



# Basic Training from SEPA

## Hydrogen Basics

In this training, we explore the recent surge in interest and government support for hydrogen, both in the U.S. and globally. We cover the different types of hydrogen—including green, blue, and purple—and examine critical issues related to its production and handling, such as flammability and combustion temperatures.

We also discuss the potential applications of hydrogen in various industrial sectors such as transportation, industry, and power generation. Additionally, we analyze the major challenges in developing a hydrogen economy, such as cost and efficiency, and explore emerging use cases that offer insights into the future of hydrogen.

## Hour 1: Rationale for Hydrogen and Critical Concepts

### Key Applications

- Hydrogen in the industrial sector will create scale.
  - Steel.
  - Cement.
- Potential transportation applications.
  - Long-haul trucking.
  - Rail.
  - Maritime.
- Long-term energy storage in the power sector.

### Why—and How—the Physics Matter

- The chemistry: advantages and challenges
  - Molecular structure (why that matters)
  - Energy density
  - Flame speed
  - Other essential characteristics
- The colors of hydrogen
  - Grey hydrogen (steam methane reformation)
  - Blue hydrogen (carbon capture and storage)
  - Purple hydrogen (nuclear)
  - Turquoise hydrogen (pyrolysis)
  - Green hydrogen (electrolysis from renewables)
- Green hydrogen: key electrolyzer technologies and opportunities for cost improvements
  - Solid oxide
  - Alkaline
  - Polymer electrolyte membranes (PEMs)
  - Anion exchange membrane
  - Wright's Law and future cost projections

## Hour 2: Value Chain Issues, Current Applications, and Policies

### The Value Chain—Transportation, Storage, and Efficiency Losses

- Transportation.
  - Compressed.
  - Liquified.
  - Liquid organic carriers.
  - Inorganic carriers (e.g., ammonia).
- Storage.
  - Caverns.
  - Purpose-built containers.
- “Well to wheel” efficiency losses in supply chain.

### Electric Power Grid Applications

- Behind-the-meter generation for reliability/resilience emerging use cases.

- Grid-scale inter-seasonal storage and turbine combustion.
  - Methane/hydrogen fuel mixtures.
  - Ammonia as a fuel.
  - Current turbine capabilities and future plans.
- Grid applications and announced projects.
  - Intermountain (LADWP).
  - New Fortress/GE—Hannibal Ohio.
  - Florida Power and Light.
  - San Diego Gas & Electric.
  - Douglas County PUD No. 1.
- U.S. federal support.
  - Hydrogen hubs and current status.
  - Inflation reduction act subsidies.
- Future developments.

## SEPA Basic Training Courses

Interested in learning more? We offer four other Basic Training courses to help you fortify your knowledge:

- **Electric System Basics**—In this training we discuss the four basic elements of the electric system, the evolution of the power grid, the growing role of distributed energy resources, and the future of the electric system.
- **Distributed Energy Resource Basics**—In this training we examine the rapid ascent of DERs; the various types of DERs and the services and value streams they can provide; and how to identify, evaluate, and optimize the use of DERs to address various challenges.
- **Energy Storage Basics**—In this training we review energy storage opportunities and use cases across the utility ecosystem, as well as different storage technologies and their role in the evolving grid.
- **Electrification of Transportation Basics**—In this training, we discuss the rapid electrification of the transportation sector and the challenges and changes necessary to efficiently and safely integrate a growing population of EVs into our power grids.

### Questions?

Contact [learning@sepapower.org](mailto:learning@sepapower.org)

