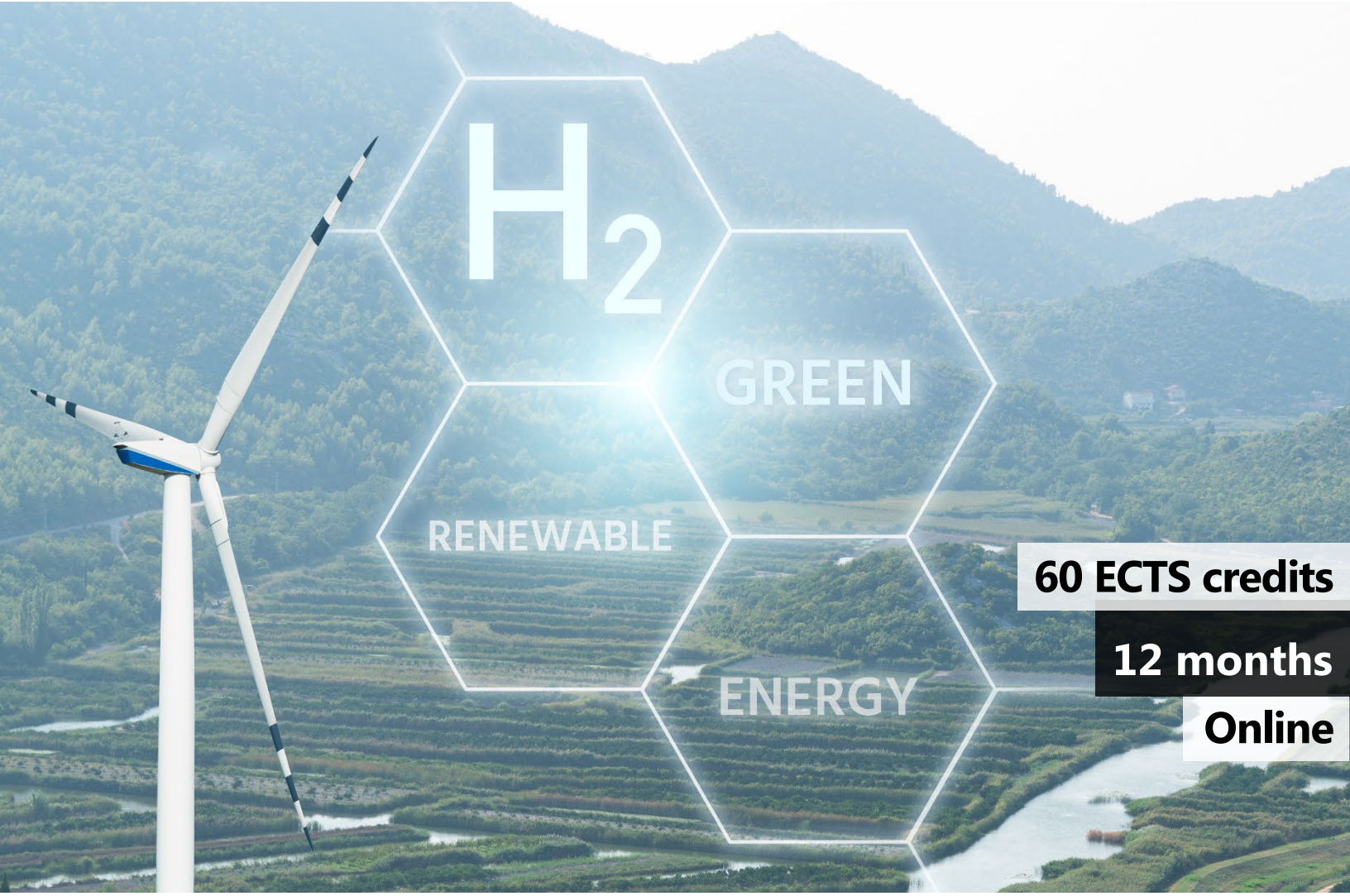


Master's Degree in Green Hydrogen Projects

UCAM
UNIVERSIDAD
CATÓLICA DE MURCIA

Structuralia

SUMMARY

STRUCTURALIA

Structuralia is an online school specialized in graduate engineering, infrastructure, construction, energy, building, new technologies, and digital transformation programs and courses. We are dedicated to providing high-quality education for engineers, architects, and STEM (science, technology, engineering, and mathematics) professionals.

