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KGID 2025 Green Growth: The Path to Sustainable Jobs

Digital and Green Technologies Reshaping Work and Employment

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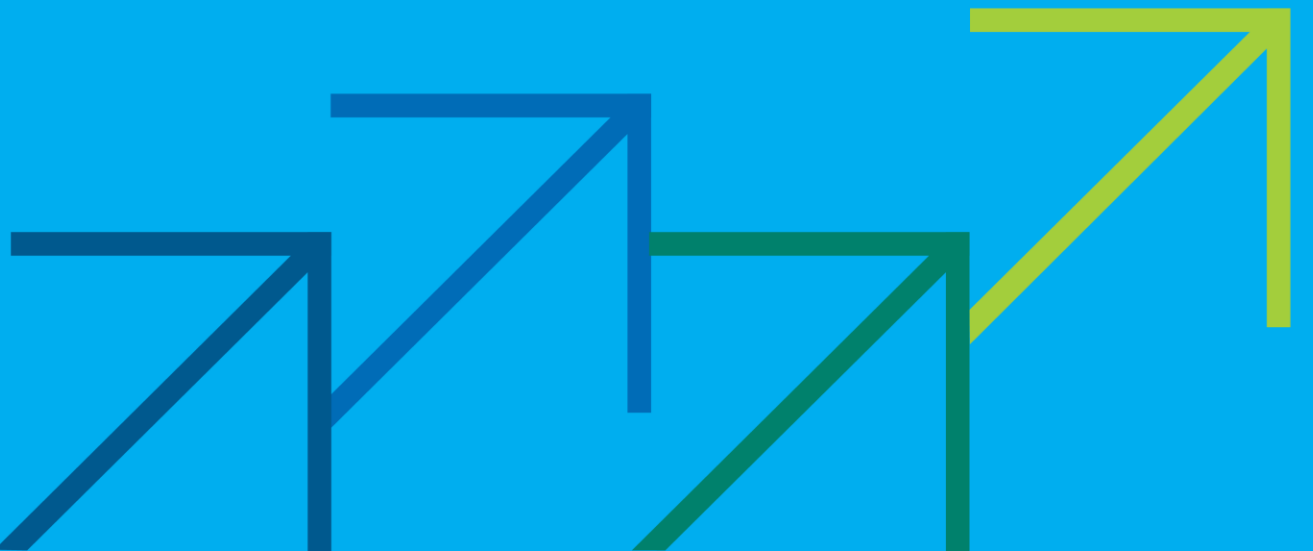

Talk Plan

- Post-Pandemic Observations: Labor Shortages and Skills-Mismatches
- Digital and Green Technologies, as a cause leading to Skills-Mismatches
- Other Causes
- Policy Implications

Post-Pandemic Observations: Labor Shortages and Skills-Mismatches

■ **Labor shortages** are unevenly distributed across sectors, largely driven by ***skills mismatches*** and changing worker preferences (ILO, 2024).

occur when workers' qualifications (SUPPLY) do not align with job requirements (DEMAND), leading to simultaneous unemployment and job vacancies.

■ **Causes of Skills Mismatches**

① *Rapid technological change* - Digitalization and the green transition are reshaping skill requirements faster than workers can adapt.

* The pandemic accelerated structural changes in demand and long term trends – including digitalization, the expansion of e-commerce and remote work, and decarbonization
→ thereby accelerating skills mismatches across labor markets (Acemoglu, 2002; Song et al., 2021).

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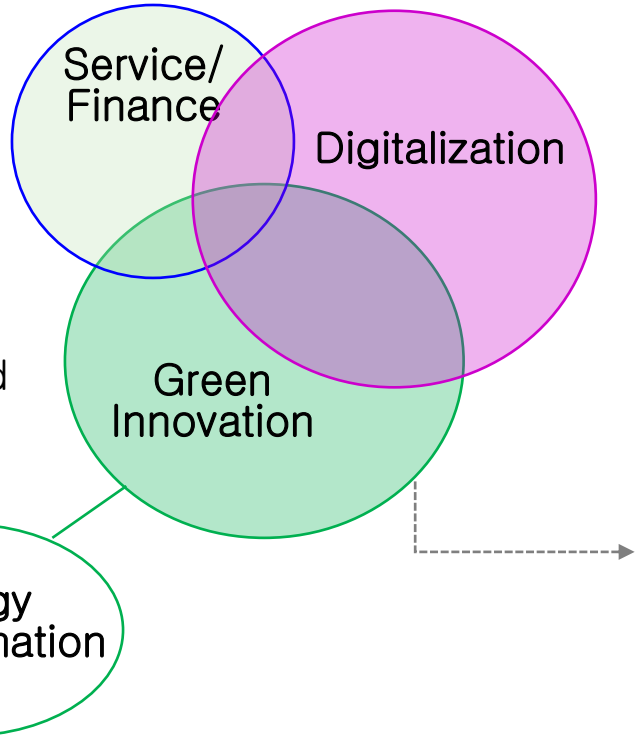
Evolving Technological Themes in the Twin Transitions – Green Transition

