



WORLD GREEN ECONOMY
ORGANIZATION



World Green Economy Report

Green Jobs: Creating and
Sustaining Prosperity in a
Changing Global Economy



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Sustaining Prosperity in a
Changing Global Economy

Foreword

HE Saeed Mohammed Al Tayer
Chairman, World Green Economy Organization



As the world starts rebuilding from the economic and social damage of the COVID-19 pandemic, an era of transformation dawns for the global economy. If 2020 was the year which compelled humanity to reevaluate the way we live, work and do business, the coming years call on us to rebuild our economies and societies in a sustainable and resilient manner, to build back better.

As the full impact of the COVID-19 pandemic is still unfolding, there is a crucial choice between designing economic recoveries to restart the classical economy or seizing the opportunity to accelerate the transition to a green economy. A green economy approach would be a deliberate choice for a green growth development approach to building back better.

We must ensure we set the world on a path towards the transition to a green economy in order to successfully and sustainably recover from the current crisis. We know that a meaningful recovery of the global economy must keep sustainability at heart. This path to a green recovery will inevitably comprise leveraging available green opportunities while consistently exploring further avenues for cross-sectoral, integrated collaboration. By transforming the economic and business models that our societies are built upon today, we can usher in a new age of a prosperity and resilience while building a future that is clean, healthy, green and climate friendly.

The World Green Economy Organization (WGEO) is committed to a global green economy transition. We believe a key pillar of this transition is the exchange of knowledge, experience, best practices and success stories. This World Green Economy Report strongly supports this tenet by compiling the prevalent policies, practices, and mechanisms that are facilitating the green economy transition around the world while also explicating a clear view of how green investments, access to green capital, and the creation of green jobs are critical to an economic transition which will enable sustainable development today and in the future.

This report, with its focus on creating and sustaining green jobs, will serve as an important reference for local, national, and global organizations from both the public and private sectors to learn from each other and facilitate the broad based adoption of a green economy agenda.

This edition emphasizes the critical role of integrated policymaking and offers an enhanced and holistic understanding of the impact that policy actions can have on the greening of various sectors from both the demand and supply sides.

It makes a strong case for the creation of enabling environments that will support the enhancement of existing and the creation of new green industries that support a climate resilience and green economy strategies. Practical and actionable policies are necessary to create the facilitative ecosystem that will be conducive for green investment, thereby spurring greater engagement in clean technology innovations and generate job opportunities. Not only are these factors important to securing livelihood opportunities, they will also contribute to meeting our sustainable development goals within the coming decade.

Now more than ever, economies need to rethink the manner in which investments are executed and importantly look closely into the social, economic and environmental value of those investments. In fact, the business case for rebuilding better is robust, considering the long-term opportunities for growth and more importantly, considering the recognized challenges associated with business-as-usual.

There are reasons for optimism, given the progress we have witnessed over the last few decades in the areas of green and sustainable development. We have carefully put together the ideas, concepts, and examples of successful projects that can serve as good practice for decision-makers and green economy practitioners across the world. This report is encouraging in terms of the richness of information and knowledge-sharing opportunities contained herein.

We are grateful to our partners, who range from national government representatives, non-governmental organizations, academic institutions, and regional multilateral organizations, who have shared with us their achievements which have contributed to making this report a comprehensive and robust snapshot of the global green economy transition. Their diversity of experience and thought have enriched the development of this report and will make it an invaluable resource to green economy practitioners around the world.

The tools and options presented here have shown results and have effectively addressed social, economic and environmental challenges. We are confident that this second edition of the World Green Economy Report encapsulates the ever-growing potential of the green economy model while contributing to the growing compendium of knowledge on the green economy transition and ultimately facilitate our actions towards setting our lives, economies, communities and societies on the path of greater sustainability as we work towards a more prosperous and resilient future for all.

Foreword

The Centre for Energy Policy,
University of Strathclyde



Today the global economy sits at a crossroads. The Covid-19 pandemic has caused economies around the world to slow down, putting jobs and livelihoods at risk, just at the time all nations need to progress in shifting economies onto transition pathways to low and net zero carbon ambitions. However, transitions must always be resilient to dynamic and evolving circumstances and it is important to recognise that urgency to transition to meet mid-century climate targets in fact creates a vital opportunity for nations and corporations to invest, support and use the green economy as a supportive and forwardlooking path to recovery. The creation of decent green jobs with appropriate conditions and pay, can not only support economic prosperity, but has important implications for the social fabric of nations around the world. Thus, decisions made in the coming months and years about both the priorities for near term recovery and for what type of economies and societies people will prosper and thrive in will be crucial.

At the Centre for Energy Policy our research and policy experience tell us that managing transitions is complex. In the UK, we've seen the social, economic and cultural consequences of shutting many key industries down overnight. While this has helped the UK meet its domestic climate change targets, the reliance on imports and their associated emissions, has only increased. We've learned that understanding the domestic and global consequences of policy actions is key to both delivering local economic prosperity and global emissions reduction targets.

The need to understand and effect the consequences of actions is a central theme running through this report. We argue that the transition to a green economy is not a challenge limited to divisions of Government in charge of energy or trade. It is a whole society challenge that requires an integrated and cooperative approach between all areas of policy and political institutions, regulatory bodies, industry and civil society. This is particularly crucial if a Just Transition that secures social and economic equity is to be delivered.

For sectors and countries that heavily rely on fossil fuel based industries, the need to plan and manage an equitable and effective transition to a green economy, one that capitalises on existing skills and expertise of workforces, will require a particularly joined up approach.

The world is ever more connected, with complex global supply chains and trade partnerships constantly evolving in the context of increasing digitalisation and technological change. As highlighted throughout our report, it is important to understand the full environmental impact and contribution of all sectors, and to identify potential new interdependencies. For example, the growth in the renewable energy sector, expected to create many new green jobs, will be heavily dependent on the extractive industries to provide required component parts such as copper and to pass on valuable capacity and infrastructure. As the global economy transitions it is crucial that environmental, employment and emissions standards are raised across all sectors and supply chains in an internationally consistent manner. This is necessary to ensure development of a truly green global economy that protects workers, meets UN Sustainable Development Goals and puts the world on a 1.5OC pathway where no nations or populations are left behind.

We hope this report effectively summarizes the challenges and opportunities available to both developed and developing countries and can be used as a tool for decision makers in public and private sector to plan, manage and make best use of the opportunities arising. As all areas of our economies work to reduce emissions and increase resource efficiency to meet climate targets, genuine green jobs can be the backbone of transitioning global economy.

Professor Karen Turner

Director of the Centre for Energy Policy at the University of Strathclyde



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Executive Summary

This year's WGEO annual report builds on its predecessor, entitled "Inspiring Innovations in Business, Finance and Policy", to focus specifically on the challenges faced by countries adopting sustainable green economy approaches, involving often complex collaborations and interactions across and between different economic sectors and actors. The primary objective of this report, published during a time of great upheaval in how people live and work in our global economy, is to understand and promote the increasing importance of green jobs in underpinning sustainable development and social wellbeing. In doing so, it emphasises linkages between innovative thinking, financing, technology, capacity building, and all other elements of the enabling environment for the green economy.

The motivation for publishing this report is to serve as a primary catalyst for knowledge-sharing between state and non-state actors in developed and developing countries, spanning the public and private sector, international organizations and think tanks, and all other key stakeholders. The broader aim is to promote the implementation of green job policies at all levels within and across nations, in a manner that endeavours to drive sustained, inclusive, and equitable job opportunity creation. The target audience includes policymakers, decisionmakers in public and private sectors, civil society actors, and other interested & relevant stakeholder groups. Amidst the global focus on mitigating anthropogenic climate change, the need to recover from the economic slump caused by the COVID-19 pandemic has taken primacy. This constitutes an important turning point for considering how economies around the world respond to both challenges. Therefore, a consistent theme throughout this report is the substantial potential value in planning and using the transition to a sustainable green economy to create green jobs and drive economic recovery.

Whatever the current context, however, the crucial conclusion emphasised throughout this report is that green jobs constitute a fundamental pillar in developing and deploying solutions to climate change and environmental degradation. In addition to ensuring that the most valuable element of the productive capacity of all economies is dedicated to lowering greenhouse gas emissions and improving the natural environment, when effectively developed green jobs contribute to improved social wellbeing by creating decent work opportunities. Both of these needs are comprehensively

reflected in the United Nation's Sustainable Development Goals (SDGs), which have been designed to be mutually inclusive and completely exhaustive. Indeed, the concept of green jobs ties into all 17 SDG's, by promoting environmental, economic, and social wellbeing.

This report also emphasises the concept and principles of a Just Transition, which were originally set out by the International Labour Organisation in 2015. It identifies the need to implement a Just Transition framework, both in creating green jobs genuinely and consistently for all economic sectors, including low-carbon sectors, while securing a fair treatment of existing jobs, and, ensuring their evolution as industrial activities change and business processes develop in ways that combine resource efficiency and emissions reductions. Fundamental to this is the imperative of determining that green jobs created in different sectors and nations are truly green, which requires that the entire value chain exhibit a small carbon footprint.

A key conclusion emerging is that the availability of skilled labour is a fundamental requisite for the transition towards low-carbon, green, and sustainable economies. An effective transition depends heavily upon shifting skillsets to meet the requirements of changing production and consumption patterns. This can be achieved through a combination of upskilling existing skills and job profiles and introducing entirely new jobs, and supporting existing and new workforce participants in qualifying to perform them. In either case, investments in education and training programs will be needed to build capacity. While structural changes in the economy will decrease demand for certain occupations, many existing skills are transferable to the needs of other sectors, enabling particularly older workers in declining occupations to transition to new ones. However, this requires appropriate support structures. This report concludes that, in addition to contributing to the development of a skilled workforce to meet the future needs for a greener economy, an effective approach to green jobs will also promote changes in consumption behaviour and stimulate market forces to adopt green or low-carbon pathways.

The report explores how legislation regarding developing renewable energy and energy efficiency programs has enabled the creation of new enterprises, many of which involve existing energy supply actors undergoing transition. Particularly where existing

capacity and expertise can be exploited, the interdependencies between sectors and markets can result in job creation / replacement in the manufacturing sector, indirect supply chains (i.e., metals), and the services sector; all three of these play a crucial role in developing the green economy and creating green jobs.

A crucial insight emerging is that the approach to framing the green transition narrative largely depends upon the stakeholders, and whether the framing is group- or constituency-focused (particularly groups such as low carbon industries), or based on sector-specific approaches. By setting appropriate environmental standards and regulations, public policy and governance plays a key role in enabling and stimulating the development of new markets. Influencing, incentivising, and supporting consumer choice and demand for higher environmental protection can further create an enabling landscape for a shift in the nature and type of economic transitions underpinning how people live and do business. A key implication is that local, regional, national, and supranational government bodies need to actively engage with private and third-party actors to design policy frameworks. Such frameworks should forge consensus to create or develop mechanisms and structures at all levels, where these are required to set and meet national economic and environmental goals while delivering decent jobs. Green jobs can create decent living and work opportunities that contribute to the wellbeing of people, in turn raising the economic competitiveness of society. Creating productive and

skilled human resource capital helps society generate sustained wealth by building a progressive low-carbon economy, whilst protecting ecological resources. Context is crucial however, and the report summarizes the challenges and opportunities available to both developed and developing countries to facilitate the adoption of green jobs and boost economic performance. Crucially, in many national contexts, policy instruments aimed at promoting green employment are integrating with environmental or lowcarbon policies. This is simultaneously a positive and negative development. The integration underscores the importance of creating green employment and it can become a dependent outcome of low-carbon policies. Indeed, green employment is not limited to low-carbon industries: extractive industries have high potential for greening their operations by implementing efficient and innovative technologies, thus creating green jobs. Green employment as a policy instrument can have a wider impact across sectors, regions, and countries. However, transitioning to a green economy almost inevitably leads to temporary job destruction until labour skills fully transfer from the existing “brown” to “green” sectors. This is not a straightforward process, given that incomes will be lost (even if only temporarily) and ramifications felt for a long time in many communities. Ideally, a brown job loss should come with opportunities to transition towards a decent job with higher long-term economic value. Crucial to ensuring that broad societal consensus builds around transitions is the need to ensure public participation through social dialogue, as this serves as an essential platform for determining the balance between environmental considerations, equity, and economic needs in developing national policies to support the green transition.



Generally, a core conclusion of this report is that, with effective planning and policy strategy, green jobs can create decent living and work opportunities that contribute to the wellbeing of people, in turn raising the productivity and prosperity of future green economies. The report makes a number of recommendations in this regard:

- Delivering a Just Transition is key, with a focus on evolution rather than revolution in how people live, work, and do business. This requires a support structure, including financial incentives, to cushion income losses and help orient existing skills with necessary green skills, along with a focus on building on the existing skills, capacity, and infrastructure strengths of a country's existing industrial landscape.
- Environmental, economic, and decent work objectives must be integrated, with a whole economy perspective on green job creation. This requires the development of effective and efficient regulatory frameworks, and the active engagement of local, regional, national and supranational government bodies with private and third-party actors to design policy frameworks and forge consensus on how national economic and environmental goals can be met while delivering decent jobs.
- Skills transfer and capacity building must be effectively enabled through the development of coordinating bodies with prime responsibility in anticipating the skills required for developing new green economic activities – especially in developing countries – with cooperation and coordination between political actors, institutions, industries, employees, and educational institutions. Encouraging short- and long-term technology transfer between nations and sectors is a crucial component of this capacity building.
- Stable supporting policy and regulatory environments must develop in ways that increase business and investor confidence in the transition. This is likely to need greater coherence and multisectoral engagement in a wider public policy framework, if confidence is to build such that businesses will invest in creating green jobs.
- Data on green jobs must improve - both to inform those challenged with creating them and to ensure progress can be assessed effectively and without misleading losses or transfers. Central to this may be the development and global adoption of a standard methodology to assess green jobs.
- Finally, if green economies and green jobs therein are to be sustainable, it is essential to increase consumer demand for low-carbon products and practice. This will require policy action to influence, incentivise, and support consumer choice and demand for higher environmental protection, while supporting the emergence of international markets for green goods and services.

Key Messages

- A central challenge is to identify, create, and sustain opportunities for green economic activity and job creation in delivering net-zero emissions. It is imperative to understand the complete environmental contribution of all sectors and potential new interdependencies.
- Effective planning for a transition and, where possible, evolution rather than revolution in how people live, work, and do business, is essential. This is especially true considering the context of the global recovery from the COVID-19 crisis, during which many industries, workers and households around the world have suffered severe hardships. During this transition phase, a support structure, such as financial incentives, can cushion income losses and help orient existing skills with necessary green skills.
- Policymakers should consider the extent to which evolutionary transitions can be supported and incentivised, both to build on the existing strengths of a country's industrial landscape, and to ensure green development constitutes a genuine component of the post-COVID recovery process.
- There is a need for policymakers and industries to explore, identify, and leverage transferable skills, capacity, and infrastructure that exist in brown sectors, which can play a role in effectively developing the green sector. There is potential for either a transitional or sustained role for a wider portfolio of activity across a range of existing and new areas.
- A regulatory framework that will enable effective and efficient integration of decent work with environmental and economic objectives is essential for countries to meet both the UN's Sustainable Development Goals and emissions reduction targets aligned with limiting the global temperature increase to 1.5°C.
- Local, regional, national, and supranational government bodies need to actively engage with private and third-party actors to design policy frameworks that support forging of consensus to develop mechanisms to meet national economic and environmental goals while delivering decent jobs. Action is also required to encourage short- and long-term technology transfer between nations and sectors.
- In the context of evolving industries, social dialogue between local authorities, trade unions, and educational institutions (research & training) regarding forecast skill needs / gaps, & employment challenges will help with the implementation of regulatory measures and monitoring policies.
- There is an urgent need for the development of coordinating bodies with prime responsibility in anticipating the skills required for developing new green economic activities. This need is particularly acute in developing countries.
- There is a need for stable supporting policy and regulatory environments that enable companies and investors to have confidence in the green transition. Separate accounting metrics or indicators to show green job employment levels is a key support mechanism in helping societies transition more smoothly to green economies.
- Policy makers should work to influence, incentivise, and support consumer choice and demand for goods and services that embody higher environmental protection. This can further create an enabling landscape for a shift in the nature and type of economic transitions underpinning how people live and do business. There is a need to create social awareness on promoting the adoption of green or recycled products.

Table of Contents

1. Introduction	11
1.1 Role of Institutions - Policies & Initiatives	21
1.2 Measuring the Impacts of Adopting a Green Strategy	24
1.3 Skills, Research & Development, & Technology & Knowledge Transfer	28
1.4 Societal Impact	30
1.5 International Cooperation	32
1.6 Investment in Human Capital	33
2. Current Employment Trends	37
2.1 Primary	40
2.1.1 Agriculture	40
2.1.2 Extractive Industries	41
2.2 Secondary	44
2.2.1 Construction & Infrastructure	44
2.2.2 Water & Waste	46
2.2.3 Industries & Manufacturing	47
2.2.4 Bioeconomy	48
2.3 Tertiary	52
2.3.1 Transport	52
2.3.2 Finance & Banking	53
2.4 Quaternary	54
2.4.1 Information Technology	54
2.4.2 Green Research & Development	54
2.4.3 Education, Training, & Continuous Learning	55
3. Impact of Investment in Renewable Energy on Green Jobs	59
3.1 The Role of Renewable Energy in Supporting the Economic Development of Nations	60
3.2 Role of Policies	61
3.3 Current Trends	64

4. Employment Potential through Adoption of Low-carbon Energy Solutions	69
4.1 The Role of Policies in a Just Transition Context	70
4.2 The Green Economy in a Just Transition Landscape	71
4.3 Current Trends	72
5. Challenges	76
5.1 Genuine Green Jobs Growth	77
5.2 Measurement & Reporting of Green Jobs	78
5.3 Local Content Development	79
5.4 Reskilling / Training & Development	79
5.5 Investments	80
5.6 Social Change & Cultural Acceptance	81
5.7 Technology Transfer	81
6. Towards a Cohesive Future	82
6.1 Economic Gain from GreenJobs	83
6.2 Green Investment Trends	88
6.3 Evolving Consumption Patterns	91
7. Outlook for Green Jobs	92
7.1 The Need for Strong Institutional Foundations to Realise Future Potential	93
7.2 Skill Transfer from Brown Sector to Green Sector	93
7.3 Socioeconomic Trends	94
8. An Overview of the Effects of COVID-19 on Economies	98
8.1 Key drivers of COVID-19 Recessions	99
8.2 COVID-19's Impact on Green Jobs	102
8.3 Opportunities	103
9. Conclusions	104
10. Recommendations	105
11. References	107

1. Introduction

This year's WGEO annual report is a step forward from the previous edition entitled "Inspiring Innovations in Business, Finance and Policy", focusing specifically on the challenges faced by countries adopting sustainable green economy approaches, involving often complex collaborations and interactions across and between different economic sectors and actors. For each country and economic sector, there exist a variety of options for sustainable development (primarily energy conservation and greenhouse gas emissions reduction), such as renewable energy, alternative energy, carbon capture and storage, green building innovations, smart cities, and sustainable transport. Further, the interconnectivity between sectors and countries means that governments and policymakers must work together to identify and adopt optimal approaches for evolving a green economy: one that delivers both sustainability and prosperity through the growth of green industry and creation of green jobs. The primary objective of this 2020 report, published during a time of great upheaval in how people live and work in our global economy, is to understand and promote the increasing importance of green jobs in underpinning sustainable development and social wellbeing. In doing so, it emphasises linkages between innovative thinking, financing, technology, capacity building, and all other elements of the enabling environment for the green economy.

This report was published to serve as a primary catalyst for knowledge-sharing between state and non-state actors in developed and developing countries - spanning the public and private sector, international organizations and think tanks, and all other key stakeholders. Increasingly, proactive approaches to foster international cooperation to promote technology transfer and developing environmentally-sustainable practices within existing industries are required. The broader aim is to promote the implementation of green job policies at all levels within and across nations, in a manner that endeavours to drive sustained, inclusive, and equitable job opportunity creation. The target audience for this report includes policymakers, decisionmakers in public and private sectors, civil society actors, and other interested and relevant stakeholder groups.

This report gives an overview of the status quo and existing practices regarding green jobs across economic sectors, and proposes practical approaches to promote a comprehensive, cohesive, and coordinated approach at national and global levels.

There is a need to consider the extent to which evolutionary transitions can be supported and incentivised to build on the existing strengths of a country's industrial landscape. In many contexts, the answer to this may be a "green evolution", rather than a "green revolution". A critical factor in this decision is equitable handling of existing jobs. The report identifies the need for creating green jobs genuinely and consistently for all economic sectors, including low-carbon sectors, by implementing a Just Transition of existing jobs and work. This approach has the benefit of treating existing jobs fairly whilst combining resource efficiency and emissions reductions in business processes. Fundamental to this, it is imperative to determine if the sectors selected for creating green jobs are truly green, i.e. if their entire value chain exhibits a small carbon footprint.

A key conclusion emerging is that the availability of skilled labour is a fundamental requisite for the transition towards low-carbon, green, and sustainable economies.

An effective transition depends heavily upon shifting skillsets to meet the requirements of changing production and consumption patterns. This can be achieved through a combination of upskilling existing skills and job profiles and introducing entirely new jobs and supporting existing and new workforce participants in qualifying to perform them. In either case, investments in education and training programs will be needed to build capacity. While structural changes in the economy will decrease demand for certain occupations, many existing skills are transferable to the needs of other sectors, enabling particularly older workers in declining occupations to transition to new ones, but this requires appropriate support structures. Action is required to ensure that this is the case, with focus on the need to sustain and/or create decent jobs while tackling climate change challenges.

This report further captures some of the challenges and opportunities created by the COVID-19 pandemic, which has severely shocked the global economy and heavily disrupted cross-border trade, supply chains, investment, and tourism. The subsequent recession is unlike that of any pandemics in the past, because today's world is much more interconnected, allowing impacts to propagate globally. In addition, the impact of the pandemic has been exacerbated by the fact that many countries were already focused on mitigating and adapting to climate change, resulting in a disproportionate impact on the new and immature green jobs. Policymakers have found themselves grappling with the disruption caused by COVID-19, the effects of which are still unfolding. With no reference point to understand the grim reality and future COVID-19-related uncertainties and its long-term impact on the society and economy, policymakers are facing unprecedented macroeconomic challenges. In the context of the pandemic, social dialogue between industry and the public to foster the adoption of environmental and climate change initiatives is crucial to successfully revive the economy and implement green economic policies that foster environmentally sustainable economic growth and promote green jobs.



What are Green Jobs?

In its 2018 report entitled “Greening with Jobs”, the International Labour Organisation (ILO) adopted the United Nations Environmental Programme (UNEP, 2008) definition of green jobs as those that: “reduce the consumption of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect and restore ecosystems and enable enterprises and communities to adapt to climate change. In addition, green jobs have to be decent”. The latter element relates to the need to provide healthy, safe, and dignified working conditions.

This definition broadly covers all economic sectors, from traditional manufacturing to the emerging efficient green sectors. The ILOs (2018) Venn diagram, recreated in Figure 1, illustrates this definition in reflecting the required interface that green jobs, created in all economic sectors, must be both “decent” and related to the provision of environmentally-friendly processes and / or green products and services.

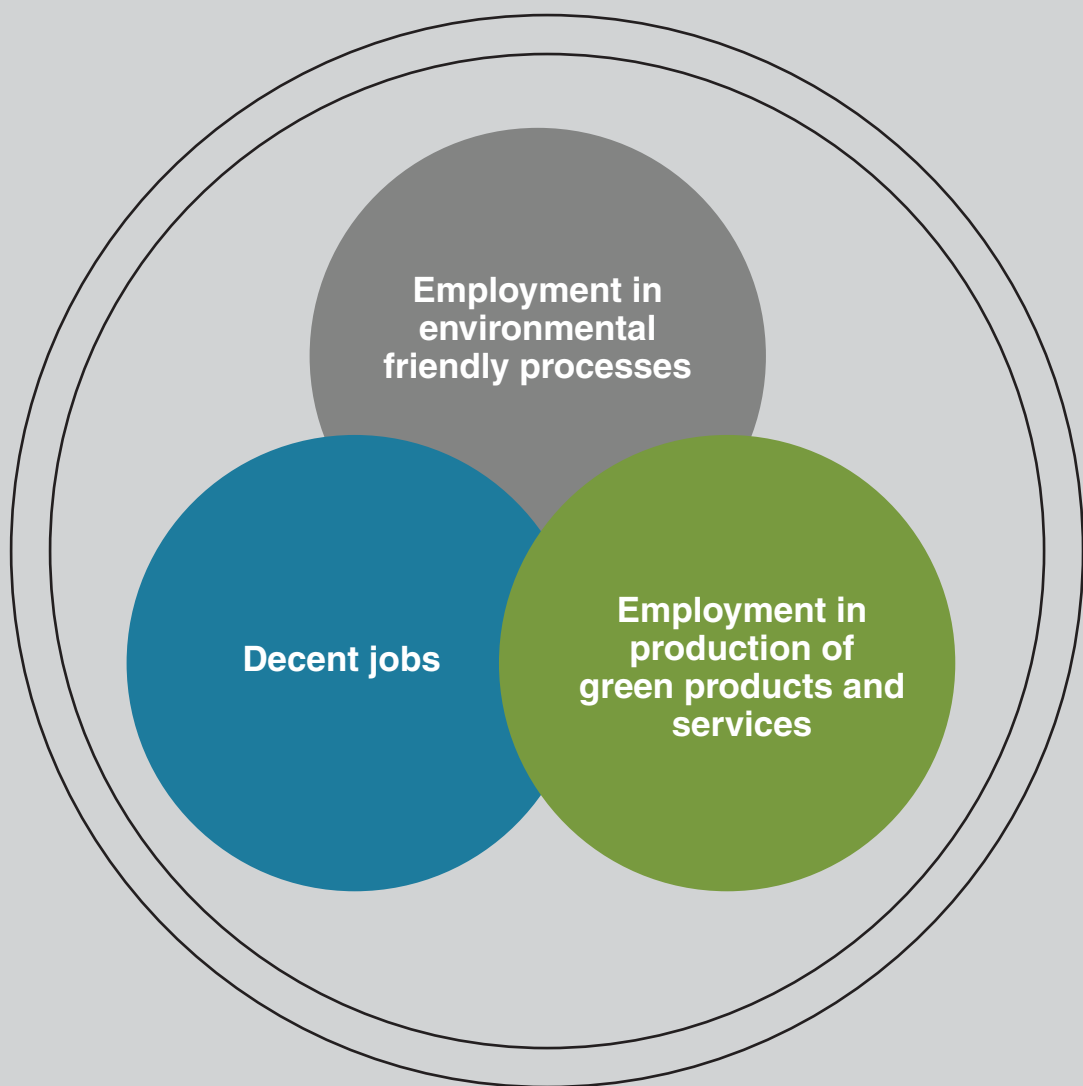


Figure 1 – Total employment Venn diagram. Source: ILO, (2018)

The Approach Adopted in the Report

While this report focuses on the ILO definition of Green Jobs, we note that this is not the only definition, and that individual nations may draw on more than one definition in an attempt to provide concise and meaningful definitions that reflect national policy needs and concerns. This brings challenges in terms of consistency, not the least of which is global assessment, given that the statistics used for quantifying and defining green jobs in different contexts will not always be comparable. Examples of some official definitions of green jobs are given in Table 1, noting that where these lack in clarity and consistency, this is perhaps reflective of the need for greater shared understanding and promotion of the increasing importance of green jobs.

Bangladesh (2008)	Green jobs refers to the direct employment which reduces environmental impact ultimately to the levels that are sustainable. This includes jobs that help to reduce the consumption of energy and raw materials, decarbonize the economy, protect and restore ecosystems and biodiversity, and minimize the production of waste and pollution.
Australia & New Zealand (2009), Taxonomy of occupations	Green collar workers consists of the following: 1) Managers, professionals and technicians who work in green organizations or who have green skills and responsibilities within other organizations that may not be considered as green, and 2) Services, clerical, sales and semiskilled workers who work in green organizations.
Bureau of Labour Statistics, US Department of Labour (2010)	Jobs that produce goods or provide services that benefit the environment or conserve natural resources; more environmentally friendly production; use fewer natural resources.
New Zealand (2010), occupation classification	Green jobs are jobs that produce goods or provide services that benefit the environment or conserve natural resources through the use of sustainable, environmentally friendly, processes and technologies.
OECD (2011) EUROSTAT (2009)	Activities which produce goods and services to measure, prevent, limit, minimize and correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources.
The Netherlands (2011)	Green jobs measure the employment in companies and institutions that produce goods and services that measure, prevent, limit, minimise or correct environmental damage, resource depletion and resource deterioration.
European Union (2012)	Jobs in environmental field or requiring environment-related skills.

Table 1 - Defining green jobs. Source: Department of Statistics, International Labour Office (Stoevska & Hunter, 2012) and ILO (2017)

This report focuses on the fundamental issue that, to analyse green jobs, it is necessary to expand on the potential employment opportunities that can be created through investing in sustainable practices. It is also necessary to assess the direct (investing in sustainable business practices), indirect (supply chain impacts), and induced (increased consumer spending) job opportunities created through adopting different policy choices by a country at the national or regional level. The ILO (2012) sets out methodologies for assessing green jobs and expands on the importance of accounting for both gross and net employment effects to measure the potential for further job opportunities to be generated subsequent to the initial creation of a range of directly-defined green jobs. This report adopts the ILO definition of green jobs.

