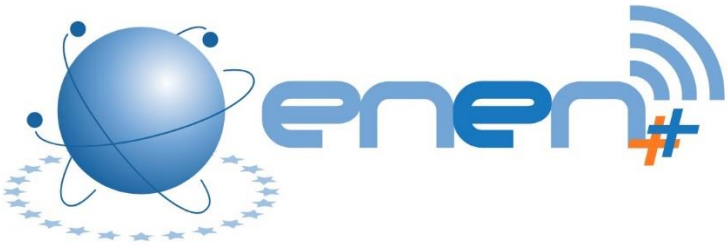
Funded by the European Union



(Project Number: 101061677)

DELIVERABLE D4.1

Gap analysis of VET offer for the European nuclear domain

Lead Beneficiary: STU

Due date: 30/11/2023 Released on: 24/11/2023

Authors:	Štefan, Čerba - Task Force leader (STU), Christian Schönfelder (ST), Veronica Rosetti (EFOMP), Csilla Pesznyák, Ildikó Boros (BME), Cristina Llorente (CIEMAT), Lois Tovey (UNIVLEEDS), Aurelian Badea (KIT), Ondrej Nemec, Ján Rataj (CTU), Eirini Michailidou, Brian Eriksen (JRC), Andreas Wielenberg, Marianne Jelinski (GRS)

Approved by Lead Beneficiary	**Reviewed by Work Package Leader**	**Approved by Coordinator**
Štefan Čerba Cerba	Christian Schönfelder C. Schönfelder	Gabriel Pavel G. Pavel

Dissemination Level		
PU	Public	**X**
RE	Restricted	
SEN	Sensitive	

Version control table

Version number	Date of issue	Author(s)	Brief description of changes made
0.1	10/11/2023	SC	First draft
1.0	22/11/23	SC	Second draft
2.0	24/11/23	SC	Final version

Disclaimer
"Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Commission. Neither the European Union nor the European Commission can be held responsible for them."

EXECUTIVE SUMMARY

Securing NPP operations, advancing research and development (R&D), and managing retirements depend on a skilled workforce. Promoting nuclear education and training (E&T) and vocational education and training (VET) across Europe is vital to sustain and improve expertise in power and non-power sectors. WP4 of the ENEN2plus project aims to create a VET program and network. The VET sector is crucial and demands continuous attention to prevent a shortage of specialists. Project actions include analysing existing VET options, building VET communities, and considering a dedicated VET platform.

The EU has been actively supporting VET through its agency European Centre for the Development of Vocational Training (Cedefop) whose mission involves promoting VET and skills policies, contributing to the development of the European Qualifications Framework (EQF), and addressing skills demand and supply. They focus on both traditional and non-traditional VET boundaries and provide extensive information on their activities and publications. Cedefop's research papers examine the changing nature of VET, emphasizing its role in upskilling and reskilling. They aim to fill a gap in understanding how VET systems across Europe facilitate vocational learning, including work-based learning and less traditional teaching methods.

The HORIZON-EURATOM-2021-NRT-01-13 call has general requirements, not specifying Initial Vocational Education and Training (I-VET) or Continuing Vocational Education and Training (C-VET). Cedefop offers examples of diverse I-VET systems in EU member states. The call seems focused on C-VET in line with lifelong learning to adapt to technological developments, but Cedefop lacks tools and data for investigating C-VET in the nuclear domain in EURATOM countries. Task 4.1 focuses on specific vocational skills in C-VET, considering factors like connection to job activities, professional experience, curriculum duration and delivery, and provider flexibility.

In Task 4.1 of WP4 in the ENEN2plus project, the current VET offer was collected and analysed in four steps: identification, categorization, evaluation, and identifying gaps. An MS Excel-based data collection template was developed, called the "VET database," to store, categorize, and evaluate the data. After a thorough review process, two versions were created, one for data analysis within WP4 and another for joint data collection with WP3, to be used for the ENEN HUB web database when it is ready. The available data from public sources were collected, resulting in 1322 VET offers across 16 EU countries and the United Kingdom. For each country with available VET a short VET summary was also created. It is important to acknowledge that the dataset used for this VET analysis may not encompass 100% of VET cases in each country and the data collection should continue.

The collected VET offers were categorized in the VET database, initially with 73 categories, later reduced to 66, and finally streamlined to 22. These categories describe various aspects of the VET offer, including the VET provider, type, language, target audience, frequency, delivery, and learning outcomes, etc.. The selection of categories was meticulous, taking into account publicly available VET data and aligning with the analysis's focus on offer quality and user relevance for European employers and VET-interested individuals.

The data evaluation aimed to identify domains without VET, analyse offer fragmentation, pinpoint key job roles and barriers, and assess the adequacy of current offerings in addressing required competencies. This evaluation began with a VET quality analysis, where a grading system was established. It involved evaluating the available information and the user-friendliness of the offer using 12 criteria, resulting in scores from 0 to 50. Based on these scores, grades ranging from A (representing uniqueness) to E (indicating the need for significant improvement) were assigned.

The result of the quality analysis are the following:

- A – 11 %
- B – 38 %
- C – 43 %
- D – 2 %
- E – 6 %

The results are generally satisfactory, with nearly 50% of cases achieving a grade A or B, indicating they are "qualified." However, a significant challenge arises from the insufficient user-orientation of many VET courses, with approximately 700 courses receiving grades of C or lower, and over 100 falling into the D or E range. The lack of user-orientation primarily results from missing information regarding certification, frequency, qualifications, and specified learning objectives. Additionally, limited availability of VET courses in English, accounting for only 20% of the courses, hampers international accessibility. One of the reasons could be that VET providers haven't considered to provide international courses.

In the next phase of the VET analysis, key nuclear jobs in the EU were identified and evaluated based on the projected increase in human resources by 2035, as identified in WP1 of this project. Since neither precise data on VET provider capacities nor the share of VET in covering new job competencies were available, several assumptions had to be made. These assumptions led to the creation of two specific scenarios: CASE1, where all new jobs require VET, and CASE2, where only a specific portion of VET, selected based on personal judgment, is required. The coverage of new jobs by VET was estimated through the time required to reach the projected number of trained staff. Based on this indicator the coverage of specific nuclear domains was evaluated as "Sufficient", "To be improved" and "Critical". The final distribution of nuclear domains is the following:

- **Sufficient** – Nuclear Materials, Nuclear Energy, Radiation Protection, Medical Applications.
- **To be improved** – Nuclear Safety, Nuclear Waste Management, Decommissioning.
- **Critical** – Management in Nuclear, Nuclear Fusion, Nuclear Safeguards and Forensics, Nuclear Security.

As the final phase of the VET analysis, the VET offer was evaluated against the specific requirements of nuclear employers and individuals. The findings revealed discrepancies between the existing VET offer and the distinct needs of stakeholders. Some key observations include:

- There is demand for more hands-on education in the curricula.
- The nuclear industry places greater importance on examinations than individuals, preferably through assignments.
- The interest in VET among young professionals is higher than the offer.
- Individuals desire for VET related to their nuclear sector, not limited to job roles.
- Accessing information about VET can be challenging or requires considerable effort.
- Email subscriptions and LinkedIn are the preferred communication channels.
- There are differing interests in nuclear domains between individuals and employers as well as between the requirements and the offer.
- Employers favour in-person VET, while individuals are open to online options.
- There is a requirement for VET to be offered in English.
- Employers prefer short VET courses, while individuals are open to longer ones.

TABLE OF CONTENT

0 ACRONYMS

ACTA	Academisch Centrum Tandheelkunde Amsterdam
ActUsLab	Actinide User Laboratory
ADR	Accord Dangereux Routier
AIFM	Italian association of medical and sanitary physics
AIN	Italian Nuclear Association
AIRP	Italian Radiation Protection Society
AITERS	Italian Association of Breast Radiology Technicians
AITRI	Italian Technical Association of Interventive Radiology
AITRO	Italian Association of Oncological Radiotherapy Technicians
ANPA - APAT	Italian National Agency for Environmental Protection now Agency for Environment Protection and for Technical Services
ANVS	Nuclear Regulatory Authority of Netherland
ASN	French Nuclear Safety Authority
BME	Budapest University of Technology and Economics
CEDEFOP	European Center for the Development of Vocational Training
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CNEN	Comitato Nazionale per l'Energia Nucleare
CPD	Continuous Professional Development
CSN	Nuclear Safety Council
C-VET	Continuing Vocational Education and Training
CVUT / CTU	Czech Technical University in Prague
CZO	Stichting College Zorg Opleidingen
E&T	Education and Training
EBAMP	European Board for Accreditation in Medical Physics
ECVET	European Credit System for Vocational Education and Training
EDCI	European Digital Credentials Infrastructure
EFOMP	European Federation of Organisations of Medical Physics
ELM	European Learning Modell
EMMA	Environmental & Mechanical Materials Assessment
ENEA DISP	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
ENEEP	European Nuclear Experimental Educational Platform
ENEN	European Nuclear Education Network

EQAVET	European Quality Assurance reference framework for Vocational Education and Training
EQF	European Qualification Framework
ESCO	European Skills, Competences and Occupations
ESF	European Social Fund
ESZI	Vocational Grammar School for Energy
EU	European Union
FANC	Federal Agency for Nuclear Control
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit
HR	Human Resources
IAEA	International Nuclear Atomic Energy Agency
IChemE	The Institution of Chemical Engineers
ICJT	Milan Čopič Nuclear Training Centre
INES	International Nuclear Event Scale
INRI	Institute for Nuclear Research and Nuclear Energy
ISCED	International Standard Classification of Education
ISIN	Nuclear Safety and Radiation Protection
I-VET	Initial Vocational Education and Training
JAVYS	Nuclear Decommissioning Company of Slovakia
JRC	European Commission's Joint Research Centre
JSI	Jožef Stefan Institute
KINT	Dutch Knowledge Infrastructure on Nuclear Technology
KIT	Karlsruhe Institute of Technology
KSU	Kärnkraftsäkerhet och Utbildning
KVI	Kernfysisch Versneller Instituut
KWS	Kraftwerksschule
MS	Microsoft
NCfN	National College for Nuclear
NCRRP	National Center of Radiobiology and Radiation Protection
NNS	Netherlands Nuclear Society
NPP	Nuclear Power Plant
NQR	Hungarian National Qualification Register
NRG	Nuclear Research and Consultancy Group vof
NRPI	National Radiation Protection Institute of Czech Republic
NUCLEATION	Nuclear Vocational Learning Community

NWA	National Nuclear Workforce Assessment
PSA	Probabilistic Safety Assessment
PWR	Pressurized Water Reactor
QDR	Qualifications Dataset Register
R&D	Research and Development
RP	Radiation Protection
RS	Radiation Safety
RWTH	Technical University of Aachen
SEFM	Spanish Medical Physics Society
SEPR	Spanish Radiation Protection Society
SFEN	French Nuclear Society
SFPM	French Society of Medical Physics
SFPR	French Radiation Protection Society
SMR	Small Modular Reactor
SNE	Spanish Nuclear Society
ST	Schoenfelder Training
STU	Slovak University of Technology in Bratislava
TSO	Technical Support Organization
TSRM-PSTRP	National federation Orders of medical radiology health technicians and technical health professions, rehabilitation, and prevention
TÜV	Technischer Überwachungsverein
UK	United Kingdom of Great Britain and Northern Ireland
UNIVLEEDS	University of Leeds
VET	Vocational Education and Training
VGB	Vereinigung der Großkesselbesitzer
WBL	work-based learning
WP	Work Package

1 INTRODUCTION

1.1 Introduction to Work Package 4 of ENEN2plus

Meeting the ambitious objective of the European Union (EU) to achieve climate neutrality by 2050 necessitates a coordinated and collective endeavour involving governments, researchers, businesses, and individuals worldwide. This imperative is especially pronounced within the realm of nuclear energy, given the EU's acknowledgment of nuclear energy's pivotal role in establishing a carbon-free European power grid. Projections indicate that nuclear power plants (NPPs) will serve as a steadfast source of low greenhouse gas energy for an estimated century or more. Several EU member states have already committed to extending the operational lifespans of existing plants, while the European nuclear industry anticipates a surge in capacity over the next decade. This expansion will encompass replacing aging units with modern, larger ones, introducing new capacities to meet escalating electricity demands, and gradually introducing small modular reactors (SMRs).

Ensuring the secure and dependable operation of these NPPs, fostering research and development for innovative technologies, and overseeing the decommissioning of retired units will all hinge upon a well-trained and proficient workforce. Promoting education and training (E&T), along with vocational education and training (VET), in nuclear disciplines across Europe requires ongoing and concerted efforts. These efforts are essential not only to sustain but also to enhance the exceptional level of expertise that has been achieved in both nuclear power and non-power sectors. This challenge is particularly pressing given the limited appeal of nuclear careers among younger generations. Although nuclear disciplines inherently hold a certain allure for talented young individuals due to their advanced nature and diverse applications, there are notable hurdles to overcome. Nuclear sciences and technologies often struggle to be perceived as a sufficiently inspiring and rewarding career choice.

WP4 of the ENEN2plus project focuses on developing a sustainable vocational training program and network. The VET sector is of paramount importance, and it necessitates ongoing efforts. In the future, the shortage of specialized professionals could potentially become a critical constraint for new projects and the long-term operation of existing ones. To address this, various actions must be undertaken as part of the project, including collecting, and analysing the current VET offerings, fostering VET learner communities, and exploring the development of a dedicated VET platform. The main objectives of WP4 are the following:

1. Understand and analyse the existing VET offer in the nuclear field.
2. Identify critical jobs in the nuclear domain and specify vocational training that will contribute to resolve the criticality.
3. Contribute to resolving the current fragmentation of the relevant nuclear vocational training opportunities in the EU, guarantee a coherent and sustainable Euratom vocational training program.

1.2 Introduction to Task T4.1 of WP4

Starting from results obtained in previous E&T projects (e.g., CINCH series to which ENEN is a member of the consortium) on analysing the VET offer for the nuclear workforce within the European nuclear field, this task continued and extended as well as deepened the analysis of the existing VET offer. The analysis focused on identifying the key domains with shortages in nuclear vocational training, the reasons for the fragmentation of the relevant nuclear training opportunities in the EU, and the barriers for a coherent and sustainable Euratom vocational training programme. Relying on related information provided and compiled through the activities of the Nuclear VET Learning Community (parallel task T4.2), the existing VET offers in the nuclear field will be further evaluated. Linking them to the professional/vocational needs as recognized in WP1, and focusing on critical jobs, the evaluation focused on detailing to what extent the required competences are insufficiently covered by the current VET offer.

According to the aims of task 4.1 the workflow consisted of the following steps:

1. **Identification** of the VET offer in EU and its structured collection.
2. **Categorization** of the VET offer based on specific criteria.
3. **Evaluation** of the categorized VET offer based on the vocational needs of stakeholders and individuals.
4. **Finding gaps** in the existing VET offer and identification of barriers.

The task was coordinated by STU and the following partners were actively involved: ST, EFOMP, BME, CIEMAT, UNIVLEEDS, KIT, CVUT, GRS. Furthermore, the European Commission's Joint Research Centre (JRC) made valuable contributions to T4.1 activities, and ENEN, set to lead the subsequent T4.3 phase, participated as an observer. We also received substantial input from WP1, particularly from Task T1.1 and T1.2, as well as from the project partners engaged in Task 3.1 of WP3. While the initial timeframe designated for Task T4.1 was 12 months, certain factors emerged during the execution of activities that necessitated a longer allocation of time. Consequently, the task's timeline was extended to 18 months.

The structure of this deliverable aligns with the actual workflow and engagement of the T4.1 task force throughout its implementation. It commences with an overview of the current state of Vocational Education and Training in the European Union, shedding light on the most significant VET-related activities and entities within the EU landscape. Subsequently, it delves into the systematic collection of available VET offerings using a Microsoft Excel-based data collection template. The document then proceeds to outline the selected categories of VET dimensions and the key domains that emerged from the data compiled. The central and pivotal segment of this deliverable involves an in-depth analysis of the existing VET offerings. This analysis is driven by the needs of individuals and nuclear employers across the EU. It not only assesses the alignment of supply and demand but also spotlights courses that exhibit superior visibility and user orientation. The last chapter outlines the interactions between task T4.1 and the ENEN HUB (also called VET platform). This chapter serves as a summary of the findings and culminates in the formulation of recommendations based on the insights garnered.

2 VOCATIONAL EDUCATION AND TRAINING IN EUROPE

2.1 Cedefop

Rather early, the EU developed and implemented policies to develop and support Vocational Education and Training in the union. Amongst others, in 1975 Cedefop was founded, the European Center for the Development of Vocational Training. Its mission is defined as (2019 version).

Support the promotion, development and implementation of the Union policy in the field of vocational education and training (VET) as well as skills and qualifications policies by working together with the Commission, Member States and social partners. To this end, enhance and disseminate knowledge, provide evidence and services for policy-making, including research-based conclusions, and facilitate knowledge sharing among and between Union and national actors.[1]

Reflecting this mission statement, Cedefop points out that after the launch of systematic European VET cooperation in 2002 (the so-called Copenhagen process), Cedefop had achieved important results in the past. Examples to note here are its involvement in:

- shaping the EQF while supporting the national frameworks linked to it,
- basing curricula and qualifications on learning outcomes,
- opening new ways of validating non-formal and informal learning and new pathways to qualifications

And:
Aiming to help inform VET policy and provision and, more broadly, people's education and career choices, Cedefop has developed EU-wide approaches to understanding current and anticipating future skills demand and supply.
…
The 2019 recast regulation formally recognised that, over time and in response to demands from its partners, Cedefop broadened its perspective by looking at skills and qualifications beyond traditional VET boundaries. The work on EQF and European tools, the analysis of VET systems and policies, apprenticeships and upskilling pathways for adults, and skills forecasts and intelligence are examples of activities that gradually have become key strands of the Agency's work.

Cedefop is active in the EU member states, and in Iceland, Norway, and the United Kingdom. Its Internet site provides extensive information about Cedefop 's activities, previous achievements, organization and policy, current and future program, and an extensive set of publications as well as further VET related links.

Important results for its activities (and generally for VET in the EU) are developed through Cedefop research projects. To prepare task 4.1 activities for work package 4 in ENEN2plus, the project *The Future of vocational education and training*[2] and its results (reports) were considered in more detail. This research project shall investigate how the content and profile of vocational education and training is changing, responding to varying demands for skills and competences at work and in society at large.

[1] See, e.g., https://www.cedefop.europa.eu/en, about Cedefop / Who we are
[2] It is building on a pre-cursor project (2016-18) on the *Changing nature and role of vocational education and training in Europe*.

Thereby it shall provide better understanding, through research and targeted testing, of the challenges and opportunities facing European VET, how these vary between countries, and how they have changed over time. While paying attention to the way VET institutions and structures change, Cedefop's work in this area shall focus on the changing content, notably on how technical and job-specific skills need to be combined in innovative ways with transversal skills and competences. The implications of these content changes for pedagogics, assessment and the institutions delivering VET shall be systematically addressed.

In this project, the research paper *The changing content and profile of VET: epistemological challenges and opportunities*[3] has been published as Volume 1 in 2022.

Introducing the aims of its work, the paper states that there is

… extensive research on how workplaces and work organisation have changed, and may change in the future, and the resulting consequences for skills. This focus of research on the skills demand side has not been matched by an equivalent body of research on the supply side. We know surprisingly little about how the structure and content of VET curricula and programmes actually interact with changes in the wider economy and society, especially over the long term.

While this publication and the results reported focus more on initial VET (I-VET), another research paper was published in 2022: *The future of vocational education and training in Europe Volume 4 Delivering lifelong learning: the changing relationship between IVET and CVET* , see [3].

This paper begins with the observation that *… VET systems play an important role in upskilling and reskilling of adults; providing the skills needed for individuals to maintain employment, improve their employment opportunities, or, more generally, to meet skills-related challenges in life.*

VET systems both comprise initial VET (I-VET) and continuous VET (C-VET). As starting point for the research, a broad concept of C-VET was used, namely *the learning of adults related to a current or a future occupation after leaving initial education*. *Therefore, the study looks broadly at the ecosystem provided by VET providers that support the learning of adults, looking specifically at learning that is relevant for the labour market, but also at the acquisition of key competences, or socially relevant adult learning (e.g. basic skills training). These programmes can lead to formal qualifications but may not.*
…
Taking this more holistic perspective, what is lacking is a clear overview and comparative perspective across Europe on how VET systems facilitate the learning of adults and what specific role they play in the different Member States.
Consequently, the study documented in this paper aims to fill this gap, thereby also showing … *for instance, how VET systems are opening to work with employers, offer more work-based learning and tailored provision, take into account prior experience, and include less traditional/classroom-based pedagogies.*

[3] see https://www.cedefop.europa.eu/files/5583_en.pdf , but also [1]

2.2 Focus on task 4.1 on C-VET

The requirements as set in the call HORIZON-EURATOM-2021-NRT-01-13 are quite general, and do not specifically address I-VET or C-VET. However, I-VET normally is regulated through member state specific policies, laws, decrees, or other national instruments. To regard and compare the education and training systems and the position of I-VET in different member states, one could consider the examples for France or Romania as shown in figure1, published by Cedefop. At first look it is apparent that these differ considerably, and this impression is confirmed when looking at the most recent compilation of all national (I-)VET systems, see [4]. Prior to and in parallel to this, Cedefop already has published more country-specific reports on the related vocational education and training systems, although at different years (between 2009 and 2022).

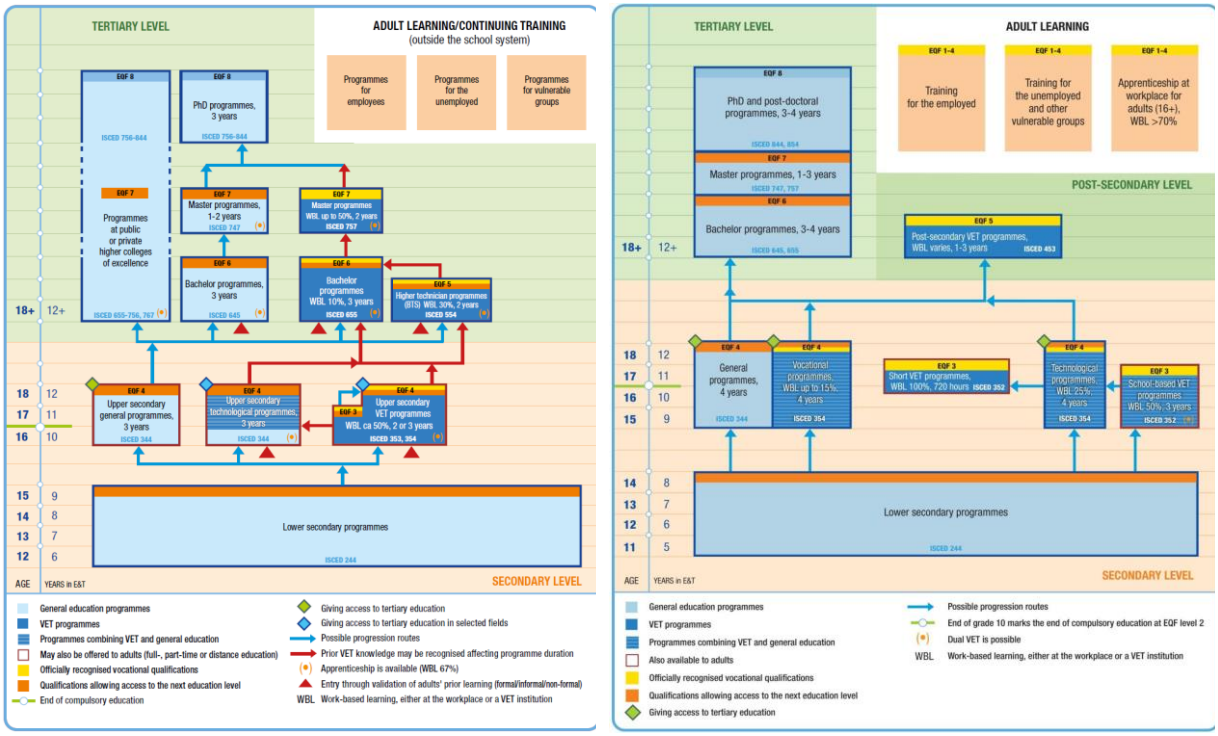


Figure 1: VET in the French (left) and in the Romanian (right) education and training system, taken from [1], [2]

Comparing the graphical representations of the VET systems in the different countries in [4], it is obvious that the vocational education and training systems in the EU member states are quite diverse for I-VET with respect to VET programs (dark blue boxes), education paths (blue or red arrows), degree of work-based learning, type of responsible public VET institutions, qualifications, access to higher educational levels (beyond EQF 4). This is valid for, at least, beyond the general structure, for the higher secondary programs as well as the tertiary level. Consequently, it seems impossible in the short-term to develop a coherent vocational training program for I-VET as requested by the call for the ENEN2plus project.

Apparently, the focus of VET addressed in the call HORIZON-EURATOM-2021-NRT-01-13 appears to be put on C-VET. This is in line with the Cedefop vision that the current work force must be prepared for life-long learning, thereby safeguarding future employment in response to technological and consumer product developments.

In this case, however, Cedefop does not yet provide suitable methods, tools, reports or data to investigate in detail the current C-VET offer in the nuclear domain in EURATOM countries.

But how to distinguish C-VET from I-VET in detail? This is discussed in [5], which, as an example, cites [6] that defines vocational education and training as education and training programs designed for, and typically leading to, a particular job or type of job:
Initial VET includes programmes mainly designed for and used by young people (we propose those under 30) at the beginning of their careers and commonly before entering the labour market. It includes many upper secondary and tertiary programmes. Continuing VET is all other sorts of VET, including enterprise training of employees and training provided specifically for those who have lost their jobs.

Additionally, [5] states

Cedefop defines CVET as 'education or training after initial education and training – or after entry into working life aimed at helping individuals to improve or update their knowledge and/or skills; acquire new skills for a career move or retraining; continue their personal or professional development'; it adds that 'continuing education and training is part of lifelong learning and may encompass any kind of education (general, specialised or vocational, formal or non-formal, etc.)' (Cedefop, 2014c, p. 51).

The Cedefop definition of CVET mentions other purposes (personal development) and is much broader than previously mentioned definitions. However, this definition also emphasizes that CVET is crucial to the employability of individuals, thus failing to acknowledge that individuals could also use the professional skills they acquire in CVET outside of jobs and labor market. CVET is basically a part of adult learning oriented towards professional development, seldom also specifically targeting youth. The Cedefop report CVET in Europe: the way ahead *(Cedefop, 2015a, p. 19) mentions that 'among all forms of adult learning, CVET is singled out by its particular orientation to professional development and meeting labor market needs.'*

In connection with the other part of the call leading to the ENEN2plus project, it is apparent that the focus of C-VET in WP4 must be laid on the aspects of *professional development and meeting labor market needs.*

Nevertheless, one must further detail which C-VET is to be considered in WP4. Here, [3] provides an interesting structure when looking at the purpose of C-VET:

Table 1: Purpose of C-VET, taken from [3]

	Has an explicit vocational/ occupation-specific focus		
Does not result in formal qualification	**Orientation 1. C-VET leading to acquisition of specific vocational/ occupation-specific skills and not leading to a formal qualification** *Forms / other names:* • Post-secondary VET (not leading to a qualification) • Training that forms part of Active Labour Market Policies (occupation oriented) • Workplace or job-related learning • Continuing Professional Education Governed by Professional Bodies (not leading to a qualification)	**Orientation 2. C-VET leading to a formal** (officially recognized vocational) **qualification** *Forms / other names:* • Post-secondary VET (leading to a qualification) • Apprenticeships • (Occupational) (Re)Training Programmes • Customised Vocational and Professional Programmes for Organisations • (Post-Tertiary) Continuing Higher Education (oriented to occupational knowledge) • Continuing Professional Education Governed by Professional Bodies (leading to a qualification)	**Results in formal qualification**

	Orientation 3. Basic skills training *Forms / other names:* • Basic skills and basic education • Training that forms part of Active Labour Market Policies (basic skills oriented) • Personal or social learning	**Orientation 4. General education tracks (academic tracks and second chance)** *Forms / other names:* • Second chance education at upper secondary levels / Basic Skills and Remedy Programmes • Higher Education Programmes Accessible to Non-Traditional (Adult) Students • (Post-Tertiary) Continuing Higher Education (oriented to more general knowledge)	
	Does not have an explicit vocational/ occupation-specific focus		

Based on these considerations, during the progression of task 4.1 activities it was decided to consider in WP4 only orientation no.1 (*acquisition of specific vocational/ occupation-specific skills and not leading to a formal qualification*), i.e.

VET leading to acquisition of specific vocational/ occupation-specific skills and not leading to a formal qualification*: this relates to vocational courses and programs not leading to a formally recognized qualification. This can include specific courses, training workshops etc. They aim at the acquisition of specific skills and possibly of a credential that has a value in the professional field. These VET courses can be linked to formal VET qualifications in the form of for instance specific modules or certificates. It can also include active labour market policy and more liberal adult education provision.* (from [3])

Furthermore, for task 4.1 the focus was narrowed to consider only C-VET with the following characteristics:

1. Connection with job activities is targeted,
2. For participating in VET, a professional experience is recommended,
3. No particular age group is targeted,
4. The maximum duration of curriculum or courses is some months,
5. C-VET providers possess high flexibility and are autonomous of further (e.g., state) regulation.

When surveying the existing VET offer, and compiling the results, it was also necessary to decide how to characterize the offer (mainly courses), or which data should be collected. For this purpose, it was decided in task 4.1. in addition to those data that are necessary to identify a VET offer (like VET provider, course name, link to course description), to mainly rely on Cedefop's analytical framework for comparing VET. Developed through the course of the Cedefop research project, the framework and its characteristics (attributes and possible values) were published separately, see [7].

Here, the authors explain that *To date, there has not been a more general tool that can be used for entire VET systems and/or sub-aspects of them that is more research-led than normative, and that is still suitable for policy analysis. To fill this gap, a framework was designed at the beginning of the Cedefop project on the* Changing nature and role of vocational education and training in Europe *initially to analyse conceptions of VET on a cross-national basis and their changes over time (see Cedefop, 2017a; 2017b; 2020b); it was further developed during the project and later extended to address the specific requirements of the follow-up project* The future of vocational education and training *in Europe (2020-22) whose goals were to deepen Cedefop's understanding of the factors shaping future developments of VET in Europe and to support policy makers and stakeholders in strengthening the overall relevance and quality of VET. It is this framework that is presented and discussed in this report. While this framework has been specifically designed to serve*

these two research projects, it may also be useful for any other comparative study on VET. (taken from [7])

In [7], the authors list the main benefits of the framework for comparing vocational education and training:

a. *it provides a holistic approach to VET systems and integrates many components that are usually not integrated;*
b. *it can be connected to different national or cultural ideas of vocational education and can help to understand them better;*
c. *it allows connections to be made between different levels of analysis and the combination of rough initial assessment with subsequent detailed analysis and explanation;*
d. *it allows for analysing whole VET systems as well as parts of them (e.g. higher VET) as well as specific aspects (e.g. assessment);*
e. *it is flexible, adaptable and connectable to newly emerging issues in VET policy and practice;*
f. *it can be combined with or complement other analytical frameworks;*
g. *it is particularly suited to 'clearing the ground' for policy work and, as such, provides a model for how research can support policy;*
h. *it is a useful aid to structuring policy debates, strategic thinking and scenario development in VET.*

For the framework, three partly overlapping perspectives were selected: an epistemological and pedagogical perspective; an education system perspective; and a socioeconomic or labour market perspective (examples see figure 2). These analytical perspectives must be distinguished from the different purposes that VET usually follows (educational, economic, and social). Consequently, in task 4.1 it was decided to deploy part of the framework for characterizing the VET offers to be compiled.

