APRIL 2024

Skills for a Sustainable Future:

How Green and Digital Skills Intersect and Will Change the Future of Work

THE burningglass INSTITUTE

IBM

Table of Contents

Foreword 3

The Green-Digital Revolution 5

Measuring the Intersection of Green and Digital Skills 7

Field Workers Adopting AI 12

Enhancing Water System Operations Resiliency 13

Upskilling to Reduce Waste 14

Early Career Opportunities for Workers by Global Region 16

Conclusion: Building Skills in a Digital and Green Future 17

Appendix 1: Skills Analysis 19

Appendix 2: Global Skills 21

References 22

Foreword

By Matt Sigelman, President of the Burning Glass Institute, and Justina Nixon-Saintil, VP and Chief Impact Officer of IBM

WHY DIGITAL SKILLING IS A CRITICAL IMPERATIVE FOR THE ENVIRONMENT, THE ECONOMY, AND LEARNERS

At the most recent Conference of the Parties meeting (COP28), participants reaffirmed their commitment to hold global temperature change to 1.5 degrees Celsius. They also acknowledged that current emissions would have to be reduced by 43% from 2019 levels, and that current progress was off target.

Why is this critical? In the last year, we witnessed the damage from increased natural disasters. During the summer of 2023, many people experienced the existential challenge of climate change. In June, New York City turned into an orange haze from the wildfires hundreds of miles north in Canada. In August, the once-lush paradise of Maui turned into a deadly tinderbox as fires spread unchecked, exacerbated by hot temperatures and dry conditions. In the fall, Libya experienced devastating floods. More areas of the world are feeling the effects of climate change, from parts of coastal Florida where homes are increasingly difficult to insure due to hurricane flood risk to India, where temperatures more than 43 degrees Celsius have become all too common. Without greater action, the consequences will only get worse as heat waves, storms, and dust bowls intensify, causing billions in economic damage to urban centers and agricultural lands alike.

Fortunately, the world is starting to take action to mitigate and slow the impact of climate change. Many countries around the world have signed international agreements which aim to limit global warming and reduce carbon emissions. Trillions of public and private capital, fueled by landmark legislations are supporting the deployment of proven renewable technologies and the development of promising interventions such as carbon capture and storage, nuclear fusion, and electric vehicles.

However, new power generation, transmission, and automotive investments alone will not be sufficient. To reach the goals outlined in many of the international agreements, the world will also need to decarbonize the entire economy, from consumer manufacturing to office buildings to transportation of finished goods. In addition to new physical investments, technology will play a major role in making existing industries more energy efficient and less carbon intensive. **Labor skills at the intersection of green and digital will also play a major role in ensuring the full and rapid deployment of technologies, integrating them into existing ways of working and ensuring that they are properly deployed in the context of their existing physical environment**.

So, what does that mean as the world adapts to a changing climate and new sustainable inventions, interventions, and strategies are adopted to achieve global emissions targets while maintaining economic growth and standards of living?

The Burning Glass Institute and IBM believe that it means new economic opportunities for workers. In 2023, Burning Glass Institute partnered with IBM to study and identify new jobs that have emerged and explore what our data says about in-demand knowledge and skills.

Demand for cutting-edge green and digital skills is creating those new job opportunities. There are expanding interactions and new intersections between the skills that drive a sustainable global

environment. These blend digital skills with many that previously had been core to jobs that were squarely in the green economy. **Green and digital jobs increasingly overlap, creating demand for workers who can work with digital skills in the green economy and for workers who deploy core green skills across the economy.**

What do we mean when we say that digital skills are intersecting with green skills and creating new economic opportunities? It means that workers who have worked in digital roles are increasingly adopting skills like energy conservation and management. It means that workers in natural resource management and solar installation increasingly need to understand artificial intelligence (AI), technical coding languages, and other digital skills as their fields adopt technology that makes them less carbon-intensive. There are also new and exciting roles that sit at the intersection of these fields. Green-digital roles like environmental data analyst and cybersecurity roles that focus on maintaining grid resilience and sustainability.

While these new opportunities are exciting, there are important steps that learners, workers, and employers must all take to develop the skills that will drive the full actualization of a greening economy and labor market. Society at large – businesses, educators, policymakers, and workers – must all find ways to invest in building new skills that will enable the green transition.

In addition to partnering with the Burning Glass Institute to develop a better understanding of these intersections, IBM supports green and digital skill building. Through **IBM SkillsBuild**, IBM has launched new courses to support learners and workers in building skills that will allow them to be competitive at this intersection of green and digital skills, and to make the world more sustainable.

The Green-Digital Revolution

Global adoption of new and innovative technologies to drive a more sustainable and less carbon-intensive economy is surging. Businesses and governments are investing in new infrastructure and systems that help reduce environmental impact and extend the useful lifetimes of existing assets and strategies. Similarly, innovative solutions are rapidly coming to market that make the world more sustainable and resilient.

What is driving these trends? A changing climate means less predictable weather and more severe weather events. These extreme events threaten broad community and human health, and business operations. The most recent **UN Intergovernmental Panel on Climate Change Report** identified that 3.3 billion people across the globe live in areas vulnerable to significant impacts from climate change. In many cases, it is an economic concern that also drives sustainability imperatives as communities explore strategies to ensure they remain resilient to a changing climate.

