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SKILLS FOR SMART SPECIALISATION IN MONTENEGRO

Aligning skills, technologies and productivity in the 'Energy and Sustainable Environment' priority domain

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Authors: Pirita Vuorinen (ETF), Miloš Bogdanović (local expert)

Peer reviewer: Cristina Mereuta (ETF)

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EXECUTIVE SUMMARY

Montenegro's *Energy and Sustainable Development* domain has strong foundations in hydropower and a growing base in solar and wind energy, but competitiveness and productivity are increasingly constrained by skills shortages, low readiness for advanced technologies, and severe gaps at technician level.

Smart specialisation, as an EU innovation policy approach designed to boost economic competitiveness, requires a clear strategic focus. Achieving its objectives depends on prioritising a small number of high-impact technology clusters, addressing core skills bottlenecks, particularly in installation, operation and system integration, and mobilising the skills ecosystem around clear, sequenced action areas that support the green and digital energy transition.

Top 4 high-impact technology clusters

Renewable electricity generation and battery energy storage systems (BESS)
Solar panels, wind turbines, hydropower systems, battery-based energy storage, grid connection and balancing solutions

Digital simulation, modelling and algorithm-based energy management
Simulation and prediction models, forecasting tools, data-driven optimisation, AI-enabled energy management and control systems

Smart grid and microgrid digitalisation technologies
Digital grid monitoring and control systems, distributed energy management platforms, real-time data and network analytics

Energy management and energy efficiency technologies
Energy auditing and monitoring systems, digital energy-management platforms, building- and system-level efficiency solutions

Core skills bottlenecks

Severe shortages of technicians and operators
Energy technicians, installers, maintenance workers, plant operators and grid technicians are in critically short supply. These profiles are essential for installing, operating and maintaining renewable generation assets, storage systems and grid infrastructure.

Weak practical and job-ready skills
VET and higher-education programmes remain overly theoretical. Limited hands-on exposure to modern equipment, digital monitoring tools, safety procedures and real operational environments reduces workforce readiness.

Insufficient digital and analytical skills at operational level
Many technicians and operators lack basic competences in system monitoring, data handling, diagnostics and digital workflows. This constrains adoption of smart grids, BESS and AI-enabled energy management systems.

Limited battery and storage-related competences
Despite high global relevance, Montenegro lacks practical experience and training capacity in battery energy storage systems. Skills in battery safety, installation, diagnostics and predictive maintenance remain underdeveloped.

Underdeveloped lifelong learning and re-skilling pathways
Adult learning provision is limited, fragmented and weakly linked to certification. The lack of short modular courses, micro-credentials and recognition of prior learning slows upskilling and requalification.

Four priority action areas

1. Priority action area 1: Strengthen practical skills for renewable generation and battery energy deployment

Focus on installation, commissioning, safety, maintenance and system integration across solar, wind and BESS. Build a continuous pipeline of job-ready technicians and engineers capable of supporting rapid renewable deployment.

Roles across the skills ecosystem:

- **VET providers:** Make renewable energy and battery technologies core curriculum content; expand work-based learning and safety training.
- **Higher education:** Strengthen applied engineering, system integration, diagnostics and laboratory-based learning linked to real projects.
- **Adult learning & BSOs:** Deliver certified short courses, fast-track requalification and on-site advisory support for companies.

2. Priority action area 2: Embed digital and analytical competences in energy system planning and operation

Build technician- and engineer-level skills in simulation, modelling, system monitoring and data-driven optimisation. Enable effective use of digital tools in grid management, forecasting and operational decision-making.

Roles across the skills ecosystem:

- **VET providers:** Integrate compulsory digital modules, system diagnostics and monitoring tools into practical training.
- **Higher education:** Expand simulation, algorithms, data analytics and AI-related content through applied projects and laboratories.
- **Adult learning & BSOs:** Scale short modular courses, micro-credentials and advisory services linked to digital energy systems.

3. Priority action area 3: Prepare the workforce for smart grids, microgrids and energy efficiency solutions

Develop operational skills in digital grid management, distributed energy systems and energy efficiency across buildings and industry. Support system resilience and productivity gains through modernised technical training.

Roles across the skills ecosystem:

- **VET providers:** Modernise electrical and energy programmes with smart-grid, microgrid and efficiency content, supported by hands-on learning.
- **Higher education:** Strengthen interdisciplinary modules linking energy, digital systems and efficiency optimisation.
- **Adult learning & BSOs:** Provide modular training, demonstration projects and company-level advisory support for energy efficiency and grid digitalisation.

4. Priority action area 4: Developing energy management and efficiency skills across the workforce

Strengthen practical skills in energy management, auditing and efficiency optimisation across buildings, infrastructure and industrial systems. Focus on reducing energy losses, improving operational performance and supporting cost-effective decarbonisation through better use of monitoring tools, data and efficiency technologies. Build a workforce capable of applying energy-efficiency measures in real operating environments, with strong emphasis on technician-level competences.

Roles across the skills ecosystem:

- **VET providers:**
  Integrate energy management and energy efficiency as core curriculum content in electrical and energy-related programmes. Strengthen hands-on training in energy auditing, measurement tools, sensor-based monitoring and basic efficiency optimisation in buildings and systems.
- **Higher education:**
  Expand applied modules on energy management, efficiency optimisation and building systems. Strengthen interdisciplinary learning linking electrical engineering, digital monitoring, building technologies and system performance analysis through laboratories and applied projects.
- **Adult learning & BSOs:**
  Deliver short, modular upskilling courses for technicians, engineers and facility managers focused on practical energy-efficiency measures. Provide company-level advisory services, demonstration projects and pre-deployment training to support adoption of energy-management systems and efficiency solutions.

Key message for decision makers

Montenegro's energy transition and future competitiveness depend less on access to technology than on the availability of skills to deploy it, with **acute shortages at technician level** now representing **the most critical bottleneck**. While the country has strong foundations in hydropower and growing capacity in solar and wind, it risks falling behind in battery energy storage, digital simulation, smart grids and advanced energy management, technologies that are shaping global productivity and skills demand. Addressing this gap requires a clear **focus on a small number of high-impact technology clusters and a rapid shift toward practical, job-ready and digitally enabled skills** across VET, higher education and adult learning. Strengthening lifelong learning, modular upskilling and requalification pathways, and improving coordination between education providers, energy companies and public institutions are essential to reduce skills mismatches, limit reliance on outsourcing and ensure that investment in the energy sector translates into sustained productivity, energy security and competitiveness.

1. INTRODUCTION

1.1 The renewable energy sector in Europe’s competitiveness and green transition

Energy security as a foundation of Europe’s competitiveness. As the EU advances towards climate neutrality, renewable energy plays a central role in strengthening economic resilience, stabilising prices and supporting long-term productivity. Europe’s energy system remains highly exposed to external shocks due to strong import dependency, which exceeded 60% in 2022 and is largely driven by oil and petroleum products. This dependence increases vulnerability to supply disruptions and price volatility, underlining the strategic importance of accelerating domestic renewable energy deployment.

Geopolitical shocks and the strategic imperative of energy autonomy. Russia’s aggression against Ukraine, followed by renewed tensions in the Middle East, has sharply increased energy prices and living costs across member states. While emergency measures have helped stabilise markets, these crises have exposed persistent risks linked to external dependence and infrastructure security. Energy autonomy, supply diversification and system resilience have therefore become central elements of Europe’s competitiveness and security agenda.

