



**ENERGYEVOLUTION**

LLC FLORIDA USA

# World of Cold – Introduction

Cryogenics Training for Science and Industry

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# About the Instructor

**James E. Fesmire** is founder and president of Energy Evolution LLC for training and consulting in energy systems, materials, and integrated design for extreme environments. Co-founder and Chief Architect with GenH2 Corp. for hydrogen servicing systems and clean energy infrastructure. Founder (retired) of the NASA Kennedy Space Center's Cryogenics Test Laboratory for R&D of energy-efficient technologies, testing, advanced materials, and systems.

- Master of Science in Mechanical Engineering (Materials Science), University of Central Florida; Bachelor of Mechanical Engineering, Auburn University
- 37 years experience in the field of cryogenics design, research, and problem-solving
- Cryogenic systems work contributed to Moon and Mars exploration, International Space Station, Space Launch System, Space Shuttle, commercial space launchers, experimental rocket programs, superconducting power, hydrogen storage and delivery, and a wide range of commercial and industrial products and energy applications.
- Numerous patents & publications in cryogenics, thermal insulation, novel materials, and energy systems
- Recipient of NASA medals for Distinguished Service, Exceptional Technology Achievement, and Exceptional Service. Member of the NASA Inventors Hall of Fame
- Recipient of the R&D 100 award and the Space Technology Hall of Fame medal for research work in aerogel insulation technology

# World of Cold – Objective

- *World of Cold* provides training for the development of technical capability related to cryogenic applications, or “putting the cold to work”
- The term *cryogenics*, in the present context, concerns the use of cold temperatures for one of two reasons: 1) using the cold to do something useful or 2) storing a lot of molecules in a small space (energy density)
- A cold temperature is any below the ambient (~273 K) but cryogenic temperatures are often defined as below 123 K (-240 °F)
- As new markets come about and more cryogenic applications proliferate, practical training is needed to meet these demands and ensure business success
- To build technical capabilities, the related key aspects of safety, processes, equipment, product development, marketing, and education of both customers and suppliers are addressed

# World of Cold – Approach

- *World of Cold* is divided into ten modules which are tailored and arranged according to specific needs
- Included with each module are hands-on “experiments.” These range from key cryogenic and vacuum demonstrations, to system design and operation, to instrumentation and thermal measurements, and case studies and lessons-learned
- This hands-on, practical approach provides a foundation for advancing or developing new technical capability in cryogenics
- The total business viewpoint considers the interplay among science, industry, and societal needs in regional and global marketplaces
- Perspectives in both historical origins and future technological trends are discussed for cryogenic systems and different applications

# World of Cold – Full List of Modules

- Module 0 World of Cold Overview
- Module I Cryo 101 (Production and Application of Cold) & Basic Safety
- Module II Cryogenic Systems Design & Operations
- Module III Vacuum, Instrumentation, and Measurements
- Module IV Cryocoolers and Applications of Cold
- Module V Thermal Insulation Systems and Testing
- Module VI Cryofuel Systems and Technologies (Liquid Hydrogen)
- Module VII Cryogenic Fluid Systems (Nitrogen, Helium, Argon, Air, Oxygen)
- Module VIII Design of Cryostats (Superconductors, Cryofuels, Research)
- Module IX Cryogenic Testing and Processing of Materials
- Module X Global Markets, Standards, and Research



# World of Cold

Cryogenics training for  
science and industry

# Energy Efficient Cryogenics

- The *clean energy future* is coming and we are here to help you create it
- Evolution doesn't just happen – it takes creativity, vision, and hard work (focused on the right problem!)
- Energy Evolution LLC is committed to helping provide a better world through better understanding and use of our global energy resources

*We're cold, but we care!*



# What is the Problem?

- Our combined expertise of training, research, engineering, manufacturing, and operations, with a professional network approach, will help define the right problem – and solve it!
- What are the barriers to implementation of new technology?
- There are many, but we work hard to bring together the three essential ingredients for success: **knowledge, value, and motivation**





