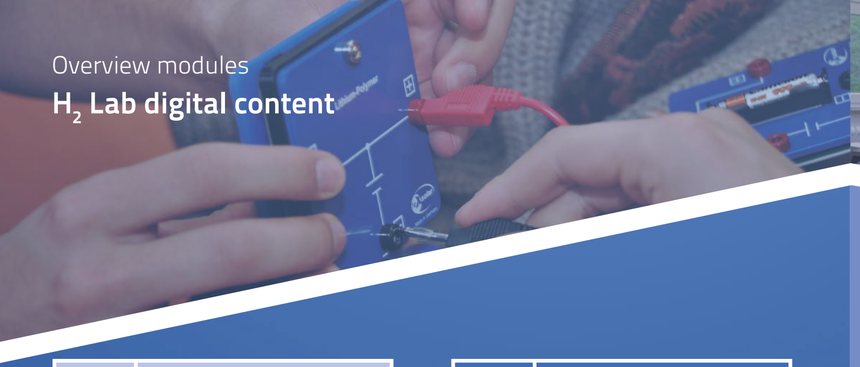

Overview modules

H_2 Lab digital content

Module 0*1 | Fundamentals of hydrogen technologies

Previous knowledge: School level STEM

Learning objectives:
- Basics of hydrogen safety
- Methods for producing hydrogen
- Applications of hydrogen and fuel cells
- Options for storing and transporting hydrogen

Duration: 3 units
- 2 – 4 hours (self-paced)
- 4 – 10 hours (as a part of the guided lessons)

Units:
1. H_2 – Physical basics and production of hydrogen
2. H_2 – Transport and Storage
3. H_2 – Application

Module 1 | H_2 Beginner: Fundamentals of fuel cells

Previous knowledge: Not required

Learning objectives:
- Basics of a solar-hydrogen energy cycle
- Conversion of electrical energy into chemical using electrolyser
- Conversion of chemical energy into electricity using fuel cells
- Types of fuel cell
- Hydrogen storage in metal-hydride cartridges

Duration: 4 units; 6 – 10 hours

Units:
1. Basic properties of the electrolyser
2. Basic properties of the PEM fuel cell
3. Basic properties of the SOFC
4. Basic properties of the DEFC

Module 2 | H_2 Advanced: Properties of the PEM fuel cells

Previous knowledge:
- Fundamentals of electrolysis
- Working principle of PEM fuel cells

Learning objectives:
- Properties of the solar cell
- Characteristics of the fuel cell
- Solar-hydrogen energy cycle for green hydrogen generation
- PEM fuel cell stack
- Efficiency of the fuel cell stack and electrolyser

Duration: 3 units; 5 - 6 hours

Units:
1. Basic experiments
2. Experiments with PEM electrolyser
3. Experiments with PEM fuel cell

Module 3 | H_2 Expert: Operating an industrial fuel cell

Previous knowledge:
- Working principle of the PEM fuel cell
- Efficiency of the PEM fuel cell

Learning objectives:
- PEM fuel cell stack
- Process control and efficiency of the fuel cell system
- Operating modes of the fuel cell system
- Recognizing and eliminating errors
- Hydrogen consumption

Duration: 1 unit; 2–6 hours

Units:
1. Hydrogen fuel cell system
   - Set up and operation of the fuel cell system
   - I-V characteristic curve of the fuel cell stack
   - Efficiency of the fuel cell stack
   - Parameters influencing the characteristic curve
   - Hydrogen consumption of the fuel cell stack
   - Efficiency of a fuel cell system

Module 0*1 Depending on the previous knowledge of the students, this module can be optional.

leXsolar

Certificates

Obtain your

Specialist Certificate in H_2 technologies!

Upon successful completion of each unit or the course, students will be rewarded with the badge or the digital certificate on blockchain respectively. The certificate acts as proof of learning and can be verified online.

- Verifiable certificate based on blockchain
- Issuer verification
- Skill pass

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leXsolar
understanding new energies

Discover the complete **Hydrogen** world!

H_2 Lab
A combined **training platform**

WORLDDIDAC WINNER 2023

Fuel cells can convert **hydrogen** into **electricity**

High-quality educational experimental system covering the main aspects of **Hydrogen** production, storage, and utilization.

Modular Training Platform

H_2 Lab

leXsolar made a commitment towards high-quality educational materials in the field of renewable energies by creating H_2 Lab: a combined training platform. leXsolar- H_2 Lab offers a complete experimental system covering the main aspects of hydrogen production, storage, and utilization of hydrogen in fuel cells. By the end of their training, students will have a solid theoretical and practical foundation in the fundamental concepts of hydrogen generation and fuel cells.

