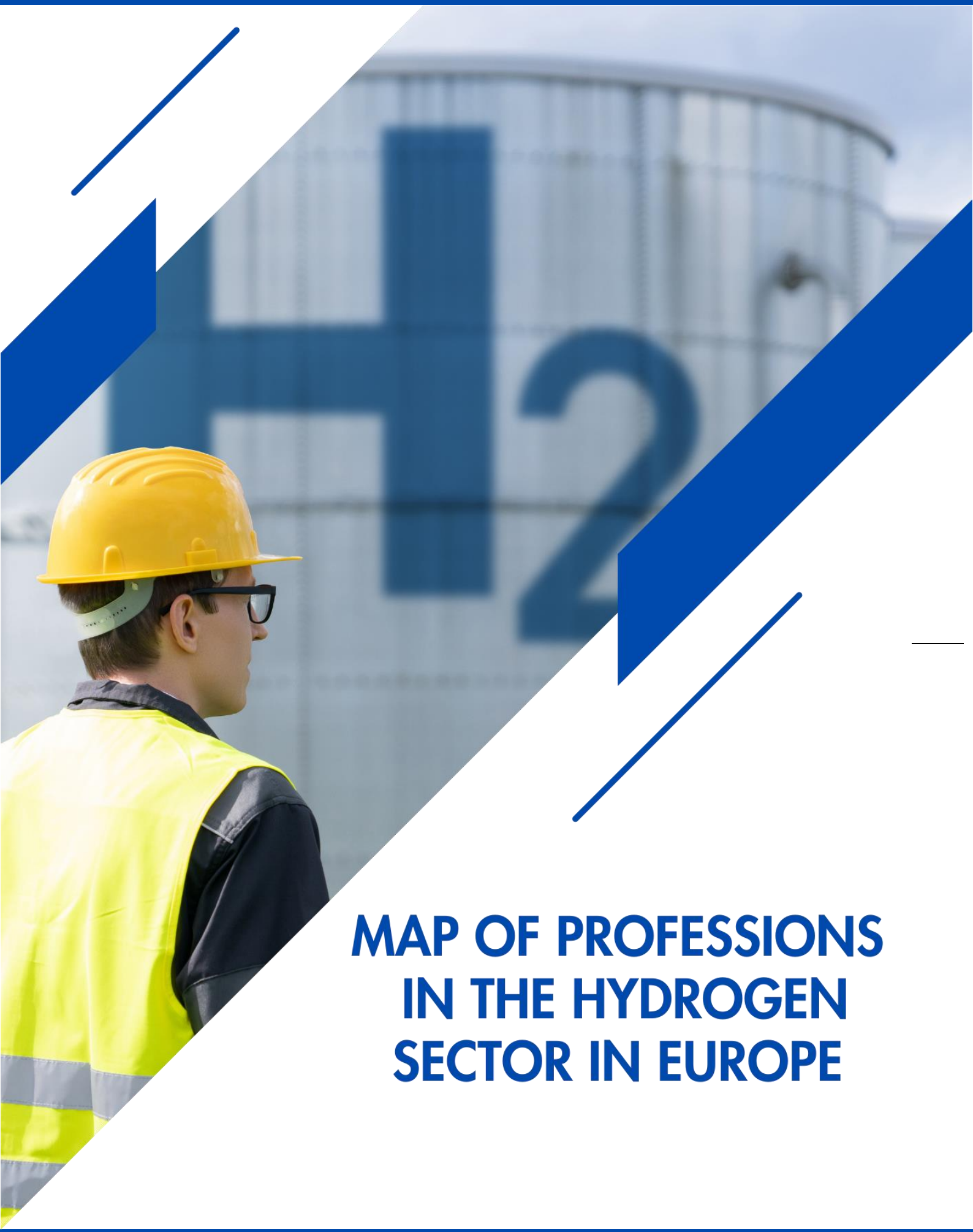

MAP OF PROFESSIONS IN THE HYDROGEN SECTOR IN EUROPE

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Introduction

The development of a hydrogen-based energy economy has been identified as a priority objective as part of the implementation of the European Green Deal, the main objective of which is for the European Union (EU) to achieve climate neutrality by 2050. In July 2020. The European Commission published a document entitled 'Hydrogen Strategy for a Climate Neutral Europe'. It points to hydrogen as a way to achieve climate neutrality (the EU assumes that our continent should achieve such neutrality by 2050).

The strategy has a so-called roadmap setting out certain milestones to achieve the stated the document's target - by 2025, the installation of hydrogen electrolysers of at least 6 GW powered solely by renewable energy will be supported. In the following years, hydrogen is to become an integral part of the EU's integrated energy system. Production would increase to 10 million tonnes of renewable hydrogen in the EU, with a capacity of at least 40 gigawatts. And by 2050, renewable hydrogen technology would reach maturity.

The document itself indicates that hydrogen can be produced by a variety of processes without specifying which solutions to bet on - wide ranges of emissions are involved, depending on the technology and energy source used. The different cost implications and material requirements are also highlighted. Several processes are mentioned in the document:

- Electricity-generated hydrogen - refers to hydrogen produced by electrolysis of water (in an electrolyser powered by electricity), regardless of the source of electricity.
- Renewable hydrogen - produced by electrolysis of water
- pure hydrogen - means renewable hydrogen
- Hydrogen from fossil fuels - refers to hydrogen produced by various processes
- Hydrogen from fossil fuels with carbon capture - is a component of hydrogen from fossil fuels, but the greenhouse gases emitted as part of the hydrogen production process are captured
- Low-carbon hydrogen - includes hydrogen derived from fossil fuels with carbon capture and hydrogen produced from electricity
- Synthetic fuels derived from hydrogen - refers to various gaseous and liquid fuels based on hydrogen and carbon.

More than 1.7 million new green jobs could be created across Europe by 2040 through the development of the hydrogen and biofuels economy, as part of the energy transition, according to a new landmark study presented by ManpowerGroup.

The hydrogen sector in Europe is growing rapidly in response to the increasing demand for sustainable and renewable energy sources. In response to these developments, the labour market in the hydrogen sector will require a wide range of professionals, from engineers to technicians and project managers. The Hydrogen Economy Sector Occupation Maps can be a key tool for career and educational planning in this fast-growing industry. The hydrogen

economy sector encompasses a wide variety of areas, from the production of hydrogen to its transport, storage and end-use applications in various industries, transport or energy or individual households.

Within the framework of an ERASMUS+ project entitled Professional and Their Skills in Hydrogen Sector, the partners carrying out this task will, on the basis of the research and analysis carried out, identify a selection of key professions that will be relevant to the development of the hydrogen industry in Europe.

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Legal environment. Europe.

One of the objectives of the European Union is to promote sustainable development based on sustainable economic growth and price stability, in a highly competitive market economy allowing full employment and social progress, and environmental protection. The way to achieve this is to provide the labour market with individuals with the right competences for the moment and with an eye to the challenges of the near and slightly more distant future. Therefore, among the actions taken by the European Commission, in agreement with the Member States, the development of skills and qualifications is one of the key elements. At the heart of these actions is the need for all citizens to acquire key competences and basic skills from an early age and to continue their education throughout their lives, so that they can move freely in the common labour market, creating economic added value.

According to the European Union's strategic documents, such as the European Pillar of Social Rights or the European Industrial Strategy, a variety of skills, competences and qualifications are needed today. This is all the more important given that Europe is currently facing a number of challenges, such as the ecological and digital transformation, which are changing the way we live, work and interact, opening up a change in skills in order to fully exploit the potential of these transitions. In addition, demographic changes are being observed, which are forcing the use of all talents and the entire potential of Europe's human capital even more efficiently than has been the case so far.

At the beginning of March 2020. The European Commission - referring, among other things, to Europe's industrial traditions - announced the foundations of the EU's industrial strategy, which is based on the so-called twofold transformation: green and digital. Its aim is to make the European Union more globally competitive, while ensuring that no one is left behind. The strategy identifies fourteen industrial ecosystems, among which are: construction, digital industries, healthcare, agri-food, renewable energies, energy-intensive sectors, transport and automotive, electronics, textiles, aerospace and defence, culture and creative industries, tourism, proximity and social economy as well as retail. However, these fourteen ecosystems cannot be seen as a disconnected and exhaustive list of priority industries for the EU in the future. Although it should be stressed that several important European industrial areas are listed, such as food, vehicles, electronics, textiles and aerospace. However, in the detailed, in-depth analyses relating to the - updated perspective of the coronavirus outbreak - the industrial strategy also presents the results of an analysis of six strategic areas in which the EU has a particular interest. These are:

- production of raw materials (especially rare earths),
- creation of lithium batteries,
- Pharmaceutical industry and production of active substances,
- hydrogen production,
- semiconductor manufacturing,
- cloud computing technologies.

The identification of competences relevant to the above-mentioned areas is necessary and a priority in view of the specific policy orientations of the European Union.

Skills

The ESCO classification distinguishes between skill/competence concepts and knowledge concepts, indicating the type of skill. In contrast, no distinction was made between skills and competences. The ESCO skills pillar contains 13 485 concepts organised according to a hierarchy that includes four sub-classifications. The components of skills/competences (no distinction is made here) are: knowledge, skills, attitudes to work and values, and language skills and knowledge. Skills as a subcategory of skills/competences are understood at ESCO level enumeratively as:

1. communication, collaboration and creativity;
2. information skills;
3. provision of assistance and care;
4. management skills;
5. working with computers;
6. handling and moving;
7. building;
8. operation of specialised machinery and equipment.

In addition, in the EU nomenclature, the skills category is applied to: digital skills, professional and technical skills and entrepreneurial skills. It is inferred that the implied meaning of the skills category.

In contrast to competences, there is a certain ad hocness and lack of full formalisation of this category in EU documents at the level of recommendations, which will become apparent after the lower category, competences.

Competences

According to the definition of competences adopted in the European Council Recommendation of 22 May 2018 on key competences for lifelong learning, key competences are those that everyone needs for self-fulfilment and personal development, employment, social inclusion, sustainable lifestyles, successful living in peaceful societies, managing life in a health-enhancing way and active citizenship. They are developed in a lifelong learning perspective: from early childhood through youth to adulthood, through formal, non-formal and informal learning, in all contexts, including family, school, workplace, neighbourhood and other communities.

Each of the key competences is considered equally important; each contributes to a successful life. These competences can be applied in different contexts and combinations. Their scopes overlap and are interrelated: the aspects needed in one area

support the competences of another. Skills such as critical thinking, problem solving, teamwork, communication and negotiation skills, analytical skills, creativity and intercultural skills, are part of all key competences. Eight key competences have been established in the reference framework:

Table 1. Key competences by policy

NAME OF THE KEY COMPETENCE	DESCRIPTION
Competence in understanding and producing information	These competences include the ability to read and write and to understand written information correctly, and therefore require knowledge of vocabulary, functional grammar and language functions. They include awareness of the main types of verbal interaction, knowledge of a range of literary and other texts, and the main features of different styles and registers language.
2. competence in multilingualism	This competence requires knowledge of the vocabulary and functional grammar of different languages and an awareness of the main types of verbal interaction and language registers. Knowledge of social conventions and the cultural aspect and variability of languages is also important.
3.Mathematical competence and competence in natural sciences, technology and engineering	Necessary knowledge in mathematics includes sound numeracy, knowledge of measures and structures, basic mathematical operations and presentation, an understanding of mathematical terms and concepts, and an awareness of questions that mathematics can answer. In the case of natural sciences, technology and engineering, the knowledge required includes the main principles governing the natural world, fundamental scientific concepts, theories, principles and methods, technology and technological products and processes, and an understanding of the impact of science, technology, engineering and human activities in general on the natural world.
4 Competencies digital	It is essential to have an understanding of how digital technologies can help with communication, creativity and innovation, and to be aware of the associated opportunities, limitations, impacts and risks. needed: to understand the general principles, mechanisms and logic behind evolving digital technologies and knowledge of the basic functionality and use of different types of devices, software and networks. It is essential: to take a critical approach to the relevance, reliability and impact of information and impact of information and data provided digitally and an awareness of the legal and ethical and ethical principles related to the use of digital technologies.

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5. personal, social and learning to learn skills	An understanding of the rules of conduct and communication generally accepted in different societies and environments is essential for successful interpersonal relationships and social participation. Personal, social and learning competences also require knowledge of the elements of mental and physical health and a healthy lifestyle. They include knowledge of one's preferred learning strategies, one's needs for competence development, and the different ways to develop competences and seek opportunities for education, training and career development or available guidance and support.
6 Competencies civic	Civic competence is based on knowledge of fundamental concepts and phenomena relating to individuals, groups, professional organisations, society, the economy and culture. It includes an understanding of common European values as expressed in Article 2 of the Treaty on European Union and in the Charter of Fundamental Rights of the European Union. It also includes knowledge of contemporary affairs and a critical understanding of major events in national, European and world history. In addition, they include an awareness of the aims, values and policies of social and political movements, as well as sustainable systems, in particular an awareness of climate and demographic change on a global scale and its causes. Knowledge of European integration is essential, as well as an awareness of cultural diversity and identities in Europe and the world. This includes an understanding of the multicultural and socio-economic dimensions of European societies and the contribution of national cultural identity to European identity.
7. competence in entrepreneurship	Entrepreneurial competence requires an awareness of the different contexts and opportunities for turning ideas into action in the personal, social and professional spheres, as well as an understanding of the process by which they are generated. It is essential to know and understanding of approaches to planning and managing projects, including both processes and resources. An understanding of economic processes and the social and economic opportunities and challenges facing an employer, organisation or society is required. An awareness of ethical principles, the challenges of sustainability, and your own strengths and weaknesses is also essential
8. Competence in terms of awareness and expression cultural	This competence requires knowledge of local, regional, national, European and global cultures and modes of expression, including their languages, heritage and traditions and cultural products, and an understanding of how these expressions can influence each other and the ideas of individuals. This includes understanding the different ways in which ideas are communicated between creator, participant and audience in written, printed and digital texts, theatre, film, dance, games, art and design, music, rituals and architecture, as well as in hybrid forms. This requires an understanding of one's own creative identity and cultural heritage in a world of cultural diversity, and how art and other cultural forms can be a way of both perceiving and shaping the world.

Source: *Council Recommendation of 22 May 2018 on key competences for lifelong learning (2018/C 189/01).*

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Qualifications

The concept of qualifications appears in the European Qualifications Framework and the ESCO classification. The European Council established the European Qualifications Framework (EQF) in the form of a Recommendation in order to facilitate the comparability of qualifications obtained in the education systems of the different EU Member States. The EQF is intended to support the cross-border mobility of human capital, i.e. both learners and and employees. Qualifications are defined here as formally validated learning outcomes and are defined in three categories, among which we distinguish:

- knowledge, i.e. all forms of information that are either theoretical or factual;
- skills, namely cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, instruments tools);
- responsibility and autonomy, which in the context of the Qualifications Framework is described as the learner's ability to apply knowledge and skills independently and responsibly. The European Qualifications Framework was defined at vocational and higher education level and was divided into eight hierarchically structured levels. The purpose of creating this framework was to develop a universal reference point for all diplomas in force in the member countries.