HS/MS
- Sustainable finance (green & transition finance)
- AI/Machine-learning for carbon data (tracking/ monitoring/assessing),
- ESG management,
- Climate risk modeling,
- Satellite and sensing for disaster and monitoring



MS/LS
- Renewable energy: Labor-intensive
- CCS, Green hydrogen;
- Smart grids and energy digitalization (grid expansion, demand-side management, advanced metering infra, grid cybersecurity)

MS/HS
- Manufacturing
  * Emerging green sectors; existing industries in transition including green cement and low-carbon steel
  * Industrial Process (electrification, heat recovery, process control with IoT/AI optimization, cloud workload carbon-scaling)
- Energy-efficient appliances and tech.
- Sustainable product design;
- Building/Retrofit (high-efficiency insulation, smart HVAC, heat pumps);
- Transport electrification (EV, battery cells/modules/packs, materials, charging infra., E-power trains);
- Carbon dioxide utilization (CCUS);
- Green social entrepreneurship

LS/MS/HS
- Circular economy and resource management

Source: ILO (2019)

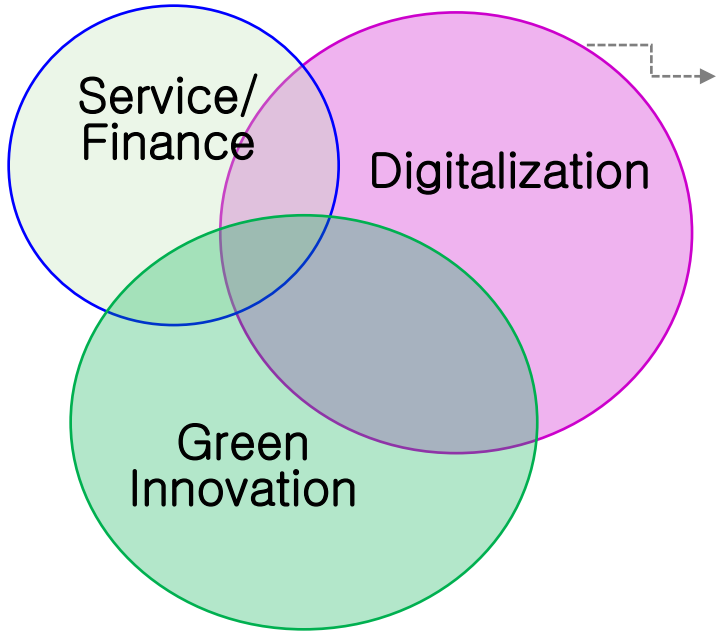
Evolving Technological Themes in the Twin Transitions – Digital Transition

HS

- Digital finance: digital lending, mobile payments, digital wallets, the expansion of cashless economies, digital currency, blockchain;
- AI/Machine-learning for financial data analysis
- Fintech,
- Cybersecurity

MS/LS

- E-business including e-commerce and e-tourism



HS/MS

- AI & robots
- Digital operation (machine learning, cloud computing, IoT, big data, edge computing)
- Remote-work
- Digital infra (telecommunication, satellite, and etc.)
- Digital products
- Data governance (industry 4.0)

