

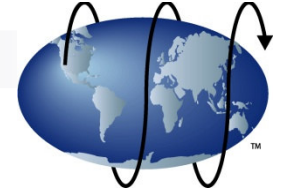
***HyPerComp ( HEI )***  
*Engineering. Inc.*

# HyPerComp Engineering, Inc.

Presentation for the Northern  
Utah Economic Summit  
September 27, 2007

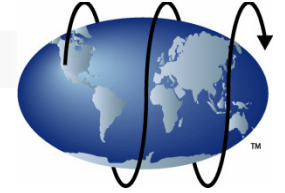


BMW 25 July 2007



# HyPerComp Engineering

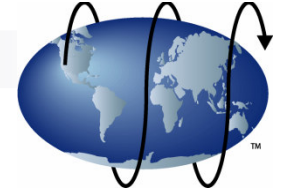
- Founded in 1996
  - Current revenues \$2 million/year
  - Currently employ 15 full time employees.
  - Core expertise is High Pressure Vessel technology
  - NASA designated Small Business Technology Transfer “Showcase” firm
  - Positive History of Meeting Commitments – RDA/EDA
  - Commercialization of High Technologies Developed for Space Applications
- Recent and current customer base
    - NASA
    - Jet Propulsion Laboratory
    - Boeing
    - Daimler
    - Dow Chemical
    - Honda
    - Toyota
    - 3M Corporation
    - Orbital Technologies, Inc.
    - Union Pacific Railroad
    - United States Air force
    - United States Navy



# Strategic Partners

- Pacific Scientific HTL/KLN, Duarte, California
  - Economic and Manufacturing Support
- Air Products & Chemicals Inc. – Allentown, PA
  - Partner with DOE's Hydrogen Technology Advisory Committee
- DOE's Savannah River Nat'l Laboratories
  - Partner with DOE's Hydrogen Codes/Standards & Technology Dev.
- Utah Governor's Office of Economic Development
  - Financial and Governmental Support
- ASME Standards Technology, LLC – New York
  - Regulatory Collaboration with DOE/ASME for H2 Code Development
- Hamilton-Sundstrand Propulsion Systems – Long Beach
  - Spacecraft cryogenic liquid pressurant & propulsion tanks

# HyPerComp Technology Applications



## ■ Alternative Fuels

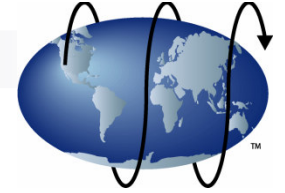
- Hydrogen
  - OEM's (Toyota, Honda)
  - Industrial Gas Industry (Air Products, Linde-Gas)
- CNG
  - Aftermarket retrofits
  - Industrial Gas Infrastructure
- On-board storage
  - 10,000 psi H2
  - 3,600 psi CNG
- Infrastructure
  - Fueling Station Storage
  - Over-the-Road Transport

## ■ Aerospace Applications

- Aircraft fire suppression
- Cryogenic Propulsion and Pressurant tanks
  - Beyond-earth-orbit spacecraft
  - Ares II launch vehicle
- Liquid Oxygen
- Liquid Hydrogen
- Liquid Nitrogen
- Liquid Helium

## ■ Homeland Security

- First-responder and fire fighter breathing apparatus cylinders



# HEI Composite Technology Benefits and Advantages

## ■ Alternative Fuels

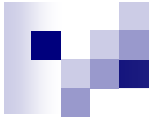
- Enabling technology to meet Department of Energy Hydrogen storage efficiency & Infrastructure goals
- Safety requirements for DOT certified high pressure gaseous storage
- Enabling technology for US Govt's Noxious Emissions Reduction

## ■ Aerospace Applications

- Aircraft fire suppression
- Cryogenic Propulsion and Pressurant tanks

## ■ Homeland Security

- Light weight composites tanks with 40% weight savings over "legacy" technology
- Improved survivability of first responders and fire fighters

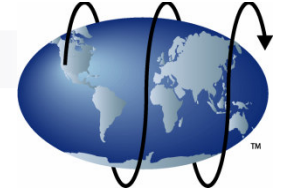


# Space & Aerospace Heritage

HEI'S HISTORIC BUSINESS MODEL HAS BEEN TO DEVELOP CUTTING EDGE COMPOSITE AND/OR PRESSURE VESSEL TECHNOLOGY IN THE AEROSPACE INDUSTRY AND TRANSFER IT INTO THE COMMERCIAL MARKET PLACE. SOME EXAMPLES INCLUDE:

