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ПАЗАРЪТ НА ТРУДА В УСЛОВИЯТА НА ДИГИТАЛНИЯ И ЗЕЛЕНИЯ ПРЕХОД: НОВИ ПРЕДИЗВИКАТЕЛСТВА И ВЪЗМОЖНОСТИ

LABOUR MARKET UNDER THE DIGITAL AND GREEN TRANSITION: NEW CHALLENGES AND OPPORTUNITIES

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Abstract: This article analyses how the labour market is being reshaped by the simultaneous digital and green transition in the European Union, with additional attention to Bulgaria as a case of uneven adaptation capacity. Its core argument is that the twin transition should not be interpreted only in terms of aggregate job creation or job destruction. Rather, it represents a structural transformation that changes tasks, qualification profiles, sectoral employment patterns and the institutional conditions of employability. The paper combines selected official indicators from Eurostat, Cedefop and OECD with findings from the literature on automation, skill-biased technological change, green jobs and just transition. The empirical evidence points in two directions at once. On the one hand, employment in the environmental economy has expanded markedly in the EU. On the other hand, deficits in digital competences, labour shortages in transition-relevant activities and uneven regional and national starting positions indicate that adaptation remains incomplete. The Bulgarian case illustrates this asymmetry through low levels of basic digital skills, demographic constraints and sectoral restructuring pressures. The article concludes that the key challenge is not technological or environmental change itself, but the unequal ability of workers, firms, education systems and public institutions to respond to it. At the same time, the twin transition creates significant opportunities for higher-quality employment, hybrid occupational profiles and stronger links between education, innovation, and employment policy.
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1. Introduction

The labour market is currently being transformed by two large and mutually reinforcing processes: digitalisation and the green transition. The first changes production through automation, artificial intelligence, data-intensive business models and platform forms of coordination. The second alters the sectoral structure of the economy through decarbonisation, energy restructuring, circular production models and new environmental standards. Analytically, these processes should be examined together because they affect not only the number of jobs, but also the content of work, the distribution of skills and the territorial pattern of adjustment.

In the recent literature, the digital transition is commonly discussed through the logic of task reallocation, job polarisation and skill-biased technological change. The central insight is that technological progress does not eliminate labour in a simple linear way; instead, it redistributes tasks between labour and capital and changes the relative value of different competences (Autor, 2022; Acemoglu and Restrepo, 2019). The green transition introduces another layer of restructuring. It expands some activities, compresses others and increases demand for new combinations of technical, digital, and environmental skills (Consoli et al., 2016; Bluedorn et al., 2023).

The European Union provides a particularly relevant setting for this discussion because policy frameworks increasingly connect technological modernisation, decarbonisation, competitiveness and social cohesion. This makes it possible to examine the twin transition not only as a general structural process but also as a policy-mediated transformation in which labour demand, skills formation and institutional adaptation interact. The available European evidence suggests that transition-related job creation is real, but so are the constraints imposed by insufficient human-capital adaptation and uneven national starting positions.

The aim of this article is to examine the principal labour-market challenges and opportunities arising from the simultaneous digital and green transition. The paper combines selected official indicators with theoretical and institutional literature in order to avoid a purely descriptive narrative. Its main thesis is that the crucial issue is not whether jobs disappear or emerge, but whether workers, firms, and institutions can adapt fast enough to the changing structure of labour demand.

2. Literature and Conceptual Framing

The digital transition transforms labour demand primarily through a shift from routine execution to task complementarities with technology. Occupations are therefore not affected uniformly. Activities that can be codified and automated are more vulnerable, whereas jobs requiring complex problem-solving, social interaction, adaptability and system oversight become relatively more valuable. Autor (2022) argues that the labour-market consequences of technological change are more nuanced than simple narratives of technological unemployment suggest. The main mechanism is the reorganisation of tasks and the creation of new productive niches. Acemoglu and Restrepo (2019) further show that automation can displace labour in some tasks while simultaneously reinstating labour through the emergence of new tasks, occupations and production functions.

The green transition operates through a related, though distinct, mechanism. It is driven by climate policy, energy-system transformation, environmental regulation and investment in low-carbon technologies. This process does not simply add a separate category of green jobs. It also changes the skill content of existing occupations, the cost structure of firms and the competitive position of sectors and regions. Research on green employment suggests that green jobs often require combinations of technical proficiency, adaptability, regulatory literacy and problem-solving capabilities that differ from traditional occupational profiles (Consoli et al., 2016; Apostel et al., 2024).