Impact of Green Policies – the Need to Identify Economic and Transition Opportunities

During any national or global economic change or disturbance, be it the need to transition to meet deep emissions reductions by the middle of the century, or widespread recession triggered by events such as the 2009 financial crisis or current Covid-19 pandemic, the economic loss of the most tangible and immediate concern to populations is from job losses. National and regional governments generally focus on designing stimulus packages to revive the economy, often with green concerns deprioritised as a policy concern due to a perceived lack of public interest and/or political feasibility. However, certainly in the current context of recovery from the Covid-19 slump, there have been increased levels of media and policy discussion over whether green actions can play a role in simultaneously stimulating recovery and setting resilient and sustainable foundations for the transition to mid-century low- and net zero-carbon targets. That is, understanding that, if stimulus packages are channelled to developing and encouraging greening the economy, there is crucial potential to help transition to a green economy model more quickly, while reviving the economy, enhancing income generation, and creating new - and / or evolving existing - jobs.

Research communities have responded with analyses that show green actions can indeed deliver the types of short-term employment, real income and GDP improvements that are crucial for near-term economic recovery from the pandemic, while also developing essential foundations for a sustainable and prosperous transition characterised by deep emissions reductions (Barbier, 2020; Battersby et al., 2020; Turner et al., 2020). For example, Turner et al. (2020) show how a combination of public and private sector actions to boost residential energy efficiency, infrastructure development to enable the transition to electric vehicles (EVs), and carbon capture and storage (CCS) in the UK can trigger job creation, GDP expansion, and income generation - both in the near-term and throughout the transition timeframe.

More generally, as set out in the first WGEO report, effective action to green economies enhances the ability to manage natural resources more sustainably and productively, & to reduce the energy consumption and waste associated with maintaining and growing economic activity levels across and within economies (Bent, 2018). There is increased understanding

among policymakers, the public, & business communities that the notion of having to accept an “economy-environment trade-off” is outdated. Increasingly, proactive approaches to developing environmentally sustainable practices within existing industries are understood to promote competition and encourage innovative practices that enable the adoption of low-carbon, sustainable production, and consumption patterns, whilst creating jobs and tackling climate change challenges.

If planned & designed effectively, developing sustainable practices can become embedded as part of the efficient operation of homes, businesses, and the wider economy, delivering economic returns through both initial investment activity and ongoing resource savings that can further drive new investment, business, trade, and employment opportunities. On the other hand, changes in how economies function will involve trade-offs, potentially involving some negative impacts, and generally with implications for how costs and benefits are distributed. This is why effective planning for a transition and, where possible, evolution rather than revolution in how people live, work, and do business is essential.



Evolutionary Approach in Creating Green Jobs

Successfully transitioning from traditional emissions-intensive industries or energy-intensive sectors (brown sectors) to a lowcarbon economy (green sector) crucially requires a skilled and available workforce (i.e. the citizens and migrants who provide a nation's human capital). Green jobs require the skills to adapt and transfer from the brown to the green sector. The qualifications and skills required to develop green jobs will affect the nature and levels of labour supply and demand. On the one hand, major economic structural change such as that required for the low-carbon transition may be viewed as increasing the demand for output and employment in one sector while destroying jobs in others. On the other hand, if economies are to transition in ways that fully exploit existing capacity and infrastructure, it is important to consider the benefits of transitioning capacity and workforces - and the job / career opportunities of the future - through the evolution rather than revolution of industrial landscapes.

Generally, there is a need for policymakers and industries to explore, identify and leverage transferable skills, capacity and infrastructure that exist in brown sectors, and which can play a role in effectively developing required green sector, potentially with a transitional or sustainable role for a wider portfolio of activity across a

range of existing and new areas. For example, a key transitional path for countries that have invested in and exploited offshore oil and gas resources may be via the marine energy sector. If firms are incentivised to apply their capacity in developing activity in a green sector that involves power generation in offshore renewable wind farms and / or carbon management through CCS that exploits the geological storage capacity, oil and gas workers can use their existing skills with minor adjustments (upskilling / reskilling) in that context (Turner et al., 2019). Such developments will, in turn, provide opportunities to both repurpose rather than decommission current productive assets, and continue to exploit and further evolve the value and jobs sustained in the extensive supply chains that have built up over decades in supporting the brown industries away from which economies must begin to transition.

Potential for Misrepresentation in the Rapid Creation of Green Jobs by Industries

One of the challenges in accounting for green jobs at the sectoral or national level is insufficient data and different methodologies employed in accounting for genuinely green jobs (Phillips & Harsdorff, 2013). Estimating the potential employment created by implementing green policy or through sustainable economic investment should consider the effects of employment – both direct within evolving industries, and indirect within supply chains. The jobs supported through the activity induced by workers and household earnings and consumption within and across economies should also be considered.

On the one hand, in estimating the complete effect, the statistical methods for accounting for jobs is important. For example, adoption of the survey and inventory methodology at the sectoral level will report only the

direct jobs. This method will not account for indirect and induced employment effects, where multiplier analyses based on interrogation of supply chain activity, often drawing on the input-output accounts many countries adopt under the UN System of National Accounts (SNA) (UNSTATS, 2020), is required. On the other hand, it is necessary to ensure that any accounting accurately identifies real and sustainable green employment within regions and nations, particularly where supply chain evolution is likely to involve a mix of transitory and imported activity.

This latter point is important. There is a need to assess the actual new (additional) green jobs created, and calculating / reporting total or employment impacts will either not account for or potentially mask gross job losses or transfers due to the transition. Accounts of net employment data derived from considering gross new green jobs minus any job losses / transfers in shifting from brown to green jobs are required to measure the real nature of evolution in green job creation. Given the potential for misreporting by and/or a lack of consistency in accounting and reporting within and across sectors or countries, a standard methodology to assess green jobs needs to be developed and adopted by all nations.

It is also important to reinforce the need for green jobs to be decent jobs, which the ILO defines as providing productive working conditions for employees in a way that ensures safety and equal opportunities.

This more qualitative dimension of green jobs is less explored and often unaccounted for. For example, the practice of ship demolition and recycling could be classed as a source of green jobs. However, there are concerns that some jobs created may be dangerous and underpaid (although this is disputed by others - “GMS responds to BBC report on ship recycling” in Global Recycler, 2020). Ensuring that this is not the case is crucially important in considering the nature of transitions, in which good practices should be maintained, with the requirement to put in place plans and design actions to improve those that are poor & unfair.

However, challenges such as a frequent lack of disaggregated or sectorally-detailed labour market information, alongside issues in classifying new and transitory industries (the Standard Industrial Classification generally used in national and international accounting practices must evolve with the industrial activities it helps report), skills, and occupations can hinder countries’ assessment of the full potential of green strategies. Thus, again, there is a need for the development of new and / or evolving common frameworks that should be adopted to standardise accounting processes in the context of green jobs.

As an illustrative example of this issue, we highlight two initiatives from South Korea and Spain, detailed in Table 2 and Table 3. In 2009, the Republic of Korea announced its “Green New Deal”. Under this initiative, South Korea had planned to invest heavily in energy conservation, recycling, clean energy development, green transportation and infrastructure, clean water supply, and technology development. National input-output tables were used to calculate the number of direct, indirect, and induced jobs likely to be created. In the same year, under the Green Jobs initiative, the Spanish government estimated the number of green jobs to be 530,947 - equivalent to 2.6% of Spain’s working population. The Spanish government followed a different approach than South Korea, with the assessment conducted using a combination of interviews and surveys to estimate the total number of jobs. However, this only accounted for direct green jobs (i.e. the estimate did not account for indirect and induced jobs).

Sector	Jobs (estimated)
Waste treatment and management	140,343
Renewable energy	109,368
Wastewater treatment, purification	58,264
Public sector	53,072
Organic agriculture, stock breeding	49,867
Forest management	32,400
Environmental services to businesses	26,354
Environmental R&D	21,929
Industry and services	20,004
Green spaces management	10,935
Environmental Education	7,871
Services	540
Total	530,947

Table 2 – Spain’s Green Jobs initiative. Source: ILO (2011).

Sector	Jobs (estimated)
Other related projects	257,100
Eco-friendly transportation networks	200,000
Environmentally-friendly living spaces	170,700
National green information infrastructure	138,100
Energy conservation	133,600
Forest restoration	16,200
Green cars and clean energy	16,100
Recycling resources	14,300
Revitalization of 4 major rivers	10,800
Water resource facilities and management	3,100
Total	960,000

Table 3 - South Korea’s Green New Deal initiative. Source: ILO (2011)

Setting Green Jobs in a Circular Economy Context

Defining and accounting for green jobs is one challenge, but ensuring their growth and sustainability requires that consideration of jobs and related income generation is set in the context of how the green economy functions. The concept of green economy initially emerged as a complementary concept to environmental sustainability: that is, mitigating the effects of climate change whilst achieving economic development. Whatever the specific nature of the industrial evolution in a country, a prerequisite for greening the economy involves reducing dependency on natural resources, with a key element of this being the adoption of practices that support more efficient use of scarce and valuable resources. In this regard, the principles underlying the notion of a circular economy (OECD, 2017a) are integral in achieving the objectives of a green economy. However it is labelled or defined, the basic characteristic of circular economy understanding is to reduce behaviour or processes that involve “take, make, use, throw away” with a focus on more efficient use of resources, and particularly strong emphasis on recycling and reuse. Another key issue is the need to consider the full footprint impact of consumption; for a specific nation and / or region therein, this inevitably involves imported as well as domestically produced goods and services.

Apart from reducing environmental footprints, a circular economy perspective brings focus on the need to boost economic output through efficiency reuse of critical raw materials, with the processes involved in systematic reuse and recycling involving the creation of both high- and low-skilled jobs. Moreover, it requires ensuring the efficient and equitable distribution of jobs and activity, particularly across those regions where the current industrial base makes the transition most disruptive.

Several developed and developing economies are supporting the transition to a circular economy approach on the basis of anticipated net economic benefits. For example, analysis by the EU commission (European Commission, 2015) has suggested that a circular economy can help EU businesses save 600 billion euros - equivalent to 8% of their annual turnover - create 580,000 jobs, and reduce EU CO₂ emissions by 450 million tonnes by 2030. A circular economy utilizes a variety of labour skills, from low-skilled jobs (for reuse and recycle), to mid-level skilled jobs (remanufacturing, biorefining), and higher professional and technical skills (e.g. increase servitisation, involving the development of systems that increase the effective use of assets, and / or shifting to biorefining at scale) (Green Alliance, 2015).





1.1 Role of Institutions - Policies and Initiatives

If green economies are to emerge, there is a need for an institutional environment that enables a coherent approach to transitioning current societies / economies to those that are sustainable in a low-carbon and resource-efficient world. This requires developing an enabling environment for:-enterprises through which economic benefits emerge, to support the education, training, and skill transfer requirements for employee, and ensuring the decent work, social justice, and reduced emissions necessary for social wellbeing and regional equality.

Crucially, if the required investments are to be forthcoming, credible and sustainable policy commitment to the environment, social, employment, and wider economic conditions constituting a green economy landscape, coupled with an effective and stable governance framework, must be in place. Similarly, this is required if citizens and consumers are to be empowered and incentivised to commit to reducing waste and the emissions they directly generate in how they live their lives.

Enterprises also benefit from a stable natural environment, with the implication that transitioning to become green and sustainable makes particular business sense in national and regional settings where there is strong reliance on exploiting natural resources (extractive industries). The slow change in consumer perceptions and preferences in favour of green and low-carbon options for delivering their heat and transport needs, and in responding to the branding of a range of goods and services, has incentivised voluntary and foresighted action taken by enterprises in setting foundations for the evolution of how business is done and what is produced. This has further impacted value chains, which has, in turn, contributed to the ability of some nations to continue to improve labour productivity while decoupling economic growth and emissions. However, these developments require complementary market developments in the regulatory landscape.

By setting appropriate environmental standards and regulations, public policy and governance plays a key role in enabling and stimulating the development of new markets. Influencing, incentivising, and supporting consumer choice and demand for higher environmental protection can further create an enabling landscape for a shift in the nature and type of economic transitions underpinning how people live and do business. On this basis, local, regional, national and supranational government bodies need to actively engage with private and third sector actors to design policy frameworks that forge consensus to create or develop mechanisms and structures at all levels, where these are required to set and meet national economic and environmental goals while delivering decent jobs.

There are several international organizations working towards these goals. One example is the Paris Committee on Capacity Building (PCCB) – a UNFCCC initiative. The primary activity of the PCCB is supporting international collaboration, especially in exchanging ideas and opportunities for local capacity building. The ultimate goal is to help national economies make the transition to sustainability and climate resilience (UNFCCC, 2020b).

National Environmental Legislation and Green Jobs

In 2017, the ILO published a working review paper entitled “Mainstreaming Green job Issues into National Employment Policies and Implementation Plan” (ILO, 2017a). This includes analysis of the adoption of national green job policies in 57 countries.

Table 4 lists the 11 countries which have recognised the environmental dimension in their national employment policies, with another two featuring green jobs. A key point to note is that, while there is a focus on employment policy more generally, the promotion of green jobs is less clearly a priority for nations, rather emerging as a co-benefit or even an unintended result. Moreover, green jobs are arguably undermined in a number of cases, being simply categorized as “new jobs”, rather than attributed as a positive outcome of adopting a green economy approach. The clear exception is the Philippines – which strategically focused on green jobs.



Country	Year	Policy
National employment policies addressing environmental sustainability		
China	2017	Promotion of employment and entrepreneurship policy
Comoros	2013	National employment policy framework document
Ethiopia	2016	National employment policy and strategy
Ghana	2015	National employment policy
Kenya	2013	Sessional paper on employment policy and strategy
Mauritius	2014	National employment policy, fourth draft
Mongolia	2016	State policy on employment
Morocco	2015	National employment strategy
The Philippines	2016	Green jobs act
Sri Lanka	2012	National human resources and employment policy
National development plans featuring green jobs		
Barbados	2013	Barbados medium term growth and development strategy (2013-20)
South Africa	2012	Our future – make it work. National development plan 2030

Table 4 - Countries with green national employment policies and national development plans. Source: (ILO, 2017a, p. 13)



1.2 Measuring the Impacts of Adopting a Green Strategy

Investigating the quantitative effect of green policies on employment

In 2012, the ILO formed the Green Jobs Assessment Institution Network (GAIN). The aim was to build capacity and support countries through collaboration to produce and make available statistical databases and economic models to quantify employment outcomes of green economic policies (ILO, 2017b). Projecting or simulating potential employment impacts of different green policy actions can provide essential understanding and policy narrative content to policymakers responsible for strategizing, enabling and providing leadership in a transition that will inevitably involve a restructuring of economies, in particular to ensure that job losses are minimized during the transition to a sustainable, low-carbon and greener economy

The specific focus of GAIN recognises that statistical tools are necessary to assess the three types of job creation – i.e. direct (through expansion), indirect (inter-industry), and induced (jobs created by the increase spending of income generated by new jobs). It is also important to gauge the impact on net employment across gross new jobs created, set against those that are lost. The ILO GAIN training Guidebook (2017) reviews multiple assessment methodologies to assess the employment impacts of greener economy policies and investments, both within specific sectors and activities, and at a macroeconomic level. The assessment methodologies listed here and compared in Table 5 can be employed in combination with one another or substituted for each other.

- Inventory and survey– data containing units of environmental goods and services produced in an economy, by sector.
- Statistical survey – household and establishment based census to assess the number of green jobs.
- Input-Output model (IO) and Social Accounting Matrix model (SAM) - empirical tools listing all economic subsectors and their interdependencies that enables the estimation of direct, indirect, and induced employment impacts triggered by increased / decreased demand for goods and services in different production sectors. SAM is more comprehensive than IO, as it includes information on governmental, enterprise, and household income flows and transfers (IO focuses on income generation).
- Computable General Equilibrium (CGE) model (for which IO/SAM constitutes the structural database) and other macroeconomic models – these enable the development of a more comprehensive (and more consistent with economic theory) view of the economy, and analyses dynamic and long-term employment effects as markets and prices adjust. There are several types of optimization models. Additionally, other econometric models and system dynamic models are employed to track the macroeconomic impacts of green economic policies on job creation (though these focus more on empirical, rather than theoretical or analytical, consistency).

	Inventories, surveys, and employment factors	Input–output (IO) analysis	Social accounting matrices
Implementation	Fast implementation; can be customized to the local context.	Relatively fast to construct; both flexible and practical.	Labour-intensive; relies on existing macroeconomic data that often are not up to date.
Core strength	Provides a useful snapshot of the current employment situation and a basis for further assessment using more complex models.	Makes possible the assessment of employment impacts within and across value chains	Brings together data on income creation and production, such as national accounts and IO tables.
Primary weaknesses	Static; effective design and data quality are essential.	Generally static; estimates potential employment effects over the short term and does not estimate distributional impacts.	Comparatively static simulation, largely limited to economic indicators (drivers).
Green economy approach fit	Provides the basis (or backbone) for any other more complex modelling effort.	Supports value chain analysis, which is often missing from macro assessments.	Makes possible analysis of trends over time but retains the level of detail of IO tables.
Policy cycle support	Makes possible estimation of short-term employment effects of increased activity in a sector. Generally useful for issue identification and policy formulation.	Makes it possible to test changes in economic activity. Generally useful for issue identification and policy formulation.	Useful for policy formulation and evaluation due to its socioeconomic coverage.
	Optimization (CGE)	Econometrics	System dynamics
Implementation	Labour-intensive; relies on existing macroeconomic data that often are not up to date	Quick analysis of trends; more laborious process to create a model.	Fast for high-level models, time-consuming for cross-sectional and detailed ones. Lack of technical skills is a concern.
Core strength	Models full economic responses to exogenous shocks (i.e., policies). Projects economy-wide impacts through changes in quantity and prices.	Uses data and existing relationships to project trends. Accurate for short-term assessments and for systems that do not change dramatically.	Captures feedback loops and accounts for delays. Makes it possible to link social, economic and environmental indicators explicitly and dynamically.
Primary weaknesses	Most models use very simple assumptions: Labour supply is fixed and a uniform, flexible, market-clearing wage balances labour supply and demand.	Cannot be used with confidence to test interventions that have never been implemented. Historical correlation may not hold true in the future.	Often lacks the level of detail offered by IO and by other macroeconomic models.
Green economy approach fit	Models economic responses to policy implementation, including distributional impacts.	Makes possible estimation of impacts for several indicators across sectors and dimensions.	Fully incorporates the main characteristics of a CGE analysis; simulates policy change over time through causal relations.
Policy cycle support	Useful for policy assessment; particularly indicated for fiscal policy analysis.	Useful primarily for issue identification and policy assessment as well as for monitoring and evaluation.	Makes possible the projection of the outcome of policies across sectors. Informs issue identification, policy formulation and assessment, and M&E.

Table 5 - Comparative review of assessment methodologies. Source: GAIN Training Guidebook, ILO (2017).

Impacts of Transition on Job Location, Occupations, and Aging Populations

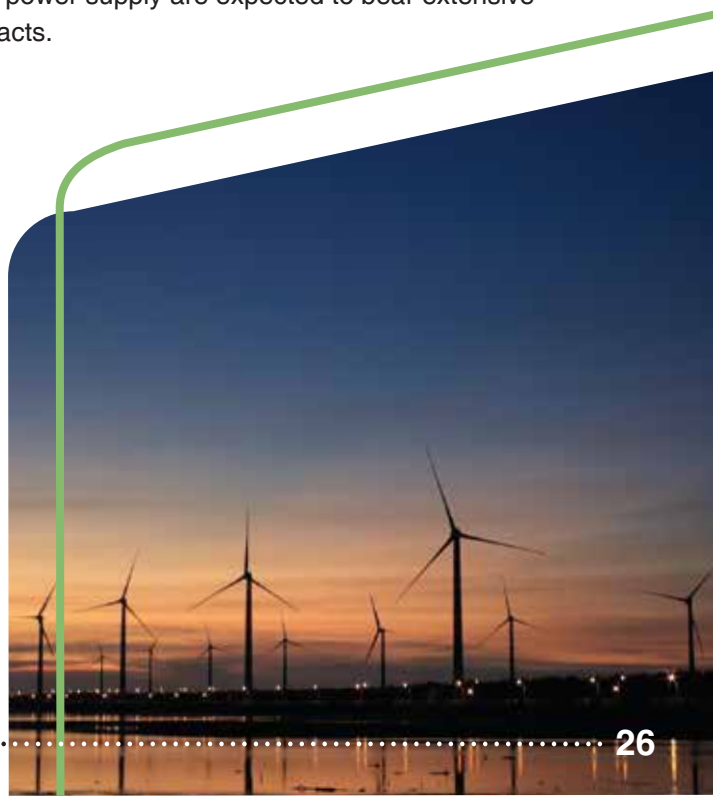
Of course, the calculation of net jobs impacts at both sectoral and macroeconomic levels provides only a limited account of how different types of people in different places are impacted. Transitioning to improve the energy, emissions, and resource efficiency of economies can open new job opportunities and move towards a low-carbon economy, but at the cost of phasing out carbon-intensive sectors, which could potentially destroy jobs and livelihoods for many workers. Providing particularly older workers and those with limited geographical mobility with training / retraining and new or adaptive skills is not an easy feat. In particular, re-employment may require workers to relocate to new and different geographical and technological environments and jobs. One challenge is how such impacts can be tracked alongside the statistical measurement made possible by network activities such as GAIN. Another is determining how negative impacts can be reduced and taking action to do so.

This emphasises the need to consider the extent to which evolutionary transitions can be supported and incentivised to build on the existing strengths of a country's industrial landscape. This in order to enable greening and decarbonisation of intractable sectors like high-value manufacturing and domestic heating, while also providing new trade opportunities. For example, such opportunities could be realised through the continued transition of unabated oil and gas extraction and use towards zero-emission energy systems, and to do so in ways that exploit existing strong supply chain links within economies. This will help provide, sustained, secure, and attractive career opportunities to existing and new workforce entrants. In considering ageing and other potentially more vulnerable workforce participants, the challenge is to provide attractive upskilling and reskilling opportunities for existing workers in the brown sector and appealing career prospects in a low-carbon and / or green industry context for the next generation. This is crucial for those nations committed to the delivery of a Just Transition in a manner consistent with the resource efficiency ethos of green economics, through developing alternative and new uses for existing capacity, infrastructure, and workforces.

On the other hand, such evolution of existing capacity may not be possible in all regions and nations, bringing the challenging requirement for a broader range of

transition planning models. For example, in Spain, the recently elected national government has both declared a climate emergency and committed to regional transition planning in several regions (Sauer, 2019). One aspect of this is for twelve out of the current fifteen coal-fired power generation plants in the country are to close by 2022, with the market moving ahead of government planning in many regards as coal-fired power generation becomes increasingly uneconomical (Marques & Velazquez, 2020). The transition challenge is not an easy one. For example, in one Spanish region – specifically impacting the city of Teruel – the company closing its power station (Endesa) has pledged to invest 1.5 billion Euros to build the biggest solar farm in Europe. The company predicts this will employ four thousand people during the decommissioning and demolition of the existing plant, and the subsequent solar panel installation. However, it can only commit to 140 sustained jobs once the new facility is operational, and the ability to use existing employees in the demolition and reinstallation may be limited.

Many of the examples emerging so far relate directly to energy supply and power generation sectors. However, greening the economy and creating green jobs is not limited to these sectors, impacting all sectors challenged to reduce emissions and increase resource efficiency. Manufacturing, transport, and services sector supply chain linkages supporting current energy and power supply are expected to bear extensive impacts.



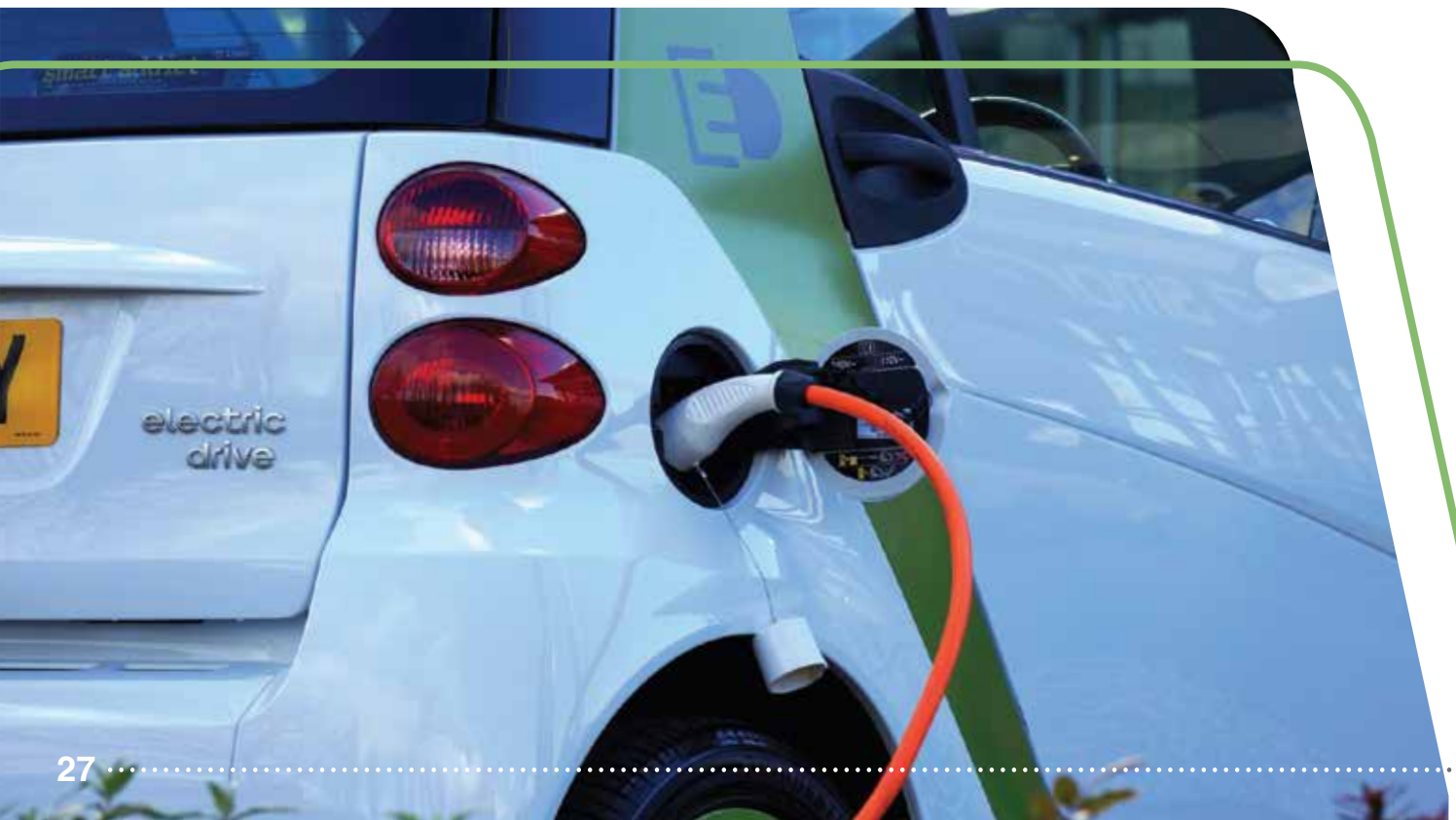
Of particular concern to many governments around the world is what transition means for high-value emissions-intensive manufacturing activities such as chemicals production, and for traditional heavy industries like steel and cement production, for which demand cannot be reduced easily. The latter point is key, as there is substantial risk that some emissions reduction actions could simply lead to geographical relocation of jobs, GDP, and emissions across borders. This has motivated a focus in some nations on reducing current emissions at their current location. For example, the UK Government – the first G7 nation to legislate on mid-century net-zero economy targets – has set out an industrial decarbonisation mission that involves establishing the world’s first net-zero carbon regional industrial cluster by 2040 and at least 1 low-carbon cluster by 2030 (Department for Business, Energy and Industrial Strategy, 2018). A crucial aspect of this is government commitment to support the development of low-carbon infrastructure to be in place and in operation in one regional cluster by 2030 as a precursor to attracting the required new private sector investment and innovation to deliver the policy mission (Department for Business, Energy and Industrial Strategy, 2018).

The sector in which concern over the need for a green revolution first began – agriculture – must not be forgotten, not the least because it constitutes the foundation of all economies around the world. This is due to its role in ensuring food supplies and the extent

of its contribution to GDP and employment in many - particularly developing - nations. Of course, the agriculture and the wider food industry – including many

high-employment and / or high-value manufacturing activities – are examples of industries which can benefit by adopting green processes, such as maintaining soil health, reducing waste, and recycling packaging, whilst creating jobs throughout and across extensive regional, national, and global supply chains.

