

Governance Framework and Implementation Paths of the Green Transformation of Vocational Education and Training in the European Union

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ABSTRACT

The European Union is deeply committed to weaving the principles of green transformation into the fabric of Vocational Education and Training (VET) systems, aiming to advance the achievement of sustainable development goals. In light of this commitment, a governance framework specifically tailored for this purpose has been developed, following a thorough analysis of the myriad factors that play a crucial role in steering the vocational education sector towards a greener future. This framework is built upon four key pillars: the roles and interests of stakeholders, the relevance and depth of the educational content, the strategic direction and aims of vocational training, and the teaching methodologies employed. It delineates four strategic directions to ensure the successful embedding of green transformation within VET: leveraging policy objectives to nurture and disseminate the principles of green transformation; refining educational techniques to better meet the expectations of the labor market; boosting the capabilities of educators to incorporate green transformation concepts in their teaching; and broadening the scope of financial support mechanisms to enhance fairness and accessibility in green-oriented educational initiatives. Furthermore, a series of case studies from various EU member countries, including France, Spain, Denmark, and Estonia, have shed light on effective governance models that include anticipating future skill needs, encouraging partnerships across different sectors, securing support from government funding, and emphasizing the education of communities at a disadvantage. These case studies provide a window into a holistic strategy for infusing green transformation into VET, with the dual objectives of preparing learners with the competencies necessary for a sustainable future and guaranteeing equitable, inclusive educational pathways in a rapidly changing employment landscape.

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1. Introduction

As global crises and challenges intensify, climate and energy issues have become critical threats to human survival and development, with "green," "sustainable," and "carbon neutrality" emerging as frequent keywords. Looking globally, the 1992 United Nations Conference on Environment and Development adopted the United Nations Framework Convention on Climate Change, which set the ultimate goal of joint efforts by all countries to tackle climate change. It also introduced a "global action plan for sustainable development" known as Agenda 21. Particularly at the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change, "green transformation" was recognized as crucial in combating climate change. The greening of skills was seen as the cornerstone of this transformation process, paving the way for promoting decent work in the labor force (ILO,2019).

The European Union occupies an important position in the global political and economic landscape, playing a significant role in global environmental and climate governance. In 2018, the EU first introduced a strategic vision for achieving carbon neutrality and in 2019, it released the European Green Deal, proposing to make Europe the first carbon-neutral continent. This goal was transformed from a political commitment into a legal obligation through the European Climate Law. In 2020, EU member states collectively signed the Osnabrück Declaration on vocational education and training as an enabler of recovery and just transitions to digital and green economies. This aims to promote the digitalization and greening of Europe's education and training sectors, enhance employability and competitiveness, and stimulate economic growth.

As the green development concept and practice continue to deepen, vocational education and training (VET) also face a green transformation. Some scholars focus on green transformations beyond the national level, analyzing goals and reasons for the greening of adult education and VET in various international organizations based on policy texts (Liu & Guan, 2022; Li & Liu, 2017; Zhang, 2021; Ouyang et al.,2023). Other scholars focus on green transformations at the national level, including both developed (Du, 2021) and developing countries (Rajput et al., 2021), analyzing the current state and paths of change in VET's green transformation from different perspectives such as students (Thirupathy & Mustapha, 2020), teachers (Kutto,2020) and other stakeholders (Brown, 2015). Overall, the existing research on the governance of the

green transition in vocational education and training (VET) within the European Union is still incomplete, and its research value has not been fully explored. Therefore, this paper, based on motivation analysis, reviews case practices from several EU member states (France, Spain, Denmark, and Estonia), summarizes the governance frameworks for the green transition of VET in these countries, and attempts to explore governance path choices at both the EU and national levels. The aim is to provide useful references for the sustainable development of vocational education in China.