Renewable energy expansion and emerging supply-chain vulnerabilities. Renewable energy is expanding steadily across the EU, accounting for 23% of total energy consumption and 41.2% of electricity use in 2022 (EEA, 2025). Capacity is projected to grow by more than 7% annually through 2030 (MI, 2025), driven primarily by wind power and increasingly efficient solar technologies. As variable renewable generation expands, energy storage becomes essential to ensure system flexibility and security of supply. However, renewable energies rely heavily on critical raw materials such as lithium, copper and cobalt which creates new strategic vulnerabilities (Nunzi, 2025). Strengthening supply-chain resilience through diversification, recycling and domestic processing is therefore an increasingly important consideration.

Skills demand and workforce readiness as constraints to the transition. The energy transition is generating significant skills demand across all qualification levels, but education and training systems are not keeping pace. The number of workers pursuing relevant qualifications is growing more slowly than labour-market needs, leading to shortages of workers with the right skills in the right places. Around half of new jobs will require primary or lower-secondary education, 37% secondary education and only 13% tertiary qualifications. Rapid technological change further increases the risk of skills obsolescence, reinforcing the need for continuous upskilling and reskilling. Low participation in adult learning and limited integration of emerging technologies into curricula risk slowing technology deployment and weakening long-term competitiveness.

1.2 Montenegro’s smart specialisation context and policy objectives

Montenegro is preparing its second Smart Specialisation Strategy for the period 2026–2031. Within this process, the European Training Foundation (ETF) has been requested to provide analytical support focused on identifying skills needs for the implementation of the strategy. This includes identifying skills needs for strengthening productivity, competitiveness, and technology adoption, while ensuring alignment with European policy priorities, including the Competitiveness Compass and the Union of Skills.

The scope of the analysis was defined around the objectives for smart specialisation defined through the Entrepreneurial Discovery Process (EDP) which was conducted in compliance with the smart specialisation methodological framework and the European Commission's EDP guidelines. In addition to the European Commission's EDP guidelines, the process was carried out in line with the *Methodology for Policy Development, Drafting and Monitoring of Strategic Planning Documents* prescribed by the Secretariat-General of the Government of Montenegro.

The Entrepreneurial Discovery Process (EDP) resulted in the definition of the following vision, strategic objective and operational objectives in the priority domain *Energy and Sustainable Development*.

Figure 1. Vision and the strategic objectives of the priority domain Energy and Sustainable Development

Vision: By 2040, Montenegro is to reach a mature stage in its transition to a carbon-neutral, climate-resilient, and circular economy, driven by innovation, decarbonisation of the energy sector, modernisation of the energy grid, and advanced technologies, while consistently upholding principles of environmental protection, resource efficiency, and waste valorisation.

Strategic objective: Advance the implementation of the green energy transition by achieving the 2031 national targets for GHG reduction, increased renewable energy share, and improved energy efficiency, in a manner that is both energy-secure and environmentally sustainable, while reinforcing human, digital, and institutional capacities and sustainable use of resources.

Source: Bole D, al (2026), Final report on the Entrepreneurial Discovery Process (EDP) implemented in the preparation of the smart specialisation strategy 2026-2031.

During the Inception phase, the specific focus areas for the priority domain were clarified as outlined in Table 1.

Table 1. Priority domain and sub-sectors for the analysis

Sub-sectors	NACE Codes (In-Scope)	Out-of-Scope
I level of priority Solar energy production, installation and management Wind energy production, installation and management Hydroelectrical production, installation and management Electric power transmission, distribution, storage and grid stability II level of priority Waste-to-energy plants (Includes energy production from biogas generated from urban waste) Green Hydrogen development	D35.12 - Production of electricity from renewable sources D35.13 - Transmission of electricity D35.14 - Distribution of electricity D35.16 - Storage of electricity D35.21 - Manufacture of gas	Energy production from biomass Nuclear power Production of electricity from non-renewable sources Trade of energy

Source: Erre Quadro's elaboration

1.3 Analytical logic and methodology: from technologies to skills and occupations

The ETF's analytical contribution focuses on three interrelated dimensions that together provide a comprehensive understanding of the technological and skills transformation required in the *Energy and Sustainable Development* priority domain. The analytical framework is designed to link global technological developments with Montenegro's national context and to translate these insights into evidence and recommendations on emerging skills and occupational needs. All stages of the analysis were informed by extensive stakeholder consultations, ensuring close alignment with sector realities and national priorities.

The first analytical dimension concerns **innovation dynamics**. This dimension examines global technological developments shaping the Energy and Sustainable Environment' priority domain through the analysis of more than 30 years of worldwide patent data. The use of global patent evidence is particularly important given Montenegro's position as a small, predominantly technology-adopting economy, where most innovations influencing domestic production and processing originate outside the country. The patent analysis enables the identification of major technological trends, growth trajectories and potential disruptors across the domain, and provides a forward-looking perspective on technologies likely to influence productivity and competitiveness in the short to medium term.

The second dimension focuses on **technology adoption readiness**. Global innovation trends do not automatically translate into national uptake. To address this gap, the analysis assesses Montenegro's readiness to adopt and deploy identified technologies by comparing global developments with national capabilities, institutional maturity, regulatory conditions and existing industry practices. This assessment applies a four-level readiness scale (low, increasing, high and stabilising) and draws on expert analysis, desk research and three rounds of stakeholder consultations. Readiness scores therefore reflect Montenegro's capacity to absorb, operate and scale external technologies, rather than domestic innovation output.

The third dimension examines **skills implications** arising from technological change. Building on the identification of priority technologies and readiness levels, the analysis applies ESCO-based semantic matching, supported by proprietary tools, to link technologies with relevant skills, competences, knowledge areas and occupational profiles. This approach makes it possible to identify skills likely to experience demand growth, highlight emerging or hybrid occupational profiles, and detect potential mismatches between technology adoption and workforce capacity. As with the readiness assessment, results were validated through expert input and stakeholder consultations to ensure their relevance for the Montenegrin labour market.

While these three dimensions structure the analytical work, the report presents its findings in two main analytical steps, reflecting how evidence is organised and used throughout the report. First, an analysis of global patent trends combined with technology-readiness scoring identifies priority technologies and assesses Montenegro's capacity to adopt and deploy them in the *Energy and Sustainable Development* domain (Chapter 2). Second, the skills and occupations associated with these technologies are identified (Chapter 3). Finally, the findings are translated into priority action areas and measures to operationalise smart specialisation through skills development and ecosystem mobilisation (Chapter 4). The recommendations were developed through a structured and iterative process that combines all analytical dimensions with extensive stakeholder consultations, ensuring close alignment with sector realities and a focus on producing actionable measures for integration into the national Smart Specialisation Strategy and its Action Plan.

This approach ensures a coherent progression from global technological developments to national adoption capacity and, ultimately, to the skills, occupations, and implementation measures required to deliver Montenegro's smart specialisation objectives.