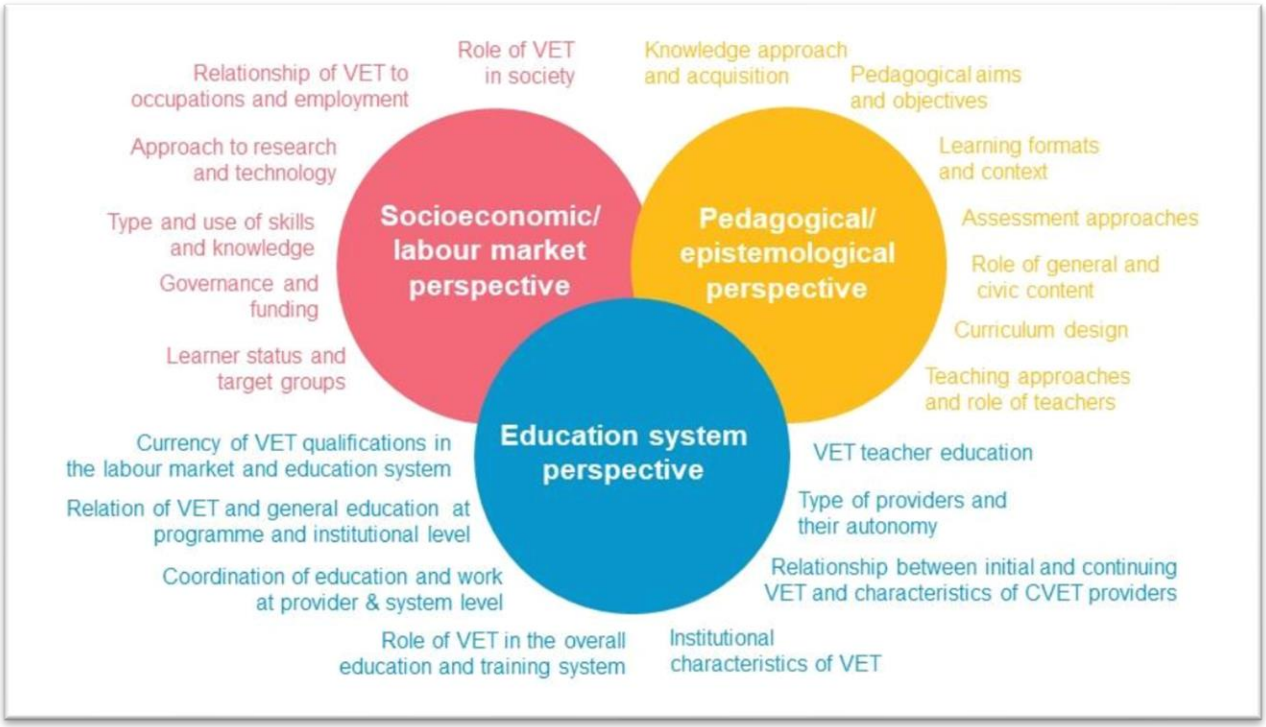


Figure 2: Three-perspective model of VET, taken from [7]

2.3 Further VET related EU initiatives and policies

The Copenhagen Process was initiated in November 2002 at a meeting in the Danish capital to agree a declaration on enhanced European cooperation in vocational education and training. This declaration responded to a request from the Barcelona European Council in March 2002 to act in the field of vocational training, similar to that taken under the Bologna declaration in higher education.[4]

The declaration emphasized that the development of a true European labour market – an essential complement to the single market for goods and services, and the single currency – relies heavily on having a skilled, adaptable and mobile workforce able to use its qualifications and competences as a kind of 'common currency' throughout Europe. In this respect, the main aims of the Copenhagen process were the development of lifelong learning and the promotion of mutual trust between the key players. The actions initiated by the Copenhagen process shall improve the quality and attractiveness of VET. It was recognized that VET in Europe is lagging behind other fields of education. Consequently, the parity of esteem between them should be raised.

The actions include for example:

- Establishing a single framework for transparency of qualifications and competences: this led to the development and implementation of Europass.
- Cooperation in quality assurance in VET should be enhanced: EQAVET was established.
- Credit transfer system for VET shall be launched - a system that enables individuals to progressively obtain credit points based on the competences they acquire along their vocational learning route, in both formal and informal settings, including common principles for validation of non-formal and informal learning: ECVET was established.
- And in general strengthening policies, systems and practices for lifelong guidance of EU citizens.

Mainly based on the *Recommendation of the European Parliament and of the Council* of 18 June 2009[5] , ECVET was launched. It is a tool designed to aid the transfer, recognition and accumulation of learning outcomes of individuals on their way to achieving a qualification. It is meant to operate in coordination with other European tools, promoting borderless mobility and lifelong learning. It shall create the potential to recognize, accumulate and transfer work-related skills and knowledge acquired during a stay in another country or in different situations, so that these experiences contribute to building up recognized vocational qualifications. The implementation of ECVET shall increase transparency of qualifications, support mobility and benefit professionals by providing a systematic and transparent way to present, document and validate their knowledge, skills and competence.

Generally, the technical components for ECVET can be classified in three main categories:

- Transparency of qualifications (qualifications, units of learning outcomes and credit points).

[4] see https://ec.europa.eu/commission/presscorner/detail/en/MEMO_04_293
[5] see https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:155:0011:0018:EN:PDF

- The accumulation process (assessment, validation and recognition of learning outcomes).
- The transfer process (memorandum of understanding, learning agreement and learners' transcript of records).

Investigating the process of introducing ECVET (see, e.g. [8] or [9]), the findings showed that most of the principles are being implemented by Member States, all sectors confounded, except for the ECVET [credit] points. A few countries expressed scepticism regarding the use of credits.

Consequently, the *Council Recommendation of 24 November 2020 on vocational education and training*[6] stated on ECVET:

During the ten years of its implementation, ECVET has widely contributed to the development of a better-quality mobility experience through the use and documentation of units of learning outcomes. The concept of ECVET points however was generally not applied and ECVET did not lead to the development of a European credit system in vocational education and training. Therefore, this Council Recommendation should include the key principles of ECVET (e.g. units of learning outcomes) related to flexibility. The ECVET tools (e.g. learning agreement and memorandum of understanding) supporting mobility of vocational learners, are to be further developed in the framework of other EU instruments such as those supported under the Erasmus+ programme. For vocational qualifications at post-secondary and tertiary level, the European Credit Transfer and Accumulation System already in use may be applied.

Also, in 2009 EQAVET was introduced through the *Recommendation of the European Parliament and of the Council* of 18 June 2009[7] . It aims at supporting Member States in improving the quality of their vocational education and training systems and to contribute to increased transparency of vocational education and training policy developments between Member States.

However, the *Council Recommendation of 24 November 2020 on vocational education and training* stated on EQAVET:

During the ten years of its implementation, EQAVET has stimulated reforms in national quality assurance systems, but did not contribute significantly to the improvement of transparency of quality assurance arrangements. Furthermore, it was mostly applied in school-based initial vocational education and training. Therefore, the 2009 EQAVET framework should be integrated into this Recommendation and elements addressing the shortcomings of its implementation in relation to the quality of learning outcomes, certification and assessment, stakeholders' consultation, the role of teachers and trainers, work-based learning and flexibility of vocational education and training should be added. In order to improve mutual learning, enhance the transparency and consistency of quality assurance arrangements in the provision of vocational education and training and reinforce mutual trust between EU Member States, EU level peer reviews of quality assurance at system level should be introduced.

Consequently, the *Council Recommendation of 24 November 2020* includes Annex II to specify the EQAVET framework, namely through EQAVET indicative descriptors and a reference set of EQAVET indicators. The indicative descriptors shall support Member States and VET providers when implementing the EQAVET framework: *They are structured by phases of the quality cycle: Planning – Implementation – Evaluation – Review. They can be*

[6] see https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020H1202%2801%29
[7] see https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:155:0001:0010:EN:PDF

applied to both initial and continuing VET and are applicable to all learning environments: school based provision and work based learning including apprenticeships schemes.

The EQAVET indicators can be used to support the evaluation and quality improvement of national/regional VET systems and/or VET providers when implementing the EQAVET framework.

Important to note here is the fact that EQAVET shall be applied not only by national VET systems, but also by VET providers, both public and private organizations.

As presented during a recent webinar to explore QA trends at VET Provider level[8] , regular surveys of the National Reference Points for quality assurance (EQAVET NRPs) show that the quality assurance cycle is very popular, and all indicators are used at the system level (most are used at the provider level). EQAVET is more often used for I-VET, but it is now also used for C-VET, on-line learning, accreditation of provision, development of curricula, non-formal and informal learning, assessment of prior learning, etc. In summary, the regular surveys indicate a growing interest in and application of EQAVET, also on VET provider level. However, the national quality assurance approaches vary as EQAVET is a framework to guide practice – it is not a quality assurance system.

As further initiative recently by the European Commission one should mention the *Digital Education Action Plan* (2012-2027)[9] . It sets out a common vision of high-quality, inclusive, and accessible digital education in Europe, aiming to support the adaptation of the education and training systems of Member States to the digital age. The action plan shall be a key enabler to realizing the vision of achieving a *European Education Area*[10] by 2025, while contributing to achieving the goals of the *European Skills Agenda*[11] .

In connection with the *European Education Area*, the *European Digital Education Hub*[12] was established, offering to join a community of practice Collaborate, exchange best practices, and develop solutions with stakeholders from all sectors of education and training in an inclusive and supportive environment.

Focusing on VET, EPALE[13] (Electronic Platform for Adult Learning in Europe) was funded under the Erasmus+ programme via the European Education and Culture Executive Agency, being part of the European Union's strategy to promote more and better learning opportunities for all adults. Now joined by more than 130.000 members, EPALE also organizes the *Community of European VET practitioners*[14].

This Community of Practice shall strengthen the VET community across the EU. It is targeting practitioners/experts dealing with skills development for young people and adults for the labour market, to help them better anticipate and prepare for future challenges.

[8] see https://ec.europa.eu/social/main.jsp?catId=89&furtherNews=yes&newsId=10649&langId=en
[9] see https://education.ec.europa.eu/focus-topics/digital-education/action-plan
[10] see https://education.ec.europa.eu
[11] see https://ec.europa.eu/social/main.jsp?catId=1223&langId=en
[12] see https://education.ec.europa.eu/de/focus-topics/digital-education/action-plan/european-digital-education-hub
[13] see https://epale.ec.europa.eu/en
[14] see https://epale.ec.europa.eu/en/practitioners-in-vet

2.4 European Learning Model

In parallel with other learning and skills related activities on a European level, for some time the *European Learning Model* (ELM)[15] has been developed (see footnote below 5). It shall provide a unified way to refer to and to describe all things related to learning, allowing for the understanding of concepts in the same way across countries and organizations. This, in turn, shall ease the data exchange process across Europe as any organization or entity working with learning can make use of the same concepts, making the data understandable even across languages when utilizing ELM. In particular, ELM will provide tools for recognizing qualifications and validating skills, thereby fostering a culture of upskilling, reskilling, and lifelong learning.

ELM may be utilized for many purposes, some of importance for ENEN2plus / WP4 are

- provide information about learning opportunities and qualifications in a unified way, e.g., to be used for course catalogues, training announcements, learning opportunity databases, and description of qualification standards;
- creating and issuing credentials (e.g., diplomas, certificates, examination results, professional certifications, etc.); a digital credential is a documented statement about a person's learning, e.g., details of event participation, or a set of learning outcomes that describe the knowledge and skills acquired through a particular learning opportunity.

The ELM consists of four different levels.

- **The first level** consists of the European Information Model which is composed of definitions and standards found in a variety of policy documents and recommendations linked to standards for learning and qualifications in Europe (such as the EQF Recommendation, the Europass Decision, the Diploma Supplement, the Micro-credentials Recommendation etc.).
- On the **second level**, ELM organizes and represents information / concepts that can be used in relation to learning and employment in Europe, additionally revealing the relations between different concepts (for instance, a 'start date' will be related to a 'learning opportunity').
- On the **third level**, the so-called Application Profiles apply specific sets of rules and restrictions on top of general information to ensure that vital data on learning opportunities (e.g., their provider), qualifications (e.g., linked learning outcomes, thematic area and qualifications framework level), accreditations (e.g., accrediting agent) and credentials (e.g., the designation of their issuers and owners) are always supplied. These rules set for example the minimum amount of data to be provided to describe a learning opportunity (for instance, it always needs to have a title), and the format in which it should be provided to ensure cohesion and interoperability.
- Finally, the ELM also allows for national, regional, or sectoral extensions of the data model and the creation of specific additional application profiles to support individual use cases and to adapt the ELM to specific needs.

[15] see https://europa.eu/europass/de/news/launch-european-learning-model and https://europa.eu/europass/de/node/2128

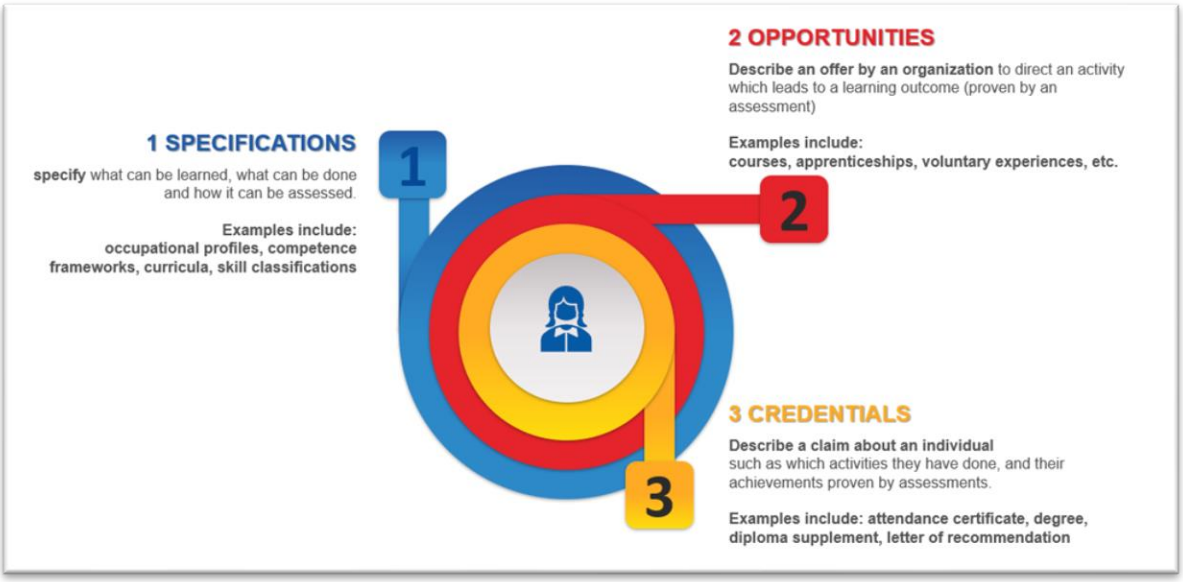


Figure 3: ELM categories (from Introduction to the European Learning Model[16])

With over 480 properties, the ELM allows for the capture of all learning related data, including formal, non-formal and informal learning and their validation, respectively.

Currently it is provided on a GitHub repository[17], the data model is in use by the European Digital Credentials Infrastructure (EDCI) and the Qualifications Dataset Register (QDR). EDCI is a set of tools, services and software to support the issuance of authentic, tamper-evident digital credentials (such as qualifications and other learning achievements) across Europe. The EDCI has been developed as part of an ongoing work to implement the new Europass Framework for supporting transparency and verifiability of citizens' skills and qualifications in Europe. The QDR is a register for publishing qualifications and learning opportunities in order to have these searchable on the Europass platform.

Consequently, the ELM allows for the creation and portability of rich data, for instance for European Digital Credentials for Learning. These represent the next logical step in the EU's policy agenda related to education: By 2025, all learners should be able to receive their education/training and professional credentials digitally and store them in a wallet. This is mentioned, e.g., in the vision of the European Education Area to be achieved by 2025, and in the Digital Education Action Plan[18].

[16] see https://europa.eu/europass/en/node/2128
[17] see https://github.com/european-commission-empl/European-Learning-Model
[18] see https://education.ec.europa.eu/focus-topics/digital-education/action-plan

3 COLLECTION OF THE VET OFFER

3.1 Development of the VET data collection templated

3.1.1 General considerations

The initial and most critical step in analysing the current VET offerings involves systematic data collection. As per the ENEN2plus project's workplan, the ENEN HUB or VET platform, a platform developed within WP2, in cooperation with Task 4.3, is intended to serve as a central hub for individuals and entities involved in E&T, VET, as well as job and internship opportunities. The HUB's development is structured in two phases, with the first phase, aiming to launch the initial version, scheduled for completion by Month 24. The second phase, which encompasses all necessary user-centric information, is targeted for completion by Month 36. Given that both phases extend beyond the scope of T4.1 activities, a decision was made to create a localized database specifically for T4.1 purposes. The chosen approach involves an offline database structured on Microsoft Excel, aptly named the "VET database." This choice was made for its suitability and ease of data management. To ensure seamless data collection while preventing unintended updates, a versioning procedure has been established, as depicted in Figure 4.

Project Number: 101061677

Tytle	Data collection template
WP task	WP4 Task 4.1
Dissemination level	CO - Confidental
Author	Štefan Čerba
Partner ID	STU
Verion	2.4.10
Repository location	Documents > Work Packages > WP4 Vocational Training > Task 4.1 > Database > V2.4
Date of the current version	28/04/2023
Review made by	Štefan Čerba
Date of data update	09/10/2023
Final version released	N/A

Figure 4: Versioning of the VET database

This versioning table, which is the initial worksheet in all iterations of the VET database, employs a three-tiered versioning system, defined as follows:

- Level 1 (A) signifies significant structural changes.
- Level 2 (B) indicates alterations in data categories.
- Level 3 (C) signifies data updates.

For instance, in Figure 4, we observe version V2.4.10, which translates to the second physical iteration, the fourth data release, and the tenth data update. The most current live version(s) is/are securely stored within the ENEN2plus repository, ensuring accessibility to all consortium members. Older versions, for archival purposes, are maintained locally at STU. It's worth noting that the VET database's dissemination level is classified as confidential, granting exclusive access to consortium members.

3.1.2 Evolution of the VET database

The initial version "V0.0.0", was released in October 2022. This version, devoid of any specific data, was primarily a demonstration to showcase the meticulously designed data categories for efficient collection and evaluation. Subsequently, it underwent multiple iterations. Notable versions are outlined below:

- V1.0.0 – Comments implemented from T4.1 partners.
- V2.0.0 - Comments implemented from WP1 and WP3 group.
- V2.1.1 – First version used for data collection.
- V2.4.10 – Latest version including the VET data – live version.
- V3.0.0 – Firs version created for joint data collection in WP3 and WP4.
- V3.1.0 - Reviewed by all interested parties.
- V3.2.0 – Version distinguishing E&T and VET related parts
- V3.5.0 - Latest version available for joint data collection – live version

As it can be seen from the list above, there are two live versions, V2.4.10 containing the latest data collected in T4.1 and V3.5.0 which is available for joint data collection between WP3 and WP4. As data related to academic E&T and VET courses are similar in their nature, the joint data collection seems to be the most straightforward step ahead, which would ease the transition of collected data to the ENEN HUB or VET platform.

3.1.3 Data collection categories

To streamline data collection and analysis, the document's structure was initially designed to encompass categories that characterize the VET offerings. The initial version, made available for review, comprised 66 specific categories including *general information about the provider and the course*, *audience and feedback*, and *VET dimensions*. Following a review by project partners, it became evident that the document's structure was overly complex for efficient work. Given that data collection primarily relied on project partners using publicly available sources, acquiring data to fulfil all categories proved challenging. Consequently, the document's structure was simplified. The most crucial 20 categories were retained in the "essential" section, while the remaining categories were moved to the "specific" section. This section is hidden but is still available for future use.

As a result, data collection focused on gathering information related to the following categories:

- VET offer
- Type of VET
- EU project
- Providing organisation
- Link to the organisation / project
- Type of provider
- Language

- Country of the venue
- Frequency
- Target audience
- Type of audience
- Level of education
- Focus of learning outcomes
- Outcome destination
- Type of nuclear domain
- Qualification after completion
- Time span of VET curriculum
- Delivery of VET
- Learning objectives specified
- Recognition of award or certificate

Data collection and feedback from WP1 and WP3 have indicated that the structure of 20 criteria may still be overly complex. In the list, the items underlined are those for which information could be consistently identified and, consequently, used for analysis.

3.1.4 Database of VET providers

In addition to acquiring VET data, an extensive exploration into information about VET providers in the European Union was conducted. This joint initiative aimed to compile data that can serve as a foundation for future updates and evaluations of VET information. Furthermore, the objective was to establish a platform for initiating dialogues with key stakeholders in the future. The data collection process utilized a specialized MS Excel template encompassing the following essential data points:

- Country of the organisation
- Name of the providing organisation
- Link to the webpage of the organisation
- Adress
- Personal contact
- E-mail
- Telephone
- Type of provider
- Language of VET courses
- Type of nuclear domain
- Courses available in the VET database

The data collection process was executed collaboratively by our partners, with each partner assigned the responsibility of supplying information pertaining to VET providers in the respective countries targeted for data collection. The information on VET providers is intricately linked to the VET database through a comprehensive mapping of courses. This linkage ensures the data's utility for future updates and facilitates seamless integration into the system. As this data contains sensitive personal data, the full list is not part of this deliverable.

3.1.5 Interactions with WP3

WP3 and WP4 of the project share very similar objectives, with a key distinction between them. WP4 primarily focuses on VET, while WP3 is dedicated to academic E&T. Given the occasional overlap and ambiguity between VET and E&T, where apart from their primary target audience, E&T programs may cater to professionals and VET courses could serve students, distinguishing between WP3 and WP4 can be quite challenging. In light of this challenge, representatives from Task 3.1 and Task 4.1 have reached an agreement to collaborate in collecting data related to both E&T and VET cases. Initially, Task 3.1 in WP3 had conducted targeted surveys for data collection. However, following this agreement, data collection was harmonized using the VET database developed within WP4. This streamlined approach significantly enhances the efficiency of project activities, establishes connections between specific project tasks, and facilitates the preparation of data for the future ENEN HUB in a standardized format.

It was decided to utilize the V3.5.0 version of the VET database for data collection. While both tasks T3.1 and T4.1 share a common goal of evaluating the collected data, their evaluation criteria and analysis outcomes differ due to the nature of their objectives. To address this distinction, a template was designed to accommodate specific categories:

- related to VET only – 10 categories;
- related to E&T only – 33 categories;
- related to both E&T and VET – 22 categories.

This structure was specifically designed to facilitate the development of the ENEN HUB and ensure it is populated with current and analysable data. The VET template is subject to examination by the IT company responsible for developing the HUB. While there is considerable overlap in the categories used, a significant portion of them pertains exclusively to either VET or E&T. To streamline the development of the ENEN HUB, an evaluation of the potential for harmonizing these data collection categories will be conducted. Should this harmonization prove feasible, the physical development of the HUB will align with the schedule outlined in document D2.1.

3.2 Summary of the collected data at country level

Although we aimed on analysing the VET offer as a whole package covering EU countries and the UK, it may be interesting to highlight country specific information. The summary of the collected data at country level is presented in the next sections.

3.2.1 European Commission's Joint Research Centre (JRC)

Under the Euratom Research and Training Programme, the JRC regularly prepares and implements training schools, courses, workshops, and lectures under physical, online or blended format in the fields of nuclear safety, nuclear security, nuclear safeguards, strategic trade control, nuclear decommissioning and waste management, as well as nuclear non-power applications. Some of these offers are specialised courses that can be appropriate for vocational training.

The JRC's nuclear education and training initiatives support EU policy priorities and aim to contribute to developing and maintaining EU's nuclear competence and expertise. They target STEM students and graduates, young professionals, first line national officers, as well as technicians and nuclear experts from various communities: Euratom, EU, international organisations and occasionally, third countries. They are provided in/by the four JRC sites where nuclear research and knowledge management activities are conducted, i.e., JRC

Karlsruhe in Germany, JRC Geel in Belgium, JRC Petten in the Netherlands and JRC Ispra in Italy. Often collaborations with other national or international nuclear training providers are established. The majority of the trainings are available in English, but in special cases, they could be provided in other EU languages.

In addition, the JRC opens its nuclear laboratories to external researchers through the "Open Access to JRC Research Infrastructures". This project enables scientists and students from EU member states' organisations and Euratom strategic partners to conduct research at licensed world-class nuclear laboratories, with the financial support of RTD. On a relevance-driven mode and through a fair and transparent selection process, the JRC opens the following nuclear facilities: the Actinide User Laboratory (ActUsLab) in JRC Karlsruhe, the Environmental & Mechanical Materials Assessment (EMMA) facilities in JRC Petten, and the European research infrastructure for nuclear reaction, radioactivity, radiation and technology studies in science and applications (EUFRAT) in JRC Geel. This initiative is also open for training, capacity building, as well as intergenerational development and transfer of competencies and skills.

3.2.2 European Federation of Organisations of Medical Physics (EFOMP)

EFOMP brings together 36 National Member Organisations, which represent more than 9200 medical physicists and clinical engineers working in the field of medical physics in the European continent with the common motto "Applying physics to healthcare for the benefit of patients, staff and public".

The recognition of the profession of 'Medical Physicist' or 'Medical Physics Expert' has a complicated history, it is not yet recognised at EU level, and EFOMP is working hard to achieve this. This situation means that even basic university training in medical physics is very different from country to country, and even among those that are part of the EU there is no common framework. To guarantee high quality vocational education, an independent organisation that accredits medical physics education and training events (European Board for Accreditation in Medical Physics -EBAMP) has been set up by medical physics societies represented by the EFOMP. EBAMP does this analysing training proposals and allocating Continuous Professional Development (CPD) credits depending on the number of hours of education and hands-on training required of participants, also for online courses. Moreover, always in the perspective of quality VET, EFOMP is working to its own new E&T Platform, probably ready by the end of 2024.

For ENEN++ Task 4.1 EFOMP has tried to collect the main web sites and platforms offering courses, webinars, online tutorials, and any kind of high-quality training in medical physics, with or without CPDs. The largest offer is in English, but there are also offers in Spanish and other languages. Some of the countries having their own online training offerings have already been catalogued, but there are others that have not yet been included. EFOMP's

3.2.3 Spain

Initial VET is the responsibility of the education authorities. Employment authorities are responsible for C-VET programs addressing companies' and workers' (employed and unemployed) skills needs, employment-training schemes and the regulation of apprenticeships contracts. It may be financed through public funds (mainly from company and worker contributions to social security). Publicly- funded programs (specialties) not linked to the national register (The National Catalog of Professional Qualifications) are included in a catalogue of training specialties of the State Public Employment Service and providers have to be registered as such. For the nuclear and radiation protection domain, the Nuclear Safety Council (CSN) is the sole nuclear safety and radiation protection authority in Spain.

Spanish legislation requires persons whose activity may affect radiation protection (RP) or radiation safety (RS) in facilities to obtain a license or accreditation issued by the Spanish Nuclear Safety Council (CSN). The regulatory body has a database of approved providers to organize these courses. Services entities, like RP Services and RP Technical Units are required that the personnel have specific training. Exposed workers without license or accreditation, must receive training in RS and RP in accordance with their potential risks and responsibilities.

The Spanish Radiation Protection Society (SEPR), affiliated to the IRPA, collects in their web the numerous specialized courses related with their competences, offered by the associated institutions and others that are relevant for the sector. The same mission has other societies, addressed for important collectives, as the Spanish Medical Physics Society (SEFM), affiliated to EFOMF, or the Spanish Associations of radiology, radiotherapy and nuclear medicine Graduates and Technicians, members of ISRRT and EFRS.

For the medical sector, the Ministry of Health, through the Commission for continuing education for the health professions, has approved provider institutions and courses accredited.

A nuclear power plant must be operated and supervised by licensed personnel. The RP service in the facility, must have a Chief with the appropriate diploma issued by the CSN. Rest of the staff working in a power plant, whether in-house or subcontracted, must receive training in RS and RP in accordance with their potential risks and responsibilities.

CEIDEN, the Spanish Nuclear Fission Energy Technology Platform, is constituted by more than 130 organization from around all the nuclear sector, has a Working group on training and knowledge management, KEEP+, which is intended to be a solid reference for the nuclear sector in all matters relating to training and knowledge management. KEEP+ has created the Spanish nuclear training catalogue, including academic training, available specialized training and the potential training that can be delivered. The Spanish Nuclear Society (SNE), organizes specialized training for their associates. It also maintains an inventory of the nuclear masters organized in Spain. Nuclear Industry Forum, organizes accredited continuous training for secondary level teachers in order to train teachers in the nuclear domain to transmit the knowledge to the new generations and ultimately attract talent to the ionizing radiation professions.

3.2.4 France

France has a long tradition in vocational education and training since the early 1970s. Initial VET is mainly regulated by the Ministries of Education and Higher Education. Different ministries develop VET qualifications and certificates are valid nationally. Vocational training for adults is under the remit of the Ministry of Labour. France compétences (2019) is the national public institution implementing vocational training and apprenticeship policies. C-VET applies to those entering the world of work or already in work, both young and adults. It aims to promote professional (re-)integration; maintaining people in work; and upskilling. The training market is open. Access and funding procedures for courses vary according to individual status: jobseekers or people in employment (private sector employees, public servants, self-employed workers). Training of jobseekers is managed by the regions, and partly by the national agency for employment. Employers (private or public) and the social partners are responsible for training people in employment. Compulsory contributions (rate set by law) are allocated to a particular purpose: to encourage companies to train their staff.

For the nuclear and radiation protection domain, French Nuclear Safety Authority (ASN) is the regulatory body in charge of, on behalf of the State, regulating nuclear safety and

radiation protection to protect workers, patients, the public and the environment from the risks involved in nuclear activities. It also contributes to informing the citizens. The ASN has many technical support associations that helps ASN in different matters and in some cases acts as training providers of specialized courses.

There are several associations related with radiation protection and with medical facilities, which have in their webs a compilation of specialized training courses, organized by them or by their associates. We can mention French radiation protection society (SFRP), the French Society of Medical Physics (SFPM) and the French Association of Paramedical Electro-Radiology Personnel (AFPPE). The French Nuclear Society (SFEN) organizes specialized events for their associates. Many of their associates are VET training providers.

3.2.5 Germany

In Germany, VET providers can be allocated to different groups according to the nuclear domain they are active in.