2. The Drivers of Green Transformation in Vocational Education and Training (VET) Governance in the European Union

2.1. Responding to Global Sustainable Development Initiatives

In 2015, all 193 member states of the United Nations unanimously adopted the "Transforming our World: The 2030 Agenda for Sustainable Development," which set forth 17 Sustainable Development Goals (SDGs) to shape global development and governance for the next 15 years. In 2016, 178 parties signed the Paris Agreement, reaching a consensus on the climate objective of "keeping the increase in global average temperature to well below 2°C." Addressing global environmental and climate changes has become a global consensus, marked by its urgency and significance. As warned by the United Nations Environment Programme (UNEP) in the "Global Environment Outlook 6," the Earth has suffered extreme damage. Without urgent and more substantial actions to protect the environment, the ecosystems of the planet and the endeavor for sustainable human development will face increasingly severe threats. To achieve the vision of "healthy planet, healthy people," nations worldwide should "completely abandon the development model that only focuses on immediate benefits at the expense of future welfare, and transition towards an economy with nearly zero waste" (Duan & Ling, 2020).

In response, the European Union explicitly set forth in the European Green Deal the goal to "increase the EU's 2030 greenhouse gas reduction targets to at least 50% and 55% compared to 1990 levels" and to achieve "net-zero greenhouse gas emissions by 2050, decoupling economic growth from resource use" as part of its medium and long-term vision (EU, 2023). Further emphasized in EU reports (2022) is that "the green transformation is a global, cross-sectoral process: it affects all industries, albeit in different ways. Skills play a core role in achieving the green transformation" (VOCED, 2023). Therefore, focusing on the governance of the green transformation of vocational education and training is considered an effective pathway to advance the green transformation of the EU's economy, society, and ecology.

2.2. Addressing Labor Market Supply and Demand Challenges

According to International Labour Organization (ILO) statistics (2018), around 1.2 billion jobs worldwide, representing 40% of all employment, directly depend on natural ecosystems. With global temperatures rising, it is projected that by 2030, 72 million full-time jobs could be lost, placing many vulnerable groups at risk of unemployment. However, if countries implement sustainable development goals and vigorously develop the green economy, about 18 million new jobs could be created globally (ILO, 2018). The ILO forecasts that under the premise of achieving sustainable energy and a circular economy, about 2% of the global workforce will be impacted, necessitating skill upgrades or new skills learning through vocational education and training to preserve jobs. Therefore, a forward-looking skills strategy is urgent for educating and training new workers, as well as updating the skills of the existing workforce to adapt to new job positions.

In the European Union, the green transformation, alongside digitalization and automation, will be a significant change direction in the coming decades, prominently reflected in career choices. This shift will lead to challenges in skill enhancement and innovation for the workforce. The focus of EU vocational education and training, employment, and skills policies will also lean towards green transformation: Firstly, individuals in declining sectors or professions facing skill obsolescence will need skills retraining oriented towards green transformation. Secondly, a significant number of young people and adults will need training to meet the growing demand for existing green jobs. Third, employees less affected by the green transition also need skills enhancement; fourth, emerging occupations related to green industries require innovation in green skills. (Cedefop, 2021). EU forecasts show that if vocational education and training can smoothly transition to green transformation, from 2020 to 2030, employment in the EU could increase by 3.7% and GDP by 1.7%, which would be higher than the growth during the same period without implementing the European Green Deal.

2.3. Enhancing the Resilience of Vocational Education and Training Development

In the understanding and application by international organizations, resilience is closely linked to sustainable development. The United Nations document "Enhancing Human Resilience: Maintaining Millennium Development Goals Progress in an Economically Uncertain Era" (2011) notes that crises have become a systemic feature of today's society and emphasizes the importance of resilience for sustainable human development (UNDP, 2015). The OECD's "Education at a Glance 2021" highlights that "preparing students for lifelong learning so they can upgrade and reacquire skills in adulthood is key to ensuring they can withstand major trends

and external shocks" (OECD, 2021). The European Union in its "European Skills Agenda for sustainable competitiveness, social fairness, and resilience" (2020) also particularly stresses the need to provide young people and adults with the knowledge, skills, and competences to enable them to make a fair transition to the green and digital economy during periods of demographic change and throughout all economic cycles (EUR-Lex, 2021).

