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Assessment of Non-nuclear Industries That Can Provide HR to Nuclear and Associated Professions

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EXECUTIVE SUMMARY

The European nuclear sector faces current and anticipated workforce requirements across operation and long-term operation, equipment supply, construction, the fuel cycle, decommissioning and radioactive-waste management. At the same time, restructuring in selected non-nuclear industries may release workers with industrial experience relevant to nuclear and associated activities. D4.4 assesses where such cross-sector transitions merit further development and the conditions under which they could contribute to nuclear recruitment.

The deliverable examines five groups of source industries and develops occupation-to-occupation transition hypotheses by comparing source tasks and competences with identified nuclear workforce needs. The assessment combines restructuring records, employer information, nuclear workforce studies and occupational and training frameworks. Cedefop informs the interpretation of employment change and replacement demand, while ESCO provides the reference vocabulary for subsequent occupational normalisation. D4.3 provides the project framework for considering destination occupational families, qualification levels and nuclear-specific competence requirements.

The analysis identifies the clearest task correspondences in mechanical and electrical maintenance, instrumentation and control, fabrication and installation, inspection and selected engineering functions. Field and auxiliary operations, process and laboratory activities, chemistry and dismantling support provide additional routes for task-specific assessment. Relevant experience may therefore provide a foundation for targeted upskilling or reskilling, but nuclear-specific requirements — including safety culture, quality and traceability, controlled work practices, configuration management, radiation protection where applicable, and plant- or role-specific preparation — must be assessed separately.

The assessment establishes priorities for developing occupational transition pathways. Implementation requires confirmation of candidate availability and interest, receiving jobs, competence and qualification requirements, and feasible training, employment and mobility arrangements. The qualitative case evidence supports these enquiries; estimates of recruitable workforce volumes and training durations require further assessment. D4.4 therefore recommends that participating organisations:

1. establish recurring occupational intelligence linking potential source workers with receiving demand;

2. organise transition partnerships around defined occupations, recruitment needs and responsibilities;
3. assess and adapt occupational bridging programmes, reusing existing provision where appropriate;
4. coordinate practical training capacity and trainer development;
5. ensure that transitions are accessible and economically viable for workers; and
6. test selected approaches and record evidence on qualification, recruitment, retention, duration, costs and implementation conditions.

Further work should also strengthen country and occupational coverage and complete the proposed Cedefop cross-check of employment change and replacement demand.

Within Skills4Nuclear, D4.4 provides occupational transition hypotheses and competence requirements for D4.5's assessment and adaptation of reskilling, upskilling and trainer programmes. It contributes cooperation and resource requirements to WP5, and occupational priorities, assessment criteria and findings on implementation conditions to WP6 and the Nuclear Skills Strategy. Cross-sector recruitment should consequently be considered a complementary contribution to nuclear workforce development, alongside initial education, workforce retention and the continuing development of existing nuclear personnel.

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ACRONYMS AND ABBREVIATIONS

AI	Artificial intelligence
ASA	Automotive Skills Alliance
ASD	AeroSpace, Security and Defence Industries Association of Europe
CAD / CAE / CAM	Computer-aided design / computer-aided engineering / computer-aided manufacturing
Cedefop	European Centre for the Development of Vocational Training
Cefic	European Chemical Industry Council
CEIDEN	Plataforma Tecnológica de Energía Nuclear de Fisión (Spanish nuclear fission technology platform)
CNC	Computer numerical control
CNC Kozloduy	Centre of Nuclear Competencies Kozloduy (Skills4Nuclear partner, Bulgaria)
COVE-WENDT	Centre of Vocational Excellence in Welding and Non-Destructive Testing
DoA	Description of the Action
DRIVES	Development and Research on Innovative Vocational Educational Skills (automotive sector skills project)
EDA	European Defence Agency
EDF	Électricité de France
EFOMP	European Federation of Organisations for Medical Physics
EHRO-N	European Human Resources Observatory for the Nuclear Energy Sector
E&I	Electrical and instrumentation
ELM	European Learning Model
EN	Norme européenne (European standard)
ENEN2plus	European Nuclear Education Network 2plus (Euratom project 101061677)
EPR2	Evolutionary Power Reactor 2 (French new-build reactor programme)
EQF	European Qualifications Framework
ERM	European Restructuring Monitor (Eurofound)
ESCO	European Skills, Competences, Qualifications and Occupations classification
ETS	Emissions Trading System (EU)

EU	European Union
EU27	27 Member States of the European Union
Euratom	European Atomic Energy Community
EUROFER	European Steel Association
FIT	Framatome Installation Tuyauterie (Framatome subsidiary responsible for the planned Cordemais piping-prefabrication activity)
FTE	Full-time equivalent
GIFEN	Groupement des industriels français de l'énergie nucléaire
GWe	Gigawatt electrical
HKM	Hüttenwerke Krupp Mannesmann
HR	Human resources
IAEA	International Atomic Energy Agency
IATF	International Automotive Task Force
I&C	Instrumentation and control
ICE	Internal combustion engine
IEA	International Energy Agency
ISO	International Organization for Standardization
JRC	Joint Research Centre (European Commission)
KEEP+	CEIDEN working group on training and knowledge management (Spain)
MATCH	French nuclear industry workforce and skills programme (GIFEN)
MW	Megawatt
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (EU statistical classification of economic activities)
NDE	Non-destructive examination
NDT	Non-destructive testing
NEA	Nuclear Energy Agency (OECD)
NPP	Nuclear power plant
NQF	National qualifications framework
OECD	Organisation for Economic Co-operation and Development
OKD	Ostravsko-karvinské doly (Czech coal-mining company)
PEJ	Polskie Elektrownie Jądrowe
PGE	Polska Grupa Energetyczna
PULSAR	European consortium on space nuclear power, propulsion and related materials testing

PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
R&D	Research and development
RNCP	Répertoire national des certifications professionnelles (France)
RP	Radiation protection
S4N	Skills4Nuclear
SMR	Small modular reactor
TPP	Thermal power plant
UK	United Kingdom
US	United States
VAE	Validation des acquis de l'expérience (France)
VET	Vocational education and training

1 INTRODUCTION

1.1 Context and purpose

Nuclear-related activities generate current and anticipated workforce needs across operation and long-term operation, refurbishment, equipment supply, construction, the fuel cycle, decommissioning and radioactive-waste management. New reactor programmes, including SMRs, may create further demand as projects mature. The requirements include technical and vocational occupations as well as specialist nuclear professions [2; 3; 15]. At the same time, decarbonisation, technological substitution and restructuring are reducing personnel requirements in selected non-nuclear activities, creating possible leads for occupational investigation.

This deliverable, prepared under Task 4.4 of Work Package 4, identifies and assesses non-nuclear industries whose declining personnel requirements could create opportunities for workforce transitions into the nuclear sector, and establishes the conditions under which the skills and experience of those workers could be mobilised [1]. Workforce availability and skills transferability are treated as distinct dimensions throughout: industrial restructuring affects employment differently across occupations, companies and territories, while workers holding relevant competences may face practical constraints on entering nuclear employment. Drawing on the workforce assessments undertaken within WP2, the deliverable provides the evidence base for targeted action under T4.4.

1.2 Objectives of the deliverable

The deliverable pursues four objectives:

- to identify potential workforce pools in non-nuclear industries and subsectors where reductions in personnel requirements are documented or anticipated;
- to assess the relevance of existing occupational profiles and competences to nuclear and associated occupations;
- to identify the upskilling and reskilling requirements attached to promising transitions; and
- to provide a common framework for prioritising and subsequently validating pathways against workforce availability, receiving demand, geographical and temporal alignment, training capacity and implementation feasibility.

1.3 Links with the other Skills4Nuclear deliverables

Within WP2 — European Forum for Nuclear Workforce and Skills — D2.1, *Analysis of Existing Nuclear Workforce Assessment Studies*, provides the methodological basis for

interpreting nuclear workforce needs. It reviews 21 workforce assessments, highlights limitations in workforce planning and occupational classifications, and compares nuclear demand with that of the hydrogen and offshore renewable energy sectors — a comparison that illustrates both competition for similar profiles and the need to distinguish occupational similarity from actual availability. Its Annex II, which lists the occupational profiles in demand in the European hydrogen sector with their ESCO correspondences, is used in Section 3.4 to characterise competing demand at occupational rather than sectoral level. D4.4 complements D2.1 by adding evidence on potential labour supply from outside the sector [2].

Within WP4, D4.3, *Tiering the Typology of EU VET Trainings Based on Industry Needs*, supplies the framework for characterising destination occupations by occupational family, EQF level, nuclear-specific competence and training pathway. D4.4 applies that framework to assess transferability and identify additional training needs, ensuring continuity with D4.5 [3].

The outputs of D4.4 feed D4.5, *Reskilling, Upskilling and Train-the-trainers Programs Assessment and Strategy*, within WP4, by identifying priority workforce groups and the competence gaps that training provision should address; they also inform WP5 for territorial cooperation and financing, and WP6 for the Nuclear Skills Strategy [1]. Section 7.3 sets out the content of each handover.

1.4 Geographical, sectoral and occupational scope

The primary geographical scope is the European Union. Evidence is examined at three complementary levels: European, to identify common patterns and opportunities for cross-border cooperation; national, to account for differences in industrial structures, nuclear programmes, qualifications and regulatory requirements; and regional or local, where restructuring and nuclear recruitment needs are geographically concentrated. This mirrors T4.4, which foresees cooperation at all three levels [1]. Evidence from other European countries or from international cases is used where it provides a methodological reference or illustrates a transferable pathway, and is distinguished from the assessment of availability within the EU.

The sectoral scope has two sides. On the supply side, the deliverable considers non-nuclear industries and subsectors for which credible evidence indicates decreasing personnel requirements within the horizons defined in Section 2.1 — through decarbonisation, technological change, changes in product demand, restructuring, plant conversion or closure, or supply-chain change — with particular attention to workers affected by decarbonisation, which Skills4Nuclear identifies as a priority [1]. The screening covers fossil-fuel industries and their supply chains, automotive activities

affected by the transition away from internal-combustion technologies, selected metallurgy and heavy industry, chemical, petrochemical and other process industries, and further documented restructuring cases with identifiable occupational profiles.

On the destination side, the deliverable covers nuclear and associated occupations for which current or future recruitment needs are identified by Skills4Nuclear workforce assessments or other sufficiently robust evidence: facility development and design, manufacturing and construction, commissioning, operation and long-term operation, maintenance and outages, radioactive waste management and decommissioning, together with the associated engineering, project-management, quality, safety and radiation-protection functions. Occupations in nuclear R&D, fusion and non-power applications are included where workforce demand is documented [2; 4]. This broad functional scope follows the JRC, which recommends a classification generic enough for comparison between Member States rather than an exhaustive list of nationally specific job titles [5].

The term "associated occupations" does not extend to all employment economically generated by nuclear activity. Following the OECD-NEA distinction between direct, indirect and induced employment, it covers identifiable occupations in contractors, engineering and construction companies, equipment manufacturers and specialist service providers whose work contributes directly to nuclear activities and for which competence requirements can be specified. Induced employment is excluded as a macroeconomic effect rather than a defined set of occupations, and higher-order indirect employment is retained only where a concrete occupational link can be demonstrated [6].

The occupational scope is defined through occupations, work functions and competences. D4.4 compares generic occupational profiles, with ESCO providing the common European vocabulary for their subsequent normalisation [7; 8]. Nuclear destination functions and requirements are examined through the JRC/EHRO-N and IAEA frameworks, covering relevant technical knowledge, safety culture, radiation-protection competence, authorisations and plant-specific preparation, while indicative qualification levels are expressed through the EQF [5; 9; 10]. The unit of analysis is an occupation-to-occupation transition pathway: Chapter 5 and Annex II organise the comparisons by source and destination occupations, comparable tasks, transferable competences, indicative destination qualification levels and additional learning and qualification requirements, while location and timing are examined in Chapters 3 to 6. Together, these elements provide occupational hypotheses and a structured basis for employer and individual assessment.

1.5 Structure of this report

The report is structured in eight chapters, followed by three annexes.

- Chapter 2 presents the methodological framework, including the time horizons, key definitions, interpretation rules, evidence sources and assessment criteria used throughout the deliverable.
- Chapter 3 examines nuclear workforce demand relevant to cross-sector transitions, including priority occupational groups and the geographical and temporal distribution of recruitment needs.
- Chapter 4 reviews the selected source industries and documented restructuring cases used to investigate potential workforce-release situations.
- Chapter 5 assesses skills transferability at occupation-to-occupation level. It compares source and destination tasks, knowledge, skills, qualifications and experience in order to identify potentially transferable competences, competence gaps and additional learning and qualification requirements.
- Chapter 6 examines the conditions affecting the feasibility of proposed transitions, including geographical and temporal alignment, employer absorption and training capacity, worker participation, institutional and financial support, and stakeholder validation.
- Chapter 7 identifies priority transition opportunities, develops recommendations for European cooperation and sets out the contribution of D4.4 to D4.5, WP5 and the Nuclear Skills Strategy.
- Chapter 8 presents the conclusions of the assessment.

Three annexes provide the supporting material for the assessment. Annex I contains the glossary used throughout the deliverable. Annex II presents the source-to-destination occupational matrix and the associated nuclear-specific requirements. Annex III provides the register of restructuring cases consulted and the corresponding supporting sources.

2 METHODOLOGY

The objectives and scope established in Chapter 1 are translated here into a common framework for assessing potential workforce transitions into nuclear and associated occupations. Drawing on the methodological findings of Skills4Nuclear D2.1, the approach brings together evidence on workforce availability, occupational relevance and nuclear demand [2]. The chapter defines the time horizons, terminology, interpretation rules, documentary sources and selection criteria through which these dimensions are examined, providing a consistent basis for the analyses that follow.

2.1 Time horizons

A cross-sector transition can contribute to nuclear workforce needs only if the reduction in personnel requirements in the source industry occurs sufficiently close in time to recruitment demand in the destination activity. Skills similarity alone is therefore insufficient: availability, demand and the time required for any upskilling or reskilling must be considered together [1].

Three operational time horizons are used:

- **Short term: up to 2030.** Restructuring, closures and employment reductions already occurring, formally announced or expected within the next few years. This is the principal horizon for identifying workers who could become available in time to meet existing or near-term recruitment needs.
- **Medium term: 2031–2035.** Structural employment changes materialising over a longer adjustment period, and nuclear needs attached to projects whose recruitment requirements increase progressively. It corresponds to the outer horizon of the current Cedefop Skills Forecast [11].
- **Longer term: beyond 2035.** Strategic context for major industrial transformations or long-term nuclear programmes. Because uncertainty grows with the forecasting horizon, such evidence is not on its own sufficient to identify a workforce pool as available.

These horizons are analytical conventions adopted for D4.4, not formal definitions established by Skills4Nuclear or Cedefop. Where a source applies different forecast periods, its original horizon is retained and reported, and evidence is mapped to the D4.4 horizons only where this introduces no artificial precision. The reference year of the underlying data, the forecast period, the date of restructuring announcements and the expected timing of their employment effects are recorded in each case.

2.2 Key definitions

Four terms carry the analytical weight of the assessment and are defined here. The remaining terms used in a specific sense — declining personnel requirements, total job openings, skill gap, transferable competences, bridging requirements, absorption potential, cross-sector workforce transition, source industry and destination occupation — are defined in Annex I.

Workforce availability. Evidence that workers holding potentially relevant competences are, or may become, available for alternative employment within the relevant horizon, whether through restructuring, closure, technological change or declining labour requirements. It cannot be inferred from a negative sectoral forecast alone.

Net employment change and replacement demand. Cedefop distinguishes net employment change (or expansion demand) — the creation or loss of jobs resulting from changes in the overall level of employment over a given period, which may be positive or negative — from replacement demand, generated by the need to replace workers leaving an occupation through retirement, movement to another occupation or exit from the labour market; total job openings combine the two. Because replacement demand accounts for a large share of future openings, an occupation may contract in net terms while still recruiting substantially [11].

Upskilling and reskilling. Cedefop defines upskilling as targeted training supplementing, improving or updating existing knowledge, skills and competences, and retraining or reskilling as training giving access to a new occupation or new professional activities [12]. In D4.4, an upskilling transition is one in which the worker's occupational profile remains substantially relevant and the requirement is to supplement it for a nuclear context — safety culture, quality, radiation protection, regulatory or plant-specific knowledge; a reskilling transition is one in which the destination requires a sufficiently different competence profile that substantial new occupational competences must be acquired, even though existing knowledge and experience may shorten the route. Neither classification implies a training duration or the absence of a certification or authorisation requirement.

Nuclear-specific competences and nuclearisation. The knowledge, skills and behaviours required to perform an occupation in a nuclear environment — safety culture, quality and traceability, radiation protection, regulatory requirements and facility-specific practices — and the integration of those competences into an existing occupational specialisation. The usage follows D4.3, which differentiates occupational families by the degree of nuclear knowledge required and labels the corresponding

categories "Nuclearization Level" [3]. A nuclearisation category describes a destination; it does not by itself determine training duration or readiness.

2.3 Rules of interpretation

The following rules guide the interpretation of workforce, occupational and restructuring evidence throughout D4.4.

R1 — A projected employment decline is not workforce availability. Negative employment growth is an indicator of possible workforce release. It does not establish that a corresponding number of workers will become available, because replacement demand may remain high in the same occupation, and because a sector may recruit overall while particular activities release workers [11].

R2 — Occupational similarity is not transition readiness. A close match between source and destination tasks is the starting point for assessing a transition, not evidence that a worker is qualified for nuclear employment. Nuclear-specific competence, plant knowledge, supervised experience and, where applicable, formal authorisation are assessed separately [9].

R3 — Announced employment reductions are not additive and are not a count of available workers. Restructuring announcements cover different populations — direct employees, contractors, port or logistics workers — and different forms of exit, including dismissal, early retirement and internal transfer. Group-level and establishment-level announcements may overlap. No aggregate is calculated from them [14].

R4 — Employment categories and units of measurement are not interchangeable. Employment figures are expressed in different units of measurement: a headcount counts persons; a full-time equivalent (FTE) converts working time into an equivalent number of full-time posts; and a labour-year is the volume of work performed by one person working full time for one year. Employment multipliers, used to estimate indirect or induced employment from direct employment, are ratios rather than counts, and direct, indirect and induced employment are different economic categories. Figures expressed in different units or categories are therefore neither added nor compared without conversion, and estimates of employment generated are never treated as numbers of workers available for recruitment [6].

R5 — A restructuring announcement reflects a company's plans at a given date; it is not a final outcome. The number of job reductions announced may change after negotiation with worker representatives or following later company decisions, and planned closures may be postponed or reversed; Table 7 contains both situations

(ExxonMobil Chemical France and Vynova). The records collected are, moreover, indicative rather than representative of all restructuring. Each record is therefore read with its announcement date and the period over which its employment effects are expected, and is re-checked before the workers concerned are treated as currently available [14].

R6 — The presence of an occupation at a site is not the availability of that occupation. Employer documentation may establish that welders, industrial mechanics, instrumentation technicians or inspectors work at an establishment without establishing that those particular workers are among those being released. Occupational presence and occupational availability are separate variables.

2.4 Data sources

D4.4 combines six complementary groups of documentary sources to examine nuclear workforce demand, restructuring in source industries, occupational correspondences and the conditions for developing transition pathways. Each group contributes a distinct part of the assessment.

Nuclear workforce demand. Skills4Nuclear D2.1 provides a structured review of existing workforce assessments and supports the interpretation of their geographical coverage, occupational detail, assumptions and time horizons. ENEN2plus D1.1, D1.2 and D1.3 extend the evidence across the nuclear industry, research, safety and waste management, and non-power applications. National assessments, the OECD-NEA outlook and dated project announcements provide further information on recruitment contexts, occupational requirements and programme timing. Chapter 3 brings these sources together while retaining the populations, units and periods used in the original assessments [2; 4; 15–28].

Occupational, competence and qualification frameworks. Skills4Nuclear D4.3 connects destination occupational families with indicative EQF levels, nuclearisation categories and training pathways. The JRC review supplies principles for organising occupational information across countries and organisations, while IAEA guidance describes work functions and their education, experience, training and qualification requirements. ENEN2plus D6.1 informs the documentary comparison of jobs, tasks and competences. ESCO provides the European reference vocabulary for the occupational normalisation proposed as a further step, and the EQF supports comparison of qualification levels. Together, these frameworks structure the generic source-to-destination hypotheses in Chapter 5 and Annex II, with receiving-role requirements to be refined through employer assessment [3; 5; 7; 8; 9; 10; 13].

Restructuring and recruitment records. Eurofound's European Restructuring Monitor (ERM) provides company- and establishment-level records of announced employment reductions and selected recruitment or expansion cases. The records identify locations, activities, employment effects and expected implementation periods. ERM focuses on large-scale events reported in selected media and company sources; its coverage provides an indicative view of restructuring, shaped by size thresholds and national reporting patterns. Factsheets may be updated when subsequent developments are reported. D4.4 uses these dated records to identify potential workforce-release settings and competing recruitment, applying the interpretation rules in Section 2.3. Annex III indexes the records consulted through case identifiers [14]. For Bulgaria, these records are complemented by regional and company information provided by the Skills4Nuclear partner CNC Kozloduy, drawing on the Territorial Just Transition Plans, national energy and recovery plans, mass-layoff notifications to the national Employment Agency and industry sources [61].

Source-industry and employer evidence. Industry-association publications, occupational frameworks, employer descriptions and establishment-specific documentation provide information on products, processes, professional activities and restructuring arrangements. Sources such as ASA and DRIVES, EUROFER, Cefic, COVE-WENDT and the aerospace and defence material help characterise the industrial and occupational contexts examined in Chapter 4. Employer information and certification records add detail where available. Their contribution is assessed according to what they document: sectoral capabilities, activities at an establishment, occupational presence or information about affected workers. Chapter 5 uses these distinctions when formulating the occupational comparisons [33–43; case references in Chapter 4].

Labour-market interpretation. The Cedefop Skills Forecast provides the distinction between net employment change, replacement demand and total job openings used throughout the assessment, which helps interpret situations in which declining personnel requirements coexist with continuing recruitment. Its use in D4.4 is conceptual: it frames the interpretation of employment developments and the questions to examine alongside local restructuring evidence, and no quantitative country-by-sector or occupational extraction is reported. Its sectoral and occupational categories provide reference points for the quantitative cross-check proposed in Section 7.4 [11; 30; 31; 37].

Training, recognition and implementation conditions. ENEN2plus D4.1 and Skills4Nuclear D4.3 inform the examination of training provision, learning outcomes, practical preparation and trainer requirements. Cedefop's validation guidelines, national validation reports and European qualification and credential resources support the

proposed treatment of prior learning and portability. OECD and IAEA publications contribute evidence on participation, workforce development and implementation conditions. The Skills4Nuclear WP5 outputs and ENEN2plus D6.2 provide complementary material on cooperation, resources and training capabilities. These sources inform Sections 5.4–5.5, Chapter 6 and the recommendations in Chapter 7 [3; 9; 29; 44–59].

The sources are interpreted according to their purpose, geographical and occupational coverage, reference period, employment category and unit of measurement. Differences between aggregate trends and establishment-level developments are examined in relation to those scopes, since local restructuring and wider recruitment can occur simultaneously. Together, this evidence base supports D4.4's occupational transition hypotheses, the assessment of additional destination requirements and the identification of the information needed for subsequent operational decisions.