LS

- Programing/coding

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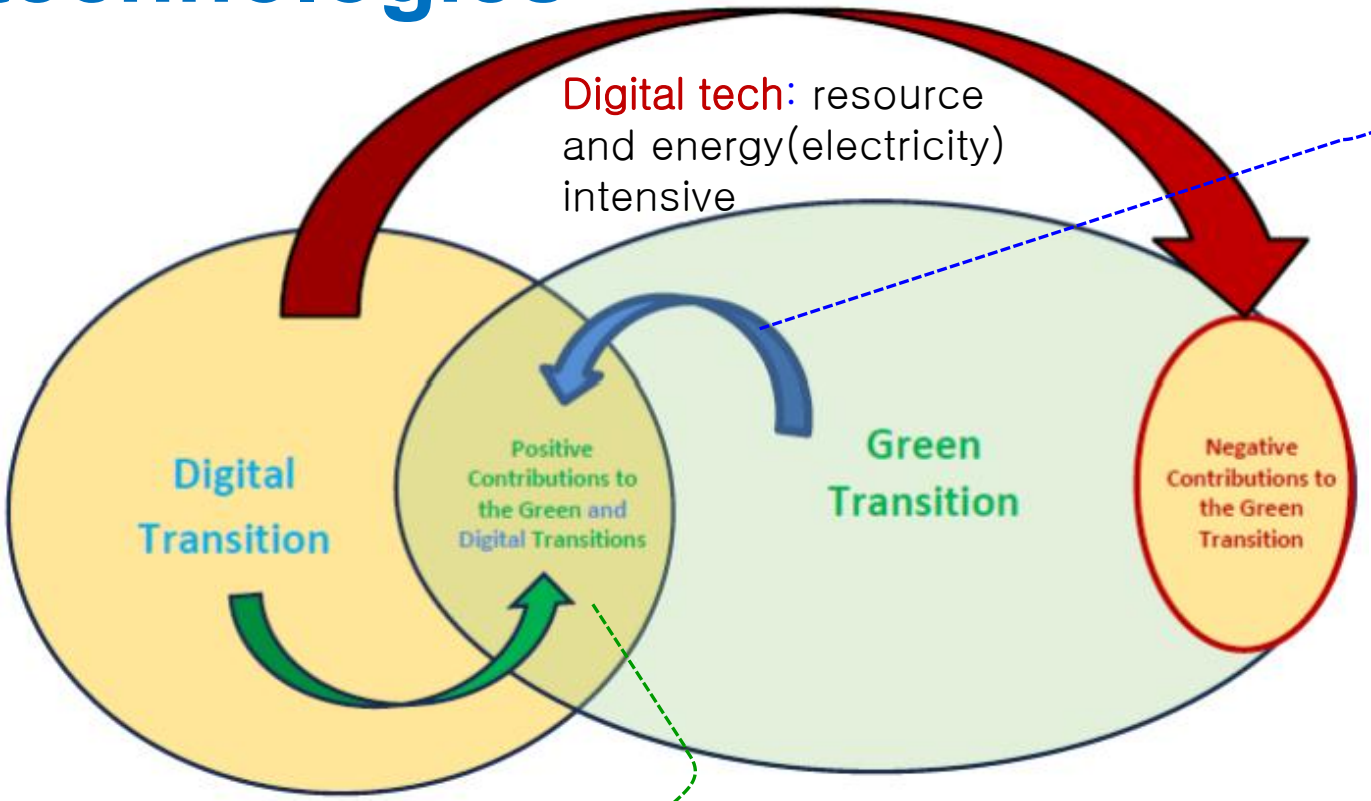
Interactions between Digital and Green technologies



Digital tools

- enhance environmental monitoring, energy efficiency, & green supply-chain management (OECD, 2023)

→ The digital transition could facilitate the Green Transition.

The process of decarbonizing the economy

- could open up new areas and opportunities for the development of digital technologies, thus stimulating digital innovation.
- Moreover, green technologies tend to be more digital than the technologies they replace → the green transition could stimulate the digital transition.

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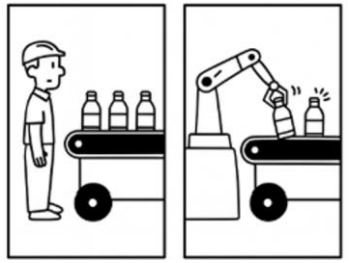
How Do Technologies Reshape Work and Employment? ①

■ The effect of green technologies

- An additional 2.5 million jobs (more than +1%) will be created by the year 2030 due to the EU green transition (Siebel, Cedefop 2023).