With nearly half of the global population vulnerable to significant environmental impact, new strategies to create a sustainable future are essential. Sustainability matters across corporations, organizations, governments, and communities. It also means that there are significant new economic opportunities and skill demands for workers. IBM and the Burning Glass Institute have partnered to examine trends in the labor market and demand for skills that will drive a sustainable future and chart a pathway for workers.

Our analysis identified an important confluence of change – the digitization and technology enablement of the future of work directly intersects with the greening of work that is driven by investments and strategies to build a more sustainable future.

Green skill growth is significant among highly digital roles. Burning Glass observed a 93.1% growth in demand for green skills from 2018–2023 as measured by the number of green skills requested per job posting. Looking across a set of jobs that are highly digitally-focused, both in office and industrial settings, we observed significant growth in green skill demand in job postings.

Digital skills have become essential skills in green roles. As the green sector has become more pervasive and in-demand across the economy, it has adopted digital strategies to remain productive. Workers must now interface with digital solutions as part of their core responsibilities.

While these two trends are deeply intertwined, they have different impacts on workers. As roles evolve to meet the needs of the green economy, new skills that enable more sustainable production and consumption are increasingly at the forefront of the labor market.

We see these changes happening broadly. This growth in demand for sustainability solutions has created new opportunities for workers and driven new forms of green-focused work and created new blends of skills. For example, some roles are specializing in new technologies, such as applying AI to complex green infrastructure. Other roles, like electricians, are seeing broad growth in green skill demand, such as solar installation. Smart energy technology and energy load management, which are often controlled by computer and microchip mean that many skilled trades need to learn basic interfacing with computers and coding. Both the deep and broad forms of emerging and changing roles have

significant opportunity to create a sustainable future. The rising green economy goes beyond the development and deployment of new climate technologies. Rather, the green revolution is transforming a much wider array of occupations across existing industries and functions, enabling them to become more energy and cost efficient.

Major changes are happening for workers in jobs that are often identified as "green jobs." Think of environmental consultants or installers of solar panels: these workers are essential to the decarbonization of the economy. Government investment and consumer preferences are driving this decarbonization, spurring investment in productivity-enhancing technologies. Unsurprisingly, workers in these industries have begun to adopt new tools such as AI, to predict electrical line failures or drones to monitor solar farm efficiency, to become more effective.

Integrating green skills drives a sustainable future. These are especially evident among digital roles. Many roles that were typically not seen as "green jobs" are now experiencing a change in the skills that are demanded to be effective, specifically significant growth in the overall green content. While often only a small portion of skill-demands in a role are green, these components can have a profound overall impact on an employee's day-to-day tasks. For example, a software engineer might be expected to know more about energy efficiency as part of their job developing large language models. These emerging skill requirements will touch many markets and sectors, from energy production and manufacturing to transportation to construction and infrastructure development.

A sustainable future is a digital future. We have seen similar transformations play out before. Over the last 40 years, the digital revolution rewrote the labor market, with most well-paying jobs now demanding digital skills, including jobs far outside the tech sector such as healthcare, energy production, and hospitality. Thus far, the sustainability revolution is following a similar pattern. But the comparison is apt for another reason: what we are experiencing today isn't just a new wave of transformation, paralleling a prior generation of change. Rather, these two revolutions intersect in many places. The emerging green economy is increasingly an extension of the digital economy while the digital world itself recognizes the imperative to become greener.

Measuring the Intersection of Green and Digital Skills

The confluence of the digital and green revolutions bears out in the underlying skills of work. While it may be enticing to imagine that new job categories will drive a sustainable future, our analysis of labor market trends and the changing content of work suggests that traditionally digital roles, such as computer programming, will evolve to support less carbon-intensive ways of working. Our analysis of the confluence between digital and green skills provides a first-of-its-kind view into how the skills-content of jobs in these fields are changing.