2.5 Sector selection

Sector selection follows a progressive screening rather than a predetermined list: the source sectors identified in Section 1.4 form the initial screening population, not a set of industries already classified as suitable. The screening applies the following selection rule, which determines the industries examined in Chapter 4 and therefore has a direct bearing on the conclusions of this deliverable:

A sector or subsector is retained for detailed assessment only where two conditions are met together:

(a) a credible prospect of reduced personnel requirements or workforce release within the horizons of Section 2.1, shown by negative projections, announced closures, technological substitution or other documented structural change; and

(b) the presence, in the source workforce, of occupations with competences potentially relevant to the nuclear and associated occupations identified in Chapter 3.

Neither condition is sufficient on its own: industrial contraction without relevant profiles is not a transition opportunity, and a strong occupational match in a sector facing continued shortages does not demonstrate availability. Section 4.1 reports the outcome of this screening, and Section 4.7 draws the corresponding conclusions for each group of industries.

Selection is undertaken at the most detailed level the evidence supports, moving from industry to subsector, activity, occupation, establishment and region. This matters where a technological transition affects only part of an industry: an aggregate sector may expand while a specific product line contracts, and sector-wide decline may conceal continuing shortages in occupations that nuclear employers also seek. The screening therefore also weighs replacement demand and competing labour demand as factors that may reduce availability rather than as grounds for exclusion. Substantial replacement recruitment by employers in the same sector reduces the likelihood that a declining occupation releases workers, but does not demonstrate that the staff of a closing establishment will be reabsorbed, since those openings may concern other occupations, other territories or other employment conditions (R1) [11]; actual re-employment possibilities are therefore verified by occupation, territory and calendar before a case is set aside. Occupations sought by several growing industries may likewise be transferable in theory but difficult to recruit in practice, in line with D2.1's emphasis on analysing nuclear skills needs within the wider industrial labour market [2].

The restructuring cases examined in Chapter 4 and listed in Annex III were selected purposively: they were chosen for their relevance to restructuring in the source industries and to occupational transitions into nuclear activities, rather than drawn as a statistically representative sample. Together with the complementary employer, regional and social-partner sources, they document industrial settings, departure arrangements and occupational connections that inform the assessment framework and the recommendations for European cooperation. The findings should be interpreted within this qualitative scope: the distribution of cases by country, sector or occupation does not establish their relative importance across Europe or support an EU-wide workforce estimate. Annex III identifies the cases and complementary sources consulted, including the recruitment examples used to examine competing demand, and provides traceability to the records; the complete history of searches and inclusion or exclusion decisions is not documented in this version.

2.6 Assessment criteria

Table 1 sets out the common assessment framework that structures D4.4's qualitative analysis of source industries and proposed occupation-to-occupation transition pathways. Its criteria guide the organisation and interpretation of available evidence.

Table 1 Assessment framework for source sectors and transition pathways

Assessment criterion	Question addressed in D4.4	Main evidence considered
1. Evidence of workforce release	Is there credible evidence that personnel requirements in the source activity are decreasing or that workers may become available?	Employment forecasts, restructuring events, closures, employer or industry evidence, regional studies; replacement demand considered as a countervailing factor (R1) [11; 14]
2. Occupational and competence relevance	Does the source workforce contain occupations, tasks, knowledge, skills or experience relevant to an identified nuclear or associated occupation?	ESCO occupational and skills profiles, source-sector occupational information, nuclear classifications, job/task and competence analysis [5; 7; 8; 13]
3. Identified nuclear workforce need	Is there evidence of current or future demand for the corresponding destination occupation or function?	S4N workforce assessments, national and sectoral nuclear assessments, employer evidence, nuclear programme timelines [1; 2]
4. Bridging requirement	How much additional competence development would be necessary before the worker could perform the destination role?	Comparison of existing competences with nuclear-specific competence, education, experience, qualification and training requirements [9; 13]
5. Temporal alignment	Does potential workforce release occur sufficiently close to nuclear recruitment demand, allowing for required training and qualification lead times?	Source-industry restructuring and forecast dates, nuclear project timelines, estimated competence-development lead times [9; 11; 14]
6. Geographical alignment and mobility	Are source workers located within plausible reach of nuclear recruitment needs, or is national or cross-border mobility realistically possible?	Regional restructuring evidence, location of nuclear demand, available evidence on mobility and labour-market constraints [2]
7. Scale and specificity of the potential workforce pool	Can the potentially relevant population be identified at a useful occupational and geographical level, and is its scale meaningful in relation to nuclear demand?	Headcount and FTE data, occupational breakdowns, employer or restructuring data, nuclear demand estimates, checked for comparability under R4 [6]

Assessment criterion	Question addressed in D4.4	Main evidence considered
8. Evidence robustness	How strong is the evidence supporting the proposed transition opportunity?	Number, independence, recency and granularity of sources; distinction between observed data, announced restructuring and modelled forecasts; stakeholder validation addressed in Section 6.5 [2; 14]

Source: adapted from the assessment dimensions in [1], [2] and [5].

Chapter 6 complements this framework by examining employer absorption capacity, access to practical training and supervision, worker interest and acceptable employment and mobility conditions, and institutional and financial support. Together, these dimensions connect potentially relevant industrial experience with the requirements and practical conditions of a receiving occupation, and provide a common basis for subsequent stakeholder assessment and operational prioritisation.

The criteria are not interchangeable. A close task correspondence cannot establish workforce availability, and a large announced reduction cannot establish occupational relevance. An undocumented criterion identifies a question for investigation; it is not evidence that the relevant competence or opportunity is absent. Timing, qualification requirements and practical feasibility must be examined together before an operational priority or a training intake is confirmed.

3 NUCLEAR WORKFORCE DEMAND RELEVANT TO CROSS-SECTOR TRANSITIONS

Applying the framework established in Chapter 2, the analysis first examines the nuclear workforce requirements to which cross-sector recruitment could contribute. *Evidence on recruitment pressure and anticipated demand is used to identify priority occupational groups, before considering their geographical and temporal distribution* and the competition for shared industrial skills. Together, these findings establish the destination context needed to assess the relevance of experience acquired in non-nuclear industries.

3.1 Evidence on workforce demand and skills shortages

The evidence indicates sustained recruitment pressure across several parts of the European nuclear sector, arising from workforce replacement, continued operation of existing facilities and the development of new activities. Skills4Nuclear D2.1, reviewing 21 workforce assessments, identifies recurring difficulties in securing the necessary skills and concludes that systemic gaps remain in data standardisation, long-term forecasting and cross-sectoral collaboration; it recommends harmonised job classification and recurring, structured assessments as the means of closing them [2].

ENEN2plus D1.1 gives the scale of future recruitment: approximately 148,000–167,000 recruitments by 2035 across the EU27 and the United Kingdom, direct and indirect employment combined. The report states the total and its retirement component — 76,000 at an assumed annual replacement rate of 2.0% and 95,000 at 2.5% — leaving some 72,000 attributable to capacity expansion, on a scenario assuming roughly ten new plants. These are cumulative requirements under the report's assumptions, not current vacancies; their interpretation must allow for the survey's coverage of eight countries and the extrapolation to the EU27 and the United Kingdom [15].

The OECD-NEA *Nuclear Energy Outlook 2026* adds stakeholder evidence. Drawing on 2024 surveys of 103 supply chain providers, 18 utility operators and nine government organisations across Asia, Europe and North America, supplemented by six interviews in 2025, it identifies workforce availability and specialised skills among the principal constraints on new build. Under its Current Trends Scenario, concurrent nuclear capacity under construction in OECD countries would rise from about 9 GWe on average over the preceding decade to more than 40 GWe in the 2030s — a proxy for pressure on supply chains and workforce that cannot be converted directly into numbers of workers (R4). The findings cover participating organisations across OECD countries and are not a harmonised measurement of European shortages. One observation bears directly on this

deliverable: interviewees report that several activities in nuclear plant construction do not require deep nuclear-specific expertise, and the report recommends attracting experienced personnel from other industries, which strengthens the rationale for investigating cross-sector transitions while leaving the availability of suitable workers to be established [16].

Occupational pressure extends well beyond specialist nuclear engineering. ENEN2plus D1.1 identifies strong demand for skilled trades in construction, maintenance and repair, including welders, fitters and boilermakers [15]. Skills4Nuclear D4.3 adds electrical, instrumentation and control, maintenance and radiation-protection occupations, and links recruitment difficulties to retirements, limited training capacity and competition for skilled personnel [3]. Competition between industries further limits the pool of suitable candidates: D2.1 identifies overlaps between nuclear occupations and those in demand in hydrogen and offshore renewable energy, which places nuclear recruitment within a wider market for shared engineering and technical capabilities [2].

Requirements also persist beyond electricity generation. ENEN2plus D1.2 identifies workforce renewal needs in nuclear research, technical support, regulation, decommissioning and radioactive waste management, and stresses that countries reducing nuclear generation still require qualified personnel for dismantling, waste and oversight; declining generating capacity therefore does not imply a corresponding decline in all nuclear employment needs [17]. Non-power applications reinforce the point: ENEN2plus D1.3 reports difficulty finding skilled radiochemistry personnel and identifies radionuclide therapies as a potential driver of additional recruitment, while an EFOMP survey conducted at the end of 2022 estimated that approximately 7% of medical physicists would retire within five years, a finding covering medical physics across radiology, radiotherapy and nuclear medicine [4].

Taken together, these findings justify investigating recruitment from non-nuclear industries as one contribution to meeting nuclear workforce requirements, but do not establish how much of that requirement cross-sector transitions could meet.

3.2 Priority nuclear and associated occupations

Destination occupations are treated as priorities where recruitment pressure or anticipated demand is documented and where the work allows meaningful comparison with experience acquired elsewhere. Operational importance also informs the selection, although a critical function is not necessarily an occupation in shortage. To accommodate differences in national and organisational job titles, destination occupations are brought together in occupational groups defined by their main field of work, following the generic, function-based approach recommended by the JRC [5].

These groups, used in Table 2 and Table 16, are distinct from the occupational families defined in D4.3, which connect destination occupations to indicative qualification levels, nuclear-specific competence requirements and training pathways, and which Chapter 5 and Annex II refer to as destination families [3]. Recruitment needs are examined separately through the workforce assessments and employer evidence reviewed in this chapter. The result is an initial focus, to be refined through national, regional and employer evidence.

The strongest recurring signals concern technical trades, engineering and project delivery. ENEN2plus D1.1 identifies recruitment difficulties for mechanical, electrical, process and nuclear engineers alongside demand for welders, fitters and boilermakers, and anticipates substantial demand for project managers, construction personnel and operators [15]. The French MATCH assessment summarised in D2.1 points to civil engineering support, boilermaking and electrical activities as the segments expecting the largest workforce additions [2]. Table 2 sets out the resulting focus. Each row corresponds to an occupational group: the second column gives examples of the destination occupations it covers, that is, the nuclear or associated occupations into which a transition may lead, and the third column explains why the group is included and what the transition assessment examines. These observations on cross-sector relevance are analytical starting points, to be tested through the competence comparisons in Chapter 5 (R2).

Table 2 Priority nuclear and associated occupational groups

Occupational group	**Illustrative destination occupations in the group**	**Reasons for inclusion and focus of the transition assessment**
Metal fabrication and installation	Welders, pipefitters, boilermakers, mechanical fitters	Recruitment pressure is reported for skilled trades supporting construction, maintenance and repair. The assessment examines relevant and similar fabrication and installation experience, together with the additional qualification, quality and documentation requirements of the destination work [3; 15].
Electrical engineering, instrumentation and control	Electricians, electrical technicians and engineers, I&C technicians and engineers	D4.3 identifies electrical and I&C occupations among the capabilities under workforce pressure. The assessment addresses electrical equipment, instrumentation, automation and fault diagnosis, while distinguishing general industrial experience from competence on nuclear plant systems [3].

Occupational group	Illustrative destination occupations in the group	Reasons for inclusion and focus of the transition assessment
Mechanical maintenance and commissioning	Industrial mechanics, mechanical technicians, maintenance engineers, commissioning engineers	The grouping combines occupational families identified in D4.3 with the maintenance and engineering needs reported in workforce assessments. Relevant experience may include equipment maintenance, testing and troubleshooting; access requirements depend on the systems, responsibilities and plant concerned [3].
Civil engineering, construction and project delivery	Civil and construction engineers, project engineers, project managers, planning specialists	Construction engineering and project management feature prominently in anticipated demand. The assessment examines experience in complex industrial projects, including scheduling, contractor coordination and delivery, and identifies the nuclear-specific requirements of the role [2; 15].
Plant operations and process support	Field and auxiliary operators, process engineers, chemistry technicians	ENEN2plus identifies demand for operators and process engineering, while D4.3 and the IAEA distinguish operational and support functions. Industrial process experience warrants investigation, but field support, chemistry work and reactor control-room responsibilities require separate assessment [3; 9; 15].
Radiation protection, decommissioning and waste management	RP and dosimetry technicians, decommissioning engineers, radioactive waste specialists, associated project personnel	ENEN2plus D1.2 identifies these domains among anticipated workforce needs. Their work combines specialist radiological competences with engineering, dismantling, environmental, logistics and handling functions; potential transitions must distinguish these responsibilities [3; 17].
Quality assurance, inspection and non-destructive testing	QA and inspection technicians, NDT technicians, quality engineers	D4.3 identifies these as relevant occupational families and IAEA guidance defines the associated work functions. Employer-level recruitment demand remains to be confirmed; existing quality or inspection experience must be assessed against the destination requirements [3; 9].

Source: compiled from [3], [5], [7], [8], [9], [15] and [17].

Specialist occupations whose importance exceeds their numerical share also remain relevant: nuclear and reactor engineers, safety and licensing specialists, radiation-protection experts and nuclear chemists, for whom entry normally requires dedicated scientific education rather than industrial experience alone. For non-power applications D1.3 identifies medical physicists, radiochemists and radiopharmacists, with reported recruitment difficulties [4]. Digital systems, cybersecurity and selected support functions provide further destinations where concrete employer needs are established. Across all these groups, qualification level and nuclear-specific competence are considered separately: D4.3's mapping spans vocational to advanced professional levels with differentiated nuclearisation requirements, so a shared EQF level does not imply an equivalent nuclear content [3].

3.3 Geographical and temporal distribution of recruitment needs

The geographical and temporal distribution of demand depends on existing facilities, planned investments and the stage each project has reached. Long-term operation, new construction and decommissioning can coexist in one country, generating different recruitment profiles. The OECD-NEA 2026 outlook supports this distinction by examining long-term operation, large-reactor construction and small modular reactor (SMR) deployment separately, and by differentiating projects under construction, planned, proposed and prospective; these categories indicate different degrees of maturity and therefore different degrees of certainty about recruitment [16]. National projections establish the context; employer and site-level evidence is needed to identify where particular occupational groups could be recruited and when their competences must be available [2; 15].

Comparison requires consistent treatment of categories and units (R4). Workforce stocks, annual recruitment flows, cumulative recruitments, concurrent construction peaks and labour-years measure different quantities; a labour-year is a volume of work, not a person [6]. National classifications also differ: MATCH counts operators and suppliers within its core direct employment perimeter, so its figures require a scope adjustment before comparison [18]. The examples in Table 3 illustrate the documented patterns; their original forecast periods and assumptions are retained and they do not constitute an updated European forecast.

Table 3 National workforce assessments: coverage, timing and interpretation for D4.4

Country and evidence base	Geographical coverage and timing	Interpretation for D4.4
France — MATCH, 2023	MATCH projects workforce requirements for operators and suppliers in the French nuclear industry over 2023–2033, including work associated with export programmes. Under the programme assumptions used in 2023, additional workforce requirements accelerate towards 2028–2029, approaching 10,000 FTE per year. Existing-fleet activities overlap with preparation, construction and equipment supply for new reactors.	A national industry projection expressed in operational work capacity. It does not allocate equivalent numbers of vacancies to individual sites, and its peak must be reassessed against subsequent project schedules [18].
Netherlands — Technopolis, 2024	Scenarios combine continued operation at Borssele with different new-build programmes. The two-reactor scenario places the main workforce peak in 2030–2035; the four-reactor scenario shifts it to 2035–2040. Civil engineering demand precedes the main mechanical and electrical installation requirements.	Conditional national scenarios based on construction schedules assumed in 2024. They identify the sequencing of demand but do not establish a confirmed regional recruitment calendar [19].
Bulgaria — national HR strategy, 2022	Employer-specific estimates: the Kozloduy NPP staffing table covers 2021–2030, while State Enterprise Radioactive Waste estimates cover 2022–2032, including activities associated with Kozloduy and Novi Han.	Organisational estimates, more specific than a national capacity scenario. Existing-facility staffing must remain separate from the strategy's new-build discussion, which draws on an earlier feasibility study. The tables do not establish a current annual construction recruitment peak [20].
Poland — national HR development plan, 2023	A 2023–2035 staffing trajectory for the organisation developing and operating the nuclear programme, with requirements changing through project preparation, construction oversight, commissioning and operation.	An organisational trajectory, not a whole-industry employment forecast. Contractor, supply-chain and regulatory requirements need separate treatment, and the original dates must be reconciled with later project announcements [21].

Country and evidence base	Geographical coverage and timing	Interpretation for D4.4
Spain — CEIDEN KEEP+, 2023	A survey of 23 companies reports 2,157 anticipated recruitments over 2023–2027, covering the companies' national and international activities.	Cumulative hiring expectations from participating employers. They cannot all be assigned to Spanish sites or interpreted as an annual national recruitment peak [22].
Finland — national competence survey, 2019	Survey of the main nuclear actors — the three nuclear power companies, the waste-management company, the VTT Technical Research Centre, the safety authority, the ministry, universities and associated industrial companies — mapping the 2017 workforce by qualification level and area of competence, with projections in five-year steps. The 2017 workforce comprised 1,895 employees with an MSc degree, 1,232 with a BSc degree and 680 with secondary-level vocational qualifications.	A competence survey of an established programme rather than a recruitment forecast. It found demand in 2023 only slightly above the 2017 workforce, expected staff with BSc and vocational qualifications to cover future needs in most fields, and indicated that MSc-qualified staff should increase by 10%. Its data date from 2017–2018 and must be re-examined against current Finnish projects [2].
United Kingdom — Nuclear Workforce Assessment, 2024	Forecasts extend to 2043, with substantial demand concentrated in the North West and South West. The assessment combines employer forecasts with modelled programme requirements and identifies increasing uncertainty beyond 2033.	Regional totals covering civil and defence activities, which require disaggregation before use. The UK provides a European comparator, but its figures must remain separate from EU totals and from estimates confined to civil nuclear activities [23].

Source: compiled from the national assessments cited [2; 18–23]; original forecast periods retained.

Table 3 covers the national assessments whose main outcomes are summarised in D2.1, for six Member States and for the United Kingdom, which is included as a European comparator [2]. This coverage remains partial: no national assessment is included for several other Member States with operating or planned nuclear facilities, such as Belgium, Czechia, Hungary, Romania, Slovakia, Slovenia and Sweden. Identifying national, programme- or employer-level assessments for these countries, with the support of consortium partners, is one of the evidence priorities set out in Section 7.4 (Table 18).

Territorial matching also depends on where workers can be trained and employed. The Dutch 2022 assessment examines regional differences in the supply of relevant graduates, including limited local supply in Zeeland and Drenthe, illustrating why a national pool cannot be assumed available near a particular employer [24].

Later project announcements provide milestones against which earlier staffing assumptions should be checked, rather than independent workforce estimates:

- **France.** EDF's December 2025 announcement identifies Penly, Gravelines and Bugey for the six-reactor EPR2 programme, first commissioning targeted for 2038; the MATCH trajectory requires review against that schedule [25].
- **Poland.** PEJ's March 2026 announcement places first nuclear concrete at Lubiatowo-Kopalino, in the Choczewo municipality in Pomerania, in late 2028, with the three units in commercial operation in 2036, 2037 and 2038. The 2023 HR plan cannot be reproduced as an unchanged recruitment calendar [26].
- **Romania.** Nuclearelectrica's May 2026 update schedules completion of Cernavodă Unit 1 refurbishment preparations towards the end of 2027, with return to the grid in 2030 [27].
- **Netherlands.** The government's June 2026 announcement retains Eemshaven, in Groningen, and Terneuzen, in Zeeland, as candidate locations without a final site decision, so earlier national scenarios cannot be assigned to a confirmed construction site [28].

Recruitment timing must be distinguished from the date at which personnel must be fully operational. Regulatory and owner/operator capabilities are required before operation, and future operating personnel may need to be recruited during construction to acquire plant-specific experience; for certain owner/operator positions the interval between recruitment and independent performance reaches five to ten years. That is a requirement for particular roles, not a standard reskilling duration [9]. MATCH similarly indicates that, for many occupations, recruitment needs to begin one to two years before the required operational capacity is reached [18].

Interpreted through the horizons of Section 2.1, attention falls, up to 2030, on documented requirements at existing facilities, refurbishment, decommissioning and sufficiently advanced project preparation; during 2031–2035, on the progression and possible overlap of construction, installation and commissioning; and beyond 2035, on strategic context. Later commissioning dates can nonetheless require recruitment within the earlier horizons. For operational assessment, each potential transition should therefore be described by its destination employer or project, actual work location, relevant phase and the period when competences are required. This provides the demand-side basis

for testing whether workers released elsewhere could complete the necessary preparation and be available in the right place at the right time.

3.4 Implications for recruitment from non-nuclear industries

The evidence supports targeted recruitment from non-nuclear industries. The occupational priorities of Section 3.2 and the recruitment contexts of Section 3.3 determine which industrial capabilities should be sought and when they must become operational. D4.3 distinguishes occupational families by qualification and nuclearisation requirements: skilled trades, engineering technicians, applied engineering professionals, quality and inspection technicians and project-management professionals are the groups whose existing foundations can be complemented by nuclear-specific preparation, which directs external recruitment towards welding and pipefitting, mechanical and electrical maintenance, instrumentation and control, equipment testing, inspection and industrial project delivery [3].

Recruitment therefore begins by comparing destination tasks with demonstrated capability, using the job analysis, task analysis, skills audit and competence assessment methods described in ENEN2plus D6.1 to separate competences that must already be present from those that can be developed after recruitment [13]. The content of the additional preparation depends on the destination: for technical trades and maintenance roles it typically covers plant and equipment knowledge, nuclear safety culture, controlled work procedures, documentation and quality requirements, with radiation-protection training proportionate to the activities performed, while engineering, inspection and project personnel require preparation on design integrity, configuration control, equipment qualification and organisational responsibilities. External recruitment is consequently linked to a defined work assignment and a corresponding development pathway [3; 9].

Functions requiring greater nuclear specialisation need separate treatment. D4.3 places reactor operations, nuclear engineering, radiation protection and nuclear safety among the families with high nuclearisation requirements, where relevant industrial experience may support entry but additional scientific knowledge, plant-specific experience and formal qualification remain necessary. Responsibilities within a family must also be differentiated: industrial inspection is distinct from responsibility for a nuclear quality assurance programme, and auxiliary plant operation from reactor control-room duties. Lead times are translated into recruitment and development milestones for each pathway: the IAEA chemistry example — a three-month lead time combined with three years of relevant work experience and specified educational requirements — shows why course duration cannot stand for the whole transition period, and since Appendix III is

based on US practices such examples identify the components to assess rather than standard European conversion durations [3; 9].

The available training offer conditions the contribution of external recruitment. ENEN2plus D4.1 identifies fragmented provision, incomplete information on learning outcomes and certification, limited availability in English and demand for stronger practical components, with approximately three-quarters of the courses collected lasting no more than two weeks; such courses may support targeted upskilling, but their suitability depends on entry requirements, content and place within a complete development pathway. The number of technically suitable candidates must therefore be weighed against the training places, facilities, instructors and workplace supervision that can actually be mobilised, as examined in Section 6.2 [29].

