

► ILO Brief

November 2024

Navigating the Future: Skills and Jobs in the Green and Digital Transitions

Scenario-based insights

Key points

- Green and digital transitions can provide opportunities for additional job creation for a large-scale job creation if effective policy measures and investment are undertaken.
- The investments to achieve universal broadband coverage (hereafter “the digital scenario”) and net zero carbon emission through the energy transition (hereafter “the green scenario”) are expected to create 23.5 million and 37.2 million more jobs than the business-as-usual scenario, respectively. When these investments are integrated (hereafter “the integrated scenario”), they can create as many as 57.6 million more jobs than the business-as-usual scenario.
- The occupations benefiting from employment gains are observed at all skill levels, with the most significant gain in the medium-skilled occupations, which are expected to see 13 million additional jobs in the digital scenario, 18.5 million in the green scenario, and 30 million in the integrated scenario. These medium-skill level occupations account for about half of the new job opportunities.
- Youth (15-24 years old) are projected to gain 3.6 million jobs in the digital scenario, 5.8 million in the green scenario, and 9 million in the integrated scenarios. These opportunities will be mainly created at medium- and high-skill levels, suggesting more opportunities for relatively higher-skilled youth but also pointing towards the need to upskill low-skilled youth.
- Despite the opportunities, the projected impacts are not always distributed broadly. The gender distribution of the additional job creation is alarmingly unequal, with women gaining smaller share of additional job creation than men by 30 percentage points in the digital scenario, 46 percentage points in the green scenario and 40 percentage points in the integrated scenario. Similarly, in all scenarios, the older workers would see lower percentage changes in additional job creation than the overall working-age population. Furthermore, certain groups of occupations are more likely to benefit or lose out during the transitions. For instance, under the energy transition scenario, occupations related to agriculture, fishery and forestry sectors are likely to experience negative employment growth in middle-income countries.
- Reskilling, upskilling, and other support from labour market institutions and employment and social protection measures, designed and implemented through social dialogue, would be crucial for workers to safeguard income generation opportunities or transition to new jobs, and for enterprises to harness the opportunities presented by green and digital transitions.

Scenarios for green and digital transitions: Insights towards 2030

By 2030, there are opportunities for additional net job creation on a large scale that can arise from the investments in digital and energy transitions.¹ The magnitude of job creation is different in different policy and investment scenarios:

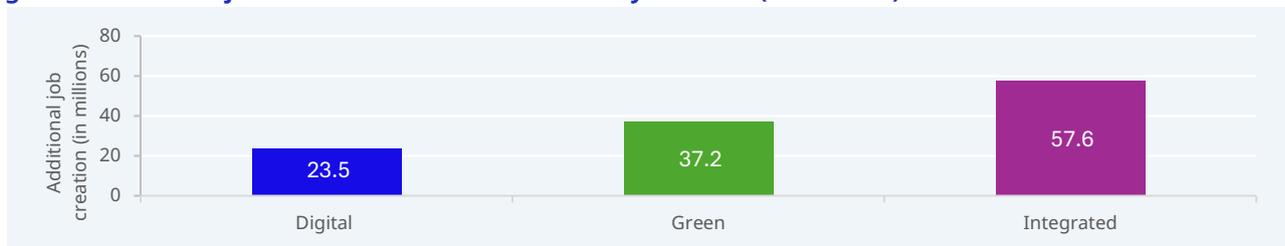
- **Digital scenario:** The main assumption is an increase in investment leading to the expansion of broadband coverage to achieve universal broadband coverage (defined as covering at least 90 per cent of the population) by 2030. The investments are expected to be allocated to the sectors that build new infrastructure. The expanded broadband

¹ This brief presents projections of employment by 2030 (in baseline, green, digital and integrated scenarios) produced by the global macro-econometric model E3ME of the Cambridge Econometrics. E3ME is a computer-based model of the world's economic, energy and environmental systems, in which behavioural relationships are estimated using econometric time-series techniques to quantify the economic and employment impacts of the implementation of policy-induced scenarios.

coverage would drive greater usage of digital technologies, improving productivity and shifting consumer spending patterns with increase in expenditure on Internet-enabled services. In this scenario, 23.5 million additional jobs can be created.

- **Green scenario:** The main assumption is the implementation of carbon pricing and other carbon emission reduction policies such as subsidies and feed-in-tariffs to support renewable energy and regulation that prevents new construction of certain types of power plants (e.g. coals). The scenario also includes assumptions about the implementation of policies, regulations and investment to improve energy efficiency, with specific focus on buildings and road transport sectors. These measures would increase the investments in renewable energy and energy efficiency to achieve net zero carbon emission by 2050.² In this scenario, 37.2 million additional jobs can be created.
- **Integrated scenario:** The main assumptions from the digital and green scenarios are combined without any additional adjustments in policies, investments and timelines. While the inputs are simply merged, the results differ from the sum of the individual scenarios due to higher investment, which is expected to generate stronger productivity gains through economies of scale. In this integrated scenario, 57.6 million additional jobs can be created.