On the other hand, what is potentially less commonly considered is the potential for agriculture and other land-use sectors to support other industries (beyond their own supply chains) and the wider economy to deliver net-zero CO₂ emissions, including (but not limited to) the allocation of land to reforestation or exploiting soils for their natural carbon capture properties. For example, Scotland’s peatlands hold over half the nation’s terrestrial carbon store and it is recognised that restoring peat-forming habitat previously drained or damaged ensures that bogs remain a long-term carbon sink rather than a greenhouse gas source. To this end, in 2019, the Scottish Government committed £11 million to help repair and restore Scotland’s peatland areas, which can store around 1.6 billion tonnes of carbon (Scottish Government, 2019).



1.3 Skills, Research and Development, and Technology & Knowledge Transfer

Skill building and the importance of digitalization

The discussion above has emphasised that the ongoing transformation towards a green economy has the potential to create new jobs while destroying others in the transition. This will be the case if the transitions are not designed and managed in a manner that enables existing and new workforces to respond to significant changes in labour demand across industries and sectors. Some occupations may face increased demand, leading to the need for new skills and qualifications, whilst other existing occupations may require upskilling that could be obtained by training. In this regard, the discussion in Section 1.3 has highlighted challenges particularly for aging and / or geographically immobile populations.

A crucial point not yet highlighted, however, is that the transition to low-carbon economies and green jobs must be set in the context of the ongoing digital revolution impacting and increasing productivity in all sectors of all economies around the world. This provides a very pertinent example of why climate, energy, and environmental policy design and delivery must integrate with the wider public policy framework, in which digital skills and capacity sit at the heart of many countries' industrial and wider economic strategies. At the very least, policymakers and the institutional frameworks supporting and regulating economic activity can play a pivotal role in coordinating the future needs and demands of different sectors for green skills and in prioritising the development of human capital to avoid future bottlenecks. More generally, the involvement of, and cooperation and coordination between, political actors, institutions, industries, employees, and educational institutions is required to identify and coordinate lifelong learning and skill-building activities.

Developing innovative resource management skills

In 2018, the ILO (2018) published a key report suggesting that embracing a circular economy - reuse, recycling, remanufacture, and repair of goods - can create 6 million new job opportunities across the world. Prior to this, joint research conducted by WRAP and the Green Alliance in 2015 demonstrated that the expansion of the circular economy in the UK can create up to 205,000 jobs across the economy. Ofcourse, as any new economic activity emerges, policymakers and industry actors must respond to the challenges and opportunities of a competitive global trading environment. For example, the WRAP / Green Alliance (2015) study highlights the fact that manufacturing new products locally means that UK companies must compete with the low-cost global providers, set against the opportunities for providing local jobs and reducing landfill by creating products by reuse (Peake & Brandmayr, 2019). Again, one emerging issue is the need for a policy and regulatory environment at national and global levels that supports green products in becoming competitive. Moreover, this needs to be set in the context of creating jobs in production and distribution, resource management, in addition to the high-skill job opportunities that lie in research and development to support an innovative circular economy.



Fostering The Creation of New Green Business Opportunities Through Technology Transfer Across Regions and Nations

Research and development are traditionally a primary conduit for technology transfer, as is the existence of multi-national industries and supply chains, in fostering the creation of new business opportunities and markets. However, the role of multilateral institutions is also key in setting foundations and the pace for developing synergy and coherence between different fields to achieve interrelated policy goals. Rapid technological changes and interdependencies between institutions can support countries' objectives in creating green business opportunities. International collaboration is important for the creation of green job opportunities in developing economies.

The evolution of global climate cooperation, initiated with the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) has led to a series of international environment agreements, with a common objective for all nations to join in the commitment of reducing GHG emissions to mitigate the resultant anthropogenic climate impacts - common but differentiated responsibilities and respective capabilities. From the beginning of the UNFCCC's efforts, an essential part of the strategy has been to support the development and transfer of technologies to support climate change mitigation / adaptation actions. In fact, specific provisions regarding technology - which are the basis for all the UNFCCC's technology related efforts - were included when the Convention was initially established in 1992 (UNFCCC, 2016). The 2015 Paris Agreement placed more emphasis on technology development and transfer with its Technology Mechanism, which the signatory nations chose as a key implementation component. The Paris Agreement further strengthened the Technology Mechanism, emphasizing the need for R&D and enhancing endogenous capacities and technologies. The first paragraph of Article 10 defined a long-term vision for technology, establishing an overarching framework for the Technology Mechanism (UNFCCC, 2020a). However, the differences in government structure and other inequalities that exist globally, such as, GDP, infrastructure quality, availability of skilled labour, and social and behavioural dynamics can pose challenges for technological transfer - in particular for low-carbon technologies (Pullanikkatil et al., 2014). It is

in the best interest of developed economies that developing countries tackle their increasing CO₂ emissions. Thus, it is essential that developed economies undertake the leadership role to promote the adoption of low-carbon technologies and other innovative and efficient technologies through private participation (ADB and ADBI, 2012). As most developing countries have limited and constrained public resources, financing is a significant obstacle.

However, if such gaps can be bridged, developing countries can largely benefit from improved environmental conditions, energy security, and increased employment opportunities – especially green and decent jobs. Domestic and international policy intervention can play a pivotal role in capacity building and transitioning to the production of climate-friendly innovation in developing countries. In addition to the obvious benefits to the global environment and developing economies, improvements to the global trade environment resulting from technology transfer would benefit developed countries (Barbieri et al., 2017). For example, modern water and waste treatment technologies are especially important to developing countries, not only to manage the large volumes of waste generated by the growing population, but also for material management and the sustainable use of land. Interactions between national and international organizations can facilitate domestic capacity building and global knowledge exchange, via interactions among government agencies, private and public enterprises, and research institutes.

“However, if such gaps can be bridged, developing countries can largely benefit from improved environmental conditions, energy security, and increased employment opportunities”

1.4 Societal Impact

Social and Regional Equity

Transitioning towards a green economy will have profound impacts on production processes and job relocation, losses, and redundancy. The 1992 Rio Declaration considered the status of social partners and tripartism to be key constituents for sustainable progress and recommended cooperation between government and social partners. The cooperation is aimed at addressing the challenges that arise from how the green transition impacts productivity, skill development and employability, the nature and extent of changes in income and labour standards, and social acceptance of environmental reforms for greening the economy.

Equity is an important element which defines decent jobs, and is an outcome of a green economy, set in terms of – improved “human well-being and social equity” (ILO, 2017a, p. 4). Consideration of equity highlights the important difference that exists between developing and developed economies when looking at labour policies. Relative daily wages, working hours, and the work environment are important factors in the determination of whether or not equity can be achieved. In addition, the priority given to achieving sustainable development varies substantially across countries. In some countries, the lack of basic needs such as clean water, food, shelter, and hygiene can create challenges in achieving equity in jobs and creating decent work. Building understanding of the concept of decent jobs at the government, social partner, and stakeholder level is essential for a green economy transition. This will ensure social equity concerns are addressed, by driving equality in gender participation, access to training of different skills, and upgrading to higher job and pay based on skills and ability (ILO, 2018). Social dialogue and collective bargaining are important instruments to achieve these ends.

Collective bargaining is an important tool applied to the process of negotiation, or a social dialogue between workers and employers, aiming to improve, regulate, and formalize the terms and conditions of employment in a collective agreement (as stated in the ILO Right to Organize and Collective Bargaining Convention, 1949 (No.98)). Social dialogue can create awareness and acceptance to find mutually beneficial solutions for workers and enterprises, building equity. An example of social dialogue around green initiatives in Argentina (ILO, 2011) is shown in Table 6.

Social Partners Involved

The Advisory Committee for Cleaner Production (Consejo Aesorparauna Producción Más Limpia, PML): based on a public / private cooperation and composed of provincial governments, technical organizations, workers, universities, and environmental NGOs

Initiative Objectives

To promote better environmental efficiency, and assist local governments and small business in implementing environmental protection measures and sustainable production practices

Primary Outcomes

- Organization of training activities about the tools and methods for cleaner production
- Diagnosis and actions for improvements in dairy companies in the Association of Small and Medium Dairy Companies
- Review of waste management and mapping of effluents produced by the businesses in the Industrial Park of Alvear to design a collective and business-specific management plan

Table 6 - An example of social dialogue around green initiatives in Argentina; social partners, objectives, and primary outcomes. Source: ILO, (2011)



Decent Jobs

The schematic relationships between employment, green jobs, and decent work in Figure 1 shows that job decency is an important dimension of green jobs. However, not all jobs are decent or fair. Some inequality of opportunity may persist in some places due to inequalities in gender, age, urban vs rural standing, and individual countries' economies. Correct accounting of decent jobs is a substantial challenge, because a green job by default is not decent without sufficient employment quality or fairness. For example, the construction or retrofitting of green buildings or the growing IT recycling sector will create green jobs, but not necessarily provide safe working conditions, adequate income, social protection, or equal rights. Without these qualities, these jobs do not meet all the criteria to be fully considered green jobs.

Sustainable Ecosystem – Land, Air, and Water

Greening the economy does not mean conserving resources, but instead emphasizes the efficient use of resources, coupled with recycle and reuse. A green economy is a sustainable economy, meeting the needs of current and future generations. A green economy balances economic growth and protecting the natural environment by minimizing the damage (conservation) to the environment (land, air, and water). Sustainability of environmental resources is integrated in the green economy. Maintaining the balance between conservation and exploitation of natural resources has led to the creation of more green jobs. A 2019 press release by the US Department of the Interior reported that national park visitor spending contributed to \$40 billion to the US economy. The spending supported 329,000 jobs in hotels, restaurants, transportation, and recreation. The report states that in 2018, national park visitors spent \$20.2 billion in communities within the national park. The report emphasizes the tremendous impact that national parks can have on a nation's economy, giving rise to conservation jobs (direct green jobs) involving varying degrees of skill and wage income potential such as zoologists, foresters, wildlife biologists, technicians, etc.

1.5 International Cooperation

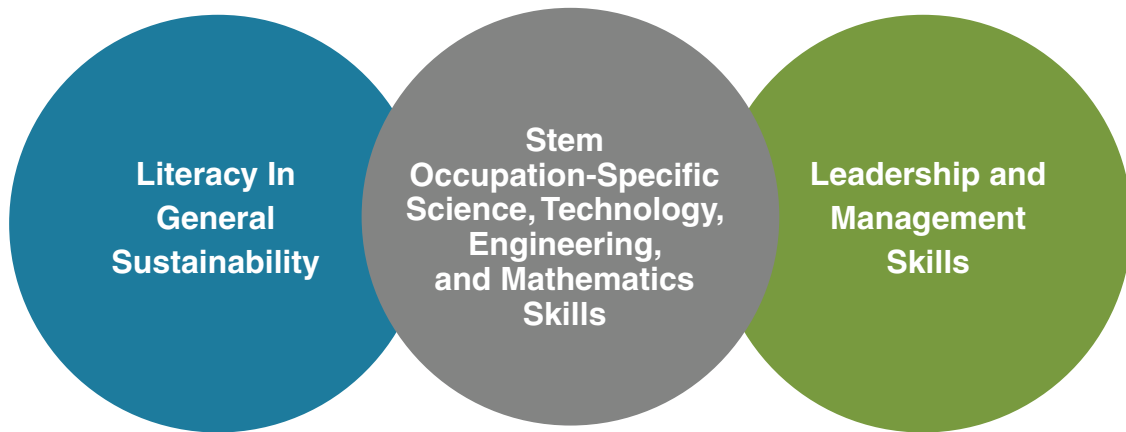
Fostering international cooperation for developing sustainable strategies is important while transitioning to environmentally sustainable economies and societies. Although policies and programs are developed in ways specific to the requirements of national interests, a globally collective transition towards sustainable development is a must, given that the earth's climate is a common resource. While sustainability is generally considered as a long-term concept, a fundamental component is acting to address climate change issues now, before critical tipping points are reached. The Paris Agreement was adopted in 2015 for this purpose, with the specific goal of limiting the global temperature increase by 2050 to less than 2° C. The Paris Agreement touches upon all Sustainable Development Goals of the 2030 Agenda for Sustainable Development, and is critical for achieving them. Besides the fact that it's inherently linked to 16 of the 17 SDGs, the Paris Agreement explicitly maps climate change countering actions to reduce emissions and build climate resilience - SDG 13 (UNEP, 2020). International organisations, such as the World Bank, have implemented investment programmes to promote low carbon economies, putting a price on carbon emissions. The World Bank grants loans for capital investment in infrastructure, water, power, and agriculture in developing countries to end global poverty. By promoting sustainable programs, the Bank is not only supporting the economic transition in developing countries but also helping them meet their Nationally Determined Contribution (NDC) targets, in which the concept of a Just Transition is embedded. Complete and coherent documentation of Just Transition principles and contexts is included in the COP24 President's Toolbox of Just Transition Strategies (COP24 Presidency, 2019). The strategies in the toolbox support tangible and pragmatic actions to bolster climate change action without sacrificing socioeconomic prosperity and wellbeing. It is not exhaustive, but has nevertheless been widely adopted by governments wishing to include Just Transition commitments in their INDCs (Glynn et al., 2020). Ancillary to the Just Transition Toolbox, labour institutions such as the ILO have designed international standards to promote green and decent jobs, and provide economic support.



1.6 Investment in Human Capital

Investing in capacity-building for transitioning to a green economy requires certainty from government, enabling enterprises to invest in the future development of a skilled workforce. The decision and commitment from governments and institutions should be made early to justify investments in capacity building. The Asian Development Bank's 2018 report identifies three types of skillsets required for a green economy:

All of these are needed for a green economy transition. Many of the general skills exist and can be transferred by upskilling or strengthened through training programs, but STEM and leadership skills require fast-track reform. Innovation and efforts by governments, industries, and international institutions can align the skills supply and demand for capacity building. Achieving green skills development reforms will require prioritisation of skill-building on political agendas and making necessary investments. Consideration should also be given to how cultural and social challenges are addressed as employees use their existing skills to transition into new sectors in different working environments.



Case Study

The concept of “estidama”, or sustainability, has long featured in the foundation of the United Arab Emirates (UAE) societal development. In 1971, the founding father and former president, His Highness the late Sheikh Zayed Bin Sultan Al Nahyan, charted the development of the UAE with a sustainable vision: balancing consumption of natural resources whilst growing the economy. The fundamental premise was that transitioning towards a greener economy is a natural progression for the country to limit its economic reliance on fossil fuels and decrease its carbon emissions (MOEW, 2014). In January 2012, the UAE launched its green growth strategy, to support

the ambition of becoming a low carbon green economy. The UAE Green Agenda 2030 was developed to implement the framework of the green growth strategy focusing on six strategic direction: Green Energy, Green Investment, Green City, Green Technologies, Climate Change, and Green Life; this is shown in Figure 2 (MOCCA, 2017). The green growth strategy was partitioned into three milestones: short-term (2017 – immediate actions), medium-term (2021 - continued momentum), and long-term (2030 and beyond – realise transformational change) (MOEW, 2014).

Strategic Directions	Strategic Objectives	Programs	Sub Programs
Green Energy	1. Competitive Knowledge Economy	1.1 National Green Innovation Program	}
		1.2 Green Diversification Program	
Green Investment	2. Social Development & Quality of Life	2.1 Integrated Green Infrastructure Program	}
		2.2 Green Workforce & Talent Program	
Green City	3. Sustainable Environment & Values Natural Resources	3.1 Natural Capital & Resilience Program	}
		3.2 Environmental Goods & Services Program	
Climate Change	4. Clean Energy & Climate Action	4.1 Integrated Power & Water Management Program	}
		4.2 National Renewable Energy Program	
Green Life	5. Green Life & Sustainable Use of Resources	4.3 National Green Economy Data Program	}
Green technologies		5.1 National Energy & Water Efficiency Program	
		5.2 National Waste-to-Resource Program	
		5.3 National Sustainable Transport Program	

Figure 2 - Structure of the Green Agenda 2030. Source: MOCCA, 2017

The multidimensional nature of the green economy poses a formidable and challenging task; successful implementation is largely dependent upon the national capacities and developmental maturity. Transformation towards building a green economy requires the participation of both the government and private sector. In support of the ongoing transformation, the UAE's Ministry of Climate Change and Environment has developed a set of key performance indicators (KPIs), which are expected to effectively measure

progress towards the Green Agenda objectives. These KPIs, categorized in three dimensions - environmental, economic, and social - measure the result of green economy actions in ways that are variously conflicting or supporting. The social KPIs (Table 7), for example, emphasize the promotion of knowledge-based green sectors, to create new green and decent jobs and develop local talent while improving the quality of life (MOEW, 2014).

Number	KPI	Description
SOC1	Labour participation rate	Labour is one of the most essential inputs for production. Raising female participation is key to success.
SOC2	Employment rate	OECD guides to measure labour market dynamics by labour participation rates and unemployment rates.
SOC3	Emiratization rate	Nationals in the workforce will provide a foundation for the long-term economic success.
SOC4	Number of green jobs	While not universally defined, jobs that contribute to environmental quality are expected to rise.
SOC5	Number of UAE patents	Number of patents is one of few measurable proxies of R&D outcomes, or more broadly, innovation.
SOC6	Global innovation index	A measure to evaluate a country's enabling environment for innovation and innovation outputs
SOC7	Global Entrepreneurship Index	Entrepreneurship is required to tackle global challenges such as poverty and climate change.
SOC8	Environmental awareness rate	Awareness creates a foundation to shift behaviour of individuals and organizations to greener one.
SOC9	Environmental behaviour rate	Personal choices in daily life greatly affect on economic outcomes as well as the environment.
SOC10	Human Development Index	A popular UN approach of measuring welfare as an alternative to GDP growth
SOC11	World Happiness Index	A measure to assess what extent individuals feel happy and satisfied with their lives in a country

Table 7 - UAE Social Green KPIs. *Italic KPIs correspond to national KPIs; Bold KPIs are Headline indicators.* Source: (MOCCAE, 2017).

As previously mentioned, the scope and definition of green job can differ substantially by country. The UAE government has developed a template to set pragmatic expectations and outcomes to measure and define Green jobs. The template, shown in Table 8, can be adopted to meet specific market needs and economic priorities as they may change in the future (MOCCAE,2019).

Employment In Green Industries	Jobs with a green component (e.g., solar panel installation)
	Jobs without a green component but created thanks to greening (e.g.administrative staff in a renewable energy company)
Employment In Non-green Industries	Jobs with a green component (e.g., energy managers of production processes)
	Jobs without a green component but created thanks to greening (e.g. workers in making steel used for wind turbines)

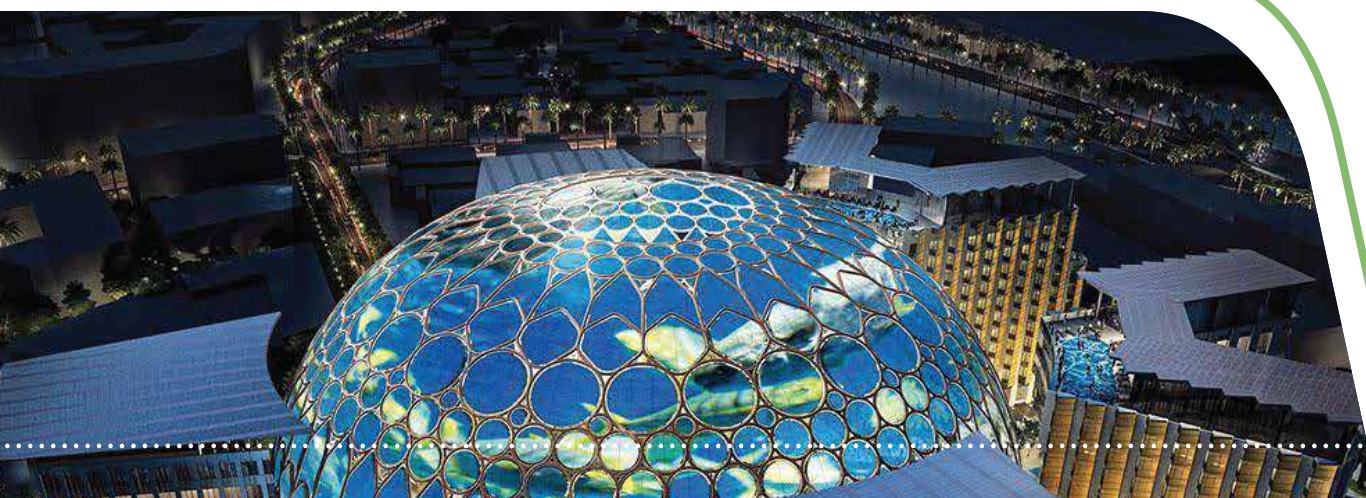
Are non-private sector jobs (government, NGOs, etc.) part of the scope?

Are freelancers and part-time job holders to be considered for counting green jobs?

Table 8 - Green jobs definition template. Source: (MOCCAE, 2019)

There are several international organizations operating in the area of building green and inclusive economies. The UN, for example, has over 20 agencies engaged on this topic; one such agency is the Partnership for Action on Green Economy (PAGE). PAGE is composed of experts from five major UN agencies, and has the remit to assist 30 countries with green economy development by 2020. The UAE is one such country, who has consulted with PAGE to develop a thoroughly considered approach to economic transformation. In fact, the UAE hosted the first global PAGE conference,

at which 66 countries were represented by 650 delegates, including more than 25 ministers. Dubai was expected to host the 4th annual global PAGE conference in 2020, coinciding with the UAEs Expo 2020. The coincidence of the two conferences was expected to present many opportunities to promote global collaboration on innovations for sustainable living (MOEW,2014). Regrettably, the Expo was postponed until 2021 due to the COVID-19 pandemic (Contents, 2020).



2. Current Employment Trends

This chapter covers current employment trends across various economic sectors and the potential opportunities to create new green jobs by transitioning towards building a greener and sustainable economy



Figure 3 shows the GHG emissions in agriculture, manufacturing, and mining compared to the number of jobs in these sectors. The transition to a greener economy will require these sectors to overhaul currently unsustainable practices, which will impact the transitioning economy, especially when operations are curtailed. However, ILO (2018) anticipate that the job losses from these closures need not be significant. The

transition to low-carbon or less energy-intensive operations in these sectors will improve the environment and provide green jobs. Resource intensive sectors play an important role in the economy they support; for example, mining supports employment in the construction sector and produces materials often considered essential to the creation of a green economy.

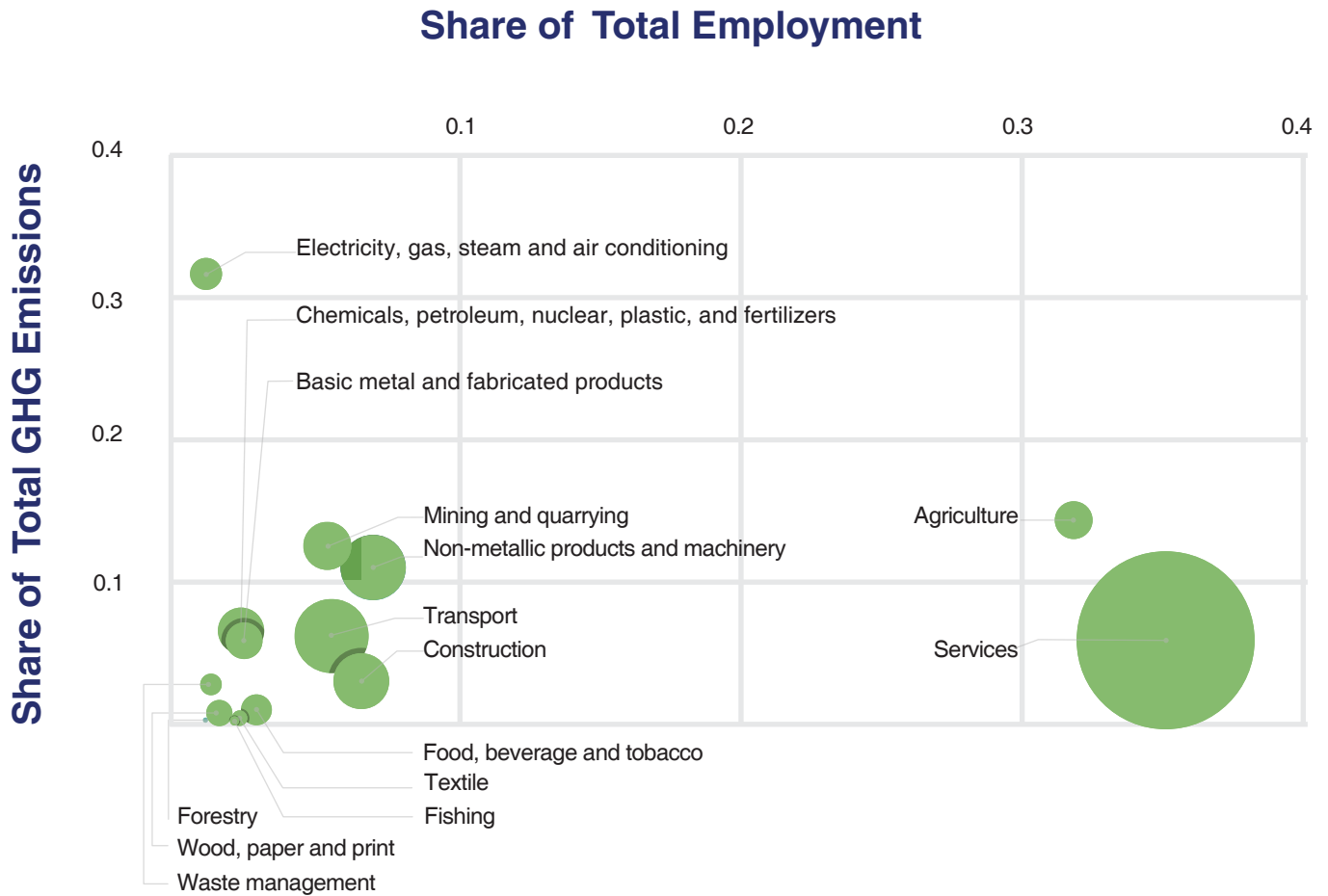


Figure 3 – Employment, GHG Emissions, and Material Extraction by Sector, 2014. Source: (ILO, 2018, P. 19)



Share of Total Employment

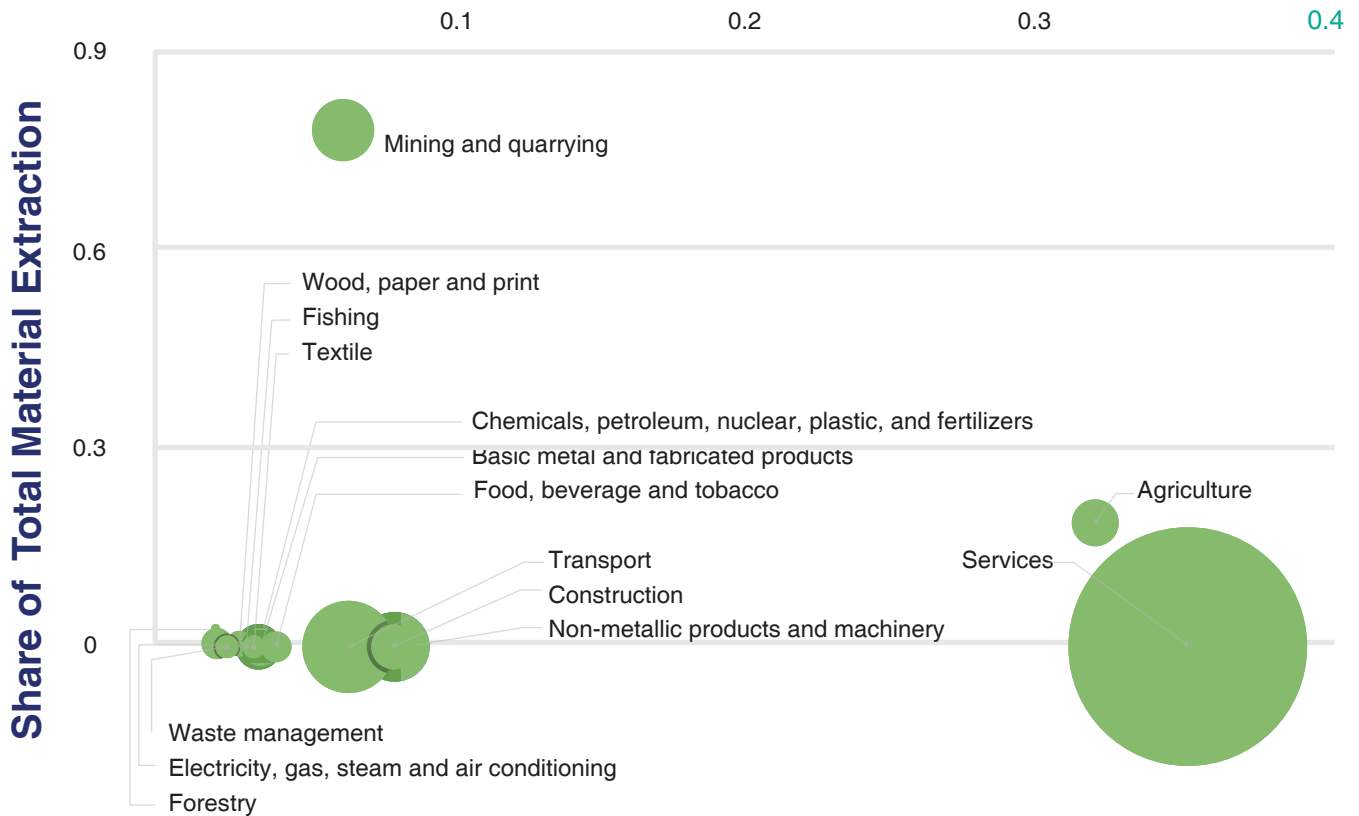


Figure 3 – Employment, GHG Emissions, and Material Extraction by Sector, 2014. Source: (ILO, 2018, p. 19)

2.1 Primary

2.1.1 Agriculture

Food production is central to the functioning of the global economy. Whilst food is integral to our survival, feed and raw materials are also important for industrial and commercial production. The global demand for agricultural commodities is driven by increasing populations, urbanisation, consumption pattern changes, and the rising demand for industrial and commercial applications. For example, biofuels have shifted the agriculture sector's production patterns. However, the sector is faced with several challenges. Globally, agriculture has a large environment footprint



Approximately 40% of the earth's surface is used for agricultural activities



70% of global water use is for irrigation (Kanianska, 2016, p. 5-8)



Increasing demand has led to rampant deforestation (land clearing)



Contributed 5.8 billion tons of CO₂e of global greenhouse gas emissions in 2016 (Ritchie & Roser, 2016)

In general, there is concern that unsustainable agriculture practices which deplete natural resources such as groundwater through overuse and unsustainable irrigation practices - and contaminate surface water with pesticides are overly dominant in the sector (Kanianska, 2016).