As for nuclear energy, the German nuclear operators and utilities (organized via VGB PowerTech, formerly the *Vereinigung der Großkesselbesitzer*[19]) early enough founded and operated a centralized training center dedicated to providing VET for the professional qualification and development of operation and maintenance staff in German power plants[20], the Kraftwerksschule (KWS), a non-profit organization. In the 1990s it was extended by an organization responsible for constructing and operating full-scope simulators (KSG Kraftwerks-Simulator-Gesellschaft mbH), and deploying them for training of operating personnel (GfS Gesellschaft für Simulatorschulung mbH) from nearly all German NPPs. After the German decision to shut down all nuclear power plants in Germany, the last three in April 2023, KSG and GfS will be decommissioned in the short-term. KWS instead will continue to provide some basic introductory training on nuclear, and focus more on training about decommissioning, and training to enable participants fulfilling legal requirements for work on nuclear sites (e.g., for radiation protection).

As for radiation protection, KWS is also a member of Qualitätsverbund Stahlenschutzkursstätten[21] (quality association of radiation protection training centers). In this association you will find further VET providers like FTU KIT[22] (training center for technology and environment at the Karlsruhe Institute of Technology) or hdt[23] (Haus der Technik) in Essen. They complement their offer through training in (nuclear) medical physics as well as on some nuclear basics.

As Siemens designed and constructed nearly all (West) German nuclear power plants in the 1970s and 1980s, the Siemens Training Center became responsible for initial training of the operation and maintenance staff of all German NPPs. After this period, the training center continued to provide initial and refresher training for staff of German NPPs, either on an introductory but also on an advanced and expert level. In the 2000s, now in AREVA, the training center had the responsibility to offer, design and implement training of the EPR operation and maintenance staff, e.g., in Finland (OL3). In parallel, training was built up for users of the Siemens / AREVA / Framatome safety I&C system platform Teleperm XS (TXS) on its design, operation, and maintenance. Consequently, Framatome[24] currently may

[19] see https://www.vgb.org/de/
[20] see https://www.kws-eg.com
[21] see https://www.strahlenschutzkurse-qsk.de/mitglieder/
[22] see https://www.fortbildung.kit.edu
[23] see https://www.hdt.de/seminare-workshops/strahlenschutz/
[24] see https://www.framatome.com/de/uber-framatome/active-future-development-your-success-is-our-goal/

provide a huge offer on different aspects on nuclear energy, including training on an engineering simulator.

The remaining German VET training providers play a minor role in Germany. AiNT, a spin-off from a nuclear chair at the technical university of Aachen (RWTH), is focusing on the training needs of the organizations (industry) active in the decommissioning and waste management business in Germany. Inforum is focusing on legal issues, in addition to some topics relevant for Germany. The TSOs (TÜV, Technischer Überwachungsverein) apparently only become active on customer demand, as a secondary business to their usual service (quality management) activities, except for: RiskTec, a subsidiary of TÜV Rheinland. Additionally, the German TSO GRS provides some short courses on several aspects of nuclear, e.g., nuclear basics, regulation, international cooperation, mainly directed to members of ministries or other authorities.

3.2.6 Italy

In Italy, VET is characterised by multilevel governance with broad involvement of national, regional, and local stakeholders. Ministries of education and labour lay down general rules and common principles for the system. Regions and autonomous provinces oversee VET programmes and most apprenticeship-type schemes. Social partners contribute to defining and creating active employment policies relevant to VET and lifelong learning. There are several levels of I-VET. These courses are organised by foundations that represent schools, universities, training centres, enterprises, and local bodies. There is permeability across VET programmes and also with the general education system.

VET for adults is offered by a range of different public and private providers. It includes programmes leading to upper secondary VET qualifications to ensure progression opportunities for the low-skilled; these are provided by provincial centres for adult education under the remit of the education ministry.

Continuing vocational training (CVET) to meet enterprise, sectoral and regional needs is:

- supported by the ESF and is managed by regions and autonomous provinces;
- directly funded by the regions and autonomous provinces;
- financed by joint inter-professional funds, managed by the social partners.

For the nuclear and radiation protection domain, the National Inspectorate for Nuclear Safety and Radiation Protection (ISIN) is the independent regulatory authority responsible for nuclear safety and radiation protection. The Inspectorate absorbs all the functions concerning nuclear safety and radiation protection already assigned by the national legislation to the CNEN(Comitato Nazionale per l'Energia Nucleare), ENEA DISP (Italian National Agency for New Technologies, Energy and Sustainable Economic Development), ANPA- APAT (Italian National Agency for Environmental Protection now Agency for Environment Protection and for Technical Services), and, finally, to the nuclear Department, technological and industrial risk, to the National Centre for Nuclear Safety and radiation protection and to the Physics Area of the National Centre for the national network of laboratories for ISPRA radioactivity activities.

There are several associations related with the radiation protection and with the medical facilities, which have in their webs a compilation of specialized training courses, organized by them or by their associates. We can mention Italian radiation protection society (AIRP), the Italian association of medical and sanitary physics (AIFM), the Italian Technical Association of Interventive Radiology (AITRI), the National federation Orders of medical radiology health technicians and technical health professions, rehabilitation, and prevention (TSRM-PSTRP), the Italian Association of Oncological Radiotherapy

Technicians (AITRO), or the Italian Association of Breast Radiology Technicians (AITERS). The Italian Nuclear Association (AIN), organizes specialized events for their associates. Many of their associates are VET training providers.

3.2.7 Slovenia

Nuclear VET in the SLO is covered primarily by a Jožef Stefan Institute as a state research institution and by its non-profit organization Milan Čopič Nuclear Training Centre (ICJT). Twenty one courses that are not funded by the EU were identified. These courses consist mainly of trainings dedicated to radiation protection, nuclear technology, safety of nuclear reactors and application of ionising radiation, and some courses are more general (internships and summer schools) that overlook a larger topic area. Most courses are offered yearly, and some are provided on demand. The courses are aimed at students, existing employees and those new to the sector.

The Jožef Stefan Institute (hereinafter referred as JSI) is the leading Slovenian research organisation. It is responsible for a broad spectrum of basic and applied research in the fields of natural sciences and technology. The staff of around 960 specialize in research in physics, chemistry and biochemistry, electronics and information science, nuclear technology, energy utilization and environmental sciences. The mission of the Jožef Stefan Institute is the accumulation - and dissemination - of knowledge at the frontiers of natural science and technology to the benefit of society at large through the pursuit of education, learning, research, and development of high technology at the highest international levels of excellence. In 2015 the total staff of the Institute was 955, including 448 PhD, 395 MSc or BSc. The Institute operates a 250 kW TRIGA research reactor, located at the Podgorica Reactor Centre, which comprises several other research departments and is located approximately 12km north-east from Ljubljana.

The Milan Čopič Nuclear Training Centre, or ICJT, is part of JSI, a leading research institution in Slovenia. The main building of the JSI is located in Vič, in the southern part of Ljubljana. ICJT is located in the Reactor Center in Podgorica near Ljubljana. About 1,000 people are employed at the institute, of which 120 are in the Reactor Center. There are 9 of us full-time employees at ICJT. Lectures are held in four lecture halls and permanent exhibition on nuclear technology is located in the basement.

3.2.8 Hungary

In Hungary, the VET system has gone through a fundamental reform in the last years. Among the changes, most important ones are the strengthening of the dual education and the separation of state-owned VET centres and private companies in higher VET education. Concerning upper secondary VET system, there are two basic school types in Hungary: the 4+1 years long vocational grammar schools ending with a secondary school leaving exam, plus giving a basic registered qualification and the 3+2 years long secondary VET schools giving a basic registered qualification, without direct enrolment to higher education.

For higher VET system, there are 2 years long programmes for students either on a school-organised or a company-organised basis. The modification of this system is in progress now, the result of which will restrict the providers to so-called VET centres for NQR qualified basic professions. Private companies can provide only VET programs on specializations and special short courses (without acknowledged qualification, only certificate can be issued).

Concerning C-VET in Hungary, it is typically out of the school system, organized and offered by companies (industrial companies or special education companies), short courses with or without any qualification. There are also 1-2 year long postgraduate courses available

organized by universities for workplaces needing special knowledge. The NQR also defines the qualifications for which training programmes are offered in adult education evening or correspondent courses, or other specific educational forms. VET in adult education must be organised based on the VET framework syllabus. In adult education VET apprenticeship contracts can be concluded.

Nuclear related VET programmes in Hungary are the following:

- Upper secondary VET programmes – the only Hungarian vocational grammar school dedicated to the (nuclear) energy sector is the ESZI (Vocational Grammar School for Energy), the vocational training centre of the NPP Paks.
- Postgraduate courses – there are different universities in Hungary providing nuclear-related postgraduate courses (1 or 2 years long).

Nuclear related C-VET in Hungary can be summarized as follows:

- There are 1-8 weeks long courses available on different topics, also in English, but basically on an on-demand organisation (no regular announcement). However, only few courses have been started up to now. Providers are usually universities, research centres. Some of these courses are supported by EU R&D and E&T projects.
- Advanced and comprehensive radiation protection courses – required for certain positions – provided by private companies, universities or by the Institute for Radiobiology and Radio-hygiene.
- Short courses are also available in Hungarian for technical staff of new NPP project. Regular and on-demand courses are organised usually by universities.

3.2.9 Romania

The main VET opportunities leading to formally recognised qualifications in Romania are I-VET, including upper secondary technological programmes, 'school- and work-based VET' programmes and post-secondary programmes and C-VET, as part of adult education.

The VET system in Romania consists of:

- Upper secondary education:
    - High school programmes with work-based learning (WBL) component of 10-20% of the total programme – not considered as IVET
    - Technological programmes with a WBL component of 16-30%, considered as part of IVET (technical professions, services, natural resources and environmental protection)
    - school- and work-based VET' programmes, typically 3-year long
- Tertiary non-university education, which includes post-secondary IVET programmes

Adult vocational training activities are offered through:

- courses organised by training providers,
- courses organised by employers inside their institutions,
- internships and specialisation,
- other forms of training.

Adult vocational training is provided by legal persons/entities (private or public) as well as, in certain cases, by individuals acting as vocational training providers. In Romania, training and education of nuclear staff is provided by Nuclearelectrica's own training centre.

For adults working in other fields, some additional courses are available. One important Nuclear VET Centre is Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering. The Training Centre of the Institute provides radiation protection courses regularly at different levels and duration. Also, on-demand courses are available.

The training/specialization programs (duration, topics and method of presentation) are established according to the purpose of the training, the competence required in the application addressed, legal provisions in force. Possible topics are:

- Transport of radioactive materials, in collaboration with authorized suppliers from the Ministry of Transport, Construction and Tourism.
- Radioprotection when using radiation sources. Level 1 and 2, duration: 30 hours, respectively 60 hours.
- Post-secondary specialization courses for technological physics and applied nuclear physics.
- Postgraduate specialization courses for technological physics and applied nuclear physics.

3.2.10 Bulgaria

The main VET opportunities leading to formally recognised qualifications in Romania are I-VET, including upper secondary technological programmes, 'school- and work-based VET' programmes and post-secondary programmes and C-VET, as part of adult education.

VET system in Bulgaria consists of:

- Upper secondary education: with high school programmes (grades 9-12/13) and school- and work-based VET' programmes.
- Tertiary non-university education (including post-secondary IVET).

Vocational competences can be acquired through:

- formal learning – provided by an accredited VET provider;
- non-formal learning – acquisition of competences either via regular performance of specific work activities or through self-training;
- informal learning – acquiring competences through training methods that are unstructured, unintended and non-institutionalised.

In Bulgaria, there are different accredited providers offering VET programmes – mainly – for radiation protection fields. They are the following:

- National Center of Radiobiology and Radiation Protection (NCRRP) is a scientific organization and a specialized body of the Ministry of Health in Bulgaria. It offers dedicated education and training for certification to work with Sources of Ionizing Radiation (SIR) for specialists with medical and non-medical education[25].
- Institute for Nuclear Research and Nuclear Energy (INRI) is part of the Bulgarian Academy of Sciences. Besides participating in academic education programs, it

[25] https://ncrrp.org/en/national-center-of-radiobiology-and-radiation-protection/

conducts specialized training and issuing certificates of legal capacity for activities with sources of ionizing radiation.[26]

- ESTRA is the e-learning platform of the Training Centre of the Kozloduy NPP, developed to provide specialised training in the form of online courses. These courses are intended for contractors and other external workers working in the controlled area of Kozloduy nuclear power plant. The courses include occupational safety, nuclear safety and radiation protection, industrial safety [27].

3.2.11 Czech Republic

Nuclear VET in the Czech Republic is covered by a variety of VET providers, companies and higher/further education providers. Thirty courses that are not funded by the EU were identified. These courses are mainly consisting of trainings dedicated to radiation protection and application of ionising radiation, and some courses are aimed at nuclear physics, mostly reactor physics. Nuclear reactor courses are usually a little longer than those courses dedicated to radiation protection. All courses are offered on demand. The courses are aimed at existing employees as well as those new to the sector.

The Czech Technical University in Prague (CTU) is one of the most important technical universities that provides education in the nuclear area. In addition to university degrees, VET courses are offered in the area of nuclear engineering. An important part of such courses is implemented at the VR-1 reactor.

The National Radiation Protection Institute (NRPI) is a public research institution. This institution operates the implementation and provides research and support activities for government institutions in the area of radiation protection. The courses offered are mostly aimed at activities important in terms of radiation protection, including measurements and evaluation of radionuclides in buildings water using sources in industry education or research X-ray facilities nuclear medicine diagnostics, and others.

UNIT, DTOCZ, and DEKRA are companies that offer a number of safety training courses that have been developed to meet the demands of regulations and the needs of the nuclear industry. Their courses are offered in the area of radiation protection in industry and healthcare.

The CEZ company operates all power reactors in the Czech Republic. The VET course provides training in radiation protection. Another Czech technical university that provides education in is nuclear reactors. Their VET activity is a summer school of nuclear engineering.

3.2.12 Slovakia

Slovakia boasts a significant nuclear power plant history, beginning with the A1 facility that utilized a KS-150 heavy water moderated CO_2 cooled reactor and experienced two nuclear accidents, notably an INES4 event in 1977 leading to its closure. Subsequently, the nuclear industry, R&D and E&T has developed a strong link with the Russian VVER-440 technology. At present, Slovakia operates 5 VVER-440 units in Jaslovské Bohunice and Mochovce, with another unit nearing completion and two undergoing decommissioning. The Slovak nuclear sector's evolution is rooted in the collaborative R&D efforts originating in the former Czechoslovakia, addressing challenges related to operating VVER-440 units, radioactive waste treatment, and nuclear power plant decommissioning. Furthermore, the

[26] http://www.inrne.bas.bg/index.php/training-center-for-specialized-training
[27] https://estra.npp.bg/moodle/?lang=en

sector extends into non-power applications, particularly in nuclear medicine, encompassing disease diagnosis and therapy, as well as radiopharmaceutical production.

In the nuclear energy and decommissioning sector, the primary key players include Slovenské elektrárne, a company operating 5 VVER-440 units along with various hydro, gas, and coal-fired power plants. Additionally, there's VUJE, a research and development company, and JAVYS, a state-owned company responsible for managing the decommissioning, treatment, and storage of radioactive waste from VVER-440 units. The nuclear field also sees the presence of several international companies, such as FRAMATOME, Jacobs, Nuvia, and more. Notable contributors to research and development include VUJE, the Slovak University of Technology in Bratislava, and the Slovak Academy of Sciences. Overseeing nuclear activities are the Nuclear Regulatory Authority of the Slovak Republic and the Public Health Authority.

The nuclear higher education system in Slovakia comprises three-degree levels: BSc, MSc, and PhD. A comprehensive education spanning all these levels is available at the Institute of Nuclear and Physical Engineering within the Faculty of Electrical Engineering and Information Technology at the Slovak University of Technology in Bratislava (STU). This is offered through programs such as "Electrical Engineering – Nuclear Engineering – Nuclear and Physical Engineering." Graduates from this program are well-prepared to work in various roles, including at nuclear power plants, nuclear waste treatment facilities, as well as in research and development.

Furthermore, education in nuclear-related fields, specifically in "Nuclear Chemistry" and "Nuclear Chemistry and Radioecology," can be pursued at the Department of Nuclear Physics and Biophysics within the Faculty of Natural Sciences at Comenius University in Bratislava. Additionally, a Master's course in "Nuclear and Sub-nuclear Physics" is offered at the Faculty of Natural Sciences at Pavol Jozef Šafárik University in Košice. Nuclear subjects are also incorporated into the curricula at the Institute of Thermal Power Engineering within the Faculty of Mechanical Engineering at STU and at the Faculty of Electrical Engineering and Informatics at the Technical University of Košice.

VET in nuclear-related fields is structured to encompass NPP operation and radiation protection. The main providers of VET courses related to NPP operation are the VUJE company and STU. VUJE offers VET training programs covering various aspects, including VVER technology, Probabilistic Safety Assessment (PSA), nuclear safety approaches, emergency planning, NPP commissioning, and licensing. They are authorized contractors for the NPP operator, delivering simulator training I-VET activities to ensure the competence of new nuclear power plant employees. Additionally, VUJE conducts C-VET courses, often catering to an international audience, including participants from organizations such as the IAEA, US NRC, or US DOE.

STU not only provides regular education and training curricula for students but also focuses on delivering C-VET as part of ongoing training for the Slovak Nuclear Regulatory Authority's staff and control physicists working for the NPP operator. They also offer C-VET courses for personnel within the NPP operator who need nuclear knowledge. Furthermore, STU plays a significant role as a founding member and coordinator of the European Nuclear Experimental Educational Platform (ENEEP)[28]. This platform, a successor to the ENEEP project, serves as a legal entity providing customized E&T and VET courses covering various nuclear topics.

In Slovakia, an integral component of nuclear-related VET involves also I-VET and C-VET courses focused on obtaining certifications for internationally recognized positions such as

[28] www.eneep.org

"Radiation Protection Officer," "Radiation Protection Expert," and "Medical Physics Expert." Some of these courses align with the criteria specified in Slovak law. These specialized courses are offered by several organizations, including VF Slovakia, Reaktortest, Ústav radiačnej ochrany, and Inžinierske služby, ensuring that individuals can attain the necessary qualifications for these critical roles in the field of radiation protection and medical physics.

3.2.13 Poland

Nuclear VET in the PL is covered by a variety of VET providers, mostly state research institutions. Eleven courses that are not funded by the EU were identified. These courses consist mainly of trainings dedicated to radiation protection and application of ionising radiation, and some courses are more general (internships and summer schools) that overlook a larger topic area. Most courses are offered on demand. The courses are aimed at existing employees and those new to the sector.

The National Centre for Nuclear Research (NCBJ) is the largest research institute in Poland and operates a nuclear reactor (the MARIA reactor). The Centre is actively involved in the development of nuclear technologies and promoting practical applications of nuclear physics methods. Major market products manufactured in the Centre include radiopharmaceuticals and a range of particle accelerators for science, various industry sectors and medicine. The Centre is an IT and R&D background infrastructure indispensable to provide expert support for decision makers in the project to develop the nuclear power industry in Poland in the coming years. This institution provides VET in the area of application of ionising radiation. This contains medical applications, operation of accelerators for nonmedical purposes, and dosimetry, management, and operation of research reactors. This institution offers more general VET that contains a variety of topics, the summer schools, and internships.

CELOR is a state institution dedicated to national radiation protection and provides VET courses related to radiation protection and nuclear safety. The Institute of Nuclear Physics, Polish Academy of Sciences, is a leading organisation in research in the area of nuclear physics. It provides courses in the radiation safety field for healthcare.

The Association of Radiological Protection Inspectors SIOR is an organisation in which members are mainly (but not only) Inspectors working on Radiological Protection: in medicine, industry, research institutes, colleges, and universities. This organisation offers VET dedicated to radiation protection and nuclear safety.

3.2.14 Sweden

In Sweden, the largest number of trainings is offered by KSU (Kärnkraftsäkerhet och Utbildning), a part of the Vattenfall company, and owned by the Swedish NPP operators. Primarily founded for initial and refresher training of the operation and maintenance staff of Swedish NPPs, it now has extended its market to offer training for the nuclear industry. On an international level only, customized training is offered to be based on clients' needs.

The Vattenfall company itself offers VET courses, apparently targeting personnel of companies that shall act as sub-contractor for nuclear related activities on the premises of the NPPs operated by Vattenfall (Ringhals, Forsmark, Oskarshamn).

Finally, SKB, the Swedish Nuclear Fuel and Waste Management Company, is active in the safe disposal of spent nuclear fuel and radioactive waste generated in the operation and decommissioning of nuclear power reactors. As such it offers courses and training programs in different areas/disciplines and for different target groups, currently however only 4 courses.

3.2.15 Belgium

Belgium has three Communities (Vlaamse Gemeenschap, Communauté française and Deutschsprachige Gemeinschaft), each responsible for its educational system and policy. Key competences are provided by compulsory education, including initial VET. In Belgium, key competences are central to compulsory education from age 6 to 18, including initial VET (ISCED levels 1-3). They are assessed at the end of elementary school and at the end of the second year of secondary education. After two years of secondary school (ISCED 2) students may continue in general education or VET (school-based or apprenticeship) leading to a vocational qualification.

Institutions in Belgium involved in VET initiatives for the nuclear/radiological sector are: SCK CEN Academy, Vinçotte, Be.Sure, ECS/EQUANS, FANC (Federal Agency for Nuclear Control – aka the Belgian Nuclear Regulator).

The SCK CEN Academy offers various training initiatives on a VET level:

1) Courses offered in an 'open' format (anyone can register, provided some pre-requisites): Training for radiation protection officers, Training for radiation workers, Basic training in radiation protection, Preparedness and response for nuclear and radiological emergencies, Decommissioning of nuclear installations, Radioactive waste disposal, Radioactive waste management.
2) Customized training courses (on demand) in various topics (in all R&D fields in which active research is performing), such as: Radiation protection, Innovative nuclear systems, nuclear energy technology, nuclear material science, Nuclear safety and safety culture, Management of emergency situations, Dismantling and decontamination, Sustainable waste and disposal, Nuclear medical applications, Radiobiology, Radio-ecology, Microbiology, Ethical aspects and evaluation of nuclear engineering.

Most of the training courses above are available in Dutch, French and English. The other institutions in Belgium involved in VET initiatives for the nuclear/radiological sector:

- Vinçotte: Training for radiation protection officers, Training for radiation workers
- Be.Sure: Training for radiation protection officers, Training for radiation workers
- ECS/EQUANS: Basic training in radiation protection, Exposure measurements, Neutron detection, Transport of radioactive material, Working with risks of radioactive contamination.
- FANC: Safety advisor for ADR transport class 7, Driver ADR transport class 7 (in collaboration with DGT), Training for professionals in scrap metal industry with a measurement portal, Training for professionals in scrap metal industry without a measurement portal

Larger companies/organizations working with nuclear/radiological applications offer in-house VET training (mainly in radiation protection for their own workers or to train radiation protection officers). Also, the various disciplines of first responders have scattered initiatives for VET training in radiation protection.

3.2.16 Netherlands

Nuclear power plays a minor role in the Dutch electricity supply, with the Borssele reactor contributing approximately 3% of the total electricity generation. The history of the development of the nuclear industry in the Netherlands can be traced back to the 1930s when researchers at the Delft University of Technology became interested in the potential

of nuclear energy and began stockpiling natural uranium. In 1994, the Dutch parliament voted to phase out the Borssele nuclear power plant by 2003. In 2003, the ruling conservative government coalition pushed back the closure date to 2013, and in 2005, the phase-out decision was ultimately abandoned. In December 2021, a new coalition government made nuclear power a central component of its climate and energy policy. In December 2022, the government outlined plans to extend the operating life of the single pressurized water reactor (PWR) unit at Borssele beyond its 2033 license expiration.

Currently, there is no higher education institution in the Netherlands offering a Bachelor's degree program in the field of nuclear science. However, several universities in the country provide specialized Master's and Doctorate programs, as well as research opportunities in this field. Delft University of Technology/Technische Universiteit Delft offers two Master's degree programs related to nuclear science, namely Chemical Engineering and Applied Physics with a specialization in Nuclear Science and Engineering. For those pursuing a Doctorate degree in the nuclear field, the Radiation Radionuclides Reactors Department provides the option to conduct research in this area. Additionally, the University of Groningen, particularly through its Kernfysisch Versneller Instituut (KVI), is actively involved in nuclear research.

Eindhoven University of Technology/Technische Universiteit Eindhoven offers various specializations related to nuclear science, including Science and Technology of Nuclear Fusion and Science in Applied Physics with a specialization in Plasma Physics & Radiation Technology. Other organizations contributing to nuclear education and research in the Netherlands include Nuclear Nederland and the Nuclear Research and Consultancy Group (NRG). In the realm of nuclear research, significant work is being carried out at various institutions. Delft University of Technology is particularly active in the Radiation Radionuclides Reactors area. Eindhoven University of Technology is involved in Coherence and Quantum Technology, Plasma and Materials Processing, and Science and Technology of Nuclear Fusion. The European Commission's-JRC Petten, NRG, the Foundation for Fundamental Research on Matter (FOM), and the University of Groningen, especially through its Kernfysisch Versneller Instituut, are all contributing to nuclear research endeavours.

Furthermore, the Fantom International Research School for Fundamental and Applied Nuclear and Atomic Physics, coordinated primarily by the University of Groningen, involves participants from institutions across the Netherlands (Groningen), Belgium (Gent, Leuven), Germany (Münster), and France (Orsay/Paris). Organizations like the Netherlands Nuclear Society (NNS), Kivi Niria, and the Dutch Knowledge Infrastructure on Nuclear Technology (KINT) play a significant role in promoting and advancing nuclear higher education and research in the Netherlands.

In the Netherlands, vocational education and training (VET) options related to nuclear technologies are relatively limited. Nevertheless, the regulatory authority (ANVS), acknowledges 19 institutes and companies as recognized entities in the field of radiation protection. These recognized institutions offer specialized training programs. It's important to note that these courses are specific to various applications of radiation protection and do not encompass nuclear engineering. Additionally, while some companies offer training exclusively to their employees, others extend these programs to external individuals. The following is the list of recognized companies: Leids Universitair Medisch Centrum; Rijksuniversiteit Groningen; Technische Universiteit Eindhoven; Nuclear Research and Consultancy Group vof (NRG); Stichting Katholieke Universiteit (RadboudUMC en Radboud Universiteit); Technische Universiteit DelftRöntgen Technische Dienst B.V., Applus+ Competence Training Center; Faculteit der Tandheelkunde,

Academisch Centrum Tandheelkunde Amsterdam (ACTA); Stichting Hoger Onderwijs Nederland, Hogeschool Inholland; Stichting Fontys; Universiteit Maastricht en Academisch Ziekenhuis Maastricht; Erasmus Universitair Medisch Centrum Rotterdam, Erasmus MC; Stichting College Zorg Opleidingen, CZO; Universiteit Utrecht, Faculteit Diergeneeskunde; Edin B.V., Edin Dental Academy; Stichting Hanzehogeschool Groningen; Stichting Hogeschool Utrecht; Dental Best; Practice; Radcon B.V.

3.2.17 United Kingdom

Nuclear VET in the UK is covered by a variety of VET providers, companies and higher/further education providers. Twenty-two individual courses have been identified to date with some providers providing bespoke courses. These include introductory courses to the nuclear sector as well as safety training. The courses typically range from a few days to two weeks and include in-person and e-learning opportunities. Courses are aimed at both existing employees as well as those new to the sector. The most important VET related actors in the UK are the National College for Nuclear, National Skills Academy for Nuclear, Nuvia group, Tüv-Süd, Backbock Training, University of Manchester, University of Surrey and IChemE.

The National College for Nuclear (NCfN) was established by the UK government in 2016 to ensure that employers responsible for nuclear operations and decommissioning, major project delivery and waste management, have access to quality skills and education provision tailored to industry needs. The NCfN aims to develop and maintain scarce and specialist skills ensuring that capability is available both now, and in the future, leveraging vocational routes to higher education. The NCfN offers five nuclear VET courses.

NSAN is a membership organisation led by nuclear sector employees in the civil and defence sectors. Their focus is on the provision of courses not only for nuclear skills but all skills for nuclear. NSAN offers six courses covering nuclear safety and nuclear science and engineering. Nuvia is an international company that offers a number of safety training courses that have been developed to meet the demands of the regulations and the needs of the nuclear industry. They offer both on demand as well as bespoke training courses.

Tüv-Süd provide testing, inspection and certification services. The Tuv Sud Academy offers training courses on ISO19443 (a nuclear specific quality management standard). They also provide bespoke training courses. Babcock provide bespoke nuclear training courses. The University of Manchester offers eight Continual Professional Development Modules covering Nuclear Technology Management. The University of Surrey offers courses on Nuclear Reactor and Health Physics and Nuclear Metrology. The Institution of Chemical Engineers (IChemE) is the UK based qualifying body and learned society for chemical, biochemical and process engineers. IChemE offers a course on Fundamentals of Nuclear Safety.

3.2.18 Ukraine

Ukraine is working towards becoming a member of the European Union and has strong skills in VET to support its extensive nuclear area. There are 15 nuclear units, the Chornobyl Exclusion Zone, Radioactive Management sites, uranium mining and processing site, nuclear legacy sites, and unique research facilities like Kharkiv Neutron Source Based on a Subcritical Assembly driven by a Linear Electron Accelerator. Ukraine's nuclear industry is supported by many schools and research centres that focus on nuclear physics and technology. These places offer education and do important research and work with other countries.

Leading Educational and Research Institutions:

- Taras Shevchenko National University of Kyiv: University's Faculty of Physics places a strong emphasis on nuclear and particle physics, contributing significantly to research in these areas.
- National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”: Proposes engineering and technical programmes in different areas. This university offers specialized courses in nuclear technology and physics, fostering research and practical applications.
- Institute for Nuclear Research of the National Academy of Sciences of Ukraine: Located in Kyiv, this institute is a hub for both fundamental and applied research in nuclear physics and energy. Owns a research nuclear reactor.
- National Science Center “Kharkiv Institute of Physics and Technology”: As one of Ukraine's oldest and largest scientific centers, KIPT is dedicated to theoretical and applied physics, including nuclear physics. Known for its particle accelerator and experimental facilities, this center is a Ukrainian leader in nuclear physics and energy research.
- Odessa National Polytechnic University: With a focus on the practical applications of nuclear technology, this university contributes to research in nuclear and particle physics.
- V.N. Karazin Kharkiv National University: An important educational and research hub, it plays a crucial role in both fundamental nuclear physics research and the training of future physicists.

There are EU-funded programmes like EU4Skills and funding from the European Investment Bank (EIB) elevating VET development in Ukraine, aligning it with modern labour market demands. These initiatives support Ukraine's educational institutions in offering updated and relevant nuclear-related courses and training.

A partnership between Westinghouse Electric Company and the Ukrainian nuclear energy utility Energoatom provides internship and development opportunities for Ukrainian nuclear professionals and graduate-level students. This includes training with Westinghouse’s AP1000 Generation III+ pressurized water reactor technology, preparing participants for engineering and technical positions in Ukraine.

The Nuclear Energy Agency (NEA) has launched the NEA-Ukraine Visiting Experts Programme, bringing Ukrainian nuclear energy experts to the Agency to work on topics related to small modular reactors. The UK has provided funding for this initiative, allowing experts from the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) to support the NEA’s work in nuclear regulation and radiological protection.