Table 2. Common characteristics of the European Qualifications Framework levels

	NEWS	SKILLS	RESPONSIBILITY AND AUTONOMY
Learning outcomes corresponding to EQF level 1	- basic general knowledge	- basic skills needed to carry out simple tasks	- working or learning under direct supervision in a structured context
Learning outcomes corresponding to EQF level 2	- basic factual knowledge in a particular field of work or science	- basic cognitive skills and practical needed to use relevant information to complete tasks and solve routine problems using simple principles and tools	- working or learning under supervision, with a degree of autonomy
Learning outcomes corresponding to EQF level 3	- knowledge of facts, principles, processes and general concepts in a particular field of work or science	- a set of cognitive, practical skills needed to perform tasks, solve problems by selecting and applying basic methods, tools, materials and information	- taking responsibility for completing tasks in work or study, adapting own behaviour to circumstances when solving problems
Learning outcomes	- factual and theoretical knowledge in the wider	- range of cognitive skills and practical needs for solving specific problems	- independent organisation within the guidelines concerning

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corresponding to EQF level 4	context of a particular field of work or study	in a particular field of work or science	work- or study-related contexts, usually predictable but subject to change - supervising the routine work of others, taking some responsibility for evaluating and improving work- or study-related activities
Learning outcomes corresponding to EQF level 5	- extensive specialist knowledge factual and theoretical in a given field of work or science and awareness of the limits of this knowledge	- comprehensive range of skills cognitive and practical needs to solve abstract problems creatively	- management and supervision in related contexts with work or study, subject to unpredictable changes - analysing and developing one's own and others' achievements
Learning outcomes corresponding to EQF level 6	- advanced knowledge in a specific field of work or science involving a critical understanding of theories and principles	- advanced skills, demonstrating proficiency and innovation needed to solve complex and unpredictable problems in a specialised field of work or study	management of complex technical or professional activities or projects,taking responsibility for decision-making in unpredictable contexts related to work or study - taking responsibility for management professional development of individuals and groups
Learning outcomes corresponding to EQF level 7	- highly specialised knowledge, of which the latest knowledge in a particular field work or study, being the basis for original thinking or research - critical awareness of the issues in terms of knowledge in a given field and at the interface between different fields	- specialised problem-solving skills needed for research or innovation activities in order to generate new knowledge and procedures and to integrate knowledge from different fields	- managing and transforming work or learning contexts that are complex, unpredictable and require new strategic approaches - accepting responsibility for contributing to or reviewing the development of professional knowledge and practice strategic team performance

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Learning outcomes corresponding to EQF level 8	- knowledge at the most advanced level in a given field of work or science and at the interface between different fields	- the most advanced and specialised skills and techniques, including synthesis and evaluation, needed to solving critical problems in research or activities innovative and to expand and redefining existing knowledge or professional practice	- demonstrating significant authority, innovation, autonomy, scientific and professional integrity and sustained commitment in the development of new ideas or processes in key work or study contexts, including research

Source: *https://europa.eu/europass/system/files/2020-05/EQF%20Brochure-PL.pdf*

According to the Treaty on European Union, responsibility for education (hereafter also: education and training), including the provision of appropriate tools to develop citizens' skills, competences and qualifications, lies with the Member States. Nevertheless, the European Union (European Commission) has an important role to play in supporting member countries, for example by developing guidelines, setting priorities and supporting the exchange of knowledge and experience between countries and experts. In addition, the European Commission initiates programmes that allow for a better understanding of national systems, thus supporting the professional and educational mobility of Europeans. The following are the two main programming documents that will shape European policy in the area of competence and qualification development of the future in the coming years, and the tools that will support this policy. The tools implemented at European level to support education and training are also described. In the following section, examples of five European countries and their approaches to shaping the competences of the future are presented. At the same time, it should be noted that at the level of European policy and policy documents, the terms 'skills' and 'competences' are used interchangeably. They refer to the broadly understood ability to take specific actions and perform tasks using knowledge, skills and social competences and one's own experiences.

In 2020, the European Commission published a Communication proposing an ambitious 5-year plan including actions to build a more sustainable, resilient and equitable Europe the next generation - **the European Skills Agenda.** This programme responds to the challenges that Europe faces in terms of: In the Agenda, the European Commission pointed out that the EU needs more than ever a paradigm shift in skills to effectively:

- **promote sustainable competitiveness:**

skills and lifelong learning are essential for long-term and sustainable growth, productivity and innovation, and are therefore a key determinant of the competitiveness of enterprises of

all sizes, in particular small and medium-sized enterprises (SMEs); only with the right skills can Europe secure a stronger position among global competitors and achieve a sustainable economic recovery focused on green and digital transformation;

- **ensure social justice:**

access to up- and re-skilling opportunities is of paramount importance for the tens of millions of workers who have been forced to work reduced hours or have become unemployed, regardless of their current level of skills or area of qualification; the rebuilding of Europe will only succeed if it proceeds coherently and no one is left behind;

- **build the resilience of the economy and society to shocks (such as a pandemic):**

for individuals, improving resilience through skills means becoming less dependent on market conditions and increasing their own potential to in life and when changing jobs. The European Commission emphasises in the Programme that to be successful, everyone in Europe must have real access to lifelong learning. Education at an early age is still crucial, but it is only the beginning. Learning after formal education will be . In addition, the starting point of comprehensive support is the identification and grouping of each person's skill set, the provision of targeted training to meet specific needs for upgrading and changing competences and qualifications, and assistance in finding a job for which there is market demand. The European Skills Programme implements **the European Pillar of Social Rights,** in particular its first principle, which guarantees the right to quality inclusive education, training and lifelong learning. It is also closely linked with the European Green Deal, the new Digital Strategy, as well as the new European Industrial Strategy and the new SME Strategy for a Sustainable and Digital Europe, as skills are central to the implementation of these initiatives. Furthermore, it also supports the Council's recommendations on the 'Bridge to Jobs - Strengthening the Youth Guarantee' and takes into account the findings of the report on the impact of demographic change. The crucial role of skills in the transition to a green economy is also highlighted in the new EU Action Plan on a Closed Economy and the EU Biodiversity Strategy 2030.

The second policy-level document defining the European Union's current competence development priorities is the Council Recommendation of 24 November 2020 on VET for sustainable competitiveness, social equity and resilience. It describes an effective education and training policy and vocational training that member states should aim to achieve through:

- equipping young people and adults with the knowledge, skills and competences to thrive in a changing labour market and society, with a view to coping with recovery and a just transition 0towards a green and digital economy, in times of demographic change and across all business cycles;
- fostering inclusion and equal opportunities;
- promoting European VET systems in an international context so that they are recognised at world level as a reference for learners;
- ensuring that the curriculum offer and qualifications in the area of vocational education and training are regularly updated, as appropriate, using the skills information collected;

- that VET providers have the right level of autonomy, flexibility, support and funding to be able to adapt their training provision to changing needs;
- ensuring that VET institutions have access to state-of-the-art infrastructure and have digitisation strategies in place;
- learner-centred VET programmes;
- inclusion in vocational education and training programmes:
  - modular approach;
  - validation mechanisms enabling the transfer, recognition and accumulation of individual learning outcomes towards a qualification or partial qualification, depending on the national context;
  - a balanced set of vocational skills, including technical skills, well adapted to all business cycles, changing workplaces and working methods, and key competences, including solid basic, digital, transversal, green and other life skills;
  - elements of learning in real working conditions, which should then also be extended in continuing vocational education and training;
- ensuring that vocational education and training drives innovation, growth and prepares for digital and green transformation and high-demand occupations;
- The integration of vocational education and training into economic, industrial and innovation strategies, including those related to reconstruction and digital and ecological transformation
  and ecological transformation;
- building centres of vocational excellence, which should act as catalysts for investment by local businesses, support for green recovery and transformation and digital transformation, European and regional strategies for innovation and smart specialisation, development of vocational education and training, including at higher qualification levels (levels 5-8 of the European Qualifications Framework);
- a combination of open, digital and participative learning environments, including learning-friendly workplaces;
- to provide quality training and education for teachers, trainers and other members of staff in the area of vocational education and training;
- providing learning mobility opportunities for learners and staff in vocational education and training, including virtual mobility.

European level tools to support competence development

The following are the tools that the European Commission, together with the Member States, is currently implementing in the area of competence and qualification development of the future.

A. European Qualifications Framework

The European Qualifications Framework (EQF) is an eight-level table representing all types of qualifications that is used to compare qualification levels in different education systems.

The Qualifications Framework increases transparency, makes it possible to compare the level of qualifications obtained in different countries and educational institutions and makes it easier to certify qualifications while abroad. The EQF covers all types and levels of qualifications, and the fact that it is based on learning outcomes (learning outcomes) makes it easy to see what competences a person has. The different levels in the EQF are ranked in order of proficiency: the lowest level is level one and the highest level is level eight. The EQF is primarily linked to the National Qualifications Framework. Thus, they comprehensively illustrate all types and levels of qualifications in Europe.

B. European Quality Assurance in Vocational Education and Training (EQAVET) framework

The European Quality Assurance in Vocational Education and Training (EQAVET) is a Europe-wide framework supporting quality assurance in vocational education and training. EQAVET encourages Member States to use indicative descriptions and indicators to improve the quality of VET.

C. European Credit system for Vocational Education and Training (ECVET) vocational education and training (ECVET)

It is a European Union tool, a transnational initiative, for the easy assessment of a learner's or worker's actual skills. This tool ensures the transparency and recognition of skills and qualifications.

D. European higher education initiative

The aim of the European universities initiative is to integrate a new generation of creative Europeans who will be able to work together in different languages, across national borders and disciplines to address the huge societal challenges and skills shortages in Europe.

E. European Higher Education Initiative

Centres of Vocational Excellence (CoVEs) bring together a wide range of local partners, such as VET providers, employers, research centres, development agencies and employment services, to develop 'skills ecosystems' that contribute to regional, economic and social development, innovation and smart specialisation strategies. They aim to provide high quality professional skills, support entrepreneurship, disseminate innovation and act as knowledge and innovation centres for companies (especially SMEs), collaborating with centres in in other countries through international cooperation platforms.

F. European *Pact for Skills*

The European Commission has launched the European Skills Pact - a common model of commitment for skills development in Europe. Companies, workers, national, regional and local authorities, social partners, interprofessional and sectoral organisations, education and training providers, chambers of commerce and employment services all have a key role to play.

G. European Framework for Digital Competences

The European Digital Competence Framework, also known as DigComp, offers a tool to improve citizens' digital competences. The framework provides a list of 21 competences (also called a conceptual reference model) at eight levels of proficiency and examples of use.
Looking at European initiatives, it is clear that, from the point of view of the European Union, skilled citizens play a key role in development, competitive advantage and innovation. This is possible because of the knowledge they generate, how they adapt and develop existing ideas, and their ability to learn new competences and adapt to a changing environment. It is the task of member countries to create the conditions in which citizens can develop the competences of the future.

Skills for smart industrial specialisation and digital transformation

In a 522-page strategic and expert report prepared by PwC for the European Commission, we read that by 2030, the Union primarily presents a vision for the development of *high-tech skills*. It recommends: the development of dual education on the German model, coordinated cooperation of many types of stakeholders (government, self-government, private sector, educational entities), readiness for retraining and further education of workers dealing with outgoing technologies. The report presents a list and categorisation of the most important competences for an EU industrial strategy. For the purpose of increasing communication and matching the competences present, it was decided to make a selection. This was further dictated by the wish to maintain the logic of separation and exhaustiveness of these competences.

At European level, the importance of knowledge, skills, competences and qualifications for economic development and for building an active and informed society. Community documents refer to technological and economic changes and economic changes in order to identify recommendations for capturing the educational response to the market requirement to meet the expected flexibility. The European Union has defined the key competences that every person should possess in order to benefit fully from and actively participate in society and to have access to quality work. A conceptual framework is being developed for the individual competences, which characterises them in detail.

At present, we have digital competences, those related to entrepreneurship and so-called interpersonal competences and those related to the ability to acquire new competences described. In addition, the European Commission is also planning to develop a conceptual framework related to related to green competences. Together with the key competences, this will constitute the initial set of competences that every European should possess. The EU recommendations represent the greatest value at the level of setting out a perspective on how to approach the new problems of linking the labour market with the education system. They provide process models, precise concepts and clear classifications. The precise adaptation of Community recommendations to national realities and conditions, on the other hand, is a separate task. It is noticeable that similar adaptation often has too slow a pace. In the context of professional/specialist competences at European level, they are not defined in relation to individual professions or in relation to emerging technologies. Instead, the

conditions that need to occur in order to be able to correctly identify them, deliver them through educational institutions, and assess and compare them are defined. A similar approach has been applied to the competences of the future, i.e. conditions are identified that need to be in place in order to properly identify and support their development. The European Commission does not decide which competence is the competence of the future, but only indicates that the competences of the future are those that will enable digital and ecological transformation, as well as the use and further development of new technologies. Nevertheless, it is clearly stated that the competences of the future are not only limited to technical issues, related to the implementation of new technologies or working methods, but also refer to interpersonal issues, attitudes and behaviour.

In our opinion, the recommended competence development model for industry is the so-called T-model. This is a concept of competence development that was first proposed by David Guest in 1991. It was subsequently popularised by Tim Brown (IDEO company). The T-model of competence was intended as an answer to the many problems caused by too narrow fields of specialisation, which additionally lack the so-called "soft" competencies, which is a significant factor in the development of the T-model. The "T" competence model was intended as an answer to the many problems resulting from too narrow specialisation areas, which, in addition, lack so-called "soft" competencies, which significantly hindered effective communication between teams.

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Legal environment. Poland

In initiating the Hydrogen Occupation Map, it should be pointed out that the sources have been classified in terms of the emergence characteristics of the source.

Classification of domestic sources

The expression of the plans and aspirations of the public authorities in the Republic of Poland as a country belonging to the structures of the European Union are strategic documents. Among these documents, development strategies developed at three levels - national, regional and local - constitute an important subcategory. All of them aim at taking and implementation of actions to ensure sustainable and balanced development and maintain socio-economic cohesion. Therefore, competences are an important element among them, which are the basis for the aforementioned development. The actions indicated and resulting from them are to contribute to the sustainable development of the country, region, local unit, including the creation of sustainable, attractive jobs, increasing the competitiveness of the economy, therefore, as an expression of action plans for the future in the area of the labour market, they are an important part of the national sources on competences. They are, therefore, documents setting the directions of action and plans for achieving the indicated goals. The more important they are, the more they allow for the effective achievement of a long-term goal through appropriate planning of minor tasks.

a. Strategy for Responsible Growth 2020 (with an outlook to 2030).