D4.4 uses the occupational inventories reviewed in D2.1 to examine profiles shared with hydrogen and offshore renewable energy. The European Hydrogen Skills Alliance inventory reproduced in D2.1's Annex II includes engineering, laboratory, maintenance, construction, welding, fitting and installation profiles that correspond to several occupational groups in Table 2, and its "missing" category identifies profiles that the hydrogen sector reports difficulties recruiting [2]; the offshore renewable energy inventory identifies further occupational overlaps [2]. For these profiles, nuclear employers compete within a wider market for industrial skills, where employment prospects depend on the timing and location of demand as well as on the conditions offered to workers.

4 ANALYSIS OF DECLINING OR TRANSFORMING INDUSTRIES

The destination occupations and recruitment contexts identified in Chapter 3 guide the examination of potential workforce sources. Chapter 4 presents the screening of selected non-nuclear industries and reviews the restructuring evidence available at company and establishment level. By relating industrial activities and occupational profiles to departure arrangements, internal redeployment and competing recruitment, the analysis identifies the source situations that provide a basis for the occupation-to-occupation comparisons developed in Chapter 5.

4.1 Screening results and justification of selected industries

The screening covers five groups of non-nuclear industries through a set of 47 case entries, including 43 cases of announced or anticipated employment reductions and four cases of recruitment or expansion. The employment-reduction cases draw on 36 European Restructuring Monitor (ERM) factsheets, as one case entry combines two related records; eight further Bulgarian cases, for which no ERM record was used, rely on regional and company information provided by the Skills4Nuclear partner CNC Kozloduy [61]. The sectoral assessment applies the selection rule of Section 2.5, together with the interpretation rules and evidence sources set out in Sections 2.3 and 2.4. ERM records are used to document restructuring events and their reported employment effects, while complementary employer, regional and social-partner sources provide additional information on industrial activities, occupational profiles and employment arrangements [14].

The screening concentrates on the industries in which occupational links with nuclear activities appeared clearest and documented restructuring affects substantial workforces. Cross-sector transitions may nevertheless originate in smaller or less visible industries, albeit on a more limited scale. For instance, at Romans-sur-Isère, in France, workers from the local footwear industry, including leather stitchers, were recruited and trained for fuel-rod assembly in Framatome's nuclear fuel fabrication activities. Their recruitment relied on the precision and meticulousness developed in leather work rather than on prior technical knowledge, with the competences specific to fuel-rod assembly acquired through training. Such opportunities are difficult to identify through restructuring records or sectoral screening, and are more readily identified through local cooperation between employers, employment services and training providers (Section 7.2).

4.1.1 Justification of the retained activities

Conventional energy, refining and related services. Selected activities are retained where closures, conversion or restructuring indicate declining personnel requirements.

Their occupational relevance derives from experience in mechanical and electrical maintenance, instrumentation and control, industrial operations and technical services. Conventional power generation and process installations warrant particular attention because these functions overlap with several of the occupational groups identified in Chapter 3. Generating companies, extraction activities and contractors require separate treatment, as their occupational composition and redeployment arrangements differ. Section 4.2 examines these distinctions and the available restructuring evidence [2; 3; 15].

Automotive manufacturing and components. The screening retains activities affected by declining requirements in conventional engines, transmissions and associated components, together with other documented restructuring where relevant industrial occupations may be affected. Maintenance, machining and tooling, automation, quality and applied engineering provide the principal occupational links to investigate. Continued recruitment and internal redeployment elsewhere in the automotive value chain must also be considered. Section 4.3 concentrates on establishments with documented exposure to internal-combustion technologies and records the reason for each reduction [3; 33–35].

Metallurgy and heavy manufacturing. Selected metal-production and fabrication activities are retained because welding, machining, mechanical maintenance, inspection and engineering capabilities are relevant to nuclear construction, equipment supply, refurbishment and maintenance. The occupational effects of restructuring depend on the production processes and functions affected: a reduction in total employment may coexist with retention or recruitment of the technical trades of interest. Section 4.4 therefore examines establishment-level evidence and distinguishes documented occupational capabilities from assumptions based on a broad industrial classification [2; 3; 15].

Chemical, petrochemical and process industries. Selected closures and production-unit restructuring justify examining process and field operators, maintenance technicians, instrumentation personnel, laboratory staff and engineers. Their experience with complex equipment, continuous processes, operating procedures and industrial quality systems provides a basis for comparison with nuclear maintenance, auxiliary operations, chemistry and process-support functions. The analysis must distinguish the units being closed from continuing activities, and identify personnel retained for shutdown work. Section 4.5 examines these source populations and their potential occupational relevance [3; 9; 15; 17].

4.1.2 Activities requiring additional investigation and competing sources of employment

Coal extraction. The reviewed records document substantial employment changes, identifiable mining locations and different departure arrangements. These findings provide a concrete basis for investigating the occupational composition of the affected workforce. The next assessment should distinguish extraction-specific occupations from mechanical, electrical, instrumentation and other technical-service profiles, and identify workers seeking further employment. Comparison with receiving employers should cover suppliers, existing nuclear activities and new-build projects, using the relevant recruitment dates and locations. Section 4.2 sets out the restructuring evidence supporting these enquiries [2; 14].

Aerospace and defence. The review identifies specific restructuring programmes and occupational competences relevant to nuclear engineering, manufacturing, testing and quality functions. It also documents competing recruitment and internal mobility, which influence the prospects for external recruitment. Section 4.6 examines these factors at programme and establishment level, providing a basis for checking which occupations are affected and whether departure arrangements and receiving demand support a potential transition [2; 3; 15]. These industries have their own development prospects and substantial workforce requirements; they are therefore not treated as a workforce pool available to the nuclear sector as a whole, although specific restructuring programmes may provide candidates to be examined individually.

Other competing industries. Hydrogen, offshore renewable energy and other industrial activities may recruit the same maintenance, engineering, project-management and skilled-trade profiles sought by nuclear employers (Section 3.4). This competing demand is considered when assessing the availability and attractiveness of a proposed transition, but evidence of shared skills alone does not justify treating these industries as additional workforce sources [2].

4.2 Fossil fuel industries and related supply chains

European decarbonisation policies are progressively reshaping fossil-fuel extraction and conventional power generation. The trend is particularly visible in coal. According to the IEA *Global Energy Review 2026*, EU coal demand declined by 5% in 2025, after falls of 23% in 2023 and 11% in 2024. The slower decline in 2025 largely reflected temporarily weak hydro and wind generation rather than a reversal of the longer-term trend. Over the preceding decade, coal use in the European Union approximately halved, driven by coal-plant closures, renewable-energy deployment and high carbon prices [32].

4.2.1 Sectoral context and establishment-level evidence

The analysis distinguishes fossil-fuel extraction, conventional power generation and related services because their occupational profiles and employment trajectories differ; Cedefop's sectoral categories and its distinction between employment change and replacement demand provide the conceptual reference for interpreting them [11]. Table 4 brings together the ERM records and the available employer, regional and social-partner information on occupational activities and departure arrangements for extraction, power-plant operation and contractor or supply-chain employment [14]. Rows C38 to C43 add the Bulgarian coal regions on the basis of estimates provided by CNC Kozloduy [61].

Table 4 Documented restructuring in fossil-fuel extraction, conventional generation and related services

Segment and site	Documented employment change and timing	Sector-specific implication
Coal extraction — Polska Grupa Górnicza, Katowice and Ruda Śląska, Poland [C3]	Approximately 5,000 job reductions during 2026. Bielszowice due to close by 30 June 2026; four-year liquidation of Wujek from 1 April 2026. ERM indicates reductions mainly concern mining and coal-processing workers, and describes the exits as principally voluntary departures, mining leave and severance arrangements, with no forced redundancies announced.	A substantial restructuring programme in the Silesian coal industry. For D4.4, the case documents the scale, location and organisation of planned exits from coal activities, supporting a targeted analysis of the occupations involved and of the different forms of departure.
Coal extraction — OKD, ČSM mine, Karviná, Czechia [C4]	Extraction ended 31 January 2026. ERM records 750 employees leaving at that point and a further 150 by 28 February 2026. A job-search assistance programme was announced.	A single mining site, explicitly dated departures and an announced job-search assistance programme provide a geographically and temporally defined setting for examining occupational transitions following the cessation of coal extraction.
Coal-fired generation — Elektrownia Rybnik, Poland [C5]	PGE plans to phase out the coal-fired plant, with around 360–400 announced job losses. Two units close during 2026, the remaining two in 2027. New highly automated gas-fired capacity is	The case illustrates how a change in generation technology alters local employment requirements. Plant operation, maintenance, electrical, mechanical and I&C functions constitute the relevant occupational areas for

Segment and site	Documented employment change and timing	Sector-specific implication
	expected to require substantially fewer operating staff.	analysing possible transitions within and beyond the generating company.
Coal-fired generation — EDF Cordemais, France [C1]	ERM records 350 planned job losses, with employment effects extending to definitive closure on 31 March 2027. EDF reports 327 EDF employees and around 150 industrial partners at the two-unit, 1,200 MW site [64]; these figures have different perimeters and are not added to the ERM figure (R3, R4).	This is the most directly documented case identified. A historical EDF occupational description records 107 employees in operations and identifies maintenance activities in instrumentation, automation, testing, electromechanics, boiler-making and valve maintenance [62] — an occupational snapshot, not a current headcount.
Contractor and service provider — Minprest Serv, Târgu Jiu/Gorj, Romania [C6]	Service provider to Complexul Energetic Oltenia announced 154 job reductions by the end of January 2026. Activities include maintenance, technical assistance, railway infrastructure upkeep and heating-system maintenance.	The case shows why contractors must be analysed separately from generating-company employees: only part of the workforce performs technical maintenance or industrial-support functions.
Oil and gas — OMV Petrom, Romania [C7]	ERM records 1,000 planned job reductions under a restructuring running from November 2025 to January 2027, classified under crude petroleum and natural-gas extraction.	The record establishes a national restructuring signal without identifying affected establishments or occupations. Site-level information is required to isolate plant operators, maintenance, electrical, mechanical, instrumentation or engineering personnel.
Coal extraction — Mini Maritsa Iztok (open-pit lignite mining), Stara Zagora region, Bulgaria [C38]	CNC Kozloduy estimates about 5,000–5,500 direct technical positions affected, or around 10,000 including the local supply chain (R4). Phased reduction and conversion from 2026–2030, in line with the Territorial Just Transition Plan approved in December 2023.	The partner identifies heavy-machinery, electrical and maintenance technicians in the affected workforce, with profiles relevant to site preparation, infrastructure, heavy mechanical maintenance and civil or geotechnical support at nuclear and decommissioning sites. The estimate concerns positions affected, not workers available for recruitment (R1).
Coal-fired generation —	CNC Kozloduy estimates about 3,000–3,500 direct technical	The partner identifies high-voltage electricians, I&C specialists, high-

Segment and site	Documented employment change and timing	Sector-specific implication
TPP Maritsa East 2, ContourGlobal Maritsa East 3, AES Maritsa East 1 and Remotex, Stara Zagora region, Bulgaria [C39]	positions. Gradual phase-out of capacity after 2026, driven by EU ETS carbon costs and the decarbonisation framework of the Territorial Just Transition Plan.	pressure welders, turbine and boiler operators and QA/QC inspectors, profiles with substantial task overlap with nuclear maintenance and operations support. Operating experience remains distinct from reactor control-room responsibilities (Section 4.2.2), and the operators and service companies concerned require separate assessment.
Coal extraction — open-pit and underground mining, Kyustendil region, Bulgaria [C40]	CNC Kozloduy estimates about 400–500 direct technical positions affected by phased mine closures under the Kyustendil Territorial Just Transition Plan (2024–2030).	Heavy mechanical and maintenance profiles, which the partner considers adaptable to equipment maintenance, civil works and waste-management support.
Coal-fired generation — TPP Bobov Dol, Kyustendil region, Bulgaria [C41]	CNC Kozloduy estimates about 700–800 direct technical positions affected by site conversion and fuel switching; no date is specified.	Mechanical fitters, pressure-vessel maintenance technicians and I&C staff, whom the partner considers suited to nuclear outage and decommissioning work.
Coal extraction — residual open-pit extraction, Pernik region, Bulgaria [C42]	CNC Kozloduy estimates about 300–400 direct technical positions subject to phase-out under the Pernik Territorial Just Transition Plan.	Maintenance technicians and machinery operators who could be eligible for cross-sector reskilling programmes.
Coal-fired generation and district	CNC Kozloduy estimates about 900–1,100 direct technical positions affected by plant	The partner reports strong compatibility of thermal-engineering, I&C, automation and pressure-equipment maintenance

Segment and site	Documented employment change and timing	Sector-specific implication
heating — TPP Toplofikatsia Pernik and technical support units, Pernik region, Bulgaria [C43]	modernisation and decarbonisation.	profiles with nuclear bridging pathways, and highlights the proximity of the capital and its education and training institutions.

Source: ERM factsheets and employer sources listed in Annex III; for the Bulgarian rows, CNC Kozloduy [61].

Cordemais is particularly relevant because the source and a potential nuclear destination activity are located on the same industrial site. EDF has confirmed the creation of a nuclear piping-prefabrication activity following the end of coal-fired generation, with commissioning planned after the closure of the power plant [63]. Framatome recruitment information published in September 2026 describes a workshop operated by Framatome Installation Tuyauterie (FIT) and intended to employ around 150 people, with machining, welding, heat treatment, materials handling and non-destructive testing among its principal processes [65]. That notice, published on 5 September 2026, refers to factory start-up in early 2029, whereas EDF's May 2025 announcement envisaged commissioning at the end of 2028; the milestone each date designates requires reconciliation with FIT (R5). This does not demonstrate that 150 former coal-plant employees will be redeployed directly, but it provides an unusually concrete case in which timing, location and industrial destination can be compared with the competences of the workforce affected by a fossil-fuel closure [C1].

Refining is represented by the Gunvor Petroleum restructuring in Rotterdam, where the ERM recorded 150 planned job reductions associated with conversion from fuel production to terminal activities, with an anticipated completion in January 2025. This case supports examining refining as a potential source activity, but the record does not establish the occupational composition or current availability of the affected workers. Process, maintenance and electrical profiles remain hypotheses for verification, while continued terminal employment and subsequent redeployment must be checked [C2].

The Bulgarian input from CNC Kozloduy documents a regional setting in which coal reductions are organised under territorial planning. The coal regions of Stara Zagora, Kyustendil and Pernik are covered by Territorial Just Transition Plans approved by the European Commission in December 2023, which secure about €1.18 billion from the Just

Transition Fund. Three elements should be distinguished. The emissions objective is set by Bulgaria's recovery and resilience plan, approved in May 2022 and amended several times since, which includes a framework for the coal phase-out and a binding commitment to cut power-sector greenhouse gas emissions by 40% by 2025 [71]. The economic trajectory, according to the partner, is a gradual phase-out of coal-fired capacity after 2026–2030, driven mainly by EU ETS carbon costs and declining economic viability [61]. The final coal-exit date is not established in this deliverable and should be checked against the version of the plan in force when the cases are verified. The conversion strategy combines phased reclamation of mining land with green industrial parks, a hydrogen valley, solar and wind generation, battery storage and gas-fired combined heat and power [61]. The partner estimates in Table 4 are ranges of affected direct technical positions; following R3 and R4, they are not added together, and they do not measure the number of workers who will seek external employment. Their particular value for D4.4 lies in the occupational profiles they identify, which the public restructuring records examined elsewhere rarely provide: high-voltage electrical engineers, electricians and substation technicians; I&C and automation specialists; industrial mechanics, pipefitters and certified high-pressure welders; and turbine operators, pressure-vessel specialists and industrial safety inspectors [C38–C43].

4.2.2 Occupational relevance and implications

D4.3 supports a focused comparison of conventional and nuclear maintenance functions. Its Cernavodă case identifies electrical, mechanical and I&C occupations within the nuclearised workforce, while its Lower VET analysis compares industrial electricians in conventional and nuclear power plants. These examples provide reference points for examining the source activities documented above; Chapter 5 develops the corresponding occupational hypotheses and preparation requirements [3].

Plant-operation occupations require more careful differentiation. Experience of continuous industrial operation, process monitoring, shift work, alarm response and strict operating procedures may be transferable, particularly for field or auxiliary operating functions, but experience in a fossil-fuel control room does not provide direct access to nuclear reactor control-room responsibilities: nuclear-specific knowledge, plant-specific training, safety responsibilities and, where applicable, formal authorisation create substantial bridging requirements. The same principle applies to process and safety functions in oil and gas. Company job titles should accordingly be mapped to ESCO occupations and skills before comparison with the nuclear destination families identified in D4.3 and ENEN2plus, so that equivalence is not assumed from similar titles or a shared energy sector [7; 8; 9].

For fossil-fuel sites the evidence record should be completed with Cedefop sectoral and occupational forecasts and replacement demand for the Coal, Oil and Gas and Electricity categories, and with regional evidence on contractors and redeployment arrangements. The latter is particularly significant here, because technically relevant workers are frequently employed outside the operator's direct workforce.

4.3 Automotive and internal combustion engine supply chains

The European automotive industry is undergoing a profound transformation driven by electrification, digitalisation and automation. These changes require substantial reskilling within the sector itself, but can also create opportunities for labour mobility towards other strategic industries. The Automotive Skills Alliance (ASA) Knowledge Hub brings together sectoral intelligence on new technologies, drivers of change, skills supply and demand and automotive job roles, notably through the DRIVES project [33]. Automotive experience can be relevant to nuclear employment, particularly in mechanical and electrical engineering, industrial automation and robotics, quality assurance, advanced manufacturing and maintenance; the potential source population must nevertheless be defined more narrowly than the automotive workforce as a whole.

4.3.1 Sectoral context and establishment-level evidence

Priority is given to establishments and suppliers whose activities are demonstrably linked to internal combustion engine (ICE) technologies and whose personnel requirements are declining: conventional engine and transmission manufacture, ICE-specific components, associated tooling and machining, and related production or development functions. The distinction matters because electrification also generates demand for batteries, electronics, software, electric powertrains and automation within the same ecosystem, and ASA emphasises a just transition, targeted reskilling and regional cooperation across the value chain [34]; workers leaving one ICE-related activity may therefore be absorbed elsewhere in the automotive sector. Cedefop's Motor vehicles category provides the sectoral reference for these activities [11], while the ERM records in Table 5 identify restructuring at specific establishments and the announced timing of employment effects [14].

Table 5 Documented restructuring in ICE-related activities and automotive component manufacturing

Site and activity	Employment effect and timing	Sector-specific implication
Marelli, Argentan, France [C11]	Manufacture of throttle bodies, an engine air-intake component. Closure announced with 167 planned job losses; employment effects from January to March 2024.	Throttle-body manufacture directly connects the establishment to internal-combustion-engine production, making this a

Site and activity	Employment effect and timing	Sector-specific implication
		clearly identified case of restructuring within the conventional powertrain value chain.
MMT-B, Blanquefort, France [C12]	Manual gearbox manufacturing for thermal vehicles. 230 planned job losses out of a workforce of 430 during 2025, linked to a sharp fall in projected demand for manual gearboxes.	The case provides strong evidence of exposure to the decline of conventional powertrains. The closure is partial rather than total, so the retained and released populations must be distinguished.
Stellantis, Metz-Borny, France [C13]	Closure of two of three gearbox production lines, 230 planned job losses between June 2024 and December 2025. Early retirement and transfers to nearby electric-motor and electric-transmission activities were offered.	The case shows that restructuring does not automatically create an external labour pool: internal transition and retirement may absorb much of the affected workforce.
Stellantis, Termoli, Italy [C14]	200 voluntary exits during 2025 at a site where traditional engine production was ending while some work was redirected towards hybrid components.	Voluntary exits are a different population from dismissals and cannot be assumed to be seeking industrial re-employment.
Magna, Untergruppenbach, Germany [C15]	162 planned job reductions by the end of 2026 in the powertrain business, attributed to declining demand and lower staffing requirements in transmission manufacturing.	The case offers a current window within the short-term horizon, which makes occupational verification with the employer worthwhile before it closes.
BorgWarner, Kirchheimbolanden, Germany [C16]	Around 400 planned job reductions starting in April 2025, affecting both production and the development centre. ERM links the restructuring partly to electromobility and the phase-out of combustion engines. The factsheet gives two different end dates: 1 January 2028 in its structured field and the end of 2028 in its narrative.	The case provides a basis for examining manufacturing and engineering functions within the same industrial programme. Departure arrangements rely on voluntary measures, partial retirement and natural attrition, with no forced redundancies announced,

Site and activity	Employment effect and timing	Sector-specific implication
		which illustrates the importance of considering the affected activities together with the mechanisms through which employment reductions are implemented.
MD Elektronik, Vratsa, Bulgaria — automotive cables and data-transmission components [C44]	ERM records 550 planned job reductions with the closure of the plant, announced on 17 February 2026, with employment effects in June 2026; most production, administrative and financial staff are dismissed, while a few employees remain for site security and closure activities. The partner's estimate of 550–650 positions also includes a Teklas Bulgaria unit, which lies outside the perimeter of this case.	Vratsa lies about 60 km from Kozloduy NPP in a straight line, with organised daily employee transport to the nuclear site according to the partner. The partner identifies I&C technicians, automation specialists, electromechanical assemblers, QA/QC inspectors and maintenance staff; their presence among the dismissed workers remains to be verified (R6).
SE Bordnetze (Sumitomo Electric Bordnetze), Mezdra, Bulgaria — automotive wiring harnesses [C45]	ERM records about 950 planned job reductions with the closure of the Mezdra plant in March 2025, within a programme of 1,050 reductions announced on 14 September 2024 that also includes about 100 at the Karnobat plant in south-eastern Bulgaria, not considered here; production was transferred to Moldova and Romania. The partner's estimate of 1,000–1,200 positions refers to Mezdra and to a site at Cherven Bryag, which the ERM record does not cover and which remains to be confirmed; the two figures are therefore not compared.	Mezdra lies about 70 km from Kozloduy NPP in a straight line. The partner identifies certified industrial electricians, cable-harness specialists and line-maintenance technicians. As the Mezdra closure took place in 2025, subsequent re-employment must be checked before the cohort is treated as available (R5).
Leoni, Pleven, Bulgaria — automotive cable harnesses [C46]	Total closure of the plant in 2024; CNC Kozloduy estimates 1,200–1,300 direct technical positions affected.	Pleven lies about 75 km from Kozloduy NPP in a straight line. The partner identifies skilled personnel in quality management, industrial

Site and activity	Employment effect and timing	Sector-specific implication
		logistics and electromechanical maintenance, eligible for cross-sector reskilling programmes. Given the 2024 closure, the current employment situation of former employees must be verified (R5).
Yazaki Bulgaria, Yambol, Sliven and Haskovo — automotive components [C47]	CNC Kozloduy estimates 800–1,000 direct positions reduced through capacity optimisation and line downsizing between 2023 and 2025.	The partner identifies quality-assurance profiles experienced with IATF 16949 and ISO 9001, process engineering and safety and maintenance profiles, which it considers adaptable to the ISO 19443 requirements of the nuclear supply chain. These plants, in south-eastern Bulgaria, lie about 240 to 265 km from Kozloduy NPP in a straight line, beyond daily commuting distance.

Source: ERM factsheets listed in Annex III; for the Bulgarian rows, CNC Kozloduy [61].

Automotive restructuring must therefore be analysed at the level of the affected technology, establishment and occupation, and the reason for each reduction recorded rather than assumed: the records retained here combine technological substitution, falling demand, relocation of activity and cost or customer decisions, and the Marelli Argentan and Stellantis Metz-Borny records in particular involve transfers of activity alongside product change [C11; C13]. Exposure to internal-combustion technologies does not by itself identify the cause of a given reduction. The ERM records are strong on site, activity, scale and timing, but do not identify the occupational composition of the affected workforce — a material evidence gap for D4.4 (R6). Redundancy figures are not divided into assumed shares of machinists, maintenance technicians, automation specialists, quality personnel or engineers; those groups are counted only where their presence among the affected workers is documented through employer information, restructuring agreements, works-council or trade-union sources, regional workforce studies or public-employment-service data.

