German Academy of Digital Education

HYDROGEN TECHNOLOGY

COURSE OVERVIEW

CREATING CHANCES

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WELCOME TO DADB
German Academy of Digital Education

Our Hydrogen Technology engineering course provides a solid introduction to the technology of green hydrogen, which will be a key part of the energy transition. In this course, students will acquire an excellent grounding in the production, storage, and real-world applications of this promising energy carrier and the technologies associated with it. In short, the DADB Hydrogen Technology course gives students what they need to get started in the future-oriented field of sustainable energy technologies.

I welcome you, and encourage you to explore hydrogen technologies and gain the know-how that is necessary to be an effective participant in the green energy revolution.

Matthias Gall

Matthias Gall
Chief Operating Officer
DADB German Academy of Digital Education

» The costs of producing green hydrogen are currently falling. In addition, many countries in Europe have drawn up hydrogen strategies that provide good framework conditions, especially **Germany** with its **groundbreaking hydrogen strategy**. «

ABOUT DADB

As a global player in the digital education market, DADB offers industry-relevant online courses in the sustainable technologies sector, bringing German engineering know-how to the world.
Our vision is to become India's leading provider of high-quality German Engineering and Industrial Education, by making international standards of learning accessible to Indian students through innovative, hands-on, and affordable online learning experiences.

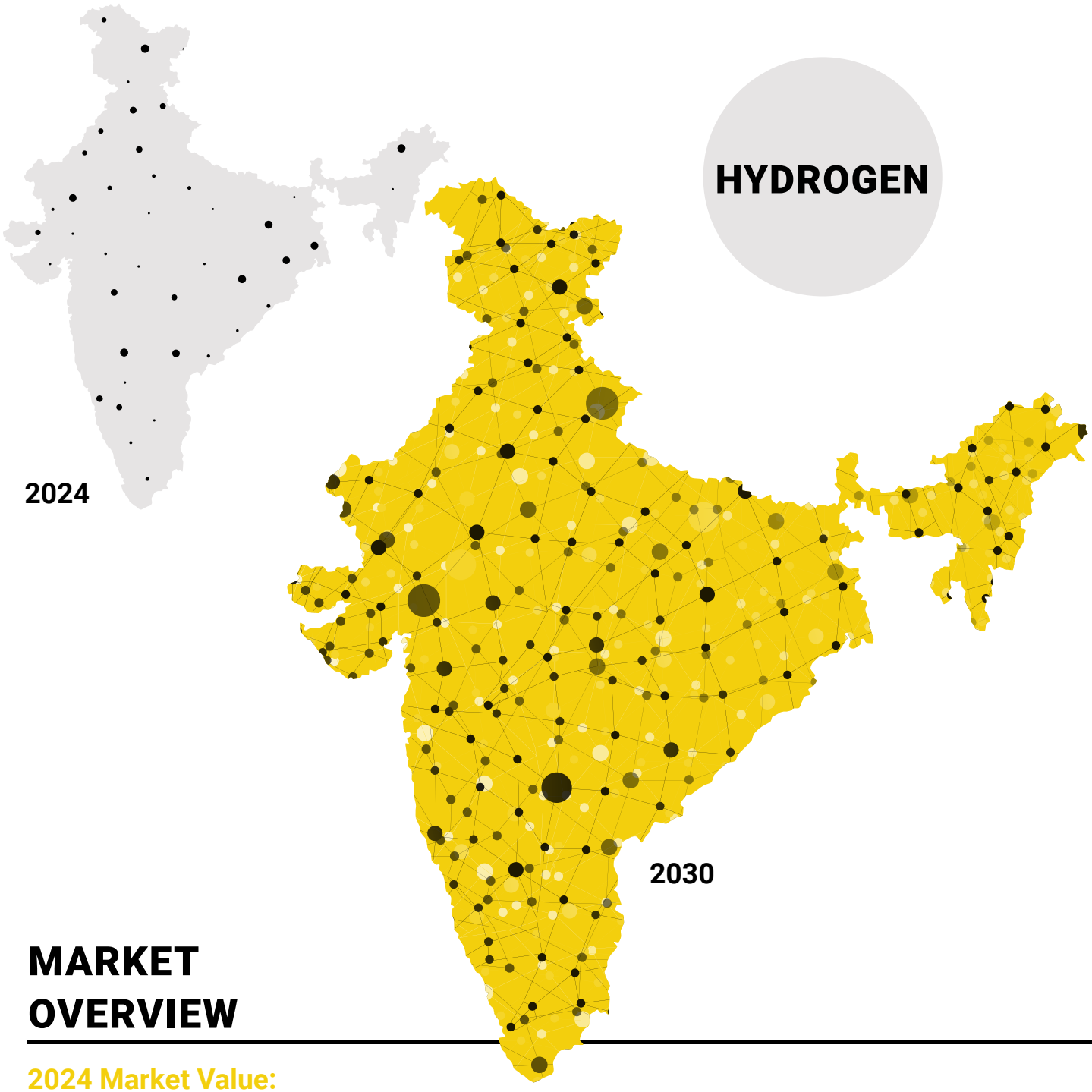
The idea emerged out of a lecture tour in India, when our Managing Director Dr.-Ing. Carsten Schröder was asked "Can we bring German professors to India and share German engineering know-how with students here?"

