CASE
SCHOOL OF ENGINEERING

Endura
PLASTICS, INC.
"Innovative Plastic Solutions"

Light-weight, Low Cost PEM Fuel Cell Stacks

Case Western Reserve University

Endura Plastics Inc.

Lead Investigators

<u>Case Western Reserve University</u>

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<u>Endura Plastics Inc.</u>

Mark DiLillo, President
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Endura Plastics Inc.

- Sub-contractor under CWRU
- Located in Kirtland OH
- specializes in the design, manufacture and assembly of critical safety products such as low pressure air sensing switches for the HVAC industry, automotive brake reservoir assemblies and precision medical components.

Role in this project:

- materials selection for the molded components
- mechanical and manufacturing analyses of the molded components
- design and selection of the tooling and molds, and molding processes required
- manufacturing and assembly of the molded components

Project Objectives

- **Demonstrate edge collected stack design capable of >1 kW/kg (system level)**
    - DOE 2010 targets: 2 kW/kg (stack), 650 W/kg (system)

- **Develop low cost, injection molded stack components**
    - DOE 2010 targets: $25/kW (stack), $45/kW (system)

- **Verify stack performance under adiabatic conditions**
- **Develop direct humidification scheme based on printed 2D microfluidics**
- **Develop optimized printable current collectors for edge collection**
- **Accelerate stack development by incorporation of multiple cell level sensors within the stack coupled with CFD modeling**

DOE Technical Barriers Addressed

Cost:

Known manufacturing processes – printing, injection molding
Low parts count, easier assembly
Eliminate costly bipolar plates, GDLs

Durability/Reliability:

Parallelled Sub-stacks for higher reliability
Design allows for membrane expansion with lower stress
Minimal balance of plant
no impact on durability issues related to impurities

Performance:

Light weight stack components
Minimal balance of plant – lower parasitic losses
Lower W/cm^2, but higher kW/kg

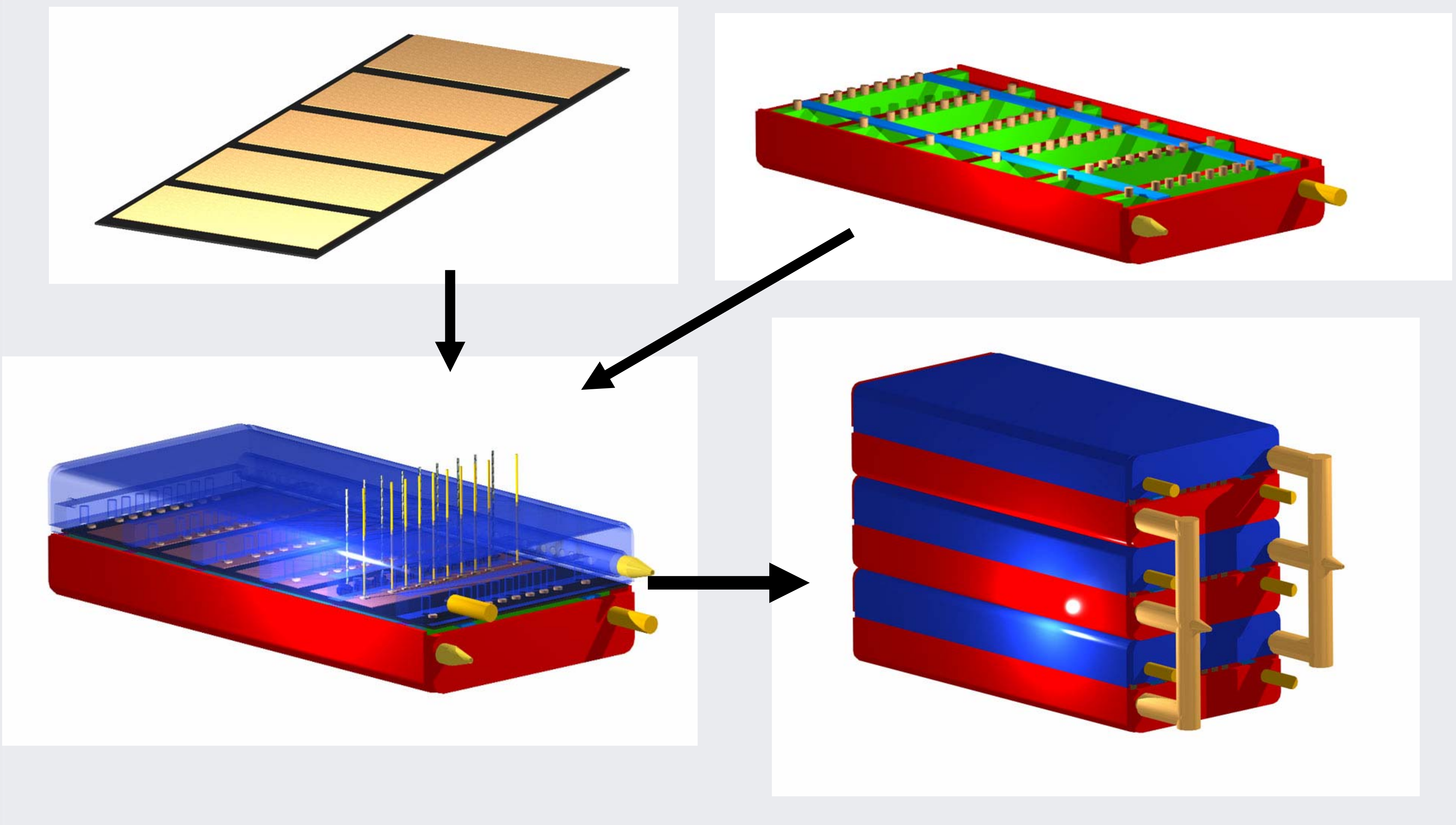
Air Management:

Ambient pressure operation – eliminate compressor/expander

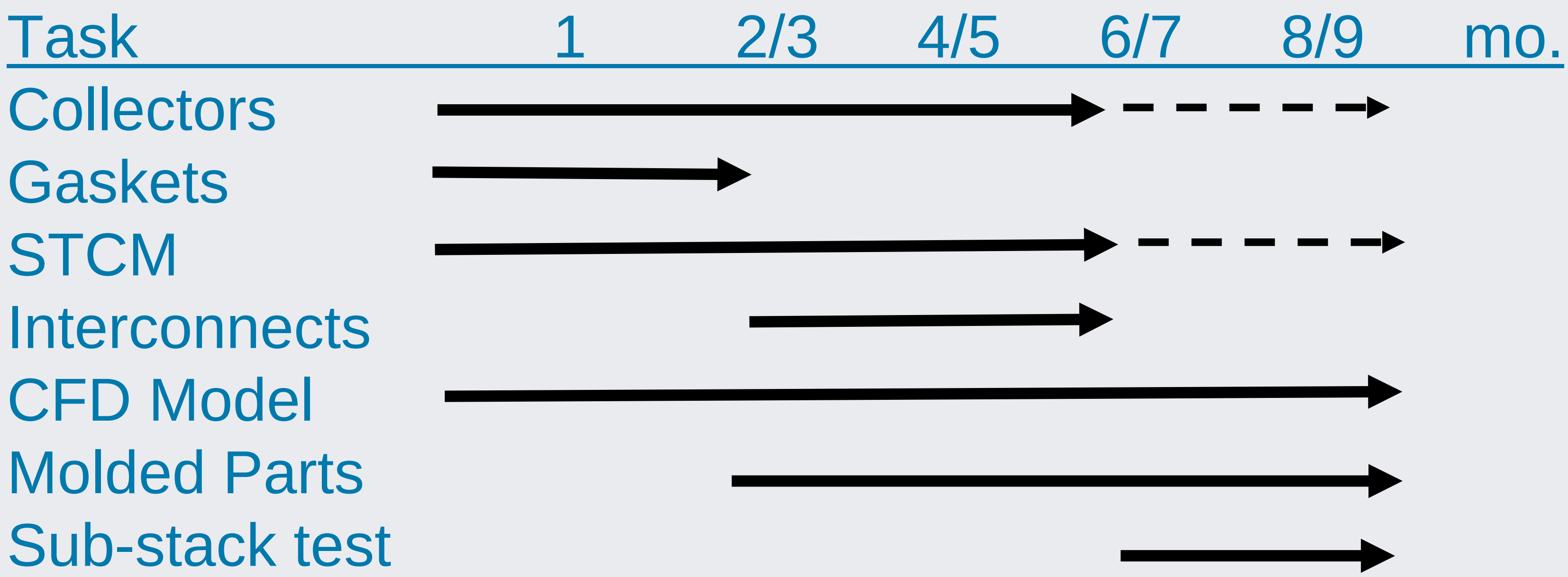
Approach

- Edge Collection of Current – no bipolar plates
- Current collector/GDL deposited directly on CCM
- Molded housings for sub-stack
  - Series electrical connection between cells
  - Reactant manifolds and seals
  - STCM humidification paths printed on housing
- Molded housings to join sub-stacks into stacks
  - Parallel electrical connection of sub-stacks
  - Manifolds
- Adiabatic Operation
  - Low pressure – no compressor/expander
  - Direct humidification of CCM (anode side)
  - No cooling plates or radiator, just a condenser

Approach



Timeline – Phase I – Materials/Process Development and sub-stack prototype



Each of the first 6 tasks has an associated milestone at month 6 for recommended materials/processes/designs for fabrication of the 1st Generation sub-stack.