Creating more job opportunities in the pursuit of sustainable development of both nature and society requires practical governance measures that continuously enhance the resilience of vocational education and training, thereby strengthening the capacity for sustainable development. As the International Labour Organization points out, "the transition to a green economy requires a transformation of the production systems, on a scale comparable to an industrial revolution" (ILO, 2018). This transformation relies on green technologies, involving the application of knowledge, skills, mechanisms, designs, and equipment to produce products or engage in activities that have minimal environmental impact or can improve environmental conditions (ILO, 2019). The development and application of green technologies are among the primary drivers of the "greening" of skills and occupations. The development of green skills within the context of lifelong learning is fundamental to achieving sustainable development goals. Therefore, in response to the societal challenge of transitioning to a green economy, enhancing the resilience of vocational education and training is a critical issue.

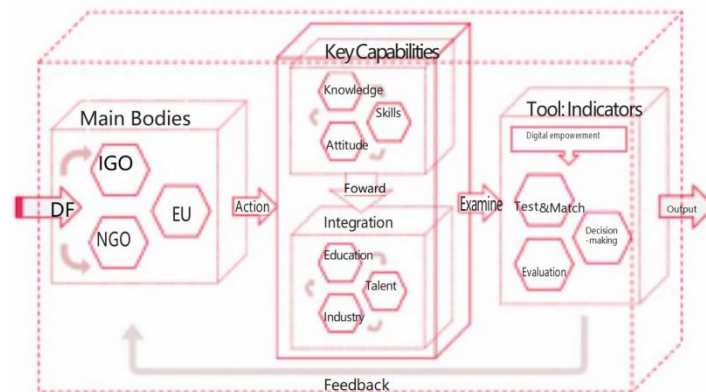
Based on the above motivation, the research questions are formulated as following:

1. What is the governance framework of the green transformation of vocational education and training in the European Union?
2. What are the implementation paths of the green transformation of vocational education and training in the European Union?

3. The Governance Framework for Green Transformation in Vocational Education and Training in the European Union

The various principles and actions adopted by the European Union in the governance of the green transformation of vocational education and training are a positive response to the needs of EU societies and global sustainable development. During this process, a more complete governance framework has been established, as shown in Figure 1, guiding the green transformation practices in vocational education and training across member states and regions.

Figure 1: Governance Framework for Green Transformation in Vocational Education and Training in the European Union



Source: *Own Compilation*

3.1. Actors: Tripartite Governance in the Policy Network

The governance of the green transformation in vocational education and training (VET) within the European Union incorporates various forms of interest alignment and governance, ensuring the diversification of governance actors and equality of participants through coordination and cooperation (Liu, 2018). This process forms a political integration structure between states and societies or between public and private sectors, while also emphasizing the active search for institutional expression by social forces within different policy networks.

Firstly, intergovernmental organizations hold irreplaceable governance value. Michael Barnett and Martha Finnemore, in their book “Rules for the World: International Organizations in Global Politics”, argue that the authority of international organizations features diversity, which decisively contributes to constructing social realities (Barnett & Finnemore, 2004). As an intergovernmental organization, the EU can leverage its influence to fully mobilize institutions and resources, exerting governance effectiveness beyond the national level, particularly in defining directions for action and establishing boundaries for these actions.

Secondly, non-governmental organizations (NGOs) play roles in coordination and assistance. The establishment of various international organizations implies a decentralization of power, often necessitating the coordination and influence of enterprises, unions, foundations, and civil society among NGOs. NGOs not only engage in cooperative, complementary, and checks-and-balances interactions with government departments of member states but also play a significant role in building and improving civil society (Fan, 2015), especially acting as policy participants, evaluators, and monitors in the governance of green transformation in VET.

Thirdly, sovereign states have decisive influence. Without the involvement of its member states, the EU's green transformation in vocational education and training cannot be truly achieved. Although the influence of various international, regional, and non-governmental organizations is growing globally, sovereign states remain the most central actors in the governance of world politics, economics, social issues, and environmental matters, especially in advancing policies and practices, and even in determining the implementation of governance concepts and goals.

