



**UPHYMOB**

## Curriculum UpHyMob

Result type: R2 – T1



### Project details

Project acronym: UPHYMOB

Project name: Upskilling the EU workforce for hydrogen fleets and infrastructure operation and maintenance.

Project code: 2021-1-ES01-KA220-VET-000028038

### Document Information

Document ID name: Design of curriculum structure

Document title: Curriculum UpHyMob Massive Online Open Course

Output Type: Deliverable

Date of Delivery: 24/05/2023

Activity type: R2-T1

Activity leader: FSV

Dissemination level: Public

Versions	Date	Changes	Type of change	Delivered by
<b>Version 01</b>	30/11/2022	First Draft	-	<b>FSV</b>
<b>Version 02</b>	19/01/2023	Second Draft		<b>FSV</b>
<b>Version 03</b>	01/02/2023	Third Draft		<b>FSV</b>
<b>Version 04</b>	8/03/2023	Fourth Draft		<b>IST - FSV</b>
<b>Version 05</b>	17/03/2023	Fifth Draft		All partners
<b>Version 06</b>	14/04/2023	Sixth Draft	Fine-tuning	<b>FSV</b>
<b>Version 07</b>	<b>24/05/2023</b>			<b>FSV</b>

### Disclaimer

The European Commission's support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

This document is proprietary to the UPHYMOB Consortium. Project material developed in the context of Project Management & Implementation activities is not allowed to be copied or distributed in any form or by any means, without the prior written agreement of the UPHYMOB consortium.

## TABLE OF CONTENTS

1.- Introduction.....	5
2.- Objectives .....	5
3.- Curriculum Structure.....	6
3.1 Method used .....	6
3.2 Course Description .....	7
3.3 Learning Units .....	9
3.4 Structure of learning units.....	10
3.5 Hours of curriculum structure, hours of teaching and hours of practice per learning unit.....	11
3.6 Assessment method.....	11
4.Methodology .....	11
5.Validation methodology .....	12
5.1 Trainer and mentor handbook .....	12
5.2 Teacher’s profile* .....	16
5.3 Definition of the work plan to be performed by the student to complete the course* .....	17
6.Target Audience.....	18

## 1.- Introduction

Hydrogen is foreseen to play a significant role in the global decarbonization goals. In this sense, the European Commission already accounts with an ambitious hydrogen strategy, with the goal of reaching a steady production of renewable hydrogen in the short-term, investing heavily in the mobility sector. In fact, Hydrogen Europe expects 10.000 hydrogen trucks on Europe's roads by 2025 and 100.000 by 2030. In order to support the movement towards a hydrogen-based transport sector, there is a pressing need for a workforce (namely technicians to be employed in the sector) with a specific set of skills, such as vehicle parts ordering and inventory management, vehicle instrumentation, diagnosis, and repair of H<sub>2</sub> power-trains, installation and maintenance of Hydrogen Refuelling Stations, following protocol for refuelling H<sub>2</sub> vehicles and hydrogen fleets. Therefore, upskilling of the workforce is of vital importance and is the only way to avoid unemployment by the imminent shift to a green mobility sector. Indeed, it is strongly believed that a workforce having proper skills to combine the two worlds of power-train maintenance and refuelling will play a key role in the next energy transition.

Research studies show there is a clear need for hydrogen skills in the whole value chain, especially in technicians and equipment operators. The current training offer available in the market is not meeting the needs of the industry, and the current workforce is still not ready for hydrogen-based technologies.

## 2.- Objectives

- OBJECTIVE 1: Definition of a VET curriculum structure (30 hours)
- OBJECTIVE 2: Create learning units with the following specifications: duration, learning outcomes, learning methods and assessment criteria according to ECVET principles.
- OBJECTIVE 3: Ensure that the curriculum corresponds to 4th EQF level.

## 3.- Curriculum Structure

### 3.1 Method used

- Review and apply the results of the previous task (R1-T4) in which the learning outcomes have been defined for the design of the curriculum structure.
- Decide the level of definition and teaching of the contents of the module based on the European Qualification Framework (EQF) and the requisites of the project.
- Definition of the modules and associated lectures that form the structure of the curriculum.
- Analyse and define the best methodology for teaching and evaluating the curriculum.
- Finally, design of the complete UPHYMOB curriculum structure with the corresponding hours per module

### 3.2 Course Description

The course will include:

LU	TITLE	Presentation	DURATION (Teaching and studying hours)	EQF Level	Learning outcomes
1	<b>Hydrogen introduction and basic properties, behavior, and definitions, equipment, inspection operation and maintenance</b>	Equipment installation is considered to be the greatest need in the short, mid and long term. Installation requires knowledge of joints, high pressure systems, controls, electric circuits, etc. It also implies to understand risks, to follow procedures and a correct handling. Most of the systems will rely on automatism and informatic controls for their maintenance.	7 hours	EQF4: Cognitive and practical skills required to generate solutions to specific problems in a field of work or study EQF4: taking some responsibility for the evaluation and improvement of work or study activities	<ol style="list-style-type: none"> <li>1. To understand hydrogen fuel properties and behavior.</li> <li>2. To be able to understand basic hydrogen technologies during this course</li> <li>3. To Know and understand the procedures</li> <li>4. To Possess an appropriate knowledge of the installation</li> <li>5. To Solve problems in an effective and safe way when it is required</li> </ol>
2	<b>Safety protocols and provisions related to hydrogen storage</b>	When working with hydrogen, as with other inflammable gases, safety is a priority. Understanding the correct way to operate and good practices is fundamental. That means that safety must be learned by all levels. Any organization working with hydrogen should develop an emergency response plan and follow it. Hydrogen safety training should be provided to all employees who handle hydrogen or related materials.	6 hours	EQF4: Cognitive and practical skills required to generate solutions to specific problems in a field of work or study. EQF4: taking some responsibility for the evaluation and improvement of work or study activities.	<ol style="list-style-type: none"> <li>1. To Review response plans based on experience</li> <li>2. To Identify and addresses concerns regarding the safe use of hydrogen</li> <li>3. To Understand the properties of hydrogen, how it compares to other fuels, and the safety mechanisms of hydrogen systems</li> </ol>

3	<b>First aid, emergency and response procedures</b>	This chapter will support the successful implementation of installation and maintenance of Hydrogen Refueling Stations by providing technically accurate safety and emergency response information for hydrogen mobility technicians, who must know how to deal in a professional manner with potential incidents or accidents involving their systems and infrastructure. Appropriate training plans should be developed after identifying potential job hazards. Personnel should be trained to evacuate and assist other persons.	6 hours	EQF4: Cognitive and practical skills required to generate solutions to specific problems in a field of work or study EQF4: taking some responsibility for the evaluation and improvement of work or study activities	1. To Identify typical ignition sources and other potential hazards 2. To Understand First aid, emergency and response procedures
4	<b>Detection and diagnosis faults in H<sub>2</sub> vehicles</b>	Hydrogen vehicles will have to work in troubleshooting, diagnose and repairing vehicles faults. Vehicles can be more complex since they have several systems integrated: high pressurized vessels, hydrogen tubing, fuel cell/s, auxiliary systems, other common systems related to the electric motor and the usual mechanic systems of traditional cars.	6 hours	EQF4: Cognitive and practical skills required to generate solutions to specific problems in a field of work or study EQF4: taking some responsibility for the evaluation and improvement of work or study activities	1.To Understand Hydrogen vehicles 2.To Understand H <sub>2</sub> combustion and To Understand H <sub>2</sub> combustion (internal combustion engine) and hydrogen fuel cell systems. 3.To Understand failure modes, effects and diagnostic analysis 4.To Use protocols and routines, control and problem solving 5.Unload of hydrogen transport trucks
5	<b>Detection and diagnosis faults in HRS parts</b>	Hydrogen Refueling Stations (HRS) are, in brief, H <sub>2</sub> infrastructures with high pressure gas storage. In the short term they are not expected to produce hydrogen on-site; they rather will account on a distributed system, based on H <sub>2</sub> transport by trailers for the supply phase.	6 hours	EQF4: Cognitive and practical skills required to generate solutions to specific problems in a field of work or study EQF4: taking some responsibility for the evaluation and improvement of work or study activities	1. To acquire knowledge on HRS infrastructures 2. To Possess an appropriate knowledge HRS maintenance and safety operation 3. To Understand HRS parts and operations refueling vehicles



### 3.3 Learning Units

5 learning units will be developed:

1. Hydrogen introduction and basic properties, behaviour, and definitions, equipment, inspection operation and maintenance.
  - a. Introduction to hydrogen
  - b. H<sub>2</sub> key properties and behaviour
  - c. H<sub>2</sub> technologies and definitions
  - d. On-site energy production and control.
  - e. Compressed and liquid H<sub>2</sub> storage
  - f. Piping and connections
  - g. H<sub>2</sub> transport and distribution
  - h. Dispensers and nozzles
  - i. Fuel cells and vehicles
  - j. References
2. Safety protocols and provisions related to hydrogen storage.
  - a. Introduction and general safety guidelines
  - b. Safe use of H<sub>2</sub>
  - c. Emergency Response Planning
  - d. H<sub>2</sub> System Safety
  - e. Employee training
  - f. Conclusions
  - g. References
3. First aid, emergency, and response procedures.
  - a. Health hazard information
  - b. Main risks occurred on a Hydrogen Refueling Stations
  - c. Main risks associated to Fuel Cell Electric Vehicles (FCEVs)
  - d. General working and safety guidelines
  - e. First aid emergency and response procedures
  - f. References

4. Detection and diagnosis faults in H<sub>2</sub> vehicles.
  - a. Hydrogen Vehicles - Internal Combustion Engine and Hydrogen fuel cell systems
  - b. Faults and diagnosis methods
  - c. Sensors and monitoring systems
  - d. Failure modes, Effect and Diagnostic
  - e. Maintenance and Inspection
  - f. Safety considerations
  - g. References
  
5. Detection and diagnosis faults in HRS parts.
  - a. Hydrogen Refueling Station (HRS): How does it work?
  - b. HRS maintenance
  - c. Overview of main failures in a HRS
  - d. HRS safe operation
  - e. References

### 3.4 Structure of learning units

The structure of each learning units will be as follow:

- Introduction
- Learning objectives
- Agenda (learners' indications how to follow the Training Material)
- Lecture notes
- Questions and answers (for the entire unit)
- Case study (for the entire unit)
- Multiple choice questions (for the entire unit)
- Videos

### 3.5 Hours of curriculum structure, hours of teaching and hours of practice per learning unit

The student method for each subject in the program is defined by continuous study. The online course is organized around learning units (5) of 6 hours each one except first learning unit of 7 hours. Total 30 hours. Theoretical knowledge (60%) with practical skills and competence (40%).

### 3.6 Assessment method

The student will be able to consult the assessment system in the course guide, within the online platform. In addition, the students will have a personal timeline of the activities for each subject at their disposal, reflected in the student's calendar.

The assessment method for each subject in the program consists into a multiple-choice questionnaire at the end of each LU, allowing a continuous monitoring of the students' progress and their knowledge of the theoretical contents.

## 4. Methodology

The online course is organized around learning units and comprises the project's training and assessment materials, contextualised in an online form (text, presentations, multimedia files, interactive tools, and exercises. Theoretical knowledge (60%) with practical skills and competence (40%).

Figure 1 shows an example of the visual appearance of the virtual classes on platform, including some information about What the students will learn and the Course Curriculum.



Figure 1: Visual appearance of the virtual classes on platform, including some information about What the students will learn and the Course Curriculum.

The training material foreseen for the Massive Open Online Course will be organized by 5 learning units (6 hours per unit): For each learning unit the input requirements are:

- A small introductory paragraph
- Lecture notes
- Questions and answers (for the entire unit)
- Case study (for the entire unit)
- Practical exercises (for the entire unit)
- Multiple choice questions (for the entire unit)
- Videos

## 5.Validation methodology

The Curriculum structure and methodology and the regulation of the elements that determine the teaching and learning processes for each LU's should be validated.

The methodology will focus on the organization of strategies or actions of the teacher. This deliverable clarifies all the aspects of the methodology that the student will be able to enjoy, from the very first step of his registration to the services that he will have at his disposal in the platform itself.

It defines the roles of the faculty that the student will be in contact with and who prepares the content to the platform.

The work planning that the student must perform in order to complete the course is also included.

It also clarifies which tools the student can use to resolve his technical questions about the functionality of the platform.

The deliverable describes the process of registration of the students.

Finally, it shows which are the communication ways that the student will be able to use to keep in contact with the staff.

### 5.1 Trainer and mentor handbook

A trainer and mentor handbook with educational instructions, learning and assessment materials and practical examples will be developed. The main purpose is to enable:

- Vehicle mechanics to acquire theoretical knowledge and practical skills that we help them to employ.
- How to integrate learning units into existing training programmes and courses.

In terms of Innovation, expected impact & transferability potential, the curriculum aimed:

- To train current and future technicians in the maintenance of H<sub>2</sub> power-trains and the installation and maintenance of HRS
- Practical application
- To be comprised by 5 learning units that can be individually embedded into existing VET offerings for fuel-cell vehicle mechanics.

The curriculum will cover the entire spectrum of skills and competences which H<sub>2</sub> mobility technicians need to:

- Understand the functions of H<sub>2</sub> power-trains and HRS
- Maintain and service H<sub>2</sub> power trains
- Install and maintain an HRS following safety protocols.