The interaction between the two transitions is especially important. The decarbonisation of industry, transport, buildings and energy systems increasingly depends on digital tools such as sensors, data analytics, AI-assisted optimisation, smart grids and platform-based coordination. Conversely, digital infrastructures themselves raise questions of energy use, resource efficiency and sustainability. As a result, labour demand shifts not only towards narrow IT occupations or environmental specialists, but also towards hybrid profiles combining digital, engineering and sustainability competences.

This combined dynamic has implications for convergence and cohesion in Europe. Bobeva, Stoyanova and Ignatov (2021) argue that the green transition affects real and green convergence unevenly across Member States and that weaker starting positions imply deeper restructuring. This argument can be extended directly to the labour market. The gains from the twin transition are unlikely to be evenly distributed unless institutional capacity, education systems, and active labour-market policies compensate for asymmetries in skills, productivity and regional industrial structures.

From this perspective, the labour market under the twin transition should be understood as a field of structural reallocation. The critical issue is not merely employment quantity, but the speed and

inclusiveness of adaptation. In this sense, digital and green transformation produce a new stratification of workers and regions according to access to training, capacity for occupational mobility and position within changing production systems.

3. Data Background and Selected Empirical Signals

For a short conference paper, the empirical task is not to build a full econometric model but to anchor the analytical argument in a compact set of official indicators. The article therefore relies on three groups of signals. The first covers structural employment effects, approximated through employment in the environmental goods and services sector. The second captures the human-capital dimension through basic digital skills. The third reflects labour-market tension through the job vacancy rate. Together, these indicators do not exhaust the topic, but they offer a coherent minimum empirical basis for discussing transition-related change.

The first signal is the expansion of employment in the environmental economy. According to Eurostat, employment in this area increased from 3.6 million full-time equivalents in 2014 to 5.8 million in 2023, with an average annual growth rate of 5.5% (Eurostat, 2026a). This trend is analytically important because it demonstrates that the green transition is not only a cost-raising or compliance-oriented process. It is also associated with the creation and expansion of labour demand in waste management, renewable energy, environmental services, resource management and related activities.

The second signal concerns digital readiness. In 2025, 60% of people aged 16–74 in the EU had at least basic overall digital skills, compared with 56% in 2023. Although this indicates gradual improvement, the value remains twenty percentage points below the EU target of 80% by 2030 (Eurostat, 2026b; Eurostat, 2026d). These figures are highly relevant for labour-market analysis because they show that the supply of transition-relevant competences is advancing, but too slowly. The European labour market is therefore entering a period in which the shortage is not only one of workers, but of adequately prepared workers.

The third signal is labour-market tension. Eurostat reports that the job vacancy rate in the EU declined from 2.3% in the fourth quarter of 2024 to 2.0% in the fourth quarter of 2025, while the euro area rate moved from 2.5% to 2.2% over the same period (Eurostat, 2026c). This does not mean that skills pressure has disappeared. Rather, it suggests that labour demand is adjusting under conditions of slower activity while shortages remain concentrated in specific activities and competence groups. For the purposes of this paper, the vacancy indicator is useful because it reveals that the twin transition operates within an already differentiated labour market rather than on an institutional blank slate.

Taken together, these selected signals justify two intermediate conclusions. First, the twin transition is already producing measurable structural change. Second, the adaptation problem is asymmetric. The expansion of transition-related activities is visible, but the ability to participate in them is uneven across countries, regions and groups of workers. This is precisely why the labour-market implications of the digital and green transition cannot be reduced to a simple net employment balance.

4. Bulgaria in the Twin Transition: Labour-Market Vulnerability and Adaptation Capacity

Bulgaria represents a particularly relevant case within the broader European discussion on the twin transition because it combines visible labour-market vulnerability with the need for accelerated technological and environmental adaptation. The country enters the digital and green transition from a weaker human-capital position than the EU average. According to Eurostat, in 2025 only 38% of people aged 16–74 in Bulgaria had at least basic digital skills, compared with 60% in the EU. This places Bulgaria among the two lowest-performing Member States, together with Romania, and far below the EU target of 80% by 2030 (Eurostat, 2026b). This gap is not only a technological indicator; it is a labour-market constraint, because digital skills increasingly function as a basic condition for employability in services, administration, manufacturing, logistics and public-sector activities.

The Bulgarian case is also important because demographic and sectoral pressures reinforce the adaptation problem. Cedefop's 2025 Skills Forecast for Bulgaria projects a decline in total employment over the forecast period, in contrast to weak but positive employment growth for the EU-27 as a whole.