3.2. Content: Key Competencies Under Green Orientation

Nicolas Schmit, the EU Commissioner for Jobs and Social Rights, believes: "Enhancing and innovating workforce skills is one of the core measures to address economic recovery and can prepare for the greening and digital transformation (EU, 2020)". Seizing the opportunities of economic and social green transformation requires the development of green skills in the workforce. Establishing a framework based on green core competencies is the cornerstone of the green transformation in vocational education and training. The European Green Deal specifically proposes the creation of a European Competence Framework to assist in the development and evaluation of knowledge, skills, and attitudes related to climate change and sustainable development.

From a historical perspective and sustainable development practice, formulating a macro-guidance Sustainability Competence Framework can describe the meanings and uses of key competencies in sustainable development and education, making it a fundamental tool to promote green skills education. With the support of the European Commission's Joint Research Centre (JRC), Chiara Scalabrino conducted a preliminary literature analysis and identified twelve sustainable development competencies divided into four capability areas: embodying the values of sustainable development, embracing the complexity of sustainable development, envisioning the future of sustainable development, and acting for sustainable development. These competencies were further explained and exemplified using Bloom's taxonomy of knowledge, skills, and attitudes (KSA) (EU, 2022).

Respecting the principle of subsidiarity in educational policy, the Sustainable Development Competence Framework can be interconnected with existing frameworks like the European Digital Competence Framework (DigComp), the European Entrepreneurship Competence Framework (EntreComp), the Digital Competence Framework for Educators (DigCompEdu), and the European Framework of Personal, Social and Learning to Learn Competences (LifeComp). This interconnection ensures coherence in educational policies and programs, achieving the vision of "Education for Sustainable Development."

3.3. Direction: Integrated Triple Helix Transformation Path

The deep integration of industry and education is not only an inevitable requirement for changing economic development methods and promoting regional industrial transformation and upgrading but also a necessary path for the development of modern vocational education and training (VET). The green transformation affects the EU's economic and labor markets and the field of VET, involving a dynamic adjustment that drives profound changes in both the supply and demand sides of the labor market. The mutual integration of green-related industries and green knowledge and skills is a strategic choice for effectively linking supply and demand.

Leydesdorff and Zawide (2010) proposed that the Triple Helix model, comprising market, organizational, and technological opportunities, can realize social functions such as creating social wealth, organizational control, and organized knowledge production. In the context of building a green-skilled society, the "Triple Helix" interaction among schools, markets, and governments is the new trend in the transformation of VET across EU countries. Firstly, the construction of the educational chain and talent chain constitutes the first spiral of the EU's green transformation. The training goals for green transformation are set based on the green labor market; through teaching synergy, knowledge synergy, and capability synergy, green changes are implemented across courses and specialties in basic theoretical knowledge, professional knowledge, industry common knowledge, and job advancement knowledge.

Secondly, the coupling of the industrial chain and educational chain forms the second spiral of the EU's green transformation. The transformation and upgrade of the VET curriculum system are based on the green development strategies of the EU and its member states, with regional industrial development influencing and guiding the setting of talent training plans, curriculum structures, and knowledge and skill frameworks.

Thirdly, the matching of the talent chain and industrial chain constitutes the third spiral of the EU's green transformation. The industrial chain provides resources, platforms, and direction for the talent chain, while the talent chain provides innovative drive for the industrial chain. On this basis, the green transformation of vocational education and training and the integration with green industries can achieve consistency at three levels: alignment with the talent training goals of industry enterprises and vocational schools; consistency with the needs of industrial green transformation; and alignment with the societal process of sustainable development.

3.4 Tools: Indicator System under Digital Empowerment

The greening and digital transformations are priority areas in the development of vocational education and training (VET) in the European Union, serving the overall strategy of sustainable

economic and social development within the EU. Mara Brugia, Deputy Director of the European Centre for the Development of Vocational Training, pointed out: "There is a crucial link between green transformation and digitalization, as the latter is a major driver of economic greening (Cedefop, 2018)." Digital governance can permeate the entire process of VET green transformation governance, achieving dynamic, efficient, comprehensive, and open continuous monitoring and adjustment.

Firstly, digital governance enables skill matching and forecasting in green transformation. A key area in the governance of green VET is the collection, forecasting, and anticipation of skills intelligence during green transformation. By leveraging big data analytics methods such as the European Skills Index (ESI), Online Job Vacancies and Skills Analysis (OJVs), and the Skills and Job Survey (ESJS), obtaining information related to labor market and skill trends is crucial for constructing a green skills formation system and achieving success.