Back in Berlin, the idea was conceived to make professors' lectures available online rather than via their own classrooms. Immediately, it became apparent that online learning had very special requirements. A new learning format has been developed to integrate students interactively into the lectures and provide insight into practice from industry experts.

We are convinced that social responsibility does not exclude economic efficiency. Over the years, we have nurtured successful partnerships with industry, universities, colleges, and skills councils, aiming at one goal – making **Made in Germany** technical education accessible for the world's younger generations. This is why our claim – **Creating Chances** – strongly represents our belief that education is essential.

DADB courses are created in close cooperation with university professors and industry experts in Germany. The digital materials are geared towards the needs of teachers and students, with clear learning objectives and innovative course content that are responsive to industry requirements and the demand for well-educated talent.

CONNECTING. COLLABORATING. COOPERATING.



MARKET OVERVIEW

2024 Market Value:
USD 72.14 MILLION
The hydrogen market in India is in its early stages but is gaining attention as a clean energy source.
Projected Growth Rate: 6.3%
The market is expected to grow steadily as advancements in hydrogen production and applications develop.

JOB PERSPECTIVES

Key skills needed are knowledge of processes and operations, and ability to apply this know-how with real-world resources.

HYDROGEN SYSTEM ENGINEER

They design, evaluate, modify, or construct fuel cell components or systems for transportation, stationary, or portable applications. On the job, engineers plan or conduct experiments to validate new materials, optimize startup protocols, reduce conditioning time, or examine contaminant tolerance.

HYDROGEN INFRASTRUCTURE SPECIALIST

The Hydrogen Specialist role is to provide specific technical expertise related to the hydrogen production & utilization, to the projects, operations & new business initiatives.

RENEWABLE ENERGY PROJECT DEVELOPER

A project developer in a renewable energy company is responsible for managing the development of renewable energy projects from inception to completion.

HYDROGEN FUEL CELL ENGINEER

The job of the fuel cell engineer is to design new fuel cell technology that improves the reliability, functionality, and efficiency of the fuel cell.

ANALYST IN HYDROGEN TECHNOLOGY

Hydrogen systems analysts evaluate R&D goals and perform resource assessments, techno-economic comparisons, market-potential projections, and financial modeling of stakeholder decisions and investment risks.

HYDROGEN TECHNOLOGIES

During the course, students will gain specialized knowledge in areas such as the production, purification and real-world applications of green hydrogen. The course places great emphasis on preparation for dealing with the complex problems that exist in this dynamic field.

Advanced manufacturing processes, efficient purification processes and innovative transport solutions are the main components of the curriculum.

LEARNING OBJECTIVES

· Understand the Fundamentals of Hydrogen

· Explore Production, Technologies, Transporting and Storing Processes

· Analyze and explore Use Cases

· Develop Practical Solutions

· Evaluate Future Trends and Innovations in Hydrogen Technologies

The course will be delivered through a combination of lectures, industrial demonstrations, interactive exercises and case studies, providing a balanced approach to both theoretical knowledge and its applications.

LEARNING OUTCOME

Upon successful completion of this course, students will be able to

1. **Understand the Fundamentals of Hydrogen Technologies**
2. **Explore Use Cases: Examine practical applications of Hydrogen Technologies in various domains such as smart homes, smart cities, and industrial automation.**
3. **Demonstrate the ability to interface with various sensors and actuators.**
4. **Understand the role of Hydrogen Technologies in enhancing efficiency, sustainability, and quality of life in these domains.**
5. **Gain insights from interviews and case studies featuring industry experts.**
6. **Understand current trends, challenges, and future developments in the Hydrogen landscape.**

By the end of this course, students will have a comprehensive understanding of Hydrogen technologies and their applications, equipping them with the skills needed to develop, implement, and manage different solutions in various professional settings.

LEARNING EXPERIENCE

A SERIES OF LECTURES BY GERMAN PROFESSORS

Using online technology, we create interactive lectures by renowned German professors.

INTERACTIVE EXCERSICES AND APPLICATIONS

A variety of interactive applications are included in our courses. By practicing and applying their skills in a controlled digital environment, students gain hands-on experience.

INDUSTRY EXPERTS

We connect theory and practice with the expertise of German and international industry experts. As a result, theoretical knowledge is tested on practical showcases.