The document is an economic plan prepared in 2016 by a team led by Mateusz Morawiecki, then Deputy Prime Minister. It replaced the previous key strategic document prepared by a team led by then-Minister Michał Boni entitled Long-term Strategy for National Development 'Poland 2030. The Third Wave of Modernity'. Industrial policy issues were prioritised in this document, as they were placed in the first place within the first strategic objective, which is "Sustainable economic growth based increasingly on knowledge, data and organisational excellence" under the slogan of "reindistrialisation", which will consist in the development of innovation in the area of industrial production through "a significant reduction in production costs, increase in productivity, improvement of product quality, individualisation of the range of products offered, better satisfaction of needs and faster response to changes in consumer expectations, reduction of consumption of primary raw materials and energy demand, reduction of production emissions and improvement of occupational safety". It was also pointed out in the SOR, that the basis for the planned processes of economic transformation are competences, as "human capital with high competences and qualifications adjusted to the challenges of the changing reality is one of the indispensable conditions for rapid economic development and improvement of the quality of life of the citizens ". For this reason, it is necessary to place emphasis on the formation of human resources for the modern economy through industrial, technical and engineering education. For this reason, it is necessary to focus on the formation of human resources for modern industry through industrial, technical and engineering education. The model of shaping competencies is to be

based on cooperation of education with market entities, including, among others, education combined with professional practice at the employer's premises, active participation of industry in the preparation of curricula, development of practical training centres, modular educational offer, qualified vocational courses and market qualifications.

b. Integrated Skills Strategy 2030

The strategy is a resolution that was adopted by the Council of Ministers on 31 December 2020 (No. 195/2020). The document takes into account the requirements arising from the Partnership Agreement, the recommendations of the OECD Skills Strategy report and the assumptions of the New European Skills Agenda. The document identifies eight strategic policy areas for skills development, among which the primary focus is on basic, transversal and vocational skills of children, young people and adults. Each area is described in detail in the document, with objectives, lines of action and a catalogue of actors who will be involved in the implementation of the strategy. The provisions of the ZSU 2030 form the basis for determining plans for the use of national and European funds.They also play an important role in the planning of projects and programmes by the administrators of individual parts. The document is the result of extensive research and analysis into the future educational context, including the problem of social exclusion due to economic and technological progress, but also digitisation, globalisation and the ageing society. He identified challenges related to the formation, development and monitoring of skills, taking into account the needs of all ministries. Promoting a culture of lifelong learning, focused on the acquisition and improvement of skills that are important for people's personal, social and professional functioning.

The skills relevant to 2030 identified by the authors of this Strategy are tabulated below (Table 3)

Table 3 Examples of skills identified in the Integrated Skills Strategy

BASIC SKILLS	TRANSVERSAL SKILLS
➢ Understand and produce information ➢ Multilingualism ➢ Mathematical ➢ In the field of life sciences, technology and engineering	➢ Digital ➢ Personal, social and learning ➢ civic ➢ On entrepreneurship ➢ In terms of cultural awareness and expression ➢ In terms of critical thinking and complex problem solving ➢ In terms of teamwork ➢ Ability to adapt to new conditions ➢ Leadership ➢ Related to Multiculturalism ➢ Related to creativity and innovation

c. Human Capital Development Strategy 2030

The aim of the work on the SRKL was to ensure that the objectives, directions of intervention, measures and projects set out in the Strategy for Responsible Development, which are the most important tasks in the policy of the Republic of Poland from the perspective of the human factor were achieved. The first specific objective of the Strategy is to raise the level of competence and qualifications of citizens, including digital ones. It is an important strategic document in the present context, as the work on the substantive and editorial update of the SRKL is coordinated by the minister in charge of labour. The development of human capital and social cohesion contributes to a fuller utilisation of labour resources and support for the growth of competitiveness of the economy, i.e. also making Poland a more attractive place to live, develop knowledge and take up work, and consequently to locate investments and economic development.

d. Social Capital Development Strategy 2030

An SRKS may seem similar to the previous strategy. However, there is an important difference between social capital and human capital. One could say that social capital is human capital enriched by interpersonal relationships and group cooperation, but a more substantive difference is that human capital is static, and therefore relates only to potential benefits, while social capital is dynamic and translated into real, actual benefits. The strategy also addresses the competence issue under the third specific objective - strengthening the socio-economic development of the country through the creative sectors (including the cultural sectors). Thus, it speaks about the development of professional competences for the needs of the creative industries. The latter are broadly understood as standard artistic activities, computer game production, design and industrial design or the fashion industry. It is difficult to imagine functioning as such an industry without creative potential, since the design of new optimisation, organisational and product solutions is de facto a fundamental aspect of the industry's operation.

Both the SOR and the SRKL indicate The important thing here is a better match between education and learning to the needs of the modern economy, which - according to the Strategy - is to be achieved through the development of digital competences at every stage of life, also through non-formal education and self-directed learning. This opportunity is also important from the point of view of extending the working lives of people of pre-retirement and retirement age. For highly skilled people, on the other hand, the acquisition and continuous improvement of digital skills is essential for work.

e. Draft Strategy for an Innovative and Efficient Economy

The document, also called Productivity Strategy 2030, is one of the strategies detailing the provisions of the SOR. It defines the directions of intervention and support instruments used to stimulate productivity growth in the business sector. The main objective of the draft strategy is to increase productivity under the conditions of a modern economy, i.e. understood as a

climate-neutral, closed-loop and data-driven economy. The project identifies seven key areas for transformation towards the economy of the future. Five of these are resources whose complementary, synergistic use will allow for increased productivity, innovation and adaptation to global macrotrends. These are: natural resources, human capital, investment, knowledge and data. In addition, special attention is given to the governance and exchange models of these resources and the institutional environment of the economy in the chapter 'Organisation and institutions'. For the reasons outlined above, competences related to the sustainable use of resources in industry, the adaptation of competences to the challenges of the future and the development of modern lifelong learning become important. All this is particularly important for industrial issues, as Poland has one of the highest shares of industry in GDP among the European Union countries. The dynamic changes taking place will require the development of new skills related to manufacturing and the use of technologies such as: cyber-physical systems, advanced production management systems, advanced robotisation, complex production data analysis systems or artificial intelligence. The strategic documents at the national level and the measures provided for in them are intended to contribute to the sustainable development of the country, region, local units, including the creation of sustainable, attractive jobs, increasing the competitiveness of the economy and ensuring its proper development dynamics and support in maintaining or gaining competitive advantage. Pursuant to Article 9 of the Act on the Principles of the Development Policy, the strategies are to serve the purpose of undertaking and implementing measures to ensure a permanent sustainable development of the country, social-economic, regional and spatial cohesion, increasing the competitiveness of the country. and spatial cohesion, increasing the competitiveness of the economy and creating new jobs on a national, regional or local scale, as well as within the framework of the development policy. In their essence, they are coherent with the directions of evaluation and experience defined from the level of the European Commission. The diversity of the European Community member states and their differences in economic development enforces the need for Poland to adapt its strategies of activities in the field of vocational education to the needs of our entrepreneurs. This is an essential element for maintaining a competitive advantage in the economy.

f. Polish Water Strategy to 2030 with an Outlook to 2040.

The vision and overarching goal of the PSW is to create a Polish hydrogen industry and develop it to achieve climate neutrality and maintain the competitiveness of the Polish economy.

The document identifies 6 specific objectives:

- Objective 1 - deployment of hydrogen technologies in power and heating;
- Objective 2 - to use hydrogen as an alternative fuel for transport;
- Objective 3 - support the decarbonisation of industry;
- Target 4 - hydrogen production in new installations;
- Objective 5 - efficient and safe transmission, distribution and storage of hydrogen;

- Objective 6 - create a stable regulatory environment.

The implementation of the PSW objectives will contribute to accelerating the decarbonisation of the most energy-intensive sectors. Its provisions will allow for environmentally friendly hydrogen production on an industrial scale and a gradual move towards building a zero-carbon economy in Poland.

The PSW identifies a total of 44 actions that will enable the achievement of its objectives. The effects of the measures set out in the PSW will support the achievement of climate and energy targets, decarbonise hydrogen production, minimise the negative socio-economic effects of moving away from coal-based power generation, increase the share of RES in the Polish energy mix and remove regulatory barriers to the development of the hydrogen market.

Implementation of the measures specified in the PSW will support the development of individual regions of Poland by, inter alia, creating hydrogen valleys in these regions, which will allow to build a value chain related to the hydrogen economy such as production, transport, storage and final industrial application of hydrogen. Among other things, the valleys will host R&D&I and investment projects that will contribute to cooperation between local, national and foreign stakeholders.

The PSW also defines horizontal activities concerning the utilisation of Polish R&D potential in hydrogen technologies and the development of production facilities for hydrogen-powered vehicles and components necessary for the hydrogen economy.

g. Conclusions and recommendations from strategic documents

In light of the strategic documents presented above, it should be noted that:

1. The terminology defining a range of phenomena between the expectations of labour market actors and the wider education system is strongly based on strategic documents from the European Union. It should be used because it allows for precise communication between stakeholders representing different sectors, which is particularly reflected in the hydrogen industry, which covers a wide range of industries. Furthermore, it allows a move away from the terminology of stable occupations towards their constituent elements, i.e. qualifications, competences and skills (see Integrated Skills Strategy).

2. Smart reindustrialisation is one of Poland's development goals. It is to be a driving force for the development of many other areas of the economy (such as trade, logistics and transport, services related to industrial design, design or research).Effective development of industry related to new technologies and modernisation and digital transformation of traditional industrial sectors is a strategic development goal for Poland. It should be considered in a broader perspective than only in relation to EU member states. The competitiveness of Polish manufacturing enterprises should be compared to global leaders,

as the level of industrialisation of the Polish economy is higher than the EU average (see Strategy for Responsible Development).

3. Matching competences to the needs of a changing labour market is a major challenge in the coming decade. This is mainly dictated by demographic reasons (closing the generation gap, influx of fewer baby boomers into the labour market when retiring) and technological reasons (see Integrated Skills Strategy).

4. Competences for the hydrogen industry are particularly challenging as they require highly specialised competences. These are competences that are a combination of what is traditionally referred to as technical, with a digital sphere and the ability to work together in an interdisciplinary and cross-sectoral way (see Strategy for Responsible Development and Draft Strategy for Innovation and Efficiency in the Economy).

5. It is important for emerging industries, including the hydrogen industry, to respond quickly to the economy's demand for specific skills. Therefore, it is important to have continuous cooperation and updated information exchange between industry partners and business environment institutions (e.g. clusters, chambers of commerce, economic zones). The latter will act as an intermediary in communication between industry and public sector institutions (ministries, agencies, research institutes). The basis for the formation of similar competences is, among other things, the updating of the knowledge of vocational teachers (see the Draft Strategy for Innovation and Efficiency of the Economy and the Integrated Skills Strategy).

6. The formation of hydrogen competences should include the following learning stages:

- professional,
- medium,
- academic,
- learning in the education system outside formal education.

Thus, the idea of Life Long Learnig for industries is a real challenge and not an abstract concept taken from EU policy documents. The mapping of occupations for the hydrogen industry should not be limited to responding to current labour market needs with the current economic climate and company plans. Instead, they should go significantly beyond extrapolating current industry scenarios (see Integrated Skills Strategy).

Legal environment. Belgium

National Reform Programme (NRP)

The Belgian National Reform Programme (NRP) 2022 outlines the country's strategic plans and structural reforms, focusing on skills, education and employment to promote sustainable development and social cohesion.

Skills development

The NRP places a strong emphasis on developing digital and technical skills to meet the demands of today's economy. It emphasises the importance of lifelong learning as a key element in maintaining a competitive and adaptive workforce. Digital skills are a particular priority, with various initiatives to improve digital skills across different demographic groups. For example, the Wallonia Recovery Plan includes a comprehensive package of basic digital skills training, ensuring uniform teaching methods and stable funding for training providers. The Flemish government is investing €60 million to strengthen digital competences in adult education and mitigate the negative effects of the COVID-19 crisis.

Education reforms

The NRP refers to the need for quality and inclusive education. Particular attention is paid to reducing school drop-out rates and promoting STEM (science, technology, engineering and mathematics) education. The STEM 2030 Agenda aims to increase enrolment in STEM courses and careers in these fields, thus strengthening STEM competencies in society. Additionally, the Digisprong initiative focuses on accelerating the digitalisation of teaching and learning in compulsory education, ensuring that all students, from primary school children to adults, acquire the necessary digital skills.

The Employment Policy Committee

To increase employment rates, the NRP outlines various labour market reforms to integrate marginalised groups such as young people, older workers and people with disabilities. These reforms include improving training and skills development, facilitating a better work-life balance and providing a supportive structure for new forms of work. The federal government aims to raise the employment rate to 80% by 2030 through these initiatives. In addition, the German-speaking community is undertaking a radical reform of technical and vocational education to address skills mismatches and support young people in finding appropriate career paths.

Strategic objectives

The NRP is in line with the European pillar of social rights and complements the fiscal measures from the Belgian Stability Programme 2022-2025, and supports the National Recovery and Resilience Plan (NRRP), ensuring a coordinated approach across different levels of government. The comprehensive strategy includes significant investments and reforms to achieve long-term economic resilience and social inclusion.

More information: https://commission.europa.eu/system/files/2022-05/pnr_2022_belgium_en.pdf

Belgium Reconstruction and Resilience Plan (NRRP)

Belgium's Recovery and Resilience Plan (NRRP) details comprehensive strategies to strengthen sustainable and inclusive growth through targeted investment in skills development, education reform and improved employment.

Skills development

The NRRP is committing significant resources to digital skills development, with an impressive investment of €395 million to strengthen digital and STEM education in communities. Initiatives such as Digisprong are crucial, equipping all students with digital devices to bridge the digital divide. The plan emphasises continuous skills development to address labour market mismatches, ensuring the workforce is adaptive and resilient.

Education reform

The NRRP's education reforms aim to create an inclusive and future-ready educational environment. Measures to reduce school drop-outs are combined with the promotion of STEM subjects, preparing students for the demands of a technologically advanced economy. The plan emphasises the importance of digital literacy, integrating it into the core curriculum to ensure that all students are equipped with essential 21st century skills.

Improving Employment

To combat Belgium's low employment rate, the NRRP includes extensive labour market reforms, focusing on the integration of marginalised groups such as people with low education, older people and migrants. These reforms aim to improve the work-life balance and adapt to new forms of work. In addition, the plan supports job creation in the growing green and digital sectors, in line with the EU's broader goals for a sustainable economy.

Broad Economic and Social Resilience

The NRRP is addressing key macroeconomic challenges with more than €1 billion for the renovation of energy-efficient buildings and €1.2 billion for sustainable mobility initiatives. These investments not only promote environmental sustainability, but also stimulate job creation. In addition, €448 million has been earmarked to modernise public administration, the justice system and healthcare through digital transformation, making services more efficient and accessible.

Green Transformation

Significant investments support the green transition, including promoting the use of hydrogen as an energy source and developing renewable energy projects such as floating solar panels in the North Sea. These measures aim to reduce carbon emissions and promote energy efficiency, contributing to Belgium's long-term environmental goals.

Digital Transformation

The NRRP's digital strategy includes significant investment in digital infrastructure and the modernisation of public services. The focus on 5G and fibre connectivity ensures that Belgium is ready for future technological developments, while enhancing cyber security and digital inclusion.

Addressing these multifaceted areas, Belgium's Recovery and Resilience Plan aims to create a resilient, inclusive and forward-looking economy capable of meeting future challenges.