Secondly, digital governance promotes the upgrade of decision-making tools. Based on labor market skills forecasts for green transformation in VET, the successful integration of Information and Communication Technology (ICT) and Labor Market Information (LMI) in career guidance services forms Decision-Making Tools (DMT) (Cedefop, 2021). This facilitates the collection and analysis of green information, the formulation of educational programs, and the enhancement of data tool performance.

Thirdly, digital governance has significant advantages in the quality assessment of vocational education and training and strategic adjustments in green transformation policies. By utilizing the collection and forecasting of VET green skills intelligence to establish Occupational Skills Profiles (OSP), a quantifiable, standardized, and comprehensive individual work skills information system is formed. This aligns with the European Skills, Competences, Qualifications, and Occupations taxonomy (ESCO), the Statistical Classification of Economic Activities in the European Community (NACE), and the European Qualifications Framework (EQF), providing quantitative analysis and key references for the quality assessment of green skills at the occupational group, sectoral, national, and pan-European levels

4. Implementation Paths for the Green Transformation of Vocational Education and Training in the European Union

Constructing pathways for the governance of green transformation in vocational education and training requires understanding its essential characteristics and inherent demands. This involves establishing feasible pathways to promote green transformation governance practices based on an analysis of transformation goals and challenges, guided by the green transformation

governance framework. Currently, the EU has primarily developed four implementation paths for the green transformation of vocational education and training.

4.1 Leveraging Policy Goals to Guide and Promote the Spread of Green Transformation Concepts

Policies have the functions of guiding, coordinating, and integrating. By releasing policies, recommendations, and reports on the green transformation of vocational education and training (VET), clear goals can be set for the governance of green transformation in VET across member states, along with comprehensive reform and development initiatives.

Firstly, overarching policy documents from the European Union that call for global "carbon neutrality" affirm the value of VET in the context of the EU's economic and social green development. Documents such as the European Green Deal, European Skills Agenda for Sustainable Competitiveness, Social Fairness, and Resilience, Communication on Achieving the European Education Area by 2025 (2020), and the Digital Education Action Plan (2020) provide conceptual and directional guidance for member states and regions.

Secondly, based on European skills forecasting, more specific development suggestions are proposed. Documents like Digital, Greener, More Resilient: Insights from the EU's Centre for the Development of Vocational Training on European Skills Forecast (2021) and Green Jobs and Skills Transition: Insights from the European Green Deal Skills Forecast Scenarios (2021) offer an overall understanding of the EU's green development and the labor market's demand for green skills. They call for effective measures to invest in VET and provide feasible recommendations, guiding the construction of high-quality, inclusive, and open European green VET systems.

Lastly, the EU actively collaborates with other international organizations to commit to VET transformations and practice sustainable development goals. For instance, joint publications with the International Labour Organization (ILO), the Organisation for Economic Co-operation and Development (OECD), and UNESCO, such as Work-based Learning and Green Transition (2022), further emphasize the implementation strength and determination to promote the green transformation of vocational education and training.

4.2 Advancing Pedagogical Reforms to Foster Coordination with the Labor Market

In the process of green transformation governance in vocational education and training (VET), the European Union faces significant challenges related to the mismatch between the supply and demand of green skills. This mismatch is evident in the scale, structure, and quality of the

workforce trained by VET, which does not adequately meet the developmental needs of the economy and society. In response to this issue, the EU has identified work-based education reform as a key pathway for advancing the governance of the green transformation in VET. Only through various forms of Work-Based Learning (WBL), which involve direct participation in creation and innovation processes, can continuously updated green skills be developed. These skills are crucial for forming the technical and organizational processes needed for the green transformation, ensuring that vocational talent output matches the labor market needs.