At the same time, Bulgaria's total population is forecast to fall by around 8% over 2020–2035, while the labour force is expected to increase by around 4%, mainly because of higher participation rates (Cedefop, 2025). This creates a specific labour-market configuration: the country needs more effective use of existing and potential labour resources at precisely the moment when digitalisation and decarbonisation are raising the skill requirements of employment.

Sectoral change further strengthens this argument. Cedefop forecasts that employment in Bulgaria's primary sector and utilities, which accounted for 20% of employment in 2020 compared with 6% in the EU-27, will decline by around 1.5% per year over 2023–2035. Agriculture alone accounted for 17% of total employment in Bulgaria in 2020, and its projected contraction indicates that transition pressures are likely to affect groups of workers whose occupational mobility may be limited by age, education, location, and access to training. At the same time, some activities connected to the twin transition show more favourable prospects. Employment in electricity is forecast to grow, while sectors such as research and development, computer programming and information services, architectural and engineering activities, electrical equipment, rubber and non-metallic mineral products, and motor vehicles are identified among the activities expected to perform relatively better (Cedefop, 2025). This confirms that the Bulgarian labour market is not only exposed to risk but also contains transition-related opportunities.

The central problem is therefore not the absence of opportunity, but the uneven capacity to access it. OECD's Skills Strategy Bulgaria emphasises that demographic change, digitalisation, globalisation and climate change are transforming the skills needed in Bulgarian workplaces and society. The report also stresses that Bulgaria needs to develop and use people's skills more effectively in order to reduce skills imbalances and support productivity and innovation (OECD, 2023). This is directly relevant to the twin transition, because green and digital jobs require not only formal qualifications, but also combinations of technical, digital, cognitive and job-specific competences.

Institutional coordination is another important limitation. Cedefop notes that Bulgaria does not yet have a fully comprehensive skills-governance approach, although skills anticipation has become more important in the national policy agenda. The development of the MyCompetence system, including competence models for key job positions in 25 economic sectors, and the establishment of mechanisms for labour-supply and labour-demand forecasting represent important steps, but Cedefop also underlines the need for better coordination between existing skills-anticipation activities (Cedefop, 2023). This is crucial because the twin transition cannot be addressed through isolated measures in education, employment policy or industrial policy. It requires a coordinated system linking employers, vocational education, universities, public employment services and regional development institutions.

From this perspective, Bulgaria illustrates the broader thesis of the article in a particularly clear way. The digital and green transition create new forms of labour demand, but the ability to benefit from them depends on institutional capacity, regional conditions and the speed of skills adaptation. If policy remains fragmented, the transition may deepen existing inequalities between workers, sectors and regions. If, however, digital-skills development, vocational education reform, adult learning, regional training partnerships and green industrial policy are better coordinated, the twin transition can become a source of labour-market modernisation rather than only a source of adjustment pressure.

5. Main Challenges for the Labour Market

One of the central challenges is the mismatch between the skills supplied by the workforce and those demanded by firms. Cedefop (2025) and the European Commission (2025) emphasise that the green transition requires more systematic investment in reskilling and upskilling, while digitalisation continuously raises the baseline competence required for employability. The evidence on basic digital skills confirms that a large share of the labour force remains below the level expected in an economy increasingly shaped by automation, digital services, and data-driven coordination (Eurostat, 2026b).

A second challenge concerns unequal exposure across sectors and occupations. Workers in carbon-intensive industries, routine manufacturing, low-productivity services and administratively standardised activities face different forms of pressure. Some jobs are threatened by automation, others by environmental restructuring, and many by both at once. This is especially relevant for middle-skilled

and low-skilled workers whose occupational mobility may be constrained by age, education, location, or poor access to training. The notion of just transition is therefore not only a climate-policy category; it is also a labour-market category referring to the social distribution of adjustment costs (ILO, 2023).

A third challenge is regional asymmetry. Labour-market adaptation depends on local firm structures, transport and digital infrastructure, education institutions and innovation capacity. Regions with diversified business sectors, stronger universities and better training ecosystems are more likely to absorb transition-related opportunities. By contrast, regions dependent on a narrow industrial base or characterised by weaker human-capital formation may face more painful adjustment. In the EU context, this territorial dimension is decisive because cohesion policy and transition policy are expected to operate jointly, yet their effects depend on local implementation capacity.