Ukrainian VET in the nuclear sector provides extensive postgraduate opportunities, including different education and training programmes by the educational institutions and specialized training centres.

Educational Institutions propose:

- Igor Sikorsky Kyiv Polytechnic Institute offers a Master's programme in "Physical Protection and Accounting and Control of Nuclear Materials" in the specialty "Atomic Energy," initiated by the Ministry of Energy and Coal Industry of Ukraine. The programme was created with support of the international partners such as the

United States, Sweden, and Canada, as well as the International Atomic Energy Agency (IAEA). It includes training in nuclear safety, physical protection systems, and emergency management.

- The Department of Nuclear Physics of the Taras Shevchenko National University of Kyiv offers opportunities for students to participate in scientific, technical, and engineering developments related to nuclear physics, starting from the third or fourth year of study.

Specializing Trainings are proposed by The State Scientific and Technical Centre for Nuclear and Radiation Safety (SSTC NRS) and the George Kuzmycz Training Centre. These programmes improve professional skills in the following areas:

- Industrial Irradiators
- Sources in Medical Radiology
- Sources in Radiotherapy and Brachytherapy
- Uranium Ore Mining and Processing
- Use of Radiation Sources
- Radiation Monitoring
- physical protection, accounting for and control of nuclear materials.

The Chornobyl Training Centre in Slavutych offers programmes in radioecology and radiobiology, imparting skills essential for managing radiological effects of nuclear accidents.

Ukraine with its strong nuclear infrastructure and comprehensive educational and research institutions, working with partners worldwide, create a solid base for vocational education and training in the nuclear field. As Ukraine moves closer to joining the European Union, its combination of local expertise and international connections in nuclear education and training makes it an important member of the global nuclear community.

4 CATEGORIZATION AND KEY DOMAINS OF VET

4.1 Development of VET criteria

As outlined in section 3.1.3, the VET criteria should align not only with the overall task objective of comprehending and analysing the key domains and critical jobs within VET but also with the aim of facilitating data collection through public sources by project partners. Therefore, this chapter consolidates the VET data gathered from 16 EU countries, the UK, and other European nations, using the designated set of 22 categories. This summary will serve as an initial foundation for constructing the ENEN hub and populating it with essential data, enabling interaction with individual VET providers and users. It's important to note that VET providers throughout the EU have varying policies for audience targeting, resulting in differences in the amount and availability of data related to their VET programs. Consequently, it was not always feasible to collect uniform data or identify key VET domains in a consistent manner. A separate chapter within this deliverable will address the visibility and user orientation aspects of VET providers.

4.2 Summary of the collected data

In total, 1322 VET offers were identified and compiled within the database. It is important to note that this information covers only 16 EU member states and the UK, and even though we focused on the whole EU + UK, unfortunately, were not able to identify data for 11 countries. Most VET offers were identified in Spain, France, Germany, and Italy. The summary of collected VET cases per country can be found in Figure 5.

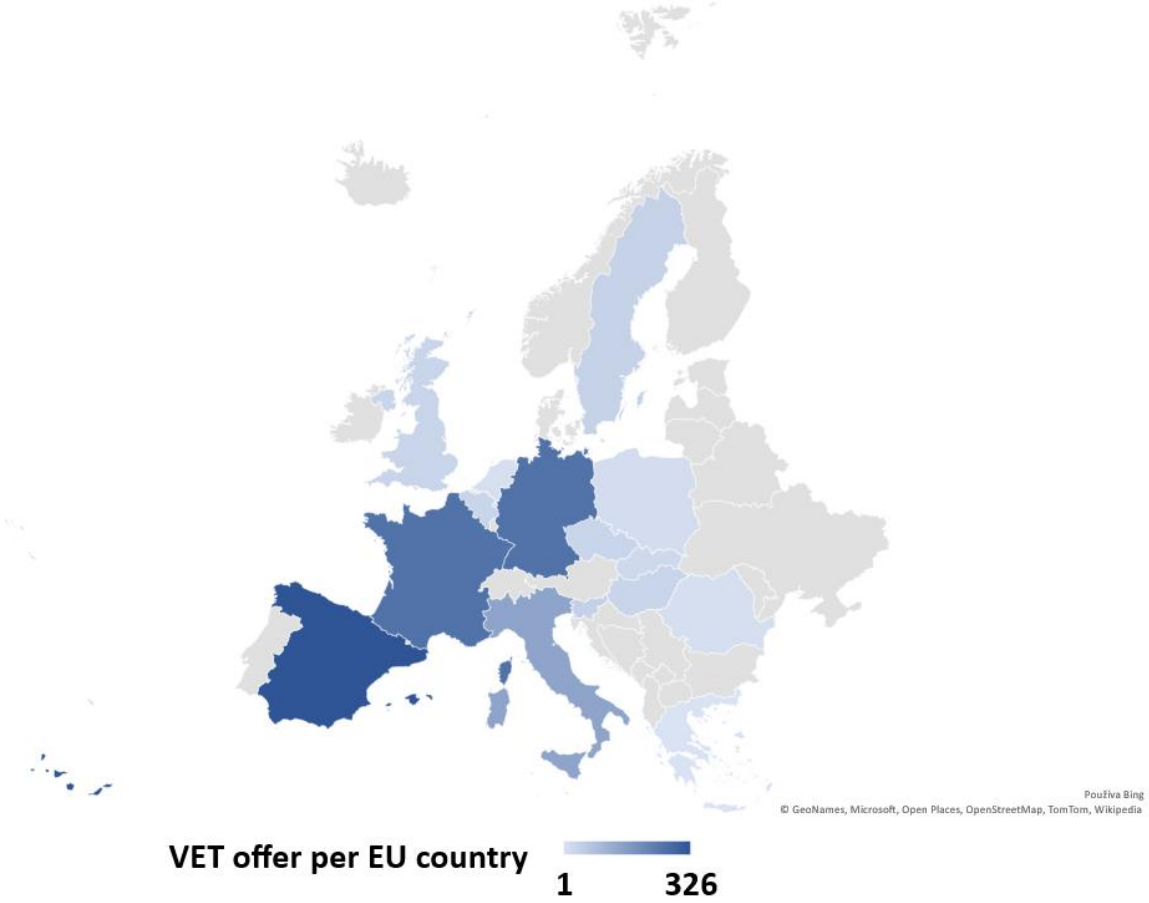


Figure 5: Summary of collected VET data per European country

4.2.1 Language

The graphical representation of the languages in which VET is offered can be found in Figure 6. The analysis reveals that there are VET offers available in a total of 14 languages. Additionally, it's worth noting that in 8 cases, the specific language was not specified. Interestingly, the distribution of VET cases across different languages closely mirrors the geographic spread of countries where VET is accessible. The preeminent languages in which VET cases are offered are as follows, with the respective number of cases provided in parentheses: Spanish (315), English (274), French (259), German (180), and Italian (126). Furthermore, there is a notable presence of VET cases in other languages, with between 10 to 30 cases available in Slovenian, Swedish, Czech, Hungarian, Polish, and Slovak, and fewer than 10 cases in Romanian, Dutch, and Bulgarian.

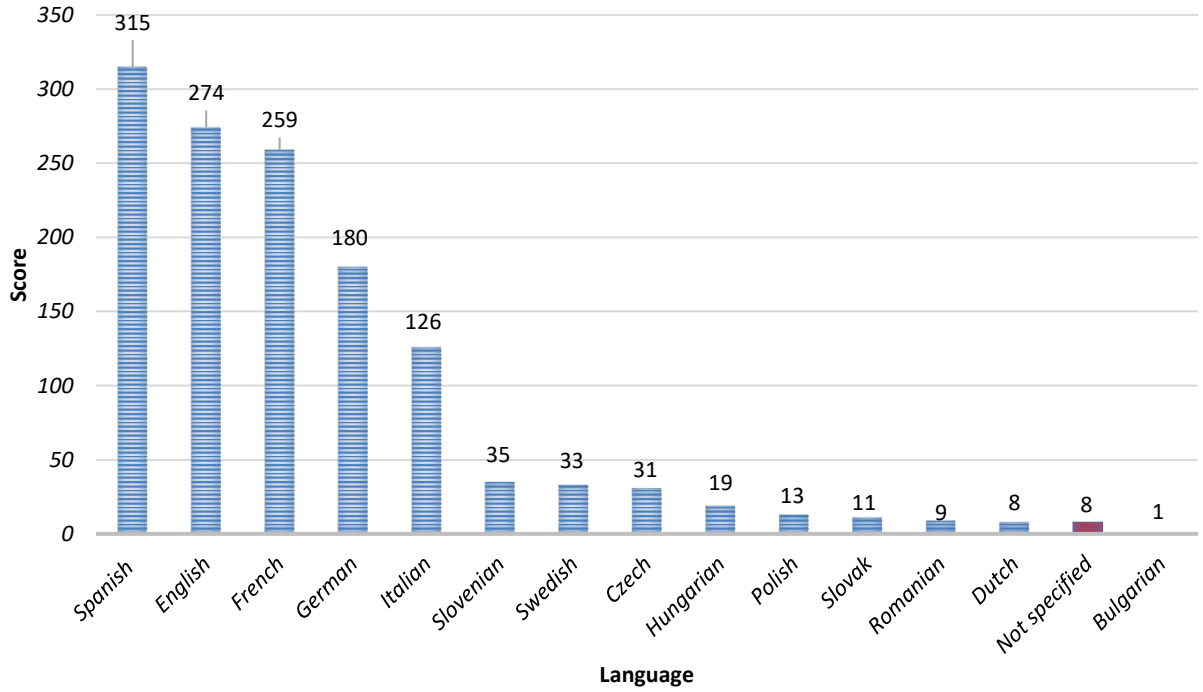


Figure 6: Summary of languages in which VET is provided

For a more detailed breakdown of VET cases provided in English across various countries, please refer to Table 2. This table serves as a concise overview of the prevalence of VET courses offered in the English language across different countries. It highlights that in the analysed countries, VET cases primarily use languages that align with their national languages. Notably, the prevalence of VET cases in the English language tends to be more significant in smaller countries with fewer VET offerings. Conversely, in strong VET countries like Germany, Spain, Italy, or France, the proportion of English-language VET courses tends to be around 30% or even notably lower. In contrast, smaller countries tend to exhibit a slightly higher proportion of English-language VET cases, possibly indicating a greater emphasis on reaching both national and international audiences.

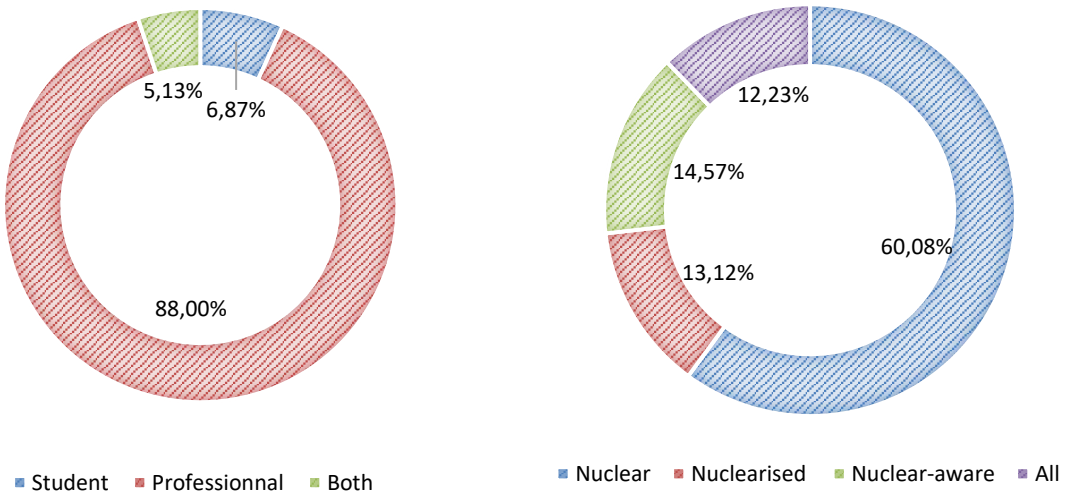
However, it's important to acknowledge that the dataset used for this VET analysis may not encompass 100% of VET cases in each country. Consequently, the actual distribution of languages could vary from what is presented in the table.

Table 2: Ratio of English VET cases per country

Country	English cases	Other cases	Rate of English cases
Belgium	21	13	62%
Bulgaria	6	1	86%
Czech republic	2	31	6%
France	8	251	3%
Germany	80	179	31%
Greece	1	0	100%
Hungary	15	19	44%
Italy	23	122	16%
Netherland	6	2	75%
Poland	3	12	20%
Republic of Cyprus	1	0	100%
Romania	1	9	10%
Slovakia	12	11	52%
Slovenia	6	35	15%
Spain	11	315	3%
Sweden	7	33	18%
UK	35	1	97%

4.2.2 Target audience

The summary of VET courses provides insights into the target audience, distinguishing between students and professionals. Although the classification used for the VET offer was provided by the T4.1 partners following personal experience and the information published by the VET, some internationally recognized common metrics were also used. One of these metrics was the classification of nuclear jobs based on the report of OECD NEA [10], categorizing the nuclear workforce as "nuclear," "nuclearized," and "nuclear-aware." Specifically, for students, the analysis delves deeper into the educational levels these VET courses cater to, with a focus on differentiating courses offered to Ph.D., M.Sc., B.Sc., and below-B.Sc. students. The summary can be seen in Figure 7, presenting the type of audience in Figure 7-a and the nuclear category of audience in Figure 7-b.



a; Type of audience

b; Nuclear category of audience

Figure 7: distribution of the target audience of VET cases

The analysis reveals that a substantial portion of the collected cases, amounting to 88%, is primarily tailored to professionals. These courses are intended to enhance the skills and knowledge of individuals already working within the nuclear industry. In addition, 7% of the cases are specifically designed for students, encompassing various educational levels, and 5% cater to both students and professionals, offering a mixed audience approach. It's worth noting that in more than 50 instances, the specific target audience was not clearly defined, which highlights the need for better categorization and data precision.

When considering the OECD NEA classification, the majority of the courses, approximately 60 %, are aimed at nuclear personnel, while 13 % target individuals classified as nuclearized, and 16 % are intended for those categorized as nuclear-aware. Moreover, 12 % of the cases are suitable for all three categories. However, it is important to acknowledge that nearly 100 cases did not have a specified classification, underscoring the importance of more comprehensive data and categorization in this context.

The breakdown of student courses depicted in Figure 8 underscores the significance of VET for Bachelor of Science (B.Sc.) students, as they account for over 50% of the cases. The remaining 50% is fairly evenly split between Master of Science (M.Sc.) and Doctor of Philosophy (Ph.D.) courses, with each of these educational levels comprising a substantial portion. In addition, there are VET cases designed for students below the B.Sc. level, but these make up less than 10% of the total student-focused VET offerings. It's important to note that this summary also encompasses cases that are accessible to both students and professionals, reflecting the flexibility and diverse educational opportunities available within the field of nuclear education and training.

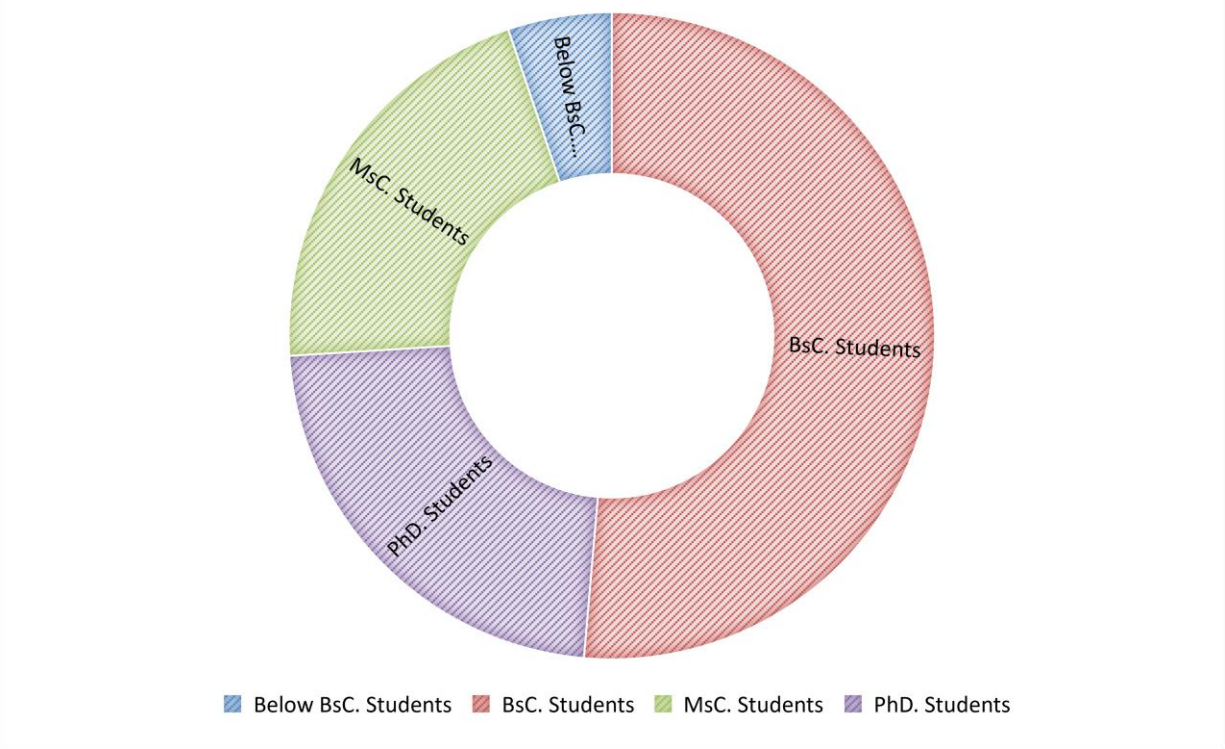


Figure 8: Level of students of VET cases

In the case of professionals, the summary further breaks down the courses by the type of profession they are designed for, providing a comprehensive understanding of the specific vocational training opportunities available for different occupational categories within the nuclear industry. This detailed analysis not only elucidates the target audience but also offers a more nuanced perspective on the diverse educational and professional needs within the field of nuclear education and training. The results are presented in Figure 9.

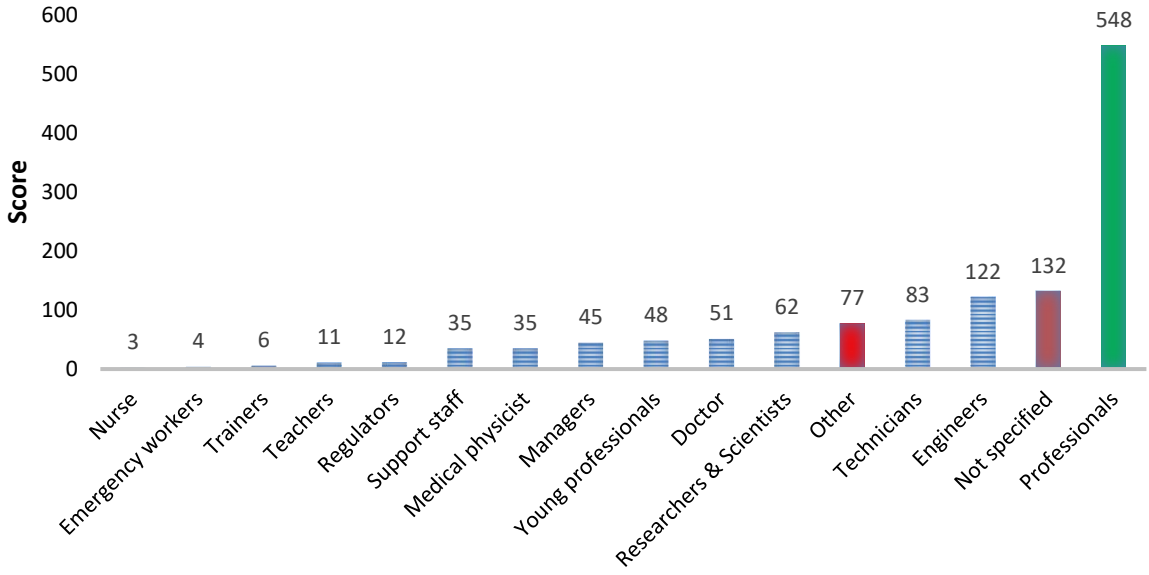


Figure 9: distribution of professions of VET cases

While the compiled list of professions comprises 13 distinct job categories, over 500 VET cases are characterized as dedicated to professionals without specific profession specifications. Additionally, there were 132 cases with unspecified or categorized as 'others.' Among the specified categories, Engineers, Technicians, and R&D workers emerged as the most prevalent, followed by Doctors, Young Professional Managers, Medical Physicists, and Support Staff. Professions such as Regulators, Teachers, Trainers, Emergency Workers, and Nurses had the least representation.

Figure 10 provides a summary of the required qualifications of the target audience, expressed in EQF levels[29]. It is evident that VET courses predominantly cater to a highly qualified audience, with EQF levels 7-8 accounting for 45 % of the cases.

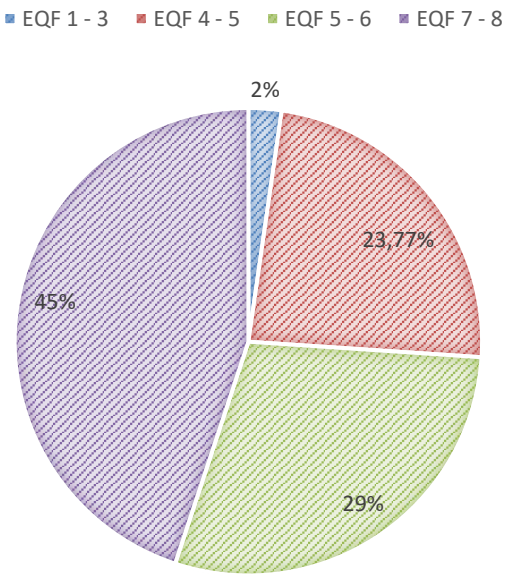


Figure 10: Qualification of the target audience expressed in EQF level

[29] https://europa.eu/europass/en/description-eight-eqf-levels

4.2.3 Nuclear domain

Information on the nuclear domain of the VET cases were summarized in 11 distinct categories, shown in Figure 11. Radiation Protection and Nuclear Energy domains received the most extensive coverage, representing 28 % and 27 % of the total cases, respectively. Following closely, Medical Applications and Nuclear Safety accounted for 11 % and 10 % of the cases, while Nuclear Materials, Waste Management, Decommissioning, and Nuclear Management exhibited variations between 2 % and 5 %. The areas with the least VET offerings were Nuclear Fusion, Nuclear Security, and Nuclear Safeguards and Forensics. It's important to note that 53 cases were unspecified, and 30 were categorized as "others."

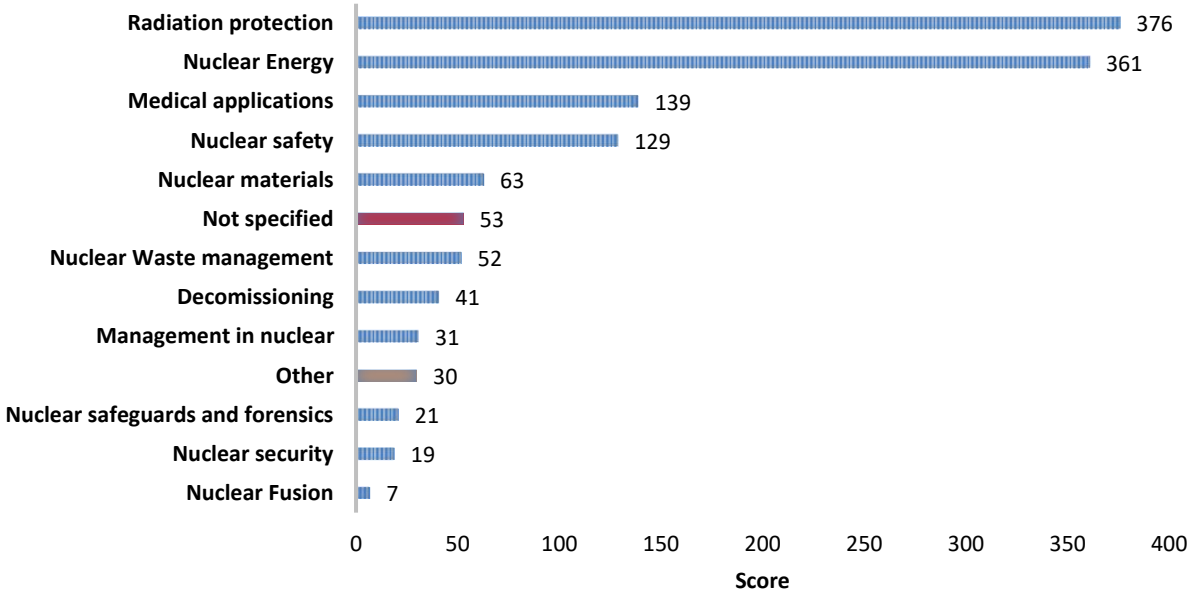


Figure 11: Distribution of nuclear domains of VET cases

4.2.4 Time span and delivery of VET

The summary related to the time span of VET offers is presented in Figure 12.

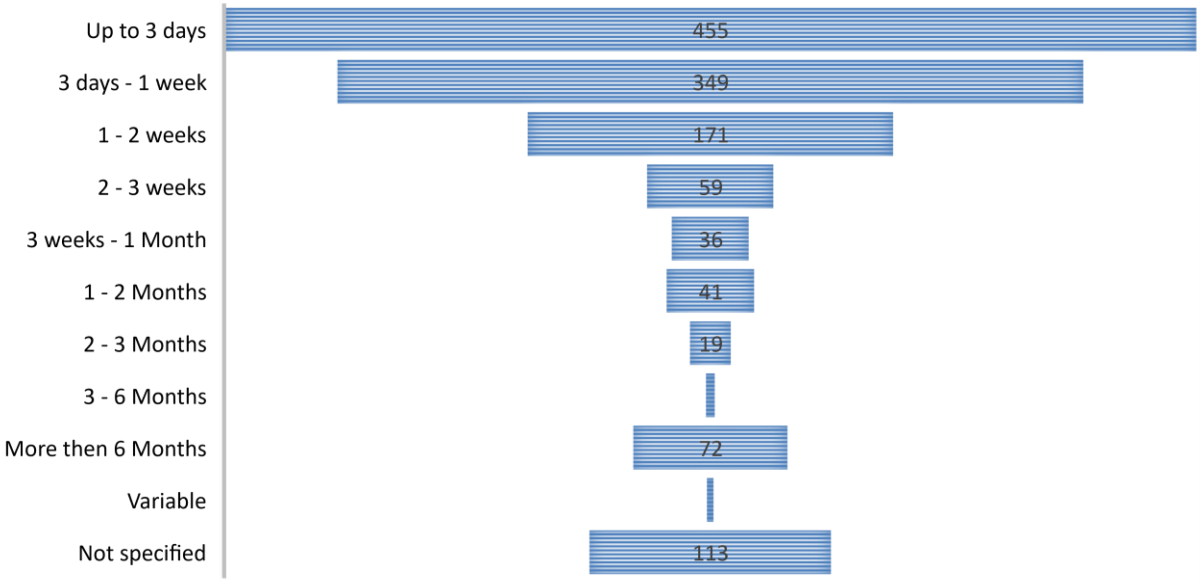


Figure 12: Time span of VET courses

The summary unveils that the compiled VET offerings encompass a blend of short-term and long-term courses. VET cases with durations of up to 3 days, between 3 days and one week, and between 1-2 weeks were the most prevalent, constituting a total of 75 % of all VET cases. Regarding long-term VET offerings, those spanning 6 months or more were the most common. Notably, 113 cases lacked specific duration information, while 3 cases exhibited variable course lengths.

Regarding the delivery of VET, Figure 13 can give a comprehensive overview. The findings reveal that 56 % of the VET cases are delivered as in-person courses with laboratory practicals or technical visits, while an additional 17 % are in-person with lectures only. In-person cases with hands-on education constitute just 4 %. In contrast, online and mixed VET cases have a smaller share, with online live sessions making up 2 % and e-learning and blended learning sessions each accounting for 1%. Although there is a strong trend of providing education online, it was concluded that the VET providers still prefer in-person delivery. Notably, 234 cases were not specified, indicating that the mode of delivery may vary from case to case.

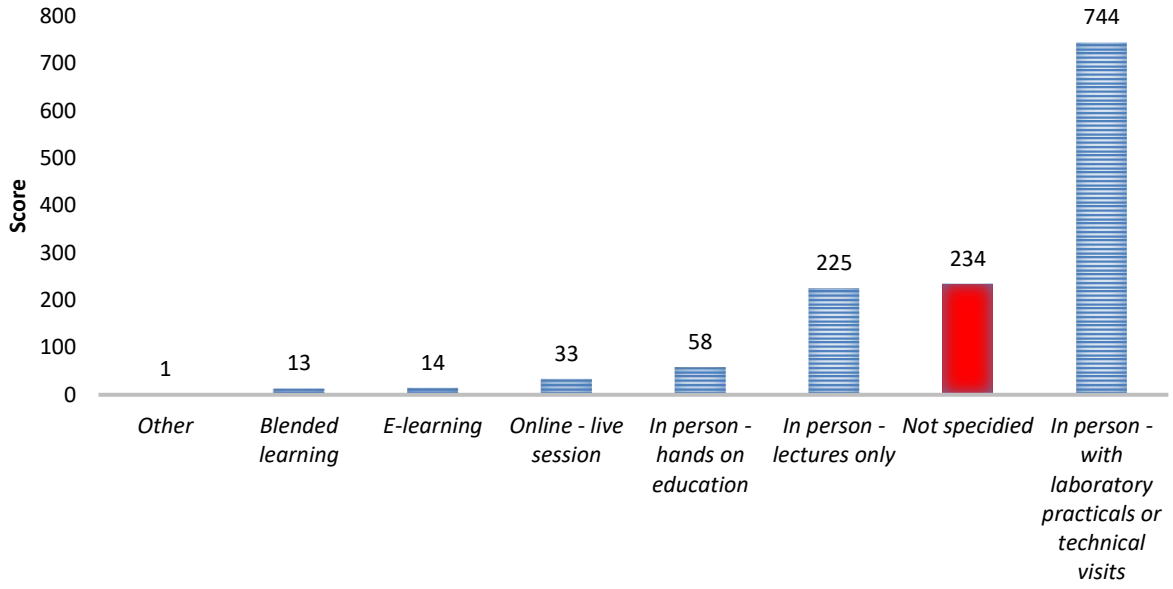


Figure 13: Delivery of VET courses

4.2.5 Qualification after completion and its recognition

An additional crucial aspect of VET delivery pertains to the qualifications obtained upon course completion and the recognition of certificates, if applicable. This information is summarized in Figure 14 for qualification methods and Figure 15 for certificate recognition. The findings indicate that certification is a component in the majority of VET cases. However, certification with examination accounts for only 12 %, and microcredentials make up just 7 %. The majority, 55 % of cases, involve VET courses with certification but without the need for examination. Additionally, there were 134 cases lacking specification, and 13 cases marked as "other" in this regard. In terms of recognition, 45 % of certificates hold international recognition, while 50 % have international recognition. Furthermore, 4 % is recognized within a specific company, and less than 1 % within a particular industrial sector.