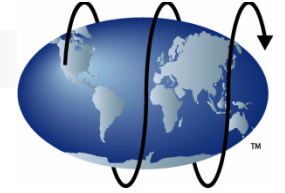
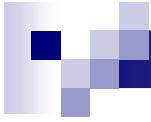
## Material Development:

- CARBON FIBER ORIGINALLY USED IN ROCKET MOTOR CASES HAVE BEEN TRANSITIONED INTO SCBA DESIGNS
- A VERY LARGE PERCENTAGE OF COMMERCIAL SCBA DESIGNS WORLD-WIDE HAVE BEEN DEVELOPED BY AND QUALIFIED BY HEI
- ANALYTICAL TECHNIQUES:
  - UTILIZATION OF NON-LINEAR FINITE ELEMENT ANALYTICAL TECHNIQUES (FEA) DEVELOPED BY THE ROCKET MOTOR INDUSTRY HAVE BEEN TRANSITIONED INTO AND BENEFITED NUMEROUS COMMERCIAL APPLICATIONS
  - DEVELOPMENTMENT OF VERY HIGH CYCLE CAPABLE COPV'S FACILITATED BY THESE ADVANCED FEA TECHNIQUES
- DESIGN OF EXPERIMENTS TECHNIQUES (DOE)
  - STATISTICALLY-BASED LABORATORY TECHNIQUES UTILIZED IN AEROSPACE INDUSTRY TO DOWNSLECT CANDIDATE MATERIALS, UNDERSTAND MULTIVARIABLE INTERACTIONS, ET AL. HAVE BEEN TRANSITIONED INTO OUR BUSINESS
  - UTILIZE DOE'S TO UNDERSTAND AND OPTIMIZE MATERIAL AND PROCESS VARIATIONS
- PROJECT/PROGRAM CONTROL AND MANAGEMENT
  - MANAGEMENT SYSTEMS ARE ROUTINELY UTILIZED IN THE AEROSPACE COMMUNITY TO CONTROL PROGRAMS, COORDINATE SUPPLIERS, TRACK PROGRESS, ET AL., IS UTILIZED EVERY DAY BY HEI TO REDUCE COSTS AND MAINTAIN SCHEDULES
- - AND NOW.....CRYOGENIC PRESSURE VESSEL TECHNOLOGY



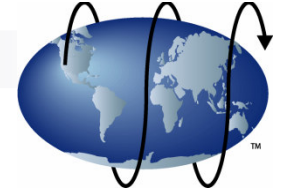
# HEI – Hydrogen Heritage

- Five years of Cryogenic Composite Pressure Vessel development with NASA MSFC for H<sub>2</sub> et. al.
- Ultra Light Weight “Liner-less” Cryogenic COPV’s for Jet Propulsion Laboratory: Pressurant & Propulsion
- On-Board Automotive H<sub>2</sub> Storage 700 Bar for Japanese OEM’s (Honda, Toyota)
- H<sub>2</sub> Infrastructure Development for US Dept of Energy for Storage/Fueling Station systems
- Collaboration with Daimler-led Group on Development of Draft for 70 Mpa H<sub>2</sub> Fueling Specification



# Cryogenic Heritage

- NASA MSFC Cryogenic COPV Development Collaboration covering
  - Damage Tolerance
  - Impact Resistance
  - Ballistic Capabilities
  - Lox Compatability
  - Radiation Capabilities
  - Materials Characterization Matrices
  - Lox, LN2, LHe, etc.



# Examples of Previously Developed HEI Tanks

<b>Configuration</b>	<b>Service Pressure (bar)</b>	<b>OAL (mm)</b>	<b>OD (mm)</b>	<b>Length/Diameter Ratio</b>	<b>COPV Weight (kg)</b>	<b>Burst Pressure (bar)</b>	<b>Water Volume (L)</b>
1	700	1039	302	3.4	39.6	2,009	42.7
2	700	833	298	2.8	29.7	1,678	33.4
3	690	504	182	2.8	5.2	1,754	7.8
4	690	1070	117	9.1	6.5	1,813	7.0
5	462	615	210	2.9	18.0	1,078	15.0
6	350	830	276	3.0	19.3	1,556	31.9
7	350	835	413	2.0	38.3	1,223	75.1