The Bulgarian cases provided by CNC Kozloduy [C44–C47] illustrate a different situation from the ICE-specific cases above. Over the last two to three years, several Tier 1 and Tier 2 suppliers in Bulgaria producing cable harnesses, mechanical parts, sensors and electronic components for European vehicle manufacturers have closed sites, relocated lines or reduced their workforce, in the context of the European automotive downturn and the transition to electric vehicles; the ERM records for Mezdra and Vratsa cite high production costs and weaker European demand respectively. Unlike the coal regions, these sites do not benefit from dedicated funding under the Just Transition Fund: support relies on general active labour-market policies, the European Social Fund Plus through the Human Resources Development Programme 2021–2027 and, potentially, the European Globalisation Adjustment Fund [61]. The partner identifies automation, I&C and robotics maintenance technicians, QA/QC inspectors experienced with IATF 16949 and ISO standards, industrial electricians and electromechanical assemblers as the main profiles relevant to nuclear. Vratsa, Mezdra and Pleven lie about 60 to 80 km from Kozloduy NPP in a straight line, and the partner reports organised daily employee transport from Vratsa, whereas the Yambol, Sliven and Haskovo plants are about 240 to 265 km away; only the north-western sites are therefore plausible candidates for daily commuting, the others implying weekly mobility or relocation (Section 6.1). As for the other cases, the partner ranges are not added (R3), and the presence of these profiles among the workers affected remains to be verified with the employers and the Employment Agency (R6).

4.3.2 Occupational relevance and implications

ASA and DRIVES provide a useful occupational lens for deciding which profiles to look for within these establishments. The DRIVES job-role framework includes Predictive Maintenance Engineers and Technicians, Automotive Quality Engineers, Automotive Engineers in Quality and Metrology, Robotic Engineers and Technicians, Automotive Engineers in Tool and Die Production and Maintenance, Automotive Engineering CAD/CAE/CAM, Advanced Powertrain Engineers and advanced manufacturing set-up roles; these roles evidence occupational capabilities present in the ecosystem, not that workers in those roles are affected by a specific restructuring event [35]. The automotive profiles identified support the occupational hypotheses developed in Chapter 5 and Annex II, particularly in maintenance, automation, machining, quality and selected engineering functions [3; 15]. For ICE-related activities, the case-specific enquiry should establish which production or development functions are affected, which technical occupations are involved and how departure dates and locations relate to nuclear recruitment and preparation requirements, while the assessment identifies the tasks and qualifications relevant to each receiving role, including any change of specialisation.

4.4 Selected metallurgy and heavy-industry activities

Metallurgy, steelmaking and selected heavy-manufacturing activities are potentially relevant sources of experienced technical personnel, employing workers with experience in welding, machining, metal fabrication, mechanical maintenance, pressure equipment, structural engineering, inspection and non-destructive testing (NDT). Consistent with Section 4.1.1, the sector is examined in detail here while its aggregate employment decline is not treated as evidence that these workers are available.

4.4.1 Sectoral context and establishment-level evidence

EUROFER's *European Steel in Figures 2026* confirms the difficult operating environment facing European steel production: EU crude-steel output fell to 125.8 million tonnes in 2025, 2.9% below the previous year and the lowest level reported in the publication, while imports accounted for around 30% of EU steel consumption. Steel nevertheless remains a major industrial employer, with approximately 293,000 direct jobs in the EU in 2025, geographically concentrated in Germany (about 74,400), Italy (30,533), France (25,000), Romania (22,640) and Poland (21,000). These totals locate industrial concentrations; they do not measure workers available for external recruitment [36].

Earlier Cedefop occupational analysis illustrates, for metal and machinery trades — welders, metal-working machine-tool occupations and machinery mechanics — how projected contraction coexists with large replacement requirements and persistent shortages, which is why employment change and replacement demand are distinguished (Section 2.4) [37]. The distinction is particularly relevant in metallurgy, because decarbonisation does not imply simple contraction: conversion from blast-furnace routes towards electric-arc furnaces, product-portfolio changes, automation and digitalisation may eliminate some positions while creating or modifying others, so a steelworks may simultaneously release workers, retain scarce technical trades and recruit different skills.

Table 6 Documented restructuring in metallurgy and heavy manufacturing

Site and activity	Employment effect and timing	Occupational evidence and sector-specific implication
Greenbrier / Astra Rail, Arad, Romania — railway rolling-stock manufacturing [C18]	Closure of the Arad wagon factory, 699 planned dismissals out of 777 employees, announced April 2025 and scheduled for completion by 30 June 2025.	Certification records under EN ISO 3834-2 (welding quality requirements) and EN 15085-2 CL1 (railway vehicles and components) document controlled welding production and associated quality requirements [66]. They provide an establishment-level basis for investigating welding, fabrication and

Site and activity	Employment effect and timing	Occupational evidence and sector-specific implication
		inspection profiles as potential sources for nuclear component manufacturing.
Rohrwerk Maxhütte, Sulzbach-Rosenberg, Germany — seamless steel tube manufacturing and steelworks [C19]	Operations ceased 1 September 2025, all 300 employees affected. The company describes its activity as the manufacture of seamless steel tubes. ERM classifies the establishment under NACE 25.53, Machining of metals — a statistical heading retained here as metadata, whose version should be identified whenever ERM records are compared with the sectoral aggregates of the employment forecasts.	A documented whole-site closure. The seamless steel-tube activity provides the industrial basis for examining metalworking, production-equipment and maintenance occupations; occupational interpretation should draw on the establishment's actual products and processes rather than on the ERM classification.
HKM, Duisburg, Germany — integrated steelworks [C20]	1,700 planned job reductions over a phased restructuring running to the end of 2028, as the site transitions towards lower-carbon steel production and an electric-arc furnace. The record updated in July 2026 sets the start of the employment effects at 30 June 2026 and identifies a voluntary-departure wave from 1 October 2026.	HKM's vocational information confirms industrial mechanics whose tasks include installation, fault diagnosis, repair, component manufacture, turning, milling, CNC machining, hydraulics, pneumatics and maintenance, and the training of automation and plant-electrical technicians [67]. Public evidence does not state whether those profiles are among the 1,700 or retained for the transformed plant. HKM also reports around 1,500 external service providers [67], to be assessed separately.
Voestalpine Böhler Bleche, Mürzzuschlag, Austria — basic steel manufacturing [C21]	Around 450 potential job reductions announced in October 2025 within a competitiveness and cost programme.	Eurofound reports that reductions are expected mainly among production and technical personnel, particularly blue-collar workers — a rare occupational indication, though it does not establish the presence or number of welders, machinists, mechanics or NDT technicians.
Tata Steel, IJmuiden, Netherlands — steel production [C17]	Restructuring revised to 1,224 planned job reductions during 2025.	The case is a counter-example: Eurofound states that reductions primarily concern management and support services alongside internal reconfiguration. A large steel-sector announcement is not by itself a source of welders, mechanics or inspection technicians.

Source: ERM factsheets and employer certification records listed in Annex III.

The Greenbrier certificates provide documentary evidence of industrial capabilities beyond a broad sector classification: the Arad EN ISO 3834-2 certificate records qualified welding processes and personnel, supervisory and inspection staff, and facilities suitable for manufacturing and inspecting welded products, while the EN 15085-2 CL1 certificate specifies the railway manufacturing scope, welding processes and material groups covered. This evidence concerns capabilities documented during the certification periods; like the HKM vocational information, it does not quantify the workers available for recruitment [66; 67; C18; C20].

Welding and inspection occupations in metallurgy and heavy manufacturing are not static manual trades. COVE-WENDT, a Centre of Vocational Excellence in Welding and Non-Destructive Testing, sets out in its Deliverable D2.1, *Curriculum & Guidelines focused on Technical Skills*, the competences required for the digitalisation and green transition of the welding sector — digitalisation of welding and materials testing, physical simulation, digital twins, artificial intelligence, measurement and control systems, digital welding quality management and AI-supported defect detection. These occupations therefore increasingly combine conventional process expertise with digital production, measurement, quality and data capabilities. The role of COVE-WENDT here is delimited: it evidences competence content and training development, not the number of workers being released from heavy industry [38].

4.4.2 Occupational relevance and implications

The metallurgy and heavy-manufacturing cases support enquiries into welding and fabrication, machining, maintenance, inspection and selected engineering profiles, whose potential connections with nuclear equipment supply, construction and maintenance, and the corresponding bridging requirements, are examined in Chapter 5 and Annex II [3; 15]. The distinctive assessment need is to connect production capabilities with the people actually affected by restructuring. A factory certificate may document a manufacturing process or quality system, while a personal qualification concerns a specified individual, method or scope; neither identifies which workers are available for external employment. Enquiries should therefore distinguish retained staff, departing workers and external contractors, and verify the relevance and current validity of welding, inspection and other trade qualifications.

For metallurgy and heavy-industry profiles, particular attention should be paid to applicable manufacturing requirements, material traceability, workmanship, inspection records and any extension of trade or NDT qualification. The receiving employer must confirm the actual duties and the additional assessment, learning and supervised practice required [3; 9].

4.5 Chemical, petrochemical and process industries

The European chemical, petrochemical and process industries are undergoing significant restructuring under the combined effects of weak demand, high energy and production costs, global overcapacity, import competition and the investment requirements of industrial decarbonisation. Cefic's Chemical Trends Reports, based on Eurostat data, give a quarterly view of the industry; the Q1 2026 report records EU27 chemical production 3.2% lower year-on-year, with particularly weak performance in other organic basic chemicals and polymers and significant contractions in Germany, Italy and the Netherlands [39]. This applies to a still substantial workforce: Cefic reports approximately 1.2 million direct employees and around 31,000 chemical companies in Europe [40]. Such aggregates establish the scale and geographical importance of the sector but cannot be read as evidence that this workforce is becoming available, since restructuring can occur alongside investment, conversion or recruitment elsewhere in the same cluster.

4.5.1 Sectoral context and site-level evidence

The analysis draws on the sectoral classification used in the Cedefop Skills Forecast to distinguish between chemical manufacturing (excluding pharmaceuticals), pharmaceutical manufacturing, and the manufacture of rubber and plastic products; as explained in Section 2.4, this use is conceptual [11]. The cases examined below are identified through restructuring records and complementary employer evidence. Potential workforce availability must be assessed for the affected activity and occupational group, taking account of employment effects, timing, shutdown staffing and redeployment arrangements [14; see Annex III].

Table 7 Documented restructuring in chemical, petrochemical and process industries

Site and activity	Employment effect and timing	Sector-specific implication
FMC/Cheminova, Rønland, Denmark — agrochemical production [C23]	Closure announced 1 September 2026 affecting 385 employees, all recorded as direct dismissals. Operations expected to cease by the end of 2026.	Departure mechanism (direct dismissals) and expected cessation of operations are recorded as two distinct dimensions of the restructuring. The case provides an establishment-level basis for examining transitions from agrochemical production.
ExxonMobil Chemical France, Gravenchon/Port-Jérôme and Nanterre, France — steam cracking	Closure of the steam cracker and polyethylene, polypropylene and adhesives units, with departures during 2025. The programme	The case lies directly within petrochemical process production and is a clear illustration of R5. The continuing refinery activity must be

Site and activity	Employment effect and timing	Sector-specific implication
and downstream polymers, and head-office functions [C24]	covers Port-Jérôme and Nanterre: the initial announcement distinguished 647 posts at the industrial site from 30 at the head office, and the ERM record was revised after negotiations from 677 announced reductions to 608 in total, with no published final allocation between the two locations.	separated from the chemical units being closed. The 608 are not attributed to Port-Jérôme alone, nor to technical occupations: head-office functions fall within the perimeter.
LyondellBasell/Covestro, Maasvlakte, Rotterdam, Netherlands — propylene oxide and styrene monomer [C25]	Closure affecting the site's approximately 160 employees, announced March 2025. The asset is undergoing safe shutdown and preparation for demolition through the end of 2026 [69].	The most useful occupational evidence in this group: LyondellBasell states that the majority of employees work in shifts in operations or the laboratory, with further departments in engineering, maintenance, logistics, health and safety and support functions [68]. Numbers per occupation and final redeployment status remain to be established.
Yara, Tertre, Belgium — ammonia and nitrogen products [C26]	Closure of the ammonia unit and concentration on premium nitrate fertilisers and industrial nitrogen chemicals. An initial estimate of 115 possible dismissals was reduced to a maximum of 61; 25 workers could use early retirement, 10 internal posts were opened and a voluntary-exit scheme introduced.	The reduction of the initial estimate following social dialogue shows how negotiated arrangements can reshape the employment effects of industrial conversion. Continued production, early retirement, internal vacancies and voluntary departure make this a documented example of differentiated departure and redeployment mechanisms, for which the revised announcement must be retained and the arrangements offered to affected workers distinguished.
Vynova, Beek/Geleen, Netherlands — PVC production [C27]	ERM recorded a 2025 closure affecting around 100 employees, production due to cease in November 2025. Vynova now states that the site is preparing to restart production in autumn 2026 with approximately 105 employees [70].	The case demonstrates why restructuring records must be updated before a workforce is designated as available. The announced restart supersedes the initial closure scenario, so the volume of that closure is not counted as available; it does not establish that all former employees are taken back, nor that the same

Site and activity	Employment effect and timing	Sector-specific implication
		occupations will fill the future posts. The number of workers who may nonetheless be on the external labour market is unknown, and Vynova's site information documents mechanical maintenance profiles [70]. The lead is suspended rather than closed, and would be reactivated only after verification of the re-engagements and of the remaining profiles.
Evonik, Witten, Germany — polyester production [C28]	Announced in June 2026 that the Witten polyester plant will close in 2027, affecting its 266 employees, within a wider restructuring programme.	The 2027 closure falls within D4.4's short-term horizon and provides an establishment-specific reference for organising occupational assessment and transition preparation ahead of the shutdown, with production cessation, individual departure and entry into receiving employment treated as distinct milestones (Section 6.1).

Source: ERM factsheets and employer sources listed in Annex III.

At Maasvlakte, the operator describes a 24/7 process facility with maintenance workshops and process infrastructure on site. Because the closure process extends through 2026, some employees may remain necessary for safe shutdown and demolition preparation after routine production has ceased: the date on which production stops is not necessarily the date on which relevant workers become available [68; 69; C25].

4.5.2 Occupational relevance, destinations and bridging requirements

The technical proximity between these industries and nuclear facilities is well supported: both involve complex process systems, continuous or semi-continuous operation, extensive mechanical and electrical equipment, instrumentation and control, preventive and corrective maintenance, formal operating procedures, process safety, quality management and strict control of plant modifications. The most relevant source groups are process and field operators, mechanical and electrical maintenance personnel, instrumentation and control technicians, laboratory and chemistry personnel, reliability and inspection functions, and process, mechanical, electrical and maintenance engineers — whose relevance must be demonstrated for the workforce affected by each restructuring rather than inferred from the type of plant.

D4.3 and ENEN2plus identify destination functions relevant to process-industry experience, including field and auxiliary operations, maintenance, I&C, chemistry and quality activities [3; 15]. Potential destinations also extend beyond electricity generation: ENEN2plus D1.2 documents engineering, technical and support functions in nuclear R&D, radioactive-waste management and decommissioning, including mechanical, electrical, I&C, process, project and quality activities, which support task-level comparisons for chemical-industry profiles, particularly in process engineering, laboratory analysis, waste-treatment systems and dismantling support [17]. Chapter 5 and Annex II develop these occupational comparisons and the corresponding additional competence requirements; for operating personnel, field and process-support duties are distinguished from reactor control-room responsibilities, which follow a dedicated preparation and qualification route (Section 4.2.2) [9].

Instrumentation personnel deserve specific attention. Their presence should not be assumed because an establishment is a process plant: ERM factsheets rarely identify individual technical occupations. Site workforce records, collective-redundancy documents, employer job classifications, works-council information or public-employment-service data should establish whether instrument technicians, E&I technicians or automation engineers are actually among the employees affected, before company-specific titles are translated through ESCO [7; 8].

These industries are therefore among the technically closest non-nuclear source environments assessed. The strongest opportunities arise where the sources jointly demonstrate that a specific establishment is releasing workers, that process operators, maintenance technicians, instrumentation personnel or engineers are among those affected, and that the timing and location of their availability correspond to identified nuclear recruitment needs. For most of the sites examined, the restructuring records identify the production unit affected but not the occupational composition of the workforce; these personnel are consequently reported as a single population, separated only where the operator publishes its own occupational description, as at Maasvlakte.

4.6 Aerospace and defence supply chains under restructuring

This section examines documented restructuring in European aerospace, space and defence activities. These sectors warrant attention because they employ highly qualified technical and engineering personnel and operate under complex systems, stringent quality requirements, traceability, testing, qualification and configuration control: experience in systems engineering, mechanical and electrical design, materials engineering, testing and qualification, quality assurance, project and configuration management and advanced manufacturing can provide a strong basis for transition.

They are not, however, declining industries or recruitment pools for the nuclear sector: aerospace and defence have their own development prospects and workforce requirements, and in several European labour markets their employers seek the same occupations as nuclear employers.

4.6.1 Sectoral context and documented restructuring

The Cedefop Skills Forecast 2026 provides a reference for interpreting the broad sectoral categories relevant to aerospace and defence activities. Its other transport equipment category is broader than aerospace, and Public administration & defence is not a proxy for defence manufacturing: aggregate forecasts cannot distinguish a satellite-assembly facility undergoing restructuring from an aircraft plant increasing production, or from a defence-electronics company recruiting engineers [11]. The ERM factsheets, which record the affected location, reported activity classification, announced employment effects and implementation dates at company or establishment level, show that recent restructuring in European aerospace is concentrated in particular activities — principally space systems — rather than reflecting a general contraction of the sector [14].

Table 8 Documented restructuring in aerospace, space and defence activities

Site or activity	Employment effect and timing	Sector-specific implication
Airbus Defence and Space — group programme [C29]	Airbus reduced its planned global restructuring from 2,500 to 2,043 positions, to be implemented by 30 June 2026: 689 in Germany, 540 in France, 303 in Spain, 477 in the UK and 34 elsewhere. 1,128 reductions concern Space Systems. The programme was expected to rely substantially on early retirement and voluntary departures.	The France and Germany rows below are geographical components of this group programme and must not be added to its total (R3).
Airbus Defence and Space — Toulouse and Élancourt, France [C30]	540 positions scheduled for reduction between January 2025 and May 2026: 424 in Toulouse, where the affected activity includes satellite assembly and testing, and 116 in Élancourt, associated with military technology.	The documented satellite assembly and testing activities at Toulouse provide a concrete industrial context for comparing production, testing and associated quality functions with nuclear supply-chain requirements.
Airbus Defence and Space —	689 planned reductions by June 2026 across sites including Ottobrunn, Friedrichshafen, Manching, Bremen, Backnang and Ulm.	Geographical dispersion across six sites prevents the cohort from being treated as a single labour pool; local works-council

Site or activity	Employment effect and timing	Sector-specific implication
Germany [C31]		and employer information would be needed site by site.
Thales Alenia Space — Toulouse and Cannes, France [C32]	Management initially announced 980 positions, while trade unions reported up to 1,124, including around 715 in Toulouse. The restructuring followed weak demand for geostationary satellites. Internal transfers were proposed rather than forced redundancies. The ERM records cited were updated on 2 June 2025 to report a freeze of the reductions until at least mid-2026.	The dated stages of the programme — announcement, internal-transfer response and June 2025 freeze — document its evolution and should be retained separately from the Airbus restructuring calendar (R5).
Thales Alenia Space — Charleroi, Belgium [C33]	Around 115–120 planned reductions announced in 2024 within the wider Space restructuring programme.	The case concerns a geographically identifiable cohort, with insufficient public occupational detail to support a pathway.

Source: ERM factsheets listed in Annex III.

The Airbus cases show why the industrial programme should be recorded alongside the company name. Airbus as a group is not a contracting workforce source: the documented reductions are concentrated substantially in Space Systems, while other Airbus activities have simultaneously recruited. The same applies to Thales, where restructuring of Thales Alenia Space coexists with recruitment elsewhere in the group.

4.6.2 Competition for the same occupational profiles

Competition for talent is central to this section. ASD Europe[1]'s *Skills in Demand in the European Defence Industry* documents the profiles sought by the sector, but is not evidence of workforce availability [41]. The European Defence Agency's *Key Skills and Competences for Defence* identifies substantial overlap between defence and civilian skills, distinguishes widely transferable skills from those requiring defence-specific experience, and highlights competition from other sectors as a factor affecting recruitment and retention [42]. In 2025 ASD Europe representatives described rapid recruitment of specialised personnel as a significant challenge, while the Agency highlighted demand for software, cybersecurity, AI and systems profiles alongside

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continuing demand for welding, sheet-metal fabrication, assembly and project management [43]. ERM business-expansion cases evidence the resulting competition.

Table 9 Documented aerospace and defence recruitment competing for the same occupational profiles

Documented recruitment case	Relevance to nuclear competition
Safran, France, 2025 — 1,250 planned job creations in France recorded by ERM; this figure is presented separately from the broader recruitment campaign [C35].	Direct competition for machinists, production personnel and manufacturing technicians also relevant to nuclear component supply chains.
French aeronautics and defence recruitment campaign run by Randstad, 2026 — more than 3,000 openings announced, including welders, mechanics, aircraft fitters, electricians, quality inspectors and engineers. The figure of more than 10,000 workers short in the sector is the recruiter's own declared estimate, not an independent measurement of vacancies [C36].	Almost exactly the occupational groups nuclear employers seek. Workers leaving one aerospace establishment may be recruited rapidly by another aerospace or defence employer.
Thales España, 2026 — 130 planned hires, around 40% in engineering disciplines including cybersecurity, AI and software, and around 25% in technical and operational roles [C37].	Continuing competition for engineers, digital specialists and technical workers even within groups undergoing restructuring in another business segment.

Source: ERM business-expansion factsheets listed in Annex III.

Workforce reductions in selected space activities therefore coexist with demand elsewhere in aerospace and defence, which often provides the first employment opportunities for the workers concerned. The occupational analysis must consider both potential transitions from restructuring programmes and these employment opportunities within the same industrial ecosystem. This is consistent with ENEN2plus D1.1, which identifies competition for talent from other industrial sectors as a workforce-planning issue, stresses that the nuclear industry requires large numbers of technicians and personnel with transferable industrial competences, and identifies possible shortages in project management, automation and control, digital I&C and quality assurance — profiles for which nuclear, aerospace and defence employers may be competing simultaneously [15].

4.6.3 Occupational relevance and implications

Occupational overlap is examined through tasks and responsibilities. D4.3 provides the destination structure: nuclear activities involve engineering professionals, engineering technicians, skilled trades, digital and cybersecurity specialists, quality functions and management roles in addition to purely nuclear occupations, with engineering professionals supporting plant design, engineering analyses, configuration management and modernisation [3]. This produces several credible transition hypotheses. Systems, mechanical, electrical and materials engineers from aerospace can be compared with applied engineering, design-support, commissioning and project-engineering functions; test and qualification personnel with commissioning, testing, quality and inspection activities; quality and configuration specialists with nuclear QA, inspection and configuration-management functions; and selected manufacturing, electrical, mechanical and maintenance technicians with nuclear supply-chain, construction, maintenance and refurbishment occupations. D4.3 classifies engineering professionals, maintenance engineers, quality-assurance specialists and I&C experts among medium-high nuclearisation groups, while many technicians, mechanics and skilled trades retain a conventional technical core supplemented by nuclear-specific competence [3].

