ESSA
EUROPEAN STEEL SKILLS AGENDA

**Blueprint "New Skills Agenda Steel":
Industry-driven sustainable European Steel
Skills Agenda and Strategy (ESSA)**

Policy Recommendations

TABLE OF CONTENT

EXECUTIVE SUMMARY

Digital transformation and climate change represent the main drivers of innovation for European industry. In particular, green and digital technologies help to increase energy and resource efficiency and contribute to keeping materials in use for longer. However, the right skills are needed to implement, operate and exploit these technologies to best effect. The ESSA project has developed a sector-driven Blueprint following a bottom-up social innovation process to address skills needs, which integrates all the relevant stakeholders (companies, training providers, research institutions, associations, social partners, policy makers, public administration, and civil society organisations). It has identified where there is need for re- and up- skilling and talent recruitment, and identified strategies for developing a highly skilled workforce, proactively addressing skills gaps, and engaging the workforce with new technological innovations. As part of the Blueprint, we offer policy recommendations to support these strategies and address the deep transformations the industry is currently experiencing.

The first policy recommendations are presented as general recommendations. Second, we offer policy recommendations at three levels in order to provide further contextualisation: European, national and regional. Third, we present some recommendations related to the specific support of small and medium-sized enterprises (SMEs).

Specifically, we recommend:

- **An Ecosystem Approach and Social Innovation Processes.**
  Skills Alliances should engage all the relevant and willing stakeholders

- **Sectoral specialisation through CVET.**
  Continuous Vocational Education and Training (CVET) provision to be made more relevant by tackling specific technical skills gaps

- **Encourage training modules focusing on or integrating transversal skills.**
  Transversal skills are of high importance to manage current and future challenges at the workplace and it is necessary to encourage national, regional and local stakeholders to adopt and develop training material

- **Promote the importance of informal and non-formal education, with a focus on mentorship. Encourage companies to facilitate knowledge transfer.**
  Knowledge transfer has been identified as a key challenge, with necessary know-how often acquired through on-the-job learning and mentoring[1]

- **Implement new instruments for new skills in the green transition.**
  For the future viability and competitiveness of a decarbonised European steel industry and to support the green transition it is essential to identify instruments to support the development of green skills and high-quality green jobs

- **Give visibility to high-skilled positions, with task variety and modern career paths in the steel industry.**
  The requirements of digital skills necessitate this focus, and that growth opportunities are attractive to new talent

- **Nourish an innovation culture at all levels.**
  Training offered to workers should go beyond responding to ad hoc needs and foster a culture of change and innovation

- **Recognising and Promoting Equality and Diversity.**
  A central challenge for the industry is to address questions relating to Equal Opportunities and encouraging Diversity

- **Integrate the industry with online training platforms (e.g. ESSA steelHub), combining online platforms with on-the-job-training.**
  Integration with digital technologies should allow learners to take advantage of remote learning, interact with simulators, and practice with hands-on laboratories

- **Investments in Industry 5.0[2] activities can produce benefits both for workers and companies.**
  Industry 5.0 could be implemented to empower workers and to evolve skills and training to benefit employers and employees

- **Emphasise the prominence of steel in every aspect of modern society and address the industry's image.**
  A multilevel and systematic image campaign is suggested by making a large use of mass-media and social media

At the European Level:

- **Establish a reliable governance structure to engage stakeholders within the Steel Alliance, and provide a platform for engaging further stakeholders.**
  A governance within existing European steel industry structures is crucial, including a Technology and Skills Foresight Radar (Observatory), an online training platform, and a European Community of Training Practice

- **Engage with European programs, tools and activities for mobility.**
  Steel companies should take advantage of mobility opportunities managed by the EU, external VET providers/ schools and/or employer mobility schemes (e.g. EURES).

At the National level:

- **Engage with national VET system institutions and national programmes.**
  Steel companies and sectoral representatives need to engage with the VET system stakeholders to integrate their immediate and future skills and qualification demands in the curricula directly and urgently. Adjusting sectoral qualifications and occupations in national catalogues is key to attract talented people

- **Encourage workers to make use of national schemes for validation of prior learning.**
  It is suggested to follow CEDEFOP recommendations on recognition and validation of non-formal and informal learning

- **Align internal company training provision with national/European frameworks/benchmarks.**
  It is recommended that steel companies align their training activities with national standards (e.g. sectoral qualifications and occupations in national catalogues)

At the Regional level:

- **For steel companies and stakeholders to lobby at the regional level.**
  Our comparative study of VET governance in the case study countries points to the regional level as the most appropriate level for companies to lobby at within an ecosystem approach

- **Engage with educational system to promote dual training and placements.**
  Steel companies should be highly aware of the opportunities of offering placements or partnering in dual training schemes to better promote the industry, attract young talents, and offer an earlier specialisation at IVET level

- **Consider the opportunities and limits of modular provision.**
  Modularity should offer valuable opportunities for shortening vocational paths, reskilling and upskilling of workers

Finally, recommendations related to SME support are:

- **Human Resources and Training support.**
  The SME perspective should be integrated in the Foresight Observatory on labour market trends and skills prospects and guidance on workforce development strategies

- **SME capacity to access quality training.**
  Training in basic and advanced digital skills, cybersecurity and environmental regulation is necessary for SMEs

- **Specific training for SME managers.**
  Raise awareness of the opportunities of technological innovation, Industry 4.0 implementation, and new business strategies

- **Identification of regional SMEs clusters.**
  The European Community of Training Practice (ECoP Steel) could offer steel SMEs an efficient networking platform

We conclude that transforming the steel sector requires a collaborative approach, a bottom-up process of social innovation, the identification of national and regional potential and the involvement of all relevant stakeholders in a governance process. We consider the implementation of these recommendations as necessary for developing a resilient industry with modern skills that is attractive to highly skilled people.

€ 125 billion
Value for the EU economy
The sector is worth billions of euros in Gross Value Added to the EU economy every year.

Source: EUROFER (https://www.eurofer.eu/)

153 million tonnes
Annual production of steel
The sector produces on average 153 million tonnes of finished steel per year.

Source: EUROFER (https://www.eurofer.eu/)

500
Production sites in the EU
The EU steel industry has 500 production sites spread out across 22 EU Member States.

Source: EUROFER (https://www.eurofer.eu/)

310,00
Highly skilled workforce
The steel sector employs 310,000 people directly and is responsible for up to 2.27 million indirect jobs.

Source: EUROFER (https://www.eurofer.eu/)

ESSA: EUROPEAN STEEL SKILLS ALLIANCE AND AGENDA

The European Steel Skills Alliance (ESSA) was developed since 2018 and co-funded by the European Commission's Erasmus+ program for sectoral Blueprints of the New Skills Agenda. Together with more than 40 partners of the steel industry (companies, associations, social partners, training providers, research and education, and civil society associations) we aim at a proactive skills adjustment of the workforce to be ready for immediate and forthcoming technological and economic developments. Within an ongoing social innovation process ESSA aims to address industry skills demands, especially in the areas of digital and green, and facilitate the social transition of the steel sector.

PARTNERSHIP

24 partners (19 associated partners), partially with double function

Steel companies

1. ThyssenkruppSteel Europe
2. ArcelorMittal (Poland, Spain)
3. Salzgitter AG
4. Sidenor
5. Barna Steel/CELSA Group (ES)
6. Tata steel Europe

Steel associations and social partners

1. EUROFER
2. World Steel Association
3. UNESID
4. Staalindustrie Verbond VZW-GSV
5. German Steel Federation Wirtschaftsvereinigung Stahl
6. Federacciai
7. European Cold Rolled Steel Association CIELFFA
8. Association of Finish Steel and Metal Producers
9. OS KOVO

Plus associated partners

1. ESTEP European Steel Technology Platform
2. IndustriALL (European Industry Union)
3. EIT RawMaterials
4. Industriarbetsgivarna (Swedish Industry Federation)
5. Polish Steel Technology Platform
6. Celsa Group (beside partner P18 BARNA representing steel companies from France, Norway, Wales, Poland and Spain
7. Enrico Gibellieri (European Steel expert)
8. Unite and Community (UK unions)
9. CEPIS Council of European Professional Informatics Society
10. University of the Basque Country
11. Warwick University
12. ArcelorMittal Italy
13. Fédération Métallurgie CFE-CGC
14. Metalowców NSZZ, "Solidarność"
15. UK Steel
16. SAAT Consulting
17. Greensteel Academy/Liberty Steel
18. Commercial Metals Company (CMC)
19. Swansea University
20. ArcelorMittal Germany

Education and training providers

1. Steel Institute VDEh
2. IMZ
3. Scuola Superiore Sant'Anna (SSSA)
4. DEUSTO
5. TKSE Training Centre
6. ArcelorMittal Training Centre Spain
7. World Steel University
8. Cardiff University
9. RINA-CSM
10. Tata Steel

Research institutions

1. TU Dortmund University
2. Cardiff University
3. RINA/CSM
4. DEUSTO
5. Scuola Superiore Sant'Anna (SSSA)
6. Visionary Analytics

In this context ESSA has developed a sector driven Blueprint following a bottom-up social innovation process, integrating all the relevant stakeholders (companies, training providers, research institutions, associations and social partners) right from the beginning of the partnership. This Blueprint is the cornerstone to developing a reliable, effective and stable cooperation among all the actors able to integrate tools and approaches with a focus on: (a) incremental adjustment of skills in production and maintenance; (b) job profile description and assessment from an industry perspective, and; (c) existing VET systems and their possible support.