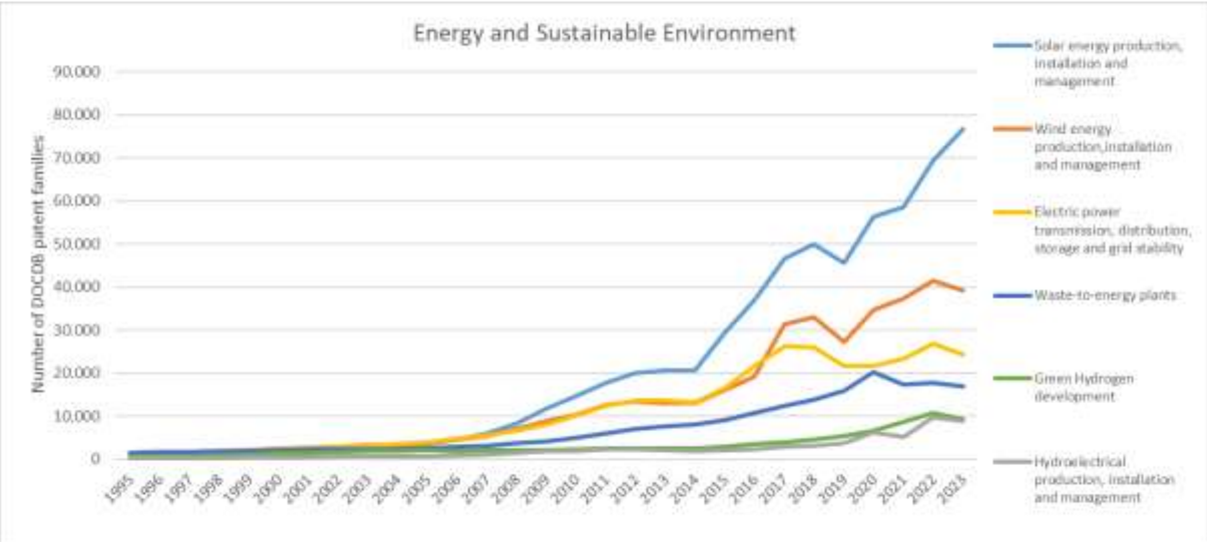
2. TECHNOLOGICAL DEVELOPMENT IN THE ‘ENERGY AND SUSTAINABLE ENVIRONMENT’ PRIORITY DOMAIN

To achieve its long-term smart specialisation objectives, Montenegro must adopt technologies that drive the green energy transition. This requires prioritising a small number of high-impact technology clusters and strengthening the technical, digital and institutional capacities needed to adopt, operate and scale them, particularly where readiness remains low (e.g. battery storage, simulation and smart grids). Chapter 2 therefore examines the global technological landscape shaping the energy sector and assesses Montenegro’s readiness to adopt and deploy relevant technologies, identifying those with the highest strategic relevance for advancing the green transition as well as the key barriers that continue to limit wider uptake.

2.1 Global patent trend analysis

For this analysis, more than **2.2 million patent documents worldwide** were examined for the period **1995–2025**, focusing on the identified sub-sectors in the *Energy and Sustainable Environment* domain (see Introduction in Chapter 1). More than half of the total patents have been filed in China, and the fraction of Chinese-born innovations has grown in recent years. Montenegro is predominantly **a technology-adopting, rather than technology-developing, economy** in the Energy and Sustainable Environment domain.

Figure 2. Time series of patent families’ filings in the Energy and Sustainable Environment sector[1]



Source: Erre Quadro’s elaboration

The examination of the *Energy and Sustainable Environment* sector and its constituent subsectors reveal a landscape characterised by robust and sustained growth, with a sensible acceleration in recent years. Notably, the subsector *Solar energy production, installation and management* emerge as the most prominent, both in terms of patent document volume and growth trajectory. A comparable –

[1] The last two years (2023–2025) are not displayed in the figure. This timeframe, referred to as the blind period, is a period when patents are subject to confidentiality and therefore the corresponding data are not yet publicly available.

although slightly less pronounced – pattern is observed for *Wind energy production, installation and management*, which also demonstrates significant activity and a positive trend over time.

It is important to clarify that subsectors such as *Electric power transmission, distribution, storage and grid stability* and *green hydrogen development* were delineated in accordance with the thematic constraints of the present study, specifically the focus on green and sustainable technologies and strategies. Therefore, their relatively minor numerical relevance may be affected by such restriction: for example, research on hydrogen technologies overall is surely much more consistent, but not necessarily sustainable, as grey, blue, white and turquoise hydrogen still relies on fossil fuels and therefore out of scope of the present investigation.

Furthermore, as already mentioned, the analysis highlights a substantial presence of Asian – particularly Chinese – patents within these datasets, especially in recent times, underscoring the global competitive dynamics shaping innovation in this domain.

2.2 Technology readiness scoring and local relevance

The identified technologies in each sub-sector were ranked using a **Global Score** that combines patent volume, growth rate and the strategic relevance of the corresponding subsectors. High-scoring technologies represent widely researched innovations with rapid growth driven by significant R&D investment and are therefore most likely to achieve widespread adoption and shape future skills demand. Lower-scoring technologies (below 0.5) remain relevant either because they are established but require updated skills, or because they are early-stage innovations with longer-term potential.

To complement the patent analysis, Montenegro's **readiness** to adopt each technology was assessed using expert insights and stakeholder consultations, supported by desk research, EU policy reviews, and available proxy indicators. This resulted in a four-level *Readiness Score*: low (), increasing (°), high (°°), and stabilizing (°°°).

Together, these two assessments provide a structured lens for identifying the technologies most relevant for Montenegro and understanding their potential contribution to the country's vision and strategic objectives.

Table 2 presents the full list of identified technological concepts. A small number of non-technological entries, *Regulatory Frameworks* and *Environment Sustainable Goals*, are included for completeness and marked with the tag "N.T." at the bottom of the ranking.

Table 2. Emerging technology and innovation clusters for Energy and Sustainable Environment sector

Technological and Innovation Concepts	Global Score	Readiness Score
Simulation & Prediction Model and Algorithm	1.000	°
Solar Panel	1.000	°°°
Wind Turbine	0.848	°°
Energy Management & Energy Efficiency	0.812	°°
Advanced Materials	0.776	°
Offshore Platforms (including floating structures)	0.739	°
Battery Energy Storage System (BESS)	0.722	
Smart- & Micro- Grid	0.617	

Technological and Innovation Concepts	Global Score	Readiness Score
Carbon Capture	0.553	
Hybrid Energy System	0.550	
Electrolyser	0.539	
Dams	0.538	°°°
Virtual Power Plant	0.537	
Novel Mechanical Transmission & Components	0.490	°
Fuel Cells	0.474	
High-Efficiency Solar Panels	0.474	°
Building Heating & Cooling	0.454	°°
Hydropower systems	0.422	°°°
Subsea Components	0.418	°
Chemical Plastic Recycling	0.396	
Incinerators	0.303	
Smart Water Management	0.303	°
Anaerobic digestion	0.167	
New generation Gasification	0.122	
Regulatory Frameworks	N.T.	°°
Environment Sustainable Goals	N.T.	°°

Source: Erre Quadro's elaboration

Montenegro has a solid foundation in mature renewable energy technologies, particularly solar panels and hydropower systems, both of which are well established globally and continue to attract incremental innovation rather than disruptive breakthroughs. In contrast, more advanced and emerging solutions remain largely absent, despite growing strategic interest. To support subsequent skills analysis, the identified technologies were clustered and prioritised through stakeholder consultations, reflecting their local relevance for Montenegro's energy transition and implementation capacity.

Solar and wind technologies show high readiness and remain key areas of development. Montenegro's expanding project pipeline positions both technologies as central to future competitiveness. Solar capacity has reached around 80 MW, supported by strong investor interest. In 2021, the state-owned utility company Elektroprivreda Crne Gore (EPCG) established Solar Gradnja to design, install and maintain photovoltaic systems, and offers programmes which enable households and small businesses to adopt solar through a zero-upfront-cost model.

Hydropower remains the backbone of the electricity system. Montenegro's high readiness reflects a mature sector with well-established infrastructure. However, globally, growth in hydropower innovation is slower compared to solar, wind, or storage technologies. Thus, Montenegro's strong hydropower base supports system stability but does not expose the workforce to emerging global skills demand.

Critical Competitiveness Gap. Some of the globally most influential technologies, those driving future skills demand, show low readiness in Montenegro. These include simulation & prediction models, battery energy storage systems (BESS), and offshore platforms. Globally, these technologies are at the centre of system flexibility, digitalisation, and resilience, and they shape demand for advanced roles such as data analysts, simulation engineers, grid modelling experts, and AI based optimisation specialists. Montenegro's low readiness contrasts sharply with global momentum.