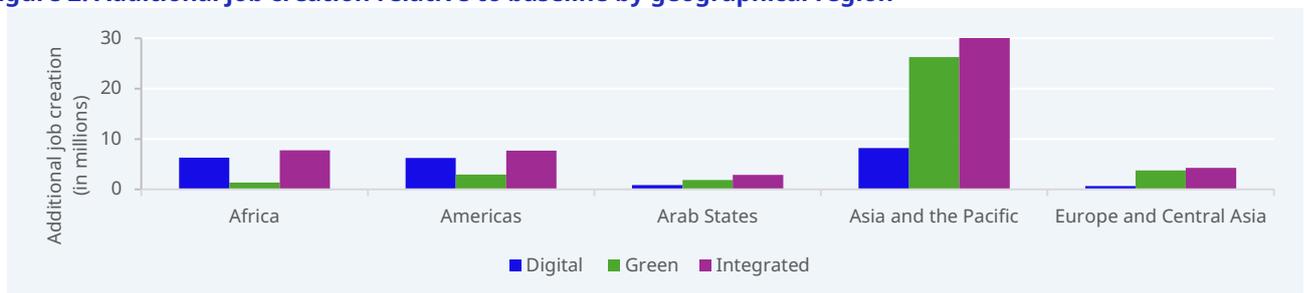
► **Figure 1. Additional job creation relative to baseline by scenario (in millions)**



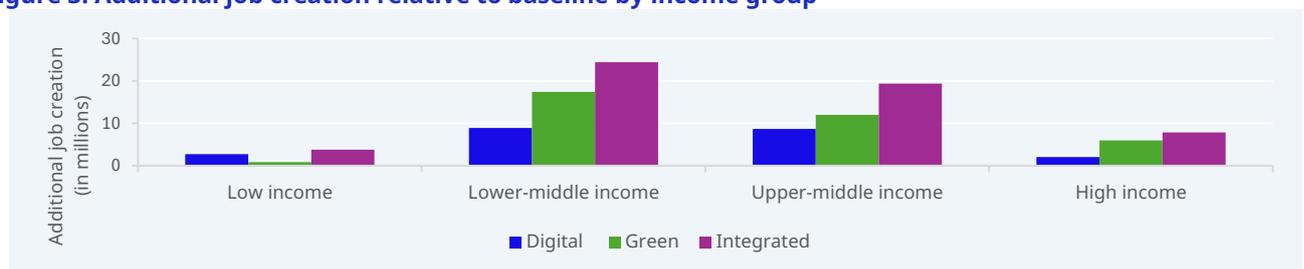
Where will the jobs be?

By geographical regions, Asia and the Pacific region will see the largest gain across all scenarios, with a particularly large gain under the green scenario with 26.3 million additional jobs, accounting for 70 per cent of the total gain worldwide. In Africa, investments for achieving universal broadband coverage are expected to create a substantial number of jobs, owing to the current low level of broadband coverage of just 37 per cent of the population, which in turn presents the region's untapped potential. By income groups, lower-middle income and upper-middle income countries account for 79 percent (43.7 million additional jobs) of total gains. This could be due to their rapid industrial modernization which is driving demand for jobs in digital and green economies, alongside significant investments in renewable energy, energy efficiency and digital infrastructure.

► **Figure 2. Additional job creation relative to baseline by geographical region**



► **Figure 3. Additional job creation relative to baseline by income group**

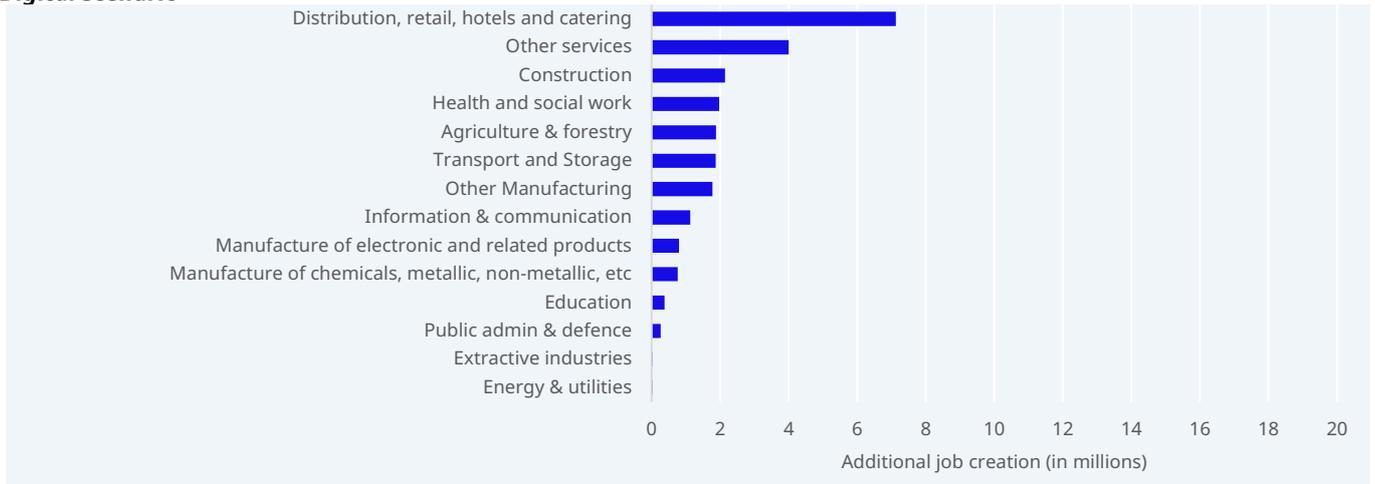


² For this modelling exercise, the reduction of CO2 emissions, energy efficiency savings, investment, and carbon prices are aligned with the IEA Net Zero by 2050 Report (2021). While these policies and investments are long-term with a time horizon of 2050, the results of the projections are presented up to 2030 only.