Our main objectives are:

- Proactive **skills adjustments**
- New **training and curricula requirements**, including new ways of more immediately implementing them within both companies and education and training institutions
- **Political support** measures by mobilising and integrating stakeholders and policy makers of the European, national and regional/ local level
- Successful sectoral **upskilling schemes** and efficient management of knowledge
- Build the attractiveness of the Steel Industry and careers for talented people (**recruitment and retention**)
- Key Performance Indicators (KPIs) to **monitor** success and adjustment needs continuously

Our Mission is:

A proactive adjustment of the future skills demands by the steel industry and for the steel industry

The Blueprint comprises five central elements for permanent implementation and running of the Skills Alliance ESSA, which will be described in the governance structure later (see details in the figure 1).
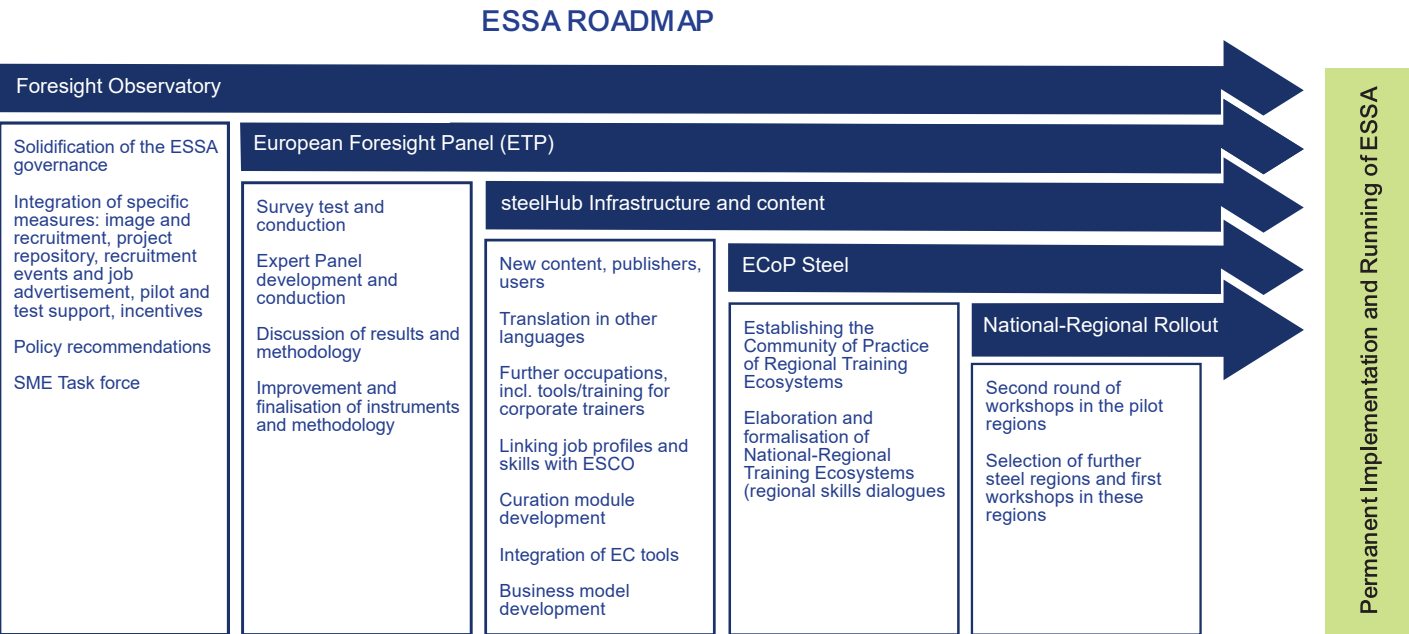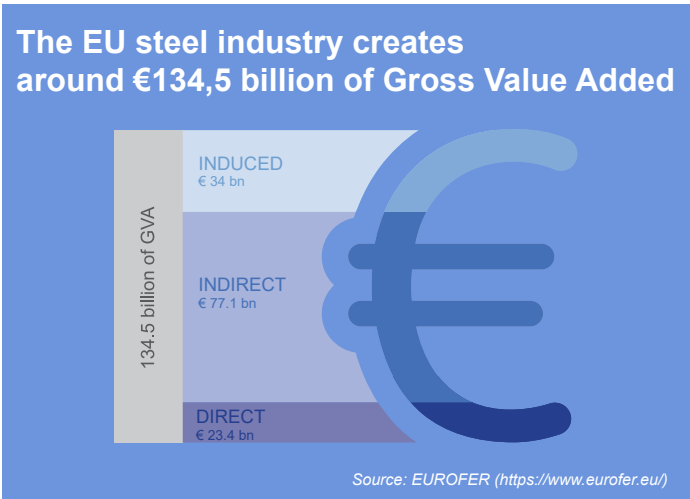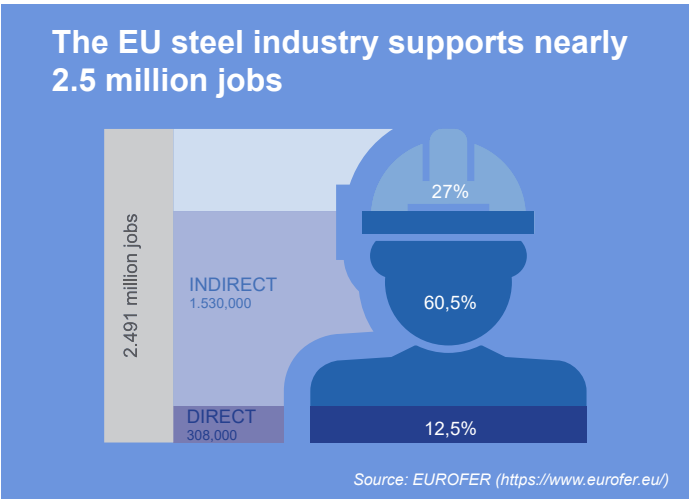
ESSA ROADMAP

Figure 1: ESSA Roadmap

In the following section we will briefly outline: (a) the current situation of the steel sector, including its technological and economic development and resulting skills demands; (b) the affected job profiles and the skills classification, and; (c) the governance structure of ESSA. In doing so, we are setting the foundation for the policy recommendations to ensure an ongoing efficient and effective process - keeping the people and their skills on the agenda of companies, associations and social partners, and public institutions at the European, national, and regional/local level.

The EU steel industry supports nearly 2.5 million jobs

2.491 million jobs

INDIRECT 1.530,000 — 27%

60,5%

DIRECT 308,000 — 12,5%

Source: EUROFER (https://www.eurofer.eu/)

The EU steel industry creates around €134,5 billion of Gross Value Added

134.5 billion of GVA

INDUCED € 34 bn

INDIRECT € 77.1 bn

DIRECT € 23.4 bn

Source: EUROFER (https://www.eurofer.eu/)

SKILLS STRATEGIES FOR A SUSTAINABLE STEEL SECTOR

In recent years, the steel sector has undertaken a path towards environmental and social sustainability following the Green Deal objectives announced by the European Commission (EC)[3], placing decarbonisation and digitalisation at the centre of every discussion concerning this specific energy intensive industrial sector.

To achieve the decarbonisation objectives, it is crucial to develop sustainable technologies, including key enabling technologies and sustainable processes, supply chains, and networks that foster higher efficiency, waste reduction, closed loops, and eco-design, as part of the incremental steps necessary for the transition to circular economy. However, transformation from a linear to a circular economy will demand change in many areas, such as business, education, finance, politics, legislation, and society as a whole.

