EPRI GTI ENERGY

GRIDED The Center for Grid Engineering Education

H2EDGE Hydrogen Education for a Decarbonized Global Economy

Hydrogen Delivery and Storage

Course Description

This course is part of an educational library of short courses developed and offered by the Hydrogen Education for a Decarbonized Global Economy (H2EDGE) program to address the emerging hydrogen industry. For the safe production, delivery, storage, and use of hydrogen, the industry must train and educate its workforce. This course provides an overview of hydrogen delivery and storage options, as well as safety considerations related to these processes. The main learning objectives that you will learn after taking this course include:

- Transmission and distribution methods available for hydrogen
- Alternate hydrogen carriers
- Hydrogen blending in natural gas pipelines
- Safety measures that should be considered in the delivery of hydrogen to customers
- Relevant codes and standards
- Underground geologic hydrogen storage
- Compressed gas and liquid hydrogen storage
- Emerging technologies for hydrogen storage

This course is being offered in an in-person format at EPRI's Washington D.C. office. It will be a two-day course:

- Lessons 1-4 on the first day (4 hours + 30-minute break)
- Lessons 5-8 on the second day (4 hours + 30-minute break)

Who Should Attend?

This course is intended for engineers, administrators, or other industry professionals from utilities or other organizations looking to increase their understanding of hydrogen delivery and storage topics, as well as those who are preparing themselves for career opportunities in the hydrogen economy.

Registration Information

Dates and Times:

- Wednesday, October 25, 2023
  - Lunch: 11:30 am – 12:30 pm
  - 12:30 pm – 2:30 pm
  - Break: 2:30 pm – 3 pm
  - 3 pm – 5 pm
- Thursday, October 26, 2023
  - Breakfast: 7:30 am – 8 am
  - 8 am – 10 am
  - Break: 10 am – 10:30 am
  - 10:30 am – 12:30 pm

PDHs Available: 8 Hours

Registration Fee: $800

Location: In-person at EPRI's Washington D.C. Office
1325 G St NW #530, Washington, DC 20005
Conference Room 131A and 131B

Register at: Cvent

Course Contacts:

Krystal York, kyork@epri.com, 269-391-4580
Eladio Knipping, eknipping@epri.com, 650-799-7088
Amy Feser, afeser@epri.com, 865-218-5909

This course is part of a series of courses on hydrogen that can either be taken together or separately. The series covers several pieces of the hydrogen value chain and includes: An Introduction to the Basics of Hydrogen Science, Trends in Electrolyzer Technology, Hydrogen Storage and Delivery, and Hydrogen Sources and End-Uses. More courses may be added to this series as H_2EDGE progresses.

Meet the Instructors



Jim McNelis is currently R&D Manager at GTI Energy, leading projects for the Low Carbon Energy Sector Infrastructure group. He has over 20 years of experience in the Natural Gas Industry, working at Peoples Gas and North Shore Gas in the Chicagoland area. Jim has led and worked in many different areas, including gas operations, compliance, technical training, engineering and operations support, customer relations, and IT. He also has experience in manufacturing, machinery design, and fabrication. Jim also has vast project management experience across all areas, including facilities, operations, business processes, and software systems.



Shadi Salahshoor is a Senior Technical Leader at GTI Energy, providing technical leadership and project management for a diverse portfolio of R&D projects aimed at advancing low-carbon energy solutions. Shadi has over a decade of experience in research, engineering, consulting, and advisory roles encompassing data-driven research, technology development, and piloting. She has extensive expertise in subsurface solutions, including reservoir evaluation, underground storage, and Carbon Capture, Storage, and Sequestration (CCUS). Shadi holds a Ph.D. in Petroleum Engineering, minoring in Data Science and Analytics from the University of Oklahoma, and is passionate about a sustainable energy future.



Shaik Afzal is a Principal Engineer in the Research and Engineering Group at GTI Energy. He works in the areas of low-carbon production and utilization of hydrogen for various downstream applications. Shaik is experienced in heterogeneous catalysis, process simulation and optimization, and techno-economic analyses. He also has two years of experience in oil refinery operations and process safety engineering. Shaik holds a Ph.D. in chemical engineering from Texas A&M University.

Course Outline

Lesson 1 – Overview of Hydrogen

- Why Hydrogen?
- Hydrogen production
- Properties and characteristics of Hydrogen
- Safety considerations

Lesson 2 – Transmission & Distribution Methods

- Liquid and gaseous hydrogen transport
- Hydrogen blending in natural gas
- Ammonia as a hydrogen carrier
- Alternate hydrogen carriers

Lesson 3 – Safety considerations

- Hydrogen blending in natural gas
- Alternate hydrogen carriers

Lesson 4 – Codes and Standards

- Pipeline and Hazardous Materials Safety Administration
- Relevant codes and standards
- Knowledge Gaps

Lesson 5 – Underground geologic storage

- Need for underground storage
- Underground storage types
- Storage cost and capacity
- Comparison with natural gas storage in the US
- Relevant codes and standards

Lesson 6 – Compressed gas hydrogen storage

- Pressurized hydrogen storage tanks and vessels
- Relevant codes and standards

Lesson 7 – Liquid hydrogen storage

- Advantages of liquid hydrogen storage
- Types of liquid hydrogen storage
- Boil-off challenge for liquid hydrogen storage

Lesson 8 – Metal hydrides

- Operation of a metal hydride system
- State of technology for metal hydrides
- Metrics to compare metal hydrides
- Available commercial metal hydrides

Electric Power Research Institute
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 USA 800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

© 2023 Electric Power Research Institute (EPRI), Inc. All rights reserved. Electric Power Research Institute, EPRI, and TOGETHER … SHAPING THE FUTURE OF ELECTRICITY are registeredservice marks of the Electric Power Research Institute, Inc.

September 2023