Interreg North-West Europe H2SHIPS

EUROPEAN UNION

System-Based Solutions for H2-Fuelled Water Transport in North-West Europe

Implementation scheme for H2SHIPS training products

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Main author	Yousif Al-Sagheer
Contributors	Robert Steinberger-Wilckens
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List of Abbreviations

CDT	Centre for Doctoral Training
CPD	Continuous Professional Development
FCHRC	Fuel Cell & Hydrogen Research Centre
FCHT	Fuel Cells and Hydrogen Technology
LMS	Learning Management System
IAPH	International Association of Ports and Harbours
IMO	International Maritime Organization
NWE	North-West Europe
SLA	Service Legal Agreement
UoB	University of Birmingham

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1 Introduction

This report aims at approaching a business model to implement the training and teaching programme provided in Deliverable LT3.2 of H2SHIPS project. The model indicates potential workforce size that can be related to the transition to zero/low carbon technology in maritime sector. Also, a training delivery model with its costing will be presented in this report.

Research has forecasted that 21.7 million full-time new jobs related to green technologies could be created by 2030 [1], [2]. Decarbonising maritime sector could involve introducing and developing green solutions for sea and inland shipping, logistics activities in ports, accompanying landside and offshore infrastructure and industrial partners across the supply chains.

The number of seafarers has declined worldwide. Currently, this is a global shortage of 165,000 maritime officers [3]. Also, there is a trend of large ships to expand digitalisation and automation, and this will be important to the changes needed for net zero. The Green Jobs Taskforce report [4] indicates that the skills requirements of the maritime sector will change significantly over the next 30 years. New training programmes will be required as vessel subsystems, mainly propulsion systems, will be adapted to meet the decarbonising targets. The skills required of crew and maritime engineers will expand to encompass the new green or carbon neutral technologies. Seafarers will be required to develop their skills to transition between sea and shore-based roles. Continuous professional development CPD courses will allow to update the skills in line with green solutions in maritime sector.

The success of the training course on hydrogen in shipping will depend on the marketing strategy that effectively targets potential participants. The marketing strategy will involve both online and offline channels to reach a wide audience. The marketing channels include social media, industry associations, email marketing, and direct mail using H2SHHIPS platform newsletter and stakeholders' network of H2SHIPS project partners. The content for the marketing channels will focus on the benefits of hydrogen in shipping and the need for skilled personnel to support the growth of sustainable shipping.

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2 Training business model

The training course will target professionals and students interested in working with hydrogen-powered vessels. This may include engineers, technicians, shipbuilders, ship operators, and students pursuing a degree in marine engineering or a related field. Qualified workforce able to operate fuel cell propulsion systems in vessels and hydrogen infrastructure will be required at both technician training level L3 and L4 and senior engineering L7 [4]. The training programmes aim at maintaining skills of engineers and technicians working in shipping industry. The design of the programme is based on experience of the universities involved in H2SHIPS project, mainly the University of Birmingham (UoB). The Fuel Cell and Hydrogen Research Centre (FCHRC) at UoB has developed courses and education materials that can be adapted to address the challenges of hydrogen in shipping projects, and to adopt new lessons learned and innovations from H2SHIPS pilots and work packages.

The training programme would focus on introducing hydrogen as a fuel in shipping, technology aspects of fuel cell propulsion systems for shipping, safety aspects of hydrogen-powered vessels, maintenance and operation, and regulations and standards.

The training course will be delivered through a combination of online and in-person modules, consisting of lectures, case studies, and hands-on training. The training can be offered in multiple languages to cater to a diverse audience.

The cost of delivering the training course will depend on several factors, including the number of participants, the duration of the training, and the delivery mode. The cost estimate for delivering the training course on hydrogen in shipping is estimated to be around £90,000-£100,000 based on similar training course of hydrogen and fuel cell technology delivered by the University of Birmingham. The cost can be categorised into five sub-budgets, which are:

1. Development of training materials and modules

   The development of training materials and modules would be a significant cost associated with delivering the training course. The cost would depend on the scope of the training course, the number of modules, and the level of detail included in each module and the qualification the trainees will get. A rough estimate of the cost of developing training materials and modules would be around £50,000.