Industry and labour market information that will anticipate and monitor skill needs for green and digital jobs represents a crucial starting point for enabling governments and businesses to anticipate changes in the labour market. In addition, it is crucial to identify the impact on skill requirements and jobs, incorporate changes into the system by revising training programmes and introducing new ones, and monitoring the impact of training on the labour market.

The availability of a suitably trained workforce able to learn will, in turn, encourage investment, technical innovation, economic diversification and job creation.

In order to understand how skills needs are shifting as the economy becomes greener, the drivers of change should be identified. Changes in employment and in skills can be the result of four drivers of change (Cedefop, 2010)[4]:
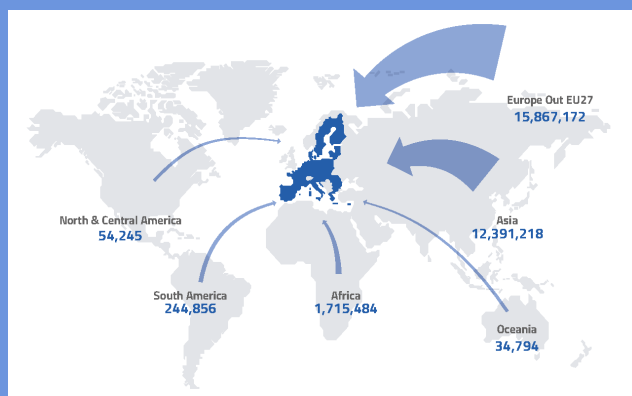
1. Physical change in the environment
2. (Green) Policies and regulation
3. (Decarbonizing) Technology and innovation, and
4. Markets for greener products and services, and consumer habits

In the case of the steel industry, similar to other Energy Intensive Industries, a stronger collaboration between the industry, public bodies and education providers, is important to find and retain talents and to up/reskill the workforce for the challenges of decarbonisation (White Research et al., 2020[5]; Antonazzo et al. 2021[6]).
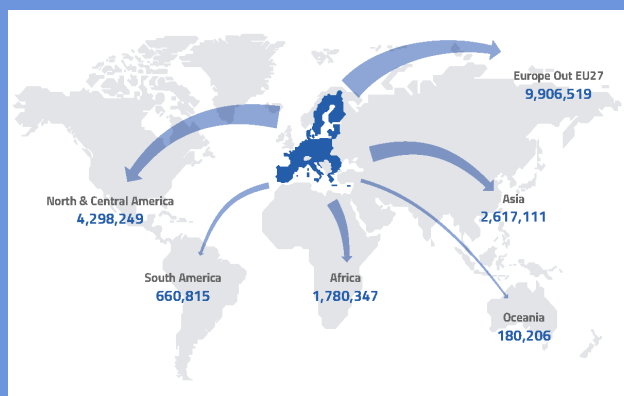
In particular, the steel industry is interested in keeping close contacts with the relevant faculties and vocational institutions that represent important reservoirs of skilled labour. Partnerships between companies and educational institutions will increase in order to give to students the possibility to carry out traineeships[7] or use companies as case studies.

These challenges are core of the ESSA Blueprint and Governance and have been addressed in order to finalise a series of policy recommendations with the aim to overcome them.

The EU imported 30.3 million tonnes of finished steel products in 2021

Europe Out EU27
15,867,172

North & Central America
54,245

Asia
12,391,218

South America
244,856

Africa
1,715,484

Oceania
34,794

The EU exported 19.4 million tonnes of finished steel products in 2021

Europe Out EU27
9,906,519

North & Central America
4,298,249

Asia
2,617,111

South America
660,815

Africa
1,780,347

Oceania
180,206

Source: EUROFER (https://www.eurofer.eu/)

(3) https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal
(4) Cedefop (2010) Skills for green jobs. European synthesis report. Luxembourg: Publications Office of the European Union
(5) White Research, Intrasoft International, Rina Consulting, Valeu Consulting, with Gibellieri E, Schröder A and Stroud D (2020) Blueprint for sectoral cooperation on skills: towards an EU strategy addressing the skills needs of the steel sector. Publications Office of the European Union.
(6) Antonazzo L, Stroud D, Weinel M, Dearden K, Mowbray A (2021a) Preparing for a just transition: meeting green skills needs for a sustainable steel industry. Community. https://indd.adobe.com/view/a9bc234c-6235-442a-8355-bc9fab727c00
(7) https://traineeships.ec.europa.eu/

NEW SKILLS FOR INDUSTRY 4.0 TECHNOLOGIES

In recent years the steel industry is becoming smart and more agile, evolving towards industry 4.0. The application of new technologies in this sector already supports and can further sustain the optimisation of the entire production chain, although the steel production is already automated to a certain extent and often the systems work in an isolated way.

The steel industry expectations from digitalisation include, first of all, the optimisation and the interactions of the individual production units, within the entire production chain (and beyond), leading to the highest quality, flexibility and productivity. Adaptive online control, through-process optimisation and synchronisation, zero-defect manufacturing, traceability, intelligent and integrated manufacturing will be the most important digitalisation trends in the future.

Digital technologies, through the continuous adjustment and the optimisation of the processes online, aim to improve the flexibility and the reliability of processes, to maximise the yield, to improve the product quality and maintenance practices. Such technologies further contribute to increase the energy efficiency and to monitor and control the environmental performance of processes in an integrated way.

The challenge in digitalisation is in the integration of all systems and productions units, through three different dimensions:

- Vertical Integration: Integration of systems across the classic automation levels from the sensor to the Enterprise Resource Planning system
- Horizontal Integration: Integration of systems along the entire production chain
- Life-cycle Integration: Integration along the entire lifecycle of a plant from basic engineering to decommissioning (Herzog, 2017[8])

In addition, the transversal integration is based on the decisions taken during the steel production chain, considering technological, economic and environmental aspects at the same time. This will only be possible by new automation and optimisation technologies and by their combination in an integrated way.

For example, Predictive Maintenance techniques can be implemented by equipment monitoring combined with intelligent decision methods. Machine Learning and Data Mining techniques can be used to anticipate maintenance work before something goes wrong. Moreover, the maintenance can be scheduled, and many checks can be made remotely, resulting in significant improvements in the maintenance equipment. Furthermore, Knowledge Management represents a key factor for improvements to be achieved in the digitalisation process. In order to overcome the barriers due to heterogeneous distribution over individual staff members, human obliviousness, and knowledge loss and erosion by staff leaving the industry, new approaches are being developed based, for example, on a knowledge-based decision support system.

Innovations in science and technology have led to an information-based organisation which transforms this information into knowledge to secure competitiveness and improve decision making. Therefore, the digitalisation process requires job profiles based on interdisciplinary teams, tasks and thinking, in order to provide interdisciplinary skills[9].

To address these issues, ESSA research (desk research, surveys, workshops) identified the current state of the digital transformation in the European Steel Industry and the resulting skills needs for the different job profiles in the steel sector.
The focus is on an incremental upskilling of the existing workforce, with a residual buy-in from external providers of competences not currently covered. by. Out of more than 200 affected job profiles in all the production areas, nine representative job profiles comprising different skills levels and production areas were selected, added by a trainer and teacher profile (ESCO number in brackets, profile description retrieved from ESCO website)[10]:

1. Maintenance and repair engineer (2141.7) focus on the optimisation of equipment, procedures, machineries and infrastructure. They ensure their maximum availability of the latter at minimum costs.

2. Process engineers (2141.9) apply engineering concepts in order to improve all kinds of production and manufacturing processes in terms of efficiency and productivity. They evaluate the variables and constraints present in given processes and present engineering solutions to optimise them

3. Manufacturing managers (1321) plan, direct and coordinate activities concerned with the production of goods, the production and distribution of electricity, gas and water, and the collection, treatment and disposal of waste. They may manage the production departments of large enterprises or can be the managers of small manufacturing companies

4. Process engineering technicians (3119.13) work closely with engineers to evaluate the existing processes and configure manufacturing systems to reduce cost, improve sustainability and develop best practices within the production process

5. Production supervisors (3122) coordinate, plan and direct manufacturing and production processes. They are responsible for reviewing production schedules or orders as well as dealing with staff in these production areas.

6. Industrial electricians (7411.1) install and maintain electricity cables and other electrical infrastructure in large industrial and commercial buildings. They perform inspections and repair defective parts of electrical systems to ensure efficiency

7. Metal processing plant operators (8121) monitor, operate, adjust and maintain single-function process machinery and equipment to process and convert mineral ores and refine, harden, roll and extrude metals.