The digital scenario will result in net employment gain in all sectors, with particularly strong employment growth in “Distribution, retail, hotels and catering”, “Other services”, “Construction”, “Health and social work”, and “Agriculture and forestry”. The green scenario will see much stronger employment growth in the “Construction” sector, as well as in “Manufacturing”, but with significant net employment loss in the “extractive industries”, likely owing to the need for renewable energy infrastructure, as well as expected decline in the demand for fossil fuels.

► **Figure 4. Additional job creation relative to baseline by economic sector (in millions)**

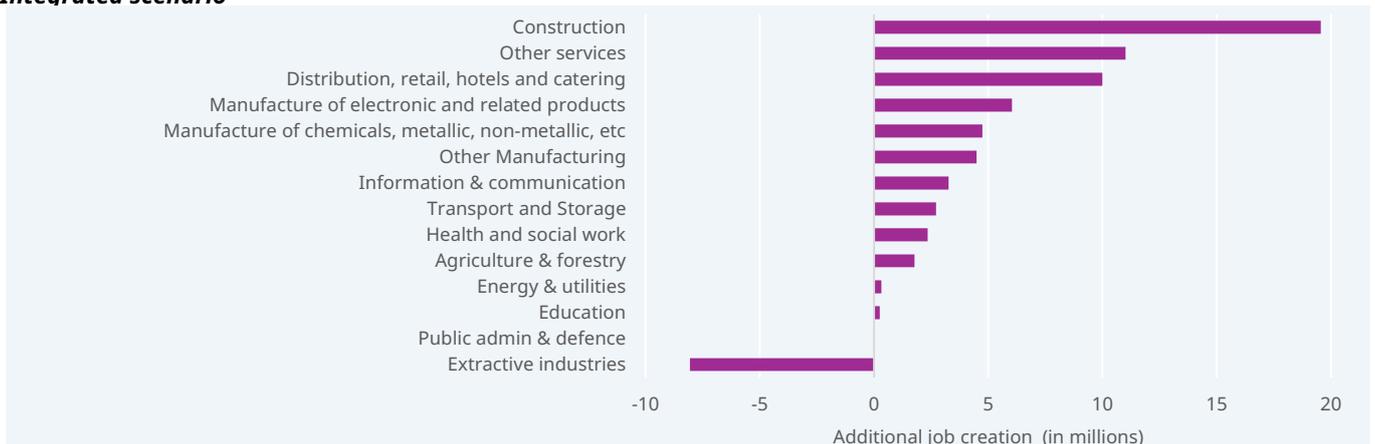
Digital scenario



Green scenario



Integrated scenario

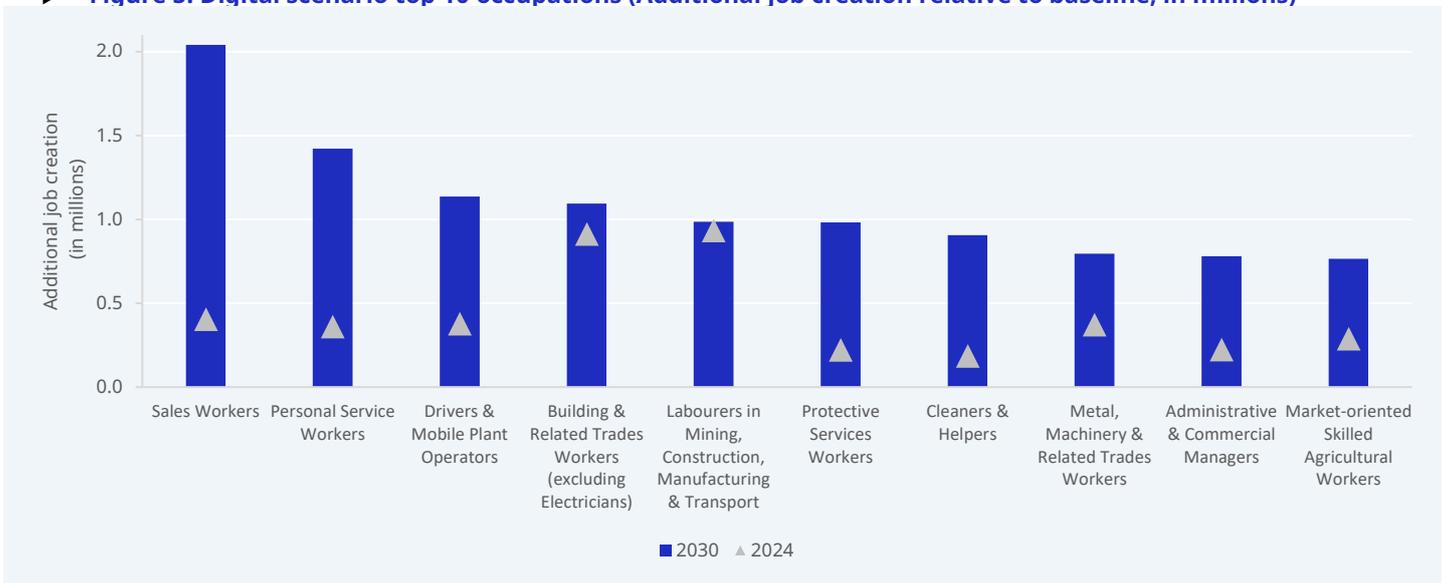


Top 10 Occupations with the largest gains

Digital scenario

The investment to achieve universal broadband coverage will create demand for workers who are essential for digital infrastructure development and maintenance and for workers who support the expansion of e-commerce and online services while meeting the demand for enhanced customer engagement and personalization. Except for “Building & Related Trades Workers” and “Labourers in Mining, Construction, Manufacturing & Transport”, which would see sizable gains in the short run as of 2024, most occupations will experience employment creation over the medium term by 2030. Most of the additional jobs created under the universal broadband coverage scenario will be due to the cascading effect of the proliferation of e-commerce and the overall increase in income and spending on goods and services.