The United Nations estimates that in 2019, a quarter of the global population was employed in agriculture, reflecting a steady decline from about 35% (2005) and 31% (2010). The contribution of rural landholders with low acreage is declining in favour of large firms that are able to diversify land use with plantation crops, livestock, and export-oriented produce - such as tropical fruits, vegetables, and flowers. While large agricultural firms create more jobs, they also tend to employ chemicals (herbicides, insecticides, fertilizers, etc) more extensively, consume more energy, and deplete the land quality more quickly. The market power of large companies has increased the sector's job potential, but the ILO (2018) argues that many of these jobs are not green jobs.

From the employment perspective, environmental sustainability is critical; the increasing frequency of natural disasters (i.e. flooding and drought) caused by climate change has decreased agricultural productivity (Gornall et al., 2010). This has subsequently resulted in conditions that negatively affected the wellbeing, health, safety, and income of farm workers, especially in developing countries. Transitioning to a green economy and creating green jobs should reverse the negative impact on land use and the climate while also creating decent jobs (ILO, 2013).

A shift to conservation in agriculture practices involves changing production methods by increasing resource efficiency and reducing emissions. There is also potential for a structural transformation, which can create employment in related sectors. For example, reforestation has the potential to create green jobs in, and supported by, the forestry sector. Moreover, due to a combination of economic and resource linkages between sectors, and the potential for agriculture to play a role in offsetting emissions generated in other sectors (refer to Section 1.1.3), the growth in green jobs created in other sectors such as manufacturing could be accompanied by an increase in number and diversity of green agricultural jobs.

However, trade-offs must be anticipated, and their impacts considered. The use of sustainable practices in agriculture can increase through a range of conservation activities, or a shift to more organic

agriculture, both of which have merits. In either case, job losses due to lower labour requirements should be expected (ILO, 2018, p. 44-51), as well as increased pressure on land use. However, agricultural sustainability can create jobs in industries that are associated with the production and distribution of agricultural products. For example, increasing the sustainability of agriculture by reducing energy consumption or waste can create employment opportunities in construction, management of renewable energy, and waste management. That is, net job creation across sectors must be considered alongside net emissions reduction in a green and transitioning context.

In order to increase yield sustainably, research and development of nutrients and innovative practices, waste reduction, and improvement in transport and storage infrastructure are required. The implication is that the transition to sustainable practices will require the adoption of complementary policies that can create new green jobs within the sector and across other sectors. One of the current challenges facing the agriculture sector is the shortage of skilled labour, though sustainable agriculture requires basic education and training. This need can create opportunities for farm field schools, or adult literacy education and training programs (particularly in developing countries), indirectly creating more green jobs



2.1.2 Extractive Industries

Employment in extractive industries is experiencing a decline due to growing mechanization, with technology obviating the need for some jobs. For example, the coal industry increasingly uses larger and advanced equipment for mining, instead of labour. Modern and efficient coal power plants are increasing productivity, which also translates to lower employment requirements. Moreover, the extractive industries share some similarities with the agriculture sector, in that both have and continue to contribute to GHG emissions, natural resource depletion, and inefficient energy and water use practices. Both have historically had some level of hazardous and unhealthy working environments, lacking decent jobs, which continues to this day in some countries and roles. While the mining sector's share in total employment is less than the agriculture sector (though the opposite may be true of income from employment and other value-added), it has a higher emissions and natural resource consumption footprint. Unlike the agriculture sector, the extractive sector is capital intensive, and historically (not as a recent development) dominated in terms of ownership and operation by large businesses.

Nonetheless, a key common characteristic that has not been fully apparent or recognised in public and policy debate is that, as primary industries, both agriculture and mining, are key upstream supply chain sectors in the production of many of the goods, services, and activities that are most commonly associated with green credentials. In a report entitled "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition" the World Bank Group (2017) predicted that the extraction and refinement of minerals such as graphite, lithium, and cobalt would increase by nearly 500% by 2050 to meet the growing demand for clean energy technologies. The demand for minerals and metals in support of the global energy system transition is forecast to be over three billion tons.

Similarly, in the case of renewable wind generation, the manufacturing processes involved in producing windmills requires, among other inputs, the use of petrochemicals, involving the extraction and consumption of fossil fuels. Linking to the World Bank Group (2017) prediction above, the batteries used to power electric vehicles have mineral requirements that may depend upon supply chain linkages extending to mining sectors in developing countries with low wages and hazardous working conditions. Public and policy

awareness is well-developed in terms of understanding the full carbon footprint of consumption choices, and, increasingly, of the social responsibility associated with corporate procurement decisions. However, the full supply chain implications in terms of environmental impacts and employment conditions are less well recognised or understood.



Mining

In many (but not all) geographical and industry contexts, substantial change is slowly and steadily taking place in the mining sector, integrating circular economy principles – i.e. produce-use-service-reuse. This has significantly impacted the sector's employment, resulting in the loss of jobs due to the structural shift in the approach towards the mining of high-carbon resources. These losses have been partially offset by employment gains through green jobs, with one example being the reallocation of jobs to the recycling and reprocessing of secondary metals. The ILO (2018) expects that job losses will be higher in developing economies, but many jobs lost can be regained through decent jobs with effective skill transformation. In a bid to reduce GHG emissions and move countries along the path to a low carbon economy, the need for non-renewable earth resources will inevitably still exist for some time, given that the requirement of some metals – and fossil fuel use in their extraction and manufacture – are integral in developing technologies for other sectors. This change will lead to the creation of fewer direct low-skill mining jobs, but with gains in more skilled and decent jobs. Investments in lowcarbon technologies and decarbonisation of the industry are being planned across the mining sector in a bid to support national and international agreements on climate emissions (World Bank Group, 2017).

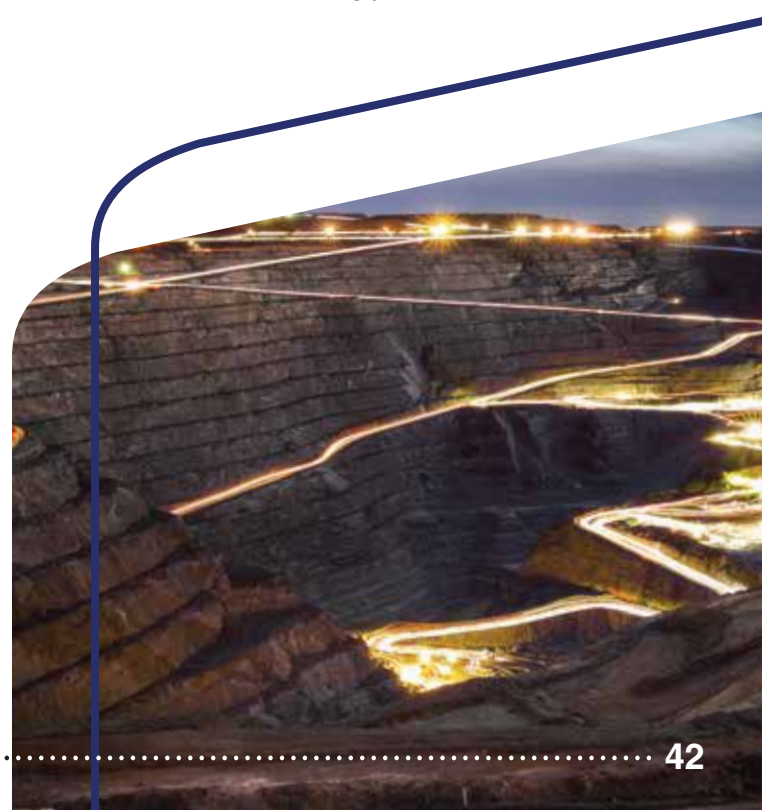
The mining sector is adopting technologies that have changed and will continue to change the nature of the workforce, such as digitalization. It is expected that digitalization in the mining sector will reportedly reduce 330,000 jobs - or 5% of the workforce - over the next decade. At the same time, the transition can be expected (and required) to improve safety, reduce emissions, and create social value through a transition to more highly-skilled and decent jobs (World Economic Forum and Accenture, 2017).

As mentioned in Section 2.1.1, transitioning to sustainable business practices can create job opportunities in other economic sectors due to strong interlinkages and the possibility of skill transfer. For example, the adoption of green practices in the energy sector could negatively impact some jobs in mining and oil / gas drilling, while creating new job opportunities for other mining sectors. Overall, approximately 2 million jobs are expected to be lost globally from reduced oil / gas extraction, coal and lignite mining, and peat extraction.

These losses should be largely offset by new jobs (estimated at around 2 million) for mining copper, nickel, and other ferrous and non-ferrous metals in support of increased demand for electronics – especially electric vehicles (ILO, 2018). This could result in a net increase in green jobs.

For example, approximately 650,000 jobs have been lost in Africa, predominantly in coal mining, coal-based power generation, and petroleum extraction and refining. These losses have been partially ameliorated by the creation of about 300,000 new jobs, which have been mostly in construction, copper mining, and machinery manufacturing (ILO, 2018). However as noted earlier, the impact on those employed in contracting sectors, especially if skills and expertise are not easily transferable, should be considered carefully.

In contrast, however, there are significant opportunities for increasing employment in decommissioning and restoration once extractive industry projects come to close. These projects include, for example, restoration of mining sites (i.e. returning the mining site safely back to the environment) and managing effluent (such as acid mine drainage). For example, Africa has over 700 million hectares of degraded mining land, and thus has the largest restoration opportunity of any continent (Festinet al., 2018). Importantly, a key driver for employment growth in this sector, in any country, is government regulation and its willingness to enforce environmental regulations that call for proper restoration / decommissioning processes.



Moreover, it is vital that governments view restoration and decommissioning as an industry that should grow, prosper, and create jobs, as opposed to viewing environmental regulation as a job killer (BenDor et al., 2015). Indeed, a recent examination of the economic potential of the ecological restoration industry in the USA found that this sector employs a larger workforce than coal mining, logging, or steel production (BenDor et al., 2015). The US ecological restoration sector employs approximately 126,000 people directly, while creating an additional 95,000 jobs indirectly, with a total (direct and indirect) economic output value of approximately \$25 billion. Another sector that demonstrates increasing potential for green jobs is the oil and gas sector, due to significant decommissioning investments. For example, £15.2 billion is expected to be spent on oil and gas decommissioning in the UK over the next ten years alone.

Oil and Gas

The ILO (2020a) estimates that nearly 6 million people are directly employed by the oil and gas industry, and ten times that number of jobs are indirectly supported by the industry. However, as recognised by the IPCC, the need to reduce emissions from fossil fuel combustion means that the sector faces significant change as we move towards a net-zero emissions world by the mid-century.

In 2020, a number of international oil companies, such as BP (BP, 2020) and Shell (Shell, 2020), have stated their intentions to become net-zero emission energy businesses. This will involve selling products with a lower carbon intensity, as well as significantly reducing the emissions associated with hydrocarbon production. Some operational actions taken towards reaching these targets, such as increasing methane monitoring and reduction, may have a limited impact on the workforce. However, the ongoing impact on the global oil and gas workforce is highly dependent on the continuing global demand for petroleum and petrochemical products. The nature, extent, and longevity of global demand - and the consequent impact - are currently uncertain and will depend on how quickly nations can reduce their reliance on oil (for road transport and aviation in particular) and natural gas (for heating). The impact on the workforce will also depend on the extent to which the industry and its supply chain is able to evolve and transition to other activities.

While the potential reduction in demand for oil and gas poses risks for the workforce, significant opportunities exist if the existing skills and expertise can be used for new purposes as the general demand for oil falls, or as production declines in maturing basins. Therefore, a key challenge for international oil companies and oil-producing nations going forward is how to transition smoothly into other activities that provide employment opportunities for both existing and new workers.

As introduced in Chapter 1, the creation of a marine energy sector, in which activities such as carbon storage and hydrogen production (which have operational similarities to oil and gas production) provide an opportunity to utilise the skills and expertise of the existing workforce. Enhanced oil recovery, developed widely in the United States, is an example of a process that allows oil and gas production and the associated workforce to transition on a path towards what may be argued to be a more sustainable practice, in which significant volumes of CO₂ can be stored as oil production matures (IEA, 2019a). Initiatives such as this may be important, as the demand for petrochemical products used in manufacturing a wide range of products, such as plastics, is likely to be sustained even as the world shifts away from more direct use of oil-based products.



International oil companies are also transitioning into sectors that are less aligned with traditional oil and gas production, such as renewable energy production and biofuels. This transition also provides opportunities for the existing workforce. For example, Equinor, the Norwegian national energy company is developing its offshore wind operations substantially, hoping to become a global leader in this sector. Equinor considers their in-depth knowledge of energy markets, skilled personnel, and network of partners and suppliers to be key strategic assets in support of a transition into the new sector (Equinor, 2020). This may provide opportunities for portions of the workforce who have expertise in offshore environment operations, where conditions are more challenging, and health and safety expertise is particularly required. However, not all transitions will provide the same employment benefits. For example, the transition into retail energy, recently experienced by Shell in the UK (Robertson & Hodges, 2019), may present fewer opportunities for the existing workforce. However, it generally does create what could be classed as green jobs, particularly as electricity sectors in countries like the UK decarbonises.

How changing working environments could pose a challenge as workers transition into new sectors is another consideration, even if requisite skills are similar. For example, an element of retraining may be needed for offshore oil and gas workers if they transition into onshore geothermal projects. Geothermal energy generation will almost always be onshore because the heat output is difficult to transport efficiently. Working onshore requires significant retraining for offshore workers as the environment poses different challenges: i.e. land-based environmental protection issues and dealing with local communities.

2.2 Secondary

2.2.1 Construction and Infrastructure

The construction sector has a large impact on the environment; the building and construction sectors combined contribute 39% of all CO₂ emissions, 28% of which is from energy consumption and 11% from the CO₂ emissions during construction (IEA, 2019b). Much of the energy consumed in buildings is wasted, due to poor construction and material quality. The waste produced during the construction of buildings further impacts the environment. To keep costs low during construction, an unskilled labour force is largely employed - especially in developing countries - which contributes to poor construction and increased material wastage. The energy consumption profile of a building is typically stable for long term use, thus unsustainable construction practices can lead to higher energy consumption and waste.



Creating Green Jobs

Investing in retrofitting of the existing building stock - residential, commercial, and public buildings - has high potential to create new jobs. The direct effects for retrofitting buildings include jobs needed to implement energy efficiency measures, while the indirect effects are associated with the jobs needed to produce and supply energy efficiency equipment and materials. Most of the jobs created for retrofitting buildings are in the construction and manufacturing industries, with a wide range of compensation levels and technical specializations, including:



Electricians



Heating, Ventilation, Air Conditioning (HVAC) Technicians



Insulation Installers



Energy Auditors



Building Inspectors



Construction Managers

It should be noted that retrofitting commercial buildings can generate significantly more jobs than in the residential sector (Krarti & Dubey, 2018). Making buildings more energy efficient, especially in the residential sector, may have an impact on total employment through the creation of induced jobs, as a

result of reduced energy bills and therefore increased consumer. However, the employment and economic impacts of energy efficiency schemes and the associated supply chains can be highly regionalised. The benefits to the local economy will depend on the share of work undertaken by local firms, as well as the extent to which improved energy efficiency actually leads to a reduction in energy bills – which can be affected by other market factors. As noted by the IEA (2015), energy efficiency can also provide multiple benefits beyond energy savings, emissions reduction, and economic benefits. These can include improved energy security, reduced energy prices, improved health and wellbeing, improved air quality, and increased energy access.

The need to meet reduced carbon emissions is driving the construction sector to think more creatively about working and living spaces and how they are connected. For example, commercial buildings have significant potential to be converted into residential buildings. This process requires input from a full gamut of skillsets, from structural engineers and architects through electricians and construction workers. Moreover, repurposing commercial buildings for residential use can mean rethinking local transport and communication links, providing further employment opportunities in transport and planning. New concepts of what a neighbourhood should look like include the 15-minute neighbourhood (where every location within a 15-minute walk), offsetting the need for longer distance travel in carbon-intensive transport. This concept can be applied by modifying existing neighbourhoods, reducing the need for cities to continually expand outwards.

These new concepts are already being pioneered in cities like Paris, Melbourne, and Ottawa. Construction of green infrastructure can boost employment and the economy by encouraging the movement of employers into the area and increasing the value of local property. For example, the Glasgow Green Renewal Project led to an increase in council tax receipts by 47% (Wentworth, 2013). Green and greengrey infrastructure can also provide similar services to grey infrastructure but at reduced cost. For example, green and green-grey infrastructure in New York provided the same water quality benefits, but costing \$1.5 billion less than traditional grey infrastructure. Investments in cycling can cause significant economic benefits in addition to health and wellbeing. Cycling schemes in the UK, for example, can generate £35 in social benefits for every £ spent (Department of Transport, 2014).

With such significant economic and social benefits, green and green-grey infrastructure projects are expected to increase along with employment in this sector. In the UK, it is estimated that 5% of all jobs in England are in the green space sector (Wentworth, 2013). With such clear economic, environmental, and social benefits of green and green-grey infrastructure, there will be significant demand for employment in this sector. Eye-catching examples of a greener vision for the cityscape include the city of Glasgow's £115M "Avenues" programme, which is currently transforming the city centre into a greener space that is more sustainable and climate resilient.

The construction of green buildings that are resource-efficient and sustainable has the potential to create green jobs, including green designers, architects, auditors, engineers, estimators, project managers, etc. These are all green, high skilled, and decent jobs. Further indirect and induced jobs are created as these sectors grow and service the local economies in which they operate. The building sector is integrated within the larger built environment of open space, residential and commercial buildings, smart and low energy transport systems, and increasing use of public transport; construction of green and sustainable buildings further results in reduced emissions and additional green jobs (United Nations Department of Economic and Social Affairs, 2011)

2.2.2 Water and Waste

Water is essential to life, and thus the global water industry is considerable both in its economic value and its carbon footprint. Revenues for the water industry globally were approximated to be almost \$700 billion in 2018 (Research and Markets & Ltd, 2018). To decarbonize the water industry, it is vital to decarbonize the electricity industry that supplies this energy-intensive sector (Ainger et al., 2009), thus driving jobs in the renewable energy sector (albeit with net job creation dependent on the nature of the transition from thermal generation). Moreover, there are opportunities to exploit energy generated by the sector itself. One example is the use of anaerobic digestion to treat wastewater; the biogas excreted by the bacteria can be used power generation. This requires the construction of significant new infrastructure to move away from more traditional aerobic digestion, which will further create new (albeit potentially time-limited) jobs. A move to decentralized water systems which aggregate non-potable water from local stormwater (harvested

from rooftop and roadside gutters) and greywater, which can be used for irrigation, flushing toilets, and other uses activities for which the high standards of drinking water are not required [citation], can further reduce the sector's carbon footprint. This approach can reduce the environmental impact of a centralised water system (Marinoski & Ghisi, 2019), and would create jobs in construction, plumbing, and the installation of rainwater harvesting systems. Electricity demand-side management (EDSM), which optimizes when energy is used relative to peak hours, is also essential to reduce the water sector's environmental footprint (Ainger et al., 2009). This also requires a skilled and knowledgeable workforce.

Waste management is the cornerstone of the green jobs' mandate to "minimize waste and pollution", cutting across all sectors of economies, so that it has a complex impact on the green economy landscape. According to the ILO (2018), the world is using more resources and generating more waste than can be absorbed by the ecosystem. To combat this situation, the waste management sector is the fastest-growing sector, having grown by 45% between 2000 and 2007 (ILO, 2017a, p. 7). In addition to the resultant growth in employment, waste management jobs are moving from landfills to incineration and recycling, and transforming into more green activity jobs. This sector has the largest potential to create local jobs employed by municipal authorities and private enterprises. The ILO (2018, p. 52) projects that the waste management industry will create 45 million jobs by 2030. The waste management and recycling sector in many countries operates in both formal and informal economies, but the workers in these sectors play an increasingly important role, especially in the urban environment, whilst facing serious work-related hazards and social stigma. To meet the challenges of waste management, it is important to provide a legal and regulatory infrastructure to support the workers and provide decent working conditions. Integrating waste pickers into a formal economy will help develop the skill base, which is important to build the circular economy, formalizing knowledge about sorting waste. Several initiatives across many countries are focussing on developing a skilled workforce in waste management. For example, the Professional Federation of Recycling Companies (FEDEREC) in France, along with private companies, developed and formalized five different qualification levels to create skilled labour capacity for the sector: manual sorting operator, mechanized sorting operator, industrial team leader, industrial equipment operator, and industrial maintenance operator (ILO, 2018).

2.2.3 Industries and Manufacturing

Industry is a very heterogeneous sector that comprises many subsectors. Industrial emissions are currently larger than the emissions from either the buildings or transport end-use sectors, representing just over 30% of global GHG emissions in 2010, and continue to increase (IPCC 2018). Despite the declining share of industry in global gross domestic product, global industry, and waste / wastewater GHG emissions grew from 10.4 GtCO₂eq in 1990 to 13.0 GtCO₂eq in 2005, to 15.4 GtCO₂eq in 2010. However, country-specific trends show a clear divergence between major emerging countries and the rest of the world. For example, the sharp rise in industrial emissions recorded during the 2000s occurred almost entirely in China (Climate Chance, 2019).

Internationally, the industrial and manufacturing sector employs 23% of the global workforce, a trend that has not changed significantly between 1991 and 2019, with the share staying between 20 and 25% over this period (International Labour Organization, ILOSTAT database, data retrieved June 2020). However the regional distribution of industry jobs has changed significantly, with notable growth in the share of employment in the East Asia and Pacific, South Asia, and Middle East and North Africa regions. This has occurred in conjunction with relative declines in the North America, Europe and Central Asia, and Latin America and Caribbean regions. These trends also indicate that, while some countries have significantly reduced their industrial emissions, it is likely that production has simply moved overseas, contributing to global reliance on imports for key materials.

Reducing emissions from industrial processes and manufacturing remains one of the key challenges facing meeting global climate targets. This is especially true for products and commodities such as steel, cement, and chemicals, all of which remain important components of global economies and continue to support the supply chains of sectors we would class as low carbon, such as renewable energy and low carbon transport. The need to mitigate emissions from electricity production may actually result in increased product demand and sectoral expansion. While this could result in job, GDP, and income retention in countries with strong industrial sectors, it is important that steps are taken to reduce emissions from industrial processes in supply chains and move towards more sustainable practices. As noted in

Chapter 1, this is being prioritised in some countries, such as the UK, where there is an ambition to reduce emissions from key industrial processes while retaining the jobs and economic contribution that these sectors provide.

Steel, Cement, and Chemicals

The production of key industrial materials such as steel, cement, and chemicals is currently central to economic development and social prosperity, as well as providing many decent jobs. However, the emissions associated with creating such products are often high and difficult to abate, due to the requisite physical and chemical reactions, and the need for high process temperatures (IEA, 2019c). This presents a key challenge for economies that are reliant on the economic output associated with industrial processes and, thus, the jobs supported. While the IPCC consider that industrial emissions could be reduced by approximately 25% through widespread upgrade, replacement, and deployment of the best available technologies - and an additional 20% through the deployment of further innovation - it is recognised that emissions from these sectors must be reduced even further (Fischedick & Roy, 2020).



The IPCC recognises that longer-term options for industry, which would allow them to reduce emissions in line with global targets and retain (and create further) jobs, may include transitions to low-carbon electricity, radical product innovations (i.e. an alternative to cement), and Carbon Capture and Storage (CCS). Whichever options are implemented in each sector, which may depend heavily on cost-competitiveness, there will be impacts on jobs. For example, the electrification of steel manufacturing would require growth in the electricity sector and the jobs needed there, while the deployment of CCS will be associated with jobs in providing carbon transport and storage, or in hydrogen production.

For example, enabling deep emissions reductions at source, by applying carbon capture in industry production, supported by a transport and storage infrastructure, is key to both meeting climate targets and ensuring protection and opportunities for workers currently employed in those sectors (ETIP ZEP, 2018). Without that, and while the global demand for products such as steel, cement, and chemicals remain, there is a risk of displacing emissions across borders. This could lead to a net increase in global emissions as national climate legislation and regulation may be less robust in the recipient nation of production relocation. The relocation of key industries to other nations also has implications for national economies as jobs, wage incomes, and GDP more generally may be lost.

2.2.4 Bioeconomy

Traditional Bioeconomy

The transformation of natural resources into products for domestic, commercial, and industrial use has played a crucial economic role across countries. Forests provide abundant natural resources, and uniquely stabilize climate, protect water, and soil, and maintain biodiversity. Forests serve as carbon sinks, absorbing carbon from the atmosphere and storing it in the wood, soil, and other organic material. Sectors that rely on biological resources in both terrestrial and marine ecosystems are primary production systems: forestry, agriculture, and fisheries. Industries use biological resources to create food, feed, fibres, biofuels, and bioenergy. The forestry sector is considered to be a significant source of wealth and employment, especially in developing countries. However, unsustainable practices in the bioeconomy sector have caused deforestation and contributed significantly to global warming. This has led to employment challenges within

the sector. Sources of employment in the forestry sector include forestry and logging, wood manufacture (hardwood products, except furniture), and paper manufacture (pulpwood products). However, not so commonly considered is non-timber forest products (NTFP) such as building materials, medicine, food, and crafts.

Broadly, the bioeconomy sector involves both formal and informal employment, creating challenges for accounting for jobs that may be largely unreported, and where the nature of work can be seasonal and often part-time. Moreover, most national statistics account for forestry employment aggregated with agriculture, fishing, and hunting, which further masks accounting challenges. However, with the new ways of production and consumption, modernization and innovation has significantly transformed forestry sector, especially in developed economies. The bioeconomy is integrating the business process model whilst reducing pollution (afforestation) and fostering economic development – i.e. increased interest in forest-based products. For example, there is a strategic push in Europe to increase the use of wood in the energy, housing, and construction sectors. The prices for quality sawn logs in Europe increased by more than 10% in 2018. As the production and processing of wood is highly energyefficient, it is being used as a substitute for materials that require energy-intensive production processes, such as steel, aluminium, concrete, or plastics (Alan Buis, 2020).



There are several key employment benefits provided by sustainable forest management. Practicing sustainable forest management means that forests will be maintained for as long as there is market value or legal protections. This provides long-term employment opportunities for rural economies. Figure 4 is an example of the fields of professional activities in the forestry sector under seven thematic areas. However, the potential for green forestry jobs differs by region and country, and largely depends on local policies.

Forestry	
Health & Recreation	Recreation, leisure and sports
	Forest Ecotherapy
Education & Research	Forest research
	Education, further training and knowledge transfer
Wood & Energy Production	Wood production
	Energy production
Agroforestry & Mountain Forestry	Agroforestry
	Mountain forestry and soil bioengineering
Social & Urban Development	Urban forestry and aboriculture
	Culture and forests
Forest Management, Inventory & Planning	Forest inventory and forest monitoring
	Pests, disease and fire control
	Planning, governance, sustainable forest management
	Risk management and contingency planning
	Biodiversity and nature protection
Biodiversity & Ecosystem Functioning	Climate change
	Forests and water
	Mycoforestry

Figure 4 – Professional Forestry Sector Activities in Seven Themes.
 Source: UNECE/FAO Forestry and Timber Section, 2018, p. 65

Trends in Education and Capacity Building

Forest research activities evolve and adapt continuously to changing social, economic, and environmental circumstances. In the past, research programmes were mostly concerned with optimizing forest management practices. Today, however, the emphasis of forest research seems to have switched to tackle more fundamental and specific subjects. These include climate change effects and phenology (modelling scenarios), biodiversity, ecosystem interaction, and biotechnology.