8. Metal working machine tool setters and operators (7223) set and/or operate various machine tools, working to fine tolerances

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(8) Herzog, K., Winter, G., Kurka, G., Ankermann, K., Binder, R., Ringhofer, M., Maierhofer, A., & Flick, A. (2017). The Digitalization of Steel Production. BHM Berg- und Hüttenmännische Monatshefte, 162, 504-513.
(9) For in-depth details on the topic "NEW SKILLS FOR INDUSTRY 4.0 TECHNOLOGIES" please refer to Deliverable 2.1 Digital Transformation in European Steel Industry: State of Art and Future Scenario https://www.estep.eu/assets/Uploads/ESSA-D2.1-Technological-and-Economic- Development-in-the-Steel-Industry-Version-2.pdf
(10) https://esco.ec.europa.eu/en/classification/occupation_main

9. Factory hands (9329.1) assist machine operators and product assemblers clean the machines and the working areas. Factory hands make sure supplies and materials are replenished

10. Training and staff development professionals (2424) plan, develop, implement and evaluate training and development programmes to ensure management and staff acquire the skills and develop the competencies required by organisations to meet organisational objectives

11. Vocational Education Teachers (2320) teach or instruct vocational or occupational subjects in adult and further education institutions and to senior students in secondary schools and colleges. They prepare students for employment in specific occupations or occupational areas for which university or higher education is not normally required

These job profiles were analysed via technical and transversal skills needs (t-shape approach), listed in detail in the figure 2 below:

	Technical skills		Transversal skills		
Physical and manual skills	Digital skills	Green skills	Social skills	Methodo-logical skills	Individual-personal skills
General equipment operation	Basic digital skills	Environmental awareness	Advanced communication and negotiation skills	Basic numeracy and communication skills	Critical thinking & decision making
General equipment repair and mechanical skills	Advanced data analysis and mathematical skills	Energy efficiency	Interpersonal skills and empathy	Basic data input and processing	Personal experience
Craft and technician skills	Cybersecurity	Water conservation	Leadership and initiative taking	Advanced literacy	Adapt to change
Gross motor skills and strength	Use of complex digital communication tools	Waste reduction and waste management	Adaptability and continuous learning	Quantitative and statistical skills	Work autonomously
Inspecting and monitoring skills	Advanced IT skills & Programming	Resource reuse/recycling	Teaching and training others	Complex information processing and interpreration	Active listening
				Process analysis	
				Creativity	

Figure 2: Technical and Transversal Skills Needs

ESSA BLUEPRINT AND GOVERNANCE

Against this background, we implemented a Blueprint for sustainably ensuring reliable alliances and strategies to adjust the skills needs of the steel industry proactively and continuously. A reliable and accepted governance structure for the main elements of the ESSA Blueprint on a European and national and regional level is comprising three main elements (see Figure 3 below):

1. The European Steel Technology and Skills Foresight Observatory as the main European coordination unit, conducting a regular (annual or bi-annual) European Steel Technology and Skills Foresight Panel (ESSA ETP)

2. The Online Training Ecosystem "steelHub"

3. The European Community of Practice of Steel Regions (ECoP Steel), connecting and supporting in steel related member states and the main European steel regions as

a European platform for the different National-Regional Training Ecosystems: exchanging, initiating, developing, and implementing good practice for skills and training

Through this structure, the demand side (skills requirements) and the supply side (training offers and exchange, industry image and recruitment activities) as well as an exchange and piloting / testing sphere for innovative solutions is given.

The European governance structure is already implemented and accepted by the related main steel industry actors on the European level: ESTEP, EUROFER, and industriALL Europe. The core coordination unit is the Focus Group People of ESTEP which has agreed to run the Foresight Observatory and Panel and to establish a European Community of Practice of Steel Regions (National-Regional Training Eco-systems). The Observatory will start its further implementation and regular activities after the project duration from July 2023 on.
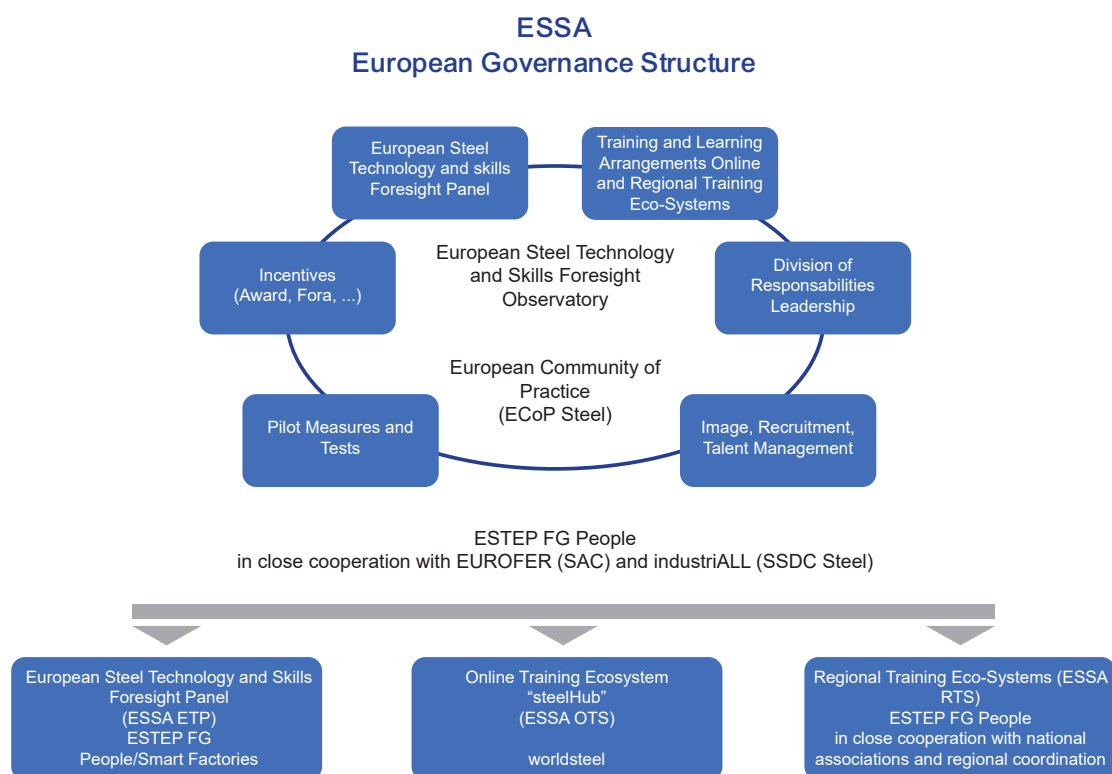

Figure 3: ESSA Governance Structure

The Observatory, steelHub, and the European Community of Practice are part of the European Steel Community, connected with present European platforms and tools beyond the steel sector, ensuring exchange with the broader European process industry (e.g. within the Process for Planet programme of A.SPIRE and via the SPIRE-SAIS Blueprint). The governance structure of ESSA is built on a division of responsibilities, clarified and checked with the European Steel Associations and social partners ESTEP, EUROFER, and industriALL.
Connections with European platforms beyond the steel sector (e.g. Pact for Skills, Centres of Vocational Excellence) and tools (e.g. ESCO, Europass) are already part of the ESSA strategy, measures and training (esp. in the steelHub and the Regional Training Ecosystems). To ensure a stronger integration of Small and Medium Sized Enterprises (SME), an "ESSA Task Force SME" was founded, ensuring and integrating the SMEs perspective.

EUROPEAN STEEL TECHNOLOGY AND SKILLS FORESIGHT OBSERVATORY

The ESSA Foresight Observatory coordinates the continuous refinement of additional relevant measures and activities planned on the European level, such as:

• Training Offers and Learning Arrangements (Online and Regional Training Eco-systems, Train the trainer programs, and its integration in the steelHub and the Community of Practice)
• Repository of Innovation Projects and Recruitment Events, Job Advertisements
• Pilot Measures and Tests
• Incentives: Awards, Funding Possibilities, Online Fora, and others
• Image/Recruitment/Talent Management campaigns and recommendations
• Policy recommendations

The Foresight Observatory is a part of the ESSA website, updated continuously as part of the ESTEP homepage. The Observatory will be the homestead of the Repository of Innovation Projects and Recruitment Events on the ESSA homepage. This repository will be also connected with the competence database of the steelHub.