The EU views work-based learning as a win-win situation that benefits all key stakeholders, including learners, employers, and social partners. Particularly, apprenticeships, as a major type of work-based learning, play a significant role in addressing youth unemployment issues in the context of green transformation. In 2021, during a high-level meeting between the European Alliance for Apprenticeships (EAfA) and the International Labour Organization, Nicolas Schmit called for increased investment in apprenticeships and the enhancement and retraining of skills to meet the challenges of the labor market and the digital and green transformations. Cesare Onestini, Director of the European Training Foundation, also noted, "Apprenticeships need to evolve with the changing skills, which includes adapting to the digitalization and greening across all sectors (ETF, 2021)." With the efforts of EU-related agencies, many partner countries have started implementing pilot apprenticeship programs or structural reforms. Assistance is also provided to EU candidate countries through the European Alliance for Apprenticeships to promote the quality, provision, image, and mobility of all work-based learning, including apprenticeships (ETF, 2023).

4.3 Ensuring the Enhancement of Teacher Capabilities to Implement the Green Transformation in Vocational Education and Training

In the context of rapidly changing technology and skill markets, the European Union recognizes that teachers, as drivers of economic recovery and fair transition to digitalization and greening, are at the forefront of educational practice. They play a crucial role in linking curriculum development, teaching, and the connection between education and work. Enhancing and updating teacher competencies is a key area for solving the implementation challenges of green transformation governance in vocational education and training.

Since 2002, the EU's focus and systematic investment in the professional development of teachers and trainers have continually strengthened, becoming one of the core agendas of EU policy. The project framework of "Teachers' and Trainers' Professional Development"

emphasizes "building inclusive, green, and digital capabilities for vocational education teachers and trainers." In terms of scope, the professional development of vocational education teachers and trainers in the EU's green transformation governance includes Initial Professional Development (IPD) conducted within higher education or higher educational level frameworks, and Continuing Professional Development (CPD) in specific areas after entering the workforce.

In terms of means, on one hand, organizational leadership is leveraged to help vocational education teachers and trainers form professional development groups to enhance their skills. For instance, the European Centre for the Development of Vocational Training has facilitated the establishment of working groups like "Schools for Success: 2030 School Agenda" and "Digital Education: Learning, Teaching, and Assessment," providing convenient channels for strengthening exchanges among vocational education teachers and trainers across different countries and fields (Cedefop, 2023). On the other hand, feasibility studies are conducted at the pan-European level, providing a digital resource platform for vocational education and training practitioners and policymakers. This platform serves as a medium for conducting surveys across Europe targeting vocational school principals, teachers, in-company trainers, and learners, providing timely guidance in the green transformation, and offering information for the formulation of policies on the professional development of vocational education teachers and trainers in the context of green transformation.

4.4 Diversifying Funding Sources to Ensure Inclusivity and Equity in the Green Transformation

The International Labour Organization's 2018 survey results reveal that the impacts of environment and employment are reciprocal: climate change can lead to unemployment among low-end industry workers; simultaneously, reduced employment rates and training opportunities can further deteriorate the environment (ILO, 2023). Thus, ensuring that vulnerable groups have access to vocational education and training is not only an effective approach to achieving green transformation governance but also a necessary requirement. The European Union actively provides diverse funding channels to enhance the inclusiveness and fairness of the green transformation governance in vocational education and training.

On one hand, the Erasmus+ program offers funds through phased and specific plans to support the development of education, training, and youth. From 2021-2027, this program plans to invest €26 billion, building on the successes of the previous phase (2014-2020), to provide more support for more participants and a broader range of organizations, positively impacting a more inclusive, cohesive, greener, and digitalized society. Annually, over 130,000 vocational

education and training learners and apprentices, as well as 20,000 professionals, are expected to benefit from it (EU, 2023).

On the other hand, the EU has established several specialized funding organizations to provide continuous and robust financial support for member states' green transformations. Firstly, the European Social Fund (ESF). Vocational education and training are key priorities for the European Social Fund to achieve green and digital recovery. The fund has a budget of nearly €99.3 billion for 2021-2027 (EU, 2023), particularly through its shared management chains with Employment and Social Innovation (EaSI) projects, which help vulnerable groups adapt to the labor market through skill enhancement and innovation. Secondly, the European Training Foundation (ETF). The ETF believes that "green transformation and the development of green capabilities depend on the effective functioning of everything from teacher training to qualification frameworks" (ETF, 2023) supports transitional countries in unlocking the potential of their human capital through reforms in education, training, and labor market systems. Thirdly, the Recovery and Resilience Facility (RRF). The RRF primarily funds infrastructure projects, modernizing the infrastructure necessary for the transformation and development of vocational education and training to better align with labor market needs (Cedefop, 2023).