Battery energy storage systems (BESS) rank high globally, yet Montenegro currently lacks operational BESS facilities. International markets are experiencing exponential growth in storage installations, creating strong demand for battery system engineers, safety specialists, installation technicians and predictive maintenance analysts. Montenegro's ongoing feasibility studies (Nikšić Steel Plant and the Pljevlja TPP), together with the unsuccessful initial public call, highlight the widening gap between global technological acceleration and domestic readiness. Without strategic pilot projects, this domain will continue to lag, constraining the development of storage-related occupations.

Artificial Intelligence for energy efficiency. Although EPCG plans to invest in AI-based energy management, the enabling technologies that make such systems effective—such as simulation and prediction algorithms and smart-grid systems—remain underdeveloped domestically. Montenegro's early-stage readiness places it behind global frontrunners, limiting its ability to fully leverage AI-driven productivity gains in the near term.

Carbon Capture shows moderate but strategic global relevance. Montenegro considers carbon capture important for extending the Pljevlja plant's life but shows no active projects.

Offshore and Floating Technologies. Offshore platforms represent a rising frontier in global renewable expansion. Montenegro's readiness remains limited to exploratory activities (floating solar pilots, wave converters). This is likely to delay the emergence of dedicated occupational profiles.

Smart Grids & Microgrids. Smart grids and microgrids are highly relevant globally but show no readiness score in Montenegro due to data gaps and digitalisation constraints. Internationally, these technologies are central to distributed energy systems. Montenegro's low readiness suggests its future labour market may not fully capture these rapidly increasing global skill demands without significant improvements in data infrastructure and analytics capabilities.

Hydrogen and Hybrid Systems. Hydrogen related technologies, such as electrolysers and fuel cells, are gaining global relevance as alternatives for long-term decarbonisation. Montenegro, however, shows no readiness scores, lacks infrastructure, and is only preparing its hydrogen strategy. This divergence indicates that Montenegro's workforce will develop hydrogen related skills later than in countries already piloting and deploying hydrogen projects.

Waste to energy technologies, such as chemical plastic recycling, anaerobic digestion, new generation gasification and incineration, show low readiness. Activities are limited to early studies, with structural barriers such as the absence of gas infrastructure and limited waste volumes at scale. Incineration and advanced recycling options are still at preliminary assessment stages. However, Montenegro has taken an initial step forward with the commissioning of its first landfill gas (biogas) power plant in Možura (Bar), indicating early practical implementation despite overall sector constraints.

The policy and regulatory framework are enabling and aligned with EU priorities. The Renewable Energy Law has been adopted and the Energy Law updated. Montenegro has ratified the Paris Agreement and committed to raising the share of renewables in final consumption by 2030. Preparations for the National Energy and Climate Plan are underway, with gradual alignment to EU emissions trading mechanisms. The Green Hydrogen Development Strategy (2026–2028) will set the institutional basis for hydrogen related developments.

3. THE IMPACT OF TECHNOLOGICAL DEVELOPMENT ON SKILLS DEMAND IN THE ‘ENERGY AND SUSTAINABLE ENVIRONMENT’ DOMAIN

To achieve the long-term vision and the strategic objectives for smart specialisation to boost economic competitiveness, Montenegro will need a workforce capable of integrating locally relevant technologies that drive the green energy transition. This requires skills that support system efficiency, strengthen energy security and enable environmentally sustainable growth across the energy sector. Chapter 3 examines these requirements in detail and links the strategic objectives for smart specialisation with the human capital needed to deliver them.

The technologies–skills–occupations mapping used in this chapter makes it possible to identify emerging skills needs and the potential rise of new professional profiles. This type of skills intelligence is essential for curriculum development, targeted training design and stronger cooperation between education providers and employers. It also highlights where skill gaps are likely to appear and where labour demand may grow in the near future.

The analysis draws on semantic algorithms that match technologies with ESCO skills and occupations. This approach reflects international developments in how digital, green and advanced technologies reshape workforce needs and generate demand for new hybrid roles. In Montenegro, these findings were examined in three dedicated stakeholder meetings, where participants assessed their relevance for the national context. Their insights confirmed that the top skill and occupation profiles identified through the analysis correspond closely to Montenegro’s emerging needs and offer a solid basis for planning future workforce development.

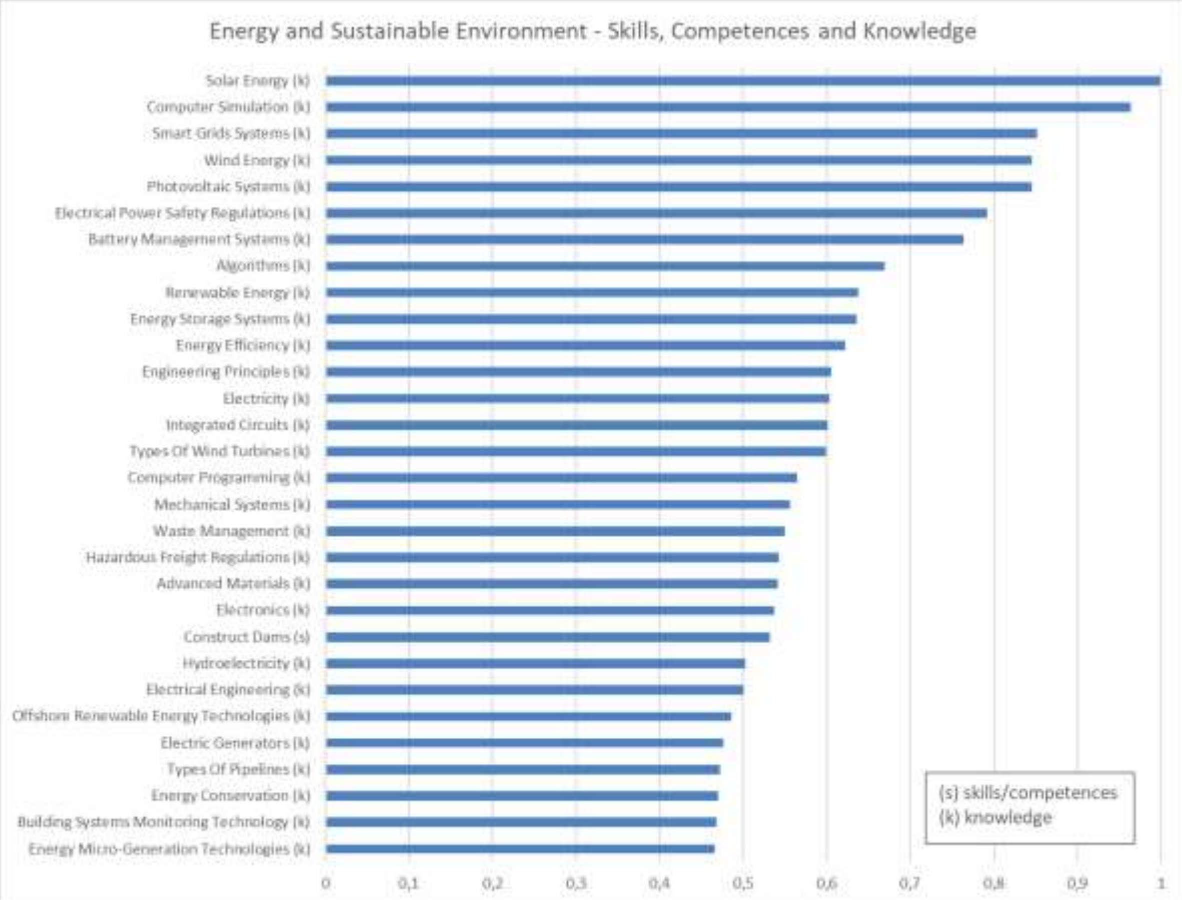
3.1 Skills demand emerging from technological change

Technological change is reshaping energy systems worldwide and creating new patterns of skills demand across renewable generation, storage and digitalised grid operations. For Montenegro, understanding these shifts is essential to ensure that the workforce can support the deployment of technologies that drive the green transition. This chapter examines how global technological trends translate into specific skill needs and identifies where new capabilities must be developed to operationalise the country’s smart specialisation priorities. It also highlights how emerging technologies influence both existing professions and the creation of new hybrid roles, reinforcing the importance of continuous upskilling and reskilling and closer cooperation between education providers and employers.