A LEARNING CONTROL

Students can monitor their progress on an ongoing basis with our self-assessment tools.

ASSESSMENTS

During the course, students take up to two intermediate exams and a final exam created in collaboration with the German professor and monitored using various proctoring tools.
Upon passing the exam, students receive a blockchain-verified certificate of completion.

INNOVATIVE LEARNING PLATFORM

Our fast and interactive learning platform enables students to learn anytime and anywhere.


Permeation through Metallic Materials Part I
Permeation through Metallic Materials Part I
Hydrogen Entry in Metal Microstructures
Hydrogen side
Membrane
Exterior
Adsorption
Desorption
Diffusion
Hydrogen Production Part III
ature Range Electrolysis
phase boundary
vapor
liquid
Energy (kJ / mol)
Cell tension (V)
ϑ (°C)
Expert Interview
DA
DB
Physical and Chemical Properties of Hydrogen
Ortho - Hydrogen
Para - Hydrogen
[p = Proton ; e = Electron]

Prof. Dr.-Ing.
Thomas Schmidt

COURSE INSTRUCTOR

Prof. Dr.-Ing. Thomas Schmidt is a leading expert in gas supply and economic analysis. He studied mechanical engineering at the Technical University of Braunschweig and RWTH Aachen University. Since 2002 he has been a professor in the Department of Energy, Buildings and Environment at Münster University of Applied Sciences.

MODULE OVERVIEW

MODULE 1
Hydrogen – Physical and Chemical Properties

MODULE 2
Hydrogen – Application Properties

MODULE 3
Hydrogen Production

MODULE 4
Hydrogen – Transporting, Converting, Liquifying, and Storing

MODULE 5
Hydrogen Applications and Use Cases

MODULE 6
Hydrogen – Economics and Future Prospects

A self-study learning module includes an introduction, learning objectives, content chapters, and additional resources, including learning control exercises, study notes, and quizzes.

MODULE 1

Hydrogen – Physical and Chemical Properties

01 Hydrogen Properties
- Origin and Industrial Uses
- Material Compatibility

02 Physical and Chemical Properties of Hydrogen
- Physical and Chemical Properties of Hydrogen
- Pressure and Temperature

03 Thermodynamics of Hydrogen Part I
- Thermodynamic Systems
- Thermodynamic Terms
- Phase Boundaries

04 Thermodynamics of Hydrogen Part II
- 2nd Law of Thermodynamics
- Important Thermodynamic Parameters
- Poly-Sized State Change

05 Thermodynamics of Hydrogen Part III
- Efficiency and Utilization Rates
- Joule–Thomson Effect
- Thermal Conductivity

06 Proportions and Concentrations of Mixtures
- Proportions of Mixtures
- Concentrations of Mixtures

MODULE 2

Hydrogen – Application Properties

07 Permeation of Hydrogen Part I
- Permeation Properties of Hydrogen
- Permeation through Metallic Materials

08 Permeation of Hydrogen Part II
- Permeation through Polymers
- Permeation through Polymeric Materials

09 Hydrogen Embrittlement and Potential Hazards
- Hydrogen Embrittlement
- Potential Hazards

10 Hydrogen-Induced Fracture: Assessment and Prevention
- Mitigating Hydrogen-Induced Brittle Fractures
- Stress, Deformation States, and Stress Components
- Evaluating Fracture Mechanics Under Quasi-Static Loading

11 Explosion Safety
- Explosion Safety Part I
- Explosion Safety Part II

12 Hydrogen Safety: Flammability, Combustion, and Explosions
- Explosion Limits
- Combustion Dynamics and Fuel Safety
- Explosion Energy of Hydrogen

13 Hydrogen Safety Engineering: Standard States, Combustion Characteristics, and Explosion Mitigation
- Safety Risks
- Specific Combustion Characteristics
- Exhaust Gas Composition

MODULE 3

Hydrogen Production

14 Hydrogen Production Part I
- Hydrogen Production Overview
- Partial Oxidation
- Coal and Biomass Gasification

15 Hydrogen Production Part II
- Technical and Practical Aspects of CCS
- Carbon Dioxide Storage Facilities-Operations and Monitoring
- CCS and the Hydrogen Industry

16 Hydrogen Production Part III
- Electrolysis
- Electrochemical Basics of Electrolysis

17 Hydrogen Production Part IV
- Electrolysis Temperature Range: 100°C
- Free Enthalpy for Electrolysis
- High Temperature Range Electrolysis

18 Hydrogen Production Part V
- Efficiency of Electrolysis
- Polymer Electrolyte Membrane Electrolysis (PEM)
- Alkaline Electrolysis (AEL)

19 Hydrogen Production Part VI
- Biological Production Processes
- Potential of Hydrogen to Reduce Greenhouse Gas Emissions
- Fermentation