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2. Trainer's fees (including travel expenses)

Experienced trainers with a background in hydrogen technology and its application in shipping will be required to deliver the training course. The trainer's fees would depend on the level of expertise required and the duration of the training course. The fees would include the trainer's travel expenses if the training is delivered on-site. The trainer's fees are estimated to be around $10,000. To identify qualified trainers, it is recommended to reach out to industry associations, academic institutions, and existing training providers. Additionally, it may be necessary to provide training to selected trainers to ensure that they are up to date with the latest developments in hydrogen technology and can effectively deliver the course content.

3. Venue rental / Equipment / Online Learning Platform

The cost of renting a venue (for practical training sessions) and equipment would depend on the location and duration of the training course. The cost would include the rental of the training venue, audio-visual equipment, and other training materials. Usually, this cost will be included in the estate cost of any fund application. The cost of venue rental or the estate cost of the course delivering institutions and equipment is estimated to be around £5,000-£10,000. The cost of developing and maintaining an online learning platform would depend on the features and functionalities included in the platform. The platform should be user-friendly, interactive, and capable of delivering a seamless learning experience. The cost of developing and maintaining an online learning platform is estimated to be around £20,000-£25,000.

For the practical training sessions, it is important to select a location that is easily accessible for participants in order to maximise participation. The location should be near a major port or shipping hub or located in a city with good transportation links. Additionally, the location should have suitable facilities for delivering practical sessions, such as hydrogen fuel cell training kits and hydrogen gas supply infrastructure (this can be replaced by hydrogen bottles).

4. Marketing and promotion

The cost of marketing and promotion would depend on the target audience and the channels used to promote the training course. The cost would

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include the development of promotional materials, advertising, and other marketing activities. The cost of marketing and promotion is estimated to be around £5,000.

5. Administrative and operational expenses

This would include travel and accommodation expenses for the trainers, catering expenses for the in-person training modules, and other unforeseen expenses. The cost of these miscellaneous expenses is estimated to be around £5,000.

The revenue for the training course will come from the fees charged to participants. The fee structure will be determined based on the duration of the training and the delivery mode. The fee structure could be based on a per-module or per-day basis. Assuming a fee of £1,500-£2,000 per participant, and an estimated participation of 50 participants, the revenue generated from the training course would be £75,000-£100,000. The cost of implementing the programme can be supported by net zero accelerating programmes from government and organisations. For instance, European Union Social Fund [5], Education and Skills Funding Agency [6], and Marine Society [7]. The fund can support offering free training to participants.

2.1 Technicians training business model

The business model of technician training programme can adopt a service legal agreement (SLA) organised by the University of Birmingham to deliver training courses for colleges on L5 Train-the-Trainer on Fuel cell and hydrogen technology. The SLA defines the responsibilities for all parties together with course delivery means and time frame and the costing agreed between the parties.

The course can be organised and offered at the first instance to technical staff, teachers and those in industry (Training-the-Trainers) over a total duration of 4 weeks, for instance, or for the duration as agreed between parties. Provision of delivering the training material can be via the University of Birmingham Canvas Learning Management System (LMS). The material will include a recorded lecture, slide set and a pdf file with a summary of the content covered. Trainees can be granted access via registration and access control and will be issued with certificates of participation upon the end of the training. The training can include practical sessions on fuel cell systems, hydrogen safety, and hydrogen storage, piping and fittings.

The course structure can be tailored to costumers needs. A Generic training syllabus can be structured as below:

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Module: Fuel Cells Basics and Hydrogen Safety

- Introduction to Fuel Cells and Hydrogen o Fuel cell background and history
  - Fuel cell basics and types
  - Introductions to applications of fuel cells

- Hydrogen Safety
  - What is Hydrogen?
  - Methods of storing and infrastructure
  - Handling hydrogen and design standards
  - Introduction to detonation & deflagration

Module: Hydrogen generation and storage

- Introduction to tools, rules of thumb and applications
  - Overview of fuel cell stack design and components
  - Introduction to tools
  - Normal operating conditions
  - Fuel cell control
  - Rules of thumb

- Installation, maintenance and troubleshooting
  - Overview of fuel cell systems
  - Technical drawings
  - Safety aspects linked to installation.
  - Maintenance and service
  - Diagnostics
  - Common problems and solutions

Module: Specialist Module Overview

  - Fuel Cell Generators (APU and Backup Power)
  - Fuel Cells for Combined Heat and Power Applications
  - H2 Fuel Cell for Transport (mainly in shipping)
  - H2 Production and Handling

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The costing per trainee can vary between £1500-£2500 depending on course duration and course content.