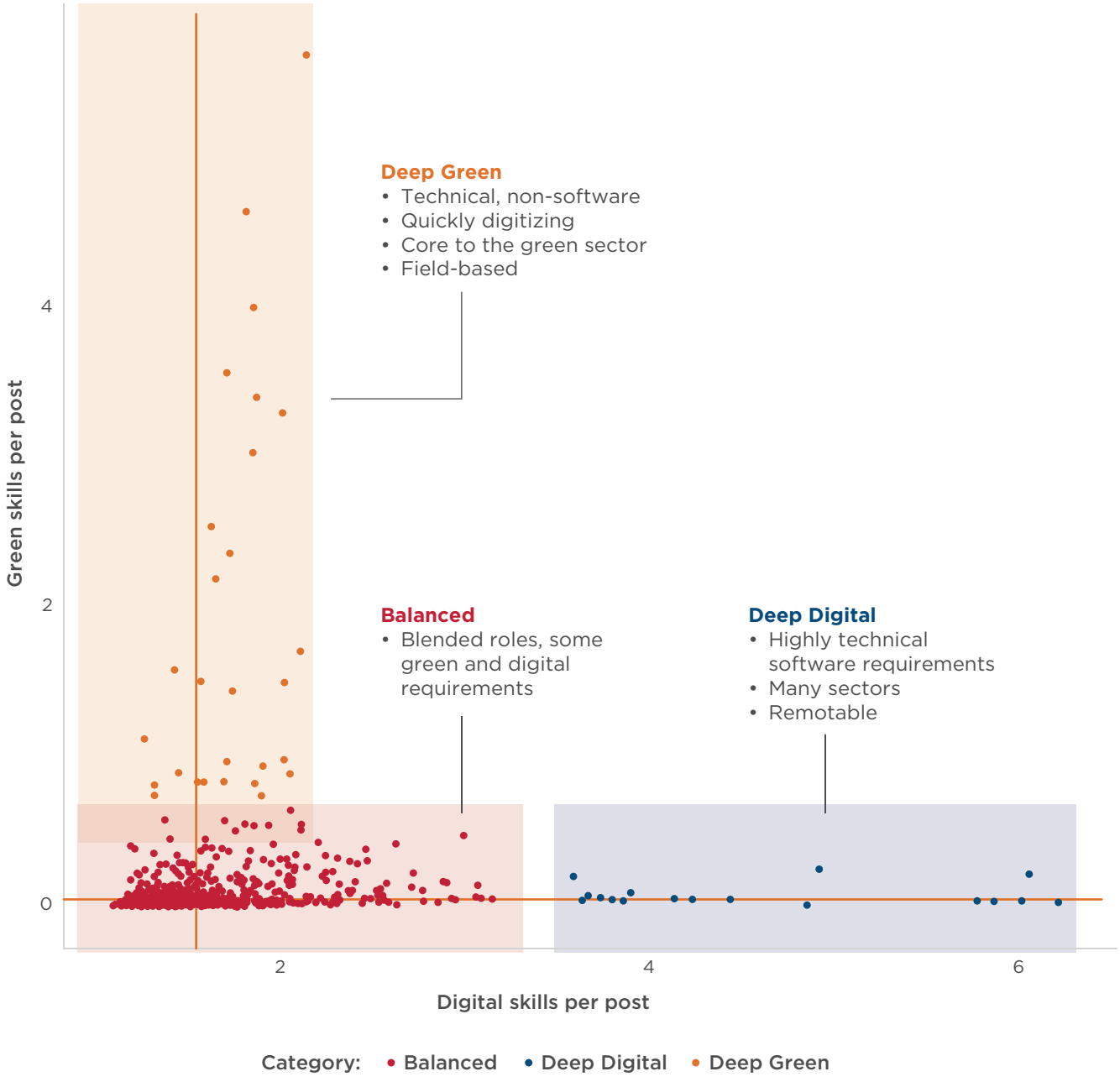
To identify trends across these different roles, we performed an analysis of the skills-content of millions of job ads across the globe and their overall skill content. We focused on roles that were in the traditionally green sectors, roles that are deeply associated with the tech industry, and roles that were highly focused in technology and digital. We identified skills that sat at the intersection of these fields and then used those highly important intersectional skills to identify jobs and roles that sat at the middle. Intersections between these roles can be seen through three job clusters: deep green roles, deep digital roles, and balanced roles.

Deep green roles are roles identified in our analysis that have high shares of overall skills that are associated with green skills and tend to be technically skilled roles, in non-software-focused positions, often in field-based work. Green skills include energy efficiency, energy management, and environmental regulations. These are roles and occupations that are often reflected in the US Department of Labor's Bureau of Labor Statistics' or the United Nations Environmental Programme's definitions of the green sector.

Deep digital roles are ones identified in our analysis that have high concentrations of digital skills. They have high technical software requirements (often requiring several software-specific coding or technical skills), are seen across multiple industrial sectors, and on average have a higher propensity for remote work. While generally lower in total content of green skill demand, there is fast growth in demand for green skills among these roles.

Balanced roles are many that have a blend of digital and green skills. These roles show balanced but relatively low levels of specialized requirements across both digital and green skills. Sitting at the intersection of the green and digital sectors are skills in **data visualization**, **automation**, and **data analytics**. These three skills are not only being deployed in the green sector to meet new ways of working but they are also critical skills for a growing spate of tech workers – especially those specializing in green roles or working in the green sector. We also see cross-cutting demand for professional skills such as communication and collaboration.

Prevalence of Green Skills versus Digital Skills in Job Postings



Source: Burning Glass Institute Analysis of Lightcast Job Postings Data

Data visualization, automation and data analytics are broad bundles of skills that capture many individual and specific skill sets that roll up into broader skill sets. The following table shows many of the individual skills that make up the broader skill categories previously described.

Critical Digital Skills Intersecting with Green Skills

Data Analysis	Automation Data	Visualization	Professional Skills
ComputerScience	Artificial Intelligence	Data Management	Collaboration
Data Management	C++	Excel	Customer Service
Data Science	Calibration	Python	Innovation
Excel	Code Review	R	Leadership
Python	IBM Maximo	SQL	Motivational Skills
R	Java		Strategic Planning
SQL	SQL		Team Building
Statistical Analysis			Problem Solving

Source: Burning Glass Institute Analysis of Lightcast Job Postings Data

Green jobs now demand digital skills. Digital skill demand in traditionally-defined green roles – such as roles for those involved in installing renewable energy, cleaning, and restoring natural resources, or building energy efficient new products – has been on the rise. Deep green roles, typified by skilled technical work, now require digital skills.