► **Figure 5. Digital scenario top 10 occupations (Additional job creation relative to baseline, in millions)**

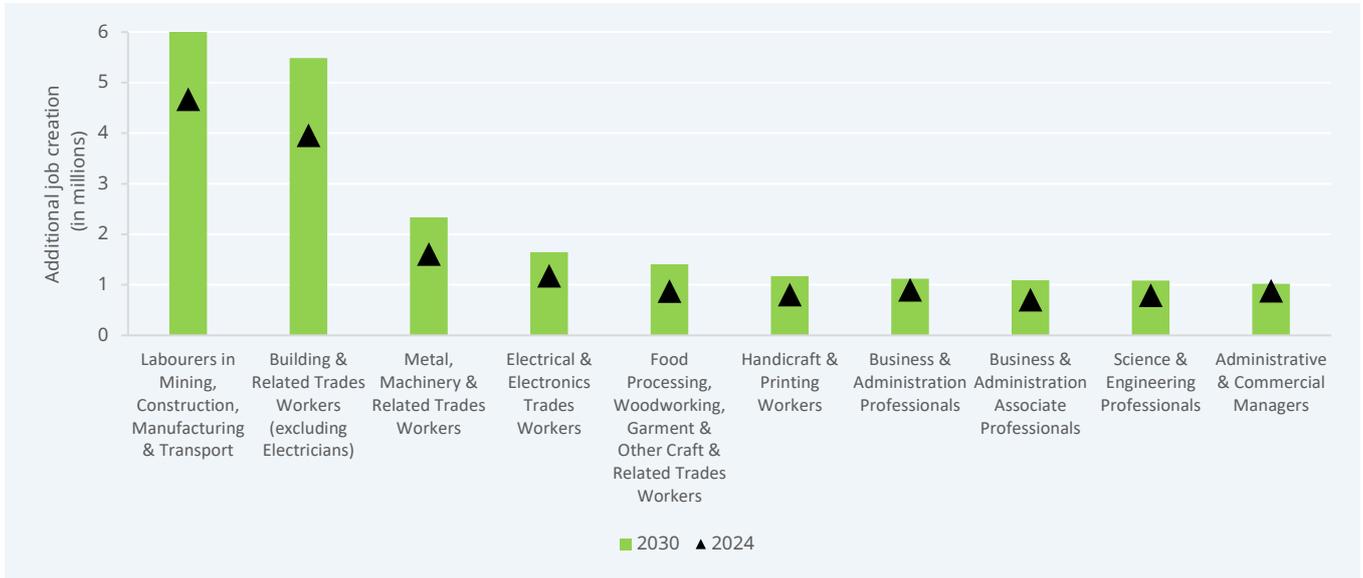


Note: The additional job creation shown in the figure is the marginal increase in employment creation under the digital scenario vis-à-vis baseline scenario. In each year shown in the figure (i.e. 2024 and 2030), there are employment creation opportunities that the digital scenario could bring on top of the baseline.

Green scenario

The climate policies and investment to achieve net zero carbon emission through the promotion of renewable energy generation and energy efficiency will create employment opportunities in various occupations that are required to facilitate the shift towards a low-carbon and more sustainable economies and societies. The demand will be particularly strong for workers who support building renewable energy infrastructure, retrofitting buildings for energy efficiency, developing green technology products, manufacturing necessary components, adopting business management and operation to align with environmental sustainability requirements, and also handicraft production that prioritizes the use of environment-friendly materials, processes, and practices. In contrast to the digital scenario, most occupations will see employment gains in the short run as of 2024. Strong employment creation potential is especially prominent for occupations closely related to labour-intensive sectors such as construction.

► **Figure 6. Green scenario top 10 occupations (Additional job creation relative to baseline, in millions)**