20 Hydrogen Production Part VII
- Hydrogen Purification Processes
- Methods for Processing Hydrogen
- Special Features of Membrane Separation

MODULE 4

Hydrogen – Transporting, Converting, Liquifying, and Storing

21 Hydrogen Transport: Pipelines Part I
- Pipeline Transport Part I
- Pipeline Transport Part II

22 Hydrogen Transport: Pipelines Part II
- Hydrogen Injection into Pipeline Networks
- Compensation of Pressure Loss
- Use of Non-Stationary Transport Containers

23 Hydrogen Handling and Compression: Odorization and Compressor Technologies
- Odorization of Hydrogen
- Compressors for Hydrogen Compression

24 Hydrogen Compressors
- Piston Compressors
- Diaphragm Compressors
- Turbo Compressors

25 Hydrogen Power and Liquefaction Technologies Part I
- Gas Engines
- The Basics of Hydrogen Liquefaction
- The Carnot Process

26 Hydrogen Power and Liquefaction Technologies Part II
- Liquefaction Processes
- Gravimetric and Volumetric Energy Density

27 Additions to Liquefaction
- Pre-Cooling, Compression, Throttling and Expansion
- Energy Balance
- Operating Parameters and Specific Efficiencies

28 Hydrogen Storage Part I
- The Underground Storage of Hydrogen
- Above-Ground Storage Facilities
- Liquid Hydrogen Storage

29 Hydrogen Storage Part II
- Alternative Physical Storage Methods
- Hydrogen Storage Material

MODULE 5

Hydrogen Applications and Use Cases

30 Hydrogen and Climate-Neutral Steel

31 Hydrogen and Ammonia Synthesis

32 Hydrogen Applications in Industry
- Hydrogen and Methanol
- Hydrogen for Process Heat in the Metalworking Industry

33 Hydrogen-Powered Transportation Part I
- Hydrogen and Transport
- Hydrogen Buses
- Hydrogen and Rail Transport

34 Hydrogen-Powered Transportation Part II
- Hydrogen in the Passenger Car Sector
- Hydrogen for Marine and Aerospace Applications
- Hydrogen in the Commercial Vehicle Sector

35 Hydrogen Filling Stations
- Hydrogen Filling Stations Part I
- Hydrogen Filling Stations Part II

36 Fuel Cells Part I
- Fuel Cells: Electrical Considerations
- Fuel Cells: Thermodynamics
- Fuel Cells: PEMFC

37 Fuel Cells Part II
- Purification and Electrolysis
- Fuel Cells: AFC, PAFC, MCFC and SOFC
- Hydrogen, Synthetic Fuels, Gas and Heat from Renewable Sources

38 Hydrogen Networks Part I
- Fatigue Strength and Crack Growth
- Odorants, Hydrogen Networks and Electrolysis
- Hydrogen Microgrids and Pipeline Networks

39 Hydrogen Networks Part II
- Hydrogen Network Capacity
- Hydrogen Network Pressure

MODULE 6

Hydrogen – Economics and Future Prospects

40 Distribution
- Hydrogen in Local Networks Part I
- Hydrogen in Local Networks Part II

41 Grid Storage
- Pipe Grids as Energy Storage for Hydrogen Part I
- Pipe Grids as Energy Storage for Hydrogen Part II

42 Sector Coupling
- Established Processes for the Production and Use of Hydrogen
- Sector Coupling
- The Economics of Green Hydrogen

43 Life Cycle Assessment and Sustainability Assessment of Hydrogen Technologies
- Life Cycle Analysis (LCA) of Hydrogen Technologies
- Hydrogen Life Cycle Stages
- Hydrogen Applications - Environmental and Cost Aspects

44 Use Case Construction Industry

45 Towards Using More Hydrogen and Green Fuels
- Demand in Energy-intensive Sectors
- Demand in the Power Sector
- Demand in Agriculture

WE HAVE MORE

Step into the world of boundless knowledge with our comprehensive range of courses.
At DADB, we believe in offering a diverse array of educational opportunities that cater to various interests and career aspirations.
From courses in renewable energies to the latest 5G technology, our offerings are thoughtfully designed to empower you on your learning journey. We invite you to explore the next page to discover the rich tapestry of possibilities that await, providing you with the tools and insights needed to excel in today's dynamic digital landscape.

DADB COURSES

INTERNET OF THINGS (IoT)
Prof. Dr.-Ing. Norbert Gronau
University of Potsdam

5G TECHNOLOGY
Prof. Dr.-Ing. Axel Sikora
Offenburg University of Applied Sciences

SOLAR ELECTRIC ENERGY SYSTEMS
Prof. Dr.-Ing. habil. Stefan Krauter
University of Paderborn

ACCESS OUR COURSES
ACCESS YOUR POTENTIAL
ACCESS THE FUTURE

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