Opportunities and Prospects for the Forestry Sector

As the world attempts to mitigate climate change and transition towards sustainable economies, relevant interdisciplinary research is critical to support economic and political decisionmakers in designing effective public policies. This is particularly true in the area of forestry research, in which diverse work opportunities

abound. Funding is also available for international collaborative research. One such source of funding, targeted at helping developing countries maintain their forests, is the UN-REDD Programme developed under the United Nations Framework Convention on Climate Change (UNFCCC). The UN's REDD (Reducing Emissions from Deforestation and forest Degradation) Programme offers incentives to nations to invest in sustainable development and reduce emissions for forested lands, essentially creating financial value for forests. The programme offers results-based payments for actions which preserve the carbon sequestration capability of existing forests. Further, the enhanced REDD+ programme goes beyond simply preventing deforestation and forest degradation.

REDD+ emphasizes the role of conservation, sustainable forest management, and enhancement of forest carbon stocks. Capacity building to develop and implement REDD+ strategies is supported by financial and technical assistance from the REDD Programme, as well as the Forest Carbon Partnership Facility (FCPF) and Forest Investment Program (FIP) - both of which are facilitated by the World Bank (Dave, 2020).

Making Strides with its National Forest Monitoring System

The Republic of the Congo joined the UN's REDD programme in 2010, and the programme has helped the Congo forge an economic development pathway in which the critical role of forests for climate change mitigation and green economy is recognized. With REDD guidance, the country has made great strides in strengthening its National Forest Monitoring Systems, and the republic was one of the first African nations to submit forest reference emission levels to the UNFCCC. Under the REDD programme, the country has developed a REDD+ investment plan, highlighting its progress in REDD+ results verification. The Congo is also focusing on climate-smart agriculture and sustainable forest management. The nation is building capacity in remote-sensing and mapping and data collection, which feeds detailed strategic analyses to guide sustainable forest management planning and implementation. In addition to the environmental benefits, these practices are essential for the country's population - 4.6 million people's livelihoods depend on the forests. The programme has fostered awareness regarding the value of the nation's forests, and emphasized the need to use its products sustainably (UNREDD Programme, 2018).



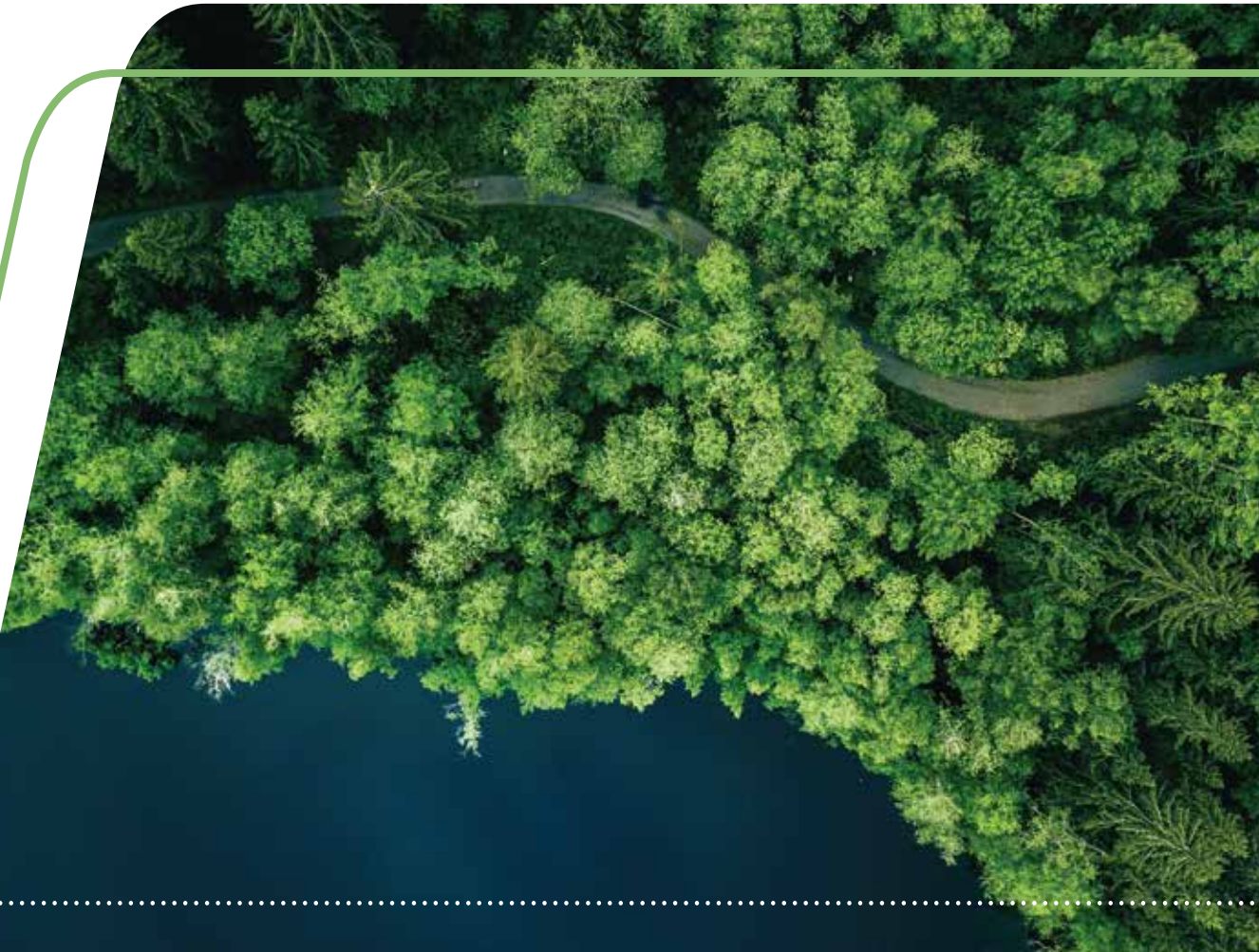
Forest Skills and Expertise

In general, a command of scientific methodology, data and statistical analysis, and scientific writing are needed. Researchers need to have the ability to analyse and investigate a specific topic or problem in a very detailed and scientific manner. Moreover, they should be able to devise a clearly defined and objective methodology to attempt to solve scientific problems. Drafting and composing research proposals, as well as the ability to teach and supervise students are also skillset requirements for researchers.

Broadly, the forestry sector needs qualified workers; while training schools exist to fill this need, the number of forestry training candidates are declining. This decline may be partially due to the high number of workplace accidents. One potential source for forestry employees is mid-career workers looking for a change. Training and retraining programs could be implemented to take advantage of this labour pool. More importantly, forestry training programs need to be updated with a focus on green practices, considering forestry as part of a green economy. This could include increasing the emphasis on new forest areas, building new forestry

value chains (textiles, construction, bioplastics, chemicals), and eco-tourism as a new forest business. Diversifying away from traditional wood-based value chains in this manner will create jobs and income opportunities in rural areas, and place forestry in a foundational role to create a strong bioeconomy

In 2018, forestry and extended wood-based value chains employed 4.5 million people in the European Union. Employment in traditional wood-based value chains decreased between 2008 and 2013; this continuing loss of jobs, mostly in solid wood, pulp, and paper manufacturing, has been largely driven by increasing productivity and decreasing demand for paper. In addition, most wood-based employment in the EU is downstream of forestry, though this is not the case in some Eastern European countries (Robert et al., 2020).



2.3 Tertiary

2.3.1 Transport

Land transport employs over 60 million workers around the world, representing more than 2% of global employment (ILO and UNECE, 2020), with many more indirect jobs in associated supply chains. By its nature transport is a sector that is crucial to reducing poverty and boosting societal and economic prosperity. Transport infrastructure connects people to jobs, education, and health services and enables the supply of goods and services around the world (The World Bank, 2020). However, because the vast majority of land transport relies on fossil fuels, and is associated with high levels of pollution it is essential that the sector evolves to lower emissions, lower pollution, and more sustainable practices. The transport sector accounts for 64% of global oil consumption, 27% of all energy consumption, and 23% of the world's energy-related CO₂ emissions (The World Bank, 2020).

However, the emissions associated with the transport sector in the future are highly dependent on transport trends in both developed and developing countries. The World Bank predicts that the number of vehicles on the road will double and reach 2 billion by 2050 (The World Bank, 2020). They note that as the developing world rapidly urbanises, there is an opportunity to build safer, cleaner, and more efficient transport systems that reduce congestion and pollution, facilitate access to jobs, and decrease energy consumption.

Green Job Opportunities

Reducing emissions from the transport sector in line with pathways compatible with a 1.5° C scenario may include a range of options that will all have a varying impact on sustaining and creating new jobs in the sector. These include avoided journeys and modal shifts due to behavioural change, adoption of improved vehicle and engine performance technologies, low carbon fuels, investment in related infrastructure, and changes to the built environment (Department for Transport, 2018). In countries such as the UK, policies have been introduced that ban the sale of petrol and diesel vehicles by the 2030s (Department for Transport, 2018); therefore, the speed of the transition will have been determined by governmental policy.

As noted by the ILO in their 2020 report, the evolution of the transport sector to one that is more sustainable will have a direct impact on jobs, both direct and indirect. Since such a transition alters the demand for certain modes of transport and this, in turn, influences demand for related goods and services, sustainable transport will necessarily involve the creation of jobs in some sectors and employment destruction in others (ILO and UNECE, 2020).

Electrification of Transport

The electrification of private transport is seen as one of the leading options for reducing emissions from that sector. The ILO estimate that the introduction of targets for all vehicles manufactured to be electric would result in a net total of almost 10 million jobs being added to world employment across all sectors (ILO and UNECE, 2020) by 2030. This transition is already well underway in countries such as Norway where over 60% of new car sales are now associated with electric vehicles (Ulven, 2020). The transition to electric vehicle production and sale for large automotive companies across the world is also increasing, which will be important for sustaining jobs in that sector. However, as EVs are simpler in mechanical terms and the motors have fewer component parts, it is likely that the value added by component suppliers may reduce compared with the production of conventional vehicles (PWC, 2019). The production of batteries is also largely being undertaken by companies outside the auto supply chain which creates new competition for legacy suppliers.

The transition to electric vehicles provides opportunities for other supply chains not previously attached to transport. For example, the electrification of private transport will significantly increase the demand for electricity, supporting more jobs in that sector. As this sector decarbonises with more renewable generation, it also creates opportunities for the creation of green jobs. Significant upgrades may be needed to the electricity network infrastructure to facilitate the implementation of electric vehicles, which will support jobs in the construction sector along with the manufacturing and production of the requisite materials (Alabi et al., 2020). The transition to electric vehicles may also support jobs in the service sector, if reduced operational costs results in increased discretionary incomes.

However, not all the impacts on employment as a result of electrification will be positive. Sectors such as oil and gas may face a reduced demand for transport fuels which could put jobs in that sector at risk. The net economic impact felt across different countries will depend on whether they are a net importer or exporter of hydrocarbons. The negative impact on people employed in conventional vehicle manufacturing will be reduced if manufacturers can adapt to the production of alternatively-fuelled vehicles. A key question remains, regarding the supply chains required to manufacture electric vehicles, and how many of the jobs in associated in their manufacture can, or should be, classed as green.

Public Transport

The increasing use of public transport is also seen as a feasible option for increasing the sustainability of transport. The ILO estimates that increasing the use of public transport by doubling investment and making public transport free could create at least 2.5 million additional jobs in the transport sector worldwide by 2030. This increases to at least 5 million jobs if the wider impact on other sectors of the economy is considered. However, public transport sectors will also need to reduce emissions and move to more sustainable practices if global emissions targets are to be met. Currently leading options include the electrification of rail transport and the use of alternatively-fuelled (such as hydrogen) buses.

2.3.2 Finance and Banking

The 2014 World Economic Forum suggested that about \$5.7 trillion would need to be invested in green infrastructure by 2020, largely in developing countries (Frankfurt School of Finance & Management – UNEP Collaborating Centre for Climate & Sustainable Energy Finance, 2014) to ensure a successful transition towards a green economy. In 2018, global investments in the low-carbon energy sector were \$620 billion (IEA, 2019d); growth had remained flat since 2016. Since then, investments have stabilized at \$600 billion per year. However, as the deployment costs of some technologies have continued to decrease, there has been a steady increase in capacity building in solar photovoltaic, wind energy, and electric vehicles (IEA, 2020a,b). Investments in battery storage and energy efficiency measures deployed at the end-user-level

have increased. Despite these positive developments, current energy investment expenditures are not aligned to meet UN sustainable development goals (IEA, 2020b); the low level of investments can adversely impact the ongoing transition of labour from brown to green jobs, as well as the process of building skilled labour workforces.

Sustainable Investing

Sustainable investments in low carbon and clean energy are directly linked with a country's financial access to domestic public and private finance and foreign direct investments. Sustainable investing has grown over the years, and more than one-quarter of assets globally are being invested by institutions under ESG (environment, social, and governance) portfolios. The world's largest institutional investors - Japan's Government Pension Investment Fund, Norway's Government Pension Fund Global, and Dutch Pension Funds-ABP, practice sustainable investing. Similarly, many institutional investors in Europe and North America have allocated portfolio funds to ESG factors. In 2016, sustainable investments constituted 26% of assets – a sum of \$22.9 trillion - which were professionally managed in Asia, Australia, New Zealand, Canada, Europe, and the United States. The share of sustainable assets had increased by 4.5% over the four years leading up to 2016 (Bernow et al., 2017).



“Sustainable investing has grown over the years, and more than one-quarter of assets globally are being invested by institutions under ESG portfolios.”

Shareholder Engagement

The scale of allocations to sustainable investments is evolving and growing rapidly. Through 2013, Europe had the highest proportion of assets, but between 2014

to 2016, the share of assets allocated to sustainable investments grew faster outside Europe, with the biggest growth seen in Japan, Australia/New Zealand and Canada. The motivations behind this growth are primarily threefold: obtaining positive return on investments, increasing firms' market value, and aligning with the demands of shareholders and the public to invest in sustainable development and climate protection (Bernow et al., 2017).

Indirect Green Jobs

The financial sector is evolving and growing along with changes in the banking sector. The increasing availability of green finance through green bonds, loans, and various other banking instruments are encouraging long-term investments in developing low-carbon economies, contributing towards meeting the objectives of UN Sustainable Development Goals.

Though there is no directly supporting data, it is reasonable to conclude that the finance and banking sectors have been creating green jobs globally by diversifying their investment portfolios.

2.4 Quaternary

2.4.1 Information Technology

Electronics waste (e-waste) is an income-generating resource for developing countries and categorised discreetly within the informal recycling sector. Predominantly, management of e-waste employs poor and unskilled workers, working in unsanitary health conditions (Lundgren, 2012). In addition, the activities for handling e-waste operate under illegal conditions in mostly developing countries. Formalization of this sector is crucial in maintaining environmental resources, protecting human health and welfare, and creating skilled green jobs. Indeed, among all types of waste management, recycling creates the most jobs. As electronics continue to become prevalent through all aspects of our lives, the electronics recycling market will continue to grow. In the UK for example, a new commercial refinery to extract precious metals from e-waste using bacteria (Palmer, 2020) is planned. E-waste management systems have substantial potential for long-term green job creation. Managing e-waste effectively and efficiently is an important stage in the transition to a green economy (Lundgren, 2012).

Energy-intensive Infrastructure

In the absence of a common international standard for manufacturing IT products, companies follow their own standards. The material used for manufacturing electronic devices often contain several toxic metals, and high volumes of water are consumed during the manufacturing process. Lifecycle management of IT systems present numerous opportunities for new, green IT jobs.

2.4.2 Green Research and Development

The UK Forestry Commission's Research Agency (2017) describes their research as regarding "social, economic, and environmental aspects of sustainable forestry in a multifunctional landscape". The scope of the agency's research agenda includes the following topics, among many others:



Forest Mensuration



Modelling and Forecasting



Land Regeneration (Afforestation)



People, Trees, & Woodlands (The Relationship Between Forestry and Society)



Forest Management (Silviculture)



Tree Improvement (Genetic Variation, Breeding)



Biodiversity (Ecosystem Services, e.g. Wildlife Management, Flood Mitigation, Carbon Sequestration)

Another focal area of forestry R&D is that of improving the physical properties of wood, in an attempt to broaden the uses to which wood can be applied. For example, some research is targeted at chemical treatment of wood to make it more robust with respect to various modes of degradation. Another area of research is that of identifying special structural characteristics of wood, in order to develop novel wood uses inspired by nature.

2.4.3 Education, Training, and Continuous Learning

Adapting to climate change and transitioning to a greener economy will require structural transformations across all economic sectors. These structural transformations will be driven largely by the changes in the physical environment, changes induced by government regulations – i.e. deploying efficient technologies - and changes in consumer demand. These effects significantly impact employment to drive the transition, and thus there is a need for coherent strategies to align education and government institutions to enable a smooth transition towards a sustainable future (Gregg et al., 2015).

The availability of skilled labour is a fundamental requisite for the transformation towards low-carbon, green, and sustainable economies. Effective transformation depends upon a shift from existing skillsets to newer skills, which can be achieved by either upskilling existing skills or introducing new jobs. In either case, investments in education and training programs will be needed to build capacity.

While structural changes in the economy will decrease demand for certain occupations, many existing skills can be applied to another sector, enabling workers from declining occupations to transition to new occupations (Gregg et al., 2015). For example, some fossil fuel industry employees will be able to transition, with additional training, to the alternative energy generation industry with relative ease, as there are many similarities in operations.

In order to realise the potential of green jobs in the green industry, it is imperative to have sufficient education and training infrastructure to create the capacity for a skilled workforce to meet demand. This is an area in which the role of an integrated public policy approach becomes particularly important to:- maximize

the potential for skill development by integrating environmental awareness and technical training at all levels of the education system (Llina et al., 2010; Cedefop, 2019). In addition to contributing to the development of a skilled workforce to meet future needs for a greener economy, this will also promote changes in consumption behaviour, and prod market forces to adopt green or low-carbon pathway.

A study comparing the skills and human capital between green and non-green jobs using data from the United States of America revealed that green jobs use more high-level skills than nongreen jobs (Consoli et al., 2016). For new green occupations, higher levels of analytical skills are desired. Importance is also given to formal education, work experiences, and on-the-job training. Transitioning from non-green jobs to green jobs is further facilitated by on-the-job training, as the skills between the two sectors are easily transferrable.



Case Study

The UAE government has selected ten economic sectors to create green jobs and to implement its strategic vision to meet the objectives set in the UAE Green Agenda 2030. The sectors on which the UAE is currently focusing for the creation of green jobs are energy, waste management, manufacturing, buildings & construction, agriculture, forestry and fisheries, transportation, services, academia, and the public sector (MOCCA, 2019). Table 9 details the number of direct green jobs in these ten sectors from 2018, with forecasts for 2021 and 2030; sectors with italicized forecast job quantities are assumed to have no growth.



	2018	2021	2030
Energy	3,510 (7.1%)	14,484 (21.4%)	15,782 (18.9%)
Renewable Energy*	1,120	9,634	5,712
Energy Efficiency	200	850	2,400
District Cooling	2,190	4,000	7,670
Waste Management	12,636 (25.5%)	16,515 (24.4%)	21,408 (25.7%)
Collection	7,400	7,400	7,400
Recycling	1,436	4,725	9,450
Waste to Energy	0	590	758
Wastewater	3,800	3,800	3,800
Manufacturing	3,000 (6.1%)	3,050 (4.5%)	3,108 (3.7%)
Buildings & Construction	2,687 (5.4%)	2,700 (4.0%)	2,750 (3.3%)
Agriculture	1,270 (2.6%)	1,520 (2.2%)	2,270 (2.7%)
Forestry	0 (0.0%)	0 (0.0%)	0 (0.0%)
Fisheries	223 (0.5%)	370 (0.5%)	600 (0.7%)
Transport	5,376 (10.9%)	7,719 (11.4%)	14,750 (17.7%)
Services	6,914 (14.0%)	7,395 (10.9%)	8,850 (10.6%)
Financial Services	64	70	100
Professional	450	450	450
Wholesale & Retail	400	400	400
Tourism	6,000	6,475	7,900
Academia	154 (0.3%)	154 (0.2%)	154 (0.2%)
Public Sector	13,750 (27.8%)	13,750 (20.3%)	13,750 (16.5%)
Total	49,520	67,657	83,422
(Nuclear power)		17,000	

Table 9 - Preliminary forecasts of green jobs per year in the UAE. *Excluding manufacturing. Construction jobs counted as up to 2018 no longer exist; construction jobs counted for 2021 and 2030 will also cease after completion. Italicized quantities indicate an assumption of no growth due to a lack of projections. Source: (MOCCA, 2019).

According to the UAE Green Jobs Program, the total share of green jobs in the UAE as of 2017 was 0.7%. In 2019, the public sector was said to have the largest share of green jobs – at 27.8% of the total, followed by waste management at 25.5%, tourism at 12.1%, transportation at 10.9%, and energy at 7.1%. These proportions are expected to shift in 2021 through 2030, with the majority of green jobs expected in renewable energy, waste management, and transportation. However, this evolution must be driven by increased investment and private participation. By 2030, more than a quarter of green jobs are forecast in waste management, 19% in energy, and 18% in transportation (MOCCA, 2019). The UAE is one of the few countries that have developed and utilized a macro-economic model using scenario analysis to estimate the economic impact of the green economy, especially for job creation. According to the scenario analysis, the green economy has the potential to create between 139,000 and 165,000 new jobs in the UAE across different sectors by 2030 (MOEW, 2014).

The UAE Green Agenda 2030, aimed at creating green jobs, is evolving and expanding to include more occupations and industries within the green economy. As the concept of green jobs is developing and being adopted by industries, the private sector, and government, the number of forecast green jobs is likely to change.



3. Impact of Investment in Renewable Energy on Green Jobs



3.1 The Role of Renewable Energy in Supporting the Economic Development of Nations

Almost all countries in the world have committed to developing national renewable energy policies. From resource-rich to resource-poor countries, all have embarked upon having a share of renewable-based energy systems. Renewable energy is not only important for clean energy, it also creates employment opportunities. Specifically, transitioning to renewable energy can create green jobs across a range of sectors, expanding capacity and creating jobs (direct and indirect) along required supply chains and in infrastructure creation, management, and operations. In addition, implementing renewable energy creates demand for research and development and encourages innovation, along with the development of infrastructure and production. In a developing country context, the more locally-distributed access to electricity offered by renewables over thermal generation and large-scale grid distribution, is also proving crucial in creating economic capacity, increasing educational attainment and, thus, enabling opportunities for more inclusive economies to emerge (IRENA, 2016, p. 32). This extends the consideration of green jobs in comprehensive ways across developing and emerging economies. It brings divergence in terms of the types of issues that need to be considered in the case of countries where renewable energy systems are replacing existing systems, as compared with those in which renewables are, in fact, allowing systems to develop for the first time.

Generally, challenges are often defined at the national level, and within regions therein. Where investment in and deployment of renewables enables new capacity development net impacts are likely to be positive, with the challenge being in ensuring the equity and inclusivity of outcomes, and the quality of green and other jobs created. On the other hand, where renewables are replacing existing ways of providing energy in particular and capacity more generally, the net impact on different types of jobs and supply chains could be negative. This is not limited to how systems operate, but also concerns how new infrastructure creation, supply chains, and associated jobs may

become more import-intensive in the context of renewables than they have historically been with energy supply dependent upon fossil fuels.

Thus, national-level policies and regulations have played an important role in the successful implementation of renewable energy projects across the world. Policy and regulatory instruments, such as incentives and financial tools, continue to strongly support the adoption of renewable energy, but with many renewables solutions increasingly becoming commercially competitive and viable. Legislation regarding developing renewable energy and energy efficiency programs has enabled the creation of new enterprises, many of which involve existing but transitioning energy supply actors. Particularly where existing capacity and expertise can be exploited, the interdependencies between sectors and markets results in job creation and/or replacement in the manufacturing sector, indirect supply chains (i.e., metals), and the services sector, play a crucial role in developing the green economy and jobs.

“Transitioning to renewable energy can create green jobs across a range of sectors, expanding capacity and creating jobs along required supply chains and in infrastructure creation, management, and operations.”

3.2 Role of Policies

For most nations, renewable energy technology has become increasingly cost-competitive over time, in large part due to governmental support and technical advancement to enable acceleration in the rate of investment. An IRENA (2016) report suggests the share of renewable energy in the energy mix will double by 2030, increasing global GDP between USD 700 billion to 1.3 trillion. Such development is directly related to the increased investment in renewable energy deployment creating opportunities for other sectors and creating direct, indirect, and induced jobs. Renewable energy demand-side programs at the community level have largely been regarded as successful, given more local control at the community level, and, in contexts where renewables bring benefits not already provided at all or by existing (or, indeed, often nonexistent) systems, greater security of energy production and access through the local distribution of energy. Features like these contribute to the UN's sustainable development goal for energy access. Community-level renewable energy projects also create local employment, both direct and indirect supply chain and capacity creation. Generally, the economic impacts of renewables often resonate beyond direct energy supply and demand; in many cases with the shift positively impacting social and economic wellbeing, and generally enabling a net reduction in negative environmental externalities.

One area where the adoption of renewables initially progressed slowly in many national contexts is in terms of end-user responses to micro-generation options in the building and industry sectors, where high upfront costs for installation have constituted a barrier. However, the decreasing cost of renewable energy technologies – especially solar photovoltaic panels has given rise to a new segment of energy consumers: “prosumers”. Prosumers are consumers of the electricity who produce some of their own energy. This may be either at home, at the community-level, or by commercial or public institutions. Prosumers are not in the business of electricity generation for profit, but instead generate to service their own consumption (although there may be effective ‘trade’ with network suppliers in balancing the supply/demand needs on both sides).

Of course, while increased micro-generation and prosumer activity is good for the environment, and helps reduce the carbon footprint of energy generation where operational supply chain activity may be limited, there may be unintended consequences. For example, while micro-grids may help limit distribution network demand, the rise of prosumers has created problems for traditional energy generators and network companies, as they have lost customer demand and the associated revenues. These further triggers unemployment pressures, which largely impact green jobs (Sajn, 2016). The installation of solar panels for prosumers may create jobs, but with current lack of data regarding the extent to which traditional jobs have transitioned in this direction.

On the other hand, in terms of the system scale supply of energy, many analyses predict that the transition to renewables (utility-scale solar PV, wind, and technologies), will ultimately contribute substantially to indirect employment gains by 2050 (IRENA, 2016). In fact, indirect employment gains from these transition activities are argued to be likely to outweigh new direct jobs at least in some timeframes. Take for example wind power projects. During the planning stage, legal and technical expertise contribute more jobs than across construction and operations and maintenance (O&M) combined. On the other hand, sustained job creation in operational phases may be more challenging in many regional contexts in what tend to be lower labour intensity activities, often with limited local supply chain requirement (IRENA, 2016)



Country/Region (source)	Year (Forecast)	Analysed Policy Intervention	Impact on GDP	Impact on Employment
Chile (NRDC and ACERA, 2013)	2028	20% Renewables in electricity generation (excl. large hydro)	+0.63% (USD 2.24 billion)	7,800 direct and indirect jobs (+0.09%)
European Union (European Commission, 2014)	2030	-40% greenhouse gas emissions in 2030	+0.46%	+1.25 million economy-wide jobs (+0.5%)
Germany (Lehr et al., 2012; Blazejczak et al. 2014; Bohringer et al. 2013)	2030	Different targets for renewable energy deployment	Up to +3%	From negative to +1% on net employment
Ireland (Pöyry Management Consulting and Cambridge Econometrics, 2014))	2020	Meeting the target for wind by 2020	+0.2% to +1.3%	+1,150 to +7,450 net jobs
Japan (IRENA and CEM, 2014)	2030	Adding 23.3 gigawatts (GW) of solar PV	+0.9% (USD 47.5 billion)	None
Mexico (own calculations based on PwC, 2015)	2030	21 GW of additional renewable power capacity	+0.2%	+134,000 in the sector
Saudi Arabia (own calculations based on K.A.CARE, 2012)	2032	54 GW of renewable	+4% (USD 51 billion)	+137,000 in the sector
United Kingdom (Cambridge Econometrics, 2012)	2030	Larger role of off-shore wind instead of natural gas	+0.8%	+70,000 net employment
United State of America (ICF International, 2015; Synapse Energy Economics et al. (2015))	2030	Decarbonisation driven by renewable energy	+0.6%	+0.5 to +1 million net

Table 10 - Previous Studies on the Projected Economic Impacts of Renewable Energy Deployment. Source: IRENA (2016).

An IRENA (2016) report highlights the role of policy intervention in the deployment of renewable energy, which should serve to help create more green and decent jobs. Table 10 suggests that anywhere between a few thousand and over a million jobs could be created by 2030, where realisation of the latter result requires effective implementation of regulations and policies to promote renewables. As discussed in Chapter 2, there are operational commonalities between fossil fuel-based sectors and low carbon energy generation. The skills employed are similar, and may only need the support of training programs to transfer. Thus, jobs lost in one sector can be transferred to the other. However, policy attention must be directed at ensuring the outcome is one of largely offsetting job losses in fossil fuel-based energy sectors at the regional and national levels. This is crucial if political and societal consensus is to develop around whether transition pathways can continue to deliver the same quality of jobs and prosperity that may have been enjoyed historically (OECD, 2017a).

On the other hand, some studies (IRENA, 2016) suggest that utility-scale solar PV energy generation has the potential to create more than twice the number of jobs per MWh of electricity than either coal or natural gas combustion. The distribution and assembly of solar panels, and the provision of post-sale service, creates additional jobs. Again, the question is whether activities like these will deliver an outcome in which transitioning away from fossil fuel to renewable energy result in sustained net increases in quality employment over time (IRENA, 2016).