Since our creation in 2001, over 200,000 students from more than 90 countries have participated in our virtual classrooms as we disseminate knowledge and guide professionals toward success.

To this effect, we collaborate with leading international experts in each field, which enables our students to specialize under the guidance of active professionals. Our constant interaction with major companies in each sector, as their specialized training provider, enables us to tailor high-quality academic material to meet the current job requirements of our students.

Our master's programs are certified by our partner universities, such as the Universidad Católica San Antonio de Murcia, UDAVINCI, or Universidad Isabel I.

Every day we strive to provide the best training for engineers, architects, and STEM professionals with a clear goal: your professional success.

BRIEF SUMMARY

The Master's degree in Green Hydrogen Projects has been designed to grant students access to cross-cutting knowledge related to key aspects of the hydrogen energy production sector. As a matter of fact, it is intended to help students develop the necessary skills to successfully participate in different projects all the way from the conceptual to the strategic stage. Therefore, and to this end, this program has been structured into 9 modules that progressively delve into the characteristics of hydrogen as an element, as well as into its energy and environmental impact.

This program also delves into the context of hydrogen as an energy source by analyzing the associated production technologies and the subsequent conversion process by means of fuel cells. It also goes into the storage and control systems within the supply chain, the repercussions of hydrogen in mobility and infrastructures, and of course, its uses and applications. In addition, other key aspects such as the construction of hydrogen filling stations, the strategic component and geopolitics of the sector, and finally, the economic and business aspects of hydrogen production, are also addressed.

Furthermore, the program provides the necessary theoretical framework, case studies, and practical exercises for students to put the acquired knowledge into practice. Finally, at the end of the course, all knowledge and skills learned throughout the duration of the master's degree will be tested by means of a final project.

WHY PURSUE THIS MASTER'S DEGREE?

Structuralia's Master's degree in Hydrogen Energy Projects is the only program that integrates all the different areas involved in the hydrogen energy sector. The main aspects included in this program are strategy design, Hydrogen as a product, associated infrastructures, and financing sources. By pursuing this master's degree, the student will be able to acquire suitable knowledge and skills that will enable him/her to manage hydrogen-related projects and respond to any situation that may arise while carrying out his/her duties.

WHO IS IT INTENDED FOR?

- Professionals in both the public and private sectors who require training in the hydrogen energy sector.
- Professionals seeking to boost their careers within the private sector or promote strategic changes within their companies.
- Anyone with either undergraduate or graduate education who is interested in learning more about the hydrogen energy sector in order to pursue a professional career in this area.
- Management staff who require an overall understanding of the hydrogen sector for strategic decision-making.

JOB OPPORTUNITIES

- Project engineer in consulting companies
- Energy company manager
- Project and technical studies manager in construction firms
- Technical staff in public administration agencies
- Process engineers
- Energy process manager
- Economist and developers in the energy sector
- Energy operations manager
- Energy business development

GOALS

By pursuing this master's degree, the student will be able to:

- Learn about hydrogen in terms of properties as an element, as an energy vector, and its environmental impact.
- Delve into hydrogen production and conversion methods.
- Apply relevant storage and control systems.
- Delve into the associated infrastructure and means of transport.
- Master the use and applications of hydrogen.
- Delve into the fundamental aspects of hydrogen fueling stations.
- Learn about the key players involved through a strategic vision of the sector.
- Master economic and business aspects associated with hydrogen energy projects.