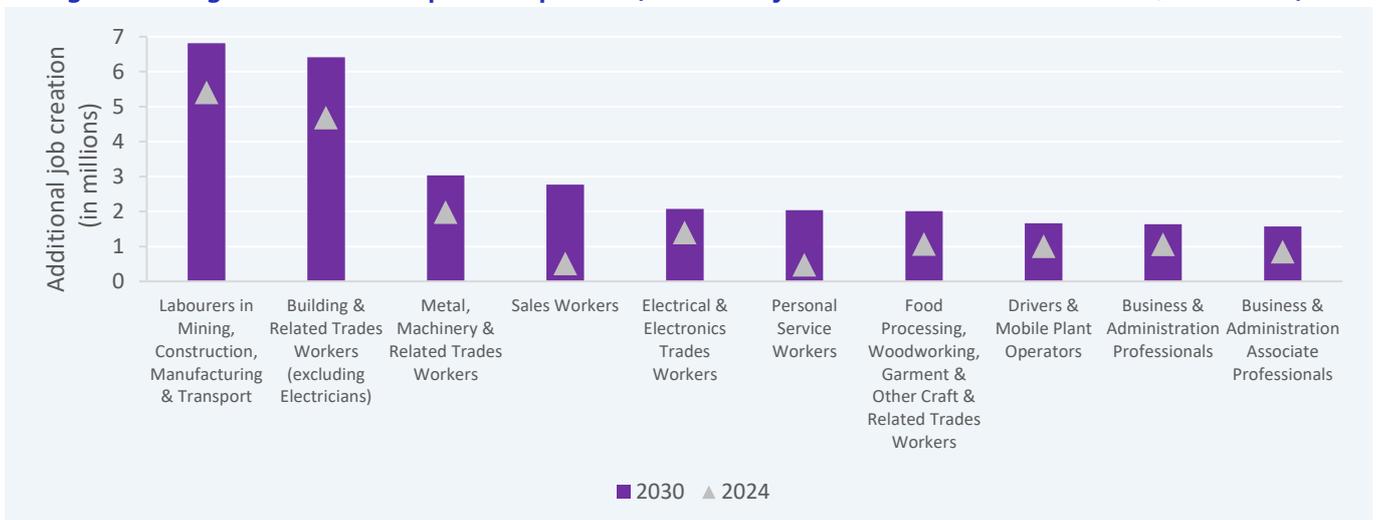


Note: The additional job creation shown in the figure is the marginal increase in employment creation under the green scenario vis-à-vis baseline scenario. In each year shown in the figure (i.e. 2024 and 2030), there are employment creation opportunities that the green scenario could bring on top of the baseline.

Integrated scenario

When integrated, the investments to achieve universal broadband coverage and energy transition will boost the demand for labourers, associate professionals and professionals. The employment opportunities will be created for various occupations related to construction, manufacturing, energy systems, sales, services and business administration. Labourers in mining, construction, manufacturing and transport play a crucial role through their involvement in the extraction of raw materials critical for renewable energy technologies, building the physical infrastructure needed for broadband expansion and environmentally sustainable buildings, as well as the facilitating the movement and storage of digital infrastructure components, green technology equipment and renewable energy materials. In the integrated scenario, not only is the size of employment creation augmented, but employment creation will also be better balanced between occupations with a mix of both short-term gains as of 2024 and medium-term gain by 2030.

► **Figure 7. Integrated scenario top 10 occupations (Additional job creation relative to baseline, in millions)**



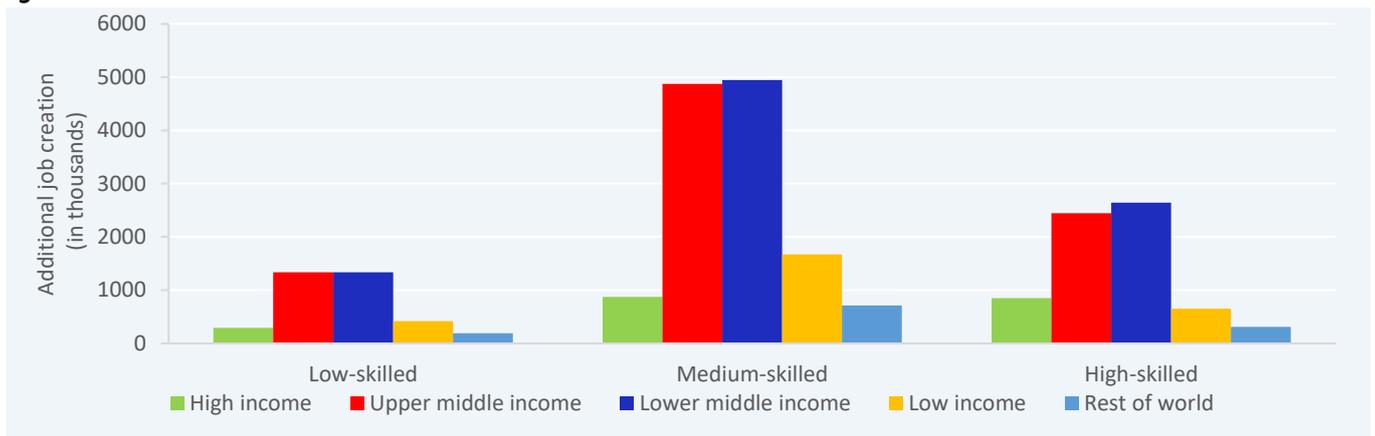
Note: The additional job creation shown in the figure is the marginal increase in employment creation under the green scenario vis-à-vis baseline scenario. In each year shown in the figure (i.e. 2024 and 2030), there are employment creation opportunities that the integrated scenario could bring on top of the baseline.