More information: https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/belgiums-recovery-and-resilience-plan_en

National Action Plan for Improving the Well-being of Workers in the performance of their work 2022-2027

The National Action Plan for Improving the Wellbeing of Workers in the Performance of Their Jobs (2022-2027) presents a multi-faceted strategy to improve the physical, mental and social wellbeing of workers in Belgium. A key element of this initiative is an emphasis on skills development, encompassing both technical skills and the necessary soft skills that are key to adapting to modern workplace dynamics and technological advances.

Key Components

Comprehensive Skills Development

The plan emphasises the need for continuous skills development, with a particular focus on upskilling and retraining initiatives to meet changing industry demands. Digital proficiency is a priority, and extensive programmes are designed to enhance employees' ability to use modern digital tools and technologies.

Mental Health and Soft Skills Development

Recognising the profound impact of mental wellbeing on overall productivity, the action plan prioritises mental health initiatives. It promotes the development of soft skills such as stress management, emotional intelligence and resilience through targeted training programmes and workshops, enabling employees to effectively manage workplace stressors and contribute to a supportive and collaborative work environment.

Workplace Safety and Ergonomic Interventions

Ensuring a safe working environment is a key part of the plan. This includes systematic risk assessments, ergonomic improvements and comprehensive safety training programmes to prevent occupational injuries and improve employee safety, ultimately reducing absenteeism and boosting morale.

Promoting Work-Life Balance

The plan advocates policies that facilitate a harmonious work-life balance, such as flexible working hours and the possibility to work remotely. These measures aim to reduce job burnout, increase job satisfaction and ultimately improve overall productivity and well-being.

Inclusive and Supportive Work Environment

Creating inclusive workplaces is the cornerstone of the action plan. It supports diversity and inclusion initiatives, ensuring equal opportunities for skills development and career advancement for all employees, regardless of their background. In addition, the plan includes provisions to support employees with disabilities through reasonable adjustments and support systems.

Cooperation with Stakeholders

Successful implementation of the Action Plan depends on robust collaboration between government bodies, employers, trade unions and other relevant stakeholders. Regular consultation and partnerships are encouraged to ensure that initiatives are effectively tailored to the diverse needs of the workforce.

Proposal

The National Action Plan for Improving Worker Wellbeing (2022-2027) presents a comprehensive and strategic framework to support a healthier, more skilled and productive workforce in Belgium. Focusing on holistic skills development, mental health, workplace safety, work-life balance and inclusivity, the plan aims to create supportive and dynamic working environments that significantly improve both individual wellbeing and organisational performance.
For more information: https://employment.belgium.be/en/publications/national-action-plan-improve-well-being-workers-performance-their-work-2022-2027

Skills anticipation activities (update 2023)

Belgium's Skills Forecasting Update 2023 offers a comprehensive overview of the country's strategic efforts to forecast and meet future skills needs. At the federal level, the initiative includes qualitative research conducted by the Federal Planning Bureau (FPB) to understand the socio-economic landscape, with a particular focus on the links between education, training and employment. This includes an analysis of early school leaving and its relationship to unemployment.

Regional efforts

Regional efforts play a key role, with Flanders and Wallonia implementing distinctive strategies to address skills shortages and adapt training to market needs. In Flanders, the Public Employment Service (VDAB) is updating its competency framework and list of shortage occupations, offering free online courses to upskill the workforce. The Flemish Dual

Education Partnership integrates vocational training with formal education, ensuring that students acquire practical skills alongside academic qualifications.

Wallonia's approach includes the Répertoire Emploi Métier (REM), a comprehensive catalogue of occupational and training profiles that serves as a guide for both jobseekers and educational institutions. Initiatives such as Job Focus address critical occupational functions, anticipating future employment needs to inform policies and training programmes.

Skills forecasting

The skills forecasting framework in Belgium includes rigorous assessments and labour market forecasts, notably conducted by regional statistics offices and the FPB. These assessments identify current and future skills gaps, informing both federal and regional policy decisions. These forecasts are key to adapting education and training programmes to ensure they are in line with evolving labour market requirements.

Funding and implementation

Skills anticipation activities are primarily funded at the regional level, with federal support through ONEM. Collaboration between federal and regional bodies ensures a coherent approach to skills development, enhancing the ability of education and training systems to respond to labour market trends.

Overall, the Skills Anticipation Action in Belgium emphasises the importance of a proactive and integrated approach to skills forecasting and development, ensuring that the workforce is prepared for future economic and technological challenges.

For more information: https://www.cedefop.europa.eu/en/data-insights/skills-anticipation-belgium-2023-update

Vocational education and training in Europe: Belgium 2018 (report)

The report 'Vocational education and training in Europe: Belgium 2018' offers a detailed overview of the vocational education and training (VET) landscape in Belgium, with a focus on the development of practical skills that meet the needs of the labour market. The report highlights a dual approach that integrates school-based learning with work-based learning, ensuring that students gain practical experience and relevant technical skills.

Dual approach

The VET system in Belgium is largely characterised by a dual approach that combines theoretical education with practical training. This method involves close cooperation between educational institutions and industry representatives, which ensures that students gain experience from the real world of work at the same time as academic knowledge. The work-based learning component is crucial as it provides students with skills directly applicable to their future careers.

Sector-specific training

VET programmes are tailored to the specific needs of different sectors, such as healthcare, ICT, engineering and technical trades. Such sector-specific training ensures that students develop the precise skills required by employers in these fields, increasing their employability and market readiness.

Continuous Skills Development

Significant attention is paid to lifelong learning and continuous skills development. VET programmes encourage ongoing education and training to help individuals adapt to technological advances and changing industry standards. This approach ensures that the workforce remains competitive and able to meet future challenges.

Digital and technical skills

With rapid advances in technology, there is a strong emphasis within VET on the development of digital and technical skills. Programmes are regularly updated to incorporate the latest technological trends, ensuring that students are well versed in current and future technologies.

Inclusivity and Accessibility

The VET system in Belgium is designed to be inclusive, offering equal opportunities for all, including marginalised groups and people with disabilities. Such inclusivity promotes a diverse and skilled workforce, which contributes to social cohesion and economic stability.

Application
The report 'Vocational education and training in Europe: Belgium 2018' highlights the key role of VET in equipping the workforce with the right skills and competences. By integrating school-based and work-based learning, focusing on sector-specific training and promoting continuous skills development, the Belgian VET system ensures that students are well prepared to meet the demands of today's labour market.

More information:
https://cumulus.cedefop.europa.eu/files/vetelib/2019/Vocational_Education_Training_Europe_Belgium_2018_Cedefop_ReferNet.pdf

Report "Perspectives économiques régionales 2024-2029".

The report 'Perspectives économiques régionales 2024-2029' offers a detailed analysis of the economic outlook for the three regions of Belgium-Flanders, Wallonia and the Brussels-Capital Region-for the coming years. It emphasises the need for strategic planning to address regional economic disparities and the importance of developing skills to support sustainable growth.

Growth forecasts

The report forecasts stable economic growth in all three regions, with Flanders expected to maintain the most dynamic growth rate. GDP growth in Wallonia is expected to be slightly lower than in Flanders, while growth in the Brussels Capital Region is expected to lag behind due to specific sectoral challenges, especially in the credit and insurance sectors.

Labour market dynamics

Employment growth has been strong in recent years, driven by a strong economic rebound after the pandemic. However, the report forecasts a slowdown in employment growth in all regions from 2023, with a noticeable decline in job creation compared to the 2016-2022 period. Productivity gains are expected to pick up, and real wage growth will stabilise after an inflationary surge in 2022.

Skills and Personnel Development

A significant element of the report is the focus on the skills needed to sustain economic growth. The development of digital skills and continuous professional development are key to maintaining competitiveness. The report highlights the need to upskill and retrain workers to meet the demands of changing industries, particularly in sectors such as ICT, healthcare and technical crafts.

Regional Employment Disparities and Trends

The report describes the different employment trends in each region. Flanders is expected to record the highest employment growth, supported by a diversified industrial base. Wallonia is struggling with higher unemployment rates, but is expected to experience stable employment growth thanks to targeted training programmes. In the Brussels Capital Region, employment growth is expected to be moderate, with a focus on increasing the employment rate among residents.

Public Finance and Investment

The financial outlook for regional governments indicates a gradual reduction in deficits, mainly due to the withdrawal of post-COVID-19 reconstruction plans.Investment in in public infrastructure and services is set to continue, albeit at a slower pace, with an emphasis on efficiency and long-term sustainability.

Inflation and Maintenance Costs

The report forecasts a normalisation of inflation rates after a jump in 2022, with expectations of moderate inflation, contributing to a gradual increase in household purchasing power. The convergence of wage growth with productivity gains is seen as crucial to maintaining economic stability.

Environmental issues

The report also addresses environmental issues, particularly greenhouse gas emissions, which may be changing due to changes in energy production and consumption. Emphasis is

placed on shifting to more sustainable energy sources to meet Belgium's long-term environmental goals.

Conclusion

The report 'Perspectives économiques régionales 2024-2029' provides a comprehensive view of the economic prospects of Belgium's regions, highlighting the importance of strategic skills development, sustainable regional growth and economic policies that favour sustainable development. It emphasises the need for continuous adaptation to technological advances and changing market conditions to ensure stable and inclusive economic growth in all regions.

More information:
ibsa.brussels/sites/default/files/publication/documents/FOR_HermReg_2024_13025_F.pdf

Co-funded by the European Union

Flanders

Flemish Reform Programme (FRP) 2023

The Flemish Reform Programme (FRP) 2023, adopted on 31 March 2023, is a strategic initiative aimed at addressing economic challenges and promoting sustainable growth through skills development. This comprehensive framework is in line with the European Semester and emphasises the importance of digital competences, lifelong learning and vocational training to meet the changing demands of the labour market.

Key Components

Macroeconomic and Market Developments

The PRGF 2023 outlines socio-economic indicators relevant to the European Semester, including EU targets for 2030. The programme envisages stable economic growth for Flanders, despite challenges such as the COVID-19 pandemic and geopolitical tensions. Employment growth remains a priority, while aiming to maintain high levels of labour productivity.

Strengthening Digital and Technical Skills

The programme highlights the critical need to develop digital skills in the modern economy. Significant investments are being made in digital education, including projects such as the I-Learn initiative, which supports personalised digital learning environments. The focus is on equipping the workforce with advanced digital competencies to remain competitive in a technologically advanced market.

Lifelong Learning and Continuing Professional Development

FRP 2023 promotes a culture of lifelong learning, aiming to significantly increase participation in training programmes. The action plan 'Building a learning society in Flanders' consolidates efforts to increase participation in training, with a target of 60% participation in training among the adult population by 2030. This approach ensures that employees regularly update their skills to remain up-to-date and flexible.

Vocational Education and Training (VET)

Vocational training is the cornerstone of FRP 2023, designed to address skills mismatches and meet labour market needs. The programme promotes dual education systems that combine academic education with practical on-the-job training. This method ensures that students gain practical experience and technical skills directly applicable to their careers.

Inclusive Employment Policies

The strategy includes measures to increase employment inclusiveness, targeting marginalised groups and people with disabilities. Policies are implemented to support

sustainable employment for these groups, providing equal opportunities for skills development and career advancement.

Sectoral and cross-sectoral cooperation

FRP 2023 supports cross-sector collaboration to address common challenges such as workforce shortages, digital transformation and inclusivity. The new generation of sectoral agreements provides a framework for cooperation, focusing on sustainable careers, lifelong learning and a better match between education and labour market needs. Cross-sectoral agreements further strengthen collaboration across sectors.

Stakeholder involvement

The programme emphasises the importance of stakeholder engagement, including input from educational institutions, industry partners and community organisations. This collaborative approach ensures that initiatives are comprehensive and effectively address the diverse needs of the workforce.

Proposal

The Flemish Reform Programme 2023 is a future-oriented strategy to promote sustainable economic growth and social well-being in Flanders. Focusing on digital skills, lifelong learning, vocational training and inclusive employment policies, the programme aims to create a resilient and flexible workforce capable of meeting future challenges.

More information: https://www.flandersineu.be/nl/vlaams-hervormingsprogramma-2023

VDAB Competency Framework

The VDAB Competency Framework, implemented by the Flemish Public Employment Service, is an advanced and dynamic approach to meeting the needs of the labour market in Flanders. The framework is designed to systematically identify and classify the key skills required for different occupations, ensuring that both the workforce and educational institutions are in line with evolving market requirements.

Identification and Classification of Competences

The VDAB framework meticulously classifies competences into core, sector-specific and occupation-specific skills. Core competencies include skills such as communication, problem solving and teamwork, which are key across all sectors. Sector-specific competencies are tailored to the unique requirements of different industries, while occupation-specific skills address the precise needs of specific roles within those sectors.

Deficit Occupations and Skill Gaps

The VDAB maintains an up-to-date list of shortage occupations that highlights areas with significant skills gaps. This list is crucial for shaping policy decisions, curricula and training programmes. By identifying these gaps, the VDAB ensures that resources are directed

towards developing the skills that are most in demand, increasing employability and supporting economic growth.

Training and development programmes

To address identified skills gaps, VDAB offers a wide range of training programmes, including online courses available to both employed and unemployed individuals. These programmes are developed in collaboration with industry to ensure they are relevant and effective, providing participants with the skills they need to succeed in the current and future labour market.

Dual Learning Pathways

An important element of the VDAB Competency Framework is the integration of dual education pathways that combine academic learning with practical on-the-job training. This approach facilitates a seamless transition from education to employment, allowing students to gain experience in real-world work settings while learning. This model not only reinforces skill acquisition, but also ensures that graduates are work-ready.

Continuous Updating and Adaptation

The VDAB Competency Framework is not static; it evolves in response to labour market trends, technological advances and economic changes. Regular updates ensure that the framework remains relevant and effective, adapting to the dynamic nature of the labour market. This adaptability is key to maintaining a skilled and competitive workforce.

Impact on stakeholders

Competency frameworks serve a range of stakeholders, including jobseekers, employers, educational institutions and policy makers. For jobseekers, it provides clear guidance on the skills needed for different occupations, which increases their employability. Employers benefit from a better-prepared and more flexible workforce, adapted to the needs of the industry. Educational institutions use the framework to adapt their curricula, ensuring that graduates have the competences required by the labour market. Policy makers use the framework to inform strategic decisions on labour market interventions and resource allocation.

Proposal

The VDAB Competency Framework is a comprehensive and dynamic tool that responds to the complex needs of the labour market in Flanders. By systematically identifying, classifying and closing skills gaps, it ensures that the workforce is equipped with the with the necessary competences to meet current and future economic challenges. Through continuous adaptation and a focus on practical training, the framework significantly increases employability and supports sustainable economic growth in Flanders.

https://www.vdab.be/
https://www.vdab.be/sites/default/files/media/files/Report%20PES_Belgium-Flanders.pdf

Flemish partnership for dual training

The Flemish Dual Education Partnership is a robust initiative designed to integrate academic learning with practical on-the-job training, facilitating a smooth transition from education to employment. A key element of this partnership is the alignment of curricula with industry standards, ensuring that students acquire both theoretical knowledge and practical skills relevant to their chosen professions.