As the falling cost of technology drives employment growth in installation and subsequent operations and maintenance requirements, it introduces challenges for suppliers and causes manufacturing jobs to shift to developing countries. This geographical shift has been observed over the past few years, as the combined share of the EU and US in global employment over time – i.e. throughout operational phases (IRENA, 2016).



3.3 Current Trends

Investment in Renewable Energy

The IEA 2019 World Energy Outlook (IEA, 2020a, 2020c) shows that capital expenditures for renewable energy increased in 2019 by 1% in onshore wind and hydropower, but declined in solar PV. However, the overall levelized cost of electricity has decreased for the three technologies, due to the decrease in capital investment costs in 2018. The IEA World Energy Outlook 2019 provides a scenario-based estimate to explore different possible futures trends of investments. The two scenarios - Stated Policies Scenario (STEPS) and Sustainable Development Scenario (SDS) - are used to estimate the global average investment in renewables; the definitions are listed below, with observed investment amounts in table 11.

	Stated Policies		Sustainable Development		Chance in 2018 vs 2031-40		
	2018	2019-30	2031-40	2019-30	2031-40	STEPS	SDS
Renewables-Based Power Generation	304	329	378	528	636	24%	109%
Wind	89	111	122	180	223	37%	151%
Solar PV	135	116	125	179	191	-7%	41%
End-Use Sectors	25	117	139	124	145	456%	480%
Total	329	456	517	652	781	57%	137%
Cumulative		5,477	5,166	7,829	7,802		

Table 11 - Global annual average investment (billion USD 2018) in renewables by scenario. Source: (IEA, 2019c)

Stated Policies Scenario

The Stated Policies Scenario reflects the impact of existing policy frameworks and today's announced policy intentions. The aim is to hold up a mirror to the plans of today's policymakers and illustrate their consequences for energy use, emissions, and energy security (International Energy Agency).

Sustainable Development Scenario

The IEA's Sustainable Development Scenario (SDS) outlines a major transformation of the global energy system, showing how the world can change course to deliver on the three main energy-related SDGs simultaneously (IEA, 2020c).

Case Study

Renewable energy, in addition to being critical for a sustainable future, is expected to have a substantial positive impact on jobs. An article by Ram et al (2020) detailed the results of extensive analysis of how renewable energy can contribute to the creation of green jobs. The authors focused on the impact to jobs from increasing the adoption of renewable energy technologies, such that 100% of global energy needs would be renewably supplied by 2050. Their analysis is based on an analytical job creation assessment of the global power market, by region, using the LUT Energy System Transition modelling tool which simulates an energy system under given conditions, s applied for 5-year time periods from 2015 to 2050. The study shows the number of jobs gained in the global power sector from 2015 to 2050, in solar PV, concentrated solar thermal power, wind turbines, hydropower, geothermal, bioenergy, nuclear, and coal- / oil- / gas-fired combustion plants. Storage technologies included lithium-ion batteries, pumped hydro storage, adiabatic compressed air energy storage, air energy storage, and gas storage (including power-to-gas).



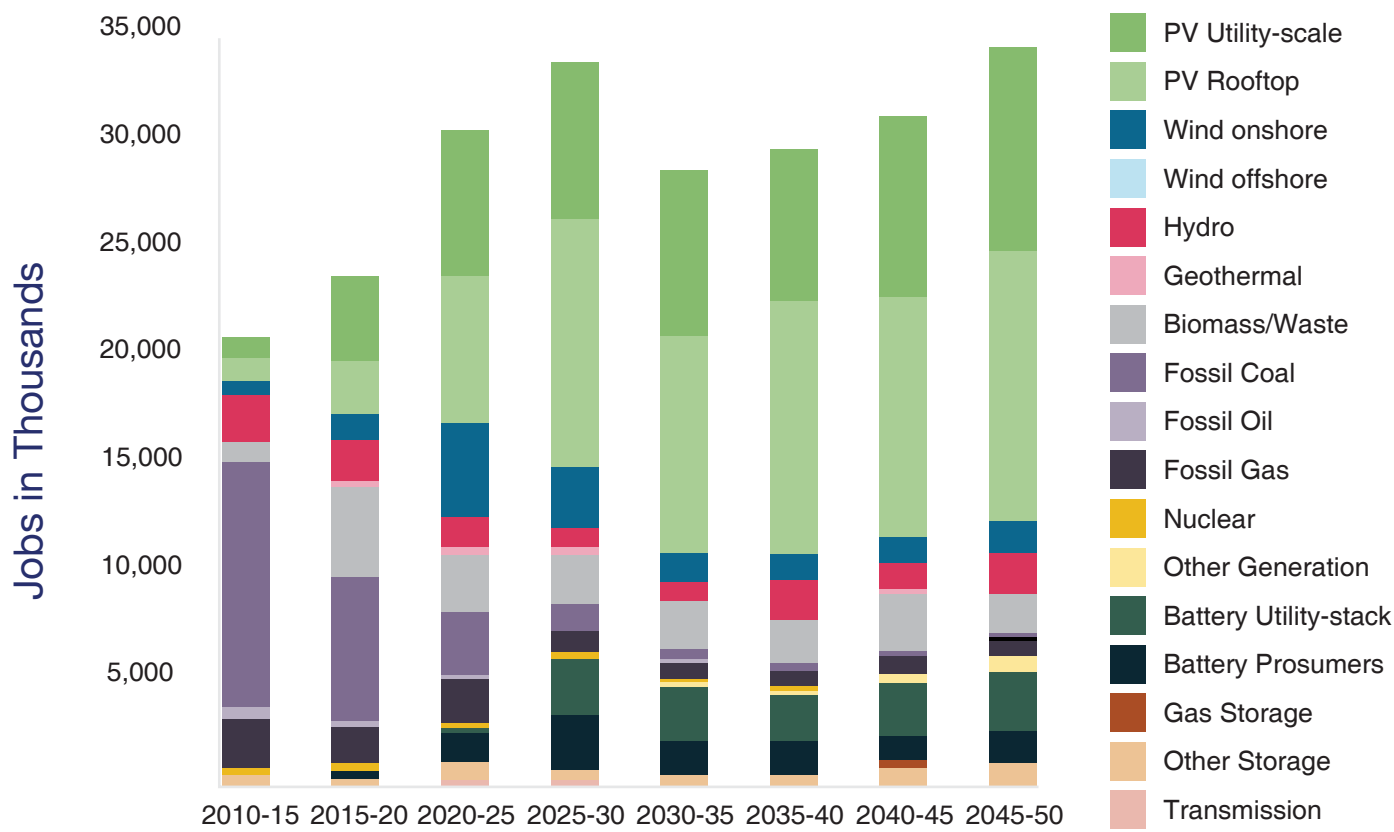
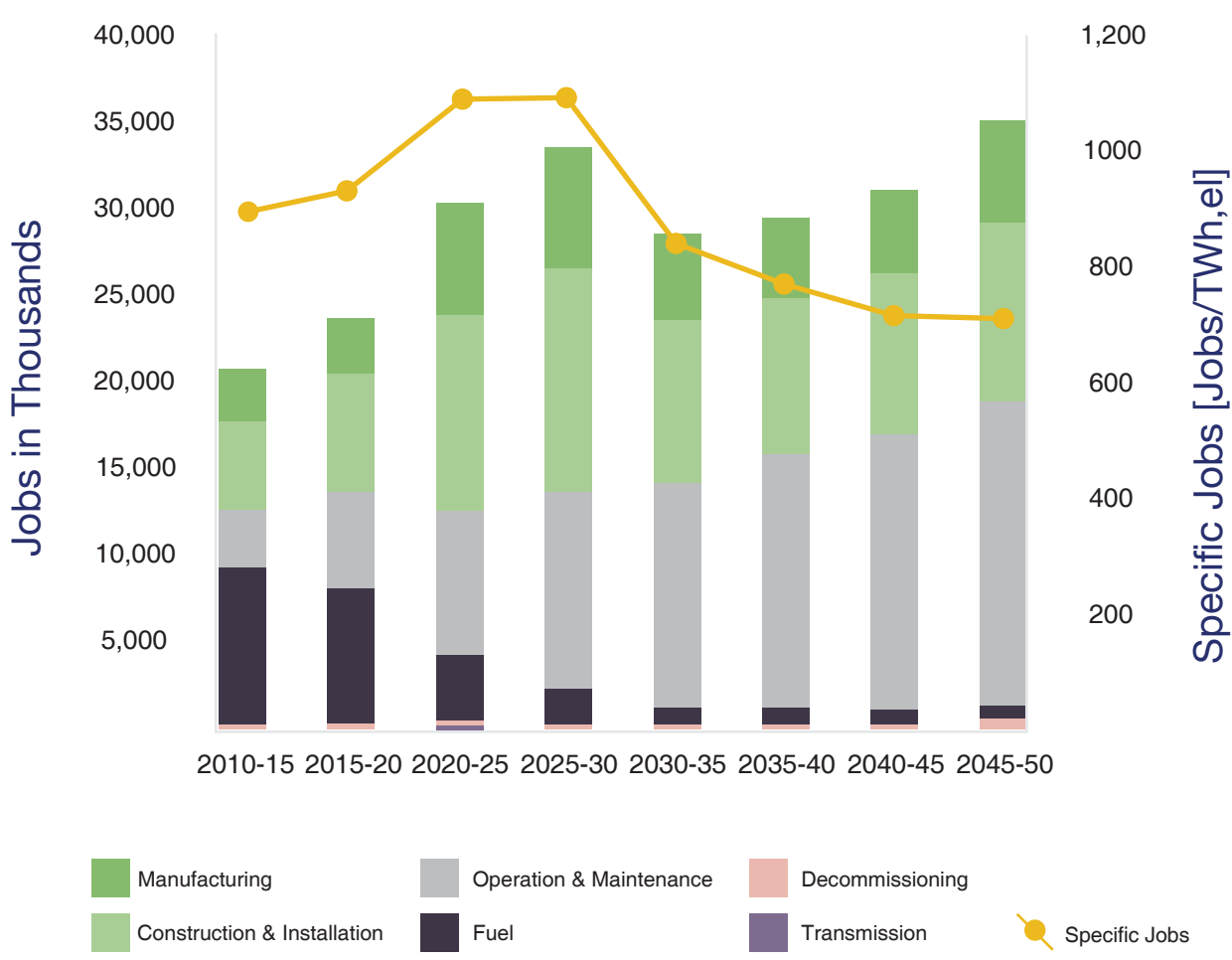


Figure 5 - Global energy jobs created by energy technology (upper) and category (lower), from 2015 to 2050. Source: Ram et al (2020)



According to the simulation results, summarized in Figure 5, as the share of renewables grows, supplanting fossil fuel and nuclear power generators, direct jobs in the energy sector globally are expected to increase by 70% by 2030. Compared to the base year of 2015, the overall jobs are forecast to be 150% higher in 2050. Direct energy sector jobs will rise from 2015, reaching 34 million by 2030. Direct employment should decrease to around 30 million, before increasing back up to 35 million by 2050. This temporary dip is due to replacement and refurbishment of large power plants. In 2050, approximately 2% of energy jobs are expected to be in decommissioning. During the transition period, as jobs in the fossil fuel and nuclear power sectors decline rapidly, they are expected to be replaced, predominantly by jobs in solar PV (22 million), batteries (4.5 million), and wind energy (1.4 million). As the share of jobs by energy technology is expected to evolve, so will the share of jobs by category. Fuel-related jobs are forecast to decline from 44% in

2015 to a mere 2% by 2050 - largely driven by the reduction in fossil fuel-based energy. Many of these jobs will migrate into operations & maintenance, growing from 15% in the base year to half of all energy jobs. Electricity demand-specific jobs (total number of jobs created annually for every TWh of annual electricity generation) are also quite stable throughout the transition, growing from about 900 jobs / TWh to 1,091 jobs / TWh in 2030, before declining to just over 700 jobs / TWh in 2050. These results suggest that the renewable energy transition will lead to an energy power system with a more stable employment profile. This would contribute to stable and sustainable economic growth, especially in developing economies, and could help solve challenges associated with youth unemployment (Ali, 2014). A further impact could be improved social wellbeing and political stability (Global unemployment to trigger further social unrest, UN agency forecasts," 2017).



Some Highlighted Results Forecast for 2050 by Region Include:

- **North America:** 2.7 million energy jobs; 360,000 jobs for hydropower and bioenergy, with 330,000 jobs in battery storage
- **South America:** fossil fuel combustion jobs to nearly disappear by 2025; total number of direct energy jobs to more than double to 2.2 million in 2030, then decline to 1.6 million by 2050
- **Europe:** 3.4 million energy sector jobs, largely in solar PV; 61% of jobs in operations & maintenance
- **Eurasia:** 925,000 energy sector jobs; largely driven by wind until 2030, then solar PV; electricity demand-specific jobs increasing from 516 to 638 jobs / TWh
- **Middle East and North Africa:** both utility scale and rooftop solar PV dominant technologies; 193,000 jobs in batteries
- **Sub-Saharan Africa:** 65% of energy jobs created in support of solar PV; 862,000 jobs in energy storage
- **South Asian Association of Regional Cooperation:** almost 6 million energy sector jobs, with over 5 million for solar PV and battery storage; direct energy jobs to increasing from 4.2 million to over 7 million then down to 5.8 million to expand rural electrification
- **Northeast Asia:** until 2030, nearly 40% of energy jobs for construction and installation; significant number of manufacturing-for-export jobs to decrease as other regions manufacture locally
- **Southeast Asia:** higher shares of jobs in biomass and hydropower until 2025, followed by solar PV (2.1 million) and battery storage (414,000); manufacturing jobs stay low until 2020, with high imports, then increase to a peak of 21% by 2035

4. Employment Potential Through Adoption of Low-Carbon Energy Solutions



4.1 The Role of Policies in a Just Transition Context

The world is facing the inevitable challenge to reduce CO₂ emissions in line with the Paris Agreement (UNFCCC, 2015) to reduce warming to not more than 2 degrees Celsius, and ideally 1.5 degrees, by 2050. This is an especially difficult challenge, given that such deep emissions reductions will require adopting measures and systemic shifts that will change the way economies work and people live their lives. History demonstrates that structural economic shifts can be a major source of both social and economic change, which affect the nature and level of economic performance, and the number and quality of jobs supported in and across different nations.

Moreover, the world and its economy are a complex and uneven landscape across developed, developing, and least developed countries, with varying abilities and extent of effort feasible in different types of nations to address the climate challenge. The idea that environmental protection somehow inevitably comes at the cost of economic value loss and job destruction is often presented as a narrative that has created social, political, and geographic divisions in the world. In contrast, the concept of Just Transition is built upon the idea that economic prosperity and social well-being can (and should) be achieved without compromising on environmental security.

The concept of a just transition has been around since the 1970s (ILO, 2011), supporting the interests of workers and communities and improving health and living standards, whilst protecting the environment. Just Transition is a powerful narrative that has its roots in the ideas of social and environmental justice, but which has expanded over time to include transformative approaches - the low-carbon transition, and moving from the brown to green / blue economy - coupled with decent jobs and environmental justice.

Just Transition has received global recognition through the efforts of the United Nations and other international agencies. However, as noted above, the United Nations Framework Convention on Climate Change

(UNFCCC) and International Labour Organization (ILO) have been most instrumental in using the concept to counter the jobs versus environment debate in the context of current discourse and agreement regarding the mid-century 2 and 1.5 degrees Celsius targets to limit global warming. Indeed, the principles of Just Transition were set out in ILO (2015) and reflected in a clause of the Paris Agreement in the context of taking account of national development priorities (UNFCCC, 2015, p. 4). In short, Just Transition reinforces the idea of developing coherent policies to meet the combined objectives of climate change, sustainable development / green economy, and green and decent jobs.

“the concept of Just Transition is built upon the idea that economic prosperity and social wellbeing can be achieved without compromising on environmental security.”

4.2 The Green Economy in a Just Transition Landscape

Just Transition and green jobs concerns have begun to reset how mitigating climate challenge is being approached at international and national levels, but there is not yet consensus or commonality in how this shift is emerging. Although Just Transition broadly means a fair transition towards a low-carbon economy, the interpretation and application of the concept differs across the world, largely shaped by local institutions, political ideologies, interest groups, and social acceptance. This is to be expected given the Paris Agreement's (2015, p. 4) application of the concept in the context of "[T]aking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities". The approach to framing the narrative largely depends upon the stakeholders, and whether the framing is group- or constituency-focused (particularly group such as low carbon industries) or based on sector-specific approaches (Just Transition Research Collaborative, 2018). A Just Transition management study assessing Australian renewable energy transitions (Goddard and Farrelly, 2018) found that sufficient political will is needed to frame a transition narrative highlighting the negative impacts of traditional energy production on workers and communities. If not, there is a real risk that traditional energy producers may frame an environment vs jobs narrative. However, if this can be countered with the presentation to communities of a compelling Just Transition narrative, such risk can be countered, enabling a successful transition for energy justice whilst supporting green and decent jobs.

The "Climate Action for Jobs" initiative, presented at the 2019 UN Climate Action Summit in New York, aims at creating decent jobs and protecting the livelihoods of workers (ILO, 2019). However, the Just Transition concept has gained the attention of policymakers, industries, and businesses. Although the concept is slowly being adopted in developed economies, its acceptance remains a significant challenge in developing and least developed economies. The main challenges faced in adopting Just Transition vary from the availability of natural resources and socioeconomic and political characteristics. Countries with developed economies on the forefront of developing Just Transition policies and roadmaps for adoption are

Spain, France, New Zealand, and Scotland. Developing countries Ghana, Philippines, and Uruguay are currently working on developing Just Transition policies, under the support of an ILO pilot program (Just Transition Research Collaborative, 2018).

ILO (2018) estimates that transitioning to a green economy through the adoption of sustainable practices including elements such as changes in the energy mix, the use of electric vehicles, adopting energy efficiency in construction of new buildings, and retrofitting existing buildings, will create a net gain of 18 million jobs. This involves 24 million jobs gained set against a loss of 6 million jobs (ILO, 2018). Most of the job losses are expected to come from scaling down carbon- and resource-intensive sectors.

Thus, climate change mitigation policies need to be about more than simply reducing GHG emissions. Effective policies should drive an economy towards sustainable green growth, with a strong focus on sustaining and improving socioeconomic wellbeing. While the transition towards a green economy will vary based on each country's local conditions, it should be inclusive, socially just, and maximize opportunities for economic prosperity. These transitions should be implemented in public policies that simultaneously create an enabling environment for sustainable enterprises to prosper, while also creating employment opportunities by directing public and private investment towards activities with reduced environmental impacts. The Just Transition can become a politically and economically viable narrative and framework to help policymakers develop such policies.



4.3 Current Trends

Long-Term Development of Low-Carbon Technologies Across Economic Sectors

Green jobs mean decent and fair jobs. However, certain new occupations, such as in renewable energy - photovoltaic panel manufacturing, wind turbine installation, or pollution control - may involve unknown hazards and occupational risks (ILO, 2017a). This is also the case in a circular economy, and especially waste and e-waste management. Thus, it is important to review occupational safety and standards of the potential new economic sectors and the jobs they support, and ascertain whether these are actually green. There are also other factors that can put the economic productivity (value of output per man-hour of work or per employee) of new green jobs at risk. For example, extreme weather and climate-induced changes in natural cycles can create difficult conditions. Sectors that are most vulnerable in this regard involve activities most exposed to and dependent on environmental conditions, such as agriculture, waste management, and construction.

Another factor impacting productivity is the movement of the labour input to production itself. For example, migration of labour - both interregional within nations and international across borders - can create unexpected over- or under-supply of labour and induce different skill gaps within particular regions and nations. More fundamentally, labour productivity in any geographical context could be affected due to the displacement of labour by a range of factors, including increased capital intensity and the shifts in the location and nature of supply chain activity to support the deployment of low carbon technologies.

In addition to these fundamental and structural drivers that can influence employment outcomes, another significant driver influencing the adoption of sustainable products is changes in consumer behaviour, both to climate policy actions (the rollout of green options), and to the dynamics of the wider economic landscape (including increased digitalization, which increasingly links to the types of green choices available). However, a crucial foundation is whether or not efficient and

accessible markets for sustainable products exist and/or can be supported by policy actions to develop. This is imperative for green economies to grow and continue to deliver prosperity through the transition.

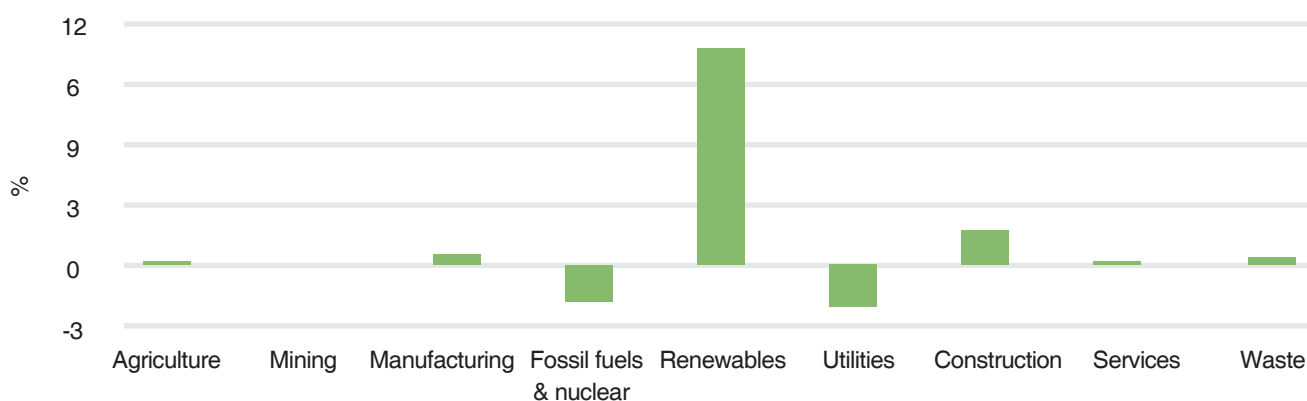
Potential for Green Jobs – Projected Trends Across Sectors

Figure 6 and Table 12, from the World Employment and Social Outlook 2018 report (ILO, 2018), assess the expected changes in employment by 2030 resulting from the IEA's sustainable energy scenario. The top panel of Figure 6 shows – as would be expected - that the sectors that will be most impacted by a sustainable transition are renewables, utilities, and fossil fuels and nuclear. It is interesting to note that renewables are expected to gain more jobs, on a percent basis, than the other two combined are expected to lose. Construction and manufacturing are also expected to see a significant increase in jobs. The bottom panel of Figure 6 shows that the ILO forecasts employment in the energy scenario to decrease in Africa (350,000 jobs) and the Middle East (300,000 jobs). These two regions will need to implement policy changes to avoid the anticipated job losses. Globally, employment should show a net increase of about a quarter of a percent, or about 18 million jobs, led by the Americas and Asia and the Pacific.

“Migration of labour- both interregional within nations and international across borders - can create unexpected over- or under-supply of labour and induce different skill gaps within particular regions and nations.”

Employment by Sector

(Percentage Difference)



Employment by Region

(Percentage Difference)

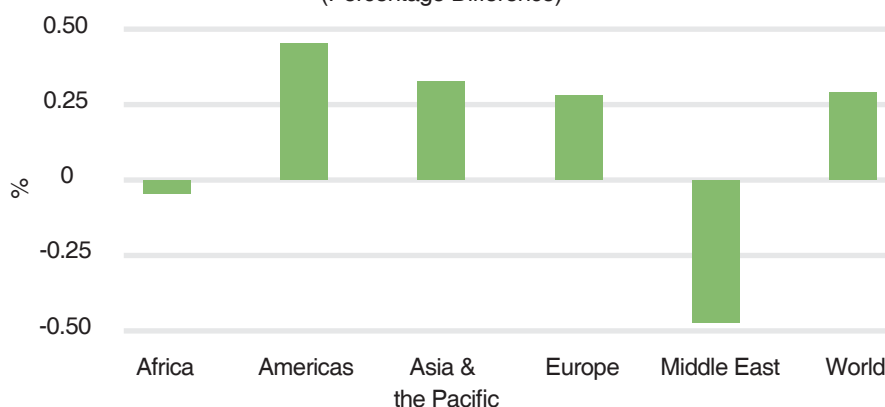


Figure 6 – Energy sustainability and employment in 2030; percentage difference in employment between the sustainable energy scenario and the IEA 6°C (business as usual) scenario by 2030. Source: ILO (2018).

Table 12 shows the sectors forecast by the ILO (2018) to experience the strongest job growth / decline by 2030 due to the transition to sustainability, in both absolute and relative terms. In either absolute or relative terms, the sectors which are expected to lose the most jobs are related to the extraction, refining, and consumption of fossil fuels. While it seems reasonable that the production of energy from coal combustion would lose a lot of jobs, it is perhaps someone unexpected that petroleum refining will lose the most jobs in absolute terms – 1.6 million jobs. In relative terms, job demand is expected to grow the most in solar thermal (3.0%), geothermal (0.4%), and wind (0.4%) energy generation (ILO, 2018, p. 43). Construction and the manufacturing of electrical machinery are forecast to be the biggest job winners 6.5 million and 2.5 million jobs, respectively. Copper ore and concentrate mining is also expected to gain more than a million jobs worldwide, as the increased

reliance on electronics requires more copper for wiring. It is very interesting to see the cultivation of vegetables, fruits, and nuts 5th in the list of absolute job winners, at 800,000 jobs (ILO, 2018, p. 44).



Industries Expected to Experience Strongest Job Demand Growth, in Absolute Terms (Millions)		Industries Expected to Experience Strongest Job Demand Decline, in Absolute Terms (Millions)	
Sector	Jobs	Sector	Jobs
Construction	6.5	Petroleum refinery	-1.6
Electrical machinery and apparatus manufacture	2.5	Crude petroleum extraction and related services, excluding surveying	-1.4
Copper ore and concentrates mining	1.2	Coal combustion electricity generation	-0.8
Hydropower electricity generation	0.8	Coal and lignite mining and peat extraction	-0.7
Vegetables, fruits, and nuts cultivation	0.8	Private households with employed persons	-0.5
Solar photovoltaic electricity generation	0.8	Gas manufacture, gaseous fuel distribution through mains	-0.3
Retail trade, except motor vehicles and motorcycles; repair of personal and household goods	0.7	Natural gas extraction and related services, excluding surveying	-0.2
Industries Expected to Experience Strongest Job Demand Growth, in Relative Terms (Millions)		Industries Expected to Experience Strongest Job Demand Decline, in Relative Terms (%)	
Sector	Jobs	Sector	Jobs
Solar thermal electricity generation	3.0	Coal combustion electricity generation	-0.19
Geothermal energy electricity generation	0.4	Crude petroleum extraction and related services, excluding surveying	-0.11
Wind electricity generation	0.4	Other petroleum and gas extraction, liquefaction, and regasification	-0.11
Nuclear energy electricity generation	0.3	Petroleum refinery	-0.08
Biomass and waste combustion electricity generation	0.3	Gas manufacture, gaseous fuel distribution through mains	-0.05
Solar photovoltaic electricity generation	0.3	Coal and lignite mining and peat extraction	-0.03
Hydropower electricity generation	0.2	Natural gas extraction and related services, excluding surveying	-0.03

Table 12 - Sectors Most Affected by the Transition to Sustainability in the Energy Sector. Source: ILO (2018)

Case Study

The Scottish Just Transition Commission (JTC) was established by Scottish Government Ministers in early 2019 to support Scotland's net-zero emissions target for all greenhouse gases by 2045. An interim report was published in February 2020 (JTC, 2020a) with a final report due in early 2021. The driving factor in using the Just Transition concept – for which the Scottish JTC cites and aligns with the ILO (2015) principles - is that it focuses on delivering a net-zero economy while allowing for maximisation of economic and social opportunities in ways that build on Scotland's existing strengths, capacity, and assets. The remit of the Just Transition Commission (set out on the JTC website at <https://www.gov.scot/groups/justtransition-commission/>) is to understand and mitigate risks that could arise in relation to regional cohesion, equality, poverty (including fuel poverty), and a sustainable and inclusive labour market. The particular challenge with which the committee must grapple is that of delivering an economic recovery from the COVID-19 pandemic that lays the foundations for a net-zero society and improves social wellbeing. This challenge is based on the acknowledgement that the outcomes of previous industrial and greening transitions in Scotland may not meet the imperatives of a Just Transition for the workforce, and may not lead to the creation of decent work and quality jobs. One of the most significant contributions of the Just Transition Commission has been to consult widely with a range of current workforce and industry stakeholders in developing a case to support the creation of new jobs for oil and gas workers, and those currently employed in the wider energy supply chain.

With the declining oil prices and reduced demand - which has been further exacerbated by the COVID-19 crisis - the workforce in the oil and gas sector is facing unprecedented challenges. The JTC is playing a pivotal role in consulting with Scottish stakeholder communities to form a solid basis for making grounded recommendations for the creation of jobs in the short-term to retain the workforce and keep associated supply chains functioning, in support of the net-zero transition. This includes the JTC's work in advising the Scottish Government on priorities in planning a green recovery from the COVID-19 economic slump (JTC, 2020b).