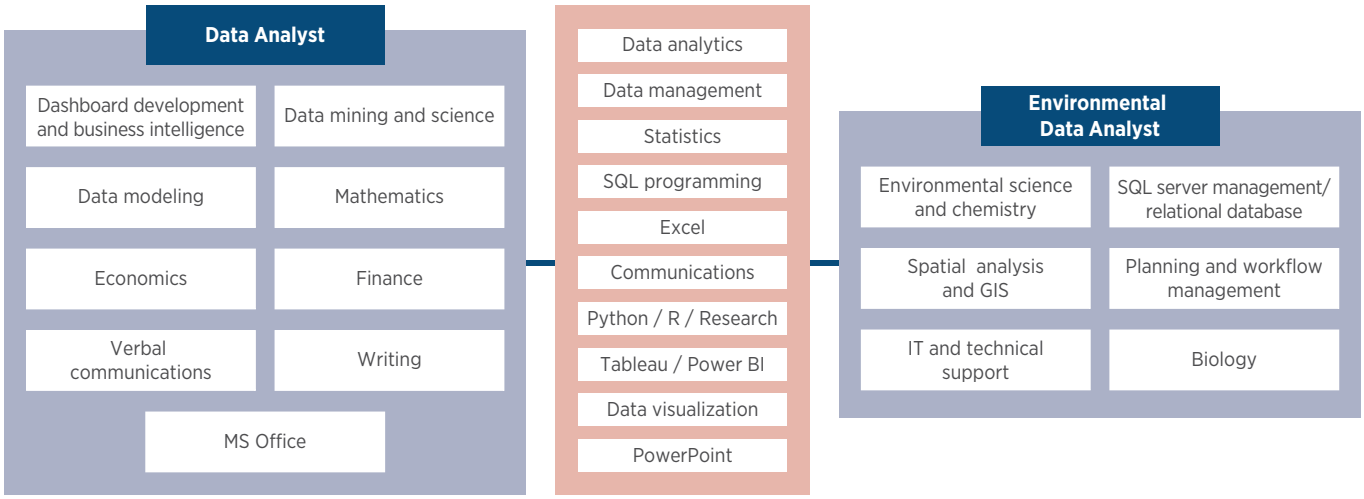
Often bespoke sets of digital skills are driving the digital revolution in deeply green work. For example, forestry and environmental science technician roles increasingly require skills in coding and interfacing with machinery using software to automate machinery, replacing significant amounts of potentially dangerous and physically demanding manual tasks. Such skills are making these technicians safer and more productive while making natural resources management more cost-effective. The Great Belt Fixed Link and Melbourne Water case studies highlighted in this report are good examples of how communities, governments, and companies are adopting digital skills strategies to enhance the productivity of deeply green roles by digitally equipping the functions and workers that serve in deeply green roles.

Digital roles are contributing to the green sector. At the same time that deeply green roles are digitizing; many deeply digital roles are greening. Digital roles increasingly require some green skill development. These growth trends seem likely to continue. In our analysis of the greening of deeply digital roles, **we observed a 93.1% growth in the frequency of green skills in job postings among deeply digital roles from 2018–2023**. In some deep digital roles, the growth of green skill demand is over 200% for roles in industrial settings and IT. These skills

often ranged across many areas including deep knowledge of a subject matter field such as physical sciences, forestry, or green building codes, and often included enhanced workplace safety and sustainability management skills.

Many digital roles now require awareness of specific green skills. Green roles such as energy conservation and management, visualizing of geospatial information, and greening and automation of processes are evident across deeply digital roles. While these workers are rarely classified as green through traditional measures, the green functions they play are incredibly important to making the economy more sustainable.

Data Analyst to Environmental Data Analyst



Source: Burning Glass Institute Analysis of Lightcast Job Postings Data

Consider a network and computer systems administrator, a role that manages and maintains computer networks. They build network systems, ensure that the systems are running and reliable, and monitor usage and access of computer networks and systems. Network and computer systems administrators are increasingly employed to set up and monitor smart infrastructure that improves energy efficiency for buildings. According to Lightcast data, demand for skills related to energy management and conservation grew by 139% from 2018–2023 among network and computer systems administrators. At the same time, core green sector capabilities like impact analysis, product cycle management, and environmental process improvement and safety are increasingly important foundational skills across deeply digital, deeply green, and balanced roles. Many workers are learning these skills on the job, but there is a need for more focused training and education.

Some roles, especially digital roles, are becoming more specialized. Deeply digital roles, including those that focus on analytics and operations, sales, or design and development, are emerging as specialized green digital jobs. For example, environmental data analysts, which represent a specialization of the broader data analyst role, are now widely prevalent. To complement the foundational analytical capabilities of a data analyst, environmental data analysts need to build skills in Geographic Information Systems (GIS) and spatial analysis, process management, and automation. Critically, they must also build a strong knowledge base in their specific application, such as energy production, environmental science, or chemistry.

We have observed similar specializations in fields like sustainable transportation managers – specialists in developing sustainable solutions to transportation; and environmental systems managers – workers who automate buildings and production facilities to be more efficient and sustainable. Other digital roles are also incorporating green skills into their work. For example, roles in cloud computing, cybersecurity, AI and machine learning (ML), and automation engineering increasingly utilize green skills.