■ The effect of digital technologies

- The employment effects of digital technologies are neither uniform nor unidirectional (Hötte, 2023).
- Early studies emphasized the *displacement effect*.
  * IT and Robots – replacing routine tasks (Lee and Shin, 2017; Autor and Dorn, 2013; Acemoglu and Restrepo, 2020; Frey and Osborne, 2017; Dauth et al., 2021), manufacturing jobs but not service sector jobs (Kim, 2024).
  * Technological progress tends to polarize labor markets—expanding both high- and low-skill jobs while displacing middle-skill employment (Goos & Manning, 2007; Autor, 2019).



- Recent studies reported the *complementarity effect*:
  * Digital tools and AI augment workers' capabilities, creating new occupations and demand for cognitive, creative, and social skills(Aum et al., 2025; Marguerit, 2025; Acemoglu & Restrepo, 2018 & 2020).
- Heterogeneous employment effect of AI
  * Firms with higher AI investment tend to have more high-skill workers, and reduce employment in non-AI positions (Babina et al., 2023; Acemoglu et al., 2022).
  * AI exposure is higher in high-skill occupations compared to the exposure to traditional technologies (Webb, 2020) → AI may substitute high-skill workers (Eisfeldt et al., 2023).

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How Do Technologies Reshape Work and Employment? ②

■ Observations in Korea

- AI, big data, and IoT reduces high-skill jobs in manufacturing sector but this displacement effects are offset by new jobs in IT services. (Aum and Shin, 2025; Han, 2023).
- The occupations most affected differ across industries: Craft jobs in manufacturing, professionals in IT services, and elementary occupations in other services have all experienced significant declines (Aum and Shin,2025).
- AI adoption reduces new hiring. At least in the short term, the impact of AI adoption on employment and wages is limited, as the increased demand for AI specialists tends to offset job reductions elsewhere (Han, 2023).
- The employment effect of digital techs shows a polarized pattern – increasing in groups with above-average exposure to AI, while decreasing in groups with below-average exposure (Lee and Hwang, 2023).
- Unlike previous technologies (such as industrial robots and software), AI tends to expose higher-income and higher-educated workers more intensively. A 10% increase in the AI exposure index is projected to reduce the employment share of affected jobs by 7 percentage points and lower wage growth by 2 percentage points over the next 20 years (Han and Oh, 2023; Song et al., 2024; Kim et al., 2024; Jang and Kim, 2025).

Post-Pandemic Observations: Labor Shortages and Skills-Mismatches (cont.)

■ **Labor shortages** are unevenly distributed across sectors, largely driven by ***skills mismatches*** and changing worker preferences (ILO, 2024).

■ **Causes of Skills Mismatches**

① *Rapid technological change*

② *Structural economic shifts*: Declining industries and emerging sectors cause workers' prior skills to become less relevant.

③ *Slow adaptation of education and training systems*: Curricula and vocational programs lag behind changing labor-market needs → Higher education

* Degree requirements have become less important in job advertisements (Fuller et al., 2022).

④ *Labor market frictions*: Limited mobility and poor information flows.

* Workers attempted to transition toward growing sectors, but candidates coming from declining occupations were less likely to achieve successful transitions, reflecting employers' hesitation to hire occupational switchers (Carrillo-Tudela et al. 2023).

⑤ *Inadequate skills forecasting and investment* → Insufficient upskilling and reskilling efforts by firms and policy makers

■ **Hence, t**he net effect of technologies on employment depends on the type of technology, labor market adaptability, negotiation between stakeholders, education, industrial policies, and policy design.

Implications

- Technological change has *ambiguous effects* on employment—both destructive and creative.
- The employment effects of the green transition: positive and need to be "decent" jobs.
- As digital technologies continue to evolve and reshape the nature of work, labor markets will need to undergo substantial adjustments — not only through retraining and upskilling to meet new demands, but also by strengthening and educating workers in areas that rely on uniquely human abilities such as creativity, empathy, ethical judgment, social skills, and complex problem-solving.
- Labor market policies, lifelong learning systems, and inclusive innovation frameworks are central to ensuring that technological progress translates into more—and better—jobs.
- Therefore, the *technological agenda* requires shifting from *job protection* to *transition facilitation* — ensuring workers can actively join and drive the transition toward expanding sectors.
  - Identifying occupations with a *high risk* and establish *reskilling programs* and *job-linked welfare policies* to strengthen the social safety net.
  - Introducing *youth employment policies* that support smoother entry into the labor market.
  - Reforming the education system — including curriculum design and lifelong learning frameworks — to better align with labor market skill demands and soft skills
  - Integrate in-company training (upskilling and vocational training for current and potential employees) with school education and industrial support policies to enhance workforce relevance and skill alignment.