PROGRAM

MODULE I: INTRODUCTION TO HYDROGEN

Unit 1: Characteristics of Hydrogen

- History of Hydrogen
- Physical properties of Hydrogen
- Chemical properties of Hydrogen
- Natural or biogeochemical cycles
- Thermodynamics of the reactions

Unit 2: Hydrogen as an Energy Vector

- Hydrogen as an energy vector
- Regenerative systems (I)
- Regenerative systems (II)
- Regenerative systems (III)
- Sources of hydrogen and primary energy

Unit 3: Environment and Sustainability

- Hydrogen as an energy alternative
- The role of hydrogen in the planet
- Environment and Hydrogen (I)
- Environment and Hydrogen (II)
- Carbon footprint and life cycle

Unit 4: Other variables of interest

- Hydrogen industry past and present
- The role of hydrogen in the climate
- Hydrogen economy
- Other technologies: Hydrogen Terminal Combustion Engines (HICE) and nuclear energy
- Sun-hydrogen binomial

MODULE II: THE CONTEXT OF HYDROGEN

Unit 1: Energy and Production

- Energy production an its evolution
- Fossil fuels. The change of an era
- Strategies for sustainability
- Energy demand and transition
- Energy and the fuel future

Unit 2: Climate Change and energy transition

- Climate change
- Effects and strategies related to climate change
- The energy transition roadmap
- The evolution of the energy transition
- Carbon credits and ESG criteria

Unit 3: Techniques and technologies for decarbonization (I)

- Vectors of the energy transition
- Renewable electricity generation, electrification, and storage
- Mobility and transportation
- Carbon capture and storage
- Circular economy and new materials

Unit 4: Techniques and technologies for decarbonization (II)

- Hydrogen (H^2)
- Bioenergy
- Integration between bioenergy processes and other technologies
- The cities of the future (Smart Cities)
- Entrepreneurship and enabling technologies and developments for decarbonization

MODULE III: HYDROGEN PRODUCTION AND FUEL CELLS

Unit 1. Hydrogen production from fossil fuels

- Hydrogen production
- Hydrocarbon reforming
- Partial oxidation and other hydrocarbon based processes
- Coal and biomass gasification
- Advantages and disadvantages. Comparison between the different processes

Unit 2. Green hydrogen production

- Electrolytic processes
- Alkaline electrolysers
- Polymer electrolyser
- Green hydrogen production alternatives
- Technological maturity level

Unit 3. Polymer fuel cells operation

- Origin and operation of fuel cells
- Composition and types of fuel cells
- Operation of polymer batteries
- Polymer battery components
- Progress and future expectations

Unit 4. Other types of fuel cells

- Solid oxide fuel cells. Geometries and materials
- Fuel cell efficiency
- Alkaline, phosphoric acid and molten carbonate batteries
- Microbial fuel cell
- Fuel cell design and costing

MODULE IV: HYDROGEN SUPPLY CHAIN

Unit 1. Storage and supply of hydrogen gas

- Storage systems and their characteristics
- Storage in the form of compressed hydrogen gas
- Pressure vessels, types, characteristics and development objectives
- Specifications of EIHP (European Integrated Hydrogen Project)
- Examples of development projects

Unit 2. Storage and supply of liquid hydrogen

- Liquid hydrogen storage systems and characteristics
- Storage, distribution and dispensing of liquid hydrogen
- Liquid hydrogen storage tanks, types, characteristics and development objectives
- Specifications of EIHP (European Integrated Hydrogen Project)
- Examples of development projects

Unit 3. Storage and supply of hydrogen in solids

- General concepts
- Metal hydrides
- Intermetallic compounds
- Carbonaceous materials and organic polymers
- Glass microspheres

Unit 4. Hydrogen system control

- Control theory
- Model-based Predictive Control (MPC)
- Hydrogen system modeling
- Control strategies
- Associated standards and regulations