The Observatory integrates and initiates also activities and campaigns to improve the image of the steel industry for recruiting and retaining talents linked to skills adjustment strategies deriving from the technological foresight and related skills requirements.
A central element conducted by the Foresight Observatory is the European Steel Technology and Skills Foresight Panel (ESSA

ETP). The ESSA ETP is foreseen as a standard survey followed by an expert panel workshop, discussing the results in its impact within a broader contextualisation. This will help to interpret the quantitative results in a broader qualitative context from the perspective of different stakeholder groups.

The ESSA ETP will be a steel sector widely accepted instrument for monitoring technological development and skills demands, awareness rising and continuous consideration of skills needs, and for creating the ground for fact-based decision making. Technological development, skills demands, and VET support will be assessed against the selected skills categories (technical, digital, green, social, personal, methodological) and the chosen representative job profiles.

ONLINE TRAINING PLATFORM STEELHUB

The Online Training Ecosystem (steelHub) sets the infrastructure for a European/worldwide exchange of training content, integrating inputs from and serving offers to steel associations and companies, VET systems, research centres, other Blueprints, European tools, and the non-formal and informal learning of individuals. The steelHub will be also serving the Regional Training Eco-Systems, linking European and regional training, and online and work-based learning.

steelHub is an open online system. Based on a business model (agreements between the training publishers and the runner of the platform worldsteel) every training provider, could offer training which could be used by every interested company, VET institution, association and individual learner. The main components are a competence map, a self-assessment and related training contents.

Figure 4: SteelHub Modules

Learning solution Directory	steelHub sets the infrastructure for a European / worldwide exchange of content to create a **Learning Solution Directory**. This directory is a collection of learning solutions delivered by Publishers into the framework of a business model managed by worldsteel (runner of the platform) and disseminated through multiple channels, like Learning Management Systems (LMS) of organisations to cover the different needs.
Skill Directory	One important component of this platform is the **Skill Directory**, which represents the current and future training needs of the steel sector. This Directory is used to curate the learning solutions. Using a standard terminology and big data infrastructure, steelHub is able to identify skill gaps and the most demanded skills for the steel sector to guide the training solutions development as well as **analyse trends** that can support governments to define new regulation and funding tools to support the transformation of the steel sector.
Capability Assessor	The integrated design of steelHub enable the possibility to develop new and innovative solutions into the context of steel **Capability Assessor**, like self-assessment, which identify skill gaps and provide an automatic and customise learning path from solution available in the Learning Solution Directory and ranking by quality.
Micro-credentials and qualification	Finally, the common language provided by Skill Directory improves the alignment of qualification provided by High Schools and University to steel sector needs. Besides, the standardisation enables the implementation of micro-credential program, which are a digital accreditation of achievement that creates Job Mobility in the sector and between sectors.

EUROPEAN COMMUNITY OF TRAINING PRACTICE (ECOP)

The European Foresight Observatory and the steelHub are connected with national-regional/local training ecosystems across Europe. The implementation of these National-Regional Training Ecosystems is characterised by:

• a quick start within a "corridor of possible developments"
• new possibilities to access and mobilise potential training
• an increased potential for education to become a "location factor" for integrated national-regional-local development (e.g. including the attraction of young people to the steel (and process industry) sector))

Up to four National/Regional Rollout Workshops were already conducted in pilot countries/regions (see figure 5 below) including the following countries:

• Germany (national rollout with focus on Rhein-Ruhr-Area)
• Spain (national rollout with focus on Basque Country and Asturia)
• Czech Republic (national rollout with focus on Moravia-Silesia)
• Finland (national rollout)
• Belgium (national rollout)
• Italy (Friuli Venezia Giulia region)
• UK (South Wales region)
• Poland (Silesia region, but also on the national basis)
• Romania (Galati region)

NATIONAL/REGIONAL ROLLOUT WORKSHOPS

Country	Regional Focus
Germany*	Rhein-Ruhr-Area, Saarland
Czech Republic*	Moravia Silesia
Spain*	Basque Country Asturia
United Kingdom	South Wales
Italy	Friuli Venezia Giulia
Poland	Silesia
Finland*	No focus region
Belgium*	No focus region
Romania	Galati region

* National Rollout
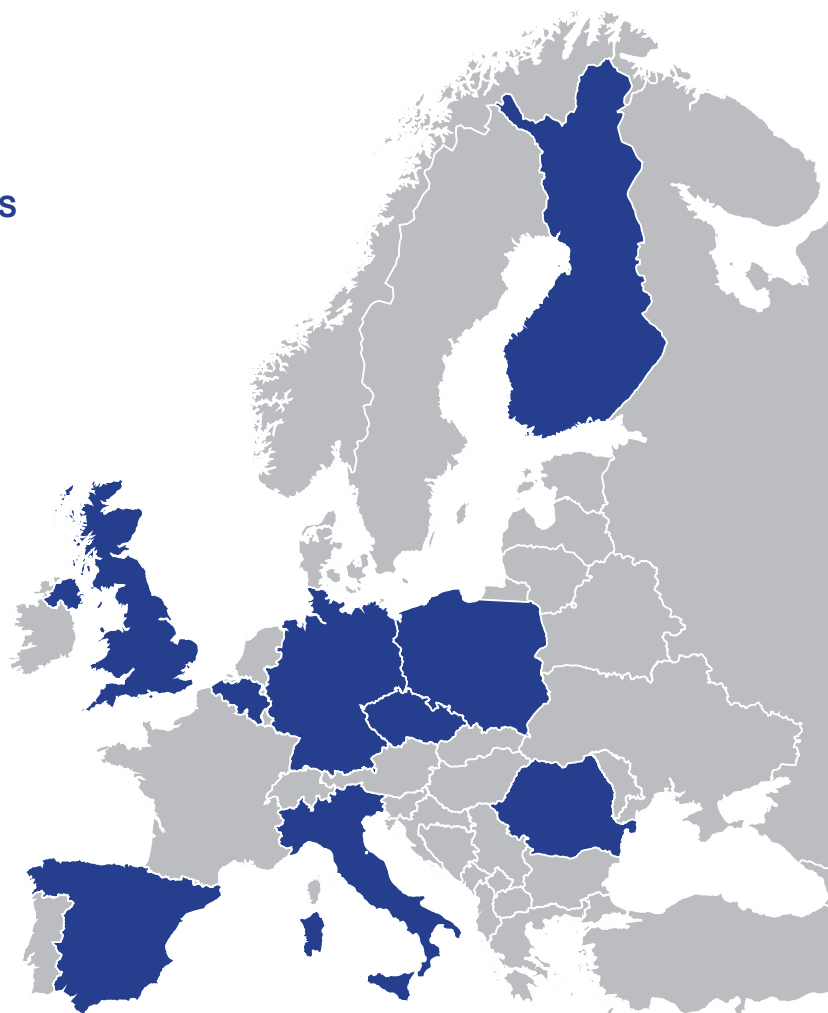
Within the rollout activities, specific national-regional/local activities were launched, ensuring ESSA reached more than one hundred additional external stakeholders from companies, training providers, education, public authorities, national employers' associations and unions, and civil society organisations.

Focusing on the national-regional challenges the following topics were taken up and discussed for specific national-regional solutions, to be supported by ESSA measures and tools:

- Recruitment problems / the poor image of the steel industry
- Need to attract female and new talent
- Unattractive job profiles for new people
- Shortage of skilled students
- Disconnection between formal training and companies' requirements
- Poor relationships among Companies, Universities and Public Administrations
- Introduction of new technologies and the decarbonisation topic
- Consideration of the SME perspective
- Need of the steelHub in all the languages of the selected regions Foreseen topics for further discussion:
- New Narrative of the Steel Industry attracting (young) people for the digital and green transition of the Steel Industry
- Digital and Green Transformation: Hydrogen Usage and Impact on Skills
- steelHub Interlinks to the Regions
- Specific SME Regions and Specific Skills Needs and Adjustment Strategies
- Human Resources Demands in Rural Steel Areas

POLICY RECOMMENDATIONS

The European Commission is aiming to shift to a human-centric orientation in the workplace. For this purpose, the Commission has been actively building directives, frameworks, action plans, and communications to ensure the main rights of workers, such as health and safety at work and equal opportunities for women and men. The Commission aims to avoid discrimination based on sex, race, religion, age, disability, and sexual orientation and to improve the working conditions contained in labour laws, including part-time work, fixed-term contracts, working hours, and informing and consulting employees. In addition, member states support the EU-level directives created by enacting complementary national-level legislation and there are similar commitments introduced at sector level. The aim and approach of the ESSA project are completely in line with the philosophy of the EU and national-level legislation. The policy recommendations created by ESSA, which are presented in this document, align with these directives[12].