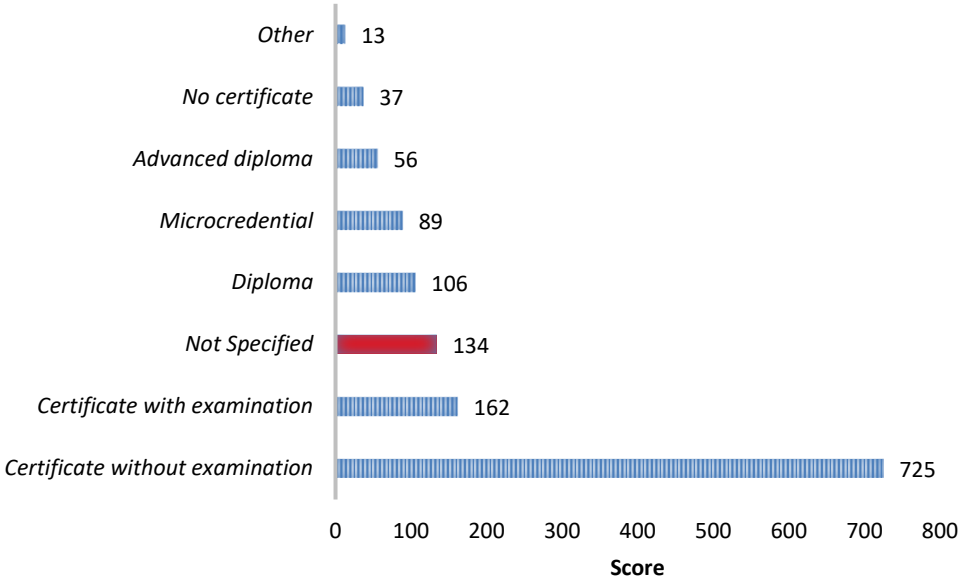


Figure 14: Qualification awarded after completing the VET course

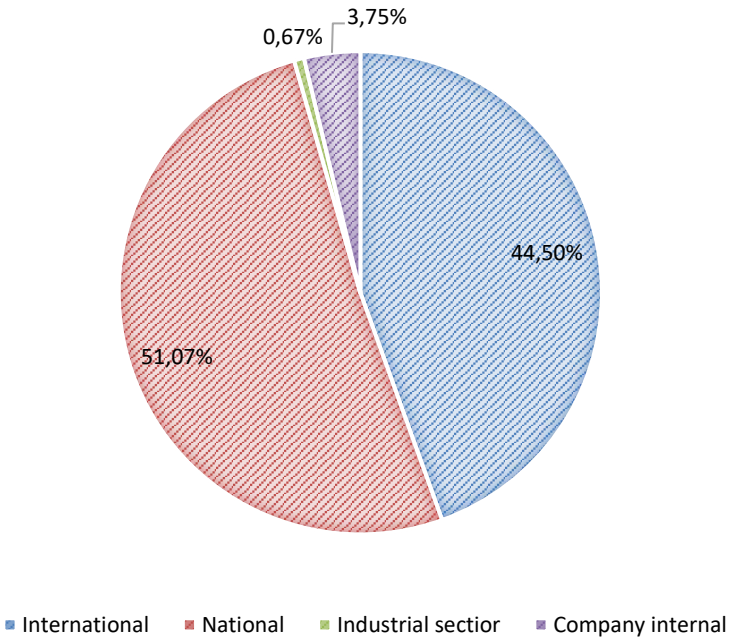


Figure 15: Recognition of VET completion certificates

4.2.6 Focus and specification of learning outcomes

According to the definition provided by IAEA [11], the emphasis on learning outcomes can be categorized into Knowledge, Skills, and Attitudes. The summary of the focus of the collected VET offerings is presented in Figure 16. It is evident that approximately two-thirds of the cases concentrate on a combination of Knowledge and Skills, with nearly 22 % emphasizing Knowledge alone and 5 % focusing solely on Skills. A minor 2 % of the VET cases incorporate methods to target Knowledge, Skills, and Attitudes simultaneously. Figure 17 illustrates that learning outcomes were clearly and extensively defined in only 20 % of the cases, while in more than 70% of the cases, they were defined to some extent. VET courses where learning outcomes were not specified at all represent only 3 %, and cases where no information is available account for an additional 4 %.

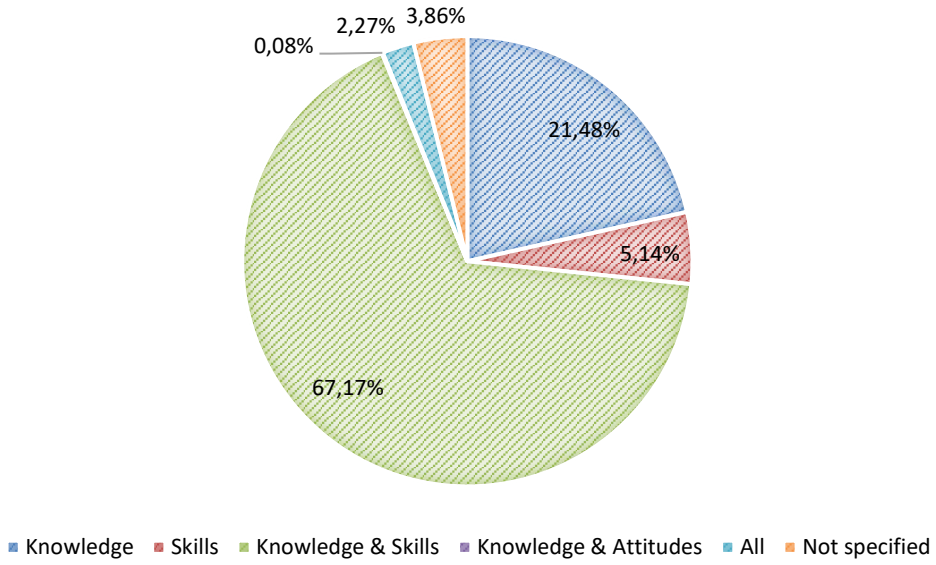


Figure 16: Focus of learning outcomes

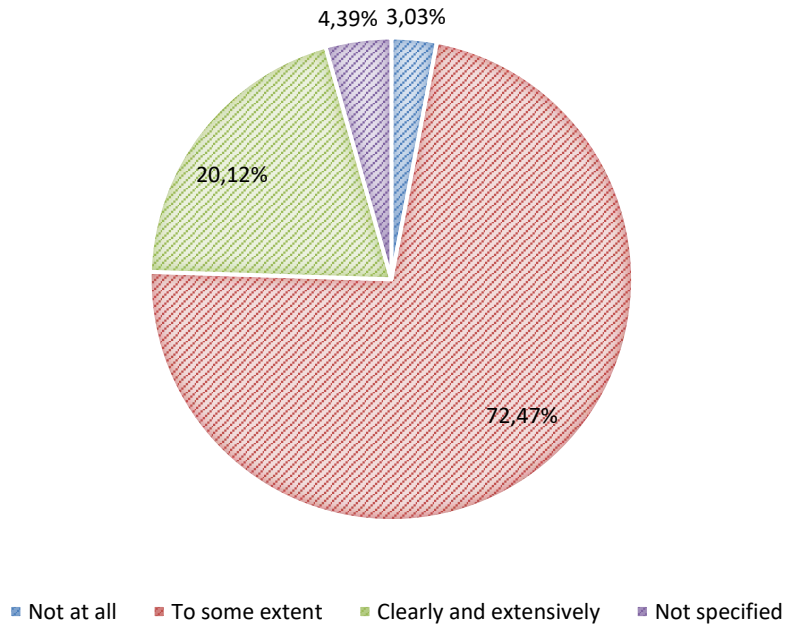


Figure 17: Specification of learning outcomes

4.3 Providers of VET in the EU

The database of VET providers consists of 290 entries, among which 161 offer specific VET cases included in the VET database. 92 % are specific legal entities and e 8% are associated with European projects. Within the category of legal entities, 32% are further or higher education providers, 30 % are companies, 13 % are schools or VET institutes, 15 % are categorized as others (agencies, national nuclear association) and 10 % not specified. Table 3 presents a list of European VET providers that offer at least 10 VET courses. This list encompasses companies and VET institutions from France, Spain, Germany, Italy, Sweden, Slovenia, Belgium, the Czech Republic, and Slovakia. Additionally, it includes European and international organizations such as the JRC and IAEA. For a comprehensive list of all VET providers, please refer to chapter 8.1 in the Annex.

Table 3: List of largest European VET providers

Company	Country	Number of VET cases
INSTN CEA	France	225
TECNATOM S.A.	Spain	121
Fortbildungszentrum für Technik und Umwelt	Germany	99
Framatome GmbH.	France	85
SOGIN GROUP. RADWASTE MANAGEMENT SCHOOL	Italy	56
CENTRO DE ESTUDIOS ENERGÉTICOS, MEDIOAMBIENTALES Y TECNOLÓGICOS (CIEMAT)	Spain	54
Jožef Stefan Institute (JSI)	Slovenia	33
ACPRO, ASESORÍA Y CONTROL EN PROTECCIÓN RADIOLÓGICA, SL.	Spain	29
KWS Energy Knowledge eG	Germany	27
KSU	Sweden	25
AIMPLAS	Spain	20
JRC/EC	EU	15
Italian Association of Radioprotection (AIRP)	Italy	14
Enusa Industrias Avanzadas S.A	Spain	13
IAEA	International	13
SCK CEN Academy	Belgium	13
SURO	Czech Republic	13
Vattenfall	Sweden	12
VUJE a.s.	Slovakia	12
Inforum	Germany	10
SOCIEDAD ESPAÑOLA DE FÍSICA MÉDICA	Spain	10
Universitat Politècnica de València	Spain	10

5 ANALYSIS OF THE CURRENT VET OFFER

The preceding chapter offers a comprehensive overview of the nature and specifics of over 1300 collected VET cases and their associated providers. In order to draw more robust conclusions, it is imperative that the gathered data undergo thorough analysis, with a focus on meeting the needs of European employers, individuals seeking vocational education and training, and gaining valuable insights into the quality and user-centric nature of information available on public web sources, from which the users can get all the necessary information. The analysis conducted in task 4.1 is designed to address these questions:

1. What domains lack sufficient nuclear vocational training?
2. Why is there fragmentation in nuclear training opportunities across the EU?
3. What barriers exist to establish a coherent and sustainable Euratom vocational training program?
4. To what extent do the current VET offerings inadequately cover the required competencies?

Answering these questions necessitates considering various aspects of VET, including the quality and user orientation of the collected offers, as well as the requirements of both the industry and individuals. The following chapters summarize each aspect of analysis.

5.1 VET quality analysis

Good visibility and user orientation are essential for VET providers to attract audience, meet their needs, maintain high quality, enhance employability, and establish a positive reputation. These factors contribute to the success and sustainability of the institution in a competitive education landscape. Therefore, the first step in the analysis of the available VET offer was the VET quality analysis focusing on the criterion of a valuable user orientation. Identifying VET providers in each EU country proved to be a challenging task. More importantly, when attempting to gather data encompassing all 73 attributes within the VET database solely from public websites, it became nearly impossible. Consequently, we narrowed our focus to a subset of attributes that allow to assess the user-orientation:

- Language and country of the venue.
- Type and qualification of the target audience.
- Type of nuclear domain.
- Time span and delivery of VET.
- Qualification after completion and its recognition.
- Focus and specification of learning outcomes.

To perform the evaluation, we have devised a methodology built upon these specific attributes. Each VET offering underwent an assessment based on these attributes, resulting in numerical scores spanning from 0 to 5. A score of 0 indicated an absence of data, while the highest achievable value represented full compliance with user-oriented criteria. Further elaboration on the scoring system is available in Table 4. Given that not all categories carry the same weight, the maximum attainable score varies depending on the case. Among these categories, those of utmost significance include language, target audience specification, core domain focus, qualifications post-completion, delivery methods, and the formulation of learning outcomes. If an "other" category was present, it was evaluated with a value of 1.

Table 4: Scoring system applied for VET quality analysis

Criteria	0	1	2	3	4	5
Language	Not specified			Any but English		English
Country	Not specified	Non-EU	EU			
Frequency	Not specified	Other	On-demand	Specified		
Target audience	Not specified			Specified roughly		Specified in detail
Level of education	Not specified			Specified		
Focus of learning outcomes	Not specified	All		Specified		
Outcomes destination	Not specified			Specified		
Nuclear domain	Not specified			Other		Specified
Qualification after completion	Not specified	No certificate		Any certificate		Micro credentials
Time span	Not specified			Specified		
Delivery method	Not specified	Other				Specified
Learning objectives specified	Not specified	Not at all		To some extent		Clearly and extensively
Recognition of certificate	Not specified		National	International		

The cumulative numerical values were then used to compute a total score for each VET offer, falling within the 0 to 50 range. Based on these scores, we assigned corresponding grades to the offers:

- 45 – 50 - A
- 40 – 44 - B
- 35 – 39 - C
- 30 – 34 - D
- 0 – 29 - E

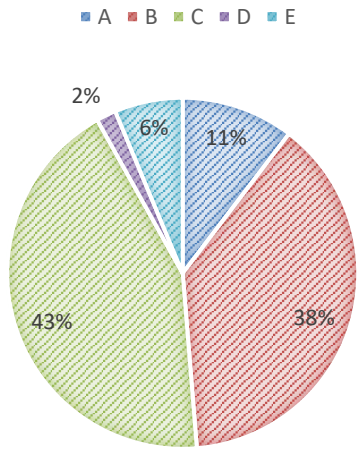


Figure 18: Overall results of the VET quality analysis

The overall results of the VET quality analysis are graphically depicted Figure 18. In a nutshell, these results are generally satisfactory, with nearly 50 % achieving a grade A or B. These cases were judged as "qualified". Nonetheless, a significant challenge arises from the insufficient user-orientation of many VET courses, with nearly 700 receiving grades of C or lower, and over 100 falling into the D or E range. To gain further insights, we can examine the *average-to-maximum* score ratios per category, as presented in Figure 19. These ratios assist in pinpointing the categories with the lowest and highest scores.

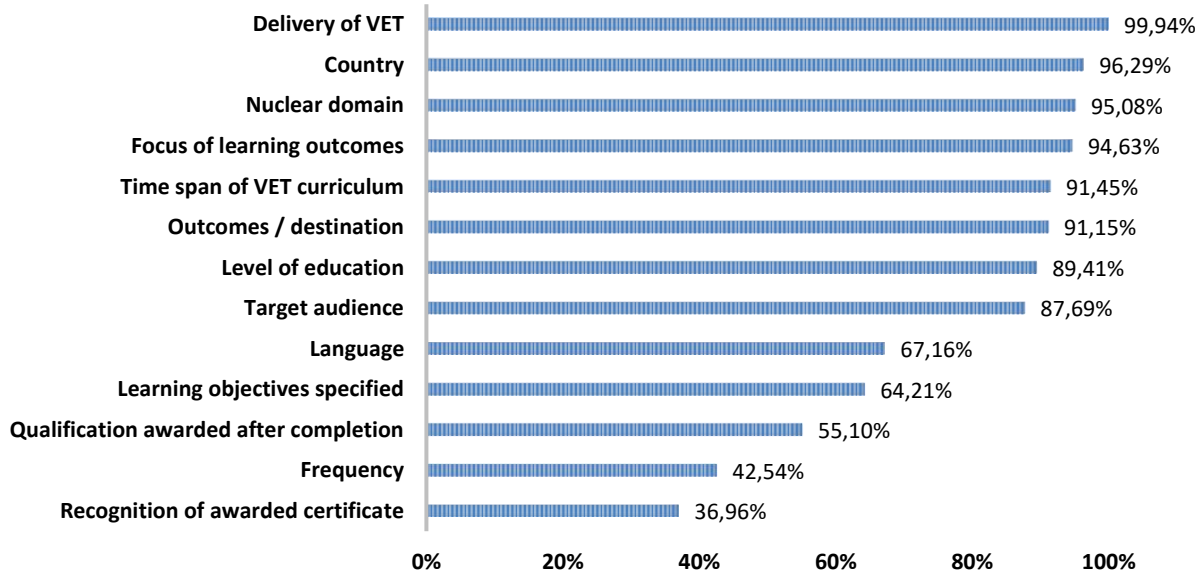


Figure 19: VET quality analysis - scores per individual category

It becomes evident that the issue of low user-orientation predominantly stems from missing information regarding the recognition of awarded certificates, frequency, qualifications granted upon completion, and the specification of learning objectives. Another notable obstacle is the limited availability of VET courses in English, which hampers international accessibility, with only 20 % of courses offered in this language. On a positive note, the data related to VET delivery, the country's nuclear domain, the focus of learning outcomes, and the time span of VET programs are well-detailed and accessible through public sources of the VET provider. The qualification ratio of VET cases, i.e., those with grade A or B, are presented in Table 5 as per nuclear domain.

Table 5: Qualification of VET cases per nuclear domain

Nuclear domain	Qualified cases	Qualification ratio [%]
Nuclear safeguards and forensics	26	89.66
Nuclear security	5	83.33
Radiation protection	150	80.65
Nuclear Energy	166	65.61
Nuclear materials	26	50.98
Nuclear safety	24	42.86
Medical applications	29	41.43
Nuclear Waste management	18	38.30
Decommissioning	2	33.33
Management in nuclear	3	30.00
Nuclear Fusion	0	0.00

The table reveals that the quality of information available for VET cases varies significantly across different nuclear domains. For instance, VET cases within the domains of nuclear safeguards and forensics, nuclear security, and radiation protection demonstrate a qualification ratio exceeding 80 %. Conversely, VET cases in the domains of nuclear waste management, decommissioning, and nuclear facility management exhibit a considerably lower ratio, falling below 40 %. Notably, in the domain of nuclear fusion, no cases met the criteria for classification with a grade of A or B.

5.2 Key nuclear jobs in the EU

In this section, we provide a comprehensive summary and analysis of the key nuclear jobs, primarily stemming from the efforts of WP1 task forces. These key nuclear jobs are evaluated in the context of the current VET offerings. Key nuclear jobs, in this context, refer to positions or roles within the nuclear industry that are of paramount importance, serving as the linchpin for the industry's operations, safety, and overall effectiveness. These positions occupy a central role in the functionality of nuclear facilities, research initiatives, and other facets of the nuclear sector. As the collected VET offer characterize the nuclear jobs as part of a specific nuclear domain, the analysis will also follow these domains.

It's important to acknowledge that the activities within WP1 were primarily focused on job positions, without taking into consideration whether individuals meet the qualifications for these positions through regular education (such as university studies), specific E&T courses, or VET. Furthermore, the report (see [12]) offers a projection of the total number of new recruits required to offset retirements and support new NPP operations and construction. However, these projections lack a breakdown into specific job categories.

Therefore, when analysing WP1 data, we needed to make certain assumptions. Specifically, we divided the total numbers of new positions based on the anticipated distribution of positions in 2023 and 2035. Additionally, since there is no available information regarding the share of VET job positions within the total number where the required basic competences could be developed through VET, we established various scenarios to account for this gap in data. These cases are the following:

1. CASE 1 – All job-related competences are developed by C-VET
2. CASE 2 – The portion of C-VET was assumed per each position separately:
    a. Positions with competences to be developed by C-VET: specialists, technicians, support staff.
    b. Positions with competences to be developed by university education: engineers, physicians, managers, scientists, etc.

When analysing the WP1 data based on the current VET offer, we made the following assumptions on the side of VET offer:

- The VET provider must be qualified, according to chapter 5.1.
- The VET case is in English.
- The VET case is in-person.
- The time span of VET course is the average in the nuclear domain.
- The maximum number of participants per VET course is 20.
- There are 230 working days per year.
- The VET cases are repeated over the whole year.
- The increase in new positions between 2023 and 2035 is linear.

In accordance with these assumptions, we have calculated the VET training capacities for specific nuclear domains, which are detailed in Table 6. These number represent the maximum capacity and are founded on the data compiled and presented in Chapter 4.2. We have considered a scenario where each qualified VET provider, capable of delivering in-person training in English, conducts a VET program throughout the entire year.

Table 6: Estimated VET capacities per nuclear domain

Nuclear domain	Yearly training capacity [k]	Personnel trained by 2035 [k]
Medical applications	1.38	16.56
Radiation protection	4.60	55.20
Nuclear Energy	33.00	396.00
Nuclear Waste management	3.84	46.08
Nuclear materials	3.04	36.48
Decommissioning	1.52	18.24
Nuclear Fusion	0.00	0.00
Nuclear safety	3.80	45.60
Nuclear security	0.00	0.00
Nuclear safeguards and forensics	4.16	49.92
Management in nuclear	0.00	0.00

It is important to highlight that these numbers are constructed upon a set of assumptions, and for a more accurate estimate, a collaborative dialogue with VET providers is warranted. Regrettably, since we have not collected information regarding the capacities of VET providers, these figures serve as a justified evaluation based on the outcomes of WP1.

Considering that the activities within WP1, which concentrate on addressing human resources needs in the EU, are categorized into three distinct segments, our summary within this chapter will align with this categorization.

5.2.1 Key nuclear jobs in the nuclear industry

The activities of the Task 1.1 in WP1 were wrapped round providing an overview of the human resources (HR) situation within the nuclear industry, from front-end fuel cycle to back-end used fuel management, including nuclear supply chains, with the aim of anticipating needs up until 2035. The nuclear industry is represented through five activity segments, namely:

- Utilities.
- Fuel fabrication, enrichment, supply and cycle.
- Design, engineering, manufacturing, and maintenance.
- Transport.
- Other.

The information related to the HR situation were collected through a literature review, national nuclear policies, and a targeted survey, developed within WP1 in cooperation with the T1.2 taskforce. The scope of the survey covered the EU27 + UK, however the study was limited to companies located in the ENEN2plus project and in the networks of Nuclear Europe. As a consequence, the responses in the survey cover only 8 countries [12].

The T1.1 activities focused on both direct and indirect jobs. While direct jobs could be estimated with rather high accuracy, the number of indirect jobs has a higher margin of uncertainty due, among other factors, to variability in job roles within supply chains. Modelling was also used as a complementary approach to surveying to account for

potential gaps in the data, and existing models for HR in the operational phase of NPPs were adapted. In addition, different scenarios were introduced to account for possible evolutions of HR needs. In the T1.1 activities skills are defined as the specific abilities and expertise possessed by an individual that enable them to effectively perform the core competencies and functional competencies required for a particular job. Jobs are aligned with EHRO-N's job classification, which means that several functions or functions with similar characteristics were grouped under a common job type [12].

Regarding the quantitative outputs of T1.1, addressing the need to replace retiring workers and maintain the sector's current capacity, it is projected that approximately 175,000 jobs will need to be recruited by 2035 in the EU27+UK, with 70,000 to 80,000 of those being direct jobs. These numbers were found out based on assuming roughly ten new NPPs to be built [12]. Based on these numbers and the share of nuclear domains the estimated new recruitment per nuclear domain can be summarized in Table 7.

Table 7: Estimated new recruitments per nuclear domain in 2035

Nuclear domain	Share on new recruitments	New direct jobs in 2035 [k]	New indirect jobs in 2035 [k]
Nuclear energy	48 %	33.58	50.38
Management in nuclear	17 %	12.14	18.21
Nuclear waste management	9 %	6.47	9.71
Radiation protection	7 %	4.86	7.28
Decommissioning	7 %	4.86	7.28
Nuclear safety	4 %	2.83	4.25
Nuclear security	2 %	1.62	2.43
Medical applications	2 %	1.21	1.82

The comparison of types of jobs in demand between the year 2023 and 2035 are shown in Figure 20. In terms of qualitative outputs, the numbers indicated that certain roles will be in high demand.

Alongside the persistent high demand in the 'other' category, which encompasses in-demand positions like welders and boilermakers, project managers are emerging as the most in-demand roles. Furthermore, there will be a requirement for process engineers, operators, and construction engineers. Additionally, expertise in nuclear-specific fields, such as radiation protection, remains critically important in the industry. However, some positions, like radiochemistry, process engineering, and reactor physics, show potential declines in demand, as indicated by the collected data [12].

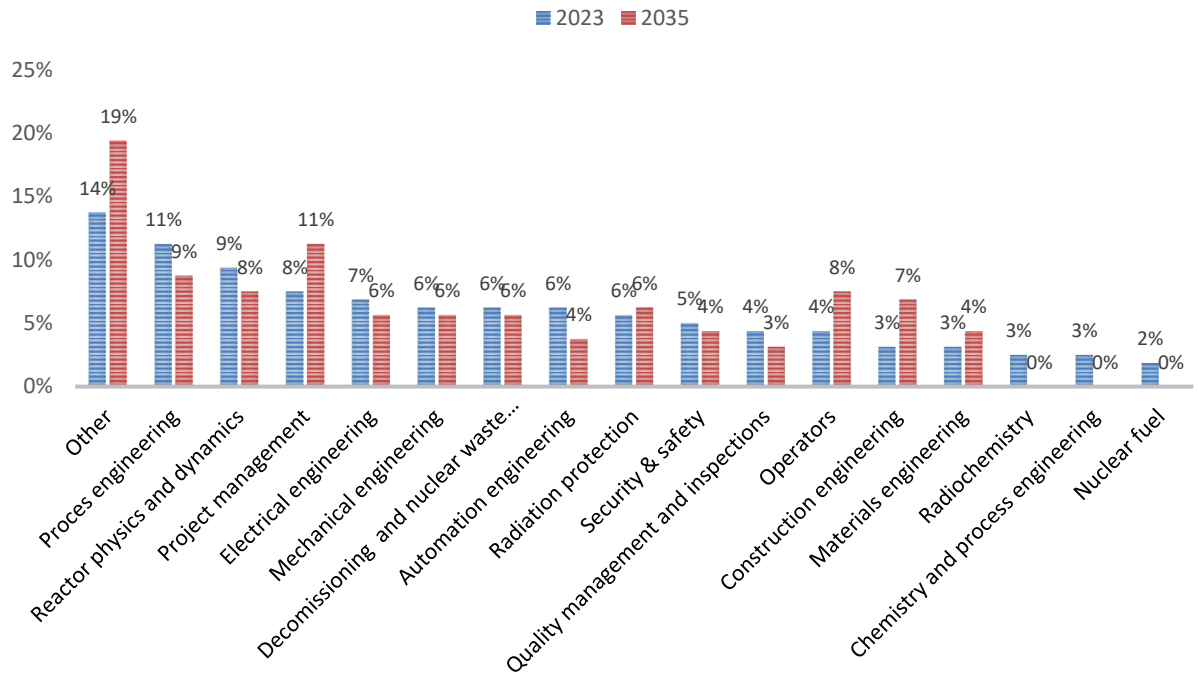


Figure 20: VET Types of jobs in demand [12]

According to [12] the HR demand in the individual activity segments is as follows:

- ***Utilities***:
  - The ”other” category that includes welders, fitter, boilmakers, etc., will be the most sought job category. Engineering positions (process, mechanical, electrical) and reactor physicists will also be in high demand.
  - The “other” category could be covered by VET provided by the utilities.
- ***Fuel fabrication, enrichment, supply, cycle***:
  - The “other" category, along with process engineers, reactor physics and dynamics specialists, and security and safety roles will have an increase.
  - The possibility of company internal VET also applies here.
- ***Design, engineering, manufacturing and maintenance***:
  - the most sought-after jobs currently include process engineers, roles falling under the "other" category, reactor physics and dynamics specialists, as well as positions related to Decommissioning, R&D, and nuclear waste management.
  - Additionally, project management roles, process engineers, and construction engineers will also be in demand.
- ***Transport:***
  - the most sought-after jobs currently involve roles in the "other" category, process engineering, and radiation protection.

In general, the prevailing trends indicate a rising demand within the "other" category, encompassing a diverse group of technical and trade professionals, across various segments within the nuclear sector. Furthermore, the forthcoming decade is projected to witness heightened demand for roles in project management and specific engineering positions, including process engineers and reactor physics specialists [12].

5.2.2 Analysis of key nuclear jobs in the nuclear industry

The analysis of critical job positions within the nuclear industry was conducted by leveraging the job categories outlined above, the total number of direct jobs within each specific nuclear domain, as detailed in Table 7, and the contribution of C-VET in covering these specific nuclear roles, as elucidated in section **Chyba! Nenalezen zdroj odkazů.**. This demand for Vocational Education and Training was translated into two scenarios: the first scenario assumed a 100% coverage of the demand for new nuclear jobs through C-VET, while the second scenario considered a specific share of C-VET for each nuclear domain. The allocation of C-VET within the second scenario was established based on the job positions designated as "top nuclear jobs" in 2035 within the WP1 questionnaire. Table 8 offers a comprehensive comparison of the projected demand for VET in 2035 and the existing VET capacity. The assumptions pertaining to VET capacity are rooted in the principles listed in section **Chyba! Nenalezen zdroj odkazů.**.

Table 8: Comparison of the demand of nuclear industry for VET in 2035 and the current VET capacity

Nuclear domain	Demand - CASE 1 [k]	Demand – CASE 2 [k]	Annual VET capacity [k]
Nuclear Energy	33.58	12.70	33.00
Management in Nuclear	12.14	8.50	0.00
Nuclear Waste Management	6.47	4.86	3.84
Radiation Protection	4.86	4.05	4.60
Decommissioning	4.86	3.24	1.52
Nuclear Safety	2.83	1.21	3.80
Nuclear Security	1.62	0.81	0.00
Medical Applications	1.21	1.21	1.43
Nuclear Materials	1.21	1.21	3.04
Nuclear Fusion	0.00	0.00	0.00
Nuclear safeguards and forensics	0.00	0.00	0.00

The data provided in the table highlights that in CASE 1, where all job positions are filled through C-VET, in line with a growing trend in certain EU countries, the current annual VET capacity would suffice for the *Nuclear Safety*, *Medical Applications*, and *Nuclear Materials* domains. In the more practical scenario, CASE 2, it becomes evident that the *Nuclear Energy* and *Radiation Protection* domains could also be adequately addressed. Nevertheless, there exists a noticeable shortfall in VET capacity to meet the demand within the *Management in Nuclear*, *Nuclear Waste Management*, *Decommissioning*, and *Nuclear Security* domains. Notably, for *Management in Nuclear* and *Nuclear Security*, where no qualified VET programs currently exist, addressing the demand necessitates the creation of new VET offerings. It's worth mentioning that N*uclear Fusion* and *Nuclear Safeguards* and forensics were excluded from the analysis due to the absence of indicated demand within these domains.

In the case of the remaining nuclear domains, fulfilling the requisite job demands within the nuclear industry would necessitate ongoing VET training efforts, involving the following initiatives:

- Nuclear Energy – 0.38 – 1.02 years
- Nuclear Waste Management – 1.27 – 1.69 years
- Radiation Protection – 0.88 – 1.06 years
- Decommissioning – 1.86 – 3.19 years

The years required to develop the competencies through VET were calculated based on Table 8 as the demand for new direct jobs in 2030 divided by the estimated annual capacity of VET providers.