#### Trainer handbook:

Provision for fuel-cell vehicle maintenance and in-house mentors working in automotive companies.

The developed guidelines to VET providers will facilitate the integration of learning units/modules into existing VET programmes.

Enhancing the relevance of their training offerings with a multiplying effect on the expected impact.

The Guide for trainer and mentor handbook consists of:

- Presentation
- Course description
- Expected learning outcomes
- Competencies (General and Specifics)
- Methodology
- Career prospects
- Target Group
- Competencies required for participation
- Teacher's profile
- Evaluation

- Title and Duration.

### Training and Assessment materials

The learning outcomes (LU's) include:

- Hydrogen introduction and basic properties, behaviour, and definitions
- H<sub>2</sub> safety protocols
- Knowledge of internal operation of H<sub>2</sub> powertrains and HRS
- Vehicle and HRS instrumentation
- Quality control for the safe and proper function of H<sub>2</sub> powertrains and HRS
- Detecting and diagnosing faults in H<sub>2</sub> powertrains and HRS parts
- Vehicle and HRS parts cataloguing, fitting, examining, and replacing defective parts

The training material will include:

- a. The UpHyMob learning units and contextualised training and assessment materials produced in R2 in online form (lecture notes/textual documents, presentations, multimedia files, online interactive tools)
- b. Additional pedagogical resources such as video units and work assignments that will be developed to be embedded into the online course, in order to increase learners' engagement and course interactivity.

The UpHyMob training material will contain video units, supporting material (slides, hand-outs, self-tests)

Furthermore, the partnership aims to run a 3-week pilot online course (R3-T3) to test the training material and identify weaknesses, areas of strengths and opportunities for improvement. The pilot will enable the partnership to evaluate and finetune the curriculum on the basis of participants' comments as drawn from actual usage and interaction with learning materials.

The learning contents and the assessment (multiple-choice questionnaire) will be delivered on the platform of the UpHyMob project, as shown in Figure 2.

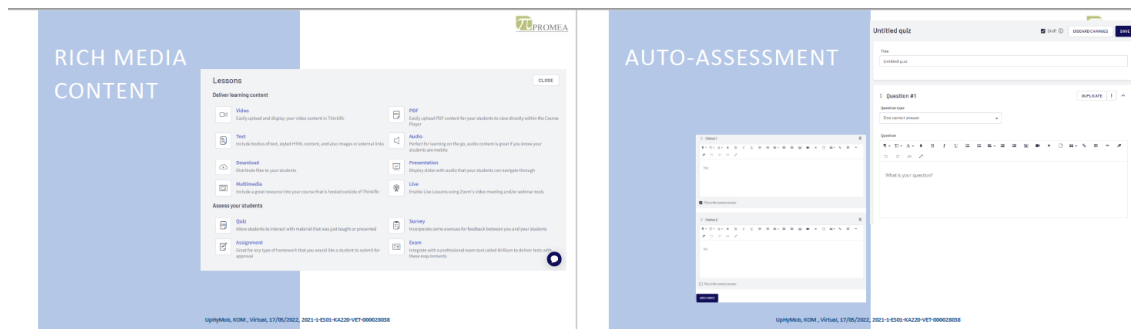


Figure 2: The rich content and auto-assessment on UpHyMob online course.

The expected learning outcomes to be achieved upon completion of this training program are the following:

1. To Understand hydrogen fuel properties and behaviour
2. To Know and understand the procedures of hydrogen fuel properties
3. To Possess an appropriate knowledge of the installation HRS
4. To Solve problems in an effective and safe way when it is required"
5. To Review response plans based on experience
6. To Identify and addresses concerns regarding the safe use of hydrogen
7. To Understand the properties of hydrogen: to understand the main differences with other fuels in terms of safety aspects
8. To Recognize and identify hydrogen vehicles, stationary power generators, storage containers, and refuelling equipment
9. To Identify typical ignition sources and other potential hazards
10. To Understand First aid, emergency, and response procedures
11. To Acquire knowledge Hydrogen vehicles
12. To Understand H<sub>2</sub> combustion. Internal combustion engines, boilers, and turbines
13. To Use protocols and routines, control and problem solving
14. Unloading process of hydrogen transport trucks
15. To Understand HRS parts and operations refuelling vehicles
16. To Possess an appropriate knowledge HRS maintenance and safety operation.

## 5.2 Teacher's profile\*

### TEACHING STAFF

A fundamental aspect that will determine the quality of the studies is the teaching staff and their adaptation to the programme objectives.

