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# AI Applications in Hydrogen Production and Storage Training Course

19 – 23 September 2027
Muscat

# AI Applications in Hydrogen Production and Storage Training Course

**Ref:** 70_1779 **Date:** 19 – 23 September 2027 **Location:** Muscat **Fees:** 6500 GBP

AI Applications in Hydrogen Production and Storage is a 1-week training course for hydrogen project, process and plant engineers and energy transition managers, in which participants build an electrolysis plant optimisation roadmap for one site. Electrolysers now run on variable solar and wind power, so stack efficiency, storage safety and the cost of each kilogram depend on decisions taken every few minutes. The course is delivered by Jupiter Prime Training.

## Why AI Applications in Hydrogen Production and Storage Matters Now

Three forces are shaping green hydrogen projects. Electrolysers coupled to renewables must ramp up and down with intermittent supply, which accelerates stack wear; offtakers in ammonia, refining, steel and heavy transport demand firm volumes at a competitive levelised cost; and hydrogen's small molecule and wide flammability range make storage and leak control a constant safety concern. Projects that read plant data well run stacks longer, schedule production against cheap power and catch leaks early. Those that do not see costs climb and confidence fall. Model oversight follows ISO/IEC 42001 AI management systems and the NIST AI Risk Management Framework NIST AI RMF.

## Who Gains Most from AI Applications in Hydrogen Production and Storage

- Engineers responsible for electrolyser stack performance, efficiency and degradation
- Engineers who design and operate compression, cavern, tank and pipeline storage
- Engineers who plan production against renewable output and offtake contracts
- Engineers accountable for process safety, gas detection and hazardous area controls
- Engineers who build cost models and investment cases for hydrogen projects

A project gains most when its process, safety and commercial engineers attend together, because stack loading, storage limits and cost per kilogram are traded against each other in the same schedule.

## AI Applications in Hydrogen Production and Storage Capabilities

Participants leave able to turn electrolyser, storage and power-price data into operating choices that protect stacks, keep inventory safe and lower the cost of supply.

- Assess stack voltage, temperature and current density trends for early degradation signs — plant reliability engineers
- Build a digital twin of an electrolysis train to test load-following strategies — process engineering leads
- Design renewable-coupled production schedules against power price and storage limits — energy traders and dispatchers
- Apply anomaly detection to gas sensor and pressure data for leak warnings — process safety officers
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Calculate levelised cost of hydrogen sensitivities from operating data — investment committees
- Specify validation and oversight rules for safety-related models — plant managers and insurers

## Key AI Applications in Hydrogen Production and Storage Terms

- Proton exchange membrane PEM electrolysis — water splitting through a solid polymer membrane, suited to fast ramping with variable renewable power.
- Alkaline electrolysis — a mature process using a liquid alkaline electrolyte, with lower stack cost but slower response to load changes.
- Stack degradation — the gradual rise in cell voltage over operating hours that raises power use per kilogram of hydrogen.
- Levelised cost of hydrogen LCOH — the lifetime cost of producing one kilogram, combining capital, power, maintenance and utilisation.
- Hydrogen embrittlement — loss of ductility in metals exposed to hydrogen, a key concern for pipelines, vessels and valves.
- Boil-off — the hydrogen that evaporates from liquid storage tanks as heat enters, which must be vented or recovered.

## AI Applications in Hydrogen Production and Storage Day by Day

## Day 1: The Green Hydrogen Value Chain and Its Data

- Hydrogen Value Chain Map: Power, Electrolysis, Storage and Offtake — Data Sources
- PEM, Alkaline and Solid Oxide Electrolysers — Operating Envelope Differences
- Offtake Demand in Ammonia, Refining and Steel — Volume and Purity Needs
- Plant Historian and Sensor Inventory — Readiness for Machine Learning
- Renewable Intermittency and Grid Connection — Load Profile Implications

## Day 2: Optimising Electrolyser Performance

- Stack Degradation Modelling From Voltage Trends — Replacement Timing
- Load-Following Strategies Under Variable Power — Efficiency and Wear Trade-Offs
- Electrolysis Plant Digital Twin — Testing Operating Set Points Safely
- Balance-of-Plant Analytics for Pumps, Dryers and Rectifiers — Auxiliary Energy Use
- Water Treatment Quality Prediction — Membrane and Electrode Protection

## Day 3: Storage Safety and Leak Detection

- Compressed, Liquid and Underground Storage Options — Inventory and Risk Profiles
- Gas Sensor Network Anomaly Detection — Early Leak Warning Thresholds
- Acoustic and Thermal Imaging Analytics — Locating Leaks on Pipework
- Hydrogen Embrittlement Monitoring — Inspection Priorities for Vessels and Pipelines
- Boil-Off and Pressure Cycling Prediction — Tank Operating Limits

## Day 4: Scheduling, Cost and Model Oversight

- Renewable-Coupled Production Scheduling — Power Price and Storage Constraints
- Solar and Wind Forecast Integration — Day-Ahead Production Commitments
- Levelised Cost of Hydrogen Sensitivity Models — Utilisation and Power Cost Drivers
- Predictive Maintenance Scheduling for Compressors — Availability and Spare Parts
- ISO/IEC 42001 and NIST AI RMF — Validating Safety-Related Plant Models

## Day 5: Practising the Electrolysis Plant Optimisation Roadmap

- Use-Case Ranking by Cost per Kilogram Impact — Stack, Storage and Scheduling
- Digital Twin Scope and Data Requirements — Sensors, Historian and Models
- Leak Detection Alarm Philosophy — Sensitivity Versus Nuisance Trips
- Investment Case for Plant Analytics — LCOH Reduction and Availability Gains
- Electrolysis Plant Optimisation Roadmap — Use Cases, Owners, Controls and Phasing

## Applying AI Applications in Hydrogen Production and Storage After the Course

- Fit a stack degradation trend model to existing voltage and current density data for one electrolyser train and compare its replacement forecast with the vendor schedule.
- Back-test a renewable-coupled production schedule on recent power price and wind or solar data to estimate the change in levelised cost of hydrogen.

## AI Applications in Hydrogen Production and Storage Questions FAQ

### What are AI applications in hydrogen production and storage, and why do they matter now?

They are machine learning methods that optimise electrolysers, monitor storage safety, detect leaks and schedule output against renewable power. They matter now because variable power accelerates stack wear and every kilogram must compete on cost with established fuels.

### Which roles gain most from AI applications in hydrogen production and storage?

Process, plant reliability, storage, safety and project finance engineers gain most. You learn to connect stack data, gas detection and power forecasts so that operating, safety and commercial choices rest on the same evidence.

### How do AI applications in hydrogen production and storage differ from a general renewable energy analytics course?

They focus on the electrolysis plant and its storage. Instead of wind or solar farm performance alone, you work on stack degradation, balance-of-plant energy, hydrogen leaks, embrittlement and the levelised cost of each kilogram.

## What do you bring back from AI applications in hydrogen production and storage?

You bring back an optimisation roadmap for one site. It ranks use cases by cost per kilogram, defines digital twin scope and data needs, sets a leak alarm philosophy and phases the investment.

## AI Applications in Hydrogen Production and Storage: The Way Forward

The electrolysis plant optimisation roadmap first informs whether stack degradation modelling or production scheduling receives data and budget. Process, safety and commercial engineers use it to agree owners and controls. After the first season of operation under the new models, revisit stack voltage trends and leak alarm rates, because they show whether efficiency gains are holding without adding safety burden.