5.2.3 Key nuclear jobs in nuclear research, safety and waste management

The key nuclear jobs in nuclear research, safety and waste management were identified based on the activities of the Task 1.2 in WP1, which were wrapped round providing an overview of the HR situation in these areas, with the aim of anticipating needs up until 2035. The target audience of Task 1.2 was represented through the following activity segments, namely [13]:

- Nuclear R&D
- Nuclear Decommissioning and Waste Management
- Nuclear Regulators (Safety and Security)

Regarding the methodology used in Task 1.2, data was gathered via the targeted survey thoughtfully prepared in close collaboration with T1.1, as explicitly outlined above. To enhance the depth of findings, data analysis from the responses was complemented by an extensive review of relevant literature. In instances where survey responses were limited, and a low response rate prevailed, we employed benchmarking and extrapolation techniques to facilitate cross-country comparisons and assessments, particularly within the EU framework. This approach was notably applied to waste management organizations, companies, and safety organizations [13].

Just as in the nuclear industry, the primary goal of Task 1.2 was to scrutinize the current and anticipated human resource requirements within the EU27 + UK region. This analysis centred on institutions engaged in the operation of research reactors, nuclear waste management entities, regulatory authorities, and technical safety organizations. The survey was meticulously designed to target 132 organizations actively involved in nuclear research and facility operation. Out of the 132 emails dispatched, a total of 30 responses was received, resulting in a response rate of 23 % [13].

As it was a challenge to obtain precise data on the nuclear workforce, it is foreseen that a National Nuclear Workforce Assessment (NWA) could be a key instrument for gaining a comprehensive grasp of both existing and forthcoming human resource requirements. It facilitates an understanding of the available skills and competencies, the identification of potential mismatches between supply and demand, and the formulation of a strategic action plan featuring corrective measures. The number of new jobs in the EU27 + UK was estimated to approximately 52,500 jobs. Indirect jobs supported through the supply chains were assumed to be similar in number, bringing the total to over 100,000 jobs. To sustain current operations, these sectors will require over 30,000 additional jobs by 2036 just to compensate for retirements [13].

The structure of the jobs is the following:

- *Nuclear R&D (Including TSOs and research reactors):*
  - Direct new jobs: 22,500.
  - Direct jobs to replace retirement:13,000.
  - Indirect jobs: 20,500.
- *Nuclear Decommissioning and Waste Management:*
  - Direct new jobs: 25,000.
  - Direct jobs to replace retirement:14,500.
  - Indirect jobs: 22,500.
- *Nuclear Regulators (safety and security):*
  - Direct new jobs: 5,000.
  - Direct jobs to replace retirement:3,000.
  - Indirect jobs: 8,000.

5.2.4 Analysis of key nuclear jobs in nuclear research, safety and waste management

The analysis of pivotal job roles within nuclear research, safety and waste management followed a methodology similar to that outlined in Chapter 5.2.2. Once again, we computed the demand for C-VET within two distinct scenarios. In the second scenario, the allocation of C-VET was determined by referencing job positions identified as the "top nuclear jobs" in 2035, as outlined in question 9 of the WP1 survey. This allocation was further refined based on the number of new job openings within each activity segment. Table 9 offers a comprehensive comparison of the demand and VET capacity pertaining to the new job positions in nuclear research, safety, and waste management anticipated for 2035. It's worth noting that the table exclusively encompasses direct jobs, as obtaining data on the distribution of indirect jobs within nuclear domains presented significant challenges.

Table 9: Comparison of the demand of nuclear research, safety and waste management for VET in 2035 and the current VET capacity

Nuclear domain	Demand - CASE 1	Demand – CASE 2	Annual VET capacity
Nuclear Energy	28.11	11.86	33.00
Nuclear Safety	12.98	12.02	3.80
Nuclear Waste Management	10.28	10.28	3.84
Radiation Protection	10.11	7.01	4.60
Management in Nuclear	8.37	5.82	0.00
Decommissioning	6.05	6.05	1.52
Nuclear Security	4.94	4.46	0.00
Medical Applications	1.43	1.43	1.38
Nuclear Materials	0.24	0.00	3.04
Nuclear Fusion	0.00	0.00	0.00
Nuclear Safeguards and Forensics	0.00	0.00	4.16

The outcomes revealed that the annual VET capacity aligns with the demand only for the *Nuclear Energy* and *Nuclear Materials* domains. In contrast, *Management in Nuclear*, *Nuclear Security*, and *Nuclear Fusion* currently lack sufficient capacity, necessitating the development of new VET programs. On the flip side, *Nuclear Safeguards and Forensics* possess available capacities, but no demand has been indicated by research centres, safety organizations, or waste management companies. For the remaining nuclear domains, achieving the estimated numbers of skilled personnel is contingent upon proactive and continuous training, necessitating concerted efforts. The time required to develop the required competencies was calculated based on Table 9 as follows:

- *Nuclear Safety – 3.16 – 3.42 years.*
- *Nuclear Waste Management – 2.68 years.*
- *Radiation Protection – 1.52 – 2.2 years.*
- *Decommissioning – 3.98 years.*
- *Medical Applications – 1.04 years.*

It's evident that bridging the gap in nuclear job positions for the domains would necessitate ongoing VET efforts extending over a period of up to 4 years. It's important to acknowledge that these capacities do not account for industry demands. Consequently, certain portions of the training capacity may have already been allocated to meet industry requirements, potentially extending the required timeframe even further.

5.2.5 Key nuclear jobs in nuclear non-power applications

Key nuclear job positions within the realm of non-power utilization of nuclear energy were discerned through the endeavours of Task 1.3 in WP1. A diverse array of non-power applications harnesses radioactive elements or radiation rays, and Task 1.3 was primarily geared toward evaluating workforce requirements for a range of non-power applications employing ionizing radiation. While the focus of Task 1.3 predominantly revolved around non-power applications in the medical sector, encompassing both therapeutic and diagnostic applications, there were also minor connections to radiation protection and nuclear materials. The scope of the task acknowledged the potential emergence of other non-power applications in fields such as space or agriculture in the future.

In terms of methodology a procedure based on literature review with secondary data sources and application of targeted surveys was adopted. The documents and reports included in the literature review consisted of the following:

- reports about human resources compiled by international organisations (containing information about targeted professional categories for EU countries,
- reports from EU projects containing relevant information on human resources for the targeted professional categories and associated applications,
- reports from national authorities or professional associations about human resources for the targeted professional categories and associated applications in specific countries [14].

The second source of information was derived from survey results, with two distinct surveys being employed. The first survey, conducted by EFOMP at the conclusion of 2022 on behalf of various European projects addressing workforce matters pertaining to Medical Physics Experts at the EU level, furnished valuable data concerning the state of Medical Physics Expert professionals and their requisite competency levels. The second survey was conducted by Task 1.2 within the ENEN2plus project, focusing on the human resource requirements of research centres, waste management entities, and safety operators [14].

5.2.6 Analysis of key nuclear jobs in nuclear non-power applications

The D1.3 report revealed that there are an estimated 10,000 medical physicists employed across EU countries, constituting approximately 4% of the total nuclear workforce. These figures encompass all medical specialties within the realm of medical physics, spanning radiology, radiotherapy, and nuclear medicine. Notably, the increasing prominence of radionuclide therapies in nuclear medicine is anticipated to exert a significant influence on the recruitment of professionals, such as medical physicists, radiopharmacists, and radiochemists, by various entities engaged in this field [14].

It is anticipated that by the year 2035, the field may undergo an expansion of up to 10%, potentially resulting in the creation of approximately 1,000 new job positions. An examination of the workforce demographics revealed that 7 % of the existing staff is set to retire within the next 5 years, with an additional 22 % falling in the age group above 51 years [14]. Considering the above mentioned, it is foreseeable that there will be a need for an additional 10 % of the current workforce to offset retirements. Consequently, in the analysis of key nuclear job positions, it is justifiable to anticipate a demand for approximately 2,000 new employees in the medical sector by the year 2035.

It has been determined that a minimum entry level for medical physicists typically entails a BSc degree in physics or equivalent qualifications. The duration of specialty training programs for medical physicists exhibits significant variability, ranging from 1 to 7 years, depending on the country, with an average duration of approximately 3.2 years. During this training period, the practical component, conducted within a suitable clinical environment, typically spans 25 % to 75 % of the total duration. Upon completion of training and qualification as a medical physics expert, continuous Vocational Education and Training for professional development is widely regarded as mandatory. Given these considerations, the anticipated increase in staff by 2,000 employees would necessitate C-VET activities to cater to the needs of the entire workforce. With an annual VET capacity in medical applications estimated at 1,430 individuals, it is plausible to meet the demand for 2,000 employees through the existing infrastructure, ensuring a reasonable level of coverage.

It's important to highlight that qualitative results were exclusively obtained for the field of medical physics. Consequently, drawing definitive conclusions regarding whether the entire domain of non-power applications can be accommodated by the current VET offerings is not feasible at this stage. To gain a more comprehensive understanding of this subject, further qualitative analysis is required, extending to areas such as the space and agricultural sectors.

5.2.7 Summary of VET demand and capacity over all sectors

The summary of VET capacity expressed in years required to meet the demand for nuclear jobs in 2035 is presented in Table 10. The values presented in the table were computed based on the estimated VET capacity and the demand expressed through two distinct scenarios, namely CASE 1 and CASE 2. Within the table, nuclear domains are arranged in ascending order based on the duration required to train the target personnel. It is anticipated that a time frame of up to 3 years between the completion of training and commencing the actual job is deemed acceptable. Consequently, nuclear domains with training periods of up to 3 years are considered adequately covered. For domains where numerous VET opportunities are already available, but the required training duration exceeds 3 years, they are categorized as "to be improved." In cases where there are limited to no VET courses available, yet a demand for VET persists, these domains are classified as "Critical."

Table 10: Capacity of VET expressed in years required to meet the demand

Nuclear domain	CASE 1 [year]	CASE 2 [year]	Coverage
Nuclear Materials	0.48	0.40	Sufficient
Nuclear Energy	1.87	0.74	Sufficient
Medical applications	3.25	3.25	Sufficient
Radiation protection	3.32	2.47	Sufficient
Nuclear safety	4.16	3.48	To be improved
Nuclear Waste management	4.36	3.94	To be improved
Decommissioning	7.18	6.11	To be improved
Management in nuclear	N/A	N/A	Critical
Nuclear Fusion	N/A	N/A	Critical
Nuclear safeguards and forensics	N/A	N/A	Critical
Nuclear security	N/A	N/A	Critical

The table reveals that the domains of *Nuclear Materials*, *Nuclear Energy*, and *Medical Applications* are adequately covered. *Nuclear Safety*, *Nuclear Waste Management*, and *Decommissioning* are covered to some extent but require improvements. According to the gathered VET data, domains such as *Management in Nuclear*, *Nuclear Fusion*, *Nuclear Safeguards and Forensics*, and *Nuclear Security* either lack available VET programs or have VET offerings that did not meet the quality assessment. Therefore, these specific nuclear domains demand substantial enhancement to align with the anticipated growth of the nuclear sector.

It's essential to acknowledge that the VET providers' capacity, as presented in this report, represents a theoretical maximum, and may vary significantly in practice. Several factors contribute to this variation, including the multiplicity of VET providers claiming competencies in various nuclear domains, potentially inflating the capacity values. However, the actual capacity to implement specific courses may be substantially lower. Additionally, the resources, infrastructure, and human capacity on the side of VET providers can significantly impact their ability to offer VET programs. Therefore, and considering indirect jobs, which were excluded from this analysis, the real gap between VET demand and offer may be significantly higher than presented in the table.

Furthermore, it's worth noting that the collection of VET offer is an ongoing process, and there may exist VET programs that were not included in the analysis. The ENEN2plus project and the WP4 taskforce did not cover the whole EU and all nuclear domains. Lastly, the assumption regarding the proportion of VET's role in covering job positions was made based on subjective judgment. To arrive at final conclusions and define the subsequent steps for improving the VET landscape in the EU, it is imperative to meticulously analyse the data, engage in discussions with all stakeholders, and initiate a dialogue with VET providers to verify the accuracy of the information extracted from their public sources.

5.3 VET needs of European employers and learners

5.3.1 Detailed results of the WP1 survey on HR needs

In addition to identifying key nuclear job positions, the WP1 questionnaire yielded valuable insights into various aspects of nuclear employers' requirements concerning VET courses and providers. The survey encompassed details about the participating companies, including their size, specific nuclear domain, staff composition, hiring projections, and, notably, their preferences for specific VET programs. The surveyed companies represented a diverse spectrum of sectors, including utilities, fuel fabrication, enrichment and supply, waste management and decommissioning, design engineering and maintenance, R&D institutes, TSOs, regulatory authorities, and transportation-related firms. 29% of them are involved in nuclear new-built projects, 44.9 % in NPP operation and 26.1% in decommissioning and nuclear back-end. Their organizational distributions across the nuclear domains is illustrated in Figure 21.

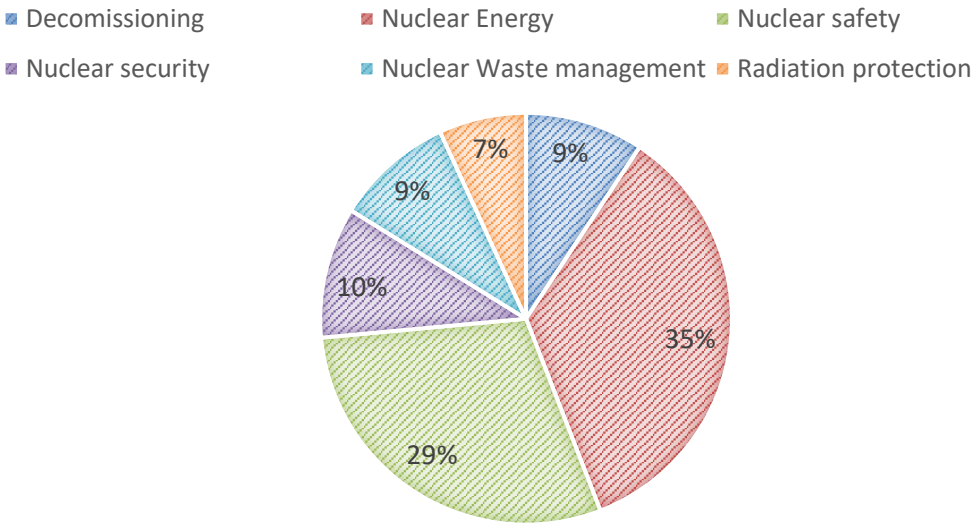


Figure 21: Nuclear domains of the companies involved in the WP1 survey

Since the primary focus of the WP1 survey was not the assessment of the VET offerings, extracting relevant information from the survey proved to be occasionally challenging. To align the data from the survey with the VET database, adjustments were made, guided by the task force's subjective evaluation. Consequently, the results and conclusions drawn from the WP1 survey contain a degree of uncertainty. The subsequent VET analysis was based on the following questions from the WP1 survey:

1. How many employees do you currently employ and how many do you foresee will be required in the future? What is their educational level?
2. Which main areas of nuclear education & training are most important for your organization? And which method of delivery do you prefer?
3. What type of VET training would your organisation / employees prefer?
4. What level of recognition of VET training does your organisation prefer?

The companies participating in the survey currently employ a total of 13,476 individuals, and their distribution by company size is depicted in Figure 22. Notably, the survey reveals a nearly equal representation of micro, small, medium, and large companies. Furthermore, Figure 23 illustrates the educational qualifications of these employees using the EQF scale and provides a projection for the year 2035.

The data indicates a slight anticipated increase in the EQF 7-8 category and EQF 6 category, while a decrease is foreseen in the EQF 4-5 category. This finding bears significant relevance to the design and focus of VET courses, particularly in terms of the educational levels they target.

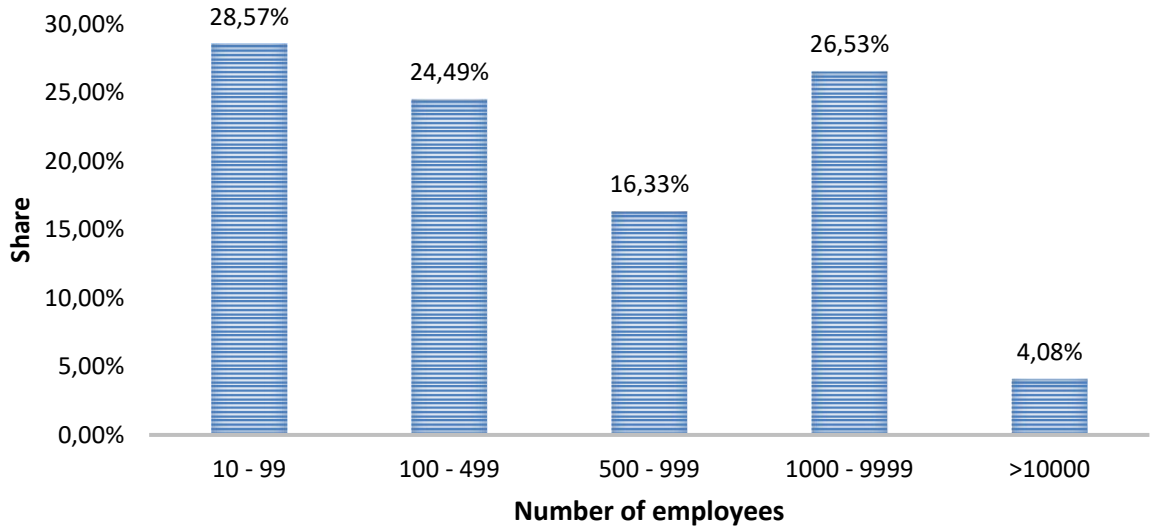


Figure 22: Distribution of companies involved in the WP1 survey in terms of their size

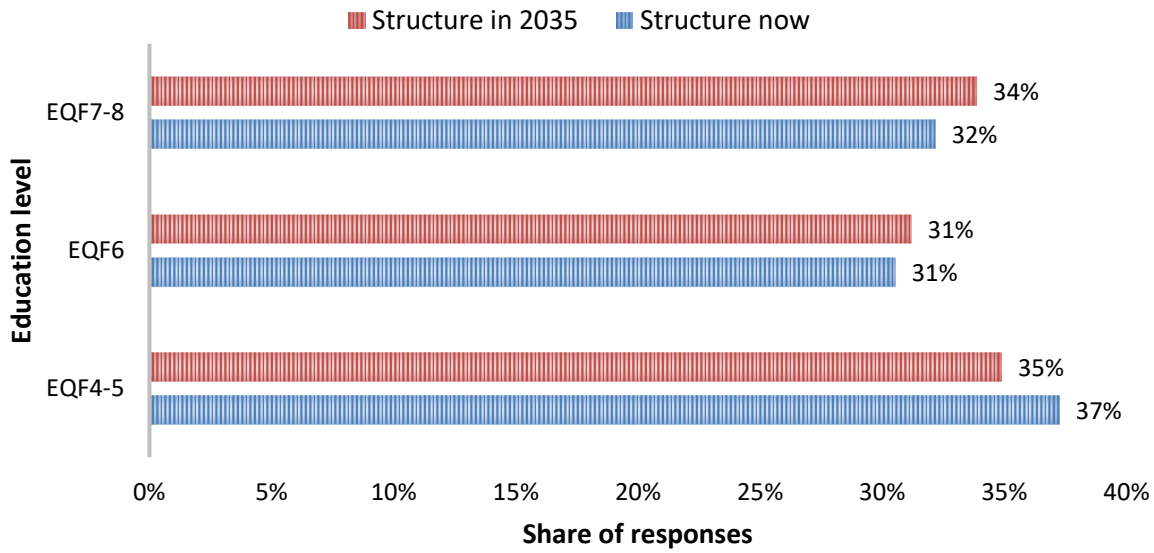


Figure 23: Distribution of the education level of companies´ staff involved in the WP1 survey

Another crucial aspect of European nuclear employers' demand pertains to the structure of VET programs and the potential examinations required for certification. Figure 26 presents a comparison between the available VET offerings, extracted from the VET database, and the preferences of employers. The comparison reveals that the demand for VET programs consisting solely of lectures is close to the available offer. However, a significant disparity becomes evident in cases involving laboratory practicals, technical visits, and hands-on education. While there is a notable demand for VET programs (42 %) that incorporate hands-on activities, only a mere 5 % of the existing offerings include such practical components. Conversely, cases featuring laboratory practicals and technical visits are overrepresented, with the supply exceeding demand threefold. Therefore, it becomes evident that in the future, VET providers should place a stronger emphasis on incorporating hands-on education to better align with the preferences of employers.

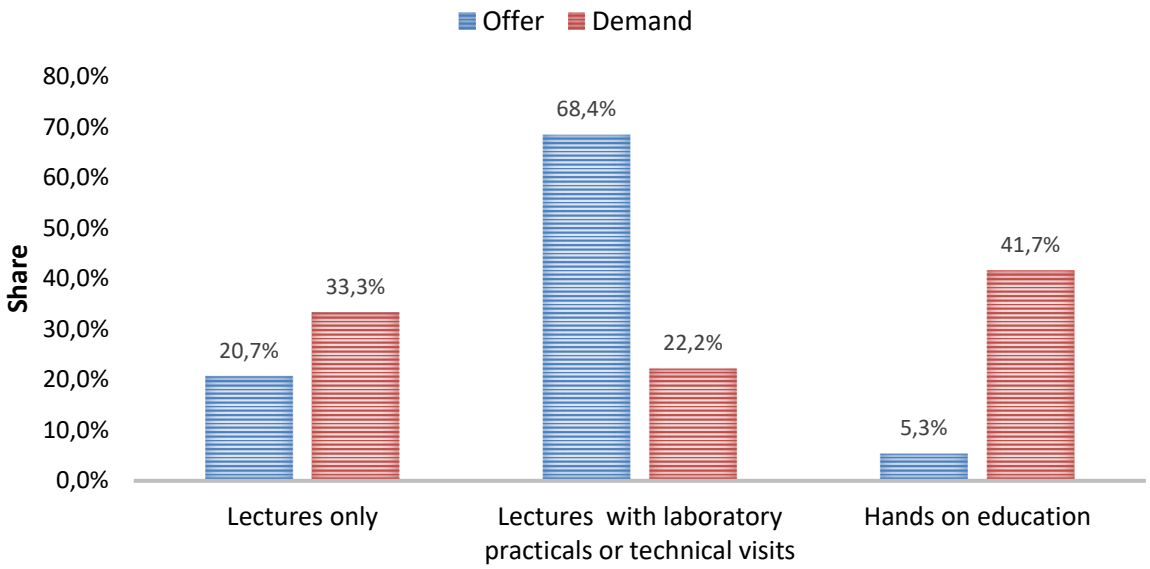


Figure 24: Comparison of the offer and the demand in terms of the structure of VET cases

Figure 25 illustrates the comparison between the supply and demand concerning the examination requirements for participants of VET courses to obtain certificates. Notably, cases without examinations are prevalent in both the available supply and the expressed demand. However, the data reveals that nuclear employers have a preference for more cases with assignments and a reduced reliance on formal examinations compared to the current offerings.

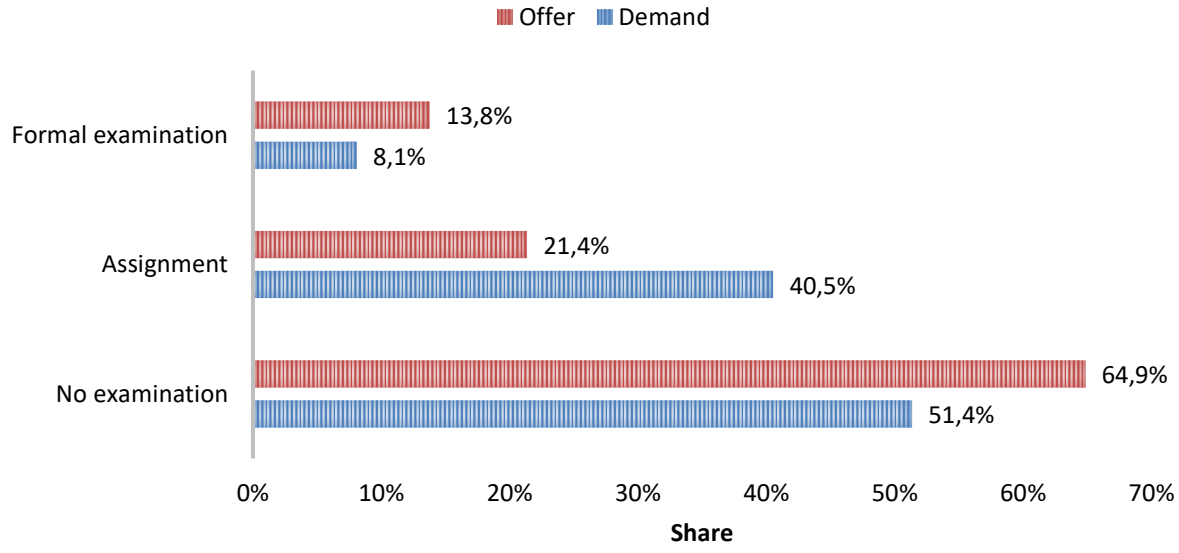


Figure 25: Comparison of the offer and the demand in terms of examination

5.3.2 Findings of the WP4 survey for VET users

Simultaneously, we conducted a questionnaire campaign that was published on social media and distributed through newsletters. This questionnaire allowed for anonymous responses, aiming to capture the needs, opinions, and comments of individual learners regarding vocational training in the nuclear sector. Here the primary target was gathering data related to the structure and content of the VET database and allowing sufficient evaluation.

The questionnaire consisted of the following parts:

1. Current nuclear domain
2. Occupation
3. Need for VET
4. Topics of VET
5. Level of VET
6. Duration of VET
7. Relation of VET and the current job position
8. Language of VET
9. Delivery of VET
10. Difficulty of finding VET offers
11. Channels of information sharing about VET offers

In total, 150 responses were collected. The distribution of respondents in terms of nuclear domains are shown in Figure 26. Figure 27 presents a comparison between the intended audience for the gathered VET programs and the occupational roles of the respondents.

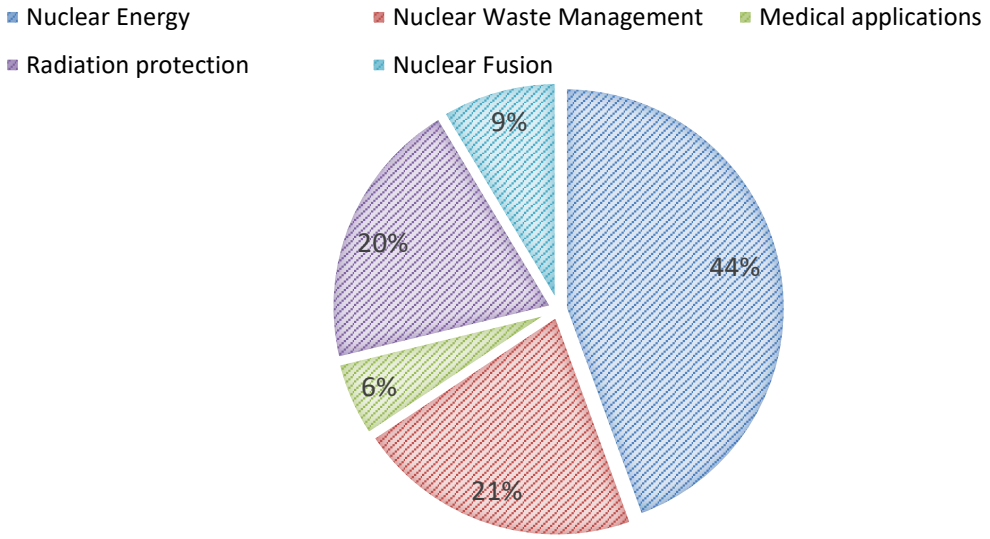


Figure 26: Nuclear domains of respondents of the WP4 survey

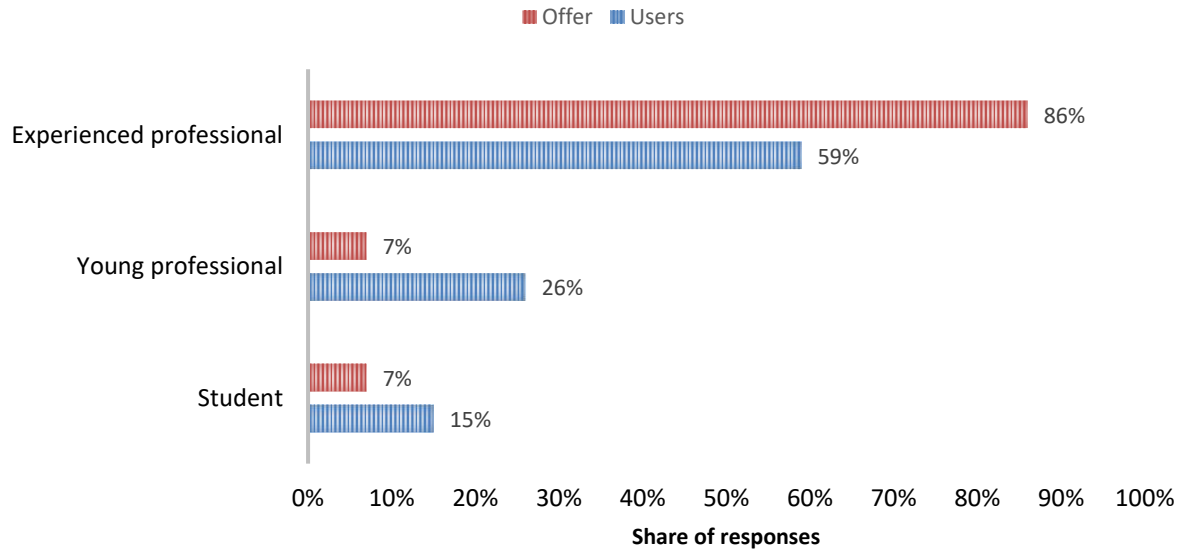


Figure 27: Occupation of VET users vs. target audience in the VET offer

The graph highlights that a substantial 86 % of the VET offer are designed for experienced professionals, with a mere 7 % tailored to young professionals and students. In contrast, the survey responses indicated that experienced professionals represented only 59 %, while young professionals and students accounted for 26 % and 15 %, respectively. This contrast underscores the potential demand for additional VET programs targeting less experienced employees, given the underrepresentation of young professionals and students in the existing VET offer.

The pertinence of VET to the current job positions of the survey respondents is depicted in Figure 28. A noteworthy observation is that merely 43% of VET users express a desire for additional training directly associated with their current job roles. A substantial 42 % of them are inclined towards more generalized topics within their industry, while 15 % express an interest in participating in VET courses pertaining to other, diverse subjects beyond their current job and nuclear industry.