MODULE V: HYDROGEN MOBILITY AND INFRASTRUCTURE

Unit 1. Land mobility

- Light transport
- Heavy duty transport
- Captive fleets
- Railway sector
- Infrastructures

Unit 2. Air and maritime mobility

- Energy transition in air transport
- Sustainable aviation fuels
- Energy transition in maritime transport
- Sustainable fuels for maritime transport
- Evolution of air and maritime transport

Unit 3. Hydrogen management

- Risk of hydrogen
- Hydrogen detection
- Security aspects
- Explosive environments
- Hydrogen risk assesment

Unit 4. Transport and logistics

- Hydrogen production pathways
- Distributed generation systems
- Comparison between generation systems
- Environmental, health, and safety aspects of the hydrogen production pathways
- Safety and risks associated with hydrogen transmissionn, distribution and storage

MODULE VI. HYDROGEN USE AND APPLICATIONS

Unit 1. Stationary applications

- Large-scale power production
- Decentralized power generation systems
- Power microgeneration systems
- Uninterruptible Power Supply Systems (UPS)
- Heat-energy combined systems

Unit 2. Mobile applications

- Introduction and future perspectives on mobile applications
- Forklift trucks
- Passenger cars and buses
- Air mobility and maritime mobility
- Other vehicles

Unit 3. Portable applications

- Reversible fuel cells
- Space applications
- Micro fuel cells
- Portable generators
- Other systems

Unit 4. Power-to-x

- Power-to-X. Basis and concepts
- Power-to-Gas (PTG)
- Power-to-Liquid (PTL)
- Power-to-Heat (PTH)

- Hydrogen and applications worldwide

MODULE VII: HYDROGEN FILLING STATIONS

Unit 1. Infrastructure equipment and components

- Materials, pipelines, and accessories
- Feed systems and storage
- Hydrogen compressors
- Auxiliary components and systems
- Hydrogen dispensers

Unit 2. Set up and operation of a hydrogen filling station

- Set up and operation of a hydrogen filling station
- Instrumentation and control systems
- Inspections protocols
- Filling station operation
- Maintenance tasks

Unit 3. Safety aspects

- Safety fundamentals
- Safety methodologies and risk assesment
- Risk mitigation, explosive atmospheres, and the atex
- Safety distance in hydrogen facilities
- Protection measures against external agents

Unit 4. Applicable regulations

- ISO 14687. Hydrogen fuel quality
- ISO 17268. Hydrogen refuelling devices
- ISO 19880-1. Fuelling stations. General requirements
- ISO 22734. Electrolyzers
- IEC 62282-3-100. Stationary fuel cell power systems

MODULE VIII: HYDROGEN GEOPOLITICS

Unit 1. Key Actors in Hydrogen Energy

- Large producers
- Large consumers
- Engineering, technology, and contractors as key players
- Government and H2 regulations
- Small producers and/or consumers

Unit 2. Business Model

- Evolution of renewable energies and Hydrogen transformation
- H2 storage or aggregate demand
- The uses of Hydrogen. Internal and external market
- H2 sales and blending
- Business model viability and limits

Unit 3. Hydrogen Roadmap

- EU's Hydrogen roadmap
- Spain's Hydrogen roadmap
- US Hydrogen roadmap
- China and Japan - Hydrogen roadmap
- Reflections on the Hydrogen roadmap

Unit 4. Strategic aspects

- The geopolitical power of Hydrogen
- Hydrogen and the geopolitics of infrastructures
- New energy world order
- Fossil fuels versus Hydrogen
- Geostrategic discourse and metadiscourse

MODULE IX: HYDROGEN ECONOMICS

Unit 1. Investment Drivers

- EU technological, economic, and environmental potential
- EU Hydrogen development plans. Hydrogen valleys
- Driving factors in the investment in Hydrogen and fuel cells
- Supply and demand development initiatives
- The technology commercialization route

Unit 2. Case studies

- Fuel cell handling equipment
- Residential use. Fuel cell Microgeneration
- Cogeneration CHP
- H_2 production without CO_2 capture (I)
- H_2 production with and without CO_2 capture (II)

Unit 3. Economic viability

- Viability plan
- Production and spending plan
- Investment and financing plan
- Reports; Operating account, balance sheet and treasury
- Main indicators, analyses, and simulations

Unit 4. Financing tools

- First steps in capital search
- Internal financing sources

  External financing sources
- Mixed financing sources
- How to negotiate financing matters

MODULE X: MASTER´S FINAL PROJECT

The program is subject to possible variations / updates of the contents to improve their quality.