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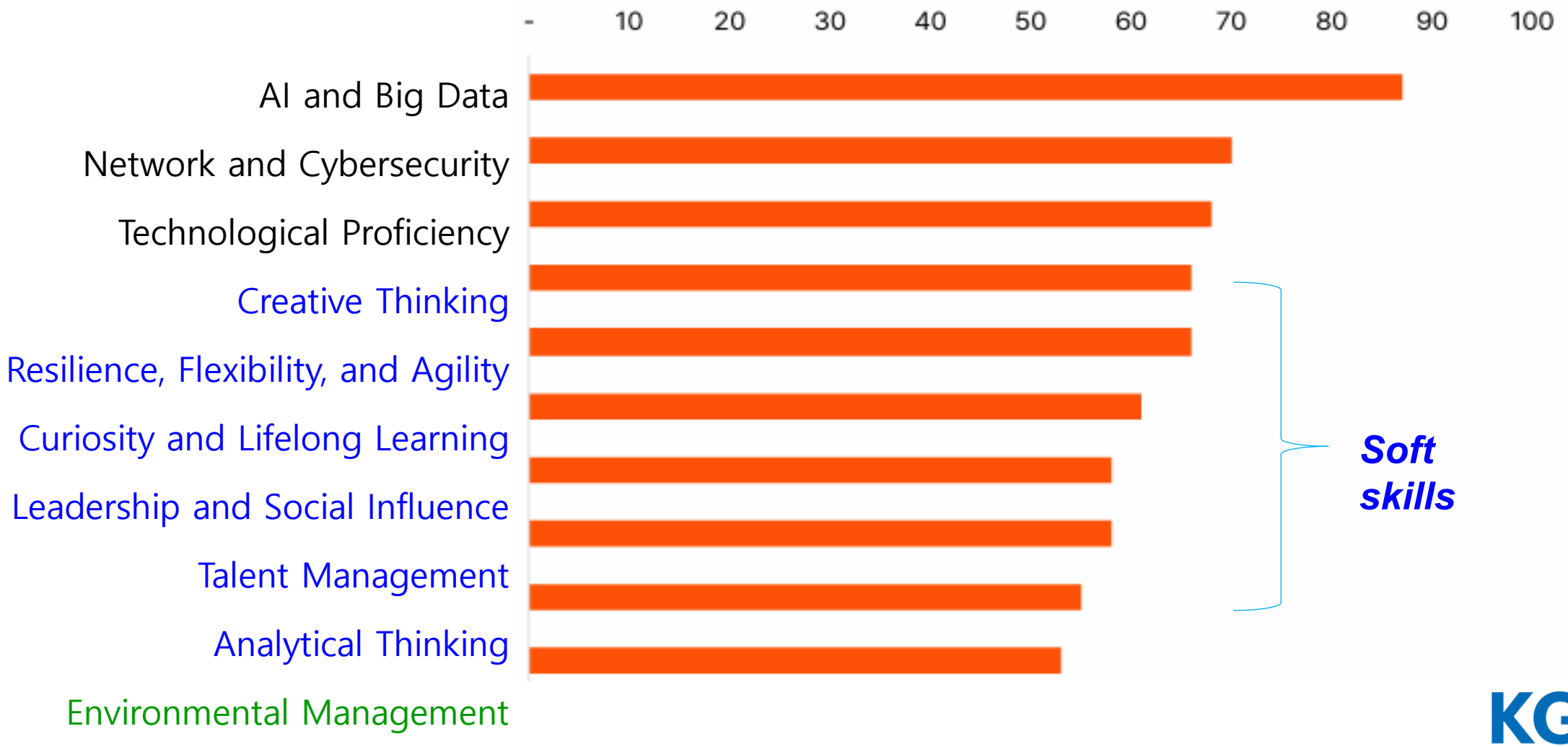
Skills Expected to Grow in Importance (2025-2030)



Source: WEF, Future of Jobs Report 2025; Samil PWC Institute.

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