As we noted at the outset of this report, the transformation of society from a linear to a circular economy will need changes in many areas, including business, education, finance, politics, legislation, and society more generally. The steel industry, as an energy intensive sector, provides an example of an industry that will need radical innovation in its operations to facilitate the digital and green transformation. However, it is evident that there exist barriers to the adoption and the application of enabling technologies, which are often related to the shape and profile of the current workforce. ESSA identifies the need for upskilling and talent recruitment, for a highly skilled workforce, a need to proactively address skills gaps, and to engage the workforce with new technological innovations.
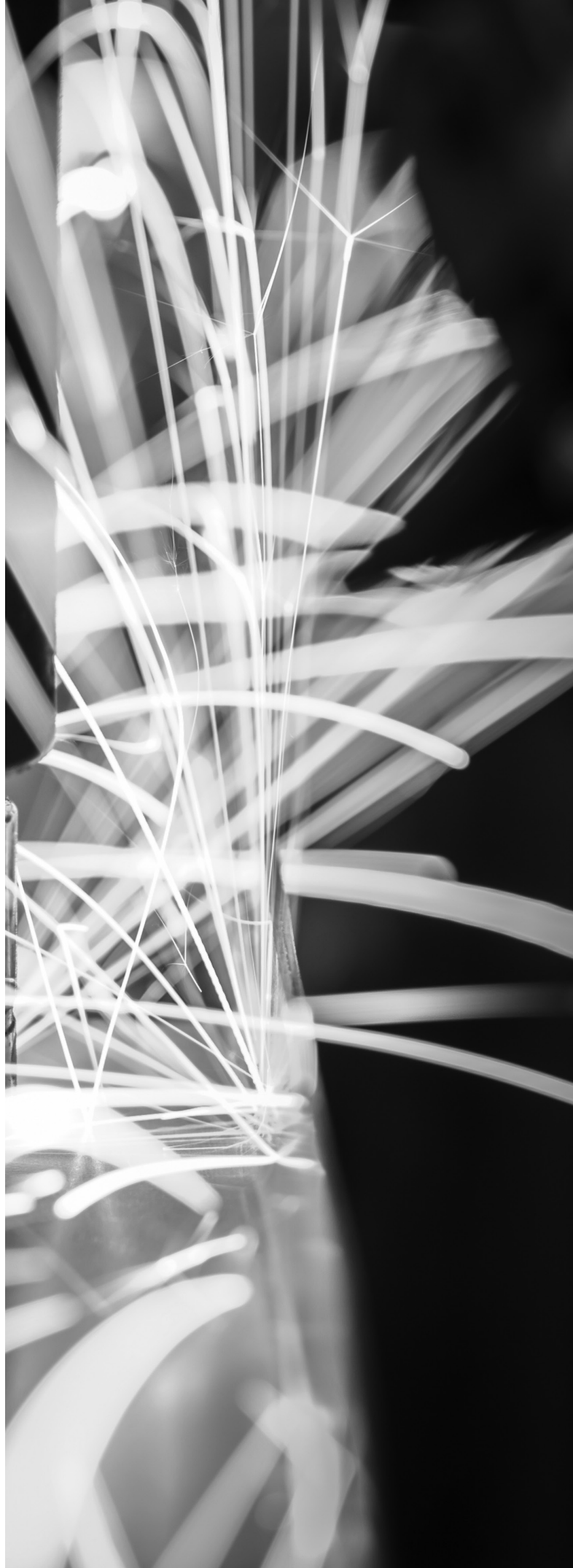
The results of ESSA[13] report that a growth in skill needs is present in all production areas, but not always to the same extent. In the steel industry, emerging skill needs tend to be concentrated in high-skilled job profiles, whereas lower-skilled (technical) job profiles are found to be less but also in need of up-skilling, remaining integral to the industry for the time being. This may hinder wider processes of upskilling across occupations and result in a growing gap between job profiles. Further, such an outcome would stand in stark contrast to broader policy goals of employability, inclusion and job stability.

To achieve this deep transformation a set of policy recommendations have been identified by ESSA[14] and classified with respect to the more general and overarching level, added by specific recommendations for the European, national, and regional level and consequent stakeholders:

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12 Further detail on relevant EU, member state and sector frameworks are available in the ESSA Blueprint (Deliverable 5.3), which is available on the project website (https://www.estep.eu/essa/download-area/deliverables/)
13 Deliverable 2.1 Digital Transformation in European Steel Industry: State of Art and Future Scenario https://www.estep.eu/assets/Uploads/ESSA-D2.1-Technological-and-Economic-Development-in-the-Steel-Industry-Version-2.pdf
14 Deliverable 4.5 Sector Skill Framework https://www.estep.eu/assets/Uploads/ESSA-D4.5-Sector-Skill-Framework-Version-2-final.pdf

GENERAL OVERARCHING RECOMMENDATIONS

- **An Ecosystem approach and Social Innovation Processes**. Skills Alliances like ESSA should engage all the relevant and willing stakeholders (companies, training providers, research institutions, associations and social partners, policy, public administration, and civil society organisations). This includes also the integration of managers, workers and trainers from different departments, combining a company with the training providers perspective - on a European and a national and regional level. Taking up this holistic approach the transformative potential and power of technological and social (people related) change will be conducted in a systemic way with different responsibilities and activities for adjusting skills proactively leading to new social practices (for new infrastructures, working conditions, behaviour and mindsets) to improve existing routines. To move things forward in this directive new alliances with new constellations, roles, tasks and responsibilities in a reciprocal interplay have to be established on the European, national, regional and local level

- **Sectoral specialisation through CVET**. From a sectoral perspective, Continuous Vocational Education and Training (CVET) provision appears more appropriate to promptly tackle specific technical skills gaps. Increasing participation in CVET is essential to realise technological, economic and social potential and contribute to the achievement of the green, digital and social transition in various industrial sectors and in the steel industry in particular. CVET needs to be addressed as a multi-dimensional, multi-stakeholder and multi-level process at the interface between learning and the workplace in the different member states.[15] Relevant stakeholders can be, depending on the state, training providers, company representatives, social partners, policy makers on national or regional level, employment agencies

- **Encourage training modules focusing on or integrating transversal skills**. Transversal or soft skills are increasingly in demand. ESSA emphasises this within the T-shaped skills approach (technical, digital, green, social, methodological, and individual skills). Transversal skills are of high importance to manage recent and upcoming challenges at the workplace: e.g. advanced IT skills, energy efficiency related skills, adaptability and continuous learning, adapt to change, autonomous work. It is also necessary to encourage national and local stakeholders, such as policy makers in the field of VET, training providers, companies, social partners or employment agencies to adopt and develop training material themselves and to integrate them into local vocational education and training systems, identifying contact points for adapting the training material to specific national and regional contexts

- **Promote the importance of informal and non-formal education, with a focus on mentorship. Encourage companies to facilitate knowledge transfer**. The industry should build on Cedefop's guidelines on non-formal and informal learning with the aims of developing common solutions to validate counselling and mentoring for knowledge transfer. Knowledge transfer has been identified as a key challenge, with necessary know-how often acquired through on-the-job learning. The aim is to address knowledge gaps left by an ageing workforce and develop one-to-one mentor led learning opportunities. To this end, companies, as well as trade unions and national associations, can make use of fundings and programmes opportunities such as European Structural Investment Funds (ESIF), European Social Fund + (ESF+), Just Transition Fund (JTF) to support the development of mentorship programmes within companies[16,17]

- **Implement new instruments for new skills in the green transition**. For the future viability and competitiveness of a decarbonised European steel industry and to support the green transition it is essential to identify instruments to support the development of green skills and high-quality green jobs. During the green transition it is necessary, moreover, to preserve high-quality jobs in the steel sector by securing good contractual conditions. According to the Clean Steel Partnership roadmap[18], it is important to ensure that we have EU leadership on clean steel in order to increase market opportunities and create jobs. At the same time, new jobs will become more challenging, as workers will have to master new advanced technologies. To achieve this, it is necessary to consider this perspective, and look for dedicated support instruments which focus on skill and job programmes