Competence development

The dual education model emphasises the acquisition of key competences, technical and soft skills. Key competences include skills such as communication, critical thinking and teamwork, which are essential in all sectors. Technical skills are specific to the student's chosen field of study, while soft skills such as adaptability and problem-solving are developed through experience in real work settings.

Framework Cooperation

The partnership involves close cooperation between educational institutions, employers and government bodies. Educational institutions provide the academic foundation, while employers offer practical training opportunities. This collaboration ensures that the training is in line with industry needs, making the skills acquired by students immediately useful in the workplace.

Individually tailored learning paths

Dual study pathways are tailored to the individual needs of students, allowing for a personalised approach to skills development. This flexibility ensures that students can develop their interests and strengths while gaining the competences needed for their future careers.

Quality management

The Flemish Dual Education Partnership includes quality management mechanisms that ensure that both the educational and and practical components meet high standards. Regular evaluations and feedback from both students and employers help to maintain the effectiveness and relevance of training programmes.

Support and Regulation by the Government

The government plays a key role in facilitating and regulating dual education programmes. It provides funding, sets quality standards and ensures that programmes are in line with with broader economic and social objectives. This support helps to create a sustainable framework for dual education.

Benefits for Stakeholders

For students, the dual education model offers a pathway to profitable employment by providing practical experience and relevant skills. Employers benefit from a steady flow of

well-trained employees who are ready to contribute immediately. Educational institutions can improve their curricula and strengthen links with industry, ensuring that their programmes remain relevant and effective.

Proposal

The Flemish Dual Education Partnership is an exemplary model for integrating education with practical training. By focusing on competence development, promoting collaboration between stakeholders and providing quality and governmental support, the partnership effectively prepares students for the demands of the labour market, thereby increasing their employability and supporting economic growth in Flanders.

For more information follow the links: https://www.earlall.eu/wp-content/uploads/2021/07/ANNICK_DL-in-Vlaanderen.pdf

Co-funded by the European Union

Wallonia

FOREM Strategic Plan

The FOREM Strategic Plan for Wallonia represents a multi-faceted approach to meet the changing demands of the labour market through a comprehensive focus on skills development. The main focus of the plan is on initiatives related to related to upskilling and retraining, tailored to industry needs, to ensure that the workforce remains flexible and competitive.

The FOREM Strategic Plan for Wallonia addresses critical skills shortages identified through a comprehensive labour market analysis. The plan highlights specific sectors and occupations that face significant deficits, such as healthcare, ICT and technical crafts. To combat these shortages, the strategy includes targeted training programmes and incentives to attract and retain talent in these high-demand industries.

Incentives include financial support for training, cooperation with educational institutions to adapt curricula and initiatives to promote careers in shortage occupations. These efforts aim to ensure a skilled and flexible workforce capable of meeting future labour market demands.

This strategic roadmap uses data-driven analysis to identify key sectors and occupations with significant skills shortages, guiding the development of targeted training programmes. Working closely with educational institutions, the plan aims to align curricula with the practical requirements of the labour market, bridging the gap between education and employment.

The strategy includes a robust framework for continuous professional development, encouraging lifelong learning to equip employees with advanced and emerging skills. Particular attention is given to the development of digital skills, recognising the key role of technology in today's industries.

In addition, the FOREM Strategic Plan promotes inclusive employment policies, supporting equal opportunities for all workers, including marginalised groups and people with with disabilities. By creating a supportive environment for career development and personal growth, the plan aims to improve the overall productivity and well-being of the workforce.

The plan also emphasises the importance of soft skills such as communication, teamwork and problem-solving, which are key to dealing with the complexity of today's working environments. Through workshops, seminars and individual counselling, the strategy seeks to shape these competencies, ensuring a well-rounded and resilient workforce.

In summary, the FOREM Strategic Plan for Wallonia is a comprehensive and dynamic approach to workforce development, prioritising skills development, lifelong learning and inclusive employment practices. It is designed to create a strong labour market that can effectively meet future challenges, ensuring sustainable economic growth and social cohesion in the region.

More information: https://www.leforem.be/citoyens/metiers-penurie.html

Brussels

Strategy: working in the Brussels Capital Region

The Brussels Capital Region's Work Strategy is a comprehensive framework designed to meet the dynamic needs of the labour market, with a strong focus on skills development. A key element of the strategy is the identification and bridging of skills gaps through robust training programmes and education alignment. The strategy emphasises the importance of digital and technical skills, ensuring that the workforce is able to effectively navigate today's technological landscape. Joint efforts with educational institutions aim to align curricula with industry requirements, while inclusive policies promote equal opportunities for all job seekers. Strategic recommendations derived from labour market analysis and skills forecasting inform policy decisions to create a resilient and flexible workforce.

Skills Gap Analysis and Training Initiatives

A central aspect of the strategy is a detailed labour market analysis to identify current and anticipated skills gaps. Training initiatives are tailored to fill these gaps, ensuring that workers acquire the necessary competencies to succeed in high-demand sectors such as ICT, healthcare and technical crafts.

Alignment of Education and Industry

The strategy fosters strong collaboration between educational institutions and industry representatives to align training programmes with actual professional requirements. Such alignment ensures that curricula remain relevant, and graduates are well prepared to meet the demands of the labour market.

Emphasis on Digital and Technical Skills

Given the increasing reliance on technology, the strategy places a strong emphasis on digital and technical skills. Continuing professional development programmes are regularly updated to incorporate emerging technologies and industry trends, ensuring a technologically competent workforce.

Inclusive Employment Practices

The strategy advocates for inclusive employment policies, ensuring that marginalised groups, including people with disabilities, have access to training and career opportunities. This approach supports a diverse and equitable workforce, contributing to social cohesion and economic stability.

Policy Recommendations and Stakeholder Involvement

Strategic recommendations resulting from labour market analyses are communicated to decision-makers to inform decision-making processes. Collaboration with stakeholders ensures that initiatives are effectively aligned with evolving workforce needs, increasing overall employment outcomes.

Proposal

The Brussels Capital Region Labour Strategy is a future-oriented approach to workforce development, emphasising skills identification, targeted training and inclusive employment practices. By aligning education programmes with industry needs and fostering digital competences, the strategy aims to create a resilient and dynamic labour market capable of meeting future economic challenges.

More information: https://be.brussels/en/about-region/values-budget-and-strategy/strategy-and-political-priorities/projects-political-priorities/strategy-working-brussels-capital-region

Belgium's Hydrogen Strategy

Belgium's Hydrogen Strategy, officially adopted on 29 October 2021 and updated in in 2022, presents a comprehensive framework to make the country a key player in the European hydrogen economy. The strategy is based on four central pillars, each addressing different aspects of hydrogen development and integration. The main objectives of the strategy are:

1. **Positioning Belgium as an Import and Transit Hub:** Belgium aims to become a major import and transit hub for renewable hydrogen in Europe. This includes the development of infrastructure to support hydrogen imports via key routes, including partnerships with countries such as Oman and Namibia. The plan also includes the development of infrastructure to import hydrogen, with the first deliveries planned for 2026. The strategy highlights Belgium's strategic advantage from its world-class ports and robust industrial network.
2. **Extending Leadership in Hydrogen Technologies**: The strategy focuses on maintaining and expanding Belgium's leadership in hydrogen technologies. This includes significant investment in research and development through funds such as the Energy Transition Fund and the Clean Hydrogen for Clean Industry initiative, among others. The plan is to develop a hydrogen test infrastructure by 2025 and to establish at least 150 MW of electrolysis capacity by 2026.
3. **Creating a Strong Hydrogen Market**: Creating a well-regulated hydrogen market is key. The Belgian government plans to establish a comprehensive framework for energy transport networks and to adapt the legal and regulatory framework for hydrogen transport through pipelines. Key milestones include the development of between 100 and 160 kilometres of hydrogen pipelines by 2026 and connection to neighbouring countries by 2028. In addition, the strategy includes the development of a European voluntary certification scheme for hydrogen and its derivatives by 2025.
4. **Investing in Cooperation**: Cooperation at regional, national and international level is seen as a key factor for success. The strategy involves structured consultation in Belgium and active participation in European and international forums dedicated to hydrogen. The establishment of the Belgian

Hydrogen Council is an example of this approach, which brings together stakeholders to drive the hydrogen agenda.

Supportive Legislation

A significant legislative advance supporting this strategy is the Hydrogen Act, approved in July 2023. This law establishes a regulatory framework for hydrogen pipeline networks, designating a Hydrogen Network Operator (HNO) responsible for the planning, development and management of these networks. This framework ensures non-discriminatory access and includes transitional measures and subsidies to support the development of hydrogen infrastructure.

Conclusion

Belgium's Hydrogen Strategy is a future-oriented plan that capitalises on the country's strategic and industrial strengths. By focusing on infrastructure development, technological leadership, market creation and cooperation, Belgium aims to become a key hub in the European hydrogen economy. This strategy not only supports the goals of related to the country's energy transition, but is also in line with broader European Union objectives such as the RePowerEU Plan and the Renewable Energy Directive III.

More information:

- FPS Economy - Belgian Federal Hydrogen Strategy: https://economie.fgov.be/en/themes/energy/sources-and-carriers-energy/hydrogen/belgian-federal-hydrogen
- PwC - Regulatory Pulse of Belgium's Hydrogen Strategy: https://news.pwc.be/energy-transition-the-regulatory-pulse-of-belgiums-hydrogen-strategy/
- IEA - Federal hydrogen vision and strategy: https://economie.fgov.be/sites/default/files/Files/Energy/View-strategy-hydrogen.pdf

Conclusions and recommendations from Belgian strategy documents

The conclusions drawn from the various Belgian policy documents collectively paint a picture of a country committed to promoting sustainable economic growth and social cohesion through comprehensive skills development, educational reforms and labour market integration. Below is a summary of the conclusions and recommendations based on these strategic initiatives.

Skills development

Belgian strategic initiatives have consistently highlighted the crucial need to strengthen digital and technical skills to meet the demands of a rapidly changing economy. The National Reform Programme (NRP) 2022 and the Flemish Reform Programme (FRP) 2023 place a strong emphasis on investment in digital skills and STEM education. These measures aim to

ensure that the workforce remains competitive and flexible, addressing the skills mismatch in the labour market and meeting future needs through continuous professional development and lifelong learning initiatives.

Education reform

The integration of academic learning with practical training is a key element of various strategies, especially in the vocational education and training (VET) systems in Flanders and Wallonia. The dual approach, which combines schooling with work experience, ensures that students gain practical experience and relevant technical skills. This method is key to aligning educational outcomes with labour market requirements, which increases employability and work readiness.

Employment and inclusiveness

Belgian policy documents, including the NRRP and the National Action Plan for Improving Workers' Welfare, emphasise inclusive employment policies. These policies aim to integrate marginalised groups, including young people, older workers and people with disabilities, into the labour market. By promoting equal opportunities for skills development and career advancement, these policies seek to create a diverse and resilient workforce.

Sectoral cooperation and stakeholder involvement

Strategic initiatives emphasise the importance of collaboration between educational institutions, industry representatives and government bodies. Sectoral and cross-sectoral, as demonstrated by the VDAB Competency Framework and the Flemish Dual Education Partnership, is key to addressing common challenges such as workforce shortages and digital transformation. Active stakeholder engagement ensures that initiatives are comprehensive and effectively adapted to meet changing workforce needs.

Environmental and digital transformations

The NRRP and Belgium's Hydrogen Strategy underline the country's commitment to environmental sustainability and digital transformation. Investments in energy-efficient infrastructure, sustainable mobility and hydrogen technologies aim to support the green transition, reduce carbon emissions and promote energy efficiency. These actions are in line with broader EU objectives and contribute to Belgium's long-term environmental goals.

Recommendations

1. Strengthening digital and technical skills: Continue to invest in digital skills and STEM education in all regions to ensure that the workforce is well prepared to handle technological advances. Programmes such as Digisprong should be expanded to include continuous updates and access to the latest technology tools and methodologies.
2. Promoting lifelong learning: Strengthening initiatives related to lifelong learning to ensure continuous skills development. This includes making more accessible and

diverse training programmes available, particularly focusing on upskilling and retraining initiatives.

3. Supporting inclusive employment practices: Implement targeted policies to integrate marginalised groups into the labour market. This includes support for people with disabilities, offering career counselling and career development programmes, and providing equal access to training opportunities.
4. Strengthening education-industry cooperation: Strengthen cooperation between educational institutions and industry representatives to align curricula with labour market requirements. This can be achieved through dual education pathways, sector-specific training programmes and regular consultation with industry experts.
5. Supporting sectoral and cross-sectoral partnerships: Promote sectoral and cross-sectoral collaboration to address common challenges and foster innovation. This includes the development of collaborative frameworks between different sectors to strengthen workforce development and address skills shortages.
6. Investing in green and digital transformations: Continue to support green and digital transformations through significant investment in sustainable technologies and infrastructure. Focus on developing a strong hydrogen market, strengthening digital infrastructure and promoting energy efficiency to meet environmental targets.

Summarising these conclusions and recommendations, Belgium can continue to build a resilient and flexible workforce capable of meeting future economic and technological challenges. These strategic efforts will ensure sustainable growth, social cohesion and long-term economic stability for the country.

Key Professional Roles, Professions and Competencies in the Hydrogen Sector

The hydrogen sector encompasses various sub-sectors, each requiring specific professional roles, professions and competences to ensure effective operation and development. The main sub-sectors are hydrogen production, storage and distribution, fuel cell technology and hydrogen refuelling infrastructure. Below is a detailed description of the key roles and competencies in each of these sub-sectors.

Hydrogen production:

1. **Chemical Engineers**
    - **Role:** Design and optimisation of hydrogen production processes such as electrolysis and steam reforming of methane.
    - **Competencies:** In-depth knowledge of chemical reactions, process optimisation and safety protocols. Knowledge of process simulation software and understanding of catalyst behaviour.

2. **Process Engineers**
    - **Role:** Overseeing the efficiency and safety of hydrogen production processes.
    - **Competencies:** Expertise in fluid dynamics, thermodynamics and chemical engineering principles. Skills in process control and optimisation and knowledge of industry standards and regulations.
3. **Research and Development scientists**
    - **Role:** Conduct research to develop new methods of hydrogen production and improve existing technologies.
    - **Competencies:** Strong analytical skills, proficiency in laboratory techniques and experience in experimental design and data analysis. Knowledge of emerging hydrogen technologies and trends.

Hydrogen Storage and Distribution:

1. **Mechanical Engineers**
    - **Role:** Design and maintenance of hydrogen storage and distribution systems.
    - **Competencies:** Knowledge of pressure vessel design, materials science and mechanical integrity assessment. Skills in the use of CAD software and experience with safety standards for high-pressure systems.
2. **Maintenance Technicians**
    - **Role:** Ensure proper operation of hydrogen storage and distribution equipment.
    - **Competencies:** Practical skills in troubleshooting, repairing and maintaining mechanical systems. Knowledge of safety procedures and preventive maintenance techniques.
3. **Safety engineers**
    - **Role:** Assessment and minimisation of risks associated with hydrogen storage and distribution.
    - **Competencies:** Understanding of risk assessment methods, security standards and regulatory requirements. Ability to design and implement security protocols and emergency response plans.