To achieve net-zero targets, significant financial investment and capacity building is needed in renewable energy, mainly in offshore wind. Redirecting and repurposing labour resources and supporting infrastructure from the oil and gas sector, supported with on-the-job training, can build capacity for next generation technologies such as CCUS and hydrogen fuel. However, the adoption of these technologies requires skilled labour and high-value manufacturing in the supply chain. Unfortunately, it seems that these needs cannot be met by Scottish supply chains as they currently exist, at least not to the extent that oil and gas supply chain needs have historically been met. With the significant pipeline of current projects in offshore wind, and in light of significant public and workforce concern that much of this will be off-shored, the JTC has advised the Scottish Government that bridging the skill gap is essential in achieving the energy transition in a manner that will be accepted as fair across Scottish society (JTC 2020a).

The Scottish JTC model does provide the basis for an approach that could be taken with other fossil fuel-rich countries transitioning towards a net-zero economy. Crucially, it demonstrates the need to focus on both broad and specific stakeholder consultation. Effective stakeholder consultation is necessary both in terms of how the ILO (2015) Just Transition Principles apply in a country-specific context, and for identifying priorities for government action in designing transition pathways. On this basis, the Scottish JTC constitutes a practical case study of how adopting a Just Transition approach can help achieve the energy transition, whilst keeping jobs for oil and gas workers using their existing skills, and even developing further skills.



5.Challenges

The earlier chapters discussed employment and investment trends across different economic sectors, and the transformative approaches towards a green economy. However, there are many types of challenges which constrain the growth of green jobs. This section details some of the key challenges which could hinder a Just Transition for green jobs.



5.1 Genuine Green Jobs Growth

A central challenge is to identify, create, and sustain opportunities for green economic activity and job creation in delivering net-zero emissions, it is imperative to understand the complete environmental contribution of all sectors and potential new interdependencies. For example, land-based sectors such as agriculture and forestry have the potential to support carbon sequestration, offsetting emissions reductions requirements from other economic sectors. These sectors are crucial in supporting and achieving net-zero emission targets for other economic sectors that cannot become net-zero without the loss of jobs and activity.

Ensuring Green Jobs Genuinely

- A. Are additional and / or constitute a Just Transition of existing jobs and work / career opportunities
- B. Sustain the decency and fairness of existing jobs (where this can be classified as good) or improve in both regards
- C. Combine resource efficiency and emissions reductions with both (a) and (b)

If climate justice is to be achieved across nations and Just Transitions within nations, as long as the world continues to (directly or indirectly) consume (currently) emissions-intensive manufactured goods (e.g. steel, cement, and chemicals), international cooperation and nationally defined priorities must focus on tackling the challenge of deep emissions reductions at source. If not, there is substantial risk of displacing emissions across borders such that the outcome is potentially net positive impacts on global emissions or any net reductions outweighing any net economic gains enjoyed by recipient nations of production relocation. In terms of the economic and just transition priorities of nations, the risk is one of offshoring not only emissions but also jobs, wage incomes and GDP.

Clean Energy Transition will be Mineral Intensive

Public and policy awareness is well developed in terms of understanding the full carbon footprint of consumption choices, and, increasingly of the social responsibility associated with corporate procurement decisions. However, the full supply chain implications in terms of environmental and worker impacts/conditions is less well recognised or understood. Extractive industries play an important role in supporting green technologies; the extraction of lithium to make batteries for powering electric vehicles is a particularly relevant example.

Globalisation of Green Jobs – Supply Chains

Supply chain interdependency is a challenge more generally. The interdependence of supply chains can have implications for policy choices, as local/regional/national governments must tackle the challenges of domestic industries that are facing global economic competition. Greening of the entire supply chain can be challenging, especially for production processes based in the least developed or developing countries. Providing green and decent job will increase costs; this can lead to competition, price wars, and ultimately strengthen the position of brown jobs.

As workers change jobs and move from brown to green, contributing to wealth creation and economic growth, the resultant induced jobs will be created based solely on consumer spending. This will make it difficult to account for the number of induced green jobs per sector, and any figures that are reported may be misleading.

“A central challenge is to identify, create, and sustain opportunities for green economic activity and job creation in delivering net-zero emissions”

5.2 Measurement and Reporting of Green Jobs

Carbon Footprint in Green Sectors

The term “carbon footprint” could be defined as the GHG emissions produced in the entire value chain of goods and services consumed. If global carbon emissions are genuinely to reduce as a result of the creation of green jobs in any sector, it is imperative to determine if the resulting activity is truly green, i.e. to ensure that carbon emissions do not simply get reallocated to other elements of the supply chain. As with other economic sectors, Information Communication and Technology (ICT) for example, is moving forward in greening their manufacturing and business operations. The manufacturing of ICT products (computers, mobile phones, networking equipment, etc) is a booming sector driven by a strong demand for innovation (Malmodin & Lundén, 2018). Production and operations in the IT sector are not commonly perceived as energy intensive. In fact, there is no common international methodology to measure energy consumption and emissions in the ICT sector (Dastbaz et al., 2015). Though hailed as a potential sector for green jobs, there are no legal frameworks available at the international level to bind ICT developers and service providers to reduce emissions. For example, the use of data centres for bitcoin mining dramatically increases ICT energy consumption. There is insufficient clarity into whether IT operations or services should be considered green. An international common standard to define and measure green and decent jobs is required in the ICT sector, as is the case more generally across industries.

International vs Regional Metric

Building on the previous point, it can be debated that a common metric by which to assess green job will not bridge the variability in environmental practices, energy intensities and the definition and practices of jobs and employment that exists across countries. For example, it may be inappropriate to say that what constitutes a

green agriculture job in a least developed country is the same as in a developed economy, here is bound to be disparity due to income levels. Regulations, standardization, and adherence to fixed pay scales are a few potential measures for consideration.

The data needed to assess and measure the nature and prevalence of green jobs by sector is lacking; most of the relevant data which exists comes from international organizations such as the ILO. This makes it difficult for policymakers to set realistic targets on the growth of green jobs, or to measure the effectiveness of relevant policies. The availability of more comprehensive data could also be important to investors; separate accounting metrics or indicators to show green job employment levels will help society transition more smoothly to a green economy.

Accounting for Green Jobs

The “value” of jobs is commonly considered in terms of labour productivity (GVA per employee hour). Finding measures of comparisons that effectively capture labour productivity across countries is a key challenge (ILO, 2018). However, this could be partially due to low levels of labour productivity. That is, labour productivity in China tends to be relatively low, so more man-hours will be needed to produce the same output as compared to a more productive country; “head count” measures of green jobs may, thus, be misleading.



5.3 Local Content Development

Lack of Interaction and Coherence With Broader Economic Development Policies, Especially in Extractive Economies

The development of green jobs in the extractive industries is likely to be closely linked with different local, regional and national government policies around the economy and environment. These green jobs will also rely on the industry's willingness and ability to ensure regulations regarding restoration and decommissioning processes are adhered to. This requires a shift in dogma away from the concept that environmental regulation and stewardship is bad for the economy. Indeed, when the regulations are followed, there is strong evidence that ecological restoration and decommissioning generates significant jobs and revenues – more than a number of other key sectors (BenDor et al., 2015). Moreover, the local content policies developed for extractive industries could be extensive but very specialized and complex due to the technical nature of business. Losses in this regard could initially become a problem in numerous political economy and social regards during the transition phase.

5.4 Reskilling / Training & Development

Accounting for Green Jobs

A study undertaken by Cedefop in 2010, and subsequently in 2019 (Llina et al., 2010; Cedefop, 2019), regarding skills for green jobs reported that there is a shortage of environmental awareness among

those responsible for teaching and training in a green sector context. While this holds globally, it is seen predominantly in developing countries. They also identified a lack of coordination between ministries, institutions, and education and training institutes, where one way this may manifest is in failing to monitor and anticipate skilled labour needs. The lack of awareness, coupled with insufficient information regarding the significant potential of jobs, has discouraged people from obtaining new skills to take up green jobs such as waste management, recycling, agriculture etc. In addition, the efforts to ensure that existing green jobs are decent has largely failed to develop interest in potential employees.

Sector-Specific Challenges

Transitioning to a green economy almost inevitably leads to temporary job destruction until labour skills are transferred from the existing brown sector to a green sector.

Agriculture: Training and skill development programs in the agriculture sector are largely focussed on increasing efficiency in food production, rather than the adoption of sustainable production systems. Identifying skill needs, involving social participation, and creating awareness about working conditions can support the transition of agriculture to a green economic sector (United Nations Department of Economic and Social Affairs, 2011).

Bioeconomy: The sector tends to be largely male dominated with an aging population. To develop a skilled workforce and catalyse innovation, new approaches - realizing sustainable and multifunctional forestry - remains a substantial challenge.

Construction: The construction sector keeps costs low and increases profit margins by compromising the quality of construction and hiring an unskilled workforce. Skills required to use innovative technologies and techniques are not employed, leading to poor construction quality.

5.5 Investments

Building Investors' Confidence in Low-Carbon Technologies - Return on Investment and Risks

A key concern for investors is ensuring both the magnitude and long-term stability of the return on investment. Traditionally investment in fossil fuel related industries has provided high and relatively sustained returns for investors, which has subsequently led to many large pension and investment firms having portfolios that are highly reliant on fossil fuel extraction. However, as climate change legislation is put in place around the world, there is growing consensus that fossil fuel extraction and burning will need to substantially decline. While low carbon projects have traditionally had to compete with projects and firms that rely on fossil fuel extraction, there is a growing opportunity for the low carbon sectors to compete for investor interest as they 'divest' from traditional investments (Nauman, 2019). A key challenge will be ensuring that the correct policy and regulatory environments exist to support the development and longer term deployment of low

carbon sectors. Only then will investors continue to trust that initiatives designed to create green economies can provide sustained and reliable returns to investors.

Removal of Fossil Fuel Subsidies

Transitioning to more environmentally practices is a key challenge for economies around the world that heavily rely on fossil fuel extraction. Nations will have to consider how subsidies or tax breaks used to encourage the exploration and extraction of fossil fuels can be reduced, while subsidies that encourage the deployment of low carbon technology increased. This must be done in a manner that protects the economic contribution that existing activity provides, both in relation to jobs and the contribution to government budgets. As discussed widely in this report, transitioning activity to more sustainable practices and using the skills of existing workers provides a key opportunity to do this.



5.6 Social Change & Cultural Acceptance

Behavioural Change: Consumer Consumption Patterns and Demand for Green Products

The firms producing green products and services directly link the prospects of creating jobs with increased turnover (Cecere & Mazzanti, 2017). There is a need to create social awareness on promoting the uptake of green or recycled products. Social dialogue on the sustainability agenda can influence consumer behaviours, and create awareness of unrestrained consumption patterns, and the environmental consequences. Social behaviour impacts government spending, as public resources get allocated to handle increasing local waste. The shift in consumption patterns from use and throw to build to last will reduce waste generation and encourage green employment.

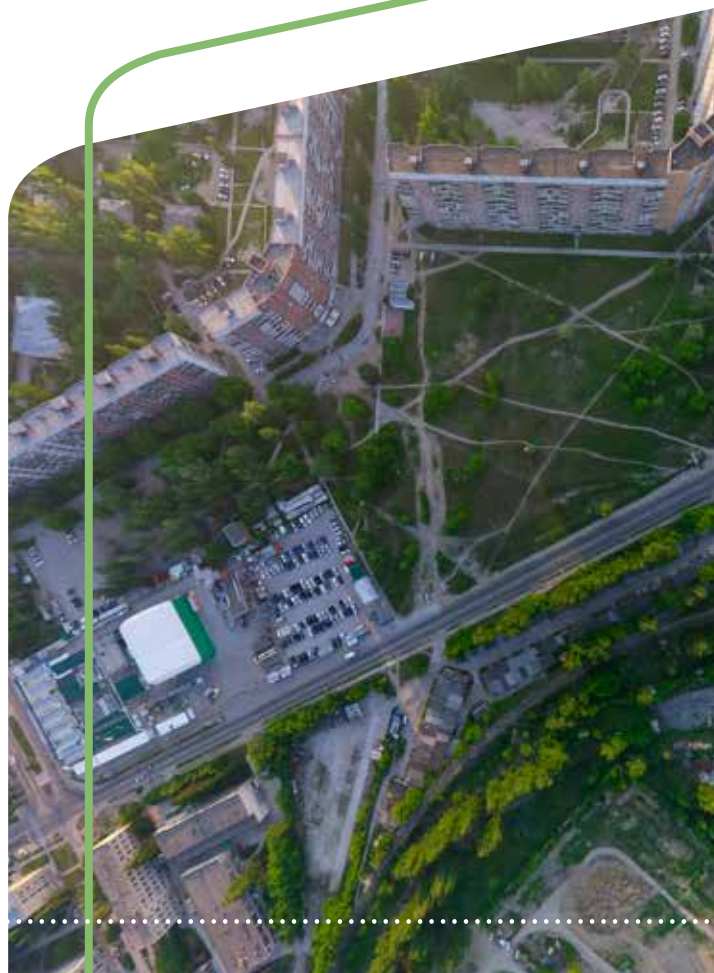
Public Engagement: Environmental Awareness & Willingness to Pay

The public's willingness to directly pay for green infrastructure interventions has been shown to be closely linked to the willingness of the local authority or government to subsidize the interventions. For example, research into the willingness of households to contribute directly to the costs of installing rain gardens (green infrastructure for flood prevention and runoff water treatment) in the Baltimore-Washington corridor, USA, demonstrated that only 18% of households were willing to pay the full costs of installation. However, when the local authority offered a rebate to partially cover costs, household willingness to pay increased substantially (Newburn & Alberini, 2016). This demonstrates that economic incentives from the government or local authority can significantly increase the installation of green infrastructure.

5.7 Technology Transfer

For effective international technology transfer projects to successfully gain traction with local governments and employ skilled workforces, it is important to assess whether existing regulations favour conventional technologies. If this is not the case, it will be difficult for environmental or low-carbon technologies to develop and create sufficient market share (European Commission, 2014).

International technology transfer can either occur through long-term sharing of technological expertise, or the shortterm sharing of technologies sans expertise. The long-term sharing of expertise can develop the local manufacturing and associated supply chains, but without the capacity to absorb the transferred knowledge, the return on technology transfer will be limited. Hence, the availability of local schemes to incentivise the development and utilization of skills and training programs, and the existence of skilled labour with relevant technical expertise will be vital in either case.



6. Towards a Cohesive Future



6.1 Economic Gain from Green Jobs

The concept of decent work in green jobs is meant to provide the means for people to afford at least a basic standard of living in a healthy and socially inclusive environment. Green jobs can create decent living and work opportunities that contribute to the wellbeing of people, in turn raising the economic competitiveness of society (ILO, 2017a). Creating productive and skilled human resource capital helps society generate sustained wealth by building a progressive lowcarbon economy, whilst protecting ecological resources. An OECD (2012) study analysed the importance of economic gain from a higher skilled workforce and from developing low carbon economies. This study found that low-skilled ‘manpower’ can be an economic

disadvantage for people and societies, decreasing the likelihood of employment and increasing dependency on social benefits, driving economic loss for society (OECD, 2012). Green and decent jobs go beyond the basic need of achieving employment, and are key to addressing income and social inequality. Skills have a strong correlation with economic and social progress, as shown in Figure 7, which demonstrates that individuals with the lowest skills are 1.8 times more likely to be unemployed compared to the highest-level foundation skills. Ongoing changes in the demand for employment imply a decline in low-skilled workers, who are hired for services not yet automated (OECD, 2012).

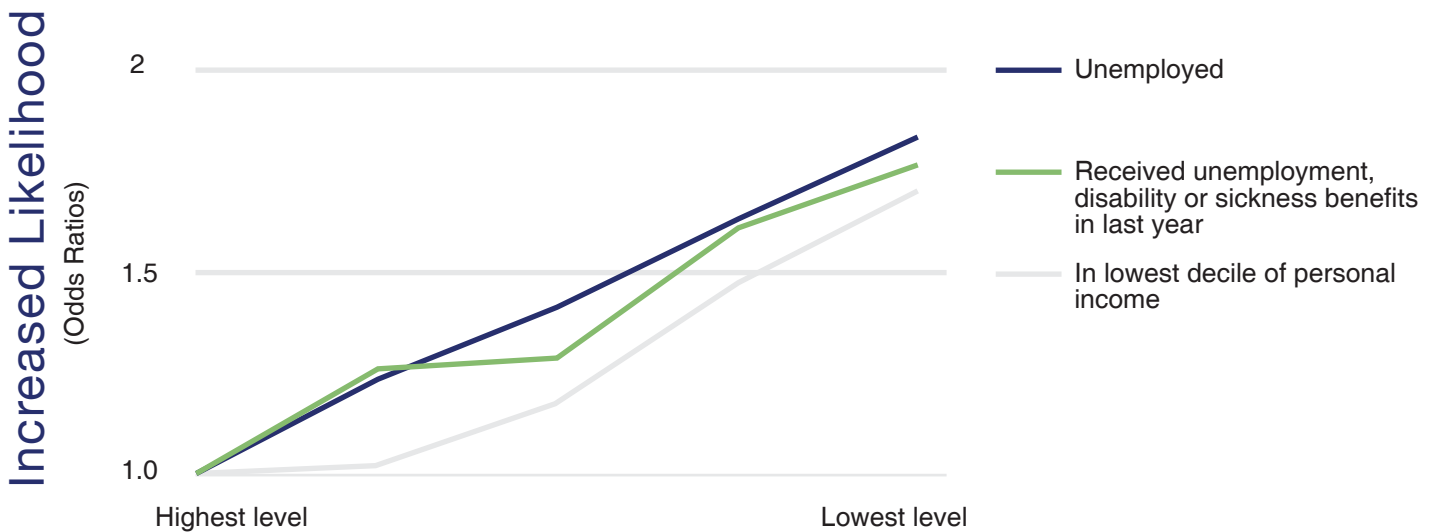


Figure 7 - Foundation Skills and Economic Disadvantage; the Increased Likelihood of Experiencing Economic Disadvantage, by Foundation Skills Level, Individuals Aged 16 to 65, Country Average. Foundation Skills are Defined as Problem Solving in Technology-rich Environments (The Ability to Use Technology to Solve Problems and Accomplish Complex Tasks); Literacy (The Ability to Understand and Use Information From Written Texts in a Variety of Contexts to Achieve Goals and Further Develop Knowledge); Numeracy (The Ability to Use, Apply, Interpret and Communicate Mathematical Information and Ideas); and Reading Components (Including Word Recognition, Decoding Skills, Vocabulary Knowledge and Fluency). Source: (OECD, 2012, p. 10).



However, skills do not convert into jobs and lead to economic growth on their own. Economy-wide, crosssectoral transformation is required to address all dimensions – economic, social, and environmental – to promote full and productive employment. Due to the economic damage associated with unemployment caused by insufficient demand for a highly-skilled workforce, the UK Commission for Employment and Skills (UKCES) has focused on promoting ambition amongst employers to create demand for highly skilled employees. Crucially, a regulatory framework that enables effective and efficient integration of decent work with environmental and economic objectives is largely missing across the world, especially in developing countries. Thus, there is an urgent need for the development of coordinating bodies with prime responsibility for the anticipation of skills required by new green economic activities. While this report identifies a range of potential opportunities for green jobs to emerge in transitioning economies - both in the nearer term and sustained over the longer term - any real consideration of the future potential for a sustained and genuine “green jobs revolution” is dependent on the wider political economy and regulatory landscape.

Employment Opportunities – Short and Long Term

The Preceding Chapters have Raised issues in Terms of the Challenges for Green jobs in Three interrelated Key Areas

- First, the extent to which substantial direct and indirect job creation associated with particularly (but not exclusively) renewable energy systems (at micro and grid level) may be largely at the investment / construction / installation stage, but more limited in operational stages.
- Second, the shift to greener capacity in the economy may involve more imported and less domestic production and supply chain activity, which may be disconcerting for national policymakers.
- Third, the transition from brown to green may involve the decline of a range of (particularly but not exclusively) resource extraction, energy supply, manufacturing, and transport-intensive activities that have historically supported substantial employment and income generation activity.

For these reasons, it is important to consider the challenge as one of transition, and, particularly, how employment opportunities in different timeframes may emerge through both intermediate and transitory activities that may aid and sustain the transition from brown to green. This is particularly important for those activities that may provide opportunities to establish new sustainable activities, as well as establishing and implementing the support / service infrastructure / capacity required for green economies to function.

For example, the term “blue economy” refers to a sustainable business growth model to harness growth opportunities in the marine sector. In many national contexts, such as (but not limited to) those in which capacity has been developed through offshore fossil fuel extraction, the blue economy is potentially a major source of new jobs creation and economic growth. In the context of resource extraction / consumption to support energy supply, infrastructure, physical capacity, and skills can be repurposed to support offshore / marine-based renewable energy generation. Many traditional oil and gas firms are already working independently or in collaboration with electricity industry participants to evolve business models and industry sectors in this direction.

More generally, a range of direct and indirect jobs can be created through eco-innovations in a range of areas, such as: reducing shipping industry emissions, adopting clean fuel and transport technologies, protecting marine environments, and transitioning to ecotourism and sustainable fishing. In 2008, the European Commission adopted their Strategy for Marine and Maritime Research. Since then, policies have been implemented to develop and actively promote private participation to unleash the sector’s growth potential. The Commission is encouraging participation of SMEs in the blue economy to drive research and innovation and create employment opportunities. Australia launched the Blue Well-being Initiative, or Blue GDP, recognizing the plethora of opportunities from ocean-based industries. However, due to gaps in knowledge and data, innovation has been held back. General lack of availability of skilled workers to apply marine technologies is another important hurdle holding back opportunities for growth and development in the blue economy (European Commission, 2020).

Such blue economy developments also provide useful examples of how support / service infrastructure and capacity need to evolve and can provide further

opportunities for both near-term and sustained job and wealth creation. For example, two new technological developments – energy harvesting and the Internet of Things – are gaining prominence in the ICT sector, especially for maritime usage. The first refers to capturing energy from ambient power sources, such as tidal power. The second allows for real-time monitoring of the operations and energy consumption of technical equipment in harsh and inaccessible marine environments. The increased adoption of these technologies has further impacted other industries, such as enabling fast-moving consumer goods (FMCG) firms to manufacture innovative products, promoting highly-skilled employment opportunities.

More generally, however, the key point to note is that the current debate over the green economy and the low / net zero transition is a whole economy debate, so a wider perspective of job creation must be adopted. For example, a study by Smith et al. (2017) considered the potential impact of hydrogen and fuel cells in the UK economy. It showed that many of the jobs and much of the value-added currently supported or sustained by the current UK gas and electricity industries are located in the service sectors, directly and indirectly servicing the front-line energy production, distribution, and supply activity. In turn, this generates wage incomes that fund (and induce) consumption, further building the wider economic landscape. As economic activity shifts from brown to green, the green economy must ultimately support this wider landscape, particularly where the former has supported valued employment across multiple sectors.



Create Opportunities for Small Businesses

Small and medium-sized enterprises (SMEs) have the potential to stimulate domestic demand for green jobs and promote development and innovations. While it is generally true that SMEs have played a crucial role in supporting economies, providing green products and services, and supporting social development, it is particularly true in developing and less developed countries. For example, SMEs in Namibia play a crucial role in the development of Namibia’s economy. It is estimated that they are responsible for more than 20% of GDP and nearly 80% of the country’s jobs (ILO,

2014). In addition, SMEs have been found to contribute to society in broader ways. Examples include tackling youth employment – based on the foundation that innovation drives interest amongst the youth, and increasing gender participation – SMEs offer equal opportunity for participation.

A study by Koirala (2019) estimates that SMEs with between 5 and 250 employees create more jobs than larger enterprises across all country income groups, as demonstrated in Table 13.

Country Income Group	Contribution of SME250 Firms
Low income	78%
Lower middle income	67%
Upper middle income	59%
High income	65%

Table 13 - Median contribution of SME250 to employment by country income group, based on a sample of 98 countries. Source: Koirala (2019).



A research study on green jobs and eco-innovations in European SMEs (Cecere & Mazzanti, 2017) conducted an empirical analysis focussing on SMEs producing green goods found that, on average, firms producing green products and services are able to create approximately 11.3 green jobs in two years. Furthermore, they found that 71% of these firms have at least one employee who qualifies as filling a green job. The results also show that increased turnover of SMEs is directly associated with the demand for green jobs. Increased demand for goods and services positively impact green jobs.

While transitioning to a low carbon economy, awareness of future skills and green jobs can help SMEs develop competitiveness and increase labour productivity. Recognizing the value of awareness, the National Observatory of Jobs and Occupations for the Green Economy (ONEMEV) in France supports the development of green jobs, supporting SMEs in developing innovative projects on biodiversity, education, research, industrial innovation, transport, and energy (Cedefop, 2019, p. 85).

The development of renewable energy projects to provide access to electricity is a good example of the benefits of green businesses in locations where this can provide key opportunities for smaller businesses operating regionally closer to the need that is being served (ILO, 2018). For example, the installation of distributed power generation systems in remote villages provides employment opportunities (both in installation and sustained operational phases), improves the wellbeing of the rural population due to electricity access, and creates a supply chain, all whilst providing green and low-carbon energy. Another example is that of building codes requiring the adoption of increased energy efficiency measures. These regulations provide many benefits to society: they create decent jobs for manufacturing efficient appliances, develop sustainable supply chains, and create employment opportunities for building auditors and technicians. Related building regulations also promote safety and efficiency standards in construction, and encourage the development of innovative building designs and technologies (IEA, 2019b).

On the other hand, there is also a potential for divergence away from the creation of local and small business opportunities when the pace of greening the economy may move ahead of the capacity of potential beneficiaries to respond. That is, while local small business capacity could ultimately develop around

markets for delivering retrofits and conducting energy audits, if energy efficiency programmes are implemented at a pace that places larger existing businesses at a competitive advantage, opportunities for new business creation could be lost. There are analogies in this regard to issues more widely raised around “making or buying” new technology, and trading off the benefits of lower-cost imports against those associated with creating and sustaining local jobs.



6.2 Green Investment Trends

In a 2019 report regarding skills for green jobs, Cedefop (2019) assessed national developments of six EU countries and found that growth in green employment has been nonlinear, impacted by the 2008-2009 financial crisis. Following the crisis, most countries, including the UK and Germany, reduced or terminated many subsidies and incentives for promoting green employment. In addition, several mechanisms that supported green employment prior to the crisis have, and are still in the process, of being removed, and this has occurred since green skills and jobs have become integrated into normal economic decision-making. An analysis (Cedefop, 2019) of green activities by the National Observatory for Jobs and Occupations of the Green Economy (ONEMEV) in France has identified two phases in the evolution of the green economy vis-à-vis jobs. The first phase, when the green economy was launched, spanned 2004 to 2011. Growth rates stabilized in the second phase – from 2011 to 2014 – when green employment peaked in 2012. According to this analysis, “ecoactivities” accounted for approximately 1.7% of employment in 2015 (Cedefop, 2019).

Current policy instruments promoting green employment are now integrated with environmental or low-carbon policies. This is simultaneously a positive and negative development. The integration underscores the importance of creating green employment and it can become a dependent outcome of lowcarbon policies. Indeed, green employment is not limited to low-carbon industries: extractive industries have high potential for greening their operations by implementing efficient and innovative technologies,

thus creating green jobs. Green employment as a policy instrument can have a wider impact across sectors, regions, and countries.

Threats from climate change are not the same across the world: the vulnerabilities to - and impacts from - climate change differs across economic sectors, geographies, incomes, and maturity of regional adaptation and resilience. Adaptation pathways and policy planning can reduce the risks. Integrating

structural reforms to promote economic growth with lowcarbon pathways creates opportunities for employment, innovation, and economic diversification towards sustainable growth. The alignment of fiscal policies to support investments in infrastructure development and environmental conservation can advance technological developments and create an enabling environment for the private sector to invest in the green economy.

According to an OECD (2017b) report, annual investments of \$6.3 trillion will be needed between 2016 and 2030 to meet global development needs to achieve long-term benefits of employment, economic growth, and social wellbeing (healthy and safe environment). Financial investments in the green sector will require the support and participation of banks, whilst the removal of fossil fuel subsidies will create a level playing field for green technologies. In addition to interest groups, policymakers, and the vocal populace, company shareholders are making efforts to support green investments. As much as it relies upon fossil fuel reserves, the global financial system is at risk. To mitigate this risk, shareholders of many large companies are pushing those firms to transition to sustainable business practices. In addition to the altruistic desire to combat climate change, these actions are driven by the need to protect share value in the coming decades (Carbon Tracker Initiative, 2017).

According to the IEA Flagship report (IEA, 2020b), there has been a steady increase in investment for sustainable development, which has “grown tenfold since 2014” (IEA, 2020b, p. 179). However, investments have not kept pace with expenditures. With regard to deploying renewables and efficiency in new projects, the market has predominantly remained stable since 2015, with most deployment used in existing projects. The slow pace in building new energy assets could be due to the slow pace in developing policies and decision-making. However, the availability of venture capital for investment in R&D and new technologies is growing at a fast pace that is expected to continue for the next two years. Total global equity by all investors for technology start-ups in 2019 was valued at \$16.5 billion (IEA, 2020b, p. 189). In an earlier section of this chapter, the role of SMEs to create new jobs was discussed, and, the IEA data plotted in Figure 8 substantiates the economic and employment value SMEs can provide by investing in the development of skilled labour and creating more green jobs.