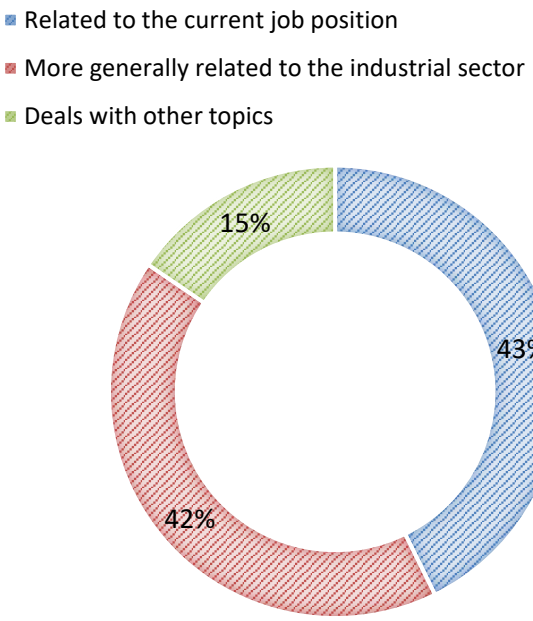


Figure 28: Relevance of VET to the current job position

Another interesting finding of the WP4 survey pertains to the ease of accessing information about available VET opportunities and the preferred channels through which interested individuals would like to search for such information. As depicted in Figure 29, a mere 4 % of respondents believe that finding information regarding VET is very easy, while a significant 96 % thinks it requires some effort or is very difficult. This observation holds paramount significance as it directly impacts the visibility of the current VET offer. Furthermore, it aligns with the conclusions drawn from the VET quality analysis presented in Section 5.1. Hence, making VET programs more visible and readily accessible to the target audience should be a foremost priority for VET providers.

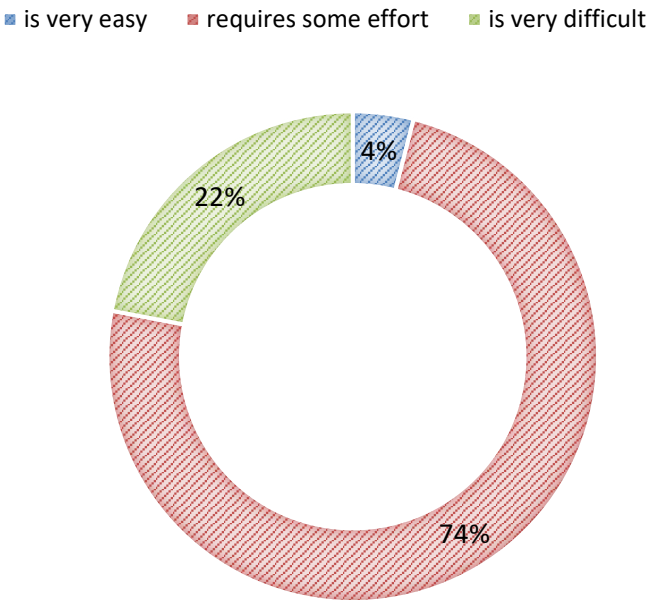


Figure 29: Difficulty of finding VET related information

As illustrated in Figure 30, the most favoured method for disseminating VET-related information is through email subscriptions, garnering 43 % of the responses. It is closely followed by LinkedIn, the VET provider's website, and social media. These findings underscore the critical importance of VET providers ensuring their visibility and offering convenient newsletter subscription options for interested individuals. In this context, the ENEN HUB appears to be a promising solution, acting as a platform that can effectively connect VET users with available offers from providers and provide them with opportunities for newsletter subscriptions. Additionally, a well-executed LinkedIn information campaign should be a part of the strategy to enhance outreach.

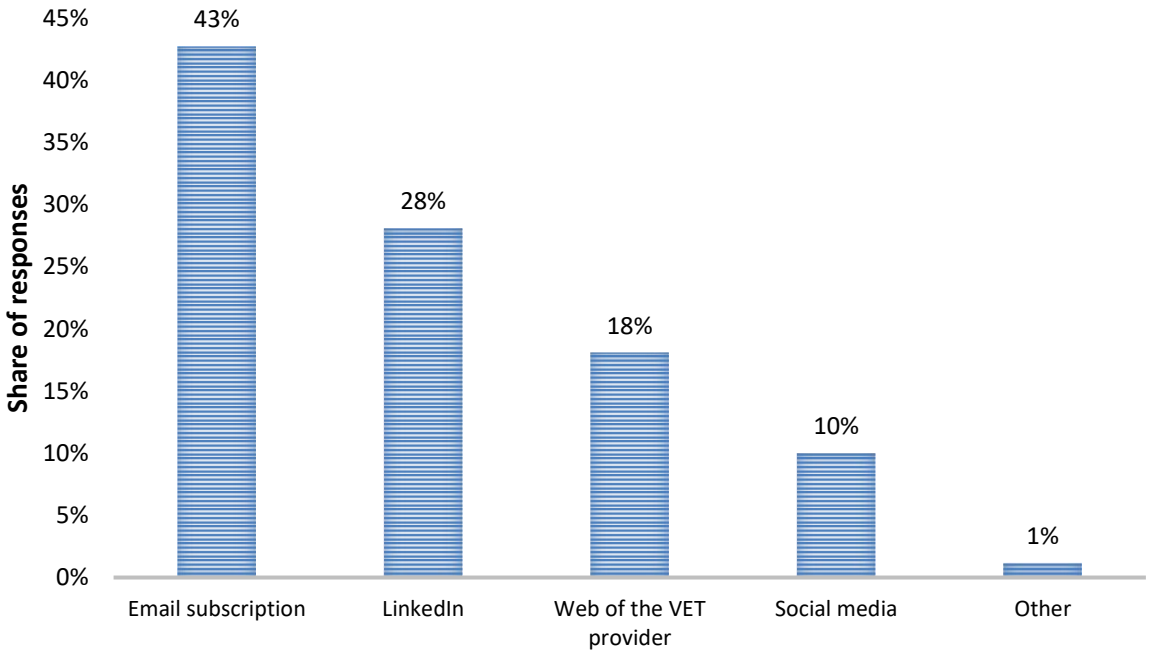


Figure 30: Most preferred channels of VET information sharing

5.3.3 Evaluation of VET offer based on common dimensions

This section pertains to the assessment of VET offerings, considering the key dimensions common to the preferences of both individual VET users and nuclear employers. The evaluation primarily concentrates on the level of interest expressed by VET users and employers in specific nuclear domains, the delivery methods of VET programs, and the optimal time frames for VET cases.

The comparison of the interest of nuclear employers and individuals in VET with the current VET offer expressed in specific nuclear domains is shown in Figure 31.

Figure 31: Comparison of the interest in nuclear domains with the available offer

Several interesting findings can be drawn:

- Radiation Protection and Nuclear Energy have the highest VET offer, 31% and 30%
- Nuclear energy is preferred by both individuals (34 %) and employers (61 %).
- Medical Applications and Nuclear Safety are offered by providers but have low interest from individuals and employers.
- Nuclear Safety is offered but not sought after by individuals and is required by only 12 % of employers.
- Nuclear Materials is offered by providers but has no demand from individuals and moderate demand (8 %) from employers.
- Nuclear Waste Management is moderately offered by providers (4 %) and has a high demand from individuals (22 %) and a moderate demand from employers (4 %).
- Decommissioning is offered by providers but have no demand from individuals and moderate demand (4 %) from employers.
- Management in nuclear is demanded only from the employers, but the number of available cases is limited.
- Nuclear Safeguards and Forensics," "Nuclear Security," and "Nuclear Fusion" have limited or no offerings, demand from individuals, or demand from employers.

The comparison of the interest of nuclear employers and individuals in VET with the current VET offer expressed through various delivery methods is shown in Figure 32. The findings can be summarized as follows:

- In-person delivery is the most widely offered delivery method at 34 %. It is highly preferred by individuals (97 %) and employers (94 %). This suggests a strong alignment between VET offerings and the preferences of both individuals and employers.
- Online delivery is offered by 32 % of providers but is not of significant interest to individuals and employers show only limited interest (3 %) in this delivery method.
- E-learning delivery is provided by 19 % of VET providers, with limited interest from both individuals (3 %) and almost no interest of employers (1 %).
- Blended delivery methods, combining both in-person and online components, are offered by 16 % of providers. However, it has no interest from individuals and negligible interest of employers (1 %).

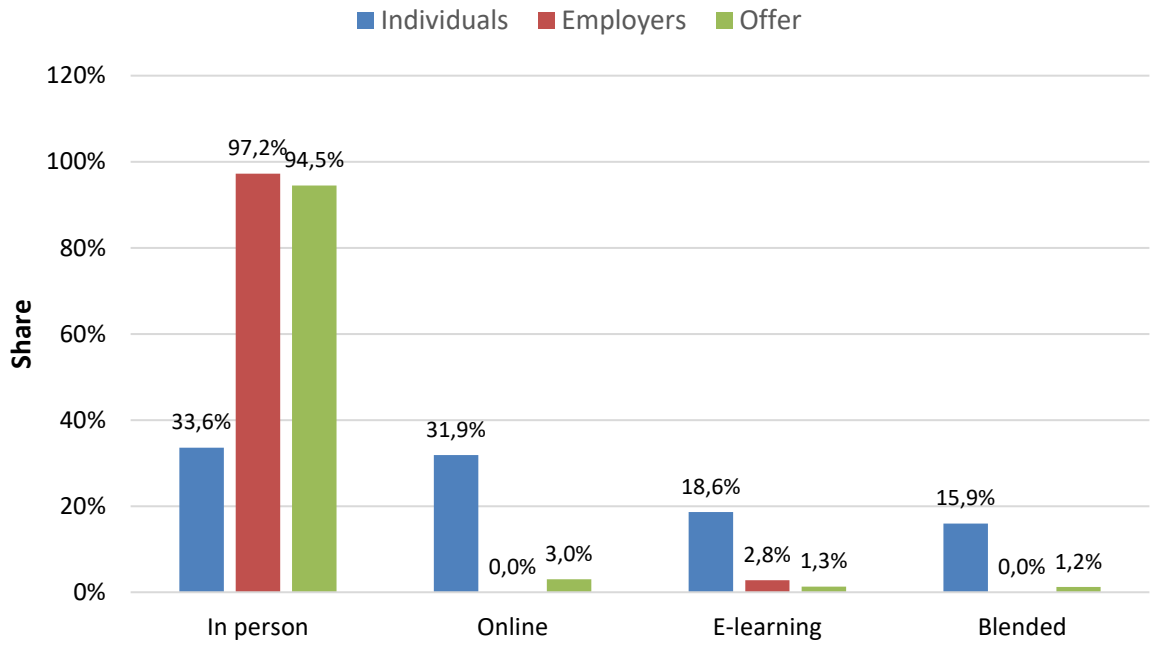


Figure 32: Comparison of the interest in different type of VET and the current offer

The final figure, Figure 33, provides a comparison of the preferences of individuals, nuclear employers, and the current VET offerings, focusing on the duration of VET cases. Given that the WP1 and WP4 surveys utilized a categorization that differed from the structure of data in the VET database, a meticulous effort was made to align VET cases into four distinct categories:

- 0 – 3 days,
- 3 days – one week,
- 1 week – 1 month,
- More than one month.

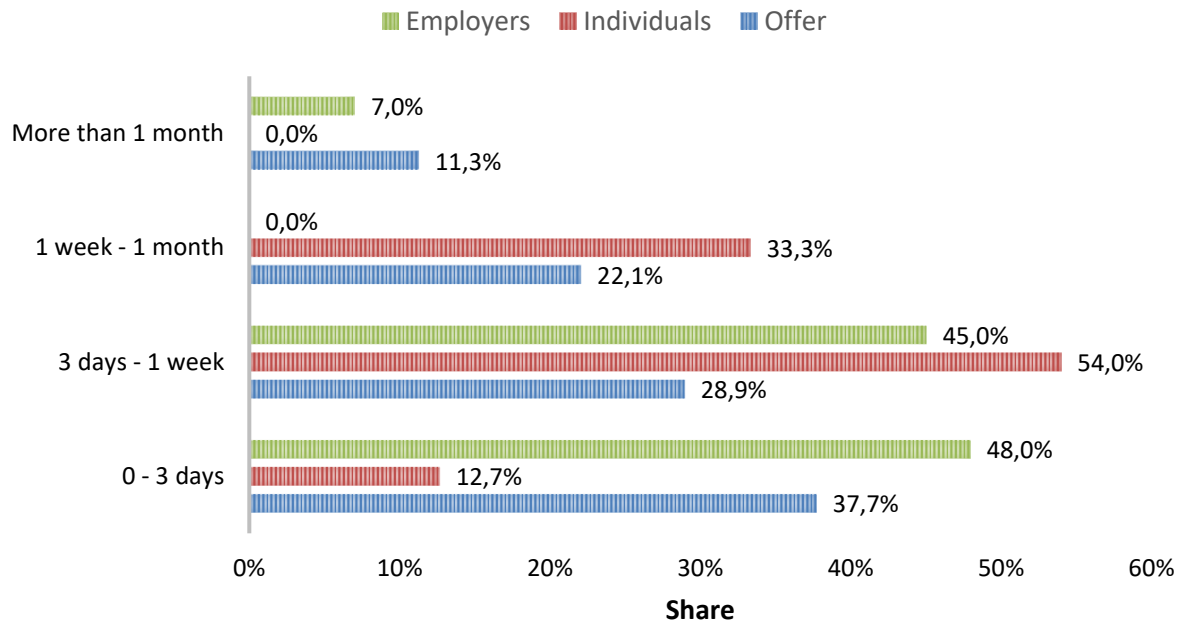


Figure 33: Comparison of the interest in VET of particular length and the current offer

The findings related to the VET courses of various time span can be summarized as follows:

- The data reveals that both individuals and employers in the nuclear sector prefer shorter-duration VET courses, with 0-3 days and 3 days - 1 week being the most favoured options.
- Employers express a significantly higher preference for short courses, with 48% favouring VET programs lasting 0-3 days. This suggests a strong demand for quick, focused training that can be quickly applied in the workplace.
- Individual users of VET courses show a preference for slightly longer programs, particularly those lasting 3 days to 1 week (54 %). This may indicate that individuals seek a bit more comprehensive training.
- Notably, employers show a 7 % preference for VET courses lasting more than one month, while individuals do not express a preference for such long-duration programs.
- The data suggest that VET providers in the nuclear sector should offer a range of course durations to cater to the varying preferences of both individuals and employers, with an emphasis on shorter and more practical courses.
- The data indicate a potential mismatch in expectations between individuals and employers regarding the duration of VET courses. VET providers should consider this when designing and offering their programs to ensure they meet the needs of both groups.

6 RECCOMENDATIONS FOR A DEVELOPMENT OF SUSTAINABLE VET PROGRAMS

This report presents a comprehensive overview of the current state of the Vocational Education and Training landscape within the European Union. It offers an initial analysis grounded in the requirements of European nuclear employers and individuals with a keen interest in vocational education and training. The findings spotlight several key issues:

1. *Fragmented VET Offer*: The data reveals a fragmented VET offering within the European Union, indicating a need for better organization and coordination.
2. *Transparency Gaps*: European VET providers seem to lack transparency in their communication with potential customers, underscoring the importance of clear and accessible information.
3. *Industry Collaboration*: The nuclear industry, research and development centres, nuclear safety-related companies, and players in the non-power applications of nuclear energy appear to be insufficiently engaged in the VET landscape.

To foster the sustainable development of VET programs in the EU, several crucial steps are recommended. These recommendations encompass:

- ENEN – the leader of the subsequent T4.3 of the ENEN2plus project.
- The providers of VET in the EU.
- Nuclear employers across all nuclear domains.
- Individuals interested in VET.

6.1 Recommendations for T4.3

As T4.3 is the successor of activities carried out in T4.1 and has the objective "To reinforce the VET offer for critical jobs, a European VET Platform shall be implemented, mainly to overcome the fragmentation of the relevant nuclear training opportunities in the EU. The requirements on that platform will be specified and detailed, covering different criteria, also for labelling VET offers", its activities should be designed and implemented considering the following recommendations.

- While we have successfully collected and evaluated over 1300 VET offers in T4.1, certain areas remain insufficiently covered due to various factors. Therefore, ongoing data collection is crucial, with a focus on addressing these identified gaps and enhancing underrepresented nuclear domains. The database should also be rigorously completed and verified.
- To elevate data quality and mitigate issues stemming from fragmentation and low visibility of VET offers, a proactive dialogue with VET providers is imperative. Collaborative efforts are needed to validate the collected data and enhance the visibility of these offers.
- Once comprehensive VET data is compiled and gaps are addressed, a more realistic evaluation should be conducted using meaningful indicators. Understanding the genuine capacities of VET providers and their willingness to contribute to a sustainable VET program is essential. Additionally, this analysis should consider recommendations from the European Council, CEDEFOP, and other stakeholders.

- To bolster the visibility of VET offers and facilitate information exchange between VET providers, European nuclear employers, stakeholders, and individuals interested in vocational activities, the finalization of the ENEN HUB, i.e., the VET platform, is vital. A communication and data management framework should be established to ensure data adequacy, accuracy, and ongoing relevance within and beyond the ENEN2plus project. The use of the European Learning Model for ENEN HUB (VET platform) design and implementation should also be investigated. In the interim, the VET database should be maintained in its current form.
- This report offers ample insights for the development and implementation of new VET cases in the areas indicated as “critical” and “to be improved” in the analysis. After their rollout, it's crucial to gauge their impact and define subsequent actions based on feedback from both providers and users of these new VET cases. Also, a close interaction with the activities of WP3 should be maintained.
- To address the demands and preferences of individual VET learners and to create a unified EU VET program capable of accommodating anticipated increases in human resources, the new VET cases provided in T4.3 should be in English to attract an international audience.

6.2 Recommendations for the VET providers

An integral aspect of fostering sustainable VET programs involves the active engagement of VET providers within the European Union. While their significance has been underscored in the preceding section, we also offer specific recommendations directed at these VET providers. The following are the key recommendations for their consideration:

- The VET quality analysis has unveiled that European VET providers presently lack transparency in their communication with potential customers. Their heavy reliance on personal connections and recommendations rather than utilizing readily accessible online channels like websites or social media impedes data collection and may deter younger generations from embracing VET programs. Thus, a pivotal recommendation for VET providers is to enhance their visibility using the strategies outlined in this report.
- Currently, less than 20% of the collected VET programs are delivered in English, with the majority presented in national languages. To address the demands and preferences of individual VET learners and to create a unified EU VET program capable of accommodating anticipated increases in human resources, VET providers should consider developing more courses in English to attract an international audience.
- European VET providers should align with the recommendations of the European Council on VET dated 24 November 2020, which emphasize the importance of improving the quality, relevance, and effectiveness of vocational education and training. Establishing clear learning outcomes for VET courses is an initial step, and enhancing the quality of information furnished by VET institutions is crucial to enable prospective users to make informed decisions.
- Furthermore, European VET providers should adapt their quality management system to adhere to the European Quality Assurance Reference Framework (the

EQAVET Framework) as described in the recommendations of the European Council on VET dated 24 November 2020.

- The ENEN HUB, designed to serve as the European gateway for VET and E&T opportunities, should include the active participation of VET course providers in its development. They should also play a pivotal role in making the hub more visible and up-to-date. VET providers have a significant role in verifying and validating the collected VET-related data.
- The dialogue between VET providers and the nuclear industry should be continuously maintained and elevated to the European level. The NUCLEATION Nuclear Vocational Learning Community established within T4.2 offers opportunities to address nuclear VET topics and expedite the collection and dissemination of VET-related competencies, experiences, and challenges within the community. Therefore, active involvement of European VET providers in NUCLEATION remains a high priority.
- In order to cope with the changing learning environment, the needs of individuals interested in VET should be well addressed and the methods of VET delivery should be improved as well as possibilities to provide vocational education and training online or through blended form should be considered.

6.3 Recommendations for nuclear employers

- The ongoing dialogue between VET providers and the nuclear industry should be consistently maintained and elevated to the European level. The NUCLEATION Nuclear Vocational Learning Community, as established within T4.2, offers opportunities to address nuclear VET topics and expedite the collection and dissemination of VET-related competencies, experiences, and challenges within the community. Therefore, active involvement of European nuclear employers, particularly HR managers and those responsible for skills development, in NUCLEATION remains a high priority.
- Representatives from nuclear industry, research centers and other relevant organizations should actively participate in discussions concerning the development and implementation of the ENEN HUB. Ensuring the HUB's accessibility and effectiveness for practical applications should involve consideration of practical perspectives. In this endeavor, the input of nuclear employers and, especially, their HR and PR experts should play a vital role.
- The VET analysis has brought to light differences in opinions between employers and individuals interested in VET, particularly with regard to the delivery and duration of VET programs. It is crucial to take into account the preferences and needs of individuals through direct communication with employees. Individual companies should also consider the requirements and preferences of their workforce.
- To facilitate the implementation of VET programs that are valuable to nuclear employers and easy to execute for providers, the nuclear industry should clearly articulate the division between vocational education and academic education.

Competencies and learning outcomes should be expressed through specific knowledge, skills, and attitudes, in alignment with [11].

- The findings of WP1 underscore a significant surge in new nuclear job opportunities across the industry, R&D, nuclear safety, and non-power applications. To assist providers in developing VET programs and encourage them to enhance their capacities, a clear business model and European-wide policy should be established, with active involvement from nuclear employers playing a pivotal role.

6.4 Recommendations for the VET learners

- Trends in human resource development reveal the impending retirement of a significant portion of experienced professionals, necessitating the transition to a younger workforce. Given the slower adaptation of VET providers, the evolution of VET programs may lag behind the changing needs of nuclear companies. Therefore, young professionals interested in VET should actively voice their preferences through their respective companies and engage with their HR departments.
- Individual VET learners should take an active role within networks such as ENEN and other European associations of young experts. These platforms provide access to the latest opportunities for vocational skill development. Learners should also share this valuable information through their personal social media channels to extend its reach.
- To contribute to the enhancement of the vocational education system in the EU, continuous feedback from individual users is indispensable. Even when not explicitly requested by VET providers, participants in vocational education and training programs should express their opinions and insights through communication channels and personal engagement, including participation in career events. Their input is invaluable for the ongoing improvement of VET offer, underscoring the need for VET providers to adhere to the European Quality Assurance Reference Framework (the EQAVET Framework).

7 CONCLUSIONS

A skilled workforce is crucial for nuclear operations and research. ENEN2plus's WP4 aims to develop a sustainable VET program and network to address this need. The European Union (EU) plays an active role in supporting VET through Cedefop, an EU agency. Its mission involves promoting VET and skills policies, contributing to the European Qualifications Framework (EQF), and addressing skills demand and supply. Cedefop's extensive activities and publications span traditional and non-traditional VET boundaries, with research papers emphasizing the evolving nature of VET and its role in upskilling and reskilling. They aim to bridge the knowledge gap surrounding how VET systems in Europe facilitate vocational learning, including non-conventional teaching methods and work-based learning. In contrast, the HORIZON-EURATOM-2021-NRT-01-13 call features general requirements without specifying Initial Vocational Education and Training (I-VET) or Continuing Vocational Education and Training (C-VET). Cedefop provides examples of diverse I-VET systems within EU member states. However, the call appears to prioritize C-VET aligned with lifelong learning to adapt to technological advancements. Nevertheless, Cedefop currently lacks the necessary tools and data to investigate C-VET in the nuclear domain within EURATOM countries.

This report focuses on specific vocational skills in C-VET. This involves considerations like aligning with job requirements, professional experience, curriculum duration, delivery methods, and provider flexibility. ENEN2plus distinguishes itself from previous projects and VET related activities by conducting comprehensive data collection and analysis, driven by the specific needs of nuclear stakeholders, and involving over 50 partners. The project initiated the development of a data collection template known as the "VET database," serving as an interim solution between the final entry point, the ENEN HUB, and the scattered public sources of VET providers in the EU. The VET database resulted from the collaborative efforts of ten partners, the ENEN association, and extensive input from WP1, WP2, and WP3 teams. Two versions were created: one for VET analysis within WP4 and another for joint data collection with WP3.

The complexity of creating a user-friendly structure capable of consolidating data from numerous web sources became evident. Initially, the database comprised 73 criteria for storing data gathered from public sources, personal contacts, previous projects, and direct input. The data collection phase highlighted the need to simplify the structure, leading to a final set of 20 indicators. Even with this simplification, many aspects of identified VET courses remained unspecified. The data collection yielded 1322 VET offers across 16 EU countries and the United Kingdom. Among these, 576 lacked information about certificates, 535 lacked details about the target audience, 233 did not specify the delivery method, 140 omitted education level information, 134 didn't detail qualifications after completion, 133 didn't specify the curriculum duration, 53 lacked information about the nuclear domain, and 51 were vague regarding learning outcomes.

In cases where information was provided, it was often unclear, making the collected VET offers appear scattered. To address this issue, a VET quality analysis was conducted, evaluating user-friendliness and available information using 12 criteria, assigning grades from A (indicating uniqueness) to E (needing significant improvement). Results showed nearly 50% of cases achieving a grade of A or B, indicating they are "qualified." However, the user-orientation of many VET courses remains a challenge, with around 700 courses receiving grades of C or lower, and over 100 falling into the D or E range. The lack of user-orientation is primarily due to missing information about certification, frequency, qualifications, and specified learning objectives. Moreover, only 20% of courses are available in English, limiting international accessibility. It's important to note that this

evaluation was based solely on public sources. Therefore, involvement from VET providers is essential to complete and validate the data. As a result, data collection and evaluation will continue as part of T4.3 activities after the completion of this task.

The subsequent activities focused on summarizing and analysing key job roles within the nuclear industry that are vital for its overall functionality, safety, and effectiveness. This analysis was carried out with a focus on specific nuclear domains and relied on data from WP1. It's worth noting that WP1 primarily concentrated on job positions and didn't delve into whether individuals meet the necessary qualifications through conventional education, specific E&T courses, or I-VET. To bridge this gap, certain assumptions were introduced. These included the distribution of new positions between 2023 and 2035 and the consideration of various scenarios for the proportion of positions suitable for C-VET. Additionally, on the VET side, assumptions regarding VET provider qualifications, language, in-person training, course duration, participant numbers, working days, and a linear increase in new positions were taken into account.

Based on these assumptions, maximum annual VET training capacities were calculated for distinct nuclear domains. It's important to note that these figures signify the highest potential capacity and should be verified through collaborative discussions with VET providers. Given the assumptions and by exclusively considering VET cases qualified following the VET quality analysis, the following represent the estimated maximal annual capacities of VET providers across specific nuclear domains:

- Nuclear Energy: 33 k
- Radiation protection: 4.6 k
- Nuclear safeguards and forensics: 4.16 k
- Nuclear Waste management: 3.84 k
- Nuclear safety: 3.8 k
- Nuclear materials: 3.04 k
- Decommissioning: 1.52 k
- Medical applications: 1.38 k

It was discovered that the remaining nuclear domains either lacked training capacities or did not meet the quality criteria. Through a combination of human resources projections, input from nuclear employers, and the estimated contribution of VET in meeting competency requirements, two scenarios were developed. These scenarios indicate the number of personnel that should undergo training in nuclear domains by the year 2035:

- Nuclear Energy: 24.56 k - 61.69 k
- Nuclear safety: 20.52 k - 25.12 k
- Nuclear Waste management: 15.14 k - 16.75 k
- Radiation protection: 11.36 k - 15.27 k
- Management in nuclear: 9.06 k - 13.22 k
- Decommissioning: 7.26 k - 8.89 k
- Nuclear security: 5.27 k - 6.55 k
- Medical applications: 4.64 k - 4.65 k
- Nuclear materials: 1.21 k - 1.45 k

Based on the figures mentioned earlier, we assessed the extent to which new job positions can be covered by VET by considering the time required to reach the projected number of

trained personnel. This evaluation categorized the coverage of specific nuclear domains as "Sufficient," "To be improved," or "Critical." The analysis revealed that the Nuclear Materials, Nuclear Energy, Radiation Protection, and Medical Applications domains could be adequately covered by the existing VET offerings. However, to meet the HR targets in Nuclear Safety, Nuclear Waste Management, and Decommissioning, enhancements in the VET offerings are necessary. The most critical areas, where either no or insufficient offerings are available, are Management in Nuclear, Nuclear Fusion, Nuclear Safeguards and Forensics, and Nuclear Security. These domains were identified in the feedback from the nuclear industry, research centres, and organizations involved in nuclear safety, highlighting the urgent need for new VET programs. It is important to note that the absence of VET offers in these domains could also be attributed to project partners' existing coverage. Therefore, before making conclusive judgments, it's crucial to ensure the accuracy of the data and validate whether these domains indeed lack VET opportunities.

The WP1 questionnaire, which aimed to identify key nuclear job positions, also provided valuable insights into the requirements of nuclear employers regarding VET courses and providers. The survey covered details about participating companies, including their size, specific nuclear domain, staff composition, hiring projections, and preferences for specific VET programs. A diverse range of sectors was represented, including utilities, fuel fabrication, enrichment and supply, waste management, decommissioning, and more. The survey revealed that 29% of companies are involved in nuclear new-built projects, 44.9% in NPP operation, and 26.1% in decommissioning and nuclear back-end. The survey's focus was not solely on VET offerings, so adjustments were made to align the data with the VET database, introducing a degree of uncertainty in the results.

The subsequent VET analysis was based on questions from the WP1 survey related to employee numbers, educational requirements, important areas of nuclear education & training, preferred delivery methods, and desired VET training types. The survey included a nearly equal representation of micro, small, medium, and large companies, with 13,476 employees in total. The anticipated distribution of employees by education level for the year 2035 revealed potential shifts in EQF categories, which has implications for VET course design. The comparison between available VET offerings and employer preferences for VET program structures and examination requirements was also presented. Notably, there is a gap between the demand for hands-on education in VET programs and the current supply, suggesting a need for providers to emphasize more practical components in their offerings. Additionally, nuclear employers prefer VET programs with assignments over formal examinations compared to the existing offerings.

A questionnaire campaign was conducted alongside other activities by WP4 to capture individual learners' needs and opinions regarding vocational training in the nuclear sector. The questionnaire was designed to gather data related to the structure and content of the VET database and allow for comprehensive evaluation. The questionnaire covered various aspects, including respondents' current nuclear domains, occupations, the need for VET, preferred topics, VET levels and durations, relevance to their current job positions, language and delivery preferences, and the ease of finding VET offers and information channels. A total of 150 responses were collected, with a distribution of respondents across various nuclear domains. An interesting observation was that the VET offers primarily cater to experienced professionals (86%), while survey respondents included a higher percentage of young professionals and students. This indicates potential demand for additional VET programs targeting less experienced employees. The relevance of VET to respondents' current job positions showed that 43% desired training directly related to their roles, while 42% preferred more generalized topics, and 15% expressed interest in diverse subjects beyond their current jobs and the nuclear industry.

The survey highlighted the difficulty of accessing information about available VET opportunities, with only 4% finding it easy. The preferred channels for disseminating VET-related information included email subscriptions, LinkedIn, VET providers' websites, and social media. These findings emphasize the need for VET providers to enhance their visibility and offer convenient newsletter subscriptions. The ENEN HUB is considered as a promising solution to connect VET users with available offers and facilitate newsletter subscriptions. An effective LinkedIn information campaign is also recommended to improve outreach.

The last part of the VET analysis, the assessment, considered the preferences of both individual VET users and nuclear employers in key dimensions. It was found out that there is a high interest in Radiation Protection and Nuclear Energy, with 31% and 30% offerings and preferences from both individuals (34%) and employers (61%) and limited interest in Medical Applications and Nuclear Safety despite being offered. Nuclear Safety is offered but not highly sought by individuals and is required by only 12% of employers. Employers seek Management in nuclear, but availability is limited. There are also limited or no offerings and interest in Nuclear Safeguards and Forensics, Nuclear Security, and Nuclear Fusion.