This chapter examines how global technological trends translate into specific skill needs and identifies where new capabilities must be developed to operationalise the country’s smart specialisation priorities. It also shows how emerging technologies influence both existing professions and new hybrid roles, highlighting the need for continuous upskilling, reskilling, and closer cooperation between education providers and employers.

Figure ranks the top 30 skills associated with technologies likely to impact the *Energy and Sustainable Environment* domain in the years ahead. These skills underscore the growing importance of digital and computational capabilities, advanced system-monitoring tools, and technical competences linked to renewable generation and grid modernisation. Together, they reflect the increasing relevance of simulation, battery management, smart-grid operations and sector-specific expertise in solar, wind and hydropower systems. Collectively, these capabilities provide a foundation for identifying priority areas for workforce development and ensuring that Montenegro’s human capital can keep pace with emerging technological trajectories.

Figure 3. Top 30 ESCO skills, competences and knowledge in Energy and Sustainable Environment sector.



Source: Erre Quadro's elaboration

Strong demand for solar, wind and hydropower skills. Sector-specific knowledge in solar, wind and hydropower systems forms the foundation of Montenegro's future skills needs. These technologies underpin the country's renewable energy transition and will continue to influence competitiveness in the years ahead. Stakeholders fully agreed with this priority and emphasised the need to maintain strong technical capabilities in these areas. They highlighted the scale of current investments in solar and wind power and the continued importance of sustaining existing hydropower facilities, even if large new plants are not expected. This shared view confirms that renewable energy production requires robust technical expertise and the ability to integrate systems into a changing energy mix.

Digital and computational skills as emerging priorities. Digital and computational skills are becoming essential components of modern energy systems. Competences such as computer simulation, algorithm development and programming enable accurate forecasting, system optimisation, fault detection and enhanced operational decision making. Stakeholders confirmed this need and stressed the central role of digital skills in supporting flexible, data driven energy management. They noted that these competences are particularly important for smart grid deployment, system planning and modelling tasks. This alignment reflects a shared understanding that digitalisation is a direct enabler of technological adoption and system efficiency.

Battery storage and battery management skills as critical areas. Battery management and energy storage competences are emerging as critical priorities for Montenegro's energy transition. These skills support system flexibility by balancing variable renewable generation and improving reliability. Stakeholders strongly agreed with these findings and placed even greater urgency on storage related skills. They noted that Montenegro currently has no operational battery energy storage systems and must therefore build local expertise from the ground up. This situation highlights a clear gap between global technological developments and Montenegro's current implementation capacity, underscoring the need for focused training and early pilot activities.

Growing importance of smart grid and microgrid skills. Skills related to smart grids and microgrids feature prominently in the analysis, reflecting the rising significance of distributed generation and digital monitoring. These competences are essential for managing household level systems, supporting rooftop solar integration and improving energy distribution efficiency. Stakeholders supported this conclusion and pointed to Montenegro's limited availability of high-quality network data and specialised software expertise. They emphasised that smart grid adoption requires improved data quality, stronger digital tools and enhanced technical capacity. This shared understanding shows that smart grids present both a technological and an organisational challenge.

Continued importance of engineering fundamentals. Engineering principles, electronics and electrical engineering remain core foundations of the energy workforce. These competences support the operation of power-electronics-intensive systems, advanced renewable installations and modern grid components. Stakeholders strongly agreed and noted concerns about the shortage of specialised engineers capable of handling complex technical tasks. They highlighted that long-term outsourcing has reduced opportunities for domestic skill development. This reinforces the conclusion that strong engineering fundamentals will continue to be essential even as new technologies emerge.

Severe shortages of technicians as a stakeholder-driven priority. While the analytical findings emphasise technical skills, they do not identify technician shortages as a distinct issue. Stakeholders, however, described the lack of technicians as one of the most urgent labour market gaps. They explained that many essential activities, such as installation, maintenance and operational support, depend on technicians with practical competences that have become increasingly scarce. This gap reflects years of declining interest in technical professions and highlights the need to strengthen vocational training and on-the-job learning opportunities. The emphasis placed on this issue by stakeholders' points to a structural challenge that directly affects implementation capacity.

Stable but limited role for hydropower-related skills. Hydropower skills remain part of the essential competence mix, particularly for maintaining existing facilities and supporting incremental upgrades. Stakeholders agreed that these skills remain relevant but clarified that major new hydropower investments are unlikely in the near term. The focus is instead on operational stability and efficiency improvements within the current hydropower system. This explains why hydropower contributes to ongoing skills needs but does not generate substantial new training demand.

Hydrogen-related skills viewed as lower priority. Although hydrogen-related technologies appear in the analysis as part of the broader set of emerging competences, stakeholders assigned them a lower priority. They noted that Montenegro currently lacks the infrastructure and practical requirements needed to justify significant investment in hydrogen-related skills. While a national hydrogen plan was adopted end of 2025, no active projects currently provide opportunities to build practical expertise. Their cautious approach reflects a focus on readiness, resource constraints and the need to prioritise skills that support immediate technology deployment.

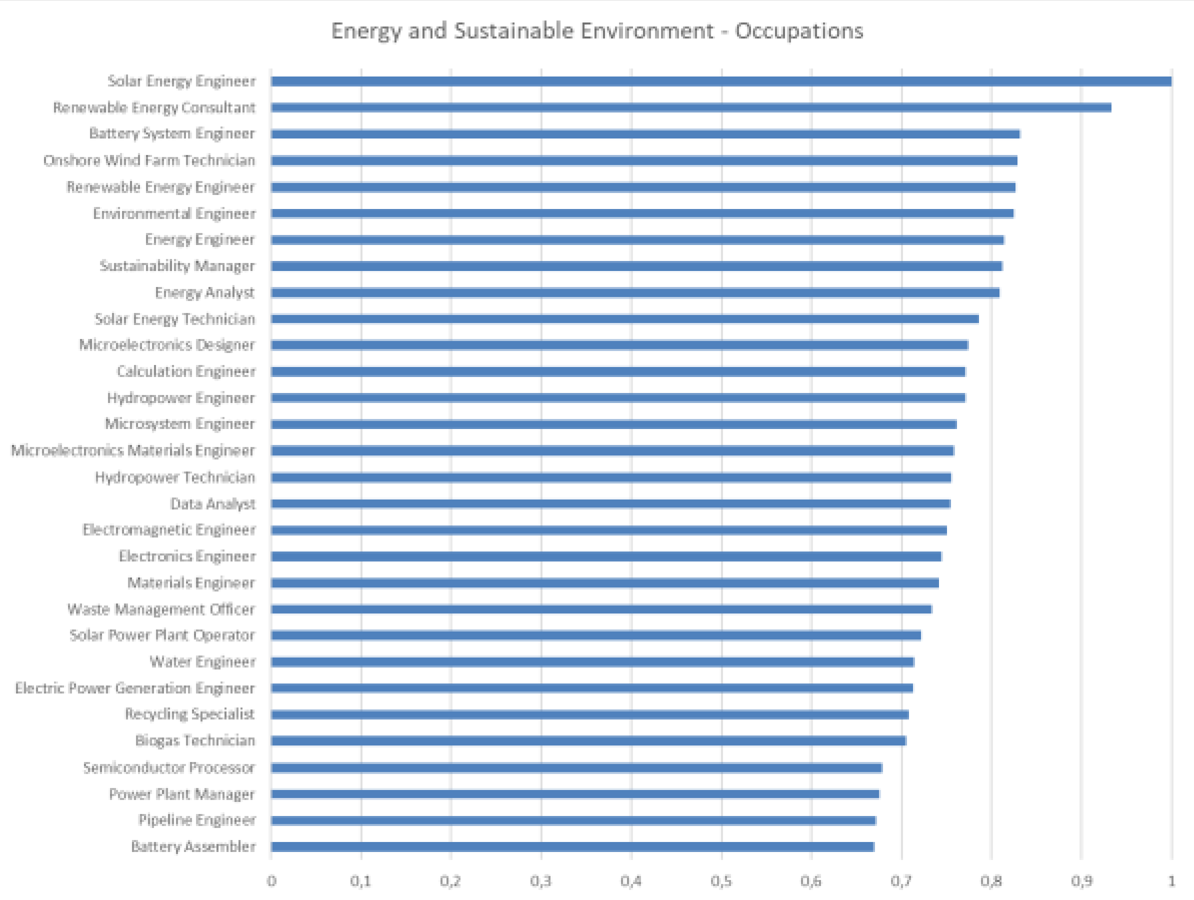
3.2 Occupations shaped by emerging technologies