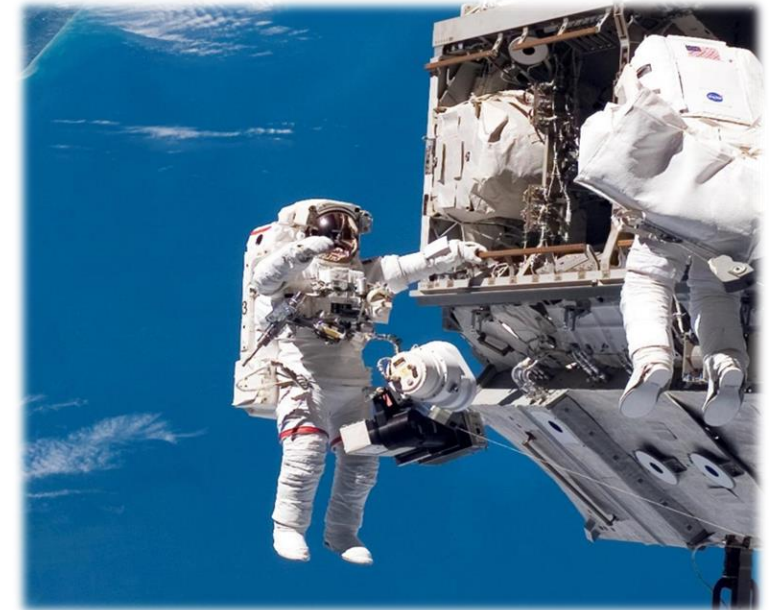
# Problem-Solving Approach

- People network: companies, manufacturers, shops, labs, institutions
- Holistic but practical approach by **thinking big and working small**
- Help design and implement technologies for energy-based needs
- Research, design, consultation, market development, training, and education in energy efficiency, energy storage, heat management, thermal insulation, materials, vacuum, and cryogenic systems



# Services

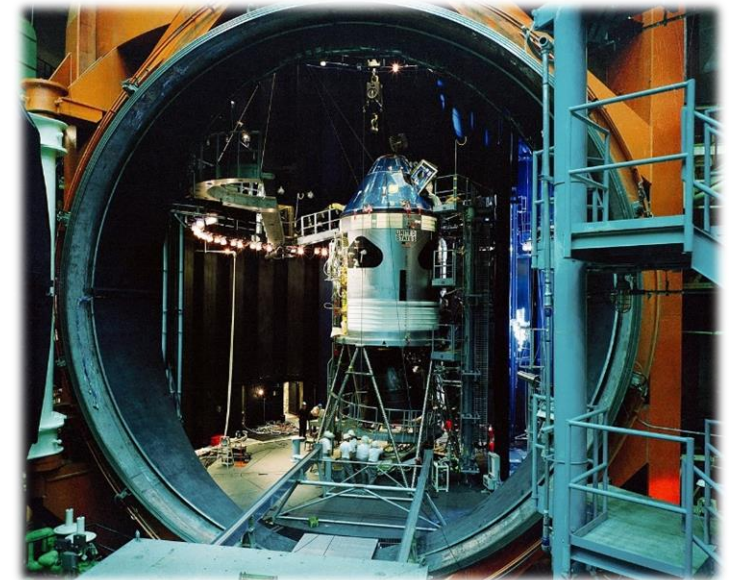
- Consulting, technical training, and education
- Hands-on, practical training in cryogenics
- Research and development (thermal systems, materials, energy storage, and cryogenics)
- Architecture and design of energy systems
- Prototypes and physical testing
- Marketing, product development, and patents
- Writing, technical reports, and proposals
- Litigation consulting and expert witness





# Technology Targets

- Hydrogen for transportation and energy infrastructure
- Energy efficiency in construction and end-product applications
- Engineering and technical consensus standards for thermal systems and materials
- Heat management for superconducting power cables and devices
- Cold chain shipping and thermal management
- Cryogenic refrigeration and process systems
- Commercial air transport and space launch systems, vehicles, and facilities





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