The teaching staff in a good institution should be composed mainly by a group of teachers specialized at different and specific technologies. UpHyMob professors work sharing their professional dedication with teaching and researching. These professionals offer the daily experience of their own jobs.

When we talk about the teaching profiles/staff, it could be said that we are dealing with the essence of the entire system of learning/study and its entire methodological grounds.

Training system combines the virtues of these professionals together with the physical and temporal flexibility, and the most complete and updated teaching methods.

#### Teachers

Lecturers are responsible for the delivery of the course modules. Among their main functions we have:

- Getting in contact with the student for the first time in order to know his/her special features (previous knowledge of the topic, professional experience in the area, proficiency in the use of computing tools, availability to study, etc).
- Guiding the student towards the study of the most representative aspects of the module, customizing it in case there are no legal restrictions.
- Updating continually the scheme, according to the latest tendencies.
- Solving doubts personally and monitoring the students who are active in the module.
- Assessing students according to a homogeneous criterion, after establishing the assessment criteria.
- Providing each student with the necessary information and items for their training as well as the fulfilment of all their objectives.
- Promoting participation in forums and chats as well as managing and moderating them.

For the UpHyMob project, teacher, tutor and coordinator are merged in a unique, professional profile.



\*This chapter applies only if the course is provided by a VET provider. Not if it is accessed by an independent learner of a Massive Open Online Course that they will have lecture notes/textual documents, presentations, multimedia files, online interactive tools and pedagogical resources such as video units and work assignments that will be developed to be embedded into the online course.

### **5.3 Definition of the work plan to be performed by the student to complete the course\***

The student must complete the whole course on the online platform.

#### Method of tutorials student to solve technical doubts.

Students can ask questions to their teachers through the e-mail, forum of the course or internal message.

If they have any issue with the platform, they can find help in the *video help section* or they can contact the staff by e-mail.

#### Definition of the course registration method

The process of registration consists of self-registration by filling the forms located at every course.

Registration and consequent steps will be given in detail in the next R3 activities.

\*This chapter applies only if the course is provided by a VET provider. Not if it is accessed by an independent learner of a Massive Open Online Course that they will have lecture notes/textual documents, presentations, multimedia files, online interactive tools and pedagogical resources such as video units and work assignments that will be developed to be embedded into the online course.

### **5.4 Validation methodology Summary**

The process of registration is implemented as a free process. The students have to carry out a form and as soon as they complete it, they will be automatically enrolled into the course and given access to the platform.

The roles of the teaching staff will be adapted depending on the number of students.

At first, a single person will fulfil the three roles, teacher and tutor/coordinator. But, if the number of students in a course requires it, these roles can be divided between several people.

The main way of communication between student and teachers will be via online tools, such as email or Teams. In addition, the contact with fellow students is supported by the platform and will be encouraged by the teacher staff, in order to establish a strong group cohesion. Under Partners preferences, phone calls can be performed between teachers and students.

## 6.Target Audience

- H<sub>2</sub> powered - train technicians
- Hydrogen Refuelling Stations (HRS) personnel, specialized in maintenance and installation
- Apprentice vehicle mechanics
- Professional profiles closely working with hydrogen fleets.

There is a clear need for hydrogen skills in the whole value chain, especially in technicians and equipment operators.

The modular curriculum structure of the UpHyMob project will be used by VET providers and in-house training centres in the H<sub>2</sub> mobility industry. The main purpose is to enable (H<sub>2</sub>) vehicle mechanics to acquire theoretical knowledge and practical skills through a combination of pedagogical resources that will help them be employed (or re-employed) in the field of the H<sub>2</sub> mobility sector.

### LEARNERS

Future H<sub>2</sub> mobility technicians and current vehicle mechanics, wishing to upskill themselves and find employment in the H<sub>2</sub> mobility sector.

### TRAINING PROVIDERS

Vocational training institutions that provide training in the automobile and RES industry; in-house training providers of hydrogen (mobility) industries.

The UPHYMOB partnership will also deliver guidelines to VET providers on how to integrate the learning units into existing training programmes and course offerings for the Renewable Energy Sector.

### HYDROGEN MOBILITY COMPANIES

UpHyMob educational resources will be available for multiplication, contextualisation and exploitation by any public/private educational entity or H<sub>2</sub> mobility / automotive company providing inhouse training.



Upskilling the EU workforce for hydrogen fleets and infrastructure  
operation and maintenance  
Pr: No.:2021-1-ES01-KA220-VET-000028038



Public and private enterprises active in the hydrogen mobility industry.