Energy efficiency is the most critical and sought-after green skill in the job descriptions that Burning Glass Institute examined.[1] An understanding and awareness of environmental regulations is critical for success in many of these digital green roles. A cybersecurity analyst for a watershed management firm may be more effective in their role when they understand overall water quality standards and processes required by law.

Finally, emergent technologies will also have huge implications on economic activity and energy demand, which will flow through skills required in the labor force. AI, powered by the cloud and enormous advances in large language models (LLMs) and other algorithms, has the potential to be a major boon for the global economy. According to consulting firm McKinsey & Company, generative AI is poised to add **$4.4 trillion** of economic activity while automating or improving the productivity of key functions such as sales & marketing, customer relations, and R&D and engineering. In the coming decades, new AI applications will redefine the tech, healthcare, finance, and education industries, among others, allowing skilled practitioners and professionals to do more in less time and at a lower cost. However, advances in AI will also mean that we need to ensure energy efficiency and overall energy management – this could be an emerging green-digital role.

As a result, future technology employees need to be cognizant of the importance of embedding sustainability across their work activities. Model design can play a huge role: redesigning GPT-3 **can reduce emissions by as much as 75%.** However, efficient model design and optimization of hardware architecture are needs that permeate all of technology. As the green imperative grows, so does the need to ensure that the tech workforce has the skills required to perform their jobs in the greenest way possible.

[1] See Appendix 1 for skills analysis details

CASE STUDY

Field Workers Adopting AI

The Great Belt Fixed Link is an 11-mile network of bridges and tunnels connecting islands in Denmark, creating a direct link between the islands of Zealand and Funen. The Link enabled road and rail access between the mainland of Denmark and its capital, Copenhagen. It is a critical piece of infrastructure for the country, reducing travel times and ferry traffic to the cities across the country. It has facilitated the use of public transportation and reduced carbon emissions. With the development of the Link, intercity train travel across Denmark now has the largest share of travel. Many intercity flights no longer operate because of the efficiency and predictability of the service.

Building the Great Belt Fixed Link remains the largest construction project in the history of the country, and maintenance of a critical piece of infrastructure is a massive undertaking with high stakes. Maintaining bridge safety is complex and ever changing. The owner and operator of the bridge, Sund and Baelt Holding A/S, previously hired mountain climbers to scale the bridge and traverse spans, taking pictures of the structure to identify areas in need of maintenance and service. This was labor intensive and time consuming – the bridge has over 300,000 square meters of concrete that has to be visually inspected every six years – a very difficult and intensive, manual task.

Routine and preventative maintenance can significantly expand the life of the bridge, decrease closure time, and improve safety. Several years ago, the company determined that it needed to improve its predictive maintenance capabilities and explored new technologies to increase the productivity and timeliness of their maintenance assessments.

Sund and Baelt adopted a strategy that used a combination of AI and Internet of Things technologies that make maintenance of the Great Belt Fixed Link significantly safer and more efficient. The firm partnered with IBM to

develop a solution that is now the IBM Maximo for Civil Infrastructure Suite, an infrastructure asset management platform. It uses AI to deploy drones, read photography from the drones, and compare it to both observed data and models of the bridge and tunnel network. When paired with historical models of traffic loads on the Link, Sund and Baelt is better able to predict its maintenance needs, improving longevity and reducing bridge downtime.

These changes also have a profound impact on many of the field-based workers like the machinery and industrial maintenance technicians that manage the Great Link Fixed Link, who now manage drones and models from asset management software rather than manually taking pictures. **These changes are projected to increase the life of the Fixed Link by 100 years, doubling its estimated lifetime, allowing it to reduce over 750,000 tons of carbon emissions through greater longevity**.

CASE STUDY

Enhancing Water System Operations Resiliency

The state of Victoria, Australia is known as the Garden State because of its rainfall and its capital, Melbourne, is known for its extensive greenspace. Greenspace, parks and natural areas, cover 19% of the land area in the city. While the city's greenspace is a significant asset, its management is a challenge – especially as the city is increasingly exposed to extreme weather events from a changing climate. This is especially true for the water and sewer system in Melbourne. For example, in 2018, the city experienced a once-in-a-thousand-year rainfall event – over 50 centimeters of rain fell in just 15 minutes – causing flash flooding and power outages. Similar challenges are expected to increase in frequency over time because of expected sea level rise and resultant storm surges.

Melbourne Water, the city's water utility, manages the network of infrastructure for stormwater management and its maintenance is central to the city's ability to manage the increasing

intensity and frequency of storms. Keeping the network of storm grates clear of debris and open is important to drain water to avoid flooding and damage from storms. The utility adopted an automated monitoring system, based in the cloud and using automated and AI software developed by IBM, to aid in the dispatching of field staff to clear and clean storm grates.

Roles at Melbourne Water doing stormwater management are still deeply focused on field-based work helping to clean, clear, and maintain infrastructure – this remains the core of their job, but the way workers perform this work has changed. New digital skills have enabled workers and the company to be more targeted and focused on directing field workers and resources to the greatest areas of need – meaning that they keep the system up and running more effectively.

In the past, maintenance was performed on a rolling basis and if a blockage happened right after an inspection, there could be significant delays in clearing it. Digital monitoring and service dispatch has helped the city and Melbourne Water adapt to increasingly frequent and intense weather events and mitigate the disruptions that those events will cause to city services – an important step in building a sustainable city.