The overlap matters most for occupations already under pressure in nuclear: D4.3 identifies welders, electricians, I&C technicians, maintenance specialists and project engineers among the groups experiencing significant pressure across construction, commissioning, operation, refurbishment and decommissioning [3]. Several of these profiles are also sought by aerospace and defence employers [43], which calls for coordinated development of these scarce skills across the industries concerned rather than for treating aerospace and defence as a whole as a source of workers for nuclear. Not all aerospace expertise is equally transferable. Experience with safety-critical design, formal verification and validation, configuration control, materials qualification, quality documentation and controlled manufacturing environments provides a relevant basis for task-level comparison with nuclear occupations. These competence areas can inform the assessment of prior learning and the identification of additional requirements in nuclear safety culture, applicable codes and quality standards, regulatory interfaces, plant-specific practices and radiation protection where relevant. Safety-significant responsibilities may also require supervised nuclear experience or formal authorisation. Security-clearance experience in defence does not replace nuclear-specific qualification [9].

ENEN2plus D1.3 identifies one further, limited destination pathway at the interface between nuclear and space, while providing no evidence that aerospace or space

workers are available for redeployment. It notes that future nuclear-space systems may require competences in nuclear engineering, reactor physics, nuclear materials and chemistry, reactor systems, thermal hydraulics, safety and radiation protection, and that candidates may come from space-oriented education before acquiring nuclear education and training. The interface is not purely theoretical: D1.3 describes European projects involving both nuclear and aerospace organisations, including the PULSAR consortium with ArianeGroup and Airbus Defence and Space. It nevertheless remains niche, since D1.3 states that human-resource requirements for nuclear space applications are limited, project-dependent and closely related to wider nuclear-market demand [4].

4.7 Conclusions of the industry screening

The five groups of industries examined are all changing, but the nature of the change differs from one group to another, and so does its significance for possible transitions into nuclear activities. Applying the selection rule of Section 2.5, the screening leads to the following conclusions for each group.

Fossil-fuel extraction and conventional generation: structural decline. Coal extraction and coal-fired generation are declining under decarbonisation policies [32]. The cases examined document dated closures and phase-outs in Poland, Czechia and France, restructuring among contractors and in oil and gas extraction in Romania, the conversion of a Dutch refinery to terminal activities, and the phased reduction of coal activities in three Bulgarian regions covered by Territorial Just Transition Plans [C1–C7; C38–C43]. This is the group in which a release of workers is most directly documented, through announced departure dates and arrangements ranging from voluntary exits and mining leave to job-search assistance. The occupations of the workers concerned are, however, rarely reported in public records, the Bulgarian partner input being an exception, and contractor staff must be assessed separately from the operators' own employees.

Automotive and internal-combustion-engine supply chains: structural transformation with employment contraction. The automotive industry is undergoing a structural transformation accompanied by employment contraction, which varies across activities and territories; Eurofound finds that new electric-vehicle activities, which are more capital-intensive and require different skills, do not offset the overall employment losses [72]. Reductions in engine, transmission and component activities [C11–C16; C44–C47] coexist with new activities in electric powertrains, batteries and electronics, and with internal transfers, early retirement and voluntary departures that may absorb a large share of the workers affected. The causes of the reductions also vary,

from technological substitution and falling demand to relocation, cost or customer decisions, as in the Bulgarian component plants, and are therefore recorded case by case.

Metallurgy and heavy manufacturing: contraction and conversion. European steel production is under pressure from low output and import competition, while the shift towards lower-carbon production routes changes the jobs required [36]. Site closures and phased restructuring [C17–C21] may release welders, machinists, mechanics and maintenance personnel, but the same sites may retain or recruit scarce technical trades, and a large announcement may concern mainly management and support functions, as at Tata Steel IJmuiden [C17].

Chemical, petrochemical and process industries: closures of units and sites. Weak demand, high energy costs and global overcapacity are leading to closures of production units and sites [39; C23–C28]. These industries are technically among the closest to nuclear facilities, but shutdown and demolition work, negotiated departure arrangements and, in one case, an announced restart show that the date on which production stops is not the date on which workers become available.

Aerospace and defence: restructuring confined to specific activities. Aerospace and defence are not declining industries. Restructuring is confined to specific activities, principally space systems [C29–C33], while both industries continue to recruit many of the profiles also sought by nuclear employers [C35–C37]. They are therefore assessed only at the level of individual programmes and establishments.

Three cross-cutting conclusions follow. First, in none of these industries does a reduction in personnel requirements translate directly into workers available for nuclear employment: internal redeployment, early retirement, voluntary departures, staff retained for shutdown and recruitment by other employers reduce the number of workers who actually seek new employment (R1, R3, R5). Second, public restructuring records document sites, activities, scale and timing well, but rarely the occupations of the workers affected (R6); closing this evidence gap with source employers, social partners, employment services and national partners, as the Bulgarian contribution illustrates, is the first step of any operational assessment. Third, the industries examined share recurring occupational competences with nuclear activities, in maintenance, fabrication and welding, process operation, testing, inspection and quality, and some cases document them at establishment level: Cordemais connects conventional generation with a planned nuclear manufacturing activity on the same site; Greenbrier Arad documents controlled welding and fabrication capabilities; and Maasvlakte

provides information on operations, laboratory and technical-support functions [C1; C18; C25].

These conclusions identify where cross-sector transitions merit further investigation; they do not designate industries whose workforce should be transferred to nuclear activities. They provide the industrial basis for the occupation-to-occupation transferability assessment in Chapter 5.

5 SKILLS TRANSFERABILITY ASSESSMENT

The restructuring cases examined in Chapter 4 identify industrial settings in which relevant occupational experience may be found. Bringing this evidence together with the nuclear workforce requirements established in Chapter 3, the present chapter develops occupation-to-occupation transition hypotheses through comparison of tasks, knowledge, skills, qualifications and experience. It examines the foundations on which nuclear preparation can build, the additional requirements associated with the receiving role, and the contribution of prior-learning recognition to defining an appropriate development pathway.

5.1 Occupational and skills transferability framework

Transferability is assessed at occupation-to-occupation rather than sector-to-sector level. Two sectors may share technologies or working environments without the workers concerned performing comparable tasks, while occupations with different job titles may involve highly similar activities. The basic unit of analysis is therefore a proposed occupation-to-occupation transition pathway linking a source occupational profile to a defined nuclear or associated destination function.

5.1.1 Reference frameworks: ESCO, JRC/EHRO-N and ENEN2plus D6.1

ESCO provides the reference framework for subsequent normalisation of the source and destination occupational profiles. Its multilingual classification describes occupations, their associated skills and knowledge, and the relationships between these concepts across the European labour market and education and training systems [7; 8]. It matters here because employer-specific job titles cannot be compared reliably across industries or countries, whereas an ESCO occupation represents a group of jobs involving similar tasks and requiring a similar skill set. Source job titles should therefore be related, where sufficiently documented, to one or more ESCO occupations before their skills and knowledge are compared with destination requirements. This normalisation — including the recording of ESCO concept identifiers, version and validation status — is not completed in the present version, and the comparisons presented are therefore occupational hypotheses. ESCO is not evidence of nuclear competence or eligibility: it distinguishes competences normally essential to an occupation from those optional according to context, so nuclear-specific requirements arising from regulation, safety significance, technology, employer arrangements or plant-specific responsibilities must be added separately to the destination profile [7; 8].

The JRC review Job Classification and Taxonomy in the Nuclear Sector provides methodological principles for organising nuclear occupational information. It stresses that a workforce assessment requires an occupational classification detailed enough to

produce meaningful results yet simple, stable and generic enough to support comparison between organisations, countries and periods, and it reproduces the OECD-NEA definition of a job taxonomy as a system characterising job profiles through the tasks, responsibilities and activities performed, the competences needed and the associated entry-level qualification, training and experience requirements. The methodological principle for D4.4 follows: comparison should not stop at occupational labels or educational level, but examine what the worker actually does and under what responsibility. The JRC finds considerable diversity between national systems, from very detailed classifications such as the UK model to the more generic Finnish approach based on specialist duties or competence areas, and concludes that an excessively detailed common list risks making European comparison more difficult. Drawing on these classification principles, D4.4 groups nuclear destinations into broad functions or competence areas — operations and operations support, electrical, mechanical and I&C maintenance, engineering and design, NDT, quality assurance and control, commissioning, project management, chemistry and process engineering — and refines their descriptions to reflect the tasks and responsibilities of the destination job where documented. Such functional categories provide a stable bridge between the heterogeneous source occupations identified in Chapter 4 and more detailed employer-specific nuclear jobs [5].

D4.4 applies the job- and task-analysis principles described in ENEN2plus D6.1 to published job descriptions, employer information and occupational frameworks. The comparison examines source activities and documented competence foundations against the requirements of candidate destinations. It produces D4.4's own cross-sector transition hypotheses. Individual skills audits and observation of work activities are reserved for subsequent verification, using evidence of the worker's qualifications, experience and practical performance to refine the proposed preparation requirements [13].

5.1.2 Comparison dimensions and classification of gaps

The dimensions in Table 10 guide the qualitative comparison of source and destination occupational profiles. They help organise the available evidence on comparable tasks, potentially transferable competences and additional requirements. They also provide a structure for examining the proposed pathways in greater detail during subsequent employer and training-provider review.

Table 10 Dimensions of the source-to-destination comparison

Comparison dimension	Questions to be examined	Examples of evidence
Tasks and work activities	Which tasks are performed in the source occupation? Which tasks are required in the destination? How much of the destination work has a comparable technical or operational basis?	Job descriptions, employer documentation, task analysis, ESCO occupational descriptions
Knowledge	Which technical, scientific, process or regulatory knowledge is already present, and which knowledge is specific to the nuclear destination?	ESCO knowledge concepts, curricula, qualifications, employer competence requirements
Technical skills	Can existing methods, tools, equipment and diagnostic or production skills be used directly or with adaptation?	Skills profiles, licences and certifications, work records, practical assessment
Transversal competences	Are relevant competences such as problem-solving, communication, teamwork, procedural discipline, project working and safety-oriented behaviour already demonstrated?	Job analysis, competence frameworks, experience records
Qualifications and certifications	Is the worker's qualification level and field appropriate? Which destination qualifications, certificates or authorisations are compulsory or employer-required?	EQF and national qualifications, professional certification, regulatory and employer requirements
Relevant experience	Is the nature and duration of previous practical experience relevant to the responsibilities of the destination role?	Employment history, experience logs, employer assessment
Work context and responsibility	How similar are the operating environment, safety significance, quality requirements, supervision and decision-making responsibilities?	Destination job specification, nuclear work-function analysis
Nuclear-specific requirements	Which competences cannot reasonably be assumed from the source occupation and must be acquired specifically for nuclear work?	Safety culture, radiation protection, nuclear QA, configuration control, regulation, site and technology-specific requirements

Source: adapted from the competence-mapping methods of [13], applied to the destination structures of [3], [5] and [9].

The comparison is deliberately broader than a skills list. A maintenance technician may possess directly relevant mechanical fault-finding skills but lack knowledge of nuclear configuration control and nuclear quality requirements; conversely, two engineering occupations may share a formal qualification level while differing substantially in tasks performed and experience required. Qualifications are one comparison dimension, not a proxy for occupational equivalence.

Three competence categories and a complementary evidence status guide the qualitative comparison of source and destination occupational profiles.

- A transferable competence refers to documented knowledge, skills or experience in the source profile that contributes directly to the performance of comparable destination tasks.
- A partially transferable competence refers to a documented technical or transversal foundation that requires adaptation, extension or application under nuclear-specific conditions.
- A competence gap is an evidenced difference between the source profile and a destination requirement that calls for additional competence development. A gap may concern specific knowledge, skills or experience even where the qualification level is appropriate [12].
- Evidence insufficient / competence to be verified applies where the available material is incomplete or too general to establish how the source profile covers a destination requirement. This status identifies the evidence needed to refine the comparison, such as task descriptions, work records, qualification details or practical assessment.

D4.4 uses these categories as a qualitative reading grid for the Annex II matrices described in Section 5.1.3. Table 11 shows how each category is applied to them.

Table 11 Application of the comparison categories to the Annex II matrices

Category or evidence status	**Application to the matrices**
Transferable competence	The "Main common tasks and occupational core" column of Table A2.1 identifies potentially reusable foundations. For example, documented experience in maintaining pumps and valves supports transferability where the receiving role involves comparable equipment and maintenance tasks.
Partially transferable competence	Reading the common tasks alongside the additional destination requirements identifies where existing capability requires adaptation. For example, mechanical maintenance experience provides a foundation for

Category or evidence status	Application to the matrices
	performing maintenance under nuclear work-control, configuration and quality arrangements.
Competence gap	A listed destination requirement becomes an evidenced gap when comparison with the documented source profile establishes the additional competence to be developed. For example, a new inspection technique constitutes a gap where the source evidence establishes that the relevant knowledge and practical capability still need to be acquired.
Evidence insufficient / competence to be verified	Where source information leaves competence coverage unresolved, the corresponding requirement remains a verification point. For example, an inspection job title requires supporting evidence on the methods practised, level of responsibility, practical experience and scope of any certification.

Note: application of the categories defined in Section 5.1.2 to Tables A2.1 and A2.2.

These competence-level findings inform the orientation of each candidate pathway, using the definitions in Section 2.2. A substantially shared occupational core supports an upskilling hypothesis; a materially different occupational core requiring substantial new professional competence supports a reskilling hypothesis; and a mixed pathway combines retained occupational competences with significant new competence areas. These orientations are refined through comparison of the documented source profile with the specified receiving duties, and assessment of prior competence then establishes the appropriate combination of targeted training, workplace learning, supervised experience, formal education, certification and employer qualification [13].

5.1.3 Assessment output and its application in this deliverable

Table A2.1 organises D4.4's occupational comparisons into fourteen grouped transition hypotheses. Each row connects source occupations and industrial contexts with candidate nuclear or associated destinations, comparable tasks, indicative destination EQF and nuclearisation levels, and principal additional requirements; the case evidence summarised in Section 4.7 supports the investigation of the corresponding occupational groups. Table A2.2 complements the mapping by organising nuclear-specific requirements and indicative preparation arrangements for the destination families.

5.2 Mapping source occupations to nuclear and associated occupations

The matrix applies the comparison framework of Section 5.1 to generic source profiles and candidate nuclear or associated destinations. D4.3 provides the destination families, indicative EQF levels and nuclearisation categories, which characterise the destination and are reference values rather than universal recruitment thresholds; the indicative EQF

6–7 range in the final row of Table 12 refers to nuclear engineering, safety and operations management profiles. Table 12 summarises the proposed correspondences, while Annex II sets out the source occupations, comparable tasks and additional requirements [3].

The IAEA work-function framework describes the destination work itself. Appendices II and III of *Human Resource Management for New Nuclear Power Programmes* describe functions including maintenance and construction, operations, plant engineering, project management, chemistry, quality assurance and non-destructive examination, and relate them to competence, education, training and indicative lead-time requirements. These are useful for identifying the nature of the gap but are not harmonised European entry requirements: Appendix III is explicitly based on US practices and the IAEA notes substantial variability between countries and organisations [9]. ENEN2plus D1.1–D1.3 extend this destination perimeter beyond the operation of nuclear power plants to technical trades, engineering and project functions, to research, safety, waste management and decommissioning organisations, and to specialist non-power pathways in radiochemistry, radiopharmacy, medical physics, environmental applications and nuclear-space activities (Section 3.1) [4; 15; 17].

Table 12 Principal transition hypotheses, by destination family

Destination family and indicative EQF / nuclearisation	**Principal source occupations identified in Chapter 4**	**Transferability assessment**
Plant operations support — EQF 3–4, medium	Field and process operators from conventional power generation, oil and gas, chemical and petrochemical plants	Source and destination roles overlap strongly in process monitoring, equipment rounds, alarm response, shift working and procedural compliance. The nearest destination is field, auxiliary or process-support work; reactor control-room operation is a separate qualification route.
Skilled trades — EQF 3–4, medium	Welders, pipefitters, boilermakers and metal fabricators from metallurgy, rolling stock, fossil energy and industrial contractors; machinists and tool-and-die personnel from automotive and heavy manufacturing	Where source and destination roles share the same trade, existing practical competence provides the foundation for a transition into nuclear work. Bridging addresses workmanship, material traceability, quality records and role-specific qualifications, including welding qualifications where applicable. A move to a different trade combines nuclear-specific preparation with

Destination family and indicative EQF / nuclearisation	Principal source occupations identified in Chapter 4	Transferability assessment
		the acquisition of additional occupational competence.
Engineering technicians — EQF 4–5, medium-high	Mechanical maintenance technicians and industrial mechanics; industrial electricians; automation, robotics and I&C technicians, from the source industries examined, where the relevant tasks are documented	Documented maintenance, electrical and automation tasks provide a basis for comparison with nuclear technician roles. Additional preparation addresses the receiving systems, configuration control, work-control arrangements and associated quality requirements.
Quality and inspection technicians — EQF 4–5, medium	NDT, inspection, metrology and quality technicians from metallurgy, automotive, aerospace and process industries	Documented experience in metrology, quality control, inspection or NDT provides a basis for comparison with the receiving duties. For NDT destinations, assessment examines the relevant method, level and practical experience and, where certification exists, its scope and validity. A move into a new inspection technique may require specific practical training and supervised experience. Nuclear bridging addresses applicable codes, acceptance criteria, traceability and inspection records. Senior nuclear QA duties may require substantial nuclear-related experience.
Applied engineering professionals — EQF 5–6, medium-high	Mechanical, electrical, process, production and materials engineers from energy, chemicals, automotive, metallurgy and aerospace; aerospace systems, test, qualification and configuration engineers	Analysis, testing, modification support and engineering documentation transfer broadly. Nuclear design basis, configuration control and applicable codes are the principal additions; safety-significant responsibilities require supervised nuclear experience.

Destination family and indicative EQF / nuclearisation	Principal source occupations identified in Chapter 4	Transferability assessment
Project and asset management professionals — EQF 6–7, medium	Project engineers and project managers from construction, process industry, automotive and aerospace	Contractor coordination, work-package management, planning and risk monitoring transfer well. Nuclear project governance, regulatory interfaces and plant-system familiarity are the additions.
Digital and cybersecurity professionals — EQF 5–6, medium	Digital systems and cybersecurity specialists from automotive, aerospace, defence and process industry	Systems, network and security competence transfers; nuclear and industrial operational-technology architecture, safety and security interfaces and change control are added.
Chemistry, waste and decommissioning functions — role-specific	Industrial chemists, laboratory technicians and process-chemistry specialists; industrial dismantling and shutdown engineers and supervisors	Existing competence in sampling, analytical chemistry and dismantling planning provides a basis for task-level comparison with nuclear chemistry, waste and decommissioning roles. Additional learning is determined by the receiving duties and recognised prior competence, including requirements in radiological characterisation, contamination control and radioactive-waste procedures where applicable.
Radiation protection technicians — EQF 4–5, high	No direct source pathway identified	Specialist radiological knowledge and practice are central to the occupation, which D4.3 classifies at a high nuclearisation level. Access follows dedicated radiation-protection training, supervised practice and the applicable qualification requirements (Section 5.4.2).
Nuclear engineering, safety and operations management — EQF 6–7, high	No direct source pathway identified	Entry normally requires dedicated scientific education, plant-specific experience and formal qualification. Relevant industrial experience may support entry, and what distinguishes this family is the conditions and lead times of access rather than the possibility of external recruitment.

Source: destination families, EQF levels and nuclearisation categories from [3]; source occupations from the cases examined in Chapter 4. Full matrix in Annex II.

The clearest task correspondences identified in D4.4 concern mechanical and electrical maintenance, I&C, fabrication and machining, inspection and NDT, and selected applied-engineering functions. These correspondences identify existing occupational competences on which preparation for nuclear work can build. D4.3 characterises the corresponding destination families predominantly at medium or medium-high nuclearisation levels [3]. The content and duration of preparation are determined through assessment of prior competence and the receiving role's requirements, including nuclear-specific knowledge, qualifications, supervised experience and workplace learning.

Plant-operation, quality and safety pathways require greater caution. Industrial operators from conventional power or process plants may bring relevant experience in shift working, process monitoring, equipment rounds, procedural compliance and abnormal-condition response, but the closest destination is normally plant operations support rather than reactor control-room operation, which the IAEA associates with dedicated plant-equipment and control-room training, position-dependent lead times and the relevant education, experience, qualification and authorisation requirements [9]. Similarly, experience in industrial QA, NDT, process safety or safety-critical engineering may be valuable without being equivalent to nuclear QA, radiation protection or nuclear safety analysis: D4.3 assigns a high nuclearisation level to radiation-protection technicians and nuclear safety professionals, while quality and inspection technicians are classified at a medium level, and in the IAEA example the QA function requires substantial nuclear-related experience [3; 9].

The mapping to decommissioning, radioactive-waste management and research further shows why the destination should not be reduced to NPP operation: ENEN2plus D1.2 identifies decommissioning and waste management, radiation protection, nuclear engineering and nuclear physics among the disciplines expected to remain in demand, and its survey shows that these organisations employ a broad range of construction, mechanical, electrical, I&C, process, project and quality competences [17]. Non-power applications, by contrast, are targeted specialist pathways rather than extensions of the general transfer matrix. ENEN2plus D1.3 indicates that entry to medical-physics training normally requires a physics degree, with engineering sciences accepted in some cases, and that recent curricula include postgraduate education and substantial clinical training; a transition from an industrial or research physicist to medical physics is therefore a substantial reskilling pathway rather than a short nuclearisation module, and the same caution applies to radiopharmacy. Industrial or research chemists may, by

contrast, provide a relevant foundation for radiochemistry, subject to dedicated radiological and nuclear training [4].

5.3 Transferable technical and transversal skills

The mappings in Section 5.2 indicate that cross-sector transferability depends less on the industrial label attached to previous employment than on the tasks actually performed. This deliverable therefore distinguishes technical skills and knowledge potentially reusable at the destination from transversal competences supporting performance across technical and organisational contexts. Neither is transferable merely because it appears in both occupational descriptions: the assessment must verify that the worker has applied the competence at an appropriate level of autonomy, complexity and responsibility. The strongest evidence is the performance of comparable work activities in the source occupation, supported by documented experience, qualifications, certifications or employer records — a task-based approach consistent with ENEN2plus D6.1 [13]. The distinction matters particularly for the group ENEN2plus D1.1 describes as nuclearised professionals: workers with formal education and experience in mechanical, electrical, chemical or civil engineering, project management, quality control, welding or other non-nuclear disciplines, who require additional knowledge to apply that expertise in a nuclear context. The report distinguishes them from nuclear-aware personnel — electricians, mechanics and craftspeople — whose occupations do not require extensive nuclear knowledge but do require appropriate nuclear training [15].

5.3.1 Transferable technical skills

For the transition hypotheses examined in Section 5.2, Table 13 summarises potentially transferable technical competences in mechanical maintenance, electrical systems, instrumentation and control, fabrication and welding, machining, industrial processes, quality and inspection, and applied engineering. The comparison focuses on the tasks associated with each source occupation and their potential contribution to the receiving role.