Technological change is reshaping not only skills but also the occupational profiles required to operate modern energy systems. New technologies in generation, storage and digital grid management are shifting workforce needs toward specialised engineering roles, advanced digital functions and hybrid profiles that combine technical and analytical capabilities.

This chapter examines how global occupational trends relate to the structural, technical and operational realities of Montenegro's energy sector. It explores which occupations are emerging, which remain essential and which are constrained by the country's technological readiness, institutional arrangements and labour-market dynamics. Together, these insights show how Montenegro can shape a future-ready workforce capable of supporting the green transition.

Figure 4 ranks the top 30 occupations associated to skills and technologies expected to influence the *Energy and Sustainable Environment* domain in the future.

Figure 4. Top 30 ESCO occupations in Energy and Sustainable Environment sector.



Source: Erre Quadro's elaboration

Renewable-generation occupations as core drivers of transformation. The occupational landscape in Montenegro's energy sector is shaped by roles linked to solar, wind and battery systems, which underpin modern renewable-energy development. Solar energy engineers, renewable energy consultants and battery system engineers remain central to future system design and deployment worldwide. This indicates that Montenegro's occupational priorities are aligned with global trends and reflect the broader shift toward clean-energy engineering and system integration. Stakeholders reinforced this direction by noting that Montenegro's competitiveness depends on professionals capable of integrating renewable assets across different regions and upgrading existing installations to meet rising demand.

Engineering and system-design occupations as structural foundations. Engineering and system-design roles form a major global cluster that includes environmental engineers, microelectronics designers, microsystem engineers and materials engineers. These occupations provide the expertise needed to integrate advanced components that support energy conversion, storage and distribution. Stakeholders felt that the demand for such profiles is well aligned with developments in Montenegro and raised concerns about persistent shortages of specialised engineers. They highlighted that weak internal training systems and long-standing reliance on outsourcing have slowed project implementation and reduced the sector's capacity to innovate.

Data and digital occupations growing with system modernisation. At the global level, digitalisation is reshaping energy systems and increasing demand for occupations linked to data-driven operations. Roles such as energy analysts, calculation engineers and data analysts now contribute to modelling, forecasting and system optimisation across modern energy infrastructures.

Stakeholder discussions confirmed that these global trends are directly relevant and already influencing domestic skills needs. They emphasised that simulation, modelling and digital energy system competences are essential for improving operational safety, optimising performance and managing variable renewable inputs.

Storage-related occupations emerging from a low domestic base. Occupations related to energy storage and system flexibility are becoming increasingly important, particularly battery system engineering roles. These occupations support the integration of storage assets needed to balance generation and manage demand. Stakeholders noted that these trends are highly relevant but difficult to realise because the country currently has no operational BESS facilities. They stressed that targeted training, pilot projects and long-term professional pathways are essential to build the domestic expertise needed to develop storage-related occupations.

Technicians and operators as essential but acutely scarce profiles. Technician and operator roles are vital across the energy system worldwide, including hydropower technicians, solar plant operators, biogas technicians and power plant managers. These occupations ensure day-to-day functioning of both mature and emerging technologies. Stakeholders strongly reinforced the relevance of these profiles and stated that technicians represent the most severe workforce shortage in Montenegro. They noted that outsourcing, emigration and limited training opportunities have reduced the supply of technicians willing to work in demanding operational settings, which affects the country's ability to deploy new technologies efficiently.

Smart- and micro-grid roles rising but limited by data and software capacity. Smart- and micro-grid related occupations focus on system analysis, digital control and distributed-generation management. These roles support rooftop solar, low-voltage digitalisation and real-time monitoring. Stakeholders emphasised that Montenegro lacks high-quality network data and specialised software skills, which limits the ability to plan, simulate and forecast grid behaviour. They noted that these capability gaps slow the emergence of smart-grid occupations in practice.

Hydropower-related occupations remain stable but not growth-driven. Hydropower-related occupations are part of the essential role mix, particularly for maintenance and upgrades of existing facilities. These roles remain important for system stability due to Montenegro's long-standing hydropower infrastructure. Stakeholders confirmed that no major new hydropower investments are expected in the near term. This means that hydropower occupations will remain relevant for ongoing operations but will not generate large new workforce demand.

Hydrogen-related occupational demand remains limited. Hydrogen-related occupations appear only weakly in the occupational landscape due to Montenegro's early stage of technological readiness. Stakeholders shared this cautious stance, explaining that Montenegro lacks the infrastructure, demand and project pipeline needed to create meaningful occupational opportunities in hydrogen. Their views reflect the need to prioritise occupations linked to technologies that can support near-term deployment and competitiveness.

System-deployment and grid-integration occupations gaining strategic importance. System-deployment and grid-integration roles support installation, commissioning and integration of new technologies into the electricity system. These occupations connect engineering expertise with operational system management. Stakeholders confirmed the growing importance of these roles and highlighted shortages in project management, grid integration and system-level coordination. They noted that limited internal training and complex procurement processes hinder the formation of interdisciplinary teams capable of managing modern energy systems.

3.3 Structural constraints shaping skills demand and technology adoption

The technician-level skills are the most important levers for raising productivity and accelerating Montenegro's green and digital transition in the energy sector. However, several structural gaps continue to slow modernisation:

Persistent shortages at medium-qualification levels. Significant labour shortages among technicians represent one of the sector's most acute constraints. The current VET structure in Montenegro does not provide sufficient preparation for the energy sector. Three-year programs for electric installers offer very limited coverage of key energy subjects, while the fourth-year energy technician track does not cover these core topics adequately. Practical training and hands-on application are crucial and must be strengthened, as they are the key to producing skilled professionals who can effectively support Montenegro's energy transition and meet industry needs. Reforming VET programs to expand coverage of essential energy subjects and integrating them into both three- and four-year curricula is urgent to ensure graduates gain the necessary knowledge, skills, and practical experience for real-world application. Strengthening occupational safety and health training at secondary level is essential to ensure safe working conditions in a sector with increasing technological complexity.

Unclear occupational definitions and widespread overqualification. The same job in the state-owned energy companies (EPCG group) is often formally open to bachelor, specialist, or master-level graduates. This creates blurred occupational boundaries and a persistent risk of overqualification. This reduces labour market efficiency, complicates workforce planning, and weakens the connection between qualifications and actual job requirements.