CASE STUDY

Upskilling to Reduce Waste

Manufacturing waste is a significant and prominent contributor to waste production. If input materials enter a manufacturing facility in poor condition or if there are issues with tooling and production processes, the materials or the output may become waste. Similarly, an input material may arrive in a condition that makes it unfit for use, such as a component that was damaged in shipping. Identifying these defects is often difficult and typically driven by human inspection. New digital strategies are helping to drive better identification of component and

output defects, leading not only to significant waste reduction, but also to better quality outputs.

Ford Motor Company found themselves in this very situation. In 2020, Ford produced over 1.7 million vehicles with dozens of different trims and feature packages. This results in a highly complex set of intermediate parts and final goods, sometimes causing defects that were not visible or noticed by the human eye.

Ford explored digital manufacturing strategies that would help advance quality control and augment human inspection strategies. Because of its longstanding excellence in automobile manufacturing, Ford already had a large frontline workforce that was ready to adopt new digital technologies to improve quality and remove waste. However, the company needed to identify strategies that would be implementable without significant downtime for their workforce.

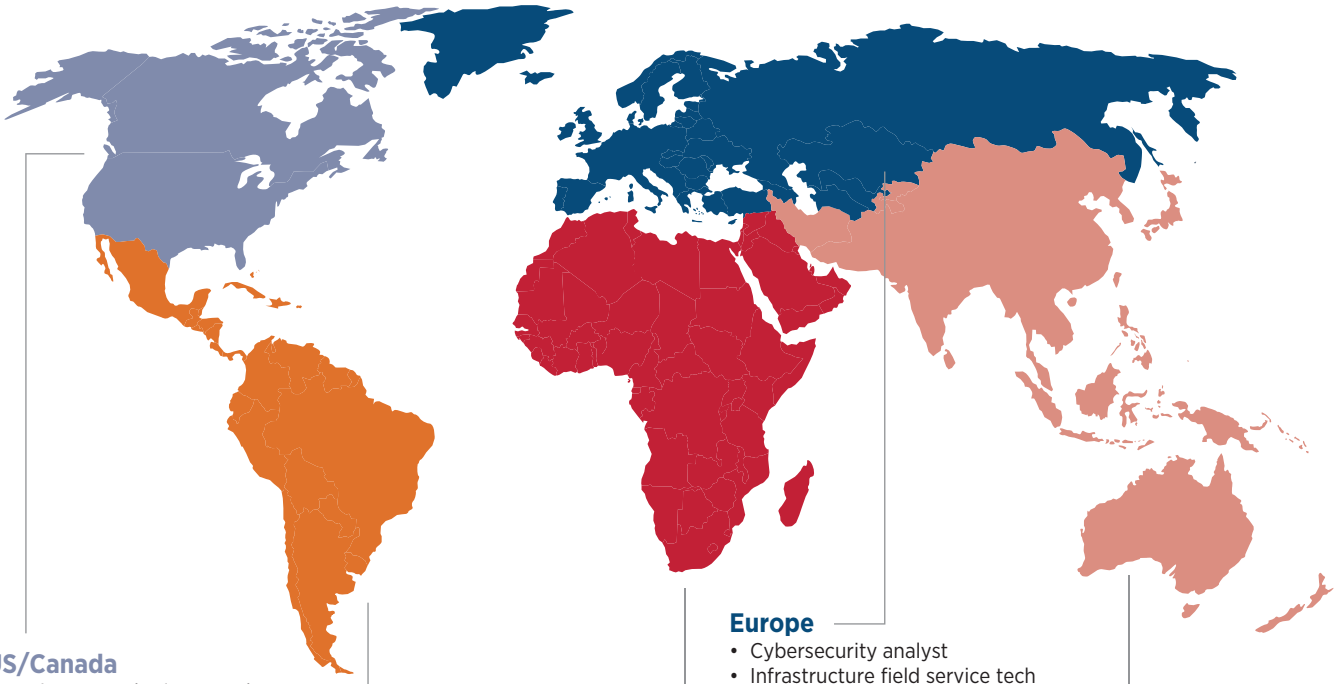
Ford partnered with IBM to develop a mobile-based AI and ML visual inspection software that is used in assembly plants. The software interfaces with a cloud-based centralized data system that trains the algorithm to identify manufacturing defects and imperfections. Over time, the software improves as humans provide more feedback. In addition, Ford ensured that its workforce was upskilled so that it was ready to use the new software on Day 1, enabling workers to better integrate it into existing workflows. While built as a sophisticated AI software application, frontline workers integrated it into the quality assurance and overall assembly process quickly and efficiently. As a result, Ford's production quality, speed, and waste have all been greatly improved. Production quality sped the inspection process and reduced overall waste out of the facility.

The strategy has been successful in identifying defects and reducing potential industrial waste. In addition to reducing waste in combustion engine vehicle manufacturing, in 2022, the IBM mobile visual inspection strategy has expanded its use cases to more complex and innovative use cases including electric vehicle assembly.

Early Career Opportunities for Workers by Global Region

Green and digital roles exist today worldwide. Some roles are broadly available and accessible no matter where a worker is in the world, while others vary by region. Certain skills are critical for competitiveness in the green economy and are often driven by broader skill sets and the global economy in general. BGI analysis identified many roles across the globe that are particularly strong opportunities for early career workers to take an on ramp into green and digital roles.