AUTHOR PROFILE

DIRECTOR - David Nieto-Sandoval González-Nicolás

Industrial Technical Engineer by the la E.U.P. (Polytechnic University) of Málaga, and Industrial engineer by the E.T.S.I.I. (Superior Industrial Engineering School) of Ciudad Real; Energy and Environment Graduate Programs Director at the Universidad Tecnológica (University of Technology). Nieto-Sandoval is also a certified professor by the EOI (Industrial organization School) in the subjects of industry, entrepreneurship, energy, new technologies and technological innovation, and also works as a Trainer in the EU energy efficiency project INDUCE. Nieto-Sandoval has been conducting his professional activities as a consultant in the field of energy and mobility infrastructure engineering by means of alternative fuels in association with different companies and clients in both the industrial private sector and public institutions.

DIRECTOR - Susana Castilla González

Susana Castilla G. holds a degree in Industrial Technical Engineering with a specialty in Mechanics and Structure by the University of Jaen. She also holds a Master's degree in Sustainable Process Management by the Heriot-Watt University in Scotland. Castilla Gonzalez is an expert in Hydrogen Engineering, and a consultant in Energy construction projects, as well as in sustainability, ecology and awareness, and development and implementation of Decentralized Generation Systems; other fields include renewable energy and Hydrogen integration, and aware ecological transition towards a new energy paradigm. In addition, Susana is a researcher, the author of several publications in Science, Energy, Awareness and Spirituality.

Lourdes Rodríguez Mayor

Lourdes Rodriguez M. holds a PhD in Chemistry with a specialty in Chemical Engineering by the Universidad Complutense de Madrid and works as a lead professor in the area of Chemical Engineering. She also held the position of Director of the National Hydrogen Center in Puertollano (2014 -2017).

Rodriguez has conducted her professional activities for 30 years both in the public sector (17 years at the University of Castilla-La Mancha, 3 years at the National Hydrogen Center), and the private sector (7 years at the spin-off Alquimia Soluciones Ambientales, and 3 at the Universidad Europea de Madrid – European University of Madrid). In addition, Lourdes has published more than 80 articles in different international scientific magazines and worked as Main researcher in the Hyacinth (Hydrogen Acceptance in the Transition Phase) project, funded by the H2020 program.

Manuel Parra Palacios

Manuel Parra is an Industrial Chemist by the Universidad Complutense de Madrid; he holds a Master's degree in Engineering and Environmental Management, and another in Industrial Safety and Risk Prevention. Parra is a certified PMP since 2009, and has worked in the fields of Engineering, teaching, and research in environmental studies, Oil & Gas Engineering, and Petrochemistry.

Juan Antonio Roldán García

Juan A. Roldán holds a Master's degree in Chemical Engineering from the University of Granada, and another in Hydrogen Production and Management from the University of Avila. Roldán is an expert in hydrogen and transport fuel cells by the Universidad San Jorge, and a highly qualified technician in hydrogen generators and fuel cell technician, as well as in combined energy and heat systems, and fuel microcells by the University of Birmingham. He is also a Hydrogen Project Manager with extensive experience in: Smart storage of renewable energy in the form of Hydrogen, hydrogen refueling for garbage trucks, continuous Hydrogen production and feeding to remote telephony base stations, electricity and heat self-supply, and bus fueling stations.