Weak preparation and uneven entry knowledge in higher education. Secondary graduates from vocational electrotechnical schools entering energy-related university program often lack strong foundational knowledge in key subjects. In contrast, most students at the Electrotechnical Faculty come from general (gymnasium) schools, as they typically possess sufficient grounding in fundamental sciences such as mathematics and physics.

Need for hybrid and multidisciplinary energy curricula. Renewable energy requires combining traditional engineering knowledge with digital skills, practical competences, and environmental protection. However, these hybrid profiles are not sufficiently supported by current programmes, and universities continue prioritising traditional study pathways at the expense of interdisciplinary content.

Training and specialisation remain dependent on external providers. For cost reasons, Montenegro is continuing to send engineers abroad for specific subject training, while cutting-edge technology training is largely dependent on foreign companies. This limits the country's capacity to build internal expertise and slows absorption of new equipment and technologies shaped by globalisation and multinational companies.

Gaps in cooperation between education providers and energy companies. Practical training is inconsistent, and structured collaboration between VET schools, universities, and energy plants is limited. Although VET programs include practical training and students do internships in energy companies, in practice these rarely provide real opportunities to learn hands-on skills or work with actual energy technologies.

Insufficient leadership and long-term workforce planning in companies. Managers need stronger strategic capabilities to articulate skills and workforce needs for 2030–2040 and to guide companies through fast-evolving technological and regulatory landscapes.

Lifelong learning is essential but underdeveloped. Addressing current and future shortages requires expanding LLL opportunities, micro-qualifications, partial qualifications, and short specialised trainings. Validation of non-formal and informal learning, on-the-job learning, and flexible continuing vocational education and training remain insufficient. Requalification programs in the energy sector usually take about 1.5 years. However, in practice, these programs are often completed with minimal effort, sometimes even easier than the regular VET path. To be truly effective, such programs need not only to ensure high-quality theoretical training but also to include substantial, well-structured practical experience so that graduates are prepared to work safely and competently in the energy sector.

Need to strengthen career guidance and early orientation. The reintroduction of career guidance in primary and secondary education can help direct learners toward energy careers, address technician shortages, and improve the overall attractiveness of the sector. Graduate transition into appropriate jobs must also be monitored and supported.

Insufficient offer across diverse learning modes. There is a growing need to clarify, expand, and ensure certification for multiple learning pathways, initial and continuing VET, micro-credentials, short-term technology-specific trainings, and modular upskilling. The current landscape lacks coherence and sufficient training volume across these modes.

Teacher and trainer professional development remains limited. Teachers and trainers need continuous professional development to keep pace with new technologies. Investment in school equipment and partnerships with private companies are necessary to ensure learners have access to modern tools, devices, and practical training environments. Curricula and textbooks also require systematic adaptation to reflect emerging technologies and smart specialisation priorities.

Need for alignment with European skills initiatives. Keeping pace with European platforms such as the Pact for Skills, net-zero academies, sectoral cooperation frameworks, Centres of Vocational Excellence (CoVEs), and joint VET and university diplomas will be essential to ensure Montenegro’s competitiveness and integration into the evolving EU skills ecosystem.

A coherent and well-coordinated reform effort will be important in the years ahead. Continued progress in clarifying occupational standards, modernising VET and higher education, expanding lifelong learning, strengthening employer engagement, and improving workplace training will help the system respond more effectively to evolving needs. At the same time, introducing hybrid and multidisciplinary programmes, aligning with European skills initiatives, enhancing practical learning across all levels, and ensuring that teachers and trainers are well supported will further strengthen the sector’s capacity. Expanding diverse learning pathways, including micro-credentials, on-the-job learning, and validation of prior learning, will also contribute to preparing a workforce capable of adopting new technologies and supporting Montenegro’s smart specialisation ambitions.

4. Operationalising smart specialisation

Chapter 6 translates the analytical findings on technologies, skills and occupations into concrete priorities for action. While previous chapters examined global innovation trends, Montenegro's readiness to adopt key technologies, and the resulting implications for skills demand, this chapter focuses on how the smart specialisation agenda can be operationalised through targeted investment in human capital and skills ecosystems. It identifies the technology–skill combinations that offer the highest potential productivity gains and outlines how education, training and workforce development systems can be mobilised to support their deployment.

Building on stakeholder consultations and evidence from the technology readiness and skills analysis, the chapter highlights a limited number of high-impact technology clusters that are critical for Montenegro's energy transition and future competitiveness. For each cluster, it clarifies the skills priorities required across qualification levels and proposes structured actions for vocational education and training, higher education, adult learning and business support organisations. Together, these actions provide a coherent framework for aligning skills development with smart specialisation objectives, strengthening implementation capacity, and ensuring that the workforce can effectively support the adoption, operation and scaling of priority energy technologies.

4.1 High-impact technology clusters and related skills priorities

4.2 Mobilising the skills ecosystem to support technology adoption

The following four recommendations translate the high-impact technology–skill pairings into concrete action areas. They outline where Montenegro should prioritise investment and reform to raise productivity, strengthen competitiveness and support the green and digital transitions across the *Energy and sustainable environment* priority domain.

Priority action area 1 – Strengthening practical skills for solar, wind and battery energy deployment

The Montenegrin education system recognizes the importance of solar, wind, and battery energy, but coverage is uneven. These topics are taught at the Faculty of Electrical Engineering Podgorica (bachelor, postgraduate, master) and at secondary vocational schools, JU Secondary School "Vaso Aligrudić" and JU Secondary Vocational School "Ivan Usković", through Energy Technician (EQF4) and Electro-installer (EQF3) programmes. Batteries receive less focus than solar and wind energy, and at the secondary level, renewable energy content is elective, limiting early exposure. Gaps in practical training, laboratory equipment, and safety practices highlight the need for stronger alignment with labour market demands and modern technology trends.

Measures to strengthen practical skills for solar, wind and battery energy deployment.

VET (secondary and non-tertiary level)	Higher education	Adult learning	
		CVET	Business support organisations (BSOs)
Introduce compulsory courses on solar, wind, and battery technologies with practical training in installation, maintenance	Expand engineering programmes with courses on system integration, electrical safety and battery technologies.	Offer short, modular upskilling courses for solar, wind and BESS systems (e.g. micro-credentials).	Support companies in identifying n identifying skill gaps in installation, safety and system integration for

VET (secondary and non-tertiary level)	Higher education	Adult learning	
		CVET	Business support organisations (BSOs)
and safety (Elektroinstaller, 3y). Increase the number of compulsory courses on alternative energy sources (renewable) and batteries (Energy Technician, 4y). Make training on electrical safety, safe work at height, and battery safety (handling, storage, installation, and risk management) mandatory. Integrate troubleshooting, diagnostics and predictive-maintenance tasks into practical training. Use real equipment, digital monitoring tools and system-integration simulators for hands-on learning.	Increase attention to batteries by offering dedicated courses and equipping faculty laboratories with specialized battery setups for experiments and training. Strengthen applied laboratory work on BESS diagnostics, inverter testing and grid-connection procedures. Develop interdisciplinary modules linking electrical engineering, digital systems and renewable-energy operation. Promote joint projects with energy companies focusing on BESS deployment and grid integration.	Create fast-track requalification pathways for electricians, mechanics and plant operators entering renewable-energy roles. Validate prior learning to accelerate entry into technician and operator roles in renewable-energy installation and maintenance.	solar, wind and BESS deployment. Provide advisory services on safety standards, commissioning procedures and EU-aligned technical requirements. Facilitate cooperation between companies and training providers to co-design practical, equipment-based training modules. Promote participation in European renewable-energy skills partnerships to strengthen training provision and attract investment.

