

# Creating a Hydrogen Economy and Clean Energy via Sustainable Ammonia Production

## New Markets and Technologies in Energy

### Introduction

Historical data on energy demand shows that during the past few decades, there has been an increase in energy consumption, which has led to a commensurate growth in carbon dioxide emissions and its negative effects on the environment worldwide. Because of the growing focus on low-carbon fuels, carbon-free hydrogen fuel is predicted to grow in importance over the next several years. Given the significant modifications needed for hydrogen energy systems and applications, ammonia seems to play a key role in the advancement of the hydrogen economy. Ammonia is seen as a potential solution to a number of issues with the use of hydrogen as a fuel due to its many advantageous qualities. Ammonia has been used for many years in a variety of industries, including refrigerants, cleaning agents, industrial fluids, fertilizers, and many more. However, from the standpoint of fuels, ammonia stands out as a promising fuel that can help lessen the reliance on fossil fuel-based energy production due to the necessity of moving towards carbon-free fuels in this period. Furthermore, ammonia is accepted as a clean solution, generated using sustainable energy sources.

Ammonia fuel cells are essential to developing ammonia energy in this sense. It is predicted that the next revolution in power generation will come from sources that are more efficient than combustion engines, fuel cells, and other renewable energy sources. The worldwide developments in ammonia-based energy production technologies are described in this training course. Additionally, the goals of a number of multinational partnerships centered on the advancement of energy technologies based on ammonia are explained. Recently developed ammonia engines are described, along with their benefits and drawbacks. Additionally, ideas for the study and development of ammonia gas turbines are highlighted.

Finally, a summary of ammonia fuel cell development and a description of the present difficulties these technologies confront are provided. There are also suggestions included on how to improve the current direct type ammonia fuel cells' performance.

### Objectives

- Following completion of this training program on "Creating a Hydrogen Economy and Clean Energy via Sustainable Ammonia Production," learners will be able to:
- Recognise the notion of the "hydrogen economy," which includes the creation of synthetic fuel, fertiliser, metal refining, transportation, and electricity.
- Learn the fundamentals of fuel cell operation.
- Discover how fuel cells are classified, as well as about physical and chemical phenomena, electrodes, and electrolytes.
- Discover how to compute the performance of fuel cells.

Recognise the benefits of the extremely effective one-step conversion of chemical to electrical energy as well as the uses for fuel cells.

Discover the Future Energy Solutions with Ammonia Fuel Cells, Ammonia Engines, and Ammonia Gas Turbines.

## Training Methodology

In order to maximize knowledge, comprehension, and retention of the material provided, this training course on Developing Clean Energy and Hydrogen Economy from Sustainable Ammonia Production will make use of a variety of tried-and-true adult learning approaches. There will be a lot of interaction and participation in the daily workshops. In this course, engaging practical exercises backed by films, group discussions, and business case studies are combined with PowerPoint presentations.

## Organizational impacts

The organization will obtain a wider range of abilities that participants acquire and utilise in their workspace to directly benefit their respective companies by sending their staff to this training session.

It provides a more comprehensive management view of the global energy industry and identifies the key success drivers for various business model categories.

- It clearly illustrates the future of hydrogen energy through a variety of technologies and uses.
- Explains how advancements in energy technology contribute to global economic growth, employment creation, and rising living standards.
- Explains how we can fulfill these objectives and still provide value to the stockholders.
- Instil in the company culture the ability to handle the fundamental problems, strategies, and ideas needed to run the energy industry profitably.

## Personal Impact

Every participant will gain technical expertise and business acumen in the energy industry, which will immediately aid in their professional development.

- Acquire mastery over the fundamentals of both present and future energy technology.
- Develop your business acumen by mastering the strategies that increase ROI, capital productivity, and operational excellence.
- Gain an understanding of the Energy Industry's value chain optimisation and implement it in your workplace to increase shareholder value.
- Understand the various success elements of the energy industry, including the relative advantages and disadvantages of the oil and gas, refining and petrochemical, and renewables sectors.

## Who should attend?

A wide range of professionals can profit from this Course N Carry Creating a Hydrogen Economy and Clean Energy via Sustainable Ammonia Production training course, however, the following are the main advantages:

In order to comprehend future technology completely, Geologists, engineers, accountants, lawyers, financial analysts, IT specialists, and managers working in the oil and gas industry Business Development Experts in the Energy Sector

- The main points of an extensive energy study program would be of interest to corporate planners, investment analysts, and directors of oil and gas companies.
- Senior Oil & Gas executives are becoming more interested in clean energy ideas, and they are using their resources to create hydrogen and further the transition of the energy industry.
- Project managers, engineers, supply planners and scheduling experts, traders, and sales staff are required to attend this course.

## Course Outline

### Day 1

#### Upstream oil, gas, and LNG exploration, production, transportation, and distribution

- The petrochemicals and downstream refining
- The keys to success are trade, marketing, and sales.
- Future developments in downstream and upstream
- The issue of global warming
- Global warming: what is it?

- The Act on Clean Air

- The latest occurrences in several global locations
- Global food security

## Day 2

### The Energy Sector and Its Evolution

- An outline of the course
- Dominant energy resources throughout history
- The LNG industry and conventional and unconventional oil and gas
- The Basics of Fuel Cell Technology
- Recognising the supply and demand dynamics of oil and gas
- The energy mix of the future
- Economy of hydrogen
- Heat engines and fuel cells
- Principles of operation for fuel cells
- Physical and chemical processes in fuel cells
- Fuel cell performance
- The benefits and uses of fuel cells
- Classification of fuel cells

## Day 3

### The Opportunities and Choices for Clean Energy

- Fuel types
- Fuel made of hydrogen
- Alcohol fuels
- Alkane fuels
- Ammonia
- Final thoughts
- Fuel made of ammonia
- Groupings of ammonia cells
- Oxygen anion conducting oxide electrode direct ammonia fuel cells
- Direct ammonia fuel cells with a solid oxide electrolyte that conducts protons
- Alkaline electrolyte fuel cells for direct ammonia fuel
- The renewable energy research lab created direct ammonia fuel cells.
- Borane and ammonia fuel cells
- Final thoughts

## Day 4

- Modelling and analysis
- Fuel cell thermodynamics using ammonia
- Ammonia fuel cell electrochemical analysis
- Final thoughts
- Ammonia fuel cell systems integrated
- Dafc- and thermal energy storage system integrated
- Combining solar thermal power plant and Dafc
- Multigeneration system based on solar towers coupled with DAFCC
- Combined internal combustion engine running on ammonia and dafc-based cogeneration system
- An integrated solar-wind system that uses afcs for energy storage to generate electricity and freshwater
- Dafc system and ammonia synthesis combined using solar photovoltaic energy
- Final thoughts
- The three flight futures
- Aviation: more dispersed and smaller?

## Day 5

### Case Studies and Conclusion

- Regenerative electrode hybrid ammonia fuel cell and battery system
- A combined geothermal and solar system using direct ammonia fuel cells
- Conclusions and recommendations for the future
- Engines using ammonia
- Gas turbines using ammonia
- Final thoughts