A fourth challenge is institutional lag. Even when demand for new competences is clearly identified, education and training systems often react too slowly. Formal education may not update curricula in time, adult learning participation may remain limited and labour-market intermediation may fail to connect workers to emerging sectors. OECD (2025a) and ILO (2024) both stress that the twin transition increases the value of lifelong learning systems, modular training and labour-market intelligence capable of anticipating occupational change rather than merely reacting to unemployment ex post.

Finally, the labour market faces a coordination problem. Digital policy, industrial policy, climate policy and employment policy are still too often developed in parallel, whereas firms and workers experience them simultaneously. This fragmentation weakens adjustment. A labour-market strategy adapted to the twin transition must therefore connect skills formation, innovation support, regional policy and social protection. Without such coordination, the transition may produce growth in high-productivity segments while at the same time deepening social and territorial inequalities.

6. New Opportunities and Policy Responses

Despite these challenges, the twin transition also opens substantial opportunities. The first is the expansion of employment in environmental activities. The long-term rise in employment in the environmental goods and services sector indicates that green transformation is not merely a regulatory burden, but also an employment-generating process linked to renewable energy, energy efficiency, waste management, environmental services and resource optimisation (Eurostat, 2026a).

The second opportunity lies in the emergence of hybrid occupations. Firms increasingly need workers who can combine technological literacy with environmental awareness and operational problem-solving. In practice, this means growing demand for technicians in energy systems, data specialists in resource management, ESG and sustainability analysts, smart-manufacturing operators, circular-economy coordinators and digitally enabled maintenance personnel. Such roles broaden the occupational space between traditional manual work and abstract professional expertise.

A third opportunity concerns productivity and job quality. When properly governed, digital tools can improve occupational safety, reduce repetitive tasks, increase resource efficiency and create more knowledge-intensive forms of work. The green transition can also stimulate investment in modern infrastructure and innovation ecosystems. Yet these gains do not arise automatically. They depend on complementary investment in training, labour standards and organisational redesign, otherwise efficiency gains may coexist with labour-market exclusion.

Policy therefore becomes decisive. Four priorities stand out. First, education systems need stronger integration of digital, technical, and environmental competences. Second, adult learning must become more accessible, modular and closely connected to labour-market demand. Third, regional and sector-specific transition strategies are necessary in order to prevent one-size-fits-all policies from widening disparities. Fourth, social protection and active labour-market policy must support mobility and adaptation, not only income replacement. In this framework, the labour market should be treated as an adaptive system whose resilience depends on institutional learning capacity.

From a strategic point of view, the twin transition should be interpreted as a test of whether Europe can reconcile competitiveness with cohesion. If policy succeeds in reducing skills deficits, supporting reallocation and encouraging innovation, the transition can generate more resilient employment struc-

tures. If not, it may produce a segmented labour market characterised by islands of high-productivity opportunity surrounded by persistent zones of exclusion.

7. Conclusion

The labour market under the digital and green transition is not entering a simple phase of technological replacement or ecological adjustment. It is moving into a period of structural recomposition in which tasks, sectors, skills, and institutions are being transformed simultaneously. The empirical signals discussed in this article point in two directions at once: the expansion of employment in the environmental economy confirms the existence of new opportunities, while deficits in digital skills and persistent labour-market mismatches reveal major adaptive constraints.

The main conclusion is that the success of the twin transition will depend less on the abstract pace of technological and environmental change than on the practical capacity to organise inclusive adaptation. This includes education reform, lifelong learning, labour-market intelligence, regional coordination and targeted support for workers exposed to transition pressures. The policy challenge is therefore not merely to create more green and digital jobs, but to ensure that broad segments of the workforce are able to access them.

The Bulgarian case confirms the importance of this institutional perspective. Low levels of basic digital skills, demographic contraction, sectoral restructuring and uneven skills-governance capacity show that the twin transition cannot be reduced to a general European narrative of green and digital modernisation. In countries with weaker starting positions, the same processes may generate stronger adjustment pressures unless they are accompanied by coordinated policies for reskilling, vocational education reform, adult learning, and regional labour-market adaptation. Bulgaria therefore illustrates both the vulnerability and the opportunity embedded in the twin transition: the risk of deeper labour-market segmentation and the possibility of accelerated modernisation if skills, innovation, and employment policies are better integrated.

In this sense, the labour market becomes a central arena in which the economic, social and territorial consequences of the twin transition are negotiated. Future research may deepen this discussion through sectoral, regional, or occupation-based empirical analysis, but the current evidence already supports a clear proposition: the digital and green transition create both risk and opportunity, and their final balance is mediated by the quality of institutions that organise adjustment.

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