Table 13 Potentially transferable technical competence areas

Technical competence area	Examples of source tasks demonstrating transferability	Potential relevance to nuclear and associated occupations
Mechanical maintenance	Preventive and corrective maintenance; equipment inspection; fault diagnosis; disassembly and replacement of components; maintenance of pumps,	Mechanical maintenance technicians, engineering technicians, maintenance engineers, commissioning

Technical competence area	Examples of source tasks demonstrating transferability	Potential relevance to nuclear and associated occupations
	valves, rotating equipment and piping; testing after intervention	and outage-support functions
Electrical systems	Installation, inspection, testing and maintenance of electrical equipment; work on motors, switchgear, cabling and distribution systems; fault finding and corrective intervention	Electricians, electrical technicians and engineers, maintenance and commissioning functions
Instrumentation, control and automation	Installation and maintenance of sensors and actuators; calibration; measurement and control-loop testing; fault diagnosis; industrial automation and control-system maintenance	I&C technicians and engineers, digital-control and maintenance functions
Fabrication, welding and pipework	Interpretation of technical drawings and fabrication specifications; preparation, fit-up and assembly of components or pipework; application of fabrication and joining processes appropriate to the source trade; checking geometry and workmanship; recording production checks	Welders, pipefitters, boilermakers and metal fabricators in nuclear component manufacturing, installation and maintenance
Machining and tooling	Interpretation of manufacturing drawings; machine and tool setup; conventional or CNC machining; adjustment of machining parameters; checking dimensions, tolerances and surface finish; inspection of finished parts	Machinists, machining technicians and tooling specialists in nuclear component manufacturing and associated supply chains
Process operation and process engineering	Process monitoring; equipment rounds; interpretation of operating parameters; alarm response; application of operating procedures; shift handover; troubleshooting and management of abnormal process conditions	Field and auxiliary operations, process-support functions, process and operations engineering
Quality, inspection and metrology	Application of inspection plans; dimensional and metrological control; non-destructive examination; interpretation of specifications and acceptance criteria; recording and	Quality and inspection technicians, NDT activities, QA/QC and manufacturing or maintenance inspection functions

Technical competence area	Examples of source tasks demonstrating transferability	Potential relevance to nuclear and associated occupations
	reporting of results; management of non-conformities	
Applied engineering and technical problem-solving	Analysis of system or component performance; preparation and interpretation of drawings and technical documentation; troubleshooting; testing; modification support; reliability analysis	Applied engineering, maintenance, plant engineering, commissioning and asset-support functions

Source: based on the destination families of [3] and [15], compared with the source occupations documented in Chapter 4.

These areas correspond to occupational families for which D4.3 proposes nuclearised rather than wholly nuclear training pathways. At Lower VET level, the technical core of many EQF 3–4 occupations remains largely unchanged and the conventional vocational content predominant, supplemented by nuclear-specific modules addressing the additional safety, quality, regulatory and documentation requirements of the nuclear environment; at Higher VET and Vocational Bachelor levels applied technical knowledge, workplace experience and nuclear specialisation are combined rather than replacing the original discipline [3]. An experienced mechanic, electrician, I&C technician or maintenance professional should not normally be treated as having to reacquire the basic occupation where the destination involves comparable tasks. ENEN2plus D1.1 supports concentrating the assessment on these fields and identifies continuing demand for project managers, operations and mechanical engineering and maintenance technicians who may originate from non-nuclear backgrounds [15].

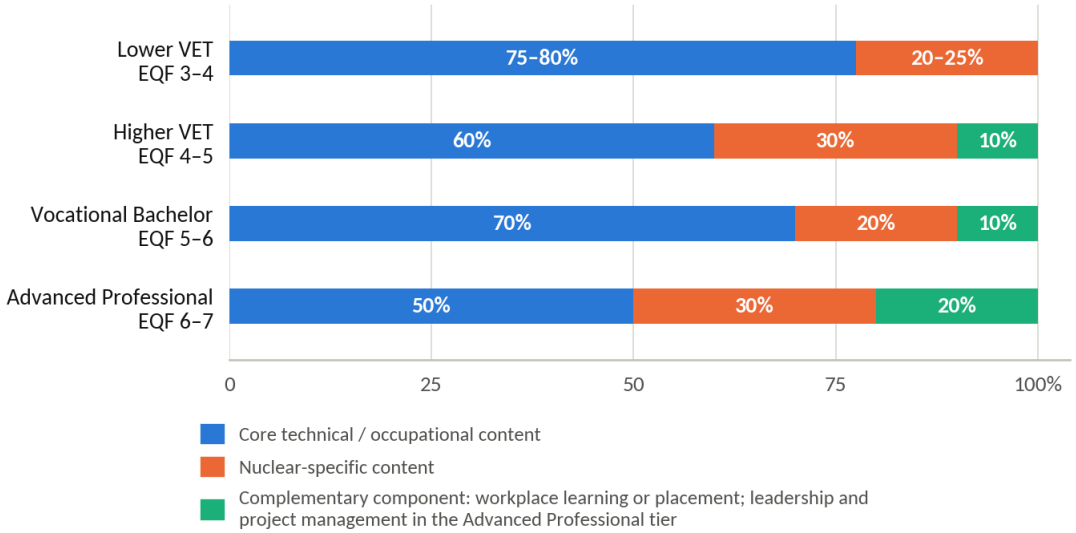
Transferability nevertheless varies within each field. Experience maintaining pumps and valves in a chemical plant provides direct evidence of mechanical-maintenance competence relevant to comparable nuclear equipment, whereas experience in a generic maintenance department without information on equipment or tasks provides much weaker evidence. Industrial instrumentation experience with sensors, actuators, calibration and control loops is relevant to I&C functions, but the source job title alone does not demonstrate competence on safety-classified nuclear I&C systems. For quality personnel, documented inspections, non-conformity management, metrology, NDT or controlled documentation provide a stronger basis than a generic quality title. The same applies to process workers.

5.3.2 Transferable transversal competences

Technical similarity alone does not explain successful performance at the destination. ENEN2plus D1.1 identifies soft skills as an important future requirement, highlighting attention to detail, adaptability, learning ability, effective communication, critical thinking, accountability and leadership [15], and ENEN2plus D6.1 similarly separates technical, scientific and regulatory competences from managerial and soft competences, identifying project management and communication within its taxonomy [13]. Relevant transversal competences include procedural discipline, technical communication, teamwork, systematic problem-solving, accurate documentation, accountability, adaptability and risk awareness. Their application depends on the receiving role: technician occupations require evidence from the execution of technical work, while supervisory and EQF 6–7 roles place greater emphasis on judgement, systems thinking, planning and leadership [3]. Assessment should use documented work situations to establish the tasks, complexity and responsibilities in which these competences were demonstrated. Experience in safety-critical industries can provide relevant evidence for this assessment. Section 5.4 addresses the additional requirements of nuclear safety culture and practice.

5.4 Nuclear-specific competence gaps and bridging requirements

This section identifies additional destination requirements by task, safety significance and level of responsibility, drawing on D4.3's occupational framework and the IAEA's distinction between education, experience, training and qualification [3; 9]. Figure 1 presents the curriculum compositions recommended in D4.3, showing how conventional technical learning, nuclear-specific content and complementary components are combined across the four VET tiers. Nuclear-specific content accounts for approximately 20–30% of the programmes represented. The figure uses the midpoints of the Lower VET ranges and combines the fundamental and applied technical components of the Vocational Bachelor tier. Workplace learning at Higher VET and Vocational Bachelor levels is distinguished from the leadership and project-management component of the Advanced Professional tier. These programme-level references help structure the discussion of training content and delivery. Individual bridging plans build on this framework through assessment of prior competence and the requirements of the receiving role, which determine the additional learning, practical experience and duration required [3].



Adapted from D4.3. Lower VET: D4.3 states ranges of 75–80% and 20–25%; mid-points are plotted. The Vocational Bachelor core aggregates categories set out separately in D4.3. A share of a curriculum is not a volume of training required by a worker whose prior learning has not been assessed.

Figure 1 Recommended curriculum composition by VET tier, adapted from D4.3 [3]

5.4.1 Common competence areas with role-dependent depth

Four areas are examined across the transition pathways. They form a common assessment structure, while the required depth and practical application vary by occupation: D4.3 identifies safety culture, radiation protection awareness, quality assurance, human performance, conduct of operations and nuclear documentation as vocational training components, with systems knowledge, configuration management and more advanced regulatory competences added for higher-level responsibilities [3].

Nuclear safety and safety culture. Workers need to understand how their tasks affect nuclear safety and apply the associated expectations in practice. Bridging should address procedural discipline, human-performance tools, reporting and escalation of anomalies, and learning from operating experience; previous experience in a safety-critical industry is assessed through relevant work situations.

Radiation protection. Three levels are distinguished throughout: general awareness, competence to perform assigned work in controlled areas, and specialist radiation-protection responsibility. Exposure and contamination controls, dosimetry and radioactive-material handling are included where relevant to the tasks and site. A general awareness module cannot establish competence as a radiation-protection technician.

Nuclear quality, documentation and regulatory requirements. Existing quality skills should be extended to the applicable nuclear requirements for traceability, controlled

instructions, inspection records, non-conformity reporting and configuration control, including the records needed to demonstrate that work was correctly performed. Training should also explain the national and organisational requirements applicable to the role, the relevant codes and standards, and the limits of the worker's responsibility; specialist licensing or safety-assessment duties require substantially greater depth than general regulatory awareness.

Plant systems and site practices. Workers need the system, equipment and procedure knowledge necessary for their assigned activities, including work coordination and interfaces with other functions; site induction should be followed by technical training and supervised application where the job requires them. The IAEA links training and qualification to plant design, the management system and regulatory requirements, and calls for construction and project personnel to be trained in quality requirements and foreign material exclusion [9].

5.4.2 Occupational gaps and indicative bridging pathways

Table A2.2 in Annex II identifies, for each of its ten destination families, the nuclear-specific requirements to assess against prior competence, together with indicative bridging arrangements and assessment evidence. Three general findings emerge from this comparison.

First, bridging for skilled trades, plant operations support, engineering technicians and quality and inspection technicians builds on occupational competences already demonstrated and relevant to the receiving role. Preparation addresses nuclear workmanship, quality and traceability, controlled documentation, systems knowledge and site practices, with foreign material exclusion and radiological work controls where applicable. Practical exercises and supervised tasks support the application of these competences in the destination environment. The depth and content of preparation reflect the equipment, tasks and responsibilities concerned. A change of trade, a new inspection method or substantially different responsibilities may also require additional occupational learning, combining upskilling with reskilling.

Second, two families call for substantial nuclear specialisation. D4.3 classifies radiation protection technicians at EQF 4–5 at a high nuclearisation level, with specialist radiological knowledge and practice central to the occupation. Nuclear engineering, safety and operations-management functions at EQF 6–7 require preparation aligned with the receiving duties and the candidate's prior education and experience. Depending on the role and applicable qualification requirements, nuclear specialisation may be developed through degree-based study or advanced professional training, alongside relevant experience and formal assessment. Operating responsibilities involve plant-

specific preparation, simulator training where applicable, and any required authorisation or licensing [3; 9].

Third, chemistry, radioactive-waste and decommissioning destinations require a task-specific assessment rather than a single EQF or nuclearisation label. Chemical or dismantling experience should be supplemented, as applicable, by plant chemistry or radiochemistry, radiological characterisation, contamination control and radioactive-waste procedures, with supervised application in the receiving facility [9; 29].

5.5 Recognition of prior learning, qualifications and skills portability

Recognition of prior learning enables workers entering nuclear and associated occupations to build on competences already acquired and concentrate further learning on the gaps identified in Section 5.4. It requires a documented decision on which existing achievements are relevant to the destination role, which need further assessment and which additional competences must be developed [3]. Three related processes are distinguished: validation of learning acquired through experience; recognition or comparison of existing qualifications; and the receiving employer's assessment of competence for a specific nuclear job. Cedefop defines validation as assessment against an established standard confirmed by an authorised body, and a qualification as a competent body's decision that the relevant outcomes have been achieved — both more specific than a declaration of experience or an employer's initial judgement [12].

5.5.1 Validating prior learning and comparing qualifications

Cedefop's 2023 guidelines provide a four-phase structure that D4.4 adapts to individual transition pathways. The intended outcome should be agreed at the outset: for example, evidence for recruitment, exemption from specified learning units or a qualification awarded through the applicable validation route [44]. Candidates should receive guidance on evidence, costs and outcomes, with clear responsibilities, confidentiality and appeal arrangements [44].

Table 14 Four-phase validation of prior learning applied to a transition pathway

Phase	Application to the transition	Recorded output
Identification	Discuss the worker's tasks and learning from employment, training and other experience. Identify relevant achievements and the target standard.	An initial profile of potentially relevant learning outcomes

Phase	Application to the transition	Recorded output
Documentation	Assemble evidence such as qualifications, work samples and employer statements, linked to the outcomes claimed.	A portfolio that allows an external reader to check the basis of each claim
Assessment	Compare the evidence with the chosen standard, using suitable interviews, tests, practical demonstrations or observation.	A record of outcomes demonstrated and those still unproven
Certification	Where the route provides for it, obtain confirmation of the assessed outcomes by the competent body through a full or partial qualification or other recognised award.	A decision specifying the award and its scope

Source: adapted from Cedefop, European guidelines [44].

Qualification comparison starts with the original award: title, awarding body, country, field, learning outcomes and status in the national system. The EQF provides eight reference levels and connects national qualifications frameworks through a formal referencing process; it facilitates comparison of levels but is neither an individual assessment nor an award of occupational equivalence. The officially established NQF/EQF reference should therefore be recorded where available, rather than a qualification level inferred from a job title or years of service [10]. An industrial electrical qualification and a nuclear technician destination may share an EQF level while differing in technical scope, assessed tasks and nuclear-specific requirements; these dimensions are compared separately. ESCO supplies a multilingual vocabulary for expressing occupational and skills correspondences, and its descriptors support mapping without certifying the worker [3; 7; 8].

The European inventory and its national reports identify the institutions and routes through which validation can produce a usable result. Two examples show why the purpose and receiving body must be specified. In France, the 2023 inventory describes *validation des acquis de l'expérience* (VAE) in relation to qualifications registered in the RNCP, with procedures determined by the awarding bodies; the jury may validate the full qualification, specified competence blocks, or decline validation, so the target certification and its validation route should be checked with the *certificateur* [45; 47]. In the Netherlands, the inventory distinguishes an education route linked to formal qualifications from a labour-market route for recognising experience; an *ervaringscertificaat* can support the education route, but the receiving institution's examination body determines its use [46]. The inventory is, however, a dated account of national arrangements: each concrete pathway should confirm current eligibility, the qualification or occupational standard, the competent assessment and awarding

bodies, acceptable evidence, language, fees and timing. For cross-border moves the receiving-country procedure is identified separately from validation in the country of origin, and where a profession is regulated the competent authority's recognition requirements must also be checked [45; 46; 48; 49].

5.5.2 Portability, micro-credentials and recording of decisions

ENEN2plus D4.1 presents learning outcomes, Europass and the European Learning Model (ELM) as complementary means of documenting and exchanging learning information, ELM providing a common structure for describing achievements, assessments, qualifications and issuers. A portable record should link each competence claim to its evidence and assessment and retain the original award and its reference standard [29]. Europass documents, including Certificate and Diploma Supplements, make the content of qualifications easier to explain, and European Digital Credentials for Learning support verification of origin and integrity. Europass states that using its tools confers no automatic recognition, and a verified record may document participation only: the receiving organisation must examine what was actually assessed and awarded [48; 49].

The distinction is material for nuclear bridging courses. In its 2023 inventory ENEN2plus recorded approximately 55% of offers with certification without examination and 12% with certification with examination. The learning outcomes, assessment method and recognition scope of each proposed course should therefore be verified: the absence of an examination does not establish that no assessment occurred, but a certificate should not be treated as proof of practical competence without evidence of the assessment supporting it [29].

D4.3 recommends stackable micro-credentials linked to occupations and nuclearisation needs, including safety culture, radiation protection, quality assurance and configuration management. These complement existing qualifications, and their value depends on whether the receiving employer or institution accepts the specific learning outcomes and assessment [3]. The Council Recommendation of 16 June 2022 provides the reference for their description and quality: a micro-credential records a small volume of learning whose outcomes have been assessed against explicit criteria, and its recommended standard description covers the learner, award title, issuer and location, issue date, outcomes, workload, level where applicable, assessment, participation mode and quality assurance [50]. For nuclear pathways, providers and employers should agree the practical tasks evidenced by each micro-credential and the site requirements remaining. Decisions to combine credentials rest with receiving organisations and the relevant awarding arrangements; accumulation does not automatically produce a qualification, and using the standard description confers no official recognition [50].

D4.4 proposes a common structure for documenting occupational transitions and preparing individual assessment. The proposed record brings together destination tasks, source qualifications, evidence of prior learning, assessment results and reference standards, recognition decisions, remaining learning needs and the corresponding training and site-qualification steps. Within this structure, demonstrated competences, outcomes awaiting assessment and confirmed learning needs should be identified separately. Each assessment or recognition decision should specify the responsible assessor or body, date, purpose and scope. This framework can support the D4.5 handover and the organisation of subsequent individual assessments, with recognition and qualification decisions remaining with the relevant bodies and receiving employers. For an experienced maintenance technician, for example, accepted evidence of mechanical diagnosis and repair could support exemption from repeated basic technical learning, while nuclear documentation, configuration control and site-specific tasks would remain in the bridging plan unless separately demonstrated and accepted. D4.5 can then assess programmes against the remaining outcomes, while employers and awarding bodies retain their respective decisions on recognition and qualification [3].

6 FEASIBILITY FRAMEWORK AND CONDITIONS FOR WORKFORCE TRANSITION

The transition hypotheses developed in Chapter 5 establish occupational correspondences and identify additional preparation requirements. Their development into practical recruitment proposals requires these findings to be considered alongside the circumstances of workers, employers and training providers. Drawing on published evidence and D2.1's recommendations for coordinated planning and stakeholder validation, this chapter examines geographical and temporal alignment, employer and training capacity, worker participation, and the institutional and financial arrangements needed to support implementation [2].

6.1 Geographical mobility and timing of transitions

Geographical feasibility should be assessed between the workers' actual area of residence, the receiving workplace and the locations used for assessment and training. A company's headquarters or a project's regional label does not identify where the work will be performed. Commuting, weekly travel, temporary assignments, relocation and cross-border employment involve different constraints. Travel time and cost, working patterns, accommodation, family circumstances and working-language requirements should be examined against a concrete employment offer. Distance alone does not establish whether a transition is feasible [2].

The transition calendar should distinguish the end of source production, individual release or availability for learning, the start and duration of required preparation, entry into supervised work and readiness for the assigned duties. Some staff may remain for safe shutdown, while others may leave or retrain before production ends. Assessment and suitable preparatory learning can begin before release where the employer and worker agree. On the destination side, construction, commissioning and operational milestones must be translated into occupation-specific recruitment dates; a project start date is not a vacancy date [9].

Temporal alignment must allow for both gaps and overlaps. Receiving demand may begin before workers can be released, or recruitment may occur after they have moved to another employer. The duration and conditions of the proposed employment should also justify the learning and mobility required. A location shared by the source and receiving activity can reduce some travel constraints but cannot resolve a gap between release and recruitment. Each proposed pathway should therefore be examined against a dated employer schedule and a delayed-demand scenario. Partners should identify who would maintain employment, income and competence if recruitment moved, and when the plan would need to be revised. Section 6.2 addresses delivery capacity, Section

6.3 workers' acceptance and Section 6.4 the resources required to make these arrangements practicable [9; 51].

6.2 Employer absorption capacity and training capacity

A forecast shortage establishes a reason to investigate recruitment; the receiving organisation must also demonstrate its capacity to integrate entrants. For each occupational group this requires funded vacancies or an approved recruitment plan, dates and locations, acceptance of the source profile, and a realistic number of entrants that supervisors can support, with direct employment, contractor employment and temporary project assignments recorded separately alongside the expected duration of work [9].

ENEN2plus D4.1 provides a structured basis for examining training capacity. Its Table 10 expresses the aggregate time required to meet an assumed target demand under specified provision and participation assumptions; these calculated capacities are theoretical maxima requiring validation with providers. The inventory nevertheless provides useful signals: it identifies a need to improve provision in nuclear safety, radioactive waste management and decommissioning, reports limited or insufficiently documented provision in several other domains, and highlights a gap in hands-on learning when employer preferences are compared with the recorded offer. These findings should guide provider enquiries rather than be treated as a census of spare places [29]. A provider confirmation should specify the relevant learning outcomes and entry requirements, cohort dates, places available after existing commitments, delivery language and location, instructors, equipment or simulator access, supervised practice and assessment arrangements. A place on a general nuclear-awareness course does not establish capacity to deliver all the requirements identified in Section 5.4, and where several programmes share an instructor, workshop or placement host, their capacities should not be added without checking scheduling constraints.

D4.3 identifies trainers combining technical expertise with pedagogical competence as a constraint on expansion, particularly for workplace learning, simulation, assessment and mentoring, and IAEA guidance requires suitable training environments and competent personnel. Scaling up therefore needs protected instructor and mentor time, preparation of additional trainers and confirmed practical learning opportunities [3; 9]. The NEA highlights the difficulty of preserving tacit knowledge as experienced personnel retire, which supports arranging overlap and supervised work before key expertise leaves [52]. The viable cohort is consequently limited by the combination of willing and eligible candidates, matched vacancies, complete training pathways and workplace

supervision available in the same period; a missing confirmation remains an evidence gap, not an assumed capacity.

6.3 Worker motivations, employment conditions and acceptance

A technically plausible pathway must offer an employment proposition that workers are willing and able to accept. ENEN2plus D1.1 recommends competitive remuneration, career progression, technically interesting work, a contribution to low-carbon energy and a supportive work environment, and IAEA guidance links remuneration, career development and programme stability to retention; these are attractiveness recommendations, not evidence that workers affected by restructuring have accepted nuclear careers [9; 15]. Consultation should compare the proposed destination with workers' current conditions and realistic alternatives — pay and benefits, income during training, contract duration, recognition of experience, progression, shift patterns, travel and periods away from home — against a concrete offer.

The assessment should distinguish motivation from practical constraints. A worker may want to retrain but lack time, transport, childcare, language support or financial security; conversely, relevant experience does not imply willingness to undertake the required learning. D2.1's Dutch evidence supports investigating these issues locally, and OECD *Skills Outlook 2025* provides broader evidence on unequal participation in adult learning and on job quality, without measuring acceptance of nuclear work [2; 53]. ENEN2plus D4.1's learner survey, with 150 responses from a campaign aimed at vocational learning in nuclear domains, reports preferences for in-person delivery and relatively short courses alongside difficulty finding training information; these findings help frame questions about format, duration and guidance but cannot estimate participation rates among workers leaving automotive, fossil-fuel or process industries [29].

For each cohort, proposed support should be tested with workers and their representatives: paid learning time, modular scheduling, accessible guidance, practical introductory visits and clear information on assessment and qualification. Recognition of prior learning can identify learning that need not be repeated, while an individual assessment remains necessary to establish the remaining requirements, and information and recruitment processes should reach contractor staff and people with different educational or career backgrounds as well as directly employed personnel. Acceptance should be recorded progressively, from interest in receiving information to willingness to enter assessment, agreement to the proposed learning and mobility arrangements, and acceptance of employment, with subsequent monitoring of completion, appointment, retention and reasons for withdrawal. These stages avoid

treating attendance at an information session or a favourable survey response as a committed transition [53].

6.4 Institutional, financial and social-partner support

Feasible transitions require an agreed division of responsibilities across the organisations concerned. Source employers can establish occupational profiles and release schedules; receiving employers define vacancies, entry requirements and workplace integration; training providers confirm delivery and assessment; public employment services support guidance and matching; and territorial authorities help coordinate local provision and support. Social partners should be involved in designing employment and learning arrangements and identifying barriers faced by workers. OECD guidance supports this coordination across education, labour-market and social policies [53].