In terms of VET delivery methods, in-person delivery is common (34%) and preferred by individuals (97%) and employers (94%). Online delivery has limited interest from both individuals (3%) and negligible interest from employers (1%). E-learning is offered by 19% of providers but has limited interest from individuals (3%) and minimal employer interest (1%). Blended delivery methods are offered by 16% of providers but have no interest from individuals (0%) and negligible employer interest (1%). Preferences for VET duration show a preference for shorter courses, with employers favouring 0-3 days (48%) and individuals preferring 3 days to 1 week (54%). Employers have a 7% preference for VET courses lasting more than one month, while individuals do not express such a preference. VET providers should offer a range of course durations, considering the varying preferences of both individuals and employers. A potential mismatch in expectations regarding VET course duration exists between individuals and employers. VET providers should consider this when designing programs.

As a final conclusion it could be said that all objectives of task 4.1 have been met. Some activities require further effort, but some also exceeded the original objectives. Unlike the original broader scope of task 4.1 we were forced to narrow the scope of data collection and analysis. There were multiple reasons, it was mostly due to the timing of activities, as well as the quality, number and access of data collected by project partners, mostly from sources not directly linked to the partners of the ENEN2project. Nevertheless, due to the good cooperation between different partners and WP teams, a considerable amount of data and information could be compiled, allowing for meaningful analysis, and resulting recommendations, which, when implemented, will contribute substantially to the development of a sustainable vocational training program and network. It should be noted that the data collection should continue even after completion of this task (mostly through T4.3) and the outcomes of VET evaluation should be considered in more detail and by involving the VET providers in the process of evaluation.

8 ANNEXES

8.1 List of VET providers

Country	VET provider	Nuclear domain	Number of VET courses
France	**INSTN CEA**	Nuclear Energy	227
Spain	**TECNATOM S.A**	Nuclear Energy	121
Germany	**Fortbildungszentrum für Technik und Umwelt**	Radiation protection	99
Germany	**Framatome GmbH**	Nuclear Energy	85
Italy	**Sogin Group - Radwaste Mmanagement School**	Nuclear Waste management	56
Spain	**CENTRO DE ESTUDIOS ENERGÉTICOS, MEDIOAMBIENTALES Y TECNOLÓGICOS (CIEMAT**	Radiation protection	55
Slovenia	**Jožef Stefan Insitute (JSI)**	Radiation protection	35
Spain	**ACPRO, ASESORÍA Y CONTROL EN PROTECCIÓN RADIOLÓGICA, SL.**	Radiation protection	29
Germany	**KWS (Kraftwerksschule)**	Nuclear Energy	27
Sweden	**KSU**	Nuclear Energy	25
Spain	**AIMPLAS – Instituto Tecnológico del Plástico**	Radiation protection	20
Austria	**JRC Ispra, JRC/EC - DG ENER (ESARDA), JRC/EC - DG ENER (EUSECTRA), JRC/EC - DG TRADE // multiple names //**	Nuclear safeguards and forensics	18
Italy	**Italian Association of Radioprotection (AIRP)**	Radiation protection	14
Spain	**Enusa Industrias Avanzadas S.A**	Nuclear Energy	13
Belgium	**SCK CEN Academy**	Radiation protection	13
Czech Republic	**SURO**	Radiation protection	13
Sweden	**Vattenfall / Ringhals**	Nuclear Energy	12
Slovakia	**VUJE a.s.**	Nuclear Energy	12
Spain	**Universitat Politècnica de València**	Radiation protection	11
Germany	**Inforum**	Nuclear Energy	10

Spain	**SOCIEDAD ESPAÑOLA DE FÍSICA MÉDICA**	Medical applications	10
Spain	**Aula Clinic**	Medical applications	9
Spain	**COMPAÑÍA INTERNACIONAL DE PROTECCION, INGENIERIA Y TECNOLOGIA (PROINSA)**	Radiation protection	9
UK	**Nuvia**	Nuclear Energy	9
UK	**TÜV Rheinland Risktec**	Radiation protection	9
Spain	**Foro de la Industria Nuclear Española**	Nuclear Energy	8
Germany	**JRC/EC - DG ENER (EUSECTRA) - European Nuclear Security Treining Centre // multiple entry //**	Nuclear safeguards and forensics	8
Poland	**NCBJ - National Centre for Nucear Research**	Radiation protection	8
Germany	**AINT (Aachen Institute of Nuclear Training)**	Nuclear Energy	7
Italy	**Italian Association of Oncological Radiotherapy Technicians (AITRO)**	Medical applications	7
Hungary	**BME NTI (Budapest University of Technology and Economics)**	Nuclear Energy	6
Hungary	**Centre for Energy Research (EK-CER)**	Radiation protection	6
Belgium	**ECS/EQUAN**	Radiation protection	6
Italy	**Galileo Galilei Institute**	Nuclear Energy	6
Italy	**Italian Association of Breast Radiology Technicians (AITERS)**	Medical applications	6
Slovenia	**Milan Čopič Nuclear Training Centre (ICJT)**	Radiation protection	6
UK	**National Skills Academy Nuclear**	Nuclear Energy	6
Hungary	**OSSKI - National Public Health Centre, Department for Radiobiology and Radiohygiene**	Radiation protection	6
Germany	**TÜV Süd**	Nuclear Energy	6
Czech Republic	**CTU**	Nuclear Energy	5
Czech Republic	**DEKRA**	Radiation protection	5
Spain	**GD Energy Services, SAU (Antes LAINSA)**	Radiation protection	5
Belgium	**JRC/EC // multiple entry //**	Nuclear materials	5

UK	**National College for Nuclear**	Nuclear Energy	5
Italy	**Campoverde srl**	Radiation protection	4
Belgium	**FANC**	Nuclear safety	4
Slovakia	**Inžinierske služby, spol. s.r.o.**	Radiation protection	4
Germany	**JRC Karlsruhe // multiple entries //**	Nuclear safeguards and forensics	4
Netherlands	**JRC/EC // multiple entry //**	Nuclear safety	4
Germany	**JRC/EC - Science Hub // multiple entry //**	Nuclear materials	4
Hungary	**Narvál Kft**	Radiation protection	4
Hungary	**AGMI Anyagvizsgáló és Minőségellenőrző ZRt (AGMI ZRt)**	Radiation protection	3
Czech Republic	**DTOZCZ**	Radiation protection	3
Spain	**Ecoquímica Logística Integral**	Nuclear safety	3
Spain	**Equipos Nucleares S.A (ENSA)**	Nuclear safety	3
Italy	**Italian association of medical and sanitary physics (AIFM). Caldirol School Higher School of Physics in Medicine "P. Caldirola"**	Medical applications	3
Bulgaria	**National Center of Radiobiology and Radiation Protection (NCRRP)**	Radiation protection	3
Spain	**Nortuen**	Nuclear Energy	3
Sweden	**SKB (Swedish Nuclear Fuel and Waste Management Company)**	Nuclear Waste management	3
Hungary	**Somos foundation**	Radiation protection	3
Slovakia	**STU - Slovak University of Technology in Bratislava, Faculty of Electrical Engineering and Information Technology, Institute of Nuclear and Physical Engineering**	Nuclear Energy	3
Italy	**UNIBO. University of Bologna**	Medical applications	3
Czech Republic	**UNIT s.r.o.**	Radiation protection	3
Spain	**Universidad Autonoma de Madrid (UAM)**	Nuclear Energy	3

Italy	**UNIROMA. Sapienza University of Rome**	Medical applications	2
Italy	**University of Palermo**	Medical applications	2
Belgium	**Be.Sure**	Radiation protection	2
Hungary	**Budapest Neutron Centre - Centre for Energy Research (EK-CER)**	Medical applications	2
Spain	**Catalan Association of Higher Technicians in Diagnostic Imaging (ACTEDI).**	Medical applications	2
Spain	**CENTRO DE ESTUDIOS SANITARIOS DR. ARDUÁN**	Radiation protection	2
France	**CFA of the Champagne Ardennes industry**	Medical applications	2
Spain	**Eduardo Torroja Institute for Construction Science**	Other	2
France	**ESTRO**	Medical applications	2
France	**Faculty of Medicine Paris-Saclay**	Medical applications	2
France	**Framatome SAS**	Nuclear Energy	2
France	**Grenoble Alpes University (UGA)**	Medical applications	**2**
Poland	**Institute of Nuclear Physics, Polish Academy of Sciences**	Radiation protection	2
Germany	**JRC/EC DG RTD - Actinide User Laboratory // multiple entry //**	Nuclear Waste management	2
Netherlands	**JRC/EC, Clearinghouse // multiple entry //**	Nuclear safety	2
Bulgaria	**Kozloduy NPP**	Nuclear Energy	2
Germany	**KSG Kraftwerks-Simulator-Gesellschaft mbH GfS Gesellschaft für Simulatorschulung mbH**	Nuclear Energy	2
Spain	**Laboratorio de la División de Ciencia de los Materiales (LADICIM) de la Universidad de Cantabria**	Nuclear materials	2
France	**Lille 1 University**	Medical applications	2
Italy	**Molise.ART**	Medical applications	2
France	**Nantes University**	Medical applications	2
Italy	**National federation Orders of medical radiology health technicians and technical health professions,**	Medical applications	2

	rehabilitation and prevention (TSRM-PSTRP)		
France	**NEA**	Other	2
France	**Paris Sorbonne**	Medical applications	2
France	**Paul Sabatier University // multiple entry //**	Medical applications	2
Italy	**Politecnico di Milano**	Nuclear materials	2
Hungary	**UNIDUNA - University of Dunaújváros**	Management in nuclear	2
Italy	**UNIPD. Universidad de Padua**	Nuclear Energy	2
Spain	**Universidad Politécnica de Madrid (UPM)**	Nuclear safety	2
France	**University of Bordeaux**	Nuclear Energy	2
Italy	**University of Pisa**	Nuclear Energy	2
France	**University of Strasbourg**	Medical applications	2
UK	**University of Surrey**	Nuclear safety	2
Slovakia	**Ústav radiačnej ochrany s.r.o.**	Nuclear safety	2
Belgium	**Vinçotte**	Radiation protection	2
France	**EAMEA (under the aegis of INSTN Saclay)**	Radiation protection	1
Bulgaria	**ABILICO AD (former RiskEng)**	Nuclear Energy	1
Czech Republic	**A-CINCH - // It's a Project //**	Nuclear materials	1
Poland	**AGH University**	Nuclear Energy	1
France	**Aix Marseille University (AMU)**	Nuclear safety	1
France	**CARIF OREF network**	Medical applications	1
Poland	**CELOR**	Radiation protection	1
Spain	**CENTRO NACIONAL DE FORMACIÓN PROFESIONAL OPERACIONAL DE CARTAGENA**	Radiation protection	1
Czech Republic	**CEZ**	Radiation protection	1

Spain	**CLÍNICA UNIVERSIDAD DE NAVARRA Unidad de Protección Radiológica**	Medical applications	1
Czech Republic	**delisa-lto // It's a Project //**	Decommissioning	1
France	**Ecole Polytechnique, ENPC, ENSM Paris, ENSTA, ENSAM, ENSCP, ESE, ECP, University of Paris 11, INSTN**	Nuclear Energy	1
Spain	**Empresarios Agrupados**	Nuclear Energy	1
France	**Erasmus Mundus JMD on Nuclear Physics**	Nuclear Energy	1
Poland	**European Nuclear Young Generation Forum**	Nuclear Energy	1
Belgium	**EUTEMPE**	Medical applications	1
Italy	**Federico II University of Naples**	Radiation protection	1
Spain	**Hospital Virgen de la Victoria. Málaga**	Nuclear safety	1
Hungary	**Hungarian Nuclear Society**	Nuclear Energy	1
Poland	**IAEA // Multiple entry //**	Not specified	1
Non-European	**IAEA // Multiple entry //**	Management in nuclear	1
Greece	**IAEA // Multiple entry //**	Nuclear materials	1
Spain	**INSTITUT DE TECNIQUES ENERGETIQUES (INTE)**	Radiation protection	1
Bulgaria	**Institute for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences**	Not specified	1
Romania	**Institute for Nuclear Research Pitesti (RATEN ICN)**	Nuclear materials	1
Italy	**Istituto Nazionale di Fisica Nucleare. INFN**	Nuclear Energy	1
Italy	**Italian Nuclear Association (AIN)**	Nuclear Energy	1
Italy	**Italian Technical Association of Interventive Radiology (AITRI)**	Medical applications	1
Belgium	**JRC Geel // multiple entries //**	Nuclear materials	1
Netherlands	**JRC Petten // multiple entry //**	Nuclear security	1
Germany	**JRC/EC - Max Planck Institute // multiple entry //**	Nuclear materials	1
Netherlands	**JRC/EC, EERA /JPNM // multiple entry //**	Nuclear materials	1

Germany	**JRC/EC, IAEA - Targeted Alpha Therapy // multiple entry //**	Medical applications	1
Non-European	**KINGS**	Nuclear Energy	1
Germany	**Leibniz University Hannover/A-CINCH**	Nuclear materials	1
UK	**NTEC**	Nuclear Energy	1
Hungary	**Nuclear Safety Research Institute (NUBIKI)**	Nuclear Energy	1
Italy	**Pianoforte // PROJECT //**	Radiation protection	1
Italy	**Politecnico di Torino**	Nuclear Energy	1
Slovakia	**Reaktortest s.r.o.**	Nuclear materials	1
France	**Rennes University**	Medical applications	1
Poland	**SIOR**	Radiation protection	1
Italy	**Tor Vergata University of Rome**	Medical applications	1
France	**Tours University**	Medical applications	1
Germany	**TÜV Nord**	Nuclear Energy	1
Spain	**UNED**	Nuclear safety	1
Italy	**UNICATT. Catholic University of the Sacred Heart**	Medical applications	1
Italy	**UNIGE. Universita di Genova**	Medical applications	1
Italy	**UNIMI. University of Milan**	Medical applications	1
Italy	**UNITO. physics department. School of Specialization in Medical Physics**	Medical applications	1
Spain	**Universidad Complutense de Madrid (UCM)**	Medical applications	1
Spain	**Universidad de Sevilla/ARIEL**	Nuclear safety	1
Spain	**Universidad Politecnica de Cataluña BarcelonaTech(UPC)**	Nuclear Energy	1
Italy	**University of Catania**	Medical applications	1
Republic of Cyprus	**University of Cyprus**	Nuclear materials	1

Italy	**University of L'Aquila.**	Medical applications	1
UK	**University of Leeds (CINCH)**	Nuclear safety	1
UK	**University of Manchester**	Management in nuclear	1
Italy	**University of Messina**	Medical applications	1
France	**University of Toulouse III - Paul Sabatier // multiple entry //**	Medical applications	1
Slovakia	**VF, s.r.o.**	Nuclear safety	1
Czech Republic	**VUT**	Nuclear Energy	1
France	**Cefipa, Center of Engineering Training**	Not specified	0
France	**Estuary Professional High School**	Not specified	0
France	**IMT INSTN**	Not specified	0
France	**IUT Aix Marseille - La Ciotat site**	Not specified	0
France	**La Magrange High School**	Not specified	0
France	**Lycée Blaise Pascal**	Not specified	0
Italy	**UNIFI, Universidad de Florencia**	Not specified	0
France	**AFPI Center**	Not specified	0
France	**Albert Einstein High School**	Not specified	0
Italy	**Ansaldo Energia S.p.A.**	Not specified	0
France	**Art et Métiers Paris Tech**	Not specified	0
France	**Avignon University**	Not specified	0
France	**Caen University**	Not specified	0
Spain	**CENTRO DE FORMACION PROFESIONAL POVISA ****	Not specified	0
Czech Republic	**Ceske drahy**	Not specified	0
France	**CFA of the Lycée Professionnel Paul Emile Victor**	Not specified	0

France	**CFAI Aquitaine Reignac site**	Not specified	0
Italy	**CIRTEN. Consorzio Interuniversitario per la Ricerca Tecnologia Nucleare**	Not specified	0
France	**Clermont Auvergne University**	Not specified	0
France	**CNAM**	Not specified	0
Spain	**COMPLEJO HOSP. UNIV. DE BADAJOZ HOSPITAL INFANTA CRISTINA**	Not specified	0
Spain	**CONTROL 7, SAU**	Not specified	0
Netherlands	**Edin B.V., Edin Dental Academy**	Radiation protection	0
France	**Emulation Dieppoise Vocational High School**	Not specified	0
Italy	**ENEA- Italian National Agency for New Technologies, Energy and Sustainable Economic Development // multiple entry //**	Not specified	0
France	**ENSE3**	Not specified	0
France	**ENSICAEN**	Not specified	0
Netherlands	**Erasmus Universitair Medisch Centrum Rotterdam, Erasmus MC**	Radiation protection	0
Spain	**ESCUELA CLÍNICA MOMPIA**	Not specified	0
Spain	**ESCUELA LEONESA DE RADIOTERAPIA**	Not specified	0
France	**ESIX**	Not specified	0
France	**Estuary Professional High School**	Not specified	0
France	**FA André Voisin**	Not specified	0
Netherlands	**Faculteit der Tandheelkunde, Academisch Centrum Tandheelkunde Amsterdam ACTA**	Radiation protection	0
France	**Faculty of Physics and Engineering, University of Strasbourg**	Not specified	0
France	**Faculty of Sciences and Techniques, University of Nantes**	Not specified	0
Spain	**FORMACIÓN ESM**	Not specified	0
Spain	**FORMACIÓN SANITARIA DEL PRINCIPADO, S.L.**	Not specified	0

Germany	**Framatome GmbH**	Nuclear Energy	0
France	**Franche-Comté University**	Not specified	0
France	**French Association of Paramedical Electroradiology Personnel (AFPPE)**	Not specified	0
France	**French nuclear energy society (SFEN)**	Not specified	0
France	**French radiation protection society (SFRP)**	Not specified	0
France	**French Society of Medical Physics (SFPM)**	Not specified	0
Spain	**FUECA (Fundación Universidad Empresa de la provincia de Cádiz)**	Not specified	0
Spain	**FUNDACIO BONANOVA INNOVACIO I FORMACIO**	Not specified	0
Spain	**FUNDACIÓN GENESISCARE (antes FUNDACIÓN IMONCOLOGY)**	Not specified	0
Spain	**FUNDACIÓN UNIV. SAN PABLO CEU CEU-INSTITUTO SUPERIOR DE ESTUDIOS PROFESIONALES**	Not specified	0
Italy	**GEATOP srl. Metrology and Survey**	Not specified	0
Czech Republic	**HDT s.r.o.**	Not specified	0
Spain	**HM HOSPITALES 1989, SA P**	Not specified	0
Romania	**Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering**	Radiation protection	0
Spain	**HOSP. UNIV. "VIRGEN DEL ROCIO" SRVO. DE PROTECCIÓN RADIOLÓGICA**	Not specified	0
Spain	**HOSP.GRAL. UNIV. DE CIUDAD REAL**	Not specified	0
Spain	**HOSPITAL CLÍNICO "SAN CECILIO"**	Not specified	0
Spain	**HOSPITAL UNIV. GREGORIO MARAÑÓN Sº DOSIMETRÍA Y RADIOPROTECCIÓN**	Not specified	0
Spain	**Hospital Universitari Dexeus**	Not specified	0
Spain	**IES "ALBERT EINSTEIN" ****	Not specified	0
Spain	**IES "SAN ALVARO" ****	Not specified	0
France	**IMT Nantes**	Not specified	0
Spain	**INFOCITEC, SL**	Not specified	0

France	**INSA**	Not specified	0
Spain	**INSTITUTO INV. BIOMEDICAS "ALBERTO SOLS". CSIC-UAM. Sº PROTECCIÓN RADIOLÓGICA**	Not specified	0
Czech Republic	**IPVZ**	Not specified	0
France	**IRUP - Higher education through work-linked training**	Not specified	0
France	**IUT Charleville, University of Reims**	Not specified	0
Slovakia	**Jacobs Slovakia s.r.o.**	Nuclear Waste management	0
Germany	**KSU AB**	Nuclear Energy	0
Netherlands	**Leids Universitair Medisch Centrum**	Radiation protection	0
Czech Republic	**LF UK**	Not specified	0
Czech Republic	**LF Univerzity Hradec Králové**	Not specified	0
France	**Lycée Léon Blum**	Not specified	0
France	**Lycée Vauban**	Not specified	0
Czech Republic	**M.G.P. spol. s r.o.**	Not specified	0
France	**Marguerite Audoux Vocational High School**	Not specified	0
Czech Republic	**Masarykova univerzita**	Not specified	0
Finland	**Ministry of Economic Affairs and Employment**	Not specified	0
Hungary	**NPP Operation Training Programme (Participating Universities: BME, Pécs, Dunaújváros, Veszprém, Miskolc, Debrecen)**	Nuclear Energy	0
Spain	**Nuclear Industry forum educational corner.**	Not specified	0
Netherlands	**Nuclear Research and Consultancy Group vof (NRG)**	Radiation protection	0
Italy	**Nucleco S.p.A.**	Not specified	0
France	**Pablo Neruda High School**	Not specified	0
France	**Polyvalent high school Les Catalins**	Not specified	0

Spain	**PROETI, SA**	Not specified	0
Spain	**PROTECCION RADIOLOGICA MÉDICA, SL**	Not specified	0
Netherlands	**Radcon B.V.**	Radiation protection	0
Spain	**RADIOFÍSICA SANITARIA E INDUSTRIAL, SL**	Not specified	0
Netherlands	**Rijksuniversiteit Groningen**	Radiation protection	0
Netherlands	**Röntgen Technische Dienst B.V., Applus+ Competence Training Center**	Radiation protection	0
Spain	**ROZONA. Formación**	Not specified	0
Spain	**SATSE. SINDICATO DE ENFERMERÍA**	Not specified	0
Slovakia	**Slovak Medical University in Bratislava**	Medical applications	0
Slovakia	**Slovenske elektrarne, a.s.**	Nuclear Energy	0
Spain	**SOCIEDAD VALENCIANA DE PROTECCIÓN RADIOLÓGICA Y RADIOFÍSICA**	Not specified	0
Italy	**Solution Corsi Academy**	Not specified	0
Spain	**Spanish Association of Radiology Technicians (AETR), Radiodiagnosis, Radiotherapy, Nuclear Medicine and Graduates.**	Not specified	0
Spain	**Spanish Nuclear Society (SNE)**	Not specified	0
Spain	**Spanish Society of Radiology Graduates and Technicians (SEGRA)**	Not specified	0
Netherlands	**Stichting College Zorg Opleidingen, CZO**	Radiation protection	0
Netherlands	**Stichting Fontys**	Radiation protection	0
Netherlands	**Stichting Hoger Onderwijs Nederland, Hogeschool Inholland**	Radiation protection	0
Netherlands	**Stichting Katholieke Universiteit (RadboudUMC en Radboud Universiteit)**	Radiation protection	0
Czech Republic	**SÚJCHBO, v.v.i.**	Not specified	0
Czech Republic	**SÚRO, v.v.i.**	Not specified	0
Netherlands	**Technische Universiteit Delft**	Radiation protection	0

Netherlands	**Technische Universiteit Eindhoven**	Radiation protection	0
France	**The French Alternative Energies and Atomic Energy Commission (CEA) // multiple entries //**	Not specified	0
France	**The Institute for Radiation Protection and Nuclear Safety (IRSN)**	Not specified	0
Italy	**The Radioprotection Institute (IRP) of ENEA // multiple entry //**	Not specified	0
Germany	**TÜV Rheinland / Risktec**	Nuclear Energy	0
Spain	**Unia. Universidad internacional de andalucía.**	Not specified	0
Spain	**UNIV. AUTÓNOMA DE BARCELONA. SRVO. DE PROTECCIÓN RADIOLÓGICA**	Not specified	0
Spain	**UNIV. DEL PAÍS VASCO. FAC. CIENCIA Y TECNOLOGÍA. DPTO. QUÍMICA INORGÁNICA**	Not specified	0
Spain	**UNIV. SANTIAGO DE COMPOSTELA SRVO. DE PROTECCIÓN RADIOLÓGICA**	Not specified	0
Spain	**Universidad Carlos III de Madrid**	Not specified	0
Spain	**Universidad de Cádiz**	Not specified	0
Spain	**UNIVERSIDAD DE GRANADA Sº PROTECCIÓN RADIOLÓGICA**	Not specified	0
Spain	**UNIVERSIDAD DE MÁLAGA VICERRECTORADO DE INVESTIGACION Y DOCTORADO**	Not specified	0
Netherlands	**Universiteit Maastricht en Academisch Ziekenhuis Maastricht**	Radiation protection	0
Netherlands	**Universiteit Utrecht, Faculteit Diergeneeskunde**	Radiation protection	0
France	**University Claude Bernard Lyon 1**	Not specified	0
Italy	**University of Cagliari.**	Not specified	0
France	**University of Nîmes/INSTN**	Not specified	0
Czech Republic	**Univerzita Karlova, Lékařská fakulta v Plzni**	Not specified	0
Czech Republic	**Univerzita Palackého Olomouc**	Not specified	0
Czech Republic	**VF, a.s.**	Not specified	0
France	**Vocational education section of La Briquerie science and technology trades high school (La Malgrange site)**	Not specified	0

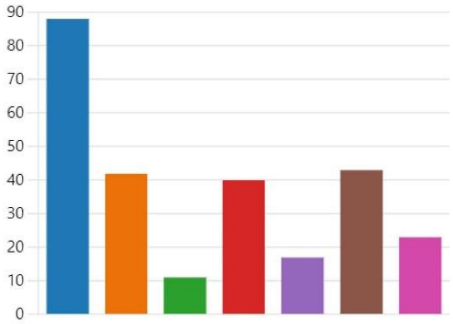
8.2 WP4 survey for individual VET users

Your needs, opinion, and comments about vocational training in nuclear

150	07:48	Aktiv
Antworten	Durchschnittliche Zeit für das Ausfüllen	Status

1. I am active in the following nuclear domain(s)

energy	88
waste	42
medicine	11
radiation protection	40
fusion	17
education	43
Sonstiges	23



2. I am

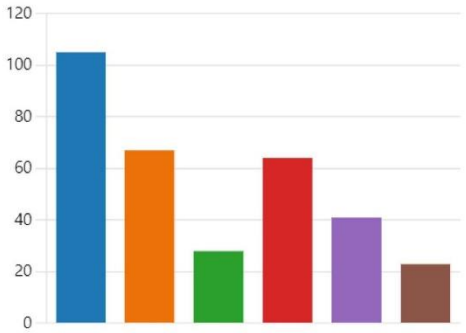
a student	21
a young professional	36
professionally active for a long t...	84
Sonstiges	9

3. I need vocational training to develop the skills required for

maintaining employment,	30
improving my employment opp...	83
more generally to better confro...	96
I do NOT need vocational traini...	4

4. For vocational training, I am interested in the following nuclear subjects (topics):

nuclear energy	105
waste	67
medicine	28
radiation protection	64
fusion	41
Sonstiges	23



5. Vocational training that I am interested in should be on the following level:

basic / introductory / overview	21
advanced	78
expert	51

6. Vocational training that I am interested in should not exceed

some hours	19
some days	81
some weeks	50

7. I would prefer to attend vocational training that

is related to my current job posi...	91
is more generally related to the ...	89
deals with other topics.	33

8. I would like to attend a vocational training in the following language:

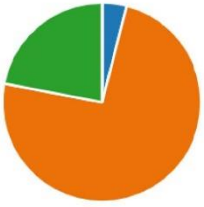
Only in my native language	4
My native language or English	86
Only English	55
Any	4
Sonstiges	1

9. I would like to attend a vocational training

Face-to-face	101
Online	96
E-learning	56
Blended learning	48
Sonstiges	0

10. Finding the vocational training that I am interested in

is very easy	6
requires some effort	111
is very difficult	33



11. I would like to receive information about existing vocational training offers through:

The webpage of the VET provid...	47
Emails after subscription	111
LinkedIn	73
Social media (Facebook, Twitter,...	26
Sonstiges	3

12. This is the place to inform us about your additional comments, or to provide us with your contact data if you would like to receive more information about our project:

39
Antworten

Neueste Antworten

4 Befragten (**10**%) antworteten **training** für diese Frage.

9 BIBLIOGRAPHY

[1] CEDEFOP V*ocational education and training in France, Short description* Luxembourg: Publications Office of the European Union, 2022

[2] CEDEFOP V*ocational education and training in Romania, Short description* Luxembourg: Publications Office of the European Union, 2019

[3] CEDEFOP *The future of vocational education and training in Europe: Volume 4 Delivering lifelong learning: the changing relationship between IVET and CVET* Cedefop research paper, No 91, Luxembourg: Publications Office of the European Union, 2023

[4] Spotlight on VET: 2020 compilation Vocational education and training systems in Europe, Luxembourg: Publications Office of the European Union, 2021

[5] CEDEFOP *The changing nature and role of vocational education and training in Europe, Volume 7: VET from a lifelong learning perspective: continuing VET concepts, providers and participants in Europe 1995-2015,* Cedefop research paper, No 74, Luxembourg: Publications Office of the European Union, 2019

[6] OECD, *Learning for jobs,* Synthesis Report of the OECD Reviews of Vocational Education and Training*, Paris,* 2010, www.oecd.org/education/skills-beyond-school/Learning%20for%20Jobs%20book.pdf

[7] CEDEFOP *The future of vocational education and training in Europe: 50 dimensions of vocational education and training: Cedefop's analytical framework for comparing VET* Cedefop research paper, No 92
Luxembourg: Publications Office of the European Union, 2023

[8] European Commission *Study on EU VET instruments (EQAVET and ECVET)*
Luxembourg: Publications Office of the European Union, 2019

[9] Van Kalleveen, A., Chenel Ramos, C., May, F.; *Status report on the European credit system for vocational education and training (ECVET) and its implementation in the nuclear sector*; EUR 29791, Publications Office of the European Union, Luxembourg, 2019

[10] OECD/NEA, *Nuclear Education and Training: From Concern to Capability*, Nuclear Development, OECD Publishing, Paris, 2012 DOI: https://doi.org/10.1787/9789264177604-en

[11] International Atomic Energy Agency; *Systematic approach to training for nuclear facility personnel: processes, methodology and practices,* IAEA nuclear energy series, ISSN 1995–7807; no. NG-T-2.8, Vienna, 2021

[12] S. Dayraut, F. Richard, D. Kechemair, G. Pavel, B. Eriksen, D. Cruz, E. Janisz, H. Eccles, J. Yazdani, L. Tovey, B. Hanson, M. Apostol, M. Constantin, Deliverable D1.1 – *Report on Human Resources needs in the nuclear industry until 2035*, ENEN2plus, 2022

[13] K. Deja, K. Daifuku, G. Pavel, Deliverable D1.2 – *Report on Human Resources needs in Research, Safety and Waste management*, ENEN2plus, 2022

[14] D. Visvikis, A. R. Paulo, K. Deja, Ch. Telloli, B. Ferrucci, R. Marques, P. Gilligan, K. Daifuku, D, Kechemair, Deliverable D1.3 – *Report on HR needs in non-power nuclear sector applications*, ENEN2plus, 2022