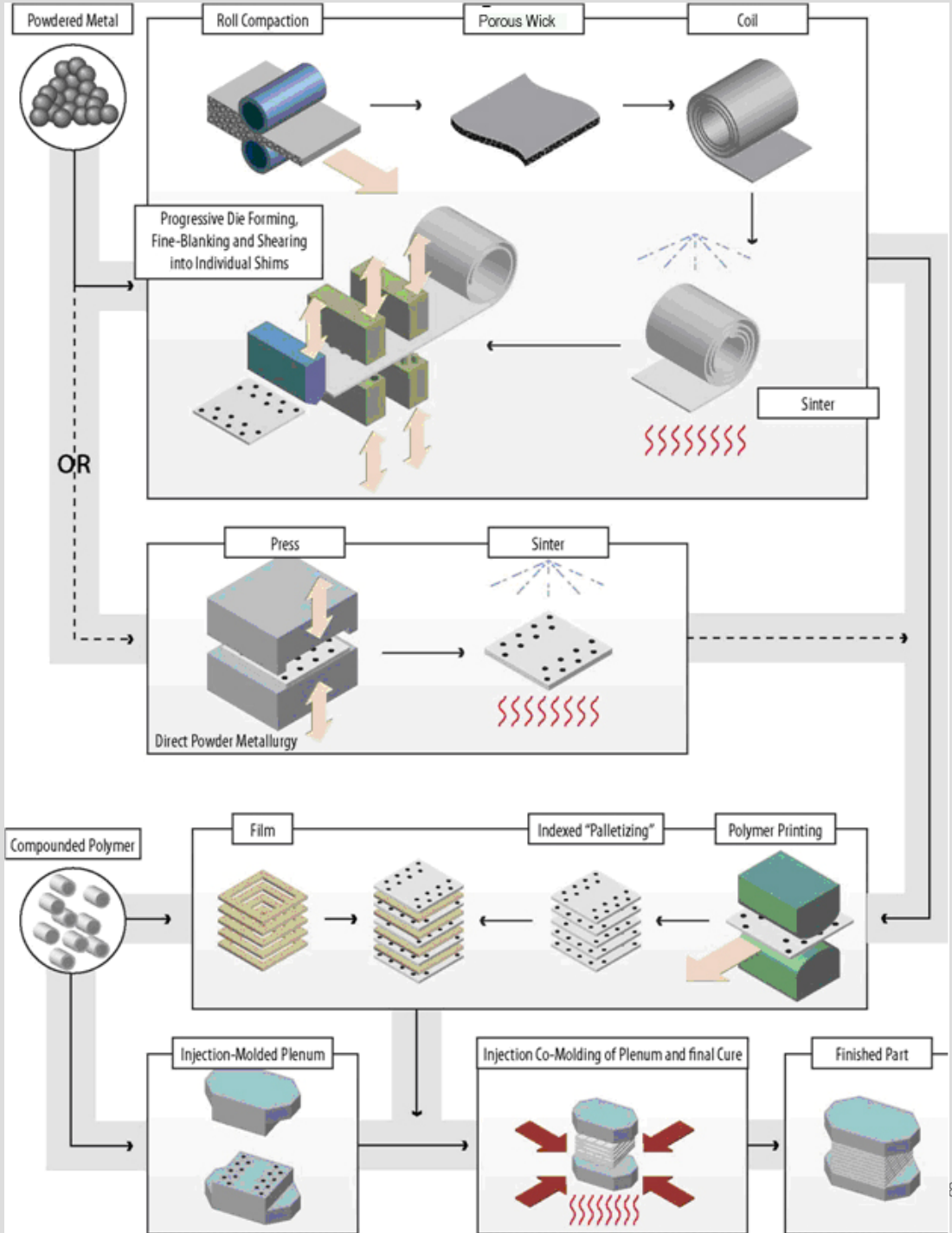
Fabrication Approach:

Raw materials:
Powder metal
Injection moldable polymer
Bonding resin

Wicks:
Powder rolling/
Progressive die stamping

Bonding layer:
Screen printing, pad stamping, robotic, discrete film, co-molding

Final co-molding and assembly



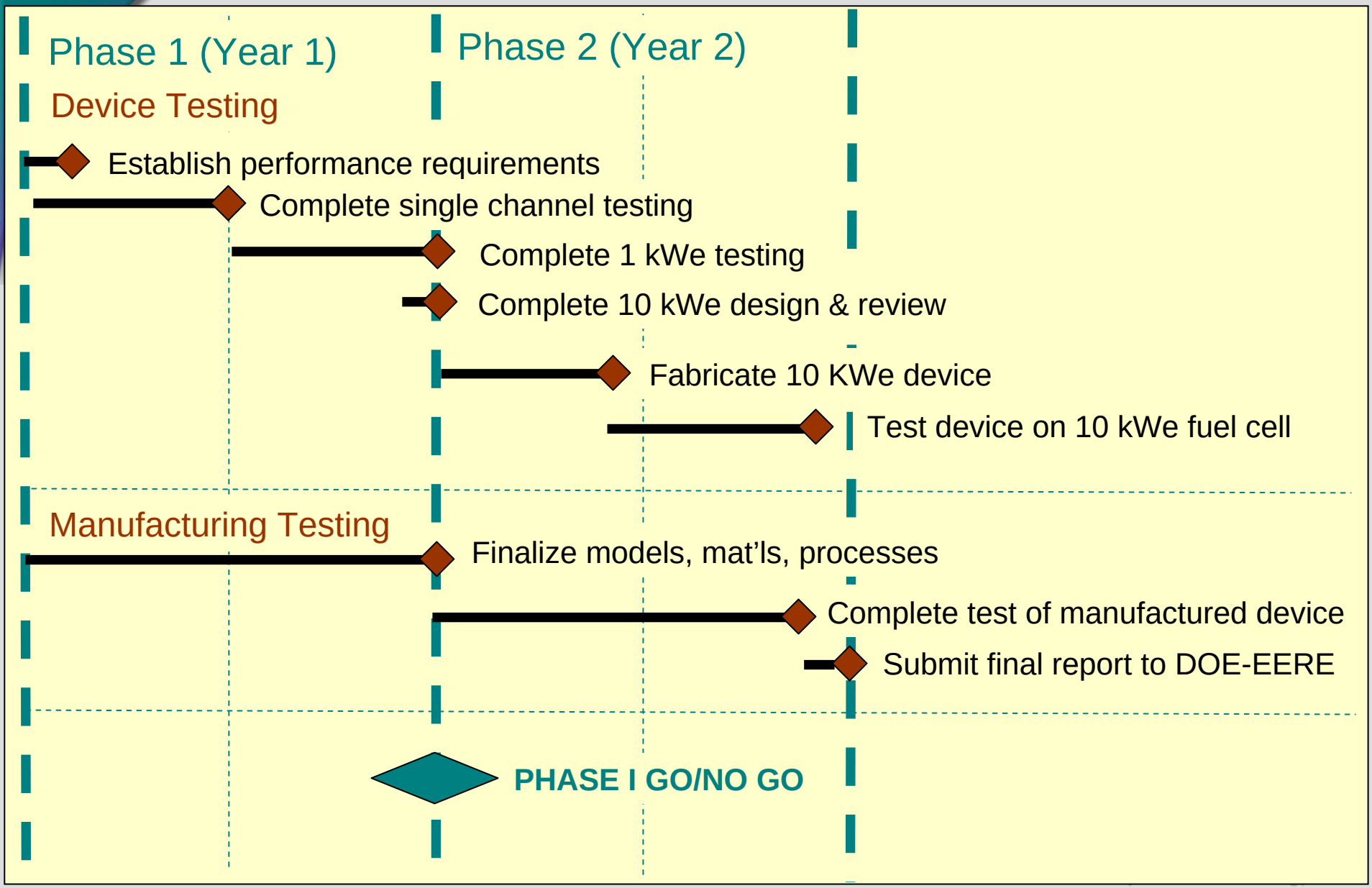
Relevant Prior Work in Manufacturing

Novel automotive components and processes
for high volume production

PACCAR Hybrid Door

Superplastic aluminum Malibu Maxx lift gift

Project Timeline (Start Date: February 2007)



Go – No Go Decision Point
12 Months/ End of Phase I

Evaluation Criteria

- Ability of device to meet weight and size targets
- Ability of device to handle varying conditions
- Costs for fabrication <$100 per device

Organizations and Budgets

- Organizations:
  - PNNL
    - Environmental Technology Directorate
    - Energy Science and Technology Directorate
  - Manufacturing Support
    - ADMA Product Inc. – Porous sheets for wicks
    - Protonex – Fabrication methods
  - System Testing Support
    - Hydrogenics
- Budget
  - FY 2007: $300K
  - FY 2008: $700K
- Needs/inputs –
  - Revise scope and schedule to reflect budget