Employment opportunities by skill levels

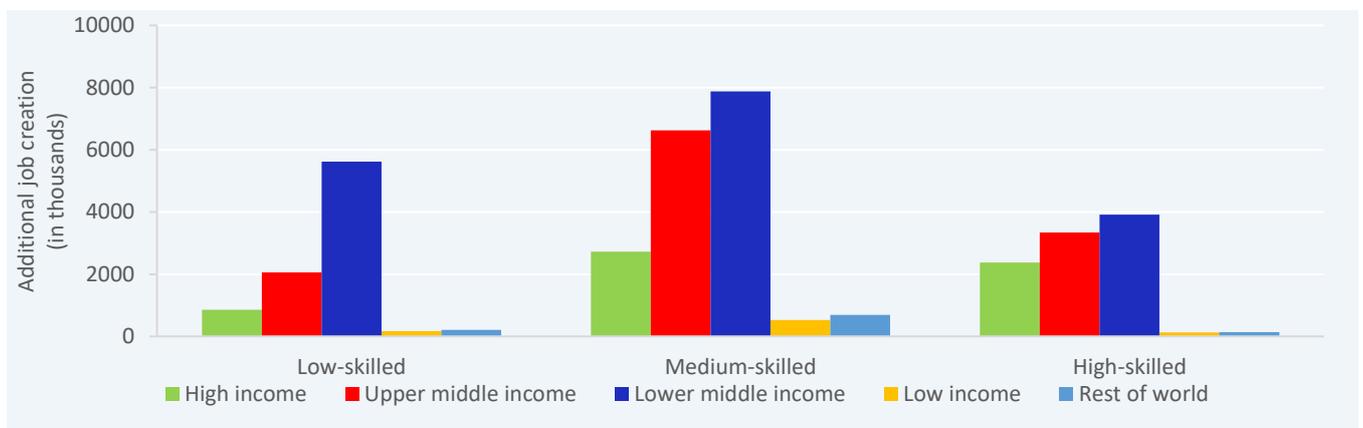
Across all the scenarios, **the biggest gains will be in the medium-skill level occupations, which will see 13 million jobs in digital, 18.5 million in green, and 30 million in the integrated scenarios.** Middle-income countries will experience the most gains.

► **Figure 8. Additional job creation relative to baseline by skill levels and country income groups (in thousands)**

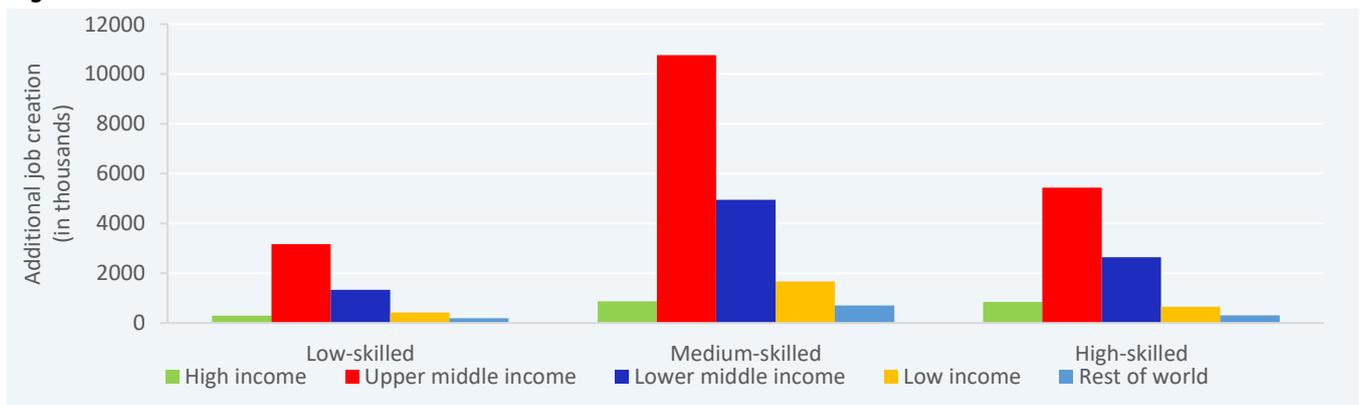
Digital scenario



Green scenario



Integrated scenario

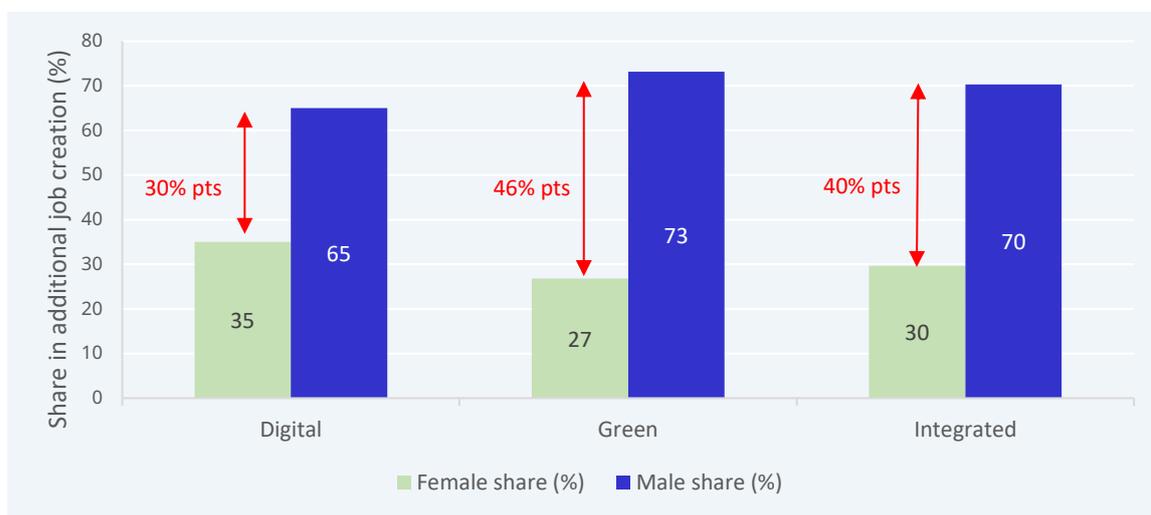


Employment opportunities by gender

Across the digital, green and integrated scenarios, **women are significantly less likely to benefit from the newly created employment opportunities**. This is because the investments to achieve universal broadband coverage and energy transition tend to create jobs for the occupations that have historically been dominated by males, such as “Labourers in mining, construction, manufacturing and transport”, “Building and related trades workers”, “Metal, machinery and trades workers”, “Electrical and electronics trades workers” and “Drivers and mobile plant operators” (See the list of top 10 occupations presented in the earlier section).