Jose Manuel Pomares Medrano

Jose M. Pomares holds a degree in Business and works as a finance consultant and cost analysis specialist. He is also a lecturer in different graduate MBA programs from the Escuela Europea de

Negocios (European Business School), and the Master's degree in Air transport enterprise management (MGTA) from ITAérea (Aeronautical School of Madrid). Pomares has worked as trainer for LinkedIn Learning (Microsoft) in Spain and Latin America, as well as a facilitator in business schools such as FEDA, Escuela de Finanzas A Coruña (Finance School of A Coruña), ESIFF (International Finance School), FEUGA (Enterprise-University Foundation), EEN (Enterprise Europe Network). In addition, Jose Manuel has worked in big companies such as Inditex, Repsol YPF, etc., and in official Engineering, Economy, and Sociology schools in Spain.

Germán Nieto Cantero

German Nieto C. holds a degree in Industrial Technology Engineering from the Engineering Superior School of the University of Seville. Since 2018, German has worked as a process and trials Engineer in the Hydrogen Department at Abengoa Innovación, in innovation, and Hydrogen technology development projects funded by the European Commission. Some of his main responsibilities include the design, construction supervision and operations of pilot fuel cell plants.

Jordi Ortega

Jordi Ortega holds a degree in Philosophy from the University of Barcelona, and a PhD (with a special award) in Political Science and Sociology from the University Carlos III; he has also completed PhD studies and research at Frankfurt University. Ortega has worked as researcher-professor at the UPC ESEIAAT (Superior School of Industrial, Aerospace, and Audiovisual Engineering of Terrassa). Moreover, he has worked as the Director of the Green Hydrogen Consortium (Consorcio del Hidrógeno Verde) inside Area 8, and director of the ExpoCO2 of the Environmental Forum. In addition to his academic and professional qualifications, Jordi is currently one of the collaborators of La Vanguardia (Newspaper) and has published several books in the fields of energy transition, circular economy, ecological transition, among others, as well as articles in different scientific magazines. Finally, he has worked as a policy-making, planning, and strategy consultant for both public administrations and business associations.

METHODOLOGY

At Structuralia, we apply a modern methodology adapted to the process of change we live in today. Our educational environment is based on an online learning system, that is, learning by observing, reflecting, and practicing with an organized and carefully programmed study pace, which comes along with the constant support from our team. Our learning solution is designed to facilitate learning at the student's own pace, with a uniform structure that includes continuous evaluations and practical exercises to reinforce knowledge.

Our program's calendar consists of 9 monthly modules, which are divided into 4 weekly teaching units. In addition, there are 3 months for the Master's Final Project (MFP). This structure may be adjusted depending on the innate complexities of the program.

Each of these units contain introductory videos on concepts, syllabus prepared by our experts (which can be viewed online or downloaded in PDF), and self-assessments. Some units may even have practical exercises or examples, if required by the expert. At the end of each module, there will be a compulsory exam in order to complete the module.

The Director will ask all students to complete a Master's project, in which they will apply everything they have learnt in the previous modules, to practical cases. Students will have 3 months to complete and submit the project, during which they will receive the support from the program's team.

Finally, you will receive the status reports from our team through regular follow-ups throughout the program.

EVALUATION

The assessment will be ongoing throughout the training program and will take into account not only the acquisition of knowledge, but also the development of skills and attitudes.

At the end of each monthly module, the student must answer a test-type exam on the online training platform, in addition to pose a variety of practical cases along the topics and optional unit test so as to achieve the maximum consolidation of technical concepts.