Timeline – Phase II – Sub-stacks into Stacks

Task 10/11 12/13 14/15 16/17 18 mo.

Collectors

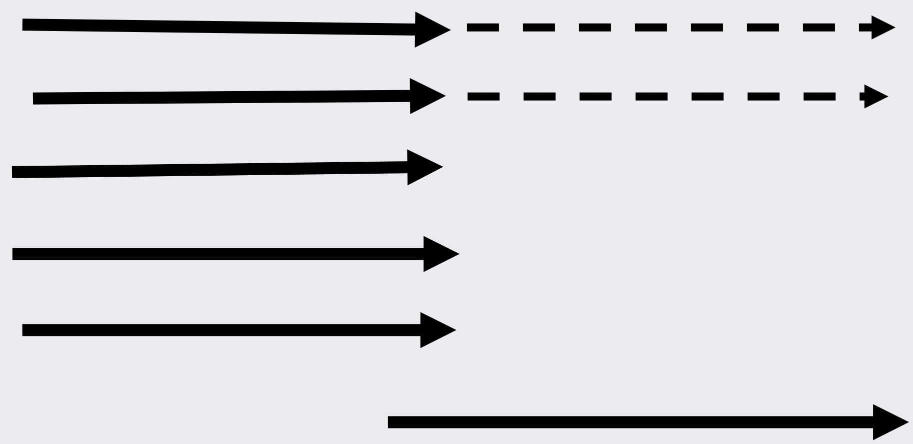
STCM

CFD Models

Stack Design

Sub-stack fab/test

Stack fab/test



Each of the first 3 tasks has milestones for recommendations for the 2nd Gen. sub-stack (mo. 11) and for the 1 kW stack (mo. 18)

Timeline – Phase III – 1 kW stack

Task	19	20	21	22	23	24
Design						
Fab/ Assembly						
Testing						

Milestone: 1kW stack to be delivered to DOE at 24 mo.

Go / No-Go Decisions

G1 – sub-stack to prototype stack

at 14 months

basis: sub-stack performance >500 W/kg

G2 – 1 kW stack fabrication

at 18 months

basis: do prototype stack results predict system level specific power >500 W/kg?

Budget / Needs

Year 1	$534,540
Year 2	$524,015
Total	$1,058,555

24 month program. This includes direct and indirect costs, subcontracts and cost share.

Needs: CCM recommendations