- **Digital Scenario:** Female share in total employment gain is smaller than male share by **30 percentage points**.
- **Green Scenario:** Female share in total employment gain is smaller than male share by **46 percentage points**.
- **Integrated Scenario:** Female share in total employment gain is smaller than male share by **40 percentage points**.

► **Figure 9. Gender gap in employment opportunities by scenario (percentage)**



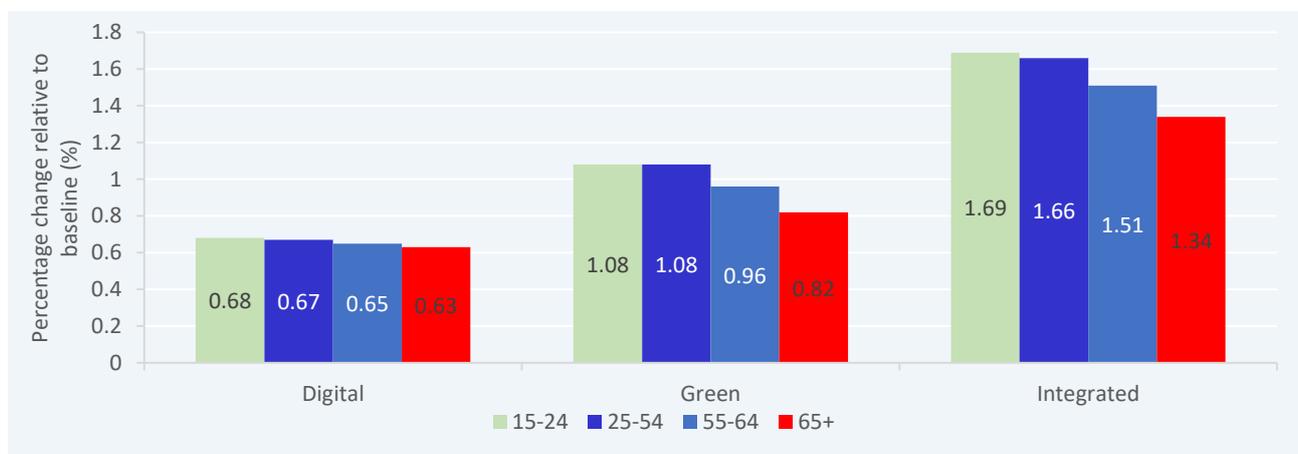
Under the digital scenario, the realization of universal broadband coverage can enable more women to work remotely and more flexibly while creating higher demand for service-oriented occupations, such as sales workers and personal service workers, where women are relatively well represented. And yet, the projections suggest that employment opportunities will still not be shared equitably between women and men. This indicates the need to further promote higher female labour force participation and access to skills development in digital skills and STEM fields among women.

To achieve an equitable energy transition, targeted measures must be put in place to address male-dominated workplace culture and practices and enhance skills development in the energy and its supporting sectors, with a particular emphasis on ensuring more opportunities for women. In particular, the Renewable Energy sector presents an opportunity to promote gender equality. According to the IRENA-ILO (2024) joint report, the female workforce accounts for 32 per cent of total employment in the Renewable Energy sector. Although this figure still falls short of parity, it is 10 percentage points higher than the female share of employment in the broader energy sector. Within the Renewable Energy sector, the Solar photovoltaics (PV) sub-sector presents a promising opportunity, with the female share of employment at 40 per cent. Efforts must be enhanced in these strategic areas to promote gender equality in the energy transition. Addressing gender disparities proactively will be key to building a more inclusive workforce that ensures both men and women benefit equitably from the opportunities presented by the digital and green transitions. Targeted measures could include - but are not limited to - gender-responsive policies across all stages of skills development, and particularly for up-skilling and re-skilling related to the transitions, along with comprehensive training programmes aimed at increasing women's participation in STEM fields and technical trades. Policies that incentivise the recruitment, retention, and advancement of women in male-dominated sectors will also be crucial, alongside gender-responsive hiring practices. The implementation of mentorship and sponsorship initiatives and the promotion of inclusive workplace cultures are also crucial for reducing occupational segregation.

Employment opportunities by age group

By 2030, employment opportunities will arise across all age groups, with **sizable gains particularly for youth (15-24 years old): 3.6 million jobs in digital, 5.8 million in green and 9 million in integrated scenarios.** In all scenarios, youth can expect slightly higher percentage changes in additional job creation (relative to baseline) than the overall working-age population. On the other hand, in all scenarios, the older workers (55-64 and 65+ years old) would see lower percentage changes in additional job creation than the overall working-age population, especially in green and integrated scenarios, but to a lesser extent in the universal broadband coverage scenario. These figures illustrate differences in the impact of digital and green transitions felt by different age groups. There is a need to address the risk of older workers not benefitting from the employment opportunities created during the transitions compared to younger cohorts to ensure no one is left behind.

► **Figure 10. Additional job creation by age group (percentage change relative to baseline)**



The employment growth for certain occupations is stronger for youth compared to the overall working-age population. These occupations tend to be at medium and high skill levels, suggesting the potential to create new demand for higher-skilled youth, but at the same time, the need to upskill lower-skilled youth to avoid widening inequality in opportunities.