5. Governance Case Studies of Green Transformation in Vocational Education and Training in the European Union

In recent years, many EU member states have developed national action plans and strategies to promote the green transformation of vocational education and training. To avoid the one-sidedness and limitations of analyzing a single country's case, this article examines the practices in four EU member states—France, Spain, Denmark, and Estonia—analyzing how they drive the green transformation of vocational education and training at the national level.

5.1 Skills Demand Forecasting

The forecasting of green skills demand is based on insights into labor market trends and their social impact factors. It involves periodic development as milestones and uses mathematical statistics as a means (Liu & Wang, 2021) providing information intelligence to government agencies, business employers, and individual workers. This plays an active role in the green transformation of vocational education and training.

In 2010, France established the National Observatory for Jobs and Skills in the Green Economy (Onemev), which built a skills forecasting network in collaboration with various national ministries and agencies, leading public employment service organizations, major vocational

education and training associations, the national statistics institute, research institutions, and regional employment and training observatories. The observatory recognizes nine green occupations and about seventy greening occupations and has developed two monitoring approaches: one is data statistics and quantification based on jobs and professions; the other is observation and analysis based on "ecological activities," discussing the comprehensive impact of green transformation on work and skills (Cedefop, 2019).

Spain's skills forecasting system is developed in parallel by different institutions involved in employment and education. It primarily consists of two parts: one is an occupational observatory supervised by the central public employment service, which needs to analyze about 200 fast-growing professions each year and clarify the skills gaps related to these professions under the analysis of regional network groups at the observatory (Cedefop, 2019); the second is monitored by the National Institute for Qualifications (INCUAL), which tracks the development of occupations, defines green skills, identifies green skills gaps, forecasts green skills needs, and determines training measures.

The cases from France and Spain demonstrate that by leveraging the functions of skills forecasting institutions, they achieve analysis of the characteristics and needs of target groups while maintaining a stable source of data, statistical information, and indicator data. Furthermore, they transform related data and qualitative analysis results into comprehensive intelligence through data processing and analysis (Cedefop, 2023).

5.2 Multilateral Collaborative Cooperation

The green transformation of vocational education and training (VET) requires the coordination of multiple stakeholders to leverage their strengths. This collaboration begins with schools, uses cities as nodes, focuses on enterprises, and relies on industries as supports (Liu & Zheng, 2023), thereby creating a combined governance force. This approach promotes the green transformation of VET and drives sustainable development shifts towards green employment, green industries, and a green ecology at the societal level.

In Estonia, VET providers and other stakeholders have sought opportunities for green transformation in the context of energy crises, climate change, and worsening environmental conditions affecting Europe. Initially, through the "Green Morning" online monthly meetings, stakeholders meet with experts in the green economy, green policies, and circular economy to discuss integrating environmental themes into VET. In 2020, the cross-sector "Green Tiger" cooperation platform was established to facilitate collaborative efforts among entrepreneurs, the public sector, NGOs, and individuals. Further, through the 2022 project "Green

Awakening—Environmentally Conscious VET," school administrators, local governments, and other stakeholders can visit companies involved in the green economy to learn from valuable experiences in green transformation in VET (Cedefop, 2022).

In France, public employment service agencies monitor and report on the development of green occupations and skills and organize employee training across regions to cultivate talent for the local green industry, promoting the economic green transition. The private sector in France can participate in the green transformation in two ways: either by directly funding training activities for employees or through training costs paid by companies under the management of nationally approved OPCAs organizations (Cedefop, 2018).

Case studies from Estonia and France reveal that the green transformation of national vocational education and training governance involves multiple practices such as web conferences, project plans, diploma certification, and expert seminars. These activities promote a sensible transition to green VET, green skills, and even the green economy through collaborative interactions among various relevant stakeholders.