ENEN2plus's national examples illustrate why responsibilities and access routes must be checked in each territory: its 2023 account describes different arrangements for employed workers and jobseekers in France, and multilevel governance and social-partner involvement in Italy. These identify counterparts rather than stating current entitlement for a particular candidate; eligibility, competent bodies and available funding must be verified for the proposed course, employment status and location [29].

A transition budget should cover assessment and recognition of prior learning, course fees, paid release or income support, travel and accommodation, language preparation where needed, equipment, supervised practice and qualification, as well as instructor and mentor time and arrangements for interruptions, reassessment or project delays. For an operational pathway, the partners should record the agreed release and recruitment arrangements, learning provision, support for mobility and income, and responsibility if the anticipated job is postponed, and identify for each contribution the payer, the period covered and its status: announced support, an application under assessment and an approved award are different levels of financial certainty. IAEA guidance emphasises that workforce investment precedes project revenues and that delays or loss of funding can interrupt development and retention [9]. Smaller employers may require shared provision or coordination to make a cohort viable, while retaining responsibility for their own employment and competence decisions, and the proposed package should be assessed against the full transition cost and the worker's circumstances, rather than course fees alone [53].

The Pact for Skills can support partnerships between employers, providers and public actors, its networking, guidance and knowledge services helping members find partners, exchange practices and identify EU or national funding opportunities. Membership

should not be entered in a pathway budget as a funding award: an applicable instrument and a confirmed contribution are still needed [54]. The European Skills Guarantee is particularly relevant to automotive restructuring: on 15 July 2026 the Commission announced six pilots to support workers at risk of unemployment in the car industry through tailored training and transitions into growing sectors. These should be presented as experiments — the announcement establishes neither completed outcomes nor a nuclear destination — and any link to a pathway would require confirmation of the participating territory, target group, receiving employer and project scope [55].

6.5 Stakeholder perspectives and validation of opportunities

The occupational hypotheses in Chapter 5 require validation before they can support implementation decisions. D2.1 recommends harmonised data collection and review with employers and other stakeholders, and ENEN2plus D6.1 describes job and task analysis, interviews, observation and skills audits for examining competence requirements; these methods can support review of the mappings in Chapter 5. Table 15 sets out a proposed consultation process; it does not report consultations undertaken for this deliverable [2; 13].

Table 15 Proposed stakeholder validation framework

Stakeholder group	Points to verify	Priority evidence
Source and nuclear employers, including relevant contractors	Occupations affected, actual release dates, destination tasks, recruitment timing and integration capacity	Dated workforce and recruitment plans; job profiles; named supervision and placement commitments
Workers and their representatives	Interest in the specific pathway; acceptable employment, learning and mobility conditions; barriers and alternatives	Documented consultation findings; cohort participation estimates; proposed or agreed employment and support conditions
Training and assessment providers	Prerequisites, learning outcomes, delivery dates, places, practical resources and recognition of results	Provider-confirmed capacity and costs; assessment plan; practical-placement agreements
Public employment services and territorial authorities	Current local availability, coordination, accessible support and implementation responsibilities	Validated local labour-market information; named contacts; support agreements and funding decisions

Source: proposed framework, based on [2], [13] and [29].

The consultation should use the same occupational definitions, geographical perimeter and time windows on both sides of the transition. Initial evidence can be gathered separately, then examined jointly to resolve discrepancies, with differences between employer estimates, worker intentions and provider commitments remaining visible until resolved; each conclusion should identify its source, date, scope and responsible contact, and the competent authority should clarify qualification or authorisation requirements where these determine access to the destination role [2; 13].

7 PRIORITISED OPPORTUNITIES AND RECOMMENDATIONS

The preceding chapters connect nuclear workforce demand with relevant experience in selected source industries, identify additional competence requirements and examine the conditions governing transition feasibility. Building on this combined assessment, this chapter establishes priorities for European cooperation and recommends actions through which participating organisations can develop and assess candidate pathways. It also specifies how D4.4's findings contribute to D4.5, WP5 and the Nuclear Skills Strategy, and identifies the evidence required to support further decisions.

7.1 Occupational priorities and framework for operational assessment

The occupational comparisons in Chapter 5 identify priorities for developing transition approaches where source and destination roles share identifiable tasks, equipment or working methods. Maintenance, fabrication, inspection and selected engineering functions provide concrete foundations for this work, alongside task-specific opportunities in auxiliary operations, chemistry and dismantling support. Table 16 translates these findings into transition routes. Each route runs from a starting point, the source experience to investigate, to an end point, the nuclear destination group, and identifies the nuclear-specific add-on that an experienced worker needs to become nuclear-ready. European cooperation can contribute most on this add-on, through common assessment approaches, learning outcomes and practical preparation; the last column sets out the conditions for implementing each route [3; 9].

Table 16 Occupational priorities for European cooperation on workforce transitions

Source experience to investigate (starting point)	Destination group (end point)	Nuclear-specific add-on (focus of European cooperation)	Conditions for implementation
Maintenance, industrial electrical work and automation in conventional energy, process industries, automotive and heavy manufacturing	Mechanical and electrical maintenance and I&C	Nuclear work control, plant systems knowledge, and configuration and documentation control, defined through common task profiles and bridging outcomes	Require demonstrated source tasks; define the destination equipment and responsibilities; provide employer assessment and supervised practice.

Source experience to investigate (starting point)	Destination group (end point)	Nuclear-specific add-on (focus of European cooperation)	Conditions for implementation
Welding, piping, metal fabrication, machining and tooling in heavy manufacturing, automotive and industrial contractors	Fabrication and component manufacturing	Material traceability, nuclear workmanship and manufacturing records, building on an assessment of existing trade competence	Verify the relevant trade qualification, procedures, materials and certification scope; distinguish an extension of competence from a change of trade.
Inspection, non-destructive testing, quality control and metrology in manufacturing and process industries	Quality, inspection and NDT	Nuclear inspection and quality requirements, such as applicable codes, acceptance criteria and inspection records, building on comparable evidence of practical competence	Assess metrology, general quality and NDT separately; confirm methods, certification scope and employer acceptance.
Mechanical, electrical, process, systems and civil engineering; construction planning, project delivery and asset management experience, including aerospace and other complex industrial activities	Applied engineering, testing, construction and project delivery	Nuclear systems, design interfaces, configuration, project governance and technical documentation, expressed as common bridging outcomes	Match the role and level of responsibility; assess required nuclear experience, particularly for safety-significant work.
Process monitoring, equipment rounds, shift work and operating procedures in	Field and auxiliary operations	Nuclear systems and work practices, through role-specific preparation building on a common assessment	Confirm plant training and supervised work; assess reactor control-room responsibilities through a separate qualification route.

Source experience to investigate (starting point)	Destination group (end point)	Nuclear-specific add-on (focus of European cooperation)	Conditions for implementation
conventional power and process plants		of operational experience	
Industrial analysis, process chemistry, shutdown and dismantling experience	Chemistry, laboratory and dismantling support	Nuclear chemistry, radiological, waste or decommissioning content relevant to the receiving function, identified through targeted task comparisons	Define the actual radiological and technical duties; establish the specialist learning and experience required.

Source: based on [3; 9; 15; 17]. Note: the table summarises the findings of Chapters 3 to 5 and Annex II; the routes are priorities for assessment and cooperation, not validated placements or a ranking by expected workforce volume.

This occupational approach connects the same destination group with relevant experience from several source industries. The table highlights cooperation priorities within the wider occupational scope of Chapter 5. Digital and cybersecurity roles offer additional opportunities for task-level comparison, with bridging focused on the nuclear systems context, industrial operational technology, safety and security interfaces and configuration control. Specialist radiation-protection, nuclear engineering and reactor-operation responsibilities follow their respective education, experience and qualification routes. Non-power applications also contribute to this wider scope where destination tasks and workforce demand are documented [3; 4; 9].

The horizons in Section 2.1, applied to the demand contexts described in Section 3.3, organise the assessment according to when opportunities may materialise. Up to 2030, assessment should concentrate on accessible recruitment and credible preparation windows; for 2031–2035, dated project scenarios provide the basis for anticipating occupational requirements and organising training capacity; beyond 2035, programme expectations inform longer-term competence development and capacity planning. Countries without a new-build programme may contribute through existing facilities, supply chains and decommissioning activities. EU assessments should retain the geographical boundaries of their sources and distinguish evidence concerning the United Kingdom and other non-EU countries [2; see Section 3.3].

For future operational assessment, D4.4 proposes three action categories combining the criteria in Section 2.6 with the feasibility conditions examined in Chapter 6.

- Ready for joint preparation means that dated evidence of a source workforce, a named receiving activity and a credible preparation window supports joint investigation, with plausible arrangements identified for training, financing, employer integration and worker participation.
- Conditional: verification required means that the occupational connection supports targeted assessment, while specific uncertainties concerning workforce availability, accessible receiving jobs, training capacity, funding or acceptable employment and mobility conditions require clarification.
- Exploratory: evidence gap on a decisive link means that a fundamental connection between the source occupational profile, destination requirements or receiving demand requires further investigation before preparation arrangements can be assessed.

These categories guide subsequent stakeholder review. Their application should record the supporting evidence, outstanding feasibility questions and the next action to be agreed with the relevant employers, workers, training providers and supporting bodies. Evidence confidence should be recorded separately for availability, destination, calendar and competences: for subsequent assessments, high confidence should require current direct verification of the critical links; moderate confidence should identify material links still awaiting confirmation; low confidence should identify a decisive link supported mainly by hypotheses or outdated evidence. The overall assessment should disclose its weakest link and explain any exception. Source date, employment-effect period and subsequent changes should be reviewed together, and an elapsed release window requires an update before workers are treated as currently available. Any future aggregation of verified local cohorts should use consistent population definitions, compatible reference periods and controls for double counting, and its reported scope should identify the cohorts and territories covered [14].

In this version, the assessment criteria of Table 1, the competence categories of Table 11 and the three action categories above are proposed as a common framework; they have not yet been applied systematically to each transition hypothesis, and the occupational comparisons of Chapter 5 remain transition hypotheses. A pathway-level record setting out, for each hypothesis, the evidence available, the main uncertainties and the next decision is therefore the first output expected from the operational assessment recommended in Section 7.2.

7.2 Recommendations

The following recommendations address European cooperation, national coordination and local implementation. Common tools and training components can be developed while employers and employment services verify particular cohorts. Approval of an intake nevertheless requires sufficiently evidenced candidate availability, receiving demand, qualification requirements, delivery capacity and participation arrangements. Table 17 identifies the respective responsibilities; the recommendations do not establish new funding commitments or contractual project milestones.

7.2.1 Recommendation 1 — Establish recurring occupational intelligence across participating countries

T4.4 and WP2 counterparts should agree a common evidence record with nuclear employers, source-sector organisations, public employment services and social partners. It should link source tasks and employment status to destination requirements, locations and recruitment periods, using ESCO correspondences where validated. Occupational availability and receiving demand should be examined in parallel. The record should distinguish directly employed staff and contractors, jobseekers, internal transfers, retirement and personnel retained for closure. National and sectoral trends should inform enquiries, while named employers supply the information needed for local matching [2; 7; 8; 14].

7.2.2 Recommendation 2 — Organise transition partnerships around occupations and receiving demand

Source and receiving employers, training providers, employment services and worker representatives should establish partnerships where the assessment identifies a plausible connection. Each partnership should specify the occupations, recruitment window, employment proposition and responsibilities for preparation. Several source establishments may contribute to one occupational route where their evidence supports it; one establishment may require several separate routes. Regional coordination should include smaller suppliers and contractors. Cross-border arrangements should be pursued where they improve access to a suitable job or training resource and are acceptable to the workers concerned [2; 9; 53].

7.2.3 Recommendation 3 — Assess and adapt occupational bridging programmes

D4.5 partners, providers and receiving employers should assess existing reskilling, upskilling and trainer programmes against the priority occupational requirements identified in D4.4. Suitable provision should be reused or adapted, with new components developed where a documented gap remains. Shared learning outcomes and assessment approaches may support nuclear safety culture, quality, traceability and

documentation, while practical content should reflect the occupation and demonstrated prior learning. National requirements, employer qualification and site-specific preparation remain part of the complete route. Micro-credentials should document assessed learning outcomes and their scope. Providers, receiving employers and relevant awarding bodies should establish how these outcomes can be recognised within each pathway, in accordance with applicable qualification requirements [1; 3; 44; 50].

7.2.4 Recommendation 4 — Coordinate practical training and trainer development

Providers and employers should identify where shared workshops, testing facilities, equipment, simulators and supervised placements can support the proposed occupational routes. Cooperation across regions or countries should address demonstrated gaps in provision, language coverage or specialist expertise. Capacity should be confirmed after existing commitments, including protected instructor and mentor time, and shared resources should not be counted more than once. Trainer development should combine technical, pedagogical and assessment competence [3; 29; 59].

7.2.5 Recommendation 5 — Make transitions accessible and economically viable for workers

Territorial partners and social partners should agree transition packages covering assessment, tuition, income during learning, travel, accommodation, language support and supervised practice. Workers should be able to assess a concrete offer, including pay, contract duration, working patterns and recognition of experience. Mobility support should respond to individual circumstances, with commuting, temporary assignments and relocation assessed separately. Agreements should also identify responsibility for employment and income continuity if recruitment is delayed. Partners should identify relevant EU, national and regional funding instruments and verify eligibility for each proposed pathway. The transition budget should distinguish funding applications from confirmed contributions [9; 53; 54; 56].

7.2.6 Recommendation 6 — Test approaches and share evidence on their results

Skills4Nuclear partners should select candidate transitions for testing within the agreed project scope, using Section 2.6 and the proposed priority and confidence conventions. Selection should consider feasibility and the lessons that can be examined across occupations and territories. A proposed operational record, distinct from the source inventory in Annex III, should identify the responsible partners, evidence dates, unresolved fields and next decisions. It should track assessment, training entry, qualification, recruitment and retention at six and twelve months after recruitment, together with

elapsed time, full costs and withdrawals. Responsibilities and review dates should be agreed with the partners concerned; priorities should be reviewed quarterly and after material changes. Extension to another setting should examine employer demand, recognition arrangements, practical capacity and the conditions supporting the observed outcome [2; 13; 59].

Table 17 Responsibilities and outputs at European, national and local levels

Level of cooperation	**Proposed responsibilities**	**Expected output**
European cooperation through Skills4Nuclear and participating networks	Agree comparable occupational records, reusable learning outcomes, trainer cooperation and evaluation methods.	Shared assessment resources and evidence on which approaches can be adapted across countries
National and sectoral coordination	Connect nuclear demand with restructuring intelligence; identify qualification arrangements, providers and applicable support.	Country-specific pathways linking the common approach to employers, institutions and available provision
Regional and employer implementation	Verify candidates and vacancies; agree learning, supervision, employment and mobility arrangements.	An employer-supported transition plan with a justified cohort size, confirmed resources and accountable delivery partners

Source: proposed allocation of responsibilities, based on [2; 3; 9; 29; 53]. Note: the levels are complementary and do not transfer national qualification or employer responsibilities to the project.

7.3 Contributions to D4.5, WP5 and the Nuclear Skills Strategy

The D4.4 handover comprises the occupational hypotheses and additional competence requirements in Chapter 5 and Annex II, together with the source inventory in Annex III, which support programme assessment and cooperation planning. An initial handover should accompany the D4.4 delivery using the evidence available, identifying for each proposed pathway the supporting evidence, unresolved fields and follow-up required, with an update schedule agreed with the recipients; completion of all local checks should not delay the transfer of generic occupational findings. Project coordination

should align this work with the applicable deliverable calendar and distinguish those deadlines from training intake and industrial recruitment dates. Any subsequent production of workforce aggregates should have an agreed owner, intended use and geographical coverage, with T4.4 and WP2 counterparts coordinating the relevant evidence under consortium arrangements.

D4.5 — programme assessment, adaptation and trainer requirements. D4.4 provides occupational transition hypotheses, comparable task foundations and indicative additional competence and qualification requirements. These findings support D4.5's assessment of existing reskilling, upskilling and trainer programmes and the identification of provision suitable for reuse or adaptation [1]. The assessment should connect the proposed occupational routes to learning outcomes, recognition arrangements, delivery language, practical facilities, trainer expertise and supervised workplace learning. It should identify reusable components and the specific adaptations or additional provision needed for the receiving roles. Programme duration and cohort size should be established from verified participant requirements and confirmed delivery capacity [3; 29].

WP5 — cooperation and financing. The handover should describe the functions of prospective transition partnerships, resources that may be shared and the costs of participation, distinguishing proposed arrangements from agreed responsibilities and confirmed funding. D5.1 provides findings on cooperation and financing conditions [57]. D5.2 documents the submitted NuclEUs proposal for a Centre of Vocational Excellence [58]. D4.4 contributes occupational priorities and practical requirements that can inform discussions with the proposed partnership. Where additional expertise or practical provision is needed, ENEN2plus D6.2 provides complementary evidence on extra-EU education and training capabilities that may support targeted cooperation and knowledge exchanges [59].

WP6 — the Nuclear Skills Strategy. D4.4 contributes occupational transition hypotheses, additional competence requirements and findings on implementation conditions to the WP4 inputs used by T6.1 and T6.2 to identify skills gaps and develop the Nuclear Skills Strategy [1]. These findings can inform the stakeholder discussions and assessment undertaken through T6.3's pilot action in Poland and the Czech Republic, including the Polish focus on transitions from fossil-fuel employment towards nuclear-related roles [1]. D4.4's proposed assessment and monitoring criteria provide a basis for examining the relevance and feasibility of candidate pathways with participating stakeholders. Feedback from the pilot action feeds the recommendations developed under T6.4 and

the updated Nuclear Skills Strategy, supporting the identification of effective approaches and lessons for subsequent application [1].

7.4 Evidence gaps and priorities for further assessment

Chapters 4 to 6 establish a documentary basis for occupational transitions and identify the information needed to develop them into practical proposals. Table 18 translates these findings into evidence priorities, proposed responsibilities and review points. It covers candidate availability and interest, receiving demand, competence and qualification requirements, delivery capacity and employment outcomes. It also identifies the work needed to strengthen European coverage and comparability, connecting local pathway assessment with the wider evidence base for cooperation [2; 13].

Table 18 Evidence priorities for implementation and European assessment

Evidence priority	Decision and proposed evidence owner	Validation point
1. Occupational availability and willingness	Source employers, employment services and worker representatives establish affected occupations, current employment status and interest in a concrete offer.	With the first local review; refresh elapsed restructuring windows before relying on them.
2. Accessible receiving demand	Nuclear employers and project owners identify tasks, locations, accepted entry profiles, recruitment dates and employment conditions.	In parallel with availability checks; reconfirm before approving an intake.
3. Competence gaps and qualification routes	Employers, assessors, providers and relevant competent bodies validate occupational mappings, prior learning, practical requirements and any estimable duration.	Before individual training and qualification plans are approved.
4. Capacity and affordable participation	Providers, hosts, territorial partners and workers confirm practical places, trainers, supervision, full costs and mobility arrangements.	Before intake and funding commitments; reassess after material changes.
5. European coverage and	T4.4 and WP2 document the selection of cases, country and occupational coverage (including national workforce	At the next assessment update and before using local findings to support

Evidence priority	Decision and proposed evidence owner	Validation point
quantitative context	assessments not yet covered in Table 3), duplicates and the Cedefop employment and replacement-demand cross-check.	national or EU-wide estimates; disclose outstanding work in earlier handovers.
6. Outcomes and conditions for extension	Employers, providers and pilot coordinators record qualification, recruitment, retention, duration, costs and withdrawals.	At each stage and six and twelve months after recruitment; before extending the approach.

Source: proposals based on [2; 11; 13; 14; 29]. Note: responsibility and timing require agreement with the organisations concerned.

Further source-side investigation should include occupational subgroups that the public restructuring records do not adequately describe. Coal extraction warrants a dedicated enquiry into relevant technical and service occupations, release arrangements and accessible destinations. Equivalent checks should apply to less documented automotive, process-industry and aerospace cases; an unknown field should trigger investigation rather than an assumed absence of transferable competence. The source inventory and occupational framework provide a starting point for extending the assessment across countries, sectors and occupations, and the next update should document the selection process and report the coverage achieved. A quantitative Cedefop cross-check is proposed to contextualise employment trends and replacement demand using compatible classifications, periods and geographical boundaries. Its findings should be combined with local evidence on affected occupations, recruitment opportunities and workers' interest to guide further enquiries. Any aggregation of subsequently verified cohorts should follow the population definitions and comparability requirements set out in Section 7.1.

8 CONCLUSIONS

D4.4 examines restructuring across five groups of non-nuclear industries and develops fourteen grouped occupational transition hypotheses. Its principal outputs are a register of industrial cases, comparisons of source and destination tasks, an analysis of additional competence requirements, and recommendations for European cooperation.

The clearest task correspondences concern mechanical and electrical maintenance, instrumentation and control, fabrication, inspection and selected engineering functions. Field and auxiliary operations, chemistry, laboratory activities and dismantling support provide further opportunities for targeted assessment. These findings identify existing occupational competences on which nuclear preparation can build. Their application to recruitment requires confirmation of the workers concerned, receiving jobs and feasible preparation arrangements.

The findings of D4.4 should be read in the light of the interdependence between the nuclear sector and the wider industrial base. Nuclear development relies on a solid, diversified and interconnected industrial ecosystem: nucleareurope reports more than 5,500 companies active in the European nuclear supply chain, covering services such as engineering, logistics, IT and material supply [60], and, in France, GIFEN identifies 1,830 companies involved in the nuclear sector, the large majority of which have diversified activities in other sectors, nuclear accounting on average for about 20% of their turnover [73]. The difficulties currently faced by some industries, such as chemicals or automotive, therefore do not make them reservoirs of labour for the nuclear sector, and significant de-industrialisation would also weaken nuclear activities by eroding the supplier base, industrial skills and training capacity on which they depend. The restructuring cases examined in Chapter 4 are accordingly used to identify occupational competences and individual career situations, not to designate industries whose workforce should be transferred only to nuclear.

Within Skills4Nuclear, the findings support D4.5's assessment and adaptation of reskilling, upskilling and trainer programmes. They also inform WP5 cooperation and resource planning and the occupational priorities developed through WP6 and the Nuclear Skills Strategy. European cooperation can support common assessment methods, reusable learning components, practical training resources and trainer development, with recognition and qualification decisions assigned to the relevant bodies and employers.

The next stage is to examine selected pathways jointly with employers, workers, training providers and supporting organisations. This work should establish practical transition proposals and generate evidence on participation, qualification, recruitment, retention and costs. Extending the country and occupational coverage, together with the proposed Cedefop cross-check, would strengthen the basis for comparison and subsequent

application. In that work, the assessment criteria and action categories proposed in this deliverable, which have not yet been applied systematically, would be applied pathway by pathway.

More broadly, the findings argue for an approach based on coordination between industries rather than on the transfer of human resources from one sector to another. Nuclear activities share occupational competences in welding, machining, maintenance, instrumentation and control, inspection, quality and engineering with the conventional energy, automotive, metallurgy, chemical and process, and aerospace and defence industries examined in this deliverable, as well as with emerging activities such as hydrogen and offshore renewable energy, several of which are recruiting for the same profiles (Sections 3.4 and 4.6). D2.1 identifies cross-sectoral collaboration among the systemic gaps in current workforce planning [2]. Coordination between industries could include shared intelligence on occupational needs within the same territories; pooled practical training capacity and trainer development for common technical skills, as illustrated by centres of vocational excellence organised around technologies used by several industries, such as COVE-WENDT for welding and non-destructive testing [38]; recognition of qualifications and prior learning across sectors (Section 5.5); and joint anticipation of activity peaks such as outages, construction phases and production ramp-ups. Existing instruments such as the Pact for Skills can support the corresponding partnerships between employers, training providers and public actors [54].