Refer to Appendix 2 for details.



US/Canada
- Environmental science tech
- Environmental compliance analyst
- Sustainability analyst
- Environmental health and safety
- Infrastructure operator

Europe
- Cybersecurity analyst
- Infrastructure field service tech
- Environmental health and safety specialist
- Infrastructure operator

Latin America
- Infrastructure operator
- Operations analyst
- Cybersecurity analyst
- Green sales representative
- Environmental project manager

Middle East/Africa
- Environmental project analyst
- Environmental health and safety specialist
- Facilities managers
- Engineering technicians

Asia and Pacific
- Sustainability analyst
- Environmental project manager
- Climate/carbon analyst
- Facilities manager
- Cybersecurity analyst

Source: Burning Glass Analysis of Lightcast Job Postings Data

Conclusion: Building Skills in a Digital and Green Future

While digital expertise and green expertise are not one and the same, they are intersectional and at that intersection lies a set of opportunities. These are opportunities for workers, for employers and firms, and for civil society.

Workers can build green digital skills to advance their careers. Workers in the green sector are increasingly adopting digital skills to enhance productivity and efficiency. Workers in the digital realm are seeing a growing demand for green skills to harmonize their work with environmental concerns, align with growing demand for environmentally friendly practices, and help manage finite resources. But these are not the only trends. Sitting at the specialization of digital-green intersections are specialized roles that focus heavily on sustainability concerns from a digital perspective. These emerging roles create new and exciting opportunities and complexity.

Employers and firms are demanding green and digital skills. Our analysis shows that firms are looking for green skills among digital workers and digital skills for green workers. Well-refined digital skills can help firms be good stewards of resources – from energy to natural resources and help them be more effective in their businesses that produce goods that impact the environment. These growing demands are evident across many sectors – they are seen in forestry with the adoption of AI just as they are seen in the technology and finance sector with the adoption of conservation and energy efficiency strategies. These improve sustainability, but also affect the bottom line.

Digital-green workers will drive a sustainable, opportunity rich future. Skilling programs at the intersection of digital and green skills will help drive sustainable and climate resilient outcomes for society. Additionally, by equipping workers in traditionally green roles with advanced digital skills, they will become more productive and effective in their roles. In addition to blended digital and green roles, we continue to see growth in demand for digital skills in green roles.

How can this emerging opportunity be more fully realized? First is building skills that sit at the intersection of digital and green skill demands. Digital strategies and technologies will greatly expand the efficacy of deeply field-based work – as is supported throughout the case studies in this report – from maintaining and extending the life of physical assets to deploying new crop management strategies, digital skills help make those efforts more efficient and help scale the intervention strategies significantly. In many cases they also help lower barriers to entry and make smaller scale enterprises more competitive.

Our analysis identifies gaps in the skills that workers have and the skills that the market is demanding for digital and green work. While there is a current gap, it is surmountable with skill building at scale – often the necessary skills can be learned or taught through flexible and digital venues. Deploying upskilling for in demand digital and green skills can happen through online learning platforms like IBM's SkillsBuild. We encourage workers, educators, and employers to think about the changes in their companies at the intersection of digital and green skills and identify a plan or partner to help advance upskilling. These steps can help to meet the digital and green skills demand we observe.

Finally, while blending digital and green skills will drive innovation in work, there will also be transformation as complex and emergent new combinations of skills drive greener and more sustainable work. These deeply intertwined trends are more than the sum of their parts: new specializations are beginning to emerge between these roles that we previously have not observed. Going forward, we expect they will continue to emerge more significantly and create a digitally-enabled, sustainable future.

Learn More

Do you want to help make a more sustainable world?

Join the Green and Digital Revolution!

Learn skills like artificial intelligence and machine learning, data analysis, data visualization, and automation and learn about how they can drive green jobs and a sustainable future.

IBM SkillsBuild offers courses at the intersection of green and digital skills.

https://skillsbuild.org/

APPENDIX 1:

Skills Analysis

To assess the demand for green skills, Burning Glass Institute collected data on millions of current and past jobholders, and on more than 100,000 job descriptions, across roles in four key areas: AI and ML, cloud computing, cybersecurity, and automation engineering. Within each of these areas, BGI collected information on specific jobs, such as software developers, computer systems engineers, and line managers. In the next decade, these roles will create millions of new jobs, account for trillions of economic activities, and determine the direction of tech hiring.

Although the demand for green skills has been growing overall, a few skills were in higher demand, as the following table shows:

Demand for key skills in crucial roles

Application	Avg. % of JDs Requiring Skill
Energy Efficiency - % of Skill Demanded Across All Roles	
Cloud Computing	30.8%
AI /ML	29.3%
Cyber	30.0%
Automation Engineering	86.9%
Environmental Regulations - % of Skill Demanded Across All Roles	
Cloud Computing	21.9%
AI /ML	13.0%
Cyber	23.2%
Automation Engineering	10.3%
Environmental and Resource Management - % of Skill Demanded Across All Roles	
Cloud Computing	13.4%
AI /ML	16.3%
Cyber	19.6%
Automation Engineering	2.0%
Water Management - % of Skill Demanded Across All Roles	
Cloud Computing	6.3%
AI /ML	13.3%
Cyber	9.1%
Automation Engineering	15.8%

Source: Burning Glass Institute Analysis of Lightcast Job Postings Data

Unsurprisingly, energy efficiency is a key skill for all four subsectors given the energy demands of the tech sector. The need is especially acute for automation engineers, but roughly 30% of cloud, AI, and cyber roles also emphasize energy efficiency. Short-form training programs are especially well-suited to energy efficiency. In the tech sector, data center engineers can be trained in energy-efficient ways to cool data centers and minimize water use. Video instruction can outline best practices about the cost and the environmental implications of better heat dissipation. This aligns private incentives (reducing electricity bills and overheating) with public environmental incentives (reducing emissions related to overuse of electricity).