Fuel Cell Technology:

1. **Electrical Engineers**
    - **Role:** Development and maintenance of electrical systems for fuel cells.

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- **Competencies:** Proficiency in the design of electrical circuits, power electronics and control systems. Knowledge of fuel cell principles and integration with renewable energy sources.

2. **Instrument and control technicians**
    - **Role:** Maintenance and calibration of instruments and control systems used in fuel cell operations.
    - **Competences:** Skills in instrumentation, automation and control technologies. Understanding of process control systems and experience with PLC and SCADA.
3. **Innovation Managers**
    - **Role:** Leading the development and implementation of innovative fuel cell-based solutions.
    - **Competencies:** Strategic thinking, project management skills and deep knowledge of fuel cell technology trends. Ability to drive innovation and manage R&D projects.

Hydrogen Refuelling Infrastructure:

1. **Hydrogen refuelling station technicians**
    - **Role:** Operation and maintenance of a hydrogen refuelling station.
    - **Competencies:** Knowledge of refuelling station components, safety protocols and hydrogen distribution systems. Skills in routine maintenance and troubleshooting of refuelling station equipment.
2. **Project Managers**
    - **Role:** Oversee the planning, execution and completion of hydrogen refuelling infrastructure projects.
    - **Competencies:** Strong organisational and leadership skills, project management experience and knowledge of engineering and construction principles. Ability to manage budgets, schedules and stakeholder relations.
3. **Regulatory and compliance specialists**
    - **Role:** Ensure that the hydrogen refuelling infrastructure complies with all applicable regulations and standards.
    - **Competencies:** Understanding of specific hydrogen regulations, safety standards and compliance requirements. Skills in regulatory analysis and ability to liaise with regulators.
    -

Co-funded by the European Union

Recommendations:

1. **Investing in Specialised Training Programmes:** Developing and supporting training programmes in partnership with educational institutions and industry stakeholders to equip the workforce with the necessary skills for each sub-sector of the hydrogen industry.
2. **Promoting Continuous Professional Development:** Encourage lifelong learning and provide opportunities for upskilling and retraining to ensure that employees' competences are up to date in the face of technological advances and industry needs.
3. **Strengthening Industry-Academy Collaboration: Strengthen** industry-academy collaboration to align educational programmes with the evolving needs of the hydrogen sector. This includes the development of industry-led training academies and joint research initiatives.
4. **Support for Inclusive Employment Practices:** Implement policies to ensure equal access to training and employment opportunities in the hydrogen sector, particularly for underrepresented groups.

By addressing these roles, occupations and competences in the various sub-sectors of the hydrogen sector, Belgium can effectively prepare its workforce for the growing demands of the hydrogen economy, promoting sustainability and technological leadership in Europe.

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Legal environment. Ireland

Creating a competency map of the hydrogen sector in Ireland involves identifying key players, including research institutions, industry leaders, government bodies and innovation centres that are active in hydrogen production, distribution, storage and related technologies.

1. Research institutions

- **University College Dublin (UCD):** UCD's Energy Institute is involved in significant research into renewable energy, including hydrogen.
- **National University of Ireland, Galway (NUI Galway):** Through its MaREI Centre, NUI Galway focuses on renewable energy and hydrogen research.
- **Trinity College Dublin:** Involved in hydrogen research as part of wider energy and sustainability initiatives.
- **Cork Institute of Technology:** known for its research into renewable energy systems, including hydrogen.

2. Industry leaders

- **ESB (Electricity Supply Board):** Leading initiative in the integration of hydrogen into the energy system, research into hydrogen production and storage.
- **Bord Gáis Energy:** Exploring the potential of hydrogen in the decarbonisation of gas networks.
- **Arigna Fuels:** working on clean hydrogen production projects.
- **Iberdrola Ireland:** investment in renewable energy projects with hydrogen as a potential energy storage medium.

3. Government bodies and policy makers

- **Sustainable Energy Authority of Ireland (SEAI):** provides funding and support for hydrogen projects and research.
- **Department of Environment, Climate and Communications: The key** government body responsible for the national hydrogen strategy.
- **Irish Government Hydrogen Task Force:** Established to guide the development and implementation of Ireland's hydrogen policy.

4. Innovation centres and projects

- **MaREI Centre:** located at NUI Galway, a key centre for research, development and innovation in marine and renewable energy, including hydrogen.
- **Hydrogen Mobility Ireland (HMI):** an industry consortium from Ireland that focuses on promoting the development and adoption of hydrogen as a transport fuel, working together to create the necessary infrastructure, regulations and conditions. HMI's

activities include developing action plans for hydrogen deployment, working with with policy makers and raising public awareness of the benefits of hydrogen as a clean energy source.
- **Galway Hydrogen Hub (GH2):** A major initiative to create a hydrogen valley in the west of Ireland.

5. Key projects

- **Green Atlantic at Moneypoint:** an ESB project to produce green hydrogen at Moneypoint.
- **HyLIGHT:** a SEAI-funded project investigating hydrogen production and storage.

Map of occupations - key sectors

1. Rearch and development

- **Chemical engineers:** Design and optimisation of hydrogen production processes, including electrolysis and reforming technologies.
- **Materials scientists:** Develop and test new materials for hydrogen storage, fuel cells and pipelines.
- **Environmental scientists:** Assess the impact of the production and use of hydrogen on the environment, ensuring sustainability.
- **Energy systems engineers**: Focus on the integration of hydrogen with existing energy systems, including power grids and transport networks.

2. Production and operations

- **Process engineers:** Oversee the operation of hydrogen production plants, ensuring efficiency and safety.
- **Electrochemical engineers:** they specialise in electrolysis processes used to produce hydrogen from water.
- **Plant managers:** Managing the day-to-day operations of hydrogen plants, ensuring compliance with safety and environmental regulations.
- **Technicians:** Provide technical support, maintenance and troubleshooting of hydrogen production equipment.

3. Distribution and infrastructure

- **Pipeline Engineers:** Design and maintenance of hydrogen pipelines, focusing on materials and safety.
- **Logistics coordinators:** Management of hydrogen distribution, including transport by pipeline, truck or other means.

- **Infrastructure planners:** Develop plans for hydrogen refuelling stations, storage facilities
  and distribution networks.

4. Safety and regulation

- **Safety engineers:** Ensure compliance with safety standards and regulations for hydrogen handling and storage.
- **Regulatory specialists:** They work on compliance with local, national and international regulations on hydrogen production and use.
- **Quality control analysts:** They monitor and ensure that the quality of hydrogen and related products meets industry standards.

5. Commercial and business development

- **Project managers:** Lead and coordinate hydrogen projects from concept to completion.
- **Business development managers:** identify new market opportunities for hydrogen technologies and develop strategies to exploit them.
- **Sales engineers:** They work with customers to understand their needs and provide technical solutions that include hydrogen technologies.

6. Education and training

- **Training coordinators:** They develop and deliver training programmes for professionals entering the hydrogen sector.
- **Researchers/academics:** Conducting research and teaching the next generation of hydrogen specialists.

7. Policy and advocacy

Policy analysts: develop and analyse policies related to hydrogen energy, focusing on government incentives, regulations and environmental impacts.

Advocacy and outreach coordinators: Working with stakeholders to promote hydrogen as a clean energy solution.

Detailed list of occupations and required competencies - hydrogen and related occupations

These occupations are identified through reports and data from industry analysis such as the FES project (https://library.fes.de/pdf-files/bueros/irland/21326.pdf), the European Clean Hydrogen Alliance (https://single-market-economy.ec.europa.eu/industry/industrial-alliances/european-clean-hydrogen-alliance_en), the National Hydrogen Strategy for Ireland

(https://www.gov.ie/en/publication/624ab-national-hydrogen-strategy/) and sectoral labour market studies such as those conducted by LinkedIn and Indeed for Ireland.

Competition in the hydrogen sector

The hydrogen sector covers a wide range of occupations, from technical positions and engineering to safety management and research positions. These include:

- Hydrogen system operators
- Hydrogen system engineers
- Hydrogen safety specialists
- Electrolysis technicians
- Fuel cell engineers
- Hydrogen storage and distribution specialists
- Environmental compliance specialists
- Project managers in hydrogen projects

Related professions

- **Chemical engineer**

Competences: Expertise in chemical processes, particularly those related to hydrogen production (e.g. electrolysis, reforming). Proficient in design, optimisation and safety standards.

- **Process engineer**

Competencies: Skills in the design and management of industrial processes for hydrogen production and handling. Knowledge of process flow, performance improvement and safety protocols.

- **Energy Systems Engineer**

Competencies: Specialised in the integration of hydrogen into energy systems, including grid management and storage solutions. Competent in energy modelling, systems analysis and sustainability assessments.

- **Materials scientist**

Competencies: Experience in the development and testing of materials used in hydrogen storage, fuel cells and distribution. Strong understanding of materials properties, corrosion resistance and nanotechnology.

- **Environmental scientist**

Competencies: Focuses on the environmental impact of hydrogen production and use. Specialises in environmental assessments, life cycle analysis and sustainability practices.

- **Electrochemical engineer**

Competencies: Specialises in electrolysis process for hydrogen production. Has knowledge of electrochemistry, cell design and performance optimisation.

- **Mechanical engineer**

Competencies: Designs and maintains mechanical systems for hydrogen production and distribution, including pumps, compressors and piping. Proficient in mechanical design, thermodynamics and fluid dynamics.

- **Electrical engineer**

Competencies: Work on electrical systems to support hydrogen production and utilisation, including power for electrolysis and integration with renewable energy sources. Specialises in electrical design, circuit analysis and power distribution.

- **Safety engineer**

Competence: Ensures compliance with safety standards related to hydrogen production, storage and transportation. Proficient in risk assessment, hazard identification and safety management systems.

- **Pipeline engineer**

Competencies: Designs and supervises the installation and maintenance of hydrogen pipelines. Has knowledge of pipeline materials, pressure management and safety regulations.

- **Project Manager**

Competencies: Manages hydrogen projects from start to finish, ensuring they are delivered on time and within budget. Proficient in project planning, resource management and stakeholder communication.

- **Plant manager**

Competencies: Oversees the day-to-day operations of hydrogen plants. Competent in operational management, safety protocols and process optimisation.

- **Operations Manager**

Competencies: Manages overall hydrogen production operations, ensuring efficiency and compliance. Proficient in operational strategy, resource allocation and team leadership.

- **Quality control analyst**

Competence: Ensures that hydrogen production meets industry standards and regulatory requirements. Proficient in quality testing, process monitoring and data analysis.

- **Regulatory affairs specialist**

Competencies: Manages compliance with local, national and international hydrogen regulations. Proficient in regulatory documentation, rule interpretation and compliance strategies.

- **Business Development Manager**

Competence: Identifies and develops new market opportunities for hydrogen technologies. Specialises in market analysis, strategic planning and relationship management.

- **Sales Engineer**

Competencies: Provides technical sales support for hydrogen products and services, bridging the gap between customer needs and technical solutions. Proficient In technical communication, product knowledge and customer relationship management.

- **Technical consultant**

Competencies: Offers organisations expert advice on hydrogen technology and systems. Proficient in technical problem solving, system design and strategic advice.

- **Logistics coordinator**

Competencies: Manages the logistics of hydrogen transport and distribution. Skilled In supply chain management, transport coordination and inventory control.

- **Infrastructure planner**

Competences: Develops plans for hydrogen infrastructure, including refuelling stations and storage facilities. Specialises in urban planning, infrastructure design and project coordination.

- **Political analyst**

Competencies: Analyses and develops policies related to hydrogen energy, focusing on incentives, regulations and environmental impacts. Specialises in policy research, data analysis and report writing.

- **Researcher**

Competencies: Conducts research on various aspects of hydrogen technology, including production methods, storage solutions and environmental impacts. Proficient in experimental design, data analysis and technical writing.

- **Researcher/professor**

Competencies: Directs research and teaching in areas related to related to hydrogen. Specialises in research methodology, curriculum development and science communication.

- **Training coordinator**

Competencies: Develops and implements training programmes for professionals entering the hydrogen sector. Skilled in curriculum design, instructional techniques and educational technology.

- **Technician (electrician/mechanic)**

Competencies: Provides practical technical support for production systems and distribution of hydrogen. Skilled in equipment maintenance, troubleshooting and technical repairs.

- **Maintenance Engineer**

Competence: Ensures the reliability and performance of hydrogen production and distribution equipment through regular maintenance. Skilled in preventive maintenance, fault diagnosis and repair strategies.

- **Hydrogen Production Operator**

Competencies: Operates equipment and control systems related to hydrogen production. Proficient in equipment monitoring, process control and safety management.

- **Hydrogen storage specialist**

Competencies: Focuses on the design and management of hydrogen storage solutions, including tanks and underground storage. Skilled In storage technology, pressure management and safety protocols.

- **Advocacy and outreach coordinator**

Expertise: promotes hydrogen technologies and works with stakeholders to build advocacy. Specialises in public relations, stakeholder engagement and communication strategy.

- **Environmental compliance officer**

Competence: Ensures that hydrogen production and distribution activities comply with environmental regulations. Specialises in environmental law, compliance audits and sustainability practices.

Review of Ireland's hydrogen sector strategy

Ireland's hydrogen strategy is a key part of its wider goals of achieving net zero carbon emissions by 2050. The government sees hydrogen as a key element in the decarbonisation of sectors that are difficult to electrify, such as heavy industry, transport and heating. The key areas of the strategy are outlined below.

Green hydrogen production

- The focus is on the production of green hydrogen by electrolysis powered by renewable energy sources, particularly wind and solar power. Ireland intends to use its considerable renewable energy resources to produce green hydrogen on a large scale.

Infrastructure development

- The strategy is to develop the necessary infrastructure for hydrogen production, storage, distribution and utilisation. This includes hydrogen refuelling stations, and storage facilities.

Integration with energy systems

- Hydrogen is expected to play a significant role in balancing the electricity grid, especially with the increasing share of renewable energy, providing storage solutions and acting as a back-up energy source during periods of low renewable generation.

Sectoral applications

- The strategy targets key sectors such as transport, especially heavy-duty vehicles and public transport, industry replacing fossil fuels in high-temperature processes, and heating that mixes hydrogen with natural gas.

Research, development and innovation (RDI)

- Support for research, development and innovation is crucial, with a focus on improving hydrogen production technologies, storage methods and applications. Collaboration between industry, academia and government is encouraged.

Policy and regulation

- The government is working to develop supportive policies, regulations and incentives to promote the hydrogen economy. This includes setting standards, safety regulations and creating a favourable investment climate.

Career direction in the hydrogen sector in Ireland

With the growth of the hydrogen sector in Ireland, there is a growing need for a skilled workforce with expertise in various aspects of hydrogen technology. Professional development in this sector is likely to follow the along the following key lines. Overall, Ireland's hydrogen sector strategy is expected to drive significant growth in both technology and professional development, with an emphasis on sustainability, innovation and cross-sector collaboration.