Such coordination could also support cross-sector career pathways, enabling workers to move between industries that share occupational competences, in either direction and at successive stages of their careers, while maintaining and developing their skills. Synergies and complementarities of this kind would strengthen the attractiveness of industrial careers and the resilience of the industrial ecosystem on which nuclear development depends. Within this perspective, cross-sector recruitment into nuclear occupations is one complementary contribution, alongside initial education, retention and continuing workforce development, connecting relevant industrial experience with defined nuclear employment opportunities. D4.5, WP5 and the Nuclear Skills Strategy developed under WP6 provide the framework in which these approaches can be examined further with the industries concerned [1].

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10 ANNEXES

10.1 ANNEX I — GLOSSARY

The terms below are used throughout this deliverable with the meanings given. The four terms that carry the analytical weight of the assessment — workforce availability, net employment change and replacement demand, upskilling and reskilling, and nuclear-specific competences and nuclearisation — are defined in Section 2.2 and are not repeated here.

- **Cross-sector workforce transition.** The movement of a worker or occupational group from a non-nuclear source industry to a nuclear or associated occupation.
- **Cross-sector career pathway.** A career route through which workers can move between industries that share occupational competences, in either direction and at successive stages of their careers, supported by coordinated training, recognition of qualifications and cooperation between employers. Unlike a cross-sector workforce transition, it does not imply a one-way movement from a source industry to a nuclear occupation.
- **Source industry and source occupation.** The activity and occupation from which such workers could come. Identification as a source implies nothing about availability.
- **Destination occupation.** A nuclear or associated occupation for which demand can be identified and against which source competences can be compared.
- **Occupational group and destination family.** An occupational group brings together destination occupations that share the same main field of work, such as metal fabrication and installation, or quality assurance, inspection and NDT; D4.4 uses these groups to set priorities (Tables 2 and 16). A destination family is one of the occupational families defined in D4.3, which classify occupations by qualification level and nuclearisation requirement; D4.4 uses them to characterise destinations in the transferability assessment (Table 12 and Annex II).
- **Declining personnel requirements.** A documented reduction in the number of workers required within an industry, activity, establishment or occupational group during the relevant period. The term refers to changes in underlying labour requirements, not to individual redundancy announcements.
- **Total job openings.** The combined number of jobs arising from net employment change and replacement demand. It is an indicator of labour demand and is not equivalent to net employment growth [11].
- **Skill gap (competence gap).** Cedefop defines a skill gap as a situation in which an individual does not possess the type or level of skills required to perform a job adequately [12]. In D4.4 the term denotes the difference between the competences held in a source occupation and those required for the identified destination.
- **Transferable competences.** Knowledge, skills and relevant experience acquired in a source occupation that contribute directly to performance in the destination without having to be acquired again. Their existence does not remove the requirement to demonstrate nuclear-specific competence.
- **Bridging requirements.** The additional learning, training, practical experience, qualification or certification needed to close the gap between a source profile and a

nuclear destination. Depending on the scale of the gap these correspond to upskilling, to reskilling, or to both.

- **Absorption potential.** The extent to which the nuclear sector could realistically recruit from an identified source workforce within the relevant period. It depends on demand, availability, transferability, bridging requirements, geographical and temporal alignment and training capacity, and is not equivalent to occupational similarity.

10.2 ANNEX II — SOURCE-TO-DESTINATION MATRIX

Table A2.1 Complete source-to-destination occupational matrix: transition hypotheses

Source occupation and industrial background	Candidate nuclear or associated destination	Main common tasks and occupational core	EQF / nuclearisation	Principal additional destination requirements
Field or process operator — conventional power generation, oil and gas, chemical or petrochemical plants	Plant operations support: auxiliary operator, field operator, process-support operator	Equipment rounds; process monitoring; interpretation of operating parameters; alarm response; shift work; application of operating procedures; permits and handovers	EQF 3–4 / medium	Nuclear safety culture; plant and system knowledge; nuclear operating procedures; quality and documentation requirements; radiation-protection awareness where applicable; employer and site-specific training. Conventional control-room experience is not equivalent to licensed reactor operation [3; 9].
Mechanical maintenance technician or industrial mechanic — fossil, chemical, automotive or heavy industry	Skilled-trade mechanical maintenance or fitting role; mechanical engineering technician in nuclear maintenance, construction or commissioning, according to the receiving duties	Preventive, corrective and predictive maintenance; pumps, valves, rotating equipment and piping; fault diagnosis; component replacement; alignment, testing and troubleshooting	EQF 3–4 / medium for skilled-trade destinations; EQF 4–5 / medium-high for engineering-technician destinations, according to tasks and responsibilities	Nuclear work-control arrangements; nuclear QA and traceability; configuration and documentation control; applicable craft qualification; plant-specific technical training and supervised workplace learning [3; 9].
Industrial electrician or electrical maintenance technician — power, process, automotive or heavy industry	Nuclear electrician; electrical engineering technician	Installation, maintenance and testing of electrical equipment; motors, distribution systems, switchgear and cabling; fault	EQF 3–5 / medium to medium-high, depending on responsibility	Nuclear electrical-system knowledge; safety classification and work controls; nuclear QA; configuration control; plant procedures; relevant authorisation and practical training [3; 9].

Source occupation and industrial background	Candidate nuclear or associated destination	Main common tasks and occupational core	EQF / nuclearisation	Principal additional destination requirements
		diagnosis; preventive maintenance		
Automation, robotics or I&C technician — automotive, chemical, oil and gas or process industry	I&C engineering technician	Sensors, actuators and instrumentation; control loops; calibration; industrial automation; diagnostics; testing and maintenance of control systems	EQF 4–5 / medium-high	Nuclear I&C architecture and safety classification; configuration management; nuclear safety culture; cybersecurity interfaces where relevant; plant-specific testing and maintenance procedures [3].
Welder, pipefitter, boilermaker or metal fabricator — metallurgy, rolling stock, shipbuilding, fossil energy or industrial contractors	Nuclear construction and component-manufacturing skilled trades; outage and refurbishment activities	Drawing interpretation; material preparation and fit-up; welding and piping fabrication; installation; repair; dimensional control	EQF 3–4 / medium	Qualification against applicable welding procedures and codes; nuclear QA and material traceability; documented workmanship; nuclear safety and radiation-protection awareness; site-specific work practices [3; 15].
Machinist, CNC operator or setter, tool-and-die technician — automotive or heavy manufacturing	Nuclear equipment and component manufacturing, machining and repair	Reading technical drawings; CNC machining; tolerances; materials; dimensional measurement; precision manufacturing	EQF 3–4 indicative / medium where treated as a skilled trade	Nuclear-grade material identification and traceability; controlled manufacturing procedures; quality records; applicable component codes and employer qualification. Principally an associated supply-chain pathway, to be retained only where corresponding employer demand is documented.
NDT, inspection, metrology or quality technician — metallurgy, automotive, aerospace or process industries	Quality and inspection technician; QC/NDE technician	Inspection planning and execution; measurement and metrology; defect detection; interpretation of acceptance criteria; documentation of inspection results	EQF 4–5 / medium	Metrology, quality assurance, inspection and non-destructive testing are not equivalent qualifications and are assessed separately: for an NDT destination the method, level, sector of validity and currency of any existing certification are identified. A transition from NDT already practised retains a substantial base, whereas a change of technique from

Source occupation and industrial background	Candidate nuclear or associated destination	Main common tasks and occupational core	EQF / nuclearisation	Principal additional destination requirements
				metrology or general quality control may require specific practical training and experience. Recognition or extension of NDT certification; nuclear codes and acceptance criteria; QA hold points; material traceability; nuclear documentation and reporting requirements — these technical requirements being distinct from the additional requirements specific to a nuclear contract. The IAEA includes radiographic and ultrasonic examination of welds and fittings within QC/NDE functions [3; 9].
Mechanical, electrical, process, production or materials engineer — energy, chemicals, automotive, metallurgy or aerospace	Applied engineering professional: maintenance, operations, plant, commissioning or project engineer	System and component analysis; technical problem solving; performance monitoring; testing; modification support; engineering documentation; coordination of corrective actions	EQF 5–6 / medium-high, with higher requirements possible for specific responsibilities	Nuclear plant and system knowledge; design basis and configuration control; applicable nuclear codes and standards; nuclear safety and QA; plant technical training; supervised nuclear experience where required [3; 9].
Project engineer or project manager — construction, process industry, automotive or aerospace	Project and asset management professional	Contractor coordination; work-package management; planning and milestones; technical interfaces; cost, schedule and risk monitoring; review of contractor proposals	EQF 6–7 / medium	Nuclear project governance; nuclear safety and quality requirements; configuration and documentation control; familiarity with plant systems and regulatory interfaces [3; 9].
Industrial chemist, laboratory technician or process-chemistry specialist —	NPP chemistry and chemistry support; selected nuclear R&D, waste-treatment or	Sampling; analytical chemistry; chemical-process monitoring; laboratory QA;	Technical to higher-education level / role-specific	Plant-specific chemistry and radiochemistry where applicable; radioactive-effluent requirements; radiation protection; contamination

Source occupation and industrial background	Candidate nuclear or associated destination	Main common tasks and occupational core	EQF / nuclearisation	Principal additional destination requirements
chemical, petrochemical or environmental laboratories	laboratory functions	interpretation of analytical results; water and process chemistry		control; nuclear laboratory procedures and QA [9; 15; 17].
Industrial dismantling, shutdown or decommissioning engineer or supervisor — fossil, chemical or heavy industry	Nuclear decommissioning engineer or project-support function; radioactive-waste and dismantling support	Plant isolation; dismantling planning; lifting and handling; contractor coordination; work sequencing; asset removal; conventional waste and logistics management	EQF 5–6 or 6–7, depending on responsibility / medium-high to high	Radiological characterisation; contamination and exposure control; radioactive-waste classification, treatment and traceability; clearance requirements; nuclear QA; radiation protection and site-specific authorisation [17].
Aerospace systems, test, qualification or configuration engineer	Applied engineering, design support, commissioning, configuration-management or project-engineering functions	Safety-critical systems engineering; verification and validation; qualification testing; configuration management; controlled technical documentation; multidisciplinary interfaces	EQF 5–7 / medium-high, depending on destination family	Nuclear design basis; nuclear safety principles; licensing and regulatory framework; nuclear codes and standards; plant configuration requirements; nuclear QA and technology-specific training [3; 9].
Digital systems or cybersecurity specialist — automotive, aerospace, defence or process industry	Digital and cybersecurity professional in a nuclear organisation	Systems administration; network and data management; cybersecurity; digital-system engineering; incident analysis	EQF 5–6 / medium	Nuclear and industrial operational-technology architecture; nuclear cybersecurity and security requirements; plant-specific systems; configuration and change control; general nuclear awareness and employer-specific qualification [3; 9].
Analytical chemist or chemistry researcher — chemicals, pharmaceuticals or research	Radiochemist in isotope production, nuclear R&D or selected waste-characterisation activities	Analytical chemistry; sample preparation; laboratory instrumentation; chemical separation; quality control;	Higher education / high	Radiochemistry; handling of radioactive materials; radiation protection; contamination control; nuclear laboratory practice and facility-specific training. Not automatic eligibility for radiopharmacy, which may

Source occupation and industrial background	Candidate nuclear or associated destination	Main common tasks and occupational core	EQF / nuclearisation	Principal additional destination requirements
		research methodology		involve additional professional and national requirements [4; 17].

Source: destination families, EQF levels and nuclearisation categories from [3]; other entries based on the references cited in each row.

Table A2.2 Nuclear-specific requirements and indicative bridging arrangements, by destination family

Destination family	Nuclear-specific requirements to assess against prior competence	Indicative bridging and assessment evidence
Skilled trades — EQF 3–4, nuclearisation medium. Electricians, welders, pipefitters, industrial mechanics	Nuclear workmanship and quality requirements; material traceability; controlled documentation; foreign material exclusion; site and radiological work controls where relevant	Targeted modules added to existing vocational competence, followed by workshop or mock-up practice and supervised tasks. Verify applicable craft or welding qualifications and assess both workmanship and completed records [3; 9].
Plant operations support — EQF 3–4, nuclearisation medium. Field and auxiliary operators	Plant systems, nuclear operating procedures, equipment status, shift interfaces and response within assigned responsibilities; radiation protection where required	Upper-secondary VET or equivalent occupational competence supplemented by plant training, supervised rounds and task demonstrations. Reactor control-room operation requires a separate training and qualification pathway [3; 9].
Engineering technicians — EQF 4–5, nuclearisation medium-high. Mechanical, electrical and I&C technicians	Nuclear systems and maintenance practices; configuration control; outage interfaces; quality records and operating experience relevant to the equipment	Advanced vocational modules in systems, maintenance, quality and configuration management; practical testing and troubleshooting under supervision; assessment on the plant equipment and procedures concerned [3; 9].
Quality and inspection technicians — EQF 4–5, nuclearisation medium. NDT, QA and inspection technicians	Nuclear acceptance criteria, applicable codes, traceability and inspection documentation; destination scope of existing inspection certification	Advanced vocational and nuclear quality modules, supervised inspections and assessment of findings and records. Verify certification scope separately. Senior nuclear QA duties may also require substantial nuclear experience [3; 9].
Radiation protection technicians — EQF 4–5, nuclearisation high. RP and dosimetry technicians	Specialist radiation-protection knowledge and its application to monitoring, dosimetry, contamination control and radiological work support	Advanced vocational training plus specialised nuclear training, practical instrument use and supervised field experience. Assess competence for the assigned radiological tasks and verify the applicable qualification requirements [3; 9].
Chemistry, waste and decommissioning functions — EQF level and nuclearisation role-specific. Chemistry and laboratory technicians, radiochemists, waste and dismantling engineers and supervisors	Plant chemistry or radiochemistry; radiological characterisation; contamination control; radioactive-waste classification, treatment and traceability; clearance requirements and nuclear quality	Task-specific assessment rather than a single EQF or nuclearisation label: existing chemical, laboratory or dismantling competence is supplemented by the radiological and nuclear content required, with supervised application in the receiving facility [9; 29].

Destination family	Nuclear-specific requirements to assess against prior competence	Indicative bridging and assessment evidence
	assurance, according to the receiving duties	
Applied engineering professionals — EQF 5–6, nuclearisation medium-high. Maintenance, operations and commissioning engineers	Nuclear technology and plant systems; safety implications of technical decisions; configuration, quality and regulatory requirements	Applied engineering or vocational Bachelor-level learning outcomes, addressed through targeted continuing training where prior competence is demonstrated. Add supervised engineering assignments and review of technical deliverables [3; 9].
Project and asset management professionals — EQF 6–7, nuclearisation medium	Nuclear project governance, safety and quality responsibilities, regulatory interfaces and system knowledge needed to coordinate work	Professional programmes with nuclear modules, supported by supervised project assignments and assessment of decisions, interfaces and documentation. Separate existing project-management experience from experience in nuclear delivery [3; 9].
Digital and cybersecurity professionals — EQF 5–6, nuclearisation medium	Nuclear systems context, safety and security interfaces, configuration and change control, and facility-specific digital practices	Vocational Bachelor-level competence plus nuclear modules and role-specific cybersecurity content. Use representative exercises and supervised system work to assess application in the destination environment [3].
Nuclear engineers, safety professionals and operations management — EQF 6–7, nuclearisation high	Advanced nuclear systems knowledge; reactor or safety analysis; licensing; safety-related judgement and operational responsibility, according to the position	Degree-based nuclear specialisation or advanced professional training, substantial relevant experience and formal assessment. Operating responsibilities require the appropriate plant and simulator training and any applicable authorisation or licensing [3; 9].

Source: occupational families and nuclearisation categories from [3], applied to the gap structure of [9].

10.3 ANNEX III — REGISTER OF RESTRUCTURING CASES CONSULTED

Each case reference links the ERM record to the complementary sources used to document occupational activities, site characteristics and implementation timelines. The final column records the ERM announcement date; publication dates and subsequent updates are specified in the corresponding source references. ERM factsheets are accessible at https://apps.eurofound.europa.eu/restructuring-events/detail/ followed by the factsheet number. Cases C38 to C47 were added from the input of the Bulgarian partner CNC Kozloduy [61]; for cases without an ERM record, the final column gives the period reported by the partner.

Table A3.1 Register of restructuring cases and employer sources consulted

Ref.	Company, site and country	Activity	Sources	ERM announcement date
C1	EDF, Cordemais, France	Coal-fired generation; planned nuclear piping-prefabrication activity on the same site	ERM factsheet 300759; EDF [62; 63; 64]; Framatome [65]	28 May 2026

Ref.	Company, site and country	Activity	Sources	ERM announcement date
C2	Gunvor Petroleum, Rotterdam, Netherlands	Refining; conversion to terminal activities	ERM factsheet 202118	10 December 2024
C3	Polska Grupa Górnicza, Katowice and Ruda Śląska, Poland	Coal extraction	ERM factsheet 204214	9 February 2026
C4	OKD, ČSM mine, Karviná, Czechia	Coal extraction	ERM factsheet 203629	5 November 2025
C5	PGE Górnictwo i Energetyka Konwencjonalna, Rybnik, Poland	Coal-fired generation	ERM factsheet 204400	4 March 2026
C6	Minprest Serv, Târgu Jiu/Gorj, Romania	Contractor services to Complexul Energetic Oltenia	ERM factsheet 203958	8 January 2026
C7	OMV Petrom, Romania	Crude petroleum and natural-gas extraction	ERM factsheet 203722	6 November 2025
C8	Zespół Elektrowni Pątnów Adamów Konin, Tomisławice, Poland	Lignite extraction	ERM factsheet 203176	7 August 2025
C9	Bosch, European restructuring	Automotive production, R&D and support	ERM factsheet 203527	25 September 2025
C10	Bosch, Mondeville, France	Automotive components	ERM factsheet 202631	11 April 2025
C11	Marelli, Argentan, France	Throttle bodies (ICE component)	ERM factsheet 200422	4 October 2023
C12	MMT-B, Blanquefort, France	Manual gearbox manufacturing	ERM factsheet 202427	28 February 2025
C13	Stellantis, Metz-Borny, France	Gearbox production lines	ERM factsheet 200952	5 March 2024
C14	Stellantis, Termoli, Italy	Engine production; partial redirection to hybrid components	ERM factsheet 202770	7 May 2025
C15	Magna, Untergruppenbach, Germany	Powertrain and transmission manufacturing	ERM factsheet 203145	23 July 2025
C16	BorgWarner, Kirchheimbolanden, Germany	Powertrain production and development centre	ERM factsheet 202597	9 August 2024
C17	Tata Steel, IJmuiden, Netherlands	Steel production	ERM factsheet 202615	9 April 2025
C18	Greenbrier / Astra Rail, Arad, Romania	Railway rolling-stock manufacturing	ERM factsheet 202618; Greenbrier Europe [66]	7 April 2025
C19	Rohrwerk Maxhütte, Sulzbach-Rosenberg, Germany	Seamless steel tube manufacturing; ERM classification NACE 25.53, Machining of metals	ERM factsheet 203263	1 September 2025

Ref.	Company, site and country	Activity	Sources	ERM announcement date
C20	HKM (Hüttenwerke Krupp Mannesmann), Duisburg, Germany	Integrated steelworks; transition to electric-arc furnace	ERM factsheet 300730; HKM [67]	9 July 2026
C21	Voestalpine Böhler Bleche, Mürzzuschlag, Austria	Basic steel manufacturing	ERM factsheet 203554	8 October 2025
C22	Dow Chemical, Terneuzen, Delfzijl and Dordrecht, Netherlands	Chemical production	ERM factsheet 300581	4 June 2026
C23	FMC/Cheminova, Rønland, Denmark	Agrochemical production	ERM factsheet 300940	1 September 2026
C24	ExxonMobil Chemical France, Gravenchon/Port-Jérôme and Nanterre, France	Steam cracking and downstream polymers; head-office functions	ERM factsheet 201076	11 April 2024
C25	LyondellBasell/Covestro, Maasvlakte, Rotterdam, Netherlands	Propylene oxide and styrene monomer production	ERM factsheet 202508; LyondellBasell [68]; Covestro [69]	19 March 2025
C26	Yara, Tertre, Belgium	Ammonia and nitrogen products	ERM factsheet 201747	15 October 2024
C27	Vynova, Beek/Geleen, Netherlands	PVC production; restart announced	ERM factsheet 203522; Vynova [70]	8 July 2025
C28	Evonik, Witten, Germany	Polyester production	ERM factsheet 300737	18 June 2026
C29	Airbus Defence and Space, group programme	Space systems and defence activities	ERM factsheet 201833	16 October 2024
C30	Airbus Defence and Space, Toulouse and Élancourt, France	Satellite assembly and testing; military technology	ERM factsheet 202186	4 December 2024
C31	Airbus Defence and Space, Germany (six sites)	Space systems and defence activities	ERM factsheet 202206	5 December 2024
C32	Thales Alenia Space, Toulouse and Cannes, France	Geostationary satellite activities	ERM factsheets 201376 and 200930	5 March 2024
C33	Thales Alenia Space, Charleroi, Belgium	Space systems	ERM factsheet 201191	16 May 2024
C34	Thales, Netherlands	Business expansion — technical profiles	ERM factsheet 204461	9 February 2026
C35	Safran, France	Business expansion — production, machining	ERM factsheet 204153	21 July 2025
C36	French aeronautics and defence recruitment campaign run by Randstad, 2026	Business expansion — welders, mechanics, fitters, electricians, quality inspectors, engineers	ERM factsheet 300561	10 June 2026

Ref.	Company, site and country	Activity	Sources	ERM announcement date
C37	Thales España, Spain	Business expansion — engineering, cybersecurity, AI, software	ERM factsheet 204238	9 February 2026
C38	Mini Maritsa Iztok, Stara Zagora region, Bulgaria	Open-pit lignite mining	CNC Kozloduy input [61]	No ERM record; Territorial Just Transition Plan approved December 2023
C39	TPP Maritsa East 2, ContourGlobal Maritsa East 3, AES Maritsa East 1 and Remotex, Stara Zagora region, Bulgaria	Coal-fired power generation	CNC Kozloduy input [61]	No ERM record; phase-out after 2026
C40	Coal mining operations, Kyustendil region, Bulgaria	Open-pit and underground coal mining	CNC Kozloduy input [61]	No ERM record; 2024–2030
C41	TPP Bobov Dol, Kyustendil region, Bulgaria	Coal-fired power generation; conversion and fuel switching	CNC Kozloduy input [61]	No ERM record; no date specified
C42	Coal extraction, Pernik region, Bulgaria	Residual open-pit coal extraction	CNC Kozloduy input [61]	No ERM record; under the Pernik plan
C43	TPP Toplofikatsia Pernik and technical support units, Pernik region, Bulgaria	Coal-fired generation and district heating	CNC Kozloduy input [61]	No ERM record; no date specified
C44	MD Elektronik, Vratsa, Bulgaria	Automotive cables and data-transmission components	ERM factsheet 204248; CNC Kozloduy input [61]	17 February 2026
C45	SE Bordnetze, Mezdra, Bulgaria (the ERM record also covers Karnobat)	Automotive wiring harnesses	ERM factsheet 201586; CNC Kozloduy input [61]	14 September 2024
C46	Leoni, Pleven, Bulgaria	Automotive cable harnesses	CNC Kozloduy input [61]	No ERM record; closure in 2024
C47	Yazaki Bulgaria, Yambol, Sliven and Haskovo, Bulgaria	Automotive components	CNC Kozloduy input [61]	No ERM record; 2023–2025

Source: Eurofound European Restructuring Monitor and the complementary sources cited for each case; cases C38–C47: CNC Kozloduy [61].