5.3 National Financial Support

In the face of continuous technological innovation, workers can increase their human capital and improve labor productivity through continual learning of new technological knowledge, which in turn promotes economic growth. Robust financial support has always been a solid foundation for the development of vocational education and training (VET) in the European Union and a driving force for developing green human capital.

The Danish Minister of Education stated: "The green transformation is a prerequisite for achieving Denmark's climate goals, and many vocational education policies are central to this (Cedefop, 2021)." The country's 2021 budget proposed strong continuing education and retraining for unemployed and employed individuals to help achieve the green agenda and Denmark's climate goals (Ministry of Children and Education of Denmark, 2021). In the same year, the Danish government allocated €7.25 million to establish knowledge centers responsible for developing and testing short-term instructional courses and materials related to the green transformation of VET, as well as assisting in enhancing teachers' green capabilities; in 2022, the allocation for climate adaptation and green transformation was increased to €13.44 million (Cedefop, 2021). In Spain, under the national "Plan for Recovery, Transformation, and Resilience" and the "Circular Economy Strategy," Madrid launched the "2021-2023 Employment Strategy," investing about €345 million annually to assist long-term unemployed individuals, youth, women, disabled persons, and other marginalized groups in receiving job

training. The "Canal de Isabel II" implemented the Young Talent Plan, providing training and scholarships for young professionals to learn and develop green skills and capabilities (Comunidad de Madrid, 2023).

The cases from Denmark and Spain show that although the specific forms of financial support and governance focuses differ between the two countries, both are aimed at achieving governance goals by incorporating the supply of green skills, socio-economic sustainable development, and climate neutrality objectives into national fiscal plans, reflecting the governance determination of member states.

5.4 Education for Vulnerable Groups

Training in green job skills and expanding employment opportunities are considered effective paths for promoting economic development and green transformation on a relatively equitable basis. Vocational education and training, including apprenticeships, are seen as the most effective ways to help vulnerable groups gain access to green jobs.

In Madrid, Spain, with the support of the European Social Fund, a "Green Employment Plan" (Empleaverde) was launched. This program focuses on developing workers' awareness of sustainable development, environmental skills, and the skills required by the labor market to adapt to the green development process of society. From 2015 to 2022, the program provided approximately 1,900 green skill courses for around 60,000 employed workers, prioritizing women, workers from rural and environmentally protected areas, older workers, those with lower education levels, and workers from lagging industries. Additionally, the Biodiversity Foundation (MITECO) implemented the "Destination Green Jobs" (Destino Empleaverde) plan, which offers 200 hours of training related to green jobs for vulnerable groups (RAND Corporation, 2023).

In France, to successfully achieve carbon neutrality, the "France Relance" plan was launched in 2021, with a total investment of €100 billion from the national government and the EU. Of this, €36 billion was allocated to train the future workforce, enhancing vocational training opportunities and strategically training young people in high-growth sectors. This support aims to assist young people and vulnerable groups seeking employment and to narrow inequality gaps. For this purpose, France's Ministry of Ecological Transition and the Ministry of Labor jointly developed a toolkit to support job seekers in transitioning from vulnerable sectors to ecological and sustainable energy sectors (RAND Corporation, 2023).

The case studies of Spain and France show that based on the skill-oriented, inclusive, universal, and diverse nature of vocational education and training, it has unique value in helping

vulnerable groups obtain social rights. In the context of rapid societal transformation, focusing on vulnerable groups as the primary recipients of green skills education and training helps alleviate unemployment issues, maintain social order, and promote social equity.

6. Conclusion

Addressing global climate issues and resolving energy crises to achieve sustainable societal development are common goals for all humanity. Vocational education and training (VET), being closely linked to socio-economic factors, plays a crucial strategic role in the green transformation of the entire labor market and in the sustainable development of society. To this end, the European Union has implemented multiple measures to drive the green governance transformation of VET, demonstrating the EU's commitment and vision towards achieving the United Nations' "Sustainable Development Agenda" goals. The EU's governance practices provide logical guidance and a pathway reference for the green transformation of VET in other countries, including the need to strengthen top-level national planning, actively explore and innovate in VET talent training models, and enhance the quality of education for talents needed in the development of the green economy.

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