- **Give visibility to high-skilled positions, with task variety and modern career paths in the steel industry**. The requirements of digital skills necessitate this focus, and growth opportunities are attractive to new talent. The development of automated processes has already impacted steel production chains, reducing manual labour and physical stress, nonetheless, steel careers are still perceived as manual and physically demanding. It has been observed that both students and jobseekers attribute great importance to positions that combine sedentary work with physical work. Therefore, the willingness to work in the steel sector could be strengthened by showing that steel careers require digital skills, offer exciting challenges and growth opportunities and are adequately remunerated by holding a series of events, seminar and fairs at all levels (i.e. EU, national and regional level). These actions are expected to reach a wide range of public (from students to skilled workers) with a specific focus on the groups for which physical work represents a disincentive to consider the steel industry. Different stakeholders can get active to enforce this: companies, sector associations, and employment agencies can have a high reach, for example

- **Nourish an innovation culture at all levels**. Whether relying on their own resources or on external providers, the training offered to workers can go beyond responding to ad hoc needs and foster a culture of change and innovation. Workers at any level could benefit from broader courses ranging from technical to transversal skills, which could help them to develop a culture of innovation that they can spread

(15) See in detail: Macroeconomic benefits of vocational education and training. Luxembourg: Publications Office. Cedefop research paper; No 40. http://dx.doi.org/10.2801/54994

(16) European Commission, Executive Agency for Small and Medium-sized Enterprises, European vision on steel-related skills and supporting actions to solve the skills gap today and tomorrow in Europe, Publications Office, 2020, https://data.europa.eu/doi/10.2826/20922)

(17) EDLESI Project(September, 2007) Paper 4d

(18) Clean steel Partnership roadmap https://www.estep.eu/assets/Uploads/200715-CSP-Roadmap.pdf

through the organisation. Among others, mobility for example can strengthen this innovation culture - companies should find a way to enable and support their employees on this path

- **Recognising and Promoting Equality and Diversity**. A central challenge for the industry, most importantly steel companies, is to address questions relating to Equal Opportunity and encouraging Diversity. Changing discrininatory and abusive 'behaviours' is at the heart of problems and solutions to the recognition and promotion of Equality and Diversity in the workplace. To address the underlying values and beliefs of individuals in the workplace, it is essential to tackle attitudes towards problem behaviour as part of a successful Diversity implementation initiative. Images and words must reinforce the message that such behaviours are unacceptable regardless of whether there is any Diversity and Equal Opportunity legal connotation. Training and learning are an effective way of communicating the Diversity and Equal Opportunity message. Recognising and promoting Diversity and Equal Opportunity have to be firmly embedded within a 'company culture' for it to thrive. In certain cases, it may mean breaking down an existing culture that is unsupportive, but this might also create an environment for greater diversity in recruitment. This kind of culture could be reinforced by policy makers at national level and bargaining tools developed by social partnersy in recruitment

- **Integrate the industry with online training platforms (e.g. ESSA steelHub), combining online platforms with on-the-job-training**. Online training has become an important option for training at distance in many fields in the last ten years, and become more prominent since the pandemic. Integration with digital technologies should allow learners to take advantage of learning opportunities remotely (e.g. lectures, webinars), interact with simulators, and practice with hands-on laboratories. Such opportunities become even more relevant for SMEs which often do not have enough resources to develop their own training programmes. The ESSA steelHub is an open training system integrating up-to-date training and offer these trainings to interested stakeholders from companies, training providers, associations, educational institutions, and individual learners. To foster this, training providers, VET-system representatives and companies need to work together

- **Investments in Industry 5.0 activities can produce benefits both for workers and companies**, due to the attraction and retention of talented people and resulting in improving companies' competitiveness. As Industry 5.0 refers to a human-centricity, this approach could be implemented to empower workers and to evolve skills and training to benefit employers and employees. According to the EU guidelines, training activities on these issues should consider the following elements:

  1. the adoption of a human-centric approach to digital technologies, including artificial intelligence
  2. the upgrading and retraining of European workers,

particularly in digital skills
  3. a modern, resource-efficient and sustainable steel industry in a transition to a circular economy
  4. a globally competitive and leading industry, increasing investment in research and innovation

- **Emphasise the prominence of steel in every aspect of modern society and address the industry's image**. For the widest reach and to increase public knowledge of the steel sector, a multilevel, systematic image campaign is suggested by making widespread use of mass-media (TV, national and local magazine and journal) and social media. To increase visibility, it is recommended to launch a series of hashtags (i.e. #lovesteel) and threads. In addition to this, it could be useful to consider the use of testimonials both for the general public and in the educational system

Furthermore, the European Steel Skills Alliance and Strategy (ESSA) could be seen as a **Blueprint for other Energy Intensive Industries strongly involved in the application of the Industrial Symbiosis and Energy Efficiency concepts**. Some of the lessons learned lead to emphasising the following actions[19] :

- **Monitor and anticipate** industry skills needs
- **Provide and promote** training in transferable, transversal skills
- **Expand and promote** online and on-the-job forms of training
- Promote (reverse) **mentorship** as a way of knowledge transfer between older and younger workers.
- **Encourage exchanges between public authorities**, education providers and steel companies to promote digital and advanced technology skills, dual education and lifelong learning
- **Promote social dialogue** to ensure that as many workers as possible are included in skills development strategies
- **Include underrepresented groups**, such as women and migrants (eg. Women in Steel Sector, UNESID)

Against this overarching, universal recommendations there are specific topics to be placed at the European, national and regional level, not forgetting the specific suggestions related to SMEs, all of which are presented in the following:

EUROPEAN LEVEL

- **Establish a reliable governance structure to engage stakeholders within the Steel Alliance and provide a platform for engaging further stakeholders**. ESSA has established an accepted governance within existing European steel industry structures (ESTEP, EUROFER, industriALL) including a Technology and Skills Foresight Radar (Observatory), an online training platform, and a European Community of Training Practice. These stakeholders need now to continue and maintain this structure and need acknowledgement by European-level stakeholders such as European Commission authorities, companies and research and development networks

(19) European Commission, Executive Agency for Small and Medium-sized Enterprises, European vision on steel-related skills and supporting actions to solve the skills gap today and tomorrow in Europe, Publications Office, 2020, https://data.europa.eu/doi/10.2826/20922)

- **Engage with European programs, tools and activities for mobility.** To improve access to skilled labour it is recommended to take advantage of **European acknowledgement and mobility opportunities** managed by VET providers/ schools or directly participate in employer-led mobility schemes (e.g. EURES). Acknowledgement can offer a valuable opportunity for workers' continuing development e.g. in relation to new technologies or processes to be implemented by a company. Make use of **EQAVET (European Quality Assurance in Vocational Education and Training) framework for monitoring quality** of provision. When designing their own training offer, it is recommended for companies to follow the four stages devised by EQAVET quality criteria, namely Planning, Implementation, Evaluation and Review, and make use of the appropriate indicative descriptors devised for VET providers. Adopting the EQAVET framework companies would align with national and European quality standards, in doing so enhancing the transparency and recognisability of the training offered. It is therefore recommended that the national and local level stakeholders, which have roles in the management of these instruments, should be better supported by the EC to exploit access to them

NATIONAL LEVEL

- **Engage with national VET system institutions and national programmes**. Many European countries have in place skills foresight programmes, mechanisms to review and update the contents of vocational qualifications, and/ or national catalogues of occupations. Steel companies and sectoral representatives need to engage with the VET system stakeholders to integrate their recent and future skills and qualification demands in the curricula in a short term. Adjusting sectoral qualifications and occupations in national catalogues (of occupational standards and qualifications) is key to attract talented people to the steel sector

- **Encourage workers to make use of national schemes for validation of prior learning**. Following the CEDEFOP recommendations on recognition and validation of non-formal and informal learning for assessing and recognising prior learning is needed (i.e. accreditation of prior learning deriving from previous learning or working experiences). These recommendations vary from country to country, but following them should offer opportunities for shortening vocational paths, especially in the case of steel-workers that have been long in the industry but do not possess an adequate qualification, or need to retrain. Here, policy makers, companies and potentially training providers should find a common path

- **Align internal company training provision with national/ European frameworks/benchmarks**. When designing their own training programmes, it is recommended that steel companies align their activities with national standards (e.g. sectoral qualifications and occupations in national catalogues). This will help workers to capitalise on their non-formal training and obtain certifications that could favour their

mobility and resilience

REGIONAL LEVEL

- **For steel companies and stakeholders to lobby at the regional level**. Our comparative study of VET governance in the case study countries points to the regional level as the most appropriate level for companies to lobby at within an ecosystem approach. In order to maximise the impact and the main results of the ESSA project, steel companies and key stakeholders in the regional context (from public authorities, associations, chambers of commerce, unions, civil society organisations, and others concerned with skills and training) must be active in the monitoring, identification and development of the skills needed in the steel sector. In addition, create tools and fora for dialogue with public and private institutions in the VET sector to update professional profiles and training paths