Environmental regulations, and resource and water management, are emerging skill areas for tech, with 15–20% of job descriptions requiring the skill in some areas. While not as ubiquitous as energy efficiency, these skills will continue to grow in demand over time as additional reporting requirements are put in place (for example, forthcoming SEC regulations on Scope 1–3 emissions). Conversely, skills such as conservation and clean energy are not frequently listed in job descriptions (usually low single-digit percentages). This suggests that background knowledge, while useful for understanding the rationale behind decarbonizing the tech industry, is not as valued by employers, who are much more focused on bottom-line cost and energy issues. To be more relevant and effective, green training should focus on areas that have direct implications on company performance such as energy efficiency and water management.

APPENDIX 2:

Global Skills

The confluence of green and digital skills is a global phenomenon. Yet the trends show the unique contours of different parts of the globe. Exploring these trends regionally helps identify the economic opportunities for workers and learners and prioritize where countries, educational institutions, and employers can make investments in skill building.

To localize the global analysis, we investigated trends in several global markets, with a focus on early career opportunities at the intersection of green and digital skills. We examined the following regions:

- US and Canada
- Europe
- Asia and the Pacific
- Mexico and Latin America
- Africa and the Middle East

There were several important trends that were clear and evident across these global regions. In the US, Canada, Europe, Asia, and the Pacific, many of the greatest opportunities at the confluence of green and digital roles are in the fields of analytics and green business management – deeply digital, green-specialized roles. This concentration of roles suggests that these markets have significant demand for skill development in analytics and visualization. Focusing on early career development in these markets often implies that workers will need to build skills through educational experiences. Some learners may attend college to build the skills necessary to serve in these roles, others may build them through work experience and innovative new learning experiences – but strong foundations in core digital skills like analytics are key.

Other markets like Mexico, Latin America, Africa, and the Middle East see significant opportunities in digitizing skilled technical work in major energy production and major manufacturing plant operations. Developing new skills and competencies across the workforces in these regions should include building skills in automation, particularly to make processes greener and more sustainable at major production facilities and in major infrastructure operations. Automation skills include training and developing AI and machine learning processes to support industrial production, manufacturing, and management of infrastructure.

References

"Building Bridges to Better Insight" IBM. 2021 https://www.ibm.com/case-studies/sund-and-baelt

"Climate Change 2022: Impacts, Adaptation and Vulnerability," Intergovernmental Panel on Climate Change. United Nations, 2022. https://www.ipcc.ch/report/ar6/wg2/

"Explaining Extreme Events from a Climate Perspective," American Meteorological Society, accessed June 6, 2023, https://www.ametsoc.org/index.cfm/ams/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/

"Efforts to Link Climate Change to Severe Weather Gain Ground," American Association for the Advancement of Science, 2016. https://www.science.org/doi/10.1126/science.351.6279.1249#:~:text=To%20make%20the%20link%2C%20researchers,the%20risk%20of%20heat%20waves

"Ford Presents Its Prestigious Innovation Award to IBM" IBM. 2021. https://www.ibm.com/blog/ford-it-innovation-award-ibm/

"Green Jobs: U.S. Bureau of Labor Statistics," accessed June 7, 2023, https://www.bls.gov/green/home.htm

"Green economy," UNEP - UN Environment Programme, October 23, 2018, http://www.unep.org/pt-br/node/23750

"Optimization could cut the carbon footprint of AI training by up to 75%" University of Michigan School of Engineering. 2023. https://news.engin.umich.edu/2023/04/optimization-could-cut-the-carbon-footprint-of-ai-training-by-up-to-75/

"The economic potential of generative AI: The next productivity frontier" McKinsey & Company. 2023. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#introduction

"This Is How Climate Change Could Impact the Global Economy," World Economic Forum, June 28, 2021, https://www.weforum.org/agenda/2021/06/impact-climate-change-global-gdp/

"Towards Zero Waste Manufacturing: A Multidisciplinary Review," Journal of Cleaner Production 168 (December 1, 2017): 1230–43, https://doi.org/10.1016/j.jclepro.2017.09.108

"Uncovering opportunities to reduce energy consumption and emissions with the IBM Envizi ESG Suite," IBM. 2023 https://www.ibm.com/case-studies/melbourne-water-envizi

"Waste Elimination for Manufacturing Sustainability," Procedia Manufacturing, 2nd International Materials, Industrial, and Manufacturing Engineering Conference. February 2015, https://doi.org/10.1016/j.promfg.2015.07.003


THE
burningglass
INSTITUTE


IBM