Interdisciplinary expertise

- Specialists with experience in renewable energy, chemical engineering, materials science and energy systems will be key. Interdisciplinary skills that combine knowledge of hydrogen technology with experience in other energy sectors will be highly valued.

Training and education

- Educational institutions are expected to expand their programmes to include hydrogen-related courses and certificates. This will include specialised training for positions related to the production, storage, distribution and use of hydrogen.

Innovation and development research

- Opportunities for research and development professionals will increase, particularly in improving hydrogen production methods such as electrolysis, developing new storage materials and developing fuel cell technologies.

Safety and regulatory compliance

- As hydrogen presents unique safety challenges, there will be a strong focus on developing expertise in safety engineering and regulatory compliance. Specialists in these areas will need to ensure that hydrogen production and distribution meet stringent safety standards.

Infrastructure development skills

- With the planned expansion of hydrogen infrastructure, there will be a need for specialists skilled in infrastructure planning, civil engineering and logistics. This includes the design and management of hydrogen refuelling stations, pipelines and storage facilities.

Policy and advocacy

- Professionals with skills in policy analysis, environmental law and advocacy will be important as Ireland develops its regulatory framework and promotes hydrogen both nationally and internationally.

Industry cooperation

- Professionals will have the opportunity to work with international partners and within multidisciplinary teams, contributing to the global development of hydrogen technologies.

Basic soft skills in the hydrogen sector in Ireland

Leadership: The ability to inspire and lead teams towards achieving organisational goals in the hydrogen sector.

Communication: Effective verbal and written communication skills to clearly communicate complex technical concepts.

Problem solving: Proficiency in identifying problems and developing strategic solutions, especially in a rapidly evolving industry.

Adaptability: Flexibility to adapt to changing technologies, policies and market conditions in the hydrogen sector.

Team collaboration: Ability to work effectively with diverse teams, fostering a collaborative working environment.

Decision-making: The ability to make informed and timely decisions that are aligned with business objectives.

Critical thinking: Strong analytical skills to evaluate complex information and make sound judgements.

Project management: The ability to plan, execute and manage projects effectively, from start to finish.

Stakeholder management: Proficiency in engaging with and managing relationships with with stakeholders, including regulators, investors and community groups.

Negotiation: Ability to negotiate contracts, partnerships and agreements that benefit the organisation.

Innovation focus: Encouraging and implementing new ideas and technologies in the hydrogen sector.

Time management: Effective time management to meet project deadlines and organisational goals.

Conflict resolution: Ability to mediate and resolve disputes within teams or with external partners.

Emotional intelligence: The ability to understand and deal with one's own emotions and the emotions of others, especially under stress.

Cultural awareness: Understanding and respecting cultural differences, especially in international cooperation.

Strategic thinking: Ability to plan for the long term and align organisational strategies with industry trends and objectives.

Networking: Building and maintaining professional relationships within the hydrogen sector and beyond.

Mentoring: guiding and supporting the professional development of team members.

Customer focus: Ensuring that the needs of the client are prioritised in project planning and implementation.

Awareness of sustainable development: Understanding of the importance of sustainability in decision-making and project development.

Risk management: Identifying potential risks and developing mitigation strategies.

Resilience: Ability to recover quickly from setbacks and maintain focus on long-term goals.

Ethical judgement: Ensuring that all business practices are conducted in accordance with to high ethical standards.

Visionary thinking: Developing and communicating a clear vision for the future of the hydrogen sector.

Motivation: Ability to motivate and lead teams towards high performance.

Organisational skills: Maintain good organisation of projects and tasks, ensuring smooth operations.

Public speaking: Confidence and ability to present information to large groups, including at conferences and public events.

Interpersonal skills: Building strong, positive relationships with colleagues, stakeholders and clients.

Learning Agility: Openness to learning new skills and adapting to new technologies and methods.

Budget management: Proficiency in managing budgets, ensuring that projects are delivered within financial constraints.

Essential hard skills in the hydrogen sector in Ireland

Renewable energy systems: Understanding wind, solar and other renewable energy sources used to produce hydrogen.

Hydrogen production technologies: Expertise in methods such as electrolysis, steam methane reforming (SMR) and other hydrogen production techniques.

Energy storage solutions: Knowledge of hydrogen storage options, including compressed gas, liquid hydrogen and metal hydrides.

Fuel cell technology: An understanding of fuel cells, their operation and applications in energy generation and transport.

Chemical engineering: proficiency in chemical processes related to the production and handling of hydrogen.

Process engineering: Skills in the design, optimisation and management of chemical processes, especially those related to hydrogen.

Safety engineering: Expertise in hydrogen-specific safety protocols, including explosion prevention procedures and safe handling of hydrogen.

Environmental impact assessment: Ability to carry out assessments and ensure compliance with environmental legislation.

Regulatory compliance: Understanding of Irish and EU regulations governing the production, storage and distribution of hydrogen.

Project management software: Proficiency in using tools such as MS Project, Primavera or similar to manage complex projects.

Data analysis: Ability to analyse data to improve process efficiency and reduce costs.

Quality control: Knowledge of quality assurance practices specific to hydrogen production and storage.

Supply chain management: Understanding of logistics and supply chains related to related to hydrogen materials and technologies.

Hydrogen refuelling infrastructure: Expertise in the design and operation of hydrogen refuelling stations.

Electrical Engineering: Understanding of electrical systems, especially those related to related to hydrogen electrolysis and fuel cells.

Materials science: Knowledge of the materials used in the storage and distribution of hydrogen, such as pipelines and tanks.

Renewable energy integration: Skills for integrating hydrogen into existing energy systems, including the grid.

Hydrogen compression technology: Understanding the technologies used to compress hydrogen for storage and transport.

Risk assessment: Ability to assess and mitigate risks associated with hydrogen projects.

Financial analysis: skills to assess the economic viability of hydrogen projects, including cost-benefit analysis.

Mechanical engineering: Proficiency in the design and maintenance of mechanical systems related to hydrogen production and storage.

Automation and control systems: Knowledge of automated systems used in hydrogen production facilities.

Piping and instrumentation: expert opinion on the design and maintenance of hydrogen piping systems.

Technical writing: Ability to write clear and precise technical documentation, including safety manuals and design reports.

Logistics of hydrogen transport: Understanding the logistics of hydrogen transport by pipeline, road and other means.

Hydrogen blending technology: Knowledge of hydrogen-natural gas blending technology.

GIS and spatial analysis: Skills in using GIS tools to plan hydrogen infrastructure such as pipelines and refuelling stations.

Life cycle assessment (LCA): Ability to carry out LCA to assess the environmental impact of hydrogen projects.

Thermodynamics: Proficiency in thermodynamics in relation to hydrogen production and fuel cells.

Control and instrumentation engineering: Expert opinion on sensors and control systems used in hydrogen systems.

Education, qualifications and training pathways: specialist knowledge and experience required in the hydrogen industry in Ireland

In Ireland, adult education and the classification of occupations is managed by several key public bodies. These bodies oversee various aspects of further education, training and vocational qualifications, ensuring that adult learners receive a quality education and that occupations are appropriately categorised and standardised.

1. **Grade**
   A bachelor's degree in engineering (e.g. chemical, mechanical, electrical, environmental), chemistry, physics or a related field is usually required. A master's or doctoral degree in a specialised field such as renewable energy, hydrogen technology or energy systems is highly advantageous.

2. **Schools**
   Leading Irish institutions offering relevant degrees are:

   - Trinity College Dublin: engineering, physics and energy systems programmes.
   - University College Dublin (UCD): Offers specialist courses in renewable energy, chemical engineering and environmental engineering.
   - University College Cork (UCC): Known for its programmes in energy engineering and environmental science, as well as the MaREI Centre for Energy, Climate and Marine Research.
   - National University of Ireland Galway (NUIG): Focuses on mechanical engineering and energy systems.
   - Dublin City University (DCU): Offers programmes in environmental science and technology and renewable energy.

3. Professional experience:

- **Industry experience:** At least 5-10 years of experience in the energy sector, with a focus on renewable energy or hydrogen technologies. Previous roles in project management, engineering design or hydrogen-related research and development are highly valued.
- **Expertise:** Experience in hydrogen production, storage or fuel cells, with proven expertise in managing complex projects in these areas.

4. Certificates:

- **Project management:** Certifications such as PMP (Project Management Professional) or PRINCE2 are often required for management positions.

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- **Safety and compliance: certification** in safety management, particularly in the handling of hazardous materials, such as NEBOSH (National Examination Board for Occupational Safety and Health).
- **Engineering certificate:** professional engineer (Chartered Engineer) status is often required and can be obtained through Engineers Ireland.

5. Recommendations and requirements:

- **Continuous learning:** Keeping up to date with the latest developments in hydrogen technology and policy developments is crucial. Attending professional development programmes and industry conferences is recommended.
- **Networking:** Active participation in industry associations, such as Hydrogen Mobility Ireland (HMI) or Engineers Ireland, can provide valuable networking opportunities and industry insight.
- **Soft skills:** in addition to the hard skills mentioned, due to the complex and evolving nature of the hydrogen industry, there is a strong emphasis on leadership, communication and strategic thinking.

Overview of education authorities and classification systems for adult education and occupations in Ireland

In Ireland, adult education and the classification of occupations is managed by several key public bodies. These bodies oversee various aspects of further education, training and vocational qualifications, ensuring that adult learners receive a quality education and that occupations are appropriately categorised and standardised.

SOLAS

The national body responsible for continuing education and training (FET) in Ireland. Oversees the delivery of programmes aimed at adult learners, including apprenticeships, vocational training and other forms of continuing education.

Key aspects:

- Continuing Education and Training Authority: SOLAS oversees the delivery of statutory education and training programmes that meet the skills needs of the economy, including the hydrogen sector.
- Skills to Advance programme: this initiative supports the upskilling of in emerging industries, such as hydrogen, by funding targeted training for

workers. This is particularly relevant for those who need to adapt existing skills (e.g. from the natural gas sector) to the hydrogen industry.

- Professional preparation: The SOLAS Convention plays a key role in the development and management of apprenticeships tailored to the hydrogen sector, ensuring that these programmes meet the technical and safety standards required by the industry.
- Working with industry: SOLAS works with industry partners to ensure that training programmes are relevant and tailored to real-world needs, which is crucial for the fast-growing hydrogen sector.
- Link: SOLAS Convention: https://www.solas.ie/

Quality and Qualifications Ireland (QQI)

QQI is responsible for the quality assurance of further education and training, higher education and qualifications across Ireland. It also maintains the National Framework of Qualifications (NFQ), which covers all levels of education and vocational qualifications.

Key aspects:

- National Framework of Qualifications (NFQ): QQI oversees the validation of qualifications in Ireland, ensuring that they meet the standards set out in the NFQ. In the hydrogen sector, qualifications are likely to range from Levels 5 to 9, depending on the complexity and expertise required for different roles.
- Relevant qualifications:
  - Level 5-6: Technical certificates in sustainable energy, renewable energy technology and basic engineering skills.
  - Level 7-8: Higher certificates, diplomas and bachelor's degrees in chemical engineering, environmental sciences, mechanical engineering and energy management.
  - Level 9: Postgraduate diplomas and masters degrees in renewable energy systems, hydrogen technology and sustainable engineering.

Programme validation: QQI ensures that any new courses developed for the hydrogen sector meet legal and academic standards, offering validation for courses offered by universities, institutes of technology and private providers.

- National Framework of Qualifications (NFQ): QQI administers the NFQ, which categorises qualifications from level 1 (primary education) to level 10 (doctoral degrees). This framework is essential for the recognition and standardisation of professional qualifications.

- Validation of qualifications: QQI verifies the qualifications offered by education providers, ensuring that they meet national standards.
- Link: QQI: https://www.qqi.ie/

Education and Training Council (ETB)

ETBs are regional bodies that deliver further education and training programmes for adult learners. They offer a wide range of courses, including those leading to recognised NFQ qualifications.

Key aspects:

- Role in vocational training: ETBs provide essential vocational training and further training opportunities, including apprenticeships and upskilling programmes that are in line with industry needs.
- Hydrogen-specific training:
  - Apprenticeships and traineeships: ETBs, in collaboration with industry, can develop specialised apprenticeships in areas such as hydrogen production, storage and safety. These programmes are typically at NFQ levels 5-7.
  - Short courses and certificates: ETBs can offer targeted short courses in hydrogen safety, fundamentals of hydrogen technology and operational skills, focusing on the most pressing needs of the workforce.
  - Continuing Professional Development (CPD): ETBs provide existing professionals from related sectors (such as oil and gas) with continuing professional development opportunities to move into the hydrogen industry.
  - Adult literacy and basic education: Programmes to improve adult literacy, numeracy and digital skills.
  - Vocational training: Courses designed to provide skills in specific occupations, often in cooperation with local businesses.
  - Link: ETBI: https://www.etbi.ie/

National Skills Council (NSC)

The NSC advises the government on the skills needs of the economy, helping to align education and training with labour market requirements. It plays a key role in the development of policies affecting adult education and vocational training.

Key aspects:

- Skills Strategy: The NSC is helping to develop and implement Ireland's National Skills Strategy, ensuring that the workforce is equipped with the skills needed for the future.
- Research and forecasting: provides data and analysis on current and future skills needs, helping education providers to develop appropriate courses.
- Link: National Skills Council: https://www.skillsireland.ie/

Central Statistical Office (CSO)

The civil society organisation classifies occupations and tracks employment statistics for various sectors in Ireland. This data is crucial to understanding labour market trends and developing educational programmes that meet occupational requirements.

- Classification of occupations: CSO classifies new and emerging occupations in the hydrogen sector, ensuring that they are accurately reflected in national labour statistics.
- Employment trend data: CSO data helps to identify emerging skills gaps and trends in the hydrogen sector, helping education institutions and public bodies to develop appropriate training and qualifications frameworks.
- Adjustments to the Standard Occupational Classification (SOC): As new roles are established in the hydrogen sector, CSOs can adjust the SOC to include these occupations, ensuring their recognition in labour market analyses.

Key aspects:

- Standard Occupational Classification (SOC): CSO uses the SOC system to categorise occupations, which is essential for labour market analysis and reporting.
- Quarterly National Household Survey: Provides information on employment, education and training among adults.
- Link: CSO: https://www.cso.ie/en/index.html

An overview of the hydrogen sector in Ireland: occupations and qualifications based on regulatory requirements

Ireland's emerging hydrogen sector is a key part of the country's transformation towards a sustainable and low-carbon economy. As the sector grows, so does the need for a workforce with specialist skills and qualifications. Key public bodies such as Quality and Qualifications Ireland (QQI), Education and Training Boards (ETBs), the Central Statistics Office (CSO) and SOLAS are instrumental in determining the occupations and qualifications required in the industry. Below is an overview of the key occupations in the hydrogen sector and relevant qualifications based on the guidelines and legal framework established by these bodies.