2.2 Engineers training business model

As the industry of fuel cells and hydrogen technology (FCHT) gradually emerges into the markets, the need for trained staff becomes more pressing. The training programme for engineers aims at addressing the supply of qualified undergraduate and graduate education (BEng/BSc, MEng/MSc, PhD etc.) in fuel cell and hydrogen technologies (FCHT) across Europe. The business model of this programme can be based on TeacHy 2020 courses offered by the University of Birmingham in collaboration with partners from research and educational institutes in Europe.

The training programme will take a lead in building a repository of university grade educational material, and design and run an MSc course in FCHT, accessible to students from all parts of Europe. The Teachy project has assembled a core group of highly experienced institutions working with a network of associate partners (universities, vocational training bodies, industry, and networks). TeacHy offers these partners access to its educational material and the use of the MSc course modules. Any university being able to offer 20 to 30% of the course content locally, can draw on the other 80 to 70% to be supplied by the project. This will allow any institution to participate in this European initiative with a minimised local investment.

The programme of engineers training will be developing solutions to accreditation and quality control of courses, and support student and industry staff mobility by giving access to placements. Schemes of Continuous Professional Development (CPD) will be integrated into the project activities. The programme can offer some educational material for the general public (e.g. MOOC's), build a business model to continue operations post-project, and as such act as a single-stop shop and representative for all matters of European university and vocational training in FCHT.

The programme can benefit from some of the established outcomes of Teachy project. For instance, the project partnership covers the prevalent languages and educational systems in Europe. The associated network has over 70 partners and a strong link to activities in education of the International Partnership for Hydrogen and Fuel Cell in the Economy (IPHE) [8].

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2.2.1 MRes & CDT programme

The Fuel Cell and Hydrogen Research Centre (FCHRC) within the School of Chemical Engineering at the University of Birmingham has been recruiting 5 PhD students per annum on average across the past 5 years. In addition, about 3 to 5 international students with stipends have been admitted to PhD studies in this centre. Interest in the MRes by Research degree has increased in the past years. The current CDT is in its 10th year and has educated a total of around 45 students, of which practically all graduates are employed in the sector. The current fee to enrol to the MRes of Hydrogen, Fuel Cells and their Applications is £4,620 (for UK students) [9]. A new CDT concentrating on hydrogen has started in Autumn 2019, led by University of Nottingham [10].

2.2.2 MSc in Fuel Cell and Hydrogen Technologies

The programme 'MSc in Fuel Cell and Hydrogen Technologies' has been developed within the EU TeacHy project (started in Nov 2017). The teaching substance has been developed with the help of 11 European partners under the lead of UoB Chemical Engineering. Now the course has been set up on Virtual Learning Environment CANVAS. The programme launched in Oct. 2019 after peer review and testing are completed in September 2019.

It is estimated that about 5 to 20 student capacity for an MSc course in FCH technologies can be continually filled in the coming years. The maximum capacity is dictated by provision and supervision of MSc projects rather than by teaching capacity. Students can enrol at UoB and follow all modules, exams and research projects at UoB. Currently, the cost of enrolment to this course is £10,980 (for UK students) [11].

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3 Conclusion

Delivering training courses on hydrogen in shipping can be a profitable business opportunity that addresses the growing demand for trained personnel in the field. The business model outlined in this report provides a framework for delivering the training course, including the estimated cost and revenue models. With the increasing demand for hydrogen-powered vessels, there is significant potential for growth in this industry, and training courses can play a vital role in ensuring a skilled workforce.

To promote the training programme, a comprehensive marketing strategy should be implemented. This would include creating a website for the training course, advertising on social media platforms, and reaching out to industry associations and organizations to promote the course. In addition, targeted email campaigns to potential participants would also be useful in promoting the course. Currently, there is a page dedicated for training courses on the H2SHIPS platform. The page can provide links to the training institutions.

Government and Industry associations and organizations should be approached to promote the course. This could include reaching out to shipping companies, port authorities, and industry associations such as the International Maritime Organization (IMO) and the International Association of Ports and Harbours (IAPH). These organizations could help with funding or supporting fund applications to implement and deliver the training business model.

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