H_2 Lab is a modular training platform designed for standard classrooms and consists of three experimental kits and a series of digital courses.

Each experimental kit contains all necessary components and is equipped in a robust aluminium suitcase. When not in use, they can be stored on the shelves, freeing up the classroom space for other uses. The modular design approach of the training equipment and interchangeability of the components within kits allows the creation of a custom-tailored curriculum. With high-quality manuals containing predefined experiments, users are immediately ready to use the experimental systems.

H_2 Expert
with 1223 leXsolar-H_2 Expert for Technicians

- Comprehensive experimental kit of PEM fuel cell technology
- Process control and data acquisition
- Efficiency of the fuel cell system
- Influence of the temperature and air supply

Certificate **Expert**
Module 3

H_2 Advanced
with 1222 l leXsolar-H_2 Professional for TVET users

- Operation and characteristics of electrolyzer
- Generation of Green hydrogen
- Operation and characteristics of PEM fuel cell stack Efficiency of fuel cell

Certificate **Advanced**
Module 2

H_2 Beginner
with 1224 leXsolar-H_2 Ready-to-go for Beginners

- Fundamentals of fuel cells
- Proton Exchange Membrane Fuel Cell
- Direct Ethanol Fuel Cell
- Direct Flame Solid Oxide Fuel Cell

Certificate **Beginner**
Module 1

Module 0[*1]

Module 0[*1] This module is focused on creating a theoretical foundation for the forthcoming experiments. Depending on the previous knowledge of the students, this module can be optional.

Key data:

Target group	TVET - Technical and Vocational Education and Training
ISCED Level[*2]	5 - Short-cycle tertiary education
Age group	16 – 50
Number of students	20–30 students per classroom
Students per equipment	6–12 Students can work simultaneously with experimental kits
Focus of lab-equipment	Green Energy Education for TVET
Subjects	Chemical, Environmental and Electrical Engineering, STEM, Renewable Energies
Quality standard	leXsolar is an official member of the Worlddidac Association and Didacta e.V.
UNESCO Sustainable Development Goals (SDG)[*3]	4 QUALITY EDUCATION; 7 AFFORDABLE AND CLEAN ENERGY; 8 DECENT WORK AND ECONOMIC GROWTH; 13 CLIMATE ACTION

[*2] UNESCO Institute for Statistics, International Standard Classification of Education ISCED 2011, UNESCO-UIS, 2012
[*3] UN General Assembly, Transforming our world: the 2030 Agenda for Sustainable Development, A/RES/70/1, 2015

Benefits:

leXsolar H_2 Lab is beneficial for all participants in the educational process:

Students:

- Scalable knowledge in hydrogen energy field
- Hands-on experience
- Verifiable certificate based on blockchain
- Great perspectives in the job market

Teachers and trainers:

- Ready-to-use equipment
- Minimal time needed for the lesson preparation
- Modular structure with progressive difficulty levels
- Automatic evaluation of the students' results

Institutions:

- Modern and attractive topic
- No extra infrastructure needed
- Cashback of lab investment with lean training infrastructure

Industry/Employer:

- Knowledge of the hydrogen economy
- Specialists with practical experience working with fuel cells
- Employees with less integration cost in workflows

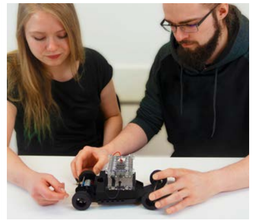
EXPERT

leXsolar-H_2 Expert

Item-No. 1223

leXsolar H_2 Expert offers a tabletop-sized experimental kit for the technical training of the Proton Exchange Membrane fuel cell systems. Due to the modular setup, the functionality of every component of the fuel cell system can be easily studied.

ADVANCED

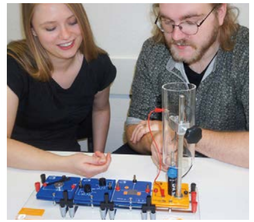


leXsolar-H_2 Professional

Item-No. 1222

H_2 Advanced is focused on the Proton Exchange Membrane fuel cell technology.

BEGINNER



leXsolar-H_2 Ready-to-go

Item-No. 1224

With leXsolar-H_2 Ready-to-go students will receive hands-on experience working with electrolyser, hydrogen generator and metal-hydride hydrogen storage, and fuel cells.