Source: Authors

Implementing these measures would:

- Build a robust pipeline of technicians and engineers with job-ready skills for the installation, operation and maintenance of solar, wind and battery energy storage systems.
- Improve system reliability and safety by strengthening competences in electrical safety, battery handling, commissioning and system integration.
- Reduce skills mismatches by aligning VET, higher education and adult learning provision more closely with labour-market needs and technology deployment.
- Accelerate the domestic deployment of renewable energy and BESS projects by increasing the availability of qualified local staff.
- Strengthen cooperation between education providers, energy companies and business support organisations through practice-based and equipment-centred training.
- Support Montenegro’s energy security and competitiveness by ensuring the workforce can deliver and scale priority renewable technologies in line with smart specialisation objectives.
- Encourage energy companies to reduce outsourcing and build in-house capacity, fostering the development of expertise and enabling staff to handle work independently in the future.

Priority action area 2 – Embedding digital and analytical competences in energy system planning and operation

Secondary-level Energy Technician (EQF4) programmes at JU Secondary School “Vaso Aligrudić” and JU Secondary Vocational School “Ivan Uskoković” introduce simulation and prediction only in the fourth year, with renewable energy as an elective, limiting early practical exposure to renewables and batteries. At the university level, the Faculty of Electrical Engineering Podgorica offers comprehensive hands-on training using multiple licensed software platforms for modelling distribution systems, renewables, and batteries, while independent design competence is further developed through professional experience.

Measures to embed digital and analytical competences in energy system planning and operation.

VET (secondary and non-tertiary level)	Higher education	Adult learning	
		CVET	Business support organisations (BSOs)
Introduce new modules on basic data handling, system monitoring tools and digital workflows. Integrate equipment-level diagnostics into practical training. Expand the use of digital simulators for system behaviour and fault detection. Make digital competences core content, not elective subjects.	Expand engineering programmes with simulation, forecasting, and system-modelling content. Strengthen courses in algorithms, data analytics and digital optimisation for energy systems. Increase laboratory work using real-time monitoring tools and modelling software. Promote joint applied projects with energy companies on AI-enabled grid planning.	Offer short, modular courses in system modelling, digital diagnostics and data-driven optimisation. Create fast-track requalification pathways for technicians needing digital skills for frontline tasks. Introduce micro-credentials linked to simulation tools and digital monitoring systems. Validate prior learning to accelerate entry into digital and data-related energy occupations.	Support companies in identifying digital skill gaps linked to simulation and modelling. Provide advisory services on digital workflow integration and AI-ready operational practices. Facilitate cooperation between companies and training providers to co-design digital training modules. Promote participation in European digital-skills partnerships to enhance training provision and attract investment.

Source: Authors

Implementing these measures would:

- Build a continuous pipeline of digitally skilled technicians, engineers and energy professionals.
- Accelerate the adoption of simulation, forecasting, modelling and data-driven optimisation across the energy sector.
- Strengthen cooperation between education providers, industry and business support organisations.
- Improve productivity, system efficiency and competitiveness of Montenegro's renewable energy sector in line with smart specialisation objectives.

Priority action area 3 – Preparing the workforce for smart grid and distributed energy system management

Education on smart and microgrids in Montenegro is limited. Secondary school programmes, Electro-installer (EQF3) and Energy Technician (EQF4), do not cover this topic, though basic knowledge is needed for installation and maintenance. Process programming should be compulsory for energy technicians. At the university level, the Faculty of Electrical Engineering Podgorica covers smart microgrids mainly in fifth-year courses, with limited practical exposure and early-stage network implementation. Key institutions: Faculty of Electrical Engineering Podgorica, JU Secondary School "Vaso Aligrudić", JU Secondary Vocational School "Ivan Uskoković".

Measures to prepare the workforce for smart grid and distributed energy system management.

VET (secondary and non-tertiary level)	Higher education	Adult learning	
		CVET	Business support organisations (BSOs)
Introduce new modules on digital grid management, real-time monitoring and smart device operation. Integrate data handling and system-monitoring tools into practical training. Modernise vocational programmes in electrical engineering, network operations and smart-device maintenance. Make digital grid competences core content, not elective subjects.	Expand engineering programmes with courses on digital grid control, microgrid design and data-driven optimisation. Strengthen modelling, forecasting and simulation content for advanced grid planning. Increase laboratory work using real-time grid-monitoring platforms and digital-control software. Promote applied projects with energy companies on digitalisation and distributed-generation management.	Offer short, modular upskilling courses in digital grid monitoring, system analytics and smart-device maintenance. Create fast-track requalification pathways for technicians needing digital grid skills. Introduce micro-credentials linked to digital workflows, equipment-level diagnostics and data-handling tools. Validate prior learning to accelerate entry into digital grid–related occupations.	Support companies in identifying digital-grid skill gaps affecting operational resilience and distributed-generation management. Provide advisory services on digital workflow integration, smart-device deployment and data-infrastructure development. Facilitate cooperation between companies and training providers to design hands-on digitalisation modules. Promote participation in European grid-digitalisation initiatives to strengthen training provision and attract investment.

Source: Authors

Implementing these measures would:

- Build a continuous pipeline of technicians and operators skilled in digital grid management and smart-device operation.
- Accelerate the adoption of smart grid and microgrid technologies across the energy sector.
- Strengthen cooperation between education providers, industry and business support organisations.
- Improve system resilience, operational efficiency and competitiveness of Montenegro's renewable energy sector in line with smart specialisation objectives.

Priority action area 4 – Developing energy management and efficiency skills across the workforce

Education on energy management and efficiency in Montenegro is limited at the secondary level. Electro-installers (EQF3) do not cover the topic, while Energy Technicians (EQF4) study it only as an elective, restricting early exposure to these essential concepts. At the university level, the Faculty of Electrical Engineering Podgorica integrates energy management and efficiency in the "Advanced Energy Networks" course. Key institutions involved are Faculty of Electrical Engineering Podgorica, JU Secondary School "Vaso Aligrudić", and JU Secondary Vocational School "Ivan Uskoković".

VET (secondary and non-tertiary level)	Higher education	Adult learning	
		CVET	Business support organisations (BSOs)
Introduce Energy Management and Energy Efficiency as a compulsory part of the high school curriculum, ensuring students gain practical skills and foundational knowledge for modern energy systems.	Consider introducing Energy Management and Energy Efficiency earlier in the curriculum, with practical exercises to enhance students' skills and experience	Provide upskilling programs for professionals with relevant technical background, focusing on practical applications, energy optimization, and efficiency improvements in existing systems.	Provide in-house, pre-delivery training for professionals with relevant technical background, focusing on practical applications, equipment operation, and optimization before implementing new system.

Source: Authors

Implementing these measures would:

- Build a pipeline of technicians and engineers with practical competences in energy management and efficiency across buildings and industrial systems.
- Improve the capacity of companies and public institutions to identify, measure and optimise energy consumption using modern tools and methods.
- Support earlier and more consistent exposure to energy efficiency concepts across VET, higher education and adult learning pathways.
- Strengthen productivity, cost efficiency and system performance by reducing energy losses and improving operational decision-making.
- Contribute to Montenegro's energy security and competitiveness by embedding energy efficiency skills as a core component of the green transition.

ACRONYMS

AI	Artificial Intelligence
BESS	Battery energy storage systems
CoVE	Centres of Vocational Excellence
CVET	Continuing Vocational Education and Training
EDP	Entrepreneurial Discovery Process
EPCG	Elektroprivreda Crne Gore
ESCO	European Skills, Competences, Qualifications and Occupations
ETF	European Training Foundation.
EU	European Union
JETPs	Just Energy Transition Partnerships
LLL	Lifelong Learning
MW	Megawatt
NLP	Natural Language Processing
PV	Photovoltaics
R&D	Research and development
VET	Vocational Education and Training

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