► **Table 1. Occupations with stronger employment potential for youth**

Scenario	#	Skill level	Occupational title
Digital	1	High	Hospitality, Retail & Other Services Managers
	2	Medium	Customer Services Clerks
	3		Personal Care Workers
	4	Low	Building & Related Trades Workers (excluding Electricians)
	5		Street & Related Sales & Service Worker
	6		Refuse Workers & Other Elementary Workers
Green	1	High	Business & Administration Professionals
	2		Information & Communications Technology Professionals
	3		Legal, Social & Cultural Professionals
	4		Science & Engineering Associate Professionals
	5	Medium	Metal, Machinery & Related Trades Workers
	6		Stationary Plant & Machine Operators
Integrated	1	High	Health Professionals
	2		Business & Administration Professionals
	3		Legal, Social & Cultural Professionals
	4		Science & Engineering Associate Professionals
	5	Medium	Customer Services Clerks
	6		Personal Care Workers
	7		Metal, Machinery & Related Trades Workers
	8		Stationary Plant & Machine Operators

Complementarity between green and digital scenarios

The net employment impact of investments in universal broadband coverage and energy transition is overall positive, except for a few occupations. For instance, under the energy transitions scenario, several agriculture-related occupations are projected to experience net employment loss compared to a business-as-usual scenario. However, under the integrated scenario, where investments are made to promote broadband coverage and energy transitions simultaneously, these net negative employment effects can be compensated, resulting in a net employment gain. This shows how investment in digital connectivity can help promote employment growth in occupations that would otherwise experience significant employment loss. The complementarity between green and digital scenario can manifest in a mutually reinforcing manner. For instance, better digital connectivity and improved access to data and devices in rural areas could promote climate smart precision agriculture to better cope with climate change. The proliferation of climate smart agriculture can, in turn, stimulate further technological advancement, which can create additional jobs in digital economy.

► **Table 2. Complementarity between green and digital scenarios for agriculture, fishery, forestry-related occupations**

Country income group	ISCO-08 2 Digit	Occupational title	Absolute number change (Thousands)		
			Green	Digital	Integrated
Upper-middle income	62	Market-Oriented Skilled Forestry, Fishery & Hunting	-24.4	13.3	62
Lower-middle income	61	Market-oriented Skilled Agricultural Workers	-20.3	359.6	61
	62	Market-Oriented Skilled Forestry, Fishery & Hunting	-99.2	66.2	62
	63	Subsistence Farmers, Fishers, Hunters & Gatherers	-44.6	78.2	63

In addition to the complementarity between green and digital transitions, the opportunity for employment creation may also exist in Nature-based Solutions (NbS). NbS are actions to protect, conserve, restore, sustainably use and manage natural ecosystems, which address social, economic and environmental challenges, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits. As of 2022, nearly 75 million people were employed in NbS, the vast majority of whom are found in lower-middle income countries. In low income and lower-middle income countries, nearly all NbS work (98 per cent and 99 percent, respectively) is in in the agriculture and forestry sector. According to the forthcoming ILO report “Decent Work in Nature-based Solution”, the investment in NbS is projected to create a significant amount of employment, particularly in lower-middle-income countries, including the occupations related to agriculture, fishery and forestry.

► **Table 3: Employment creation through investment in Nature-based Solutions, Basic Scenario (in thousands)**

Country income group	ISCO-08 2 Digit	Occupational title	Nature-based Solution Basic scenario
			Number of Employment (Thousands)
Lower-middle income	61	Market-oriented Skilled Agricultural Workers	3,789
	62	Market-Oriented Skilled Forestry, Fishery & Hunting	880
	63	Subsistence Farmers, Fishers, Hunters & Gatherers	1,013

Conclusions

The investments to achieve universal broadband coverage and energy transition would create substantial opportunities for new employment creation. Integrating these investments can augment the positive employment impact and compensate for the possible negative impact on some occupations. The scenario-based insight suggests strong employment creation potential for youth in green and digital transitions, especially in medium-skilled occupations in middle-income countries. The role of Technical and Vocational Education and Training (TVET) would be crucial to promote the employability of youth focusing on the skills needed in green and digital economies.

The occupations with high employment creation potential identified in each scenario suggest that training programmes should be developed and implemented for variety of roles such as service-oriented roles and construction-oriented occupations in the digital scenario, STEM-intensive and machinery operation-related occupations in the green scenario and health professional and business and administration professionals in the integrated scenario, among others. These occupational demand point towards the future skills needs for medium to higher-skilled youth, and at the same time the need to enhance the efforts to upskill lower-skilled youth to ensure inclusive access to employment opportunities.

In addition to opportunities, the scenario-based insights also reveal challenges such as gender gaps, uneven benefit for older workers and risks of job losses in certain economic sectors, such as extractive sectors. The evidence highlights the need for targeted measures for social inclusion, particularly gender- and age-responsive measures. Such measures will need to be prioritised to ensure that digital and green transitions can benefit all and to counteract the possible exacerbation of occupational segregation across gender, exclusion of older workers and the loss of livelihoods among workers in resource-intensive sectors.

The evidence presented in this brief provides scenario-based insights into both opportunities and challenges in green and digital transition to inform skills development policies and programmes for inclusive transitions with a strong emphasis on advancing social justice through social dialogue. Reskilling, upskilling, and other support from labour market institutions and employment and social protection measures, designed and implemented through social dialogue, would be crucial.

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