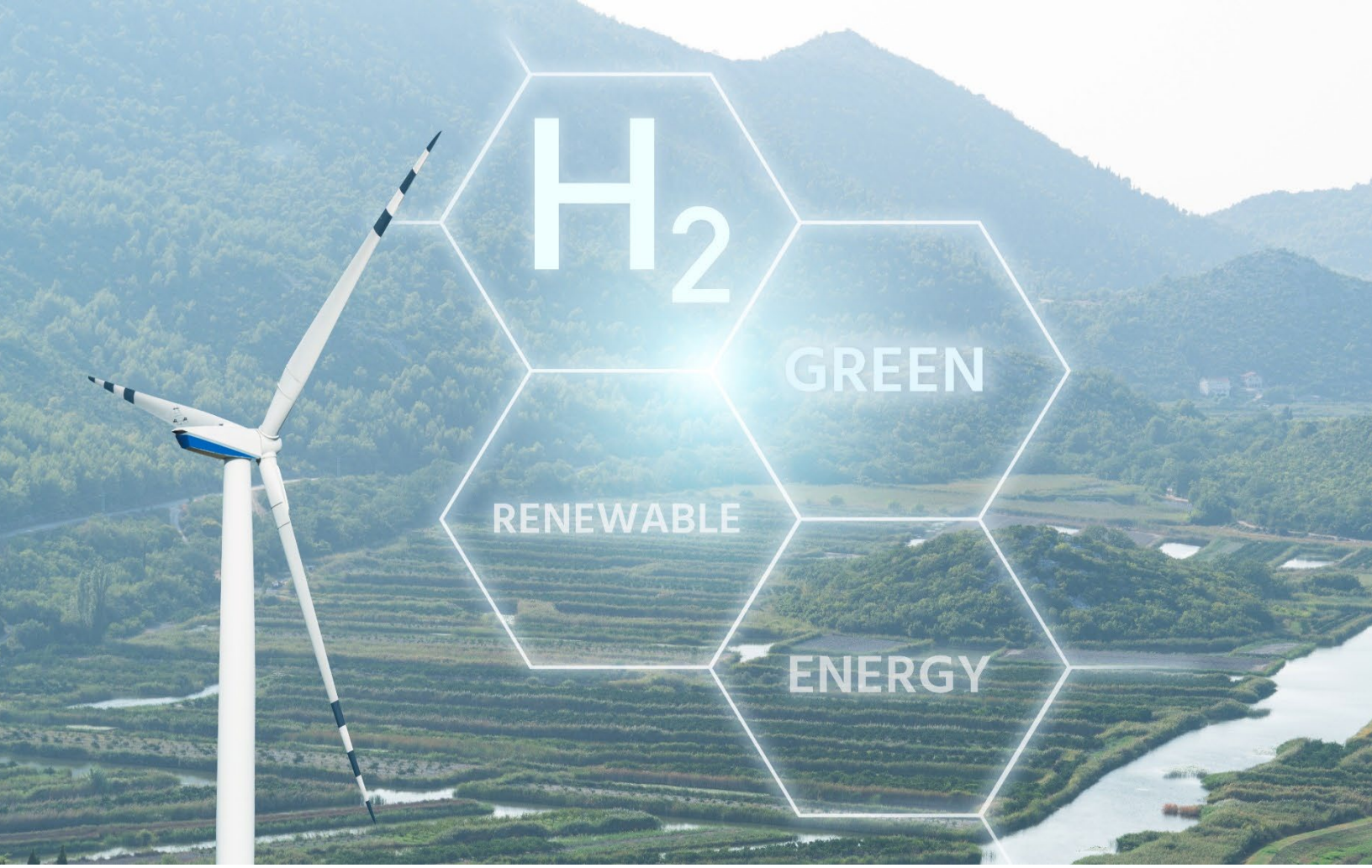
To obtain the degree it will be necessary to pass the assessable modules of the program.

DEGREE

Students who have visualized all the lessons, successfully passed the self-assessments and exams, and submitted the master's final project, will receive Structuralia's certificate and the title of Master of Professional Development by the Universidad Católica San Antonio de Murcia (UCAM), in digital format.

Likewise, the student can request a certificate of completion of his/her master's degree, or a certificate of completion from Structuralia.

The student may also request a the Hague Apostille on his/her certificate of completion from the university an additional fee.



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