- **Engage with educational system to promote dual training and placements**. Steel companies should be highly aware of the opportunities of offering placements or partnering in dual training schemes to better promote the industry, attract young talents, and offer an earlier specialisation at IVET level. Older or more mature talent might similarly be encouraged where labour shortages are evident, and bring a wider range of experience. It is recommended that steel companies engage with opportunities for offering placements or partnering in dual training schemes, and to promote them with national stakeholders. This will be useful to better promote the industry, attract young (and older) talents, and offer an earlier specialisation at IVET level

- **Consider the opportunities and limits of modular provision.** Whether modularity allows for shortening vocational paths through recognition of prior learning or adding extra modules to core contents, these opportunities should be known and well understood by companies to make the best use of them. Modularity should offer valuable opportunities for shortening vocational paths, reskilling and upskilling of workers

SME SUPPORT

- **Human Resources and Training support**. Since many SMEs often lack resources for a structured HR department, the SME perspective should be integrated in the Foresight Observatory on labour market trends, skills prospects and guidance on workforce development strategies. Next iterations of the foresight should include a higher share of SMEs representatives in order to achieve a more nuanced understanding of their specific skills needs and technological patterns across businesses

- **SME capacity to access quality training** is needed to overcome local training barriers. More tailored training in terms of form and contents should be offered via the steelHub. In particular, training in basic and advanced digital

skills, cybersecurity and environmental regulation would be beneficial for SMEs

- **Specific training for SME managers** is necessary. Considering the centrality of owner's vision for SMEs, in particular, courses that can raise awareness of the opportunities of technological innovation, Industry 4.0 implementation, and new business strategies seem to be most pressing. Training providers should develop adequate training offers, targeted to SME managers

- **Identification of regional SMEs clusters**, supported and integrated in the European Community of Training Practice (ECoP Steel). Considering the often limited participation of SMEs in broader industrial and service networks, the ECoP could offer steel SMEs an efficient networking platform, in doing so providing a means to overcome information and innovation barriers. In way provide a better representation of SMEs needs to achieve a proper understanding of the different skills needs and technology models of enterprises

Blueprint "New Skills Agenda Steel": Industry-driven sustainable European Steel Skills Agenda and Strategy (ESSA)

Policy Recommendations at a glance

POLICY
RECOMMENDATIONS

Digital transformation and climate change represent the main drivers of innovation for European industry. In particular, green and digital technologies help to increase energy and resource efficiency and contribute to keeping materials in use for longer. However, the right skills are needed to implement, operate and exploit these technologies to best effect. The ESSA project has developed a sector-driven Blueprint following a bottom-up social innovation process to address skills needs, which integrates all the relevant stakeholders (companies, training providers, research institutions, associations, social partners, policy makers, public administration, and civil society organisations). It has identified where there is need for re- and up- skilling and talent recruitment, and identified strategies for developing a highly skilled workforce, proactively addressing skills gaps, and engaging the workforce with new technological innovations. As part of the Blueprint, we offer policy recommendations to support these strategies and address the deep transformations the industry is currently experiencing.

The first policy recommendations are presented as general recommendations. Second, we offer policy recommendations at three levels in order to provide further contextualisation: European, national and regional. Third, we present some recommendations related to the specific support of small and medium-sized enterprises (SMEs).

Specifically, we recommend:

- **An Ecosystem Approach and Social Innovation Processes.**
  Skills Alliances should engage all the relevant and willing stakeholders

- **Sectoral specialisation through CVET.**
  Continuous Vocational Education and Training (CVET) provision to be made more relevant by tackling specific technical skills gaps

- **Encourage training modules focusing on or integrating transversal skills.**
  Transversal skills are of high importance to manage current and future challenges at the workplace and it is necessary to encourage national, regional and local stakeholders to adopt and develop training material

- **Promote the importance of informal and non-formal education, with a focus on mentorship. Encourage companies to facilitate knowledge transfer.**
  Knowledge transfer has been identified as a key challenge, with necessary know-how often acquired through on-the-job learning and mentoring[1]

- **Implement new instruments for new skills in the green transition.**
  For the future viability and competitiveness of a decarbonised European steel industry and to support the green transition it is essential to identify instruments to support the development of green skills and high-quality green jobs

- **Give visibility to high-skilled positions, with task variety and modern career paths in the steel industry.**
  The requirements of digital skills necessitate this focus, and that growth opportunities are attractive to new talent

- **Nourish an innovation culture at all levels.**
  Training offered to workers should go beyond responding to ad hoc needs and foster a culture of change and innovation

- **Recognising and Promoting Equality and Diversity.**
  A central challenge for the industry is to address questions relating to Equal Opportunities and encouraging Diversity

- **Integrate the industry with online training platforms (e.g. ESSA steelHub), combining online platforms with on-the-job-training.**
  Integration with digital technologies should allow learners to take advantage of remote learning, interact with simulators, and practice with hands-on laboratories

- **Investments in Industry 5.0[2] activities can produce benefits both for workers and companies.**
  Industry 5.0 could be implemented to empower workers and to evolve skills and training to benefit employers and employees

- **Emphasise the prominence of steel in every aspect of modern society and address the industry's image.**
  A multilevel and systematic image campaign is suggested by making a large use of mass-media and social media

EUROPEAN LEVEL

- **Establish a reliable governance structure to engage stakeholders within the Steel Alliance, and provide a platform for engaging further stakeholders.**
  A governance within existing European steel industry structures is crucial, including a Technology and Skills Foresight Radar (Observatory), an online training platform, and a European Community of Training Practice

- **Engage with European programs, tools and activities for mobility.**
  Steel companies should take advantage of mobility opportunities managed by the EU, external VET providers/ schools and/or employer mobility schemes (e.g. EURES).

NATIONAL LEVEL

- **Engage with national VET system institutions and national programmes.**
  Steel companies and sectoral representatives need to engage with the VET system stakeholders to integrate their immediate and future skills and qualification demands in the curricula directly and urgently. Adjusting sectoral qualifications and occupations in national catalogues is key to attract talented people

(1) European Commission, Executive Agency for Small and Medium-sized Enterprises, European vision on steel-related skills and supporting actions to solve the skills gap today and tomorrow in Europe, Publications Office, 2020, https://data.europa.eu/doi/10.2826/20922
(2) Industry 5.0: Industry 5.0 decrease emphasis on the technology and assume that the potential for progress is based on collaboration among the humans and machines. (Adel, A. Future of industry 5.0 in society: human-centric solutions, challenges and prospective research areas. J Cloud Comp 11, 40 (2022). https://doi.org/10.1186/s13677-022-00314-5

- **Encourage workers to make use of national schemes for validation of prior learning.**
  It is suggested to follow CEDEFOP recommendations on recognition and validation of non-formal and informal learning

- **Align internal company training provision with national/European frameworks/benchmarks.**
  It is recommended that steel companies align their training activities with national standards (e.g. sectoral qualifications and occupations in national catalogues)

REGIONAL LEVEL

- **For steel companies and stakeholders to lobby at the regional level.**
  Our comparative study of VET governance in the case study countries points to the regional level as the most appropriate level for companies to lobby at within an ecosystem approach

- **Engage with educational system to promote dual training and placements.**
  Steel companies should be highly aware of the opportunities of offering placements or partnering in dual training schemes to better promote the industry, attract young talents, and offer an earlier specialisation at IVET level

- **Consider the opportunities and limits of modular provision.**
  Modularity should offer valuable opportunities for shortening vocational paths, reskilling and upskilling of workers

SME SUPPORT

- **Human Resources and Training support.**
  The SME perspective should be integrated in the Foresight Observatory on labour market trends and skills prospects and guidance on workforce development strategies

- **SME capacity to access quality training.**
  Training in basic and advanced digital skills, cybersecurity and environmental regulation is necessary for SMEs

- **Specific training for SME managers.**
  Raise awareness of the opportunities of technological innovation, Industry 4.0 implementation, and new business strategies

- **Identification of regional SMEs clusters.**
  The European Community of Training Practice (ECoP Steel) could offer steel SMEs an efficient networking platform

We conclude that transforming the steel sector requires a collaborative approach, a bottom-up process of social innovation, the identification of national and regional potential and the involvement of all relevant stakeholders in a governance process. We consider the implementation of these recommendations as necessary for developing a resilient industry with modern skills that is attractive to highly skilled people.

For further information:

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