Legal requirements and industry standards Qualifications and training programmes for the hydrogen sector must comply with specific legal requirements and industry standards, including:

- Health and safety regulations: Professionals in the hydrogen sector must be trained to comply with national health and safety regulations, particularly given the high risks associated with the associated with hydrogen production and storage.
- Environmental regulations: Training programmes must include modules on environmental compliance, ensuring that hydrogen projects meet all legal requirements related to emissions, waste management and sustainability.
- Technical standards: engineering and technical positions require adherence to international standards for hydrogen technology, including those set by bodies such as the International Organisation for Standardisation (ISO).

Policies, documents, council strategies and research strategies related to the hydrogen sector in Ireland. These documents and strategies provide a comprehensive framework for the development of the hydrogen sector in Ireland, aligning with both national and EU policy objectives. The focus is on integrating hydrogen into the Irish energy system, fostering innovation and building the necessary infrastructure to support a sustainable hydrogen economy.

1. Ireland's national hydrogen strategy.

Summary Statement: The Irish Government has developed a comprehensive National Hydrogen Strategy that outlines a roadmap for hydrogen production, infrastructure and integration into the energy system. The strategy focuses on green hydrogen and aims to harness Ireland's renewable energy resources.

Link: Irish Government - National Hydrogen Strategy: https://assets.gov.ie/263248/f982c10f-eca6-4092-a305-90000e5213ed.pdf

2. Climate Action Plan 2023.

Summary Statement: The Climate Action Plan sets out Ireland's overall strategy to achieve a 51% reduction in greenhouse gas emissions by 2030 and net zero emissions by 2050. Hydrogen is highlighted as a key technology for decarbonising sectors such as heavy industry and transport.

Link: Climate Action Plan 2023: https://www.gov.ie/en/publication/7bd8d-climate-action-plan-2023/

3. National energy and climate plan 2021-2030

Summary: The National Energy and Climate Plan sets out Ireland's energy and climate objectives and climate targets for Ireland for the period 2021-2030. It identifies hydrogen as a key element in the transition to a low-carbon economy, particularly for energy storage and the decarbonisation of heavy industry.

Link: National Energy and Climate Plan 2021-2030: https://www.gov.ie/en/publication/c7750-national-energy-and-climate-plan-2021-2030/

4. Renewable Energy Support Scheme (RESS)

Synopsis: RESS supports the development of renewable energy projects in Ireland, including those involving hydrogen. It aims to stimulate investment in renewable energy, with hydrogen being a potential beneficiary in the context of energy storage and grid balancing.

Link: Renewable Energy Support System (RESS): https://www.gov.ie/en/publication/7fbeb-renewable-electricity-support-scheme/

5. The Climate Action and Low Carbon Development (Amendment) Act 2021.

Summary Statement: This legislation sets legally binding targets for Ireland to achieve net zero emissions by 2050. Hydrogen is recognised as a key technology for achieving these targets, particularly in sectors where direct electrification is a challenge.

Link: Climate Action and Low Carbon Development (Amendment) Act 2021: https://www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2021/

6. EU hydrogen strategy (2020)

Summary: The EU Hydrogen Strategy is a key document that outlines the European Union's vision for increasing renewable hydrogen production and integrating it into the EU energy system. Ireland is part of this strategy to develop its hydrogen economy within the wider EU framework.

Link: EU hydrogen strategy: https://ec.europa.eu/energy/topics/energy-system-integration/hydrogen_en

7. European Green Deal

Summary: The European Green Deal is the EU's roadmap for making the economy sustainable by turning climate and environmental challenges into opportunities. Under this plan, hydrogen plays a key role in achieving carbon neutrality by 2050.

Link: European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

8. Irish Renewable Energy Directive (RED II)

Summary: RED II is part of EU legislation aimed at increasing the use of renewable energy sources in the EU energy mix. It contains provisions for the use of renewable hydrogen in transport and other sectors.

Link: Renewable Energy Directive (RED II): https://ec.europa.eu/energy/topics/renewable-energy/renewable-energy-directive/overview_en

9. The Hydrogen Mobility Action Plan for Ireland (HMI)

Synopsis: HMI is an industry consortium working to develop a roadmap for hydrogen deployment in the transport sector in Ireland. The roadmap outlines the steps needed to create a hydrogen refuelling infrastructure and promote the adoption of hydrogen vehicles.

Link: Hydrogen Mobility Ireland: https://hydrogenireland.org/hmi/

10. The MaREI Centre for Energy, Climate and Marine Research

Abstract: MaREI is a key research centre in Ireland that supports the hydrogen sector through research, development and innovation in energy and climate related technologies. The centre plays a significant role in the development of hydrogen technology and policy in Ireland.

Link: MaREI Centre: https://www.marei.ie/

11. Publications of the Sustainable Energy Authority of Ireland (SEAI)

Synopsis: SEAI provides various reports and publications on renewable energy, including the potential for hydrogen in Ireland. These documents offer insights into the technical, economic and environmental aspects of hydrogen energy.

Link: SEAI publications: https://www.seai.ie/publications/

12. Northern Wind Energy Hub Initiative (NSWPH)

Synopsis: Although the NSWPH is not exclusively an Irish initiative, it involves Ireland as part of a wider effort to develop offshore wind energy in the North Sea, with hydrogen as a key energy carrier. The initiative supports Ireland's renewable energy goals by exploring the production of hydrogen from offshore wind energy.

Link: North Sea Wind Energy Hub: https://northseawindpowerhub.eu/

13. The European Clean Hydrogen Alliance

Abstract: Ireland participates in the European Clean Hydrogen Alliance, which brings together industry, public authorities and civil society to support the deployment of hydrogen technologies in the EU. The Alliance focuses on investment, regulation and market development for hydrogen.

Link: European alliance for clean hydrogen: https://ec.europa.eu/growth/industry/strategy/industrial-alliances/european-clean-hydrogen-alliance_en

14. The Irish Offshore Renewable Energy Development Plan (OREDP)

Synopsis: The OREDP outlines the development of offshore renewable energy in Ireland, with potential links to offshore wind hydrogen production. The plan supports the exploration of renewable hydrogen as a complement to offshore wind power.

Link: Offshore renewable energy development plan: https://www.gov.ie/en/publication/56dd1-offshore-renewable-energy-development-plan-oredp/

15. The National Development Plan 2021-2030

Summary: The National Development Plan (NDP) includes significant investment in renewable energy and infrastructure, with hydrogen playing a role in decarbonising energy and transport. The NDP supports the development of the hydrogen economy as part of a wider Irish infrastructure strategy.

Link: National Development Plan 2021-2030: https://www.gov.ie/en/publication/774e2-national-development-plan-2021-2030/

16. Department for Environment, Climate and Communications

Summary: The key government body responsible for the national hydrogen strategy. The 2023 Annual Report highlights what has been done and the next steps for the environment, climate and communications, including hydrogen in Ireland.

Link: https://www.gov.ie/en/publication/2d288-annual-report-2023/

17. Hydrogen hub in Galway (GH2)

Synopsis: A major initiative to create a hydrogen valley in the west of Ireland, comprising seven members: NUI Galway, Galway Port, CIÉ Group and Bus Éireann, Aran Islands Ferries, Lasta Mara Teo, Aer Arann Islands and SSE Renewables.

Link: https://vb.nweurope.eu/media/17644/h2go-news-june-2022.pdf

18. Water light

Summary: A 3-year project funded by Science Foundation Ireland (SFI) and a 25-strong industry consortium through MaREI.

Link: https://www.marei.ie/project/hylight/

19. University College Dublin (UCD)

Abstract: The UCD Energy Institute is involved in significant research into renewable energy, including hydrogen.

Link:https://researchrepository.ucd.ie/entities/publication/61632ae5-dde9-4485-9737-a3b88934712d

These documents and policies provide a comprehensive picture of the regulatory landscape for the hydrogen sector in Ireland.

Regulations and policies relating to the hydrogen sector in Ireland with links to relevant documents where available:

1. National Hydrogen Strategy - a roadmap for hydrogen development in Ireland.

Link to document: https://www.gov.ie/en/publication/7b3a2-national-hydrogen-strategy/

2. Climate Action Plan 2023 - Identifies measures, including the production and use of hydrogen, and the critical nature of the hydrogen sector in the decarbonisation of various industries.

Link to document: https://www.gov.ie/en/publication/7bd8d-climate-action-plan-2023/

3. Renewable Energy Support Scheme (RESS) - Supports renewable energy projects, including hydrogen.

Link to document: https://www.gov.ie/en/publication/7b3a2-renewable-energy-support-scheme-ress/

4. Hydrogen production and storage regulations - Guidelines for hydrogen production and storage facilities.

Link to document: https://www.epa.ie/publications/compliance--enforcement/

5. Energy security policy framework - addresses the diversification of energy sources, including hydrogen.

Link to document: https://www.gov.ie/en/publication/8f5b0-energy-security-policy-framework/

6. National Policy Statement on the Bioeconomy - Discusses the role of hydrogen in the bioeconomy.

Link to document: https://www.gov.ie/en/publication/7eabf-national-policy-statement-on-the-bioeconomy/

7. Marine Renewable Energy Development Plan - Includes hydrogen as part of the marine energy strategy.

Link to document: https://www.gov.ie/en/publication/7d7b6-offshore-renewable-energy-development-plan/

8. Irish Sustainable Energy Authority (SEAI) guidance - Support for hydrogen projects.

Link to document: https://www.seai.ie/

9. Green Hydrogen Strategy - Focus on the development of green hydrogen technology.

Link to document: https://www.gov.ie/en/publication/7b3a2-green-hydrogen-strategy/

10. European Green Deal - an EU framework influencing hydrogen policy in Member States.

Link to document: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

11. Hydrogen safety guidelines - Regulations for the safe handling and use of hydrogen.

Link to document: https://www.hsa.ie/

12. Hydrogen International Energy Cooperation (IEA) Programme - Ireland's involvement in international hydrogen initiatives.

Link to document: https://www.ieahydrogen.org/

13. EU Hydrogen Strategy - A framework for the development of hydrogen in Europe.

Link to document: https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

14. National Development Plan 2021-2030 - Includes investments in hydrogen infrastructure.

Link to document: https://www.gov.ie/en/publication/7b3a2-national-development-plan-2021-2030/

15. Carbon tax policy - Encourages low carbon technologies such as hydrogen.

Link to document: https://www.gov.ie/en/publication/7b3a2-carbon-tax-policy/

16. Hydrogen research and innovation strategy - promotes research and development of in hydrogen technologies.

Link to document: https://www.gov.ie/en/publication/7b3a2-hydrogen-research-and-innovation-strategy/

17. Natural Gas Regulation - Impact of hydrogen blending in natural gas networks.

Link to document: https://www.cru.ie/

18. Electricity Regulation Act 1999. - Framework for the integration of hydrogen into the electricity grid.

Link to document: https://www.cru.ie/

19. Waste Management Policy - Discussion of waste to hydrogen conversion processes.

Link to document: https://www.epa.ie/

20. Transport policy - includes hydrogen fuel cell vehicles and infrastructure development.

Link to document: https://www.gov.ie/en/publication/7b3a2-transport-policy/

Conclusion

The growth of the hydrogen sector in Ireland is supported by a robust public body framework that ensures the workforce is equipped with the necessary qualifications and skills. Through QQI, ETB, SOLAS and CSO, Ireland is well placed to meet the demands of this emerging industry, providing clear pathways for education, training and professional development. As the sector grows, these bodies will continue to adapt and develop their offerings to meet the changing needs of the industry and ensure that Ireland remains at the forefront of the global hydrogen economy.

Summary

An interdisciplinary team of experts from the partner countries implementing the **PROFESSIONALS AND THEIR SKILLS IN HYDROGEN SECTOR** project under ERASMUS+ has selected 10 occupations common to the reference regions of Europe. The selection of professions was based on research and market analysis of Community countries. As a result of the involvement of experts representing the project consortium, 10 professions were identified as essential for the further development of the hydrogen sector in Europe.

As a result of in-depth analyses and based on the reflections of the work of international expert teams within the framework of the implemented project, the key summary is to take into account the diversity of the advancement of vocational education systems in European countries and the level of development of hydrogen technologies. There may be differences in the professions of the hydrogen industry in individual EU countries.

Selection of occupations for the Occupation Map with a description of the competences in the selected hydrogen economy occupations:

A. Chemical Engineers

Role: Design and optimisation of hydrogen production processes such as electrolysis and steam reforming of methane.

Competencies: In-depth knowledge of chemical reactions, process optimisation and safety protocols. Knowledge of process simulation software and understanding of catalyst behaviour

B. Process Engineers

Role: Overseeing the efficiency and safety of hydrogen production processes.

Competencies: Expertise in fluid dynamics, thermodynamics and chemical engineering principles. Skills in process control and optimisation and knowledge of industry standards and regulations.

C. Mechanical Engineers

Role: Design and maintenance of hydrogen storage and distribution systems.

Competencies: Knowledge of pressure vessel design, materials science and mechanical integrity assessment. Skills in the use of CAD software and experience with safety standards for high-pressure systems.

D. Maintenance Technicians

Role: Ensure proper operation of hydrogen storage and distribution equipment.

Competencies: Practical skills in troubleshooting, repairing and maintaining mechanical systems. Knowledge of safety procedures and preventive maintenance techniques.

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E. Hydrogen system safety engineers

Role: Assessment and minimisation of risks associated with hydrogen storage and distribution.

Competencies: Understanding of risk assessment methods, security standards and regulatory requirements. Ability to design and implement security protocols and emergency response plans.

F. Hydrogen refuelling station technicians

Role: Operation and maintenance of a hydrogen refuelling station.

Competencies: Knowledge of refuelling station components, safety protocols and hydrogen distribution systems. Skills in routine maintenance and troubleshooting of refuelling station equipment.

G. Hydrogen market and regulatory and policy analyst

Role: Analysis and knowledge of development trends in the hydrogen industry, including knowledge of current legislation

Competences: analytical skills, ability to think logically, accuracy and attention to detail, high communication skills which are essential to work with business teams, ability to work in a team, ability to present data, knowledge of English at min. B2, experience in working with statistical or data mining packages, knowledge of EU hydrogen regulations and policies.

H. Hydrogen system designer

Role: Design of hydrogen storage systems and associated hydrogen plants

Competencies: The hydrogen system designer must understand hydrogen as an energy carrier, including skills in engineering principles, gas safety and system integration. Key to this profession are technical knowledge with knowledge of hydrogen properties, safe operation and system design, regulatory compliance in terms of knowledge of European legislation and hydrogen regulations, particularly in terms of safety standards, environmental guidelines and pipeline transport regulations, risk management and risk assessment including the ability to carry out safety assessments and design systems to minimise risk, in line with the Hydrogen Competency Framework, which emphasises skill levels from basic awareness to practical expertise.

I. Hydrogen storage and transport logistician

Role: Organising and supervising processes related to the transport and storage of hydrogen.

Competencies: Understanding of logistics processes, planning and organisational skills, knowledge of logistics technologies, knowledge of hydrogen storage and transport technologies, problem-solving skills and effective communication and collaboration.

J. Research and Development scientists

Role: Conduct research to develop new methods of hydrogen production and improve existing technologies.

Competencies: Strong analytical skills, proficiency in laboratory techniques and experimental design and data analysis. Knowledge of emerging hydrogen technologies and trends.

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