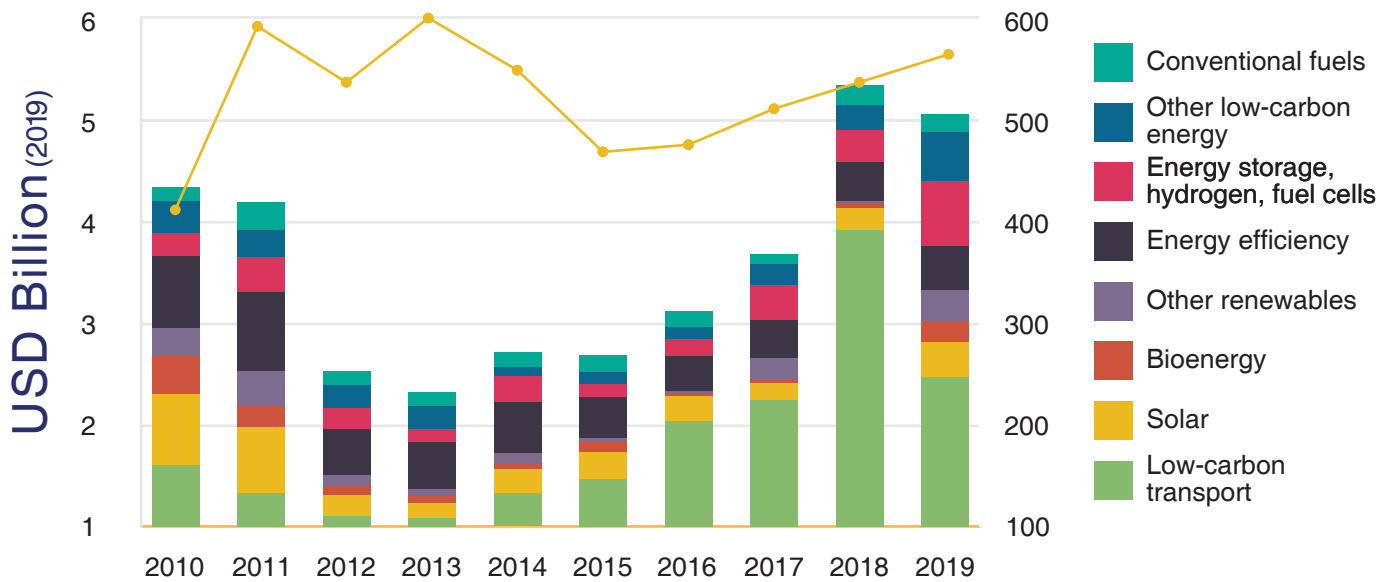


Figure 8 - Global Early-Stage Venture Capital Investment in Energy Technology Companies. Source: IEA (2020b).

Most countries are aligning economic growth objectives with environmental objectives, employment goals and regulations, along with implementing market-based instruments. Table 14 presents examples of green growth strategies and employment goals across the globe (ILO, 2017b, p. 16-17).



Country	Examples of Comprehensive Green Economy or Green Growth Initiatives
Barbados	The National Strategic Plan 2006–25 includes “Building a green economy – Strengthening the physical infrastructure and preserving the environment” and “Building social capital” as two of six strategic goals. The plan includes strategies to create new businesses and expand existing enterprises on a sustainable basis, supported by a modern, synergistic manpower planning framework for decent work and the creation of quality jobs.
Chile	Chile launched the National Green Growth Strategy in December 2013, outlining a set of actions over the short, medium and long term (2014–22). Actions include implementing environmental management instruments, promoting the market for environmental goods and services and monitoring and measuring progress.
China	The 12th Five-Year Plan (2011–15) set as key themes the rebalancing of the economy, reducing social inequality and protecting the environment. There are plans to invest US\$468 billion in greening key economic sectors, in particular waste recycling and reutilization, clean technologies, and renewable energy. An estimated 35,000 enterprises and institutions in environment protection and its related industries employ 3 million workers. Employment and skills policies for green jobs are in preparation.
European Union	EuroWpe 2020 (2010–20), a European strategy for smart, sustainable and inclusive growth, sets key targets covering employment, education, research and innovation, social inclusion, poverty reduction and climate/energy. Employment targets include the following: 75 per cent of the population ages 20–64 should be employed while meeting the EU’s objective of 20 per cent of energy generation from renewable sources. Meeting the target of 20 per cent higher energy efficiency by 2020 would create over one million new jobs.
Ethiopia	Climate Resilient Green Economy (CRGE) Initiative (2011–2025): Seeking to achieve middle-income status by 2025 in a climate-resilient green economy, the CRGE Initiative promotes socio-economic targets such as rural development; health; the creation of employment in high value-added production; local production of efficient stoves; and afforestation/ reforestation as well as forest management; livestock development, in particular poultry production; and rural employment.
Indonesia	Through its National Action Plan Addressing Climate Change (2007), based on a triple-track strategy that is pro-poor, pro-job and pro-growth, Indonesia has voluntarily committed to reducing its greenhouse gas emissions by 26 per cent, and up to 41 per cent by 2020 with international support. A Climate Change Sectoral Roadmap that includes green jobs and skills was developed to mainstream climate change in the Indonesian national mid-term development plan (2010–14), while a National Action Plan on Mitigation and Adaptation to Climate Change on Public Works consists of policies, strategies and programmes to lower impacts of climate change.
South Africa	The Green Economy Accord (2011), adopted as one of the accords under South Africa’s New Growth Path, was signed by representatives of the South African Government, business representatives, organized labour and the community constituency at the Parliament of South Africa in November 2011. The Accord sets the goal of creating at least 300,000 jobs by 2020 in the green economy and activities that green the economy, including in manufacturing, energy efficiency, recycling, transport, and energy generation.
United Arab Emirates	A long-term national initiative, A Green Economy for Sustainable Development (2012–21), seeks to position the country as a centre for the export and re-export of green products and technologies through programmes and policies in the areas of energy, agriculture, investment, sustainable transport and construction.
United Kingdom	The Low Carbon Transition Plan: National Strategy for Climate and Energy (2009–20) seeks to make a necessary transition to a low-carbon economy through the creation of new business and employment opportunities in renewable energy and building, among others, and to cut emissions by 34 per cent from 1990 levels by 2020.

Table 14 – Examples of green growth strategies including employment goals. Source: (ILO, 2017b).

In summary, coherence between environmental policies, national and regional development strategies, and skill development are required for a successful green economy transition.

6.3 Evolving Consumption Patterns

Circular Economy

With increasing consumerism, annual global waste is expected to reach 3.4 billion tonnes over the next 30 years. In 2016, reported global waste reached approximately 2.0 billion tonnes (The World Bank, 2018). There is a large-scale transition underway in many countries to develop a circular economy (recycling, reuse, remanufacture), which will increase the productivity of resources, create new economic opportunities, reduce emissions and waste, promote innovation, and generate skilled green jobs (OECD, 2017a). The ILO (2018) report estimates 6 million new employment opportunities can be created by a circular economy. However, there is also a requirement to build the technological and infrastructure capacity for waste handling, which will create indirect jobs for the sector. In addition to direct results, the circular economy model is expected to drive social and behavioural change, promoting the use of more durability of goods, rental of some types of goods, and a newer emphasis on repair, all of which can create green jobs.

Companies attempt to create niche markets by encouraging stability in generally fast-changing consumer preferences for products and services. Many companies are undergoing the transition to the business model called servitisation – providing / delivering services, rather than merely selling a product. The justification for this transition should be apparent: selling an item generates revenue once, but selling service generates revenue multiple times. For example, an automobile dealer can sell a new car (product) and offer maintenance on it (service warranty).

Food Production and Processing Industry

Agriculture is one of the most important economic sectors in many countries, often employing the largest

share of workers, but mostly unskilled. Social dialogue between policymakers and farmers can support the development of a sustainable agriculture sector. Diversification away from staple foods to high-value crops is also underway in many regions, due to technological innovation, expanded infrastructure in rural areas, and changes in food demand. A study by Herren et al. (2012) assessed the agriculture sector by running a macroeconomic model stimulating green investments. Their findings indicated that transitioning to a sustainable agriculture system could create 200 million full-time jobs across the global food production system by 2050.

However, food production is most vulnerable to climate change, due to its reliance on often erratic weather. Farmers engaged in food production require training and skills to better prepare themselves against adverse climate conditions. Training and skill-building for farmers to tackle the changing weather patterns by applying climate-resilient agricultural techniques is needed. Important techniques in this regard include crop rotation / cultivation, soil fertility management, organic farming practices, and plant disease management (ILO, 2018).

The issues discussed in this chapter highlight the evolving nature of economies around the world. In many countries and sectors, the nature of investment, production, and consumption is transitioning towards more sustainable practices. This is being done with the knowledge that the transition to a green economy is not only essential to meet global climate targets, but if done the right way - by protecting and transitioning existing workforces, for example - can lead to sustainable economic prosperity.



7. Outlook for Green Jobs

While this report identifies a range of potential opportunities for green jobs to emerge in transitioning economies, both in the nearer term and sustained over the longer term, any real consideration of the future potential for a sustained and genuine “green jobs revolution” is dependent on the wider political economy and regulatory landscape. Crucially, a regulatory framework that will enable effective and efficient integration of decent work with environmental and economic objectives is largely missing across nations, especially in developing countries. Thus, there is an urgent need for the development of coordinating bodies with prime responsibility in anticipating the skills required for developing new green economic activities. Such institutions can coordinate between the national policymakers working on environmental and sustainable development policies, and organisations that focus on labour markets and skill development policies or vocational training programs. In the UK for example, the Departments of Business, Innovation and Skills, Energy and Climate Change, and Environment, Food and Rural Affairs came together for a short time to prepare an impactful policy paper entitled “Enabling the Transition to a Green Economy” (The European Centre for the Development of Vocational Training, 2018).



7.1 The Need for Strong Institutional Foundations to Realise Future Potential

Traditionally, environmental and employment objectives have been largely developed separately in many nations. To build a robust, resilient, and sustainable economy, a greater coherence and multi-sectoral engagement in a wider public policy framework are required to cover policy areas and instil confidence in businesses to invest in creating green jobs.

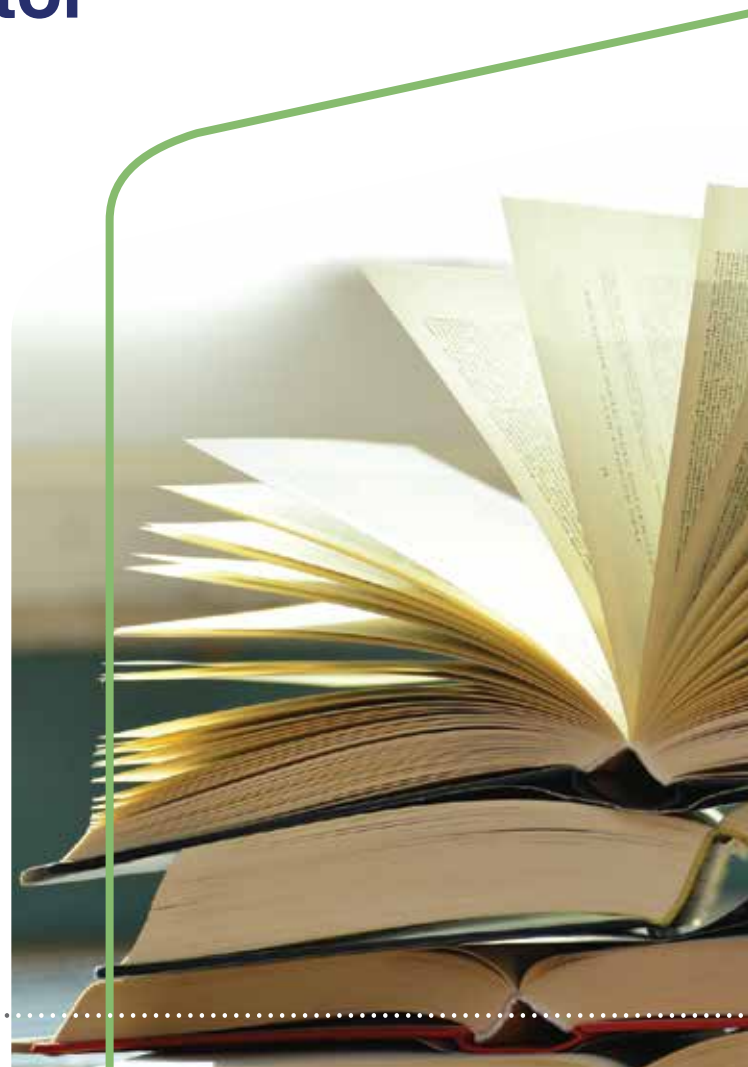
Restructuring and retraining for a wide range of industries should include mining, cement, petroleum, and chemicals. Those sectors' transitions will not only directly create new green jobs, but will also create additional jobs indirectly, including

through innovation and research and development. However, the adoption of new technologies and practices, which may come with significant costs for the industries mentioned, will require stable supporting policy and regulatory environments that gives companies and investors confidence in the transition. While greening business processes, dedicated efforts are also required to ensure social inclusion and equity, as industries and sectors transition. Investing in building new skills, supporting skill transfer with training, and including the ageing workforce throughout the transition process will create strong institutional foundations.

7.2 Skill Transfer from Brown Sector to Green Sector

Financial Mechanisms to Promote Skill Development for Transitioning to Green Jobs

Public institutional frameworks are a core foundation that underpins the wider enabling political and economic landscape. A key element of this landscape is finance mechanisms to enable jobs and skills transfer. While transitioning any one or more sectors (and related supply chain activity) from the existing brown state to one consistent with a green economy model, some temporary disruption or even destruction of jobs may be likely. Reskilling is a core requirement if existing jobs are to evolve and be sustained, and for new jobs to be created. During this transition phase, a support structure, such as financial incentives, can cushion the income loss and help orient existing skills with necessary green skills (European Commission, 2013). A capable workforce with skills that meet the green job requirements must be developed; investments in human capital is needed across economies.



Long-term and Economy-wide Skill Portfolio

To support a long-term goal for a green economy, and to develop employment opportunities (direct and indirect), a wide portfolio of skills and education programs are required. Industrial collaboration with universities and governments can support collaborative long-term research, which can benefit the industries and build labour capital through collaborations. The transition to a green economy also requires capacity building to deliver high-quality products and services. In many cases, this will require upskilling the workforce to perform jobs to higher standards. For example, high-quality construction standards will require the labour workforce to be trained or upskilled, as necessary. The availability of skills to meet future

demand gives confidence amongst investors and businesses planning how and where to invest.

Positive impacts on jobs resulting from the transition to sustainability in the energy sector may also be found in nonenergy sectors. A study by Fülleman et al., (2019) forecast the energy transition scenario to 2050 for Switzerland. Their analysis showed a 17% increase in employment in business activities related to energy; a full third of these jobs are expected to be induced in non-energy related sectors. Primarily, these would be expected to be green jobs in public transport and building retrofits, which provide jobs that generally cannot be outsourced across national boundaries (though may involve foreign direct investment).

7.3 Socioeconomic Trends

Social Dialogue and Good Governance

Green and decent jobs is the central theme of this report, following the need for societies to transition from unsustainable practices to a green and sustainable future. However, the key to adopting a sustainable pathway is through participatory governance, in which social dialogue is an important element for promoting the adoption of a sustainable development agenda (Hermans et al., 2016). Furthermore, sustainable development can mean different things in different countries. For example, in some parts of the world, access to energy - which is considered to be such a basic need that it features in the UN 2030 agenda as Sustainable Development Goal (SDG) 7 – is a pressing need. For countries in which basic needs (clean water, food, and shelter) are not yet met, and the government has been slow to adopt the necessary policy framework, social dialogue can play a key role in driving the necessary change. In the absence of basic needs, it should be possible to improve if the stakeholders are engaged effectively. For situations in which a common sustainability template may fail, green and decent jobs can be successfully promoted in line with the specific challenges of the local environment. An ILO report (Papadakis, 2008) regarding information sharing among representatives of governments or social

partners regarding issues of common interest relating to economic and social policy” (ILO, 2017c, p. 4).

Transitioning to a green economy almost inevitably leads to temporary job destruction until labour skills are transferred from the existing brown sector to a green sector. This will not be an easy accomplishment, as incomes will be lost (even if only temporarily). On the other hand, a brown job loss should ideally come with opportunities to transition towards a decent job with higher longterm economic value. Public participation through social dialogue can serve as a platform for determining the balance between environmental considerations, equity, and economic needs to develop national policies supporting the green transition.

Social dialogue on the sustainability agenda can influence consumer behaviour and create awareness regarding unrestrained consumption patterns and its consequences on the environment and public spending. For example, unrestrained consumption leads to increased waste, which then requires local authorities to divert public funds to waste handling, away from better uses.

Decent Jobs and a Healthy Environment

Transitioning to a low carbon economy offers opportunities to create decent work and improve social inclusion and equity. However, this must be achieved through implementing mixed economic policies (industrial, sectoral, and labour), whilst meeting regional- and sector-specific challenges (ILO, 2012, 2015). At the industry level, social dialogue between local authorities, trade unions, and educational institutions (research and training) regarding forecast skill needs / gaps, and employment challenges will help with the implementation of regulatory measures and monitoring policies. At the enterprise level, the dialogue will help support skill development and healthy and safe occupational environments.

An effective transition towards a green economy will require the development of a regulatory framework upheld by three pillars: economy, society, and environment (ILO, 2015). The concept of decent work acts as a catalyst in developing a coherent policy framework that integrates varying stakeholders' objectives, including industrial investments, social protection for the workforce, and environmental protection by adopting low carbon pathways. Green jobs cannot be justified as green if they don't protect workers' rights and interests whilst promoting social dialogue to address worker's concerns. Many countries are developing a circular economy, which has been identified as having the potential to create 6 million jobs worldwide (ILO, 2018). This will require a large labour force for material recovery, but these jobs cannot be called green unless measures are undertaken to make them decent jobs, by protecting the workers exposed to significant amount of hazardous waste. This is becoming increasingly important for the handling of e-waste.

Labour Productivity

It is a misconceived notion that employment loss in resourceintensive industries is primarily due to the green transition. In fact, the decline in employment has been occurring over the past several decades, driven by increasing automation and rising labour productivity (ILO, 2012).

With continuing advancement in automation and technology, labour productivity will most likely continue to increase across all economic sectors, resulting in further overall employment declines. Increased adoption of robotics and artificial intelligence will see further reduction in jobs, and this may particularly in brown jobs where intelligent robotics can replace labour. However, similar transitions will also occur in green jobs, as the sector matures (ILO, 2013). However, available (due to unemployment) labour may sustain policies that can bring structural reforms promoting the creation of jobs for a skilled workforce.

Case Study

- **Skills development strategy:** To reduce the mismatch between supply and demand for green jobs, an indepth analysis on prospective green skills, domestic workforce requirements, and retraining needs are being analysed. A key aim is to bring more UAE nationals into the workforce.
- **Training for potential workforce:** Policies to support workers interested in green jobs is being mapped, coupled with policies promoting the training of entrepreneurial skills, and encouraging the participation of women in green jobs.
- **Recruitment services:** A labour market intermediation for green jobs through providing employment services and/or private recruitment agencies in offering green career guidance and matchmaking events and online platform.
- **Financial incentives:** Many financial incentives are being evaluated, including tax exemptions for green companies, low-interest credits or guarantees for green entrepreneurs and cleaner production processes, and subsidies for hiring UAE nationals to fill skilled green jobs.

The UAE is positioning itself as a leader in sustainable development, largely due to its emphasis on data, research, innovation, and partnerships. The strategies, visions, policies, and plans detailed in the rest of this case study are all the result of data analysis and research (MOCCA, 2019 and DCCE, 2019) obtained and performed as part of the UAE's comprehensive environmental monitoring program, which allows researchers to understand the impact of economic activity on the environment. It also allows researchers to evaluate how policies focused on climate change, energy, water, food production, and human health interact. Scientific research, innovation, and R&D is an important factor in the monitoring program, and the country regularly hosts meetings of leading global sustainable development experts. Due to its open and collaborative approach to economic development, the UAE has established many partnerships with other governments, businesses and other organizations (UNEP, UNDP, ILO, IRENA), who are credited with providing (MOEW, 2014; MOCCA, 2017 and 2019) essential support for achieving the country's goals.

Short-Term Vision 2030

The United Nations has defined a set of 17 goals - Sustainable Development Goals (SDGs) - that aim to provide better living conditions to all by 2030. The SDGs factor in sustainability policies and plans in countries around the world. As part of the UAE's Short Term Vision 2030 plan, the country has set an objective to achieve the SDGs and support measures, nationally and internationally. Essentially, the Vision aims to integrate the green economy and sustainable development to create green jobs. Here we consider three of the more notable strategies listed above.

Dubai 3D Printing Strategy

This initiative aims to exploit technology for the service of humanity and promote the status of the UAE and Dubai as a leading hub for 3D printing technology by the year 2030. 3D printing is a resource-saving and efficient technology, particularly as compared to subtractive technologies. It also helps in reducing manufacturing and inventory requirements, reduces fuel consumption, and waste through recycling. The Dubai government has set a 2030 goal to have 25% of its buildings 3D printed.

Dubai 3D Printing Strategy
<https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/local-governments-strategies-and-plans/dubai-3dprinting-strategy>

Dubai Industrial Strategy 2030

Dubai Industrial Strategy 2030 aims to position Dubai as a preferred global destination for knowledge-based, sustainable and innovative manufacturing, specializing in six sub-sectors: aerospace, maritime, aluminum and fabricated metals, pharmaceuticals and medical equipment, food and beverages, and machinery and equipment. These sectors all have strong prospects for future growth and high potential for exports; their economic impacts are expected to materialize in the mid- to long-term. They also factor heavily in the Dubai Industrial Strategy and Dubai Plan 2021.

Dubai Industrial Strategy 2030 -
<https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/local-governments-strategies-and-plans/dubai-industrial-strategy-2030>



Abu Dhabi Economic Vision 2030

Abu Dhabi's Economic Vision 2030 is a long-term transformation plan by the Government of Abu Dhabi to transform the economy by diversifying away from oil to a knowledge-based economy. It sets out several immediate economic priorities:

- Building an open, efficient, effective, and globally integrated business environment
- Adopting a disciplined fiscal policy that is responsive to economic cycles
- Establishing a resilient monetary and financial market environment with manageable levels of inflation
- Driving significant improvement in the efficiency of the labour market
- Developing a sufficient and resilient infrastructure capable of supporting anticipated economic growth
- Developing a highly-skilled and highly-productive work force
- Enabling financial markets to become the key financiers of economic sectors and projects
- Abu Dhabi Economic Vision 2030 - https://www.abudhabi.ae/cs/groups/public/documents/publication/mtmx/nju0/~edisp/adeqp_nd_131654_en.pdf

In addition, there are several relevant strategies the country aims to achieve, some of which are listed below:

- Environment Vision 2030 (Abu Dhabi) - <https://www.ead.ae/Publications/Environment%20Vision%202030/Environment-Vision-2030-Eng.pdf>
- Plan Abu Dhabi 2030 - <https://www.ecouncil.ae/PublicationsEn/plan-abu-dhabi-full-version-EN.pdf>
- Abu Dhabi Transportation Mobility Management Strategy - <https://u.ae/en/about-the-uae/strategiesinitiatives-and-awards/local-governments-strategies-and-plans/abu-dhabi-transportation-mobilitymanagement-strategy>
- Surface Transport Master Plan (Abu Dhabi) - https://www.ecouncil.ae/PublicationsEn/surface_transport_master_plan_en.pdf
- Dubai Autonomous Transportation Strategy - <https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/local-governments-strategies-and-plans/dubai-autonomous-transportation-strategy>

Long Term 2050 - UAE

The UAE's Long Term Vision 2050 charts a long-term path towards becoming a green and sustainable economy. Under this vision, the government is reducing its economic dependency on fossil fuels and diversifying towards a greener, cleaner, and innovative economy. Progress towards achieving the objectives of Vision 2021, Vision 2030, and Vision 2050 have laid the foundation for Centennial 2071, highlighting the nation's commitment to reduce greenhouse gas emissions and improve the environment (air, groundwater, marine water) and biodiversity. The UAE Energy Strategy for 2050 focusses on mitigating the effects of climate change, including increasing the share of clean energy in the energy mix to 50% by 2050. The country aims to become a global leader in low carbon technology.

8. An Overview of the Effects of COVID-19 on Economies



8.1 Key drivers of COVID-19 Recessions

The World Bank's Global Economic Prospects, 2020 edition, investigates the worldwide impacts of the COVID-19 pandemic, across various dimensions: economic, regional outlook – macroeconomic implications, short- and long-term growth effects, etc. The report identifies the effects of the pandemic on productivity and documents three reasons why COVID-19 is a more significant global disaster than its predecessors, adversely affecting labour productivity. Three key drivers are identified:

Global Reach

Pandemics are rare events, but their impacts can be longlasting. Epidemics in the recent past were regionally contained, and mostly in developing or LDC economies. Examples in this century include SARS in East Asia (2002- 03), MERS in the Middle East (2012), Ebola in West Africa (2014-15), and Zika (2015-16) (World Bank Group, 2020, p. 157). However, COVID-19 spread across the entire world, with the substantial risk to life causing governments to shut down large elements of economies and trade, triggering necessary economic losses where no single country has been left untouched. Today's interconnected world, relying on global trade networks and the movement of people, has left many countries vulnerable, with impacts feeding through both domestic and international markets, and complex supply chains. This has greatly amplified the impacts of the pandemic, where the health and wellbeing of populations are likely to be affected in multiple ways in coming months and years over and above the direct dangers of the virus itself.

Mitigation Measures / Social Distancing

The social distancing requirement implemented in most countries has hit services sectors the most. As the virus is expected to continue to exist even after a vaccine is found, the sector's recovery will be slow due to

restrictions that will inevitably act to lower labour productivity (World Bank Group, 2020). For the service sector to regain its former economic position, many efforts will be required in changing the ways of doing business during and after the pandemic. The crucial nature of the challenge lies in the fact that the role of the services sector has become increasingly important in developing economies in the last two decades, compared to other sectors, such as manufacturing and agriculture. Figure 9 shows the growth of GDP value-added from the services sector between 1997 and 2015, across different economies (Buckley & Majumdar, 2018).

The increasing share in global economic growth of the service sector has increased employment opportunities in most countries. In 2017, 70% of labour employment was in the services sector in OECD countries, including government and private services. Figure 10 shows the contribution of services to GDP value added and employment in OECD countries.

For developing and least-developed countries, diversifying to the services sector created a new frontier for economic gains, allowing them to increase their participation in international trade. However, the international services trade is affected by national and domestic policies (Buckley & Majumdar, 2018, p. 3). This has become evident during the COVID-19 pandemic, with growing shortages of basic medical and food supplies across the world due to increased trade dependencies. With local manufacturing of goods and services in decline, the impacts of the global interconnections during the COVID19 pandemic have impacted most in countries that are entirely dependent on imports. It is possible that large importing countries have envisaged the need to develop local opportunities to become partially self-reliant, to avoid facing again similar vulnerability in the future, but this should give cause for concern as it could lead to adoption of unsustainable practices. Whatever the outcome, there will surely be a requirement to restructure international trade relations to safeguard economic interests and reduce vulnerability, perhaps creating more local jobs to boost local economies. This may create opportunities for green and decent jobs during the process of economic recovery. New investments are likely to be needed for the adoption of advanced

technologies and to develop the skilled workforce required, creating new opportunities for green economic recovery, employing environmentally friendly and energyefficient processes. Mitigation measures, such as working from home, social distancing, or using local produce, can encourage investments in innovative and efficient digital technologies such as artificial intelligence and robotics. Overall, the current pandemic situation can create new opportunities for structural economic shifts (WBG, 2020a, p. 157).

Financial Setback / Crisis:

Even the 2008-09 global financial crisis that the world witnessed did not have as wide an impact as the COVID-19 pandemic (WBG, 2020a, p. 157- 159). The economy wide losses to business due to the nearly complete cessation of economic activity led to a larger disaster, affecting most household and businesses, leading to financial breakdown and bankruptcies. Job losses across all sectors burdened national fiscal

balances, overstressing governmental resources. The development of institutional frameworks to boost economic recovery can be seen as a long-term process, advantageous for reducing bottlenecks in overhauling the governing structure in developing countries. This process is expected to create a sustainable business environment conducive to expanding investment in sectors that – as has become evident during the pandemic - were neglected, including public healthcare and education in developed economies (WBG, 2020a, p. 157- 159). There is also an opportunity for countries to restructure their financial systems to integrate climate action with fiscal incentives to drive strong, inclusive economic growth towards low carbon pathways (OECD, 2017b). However, fiscal reforms and financial investments to diversify the economy require careful calibration specific to a country and socioeconomic structure (WBG, 2020A). There is a need to prioritise public spending to promote innovation and green developments (transport infrastructure, the built environment), pricing reforms (fossil fuel subsidy elimination to promote green energy) and to encourage change in unsustainable consumerism (Barbier, 2020)

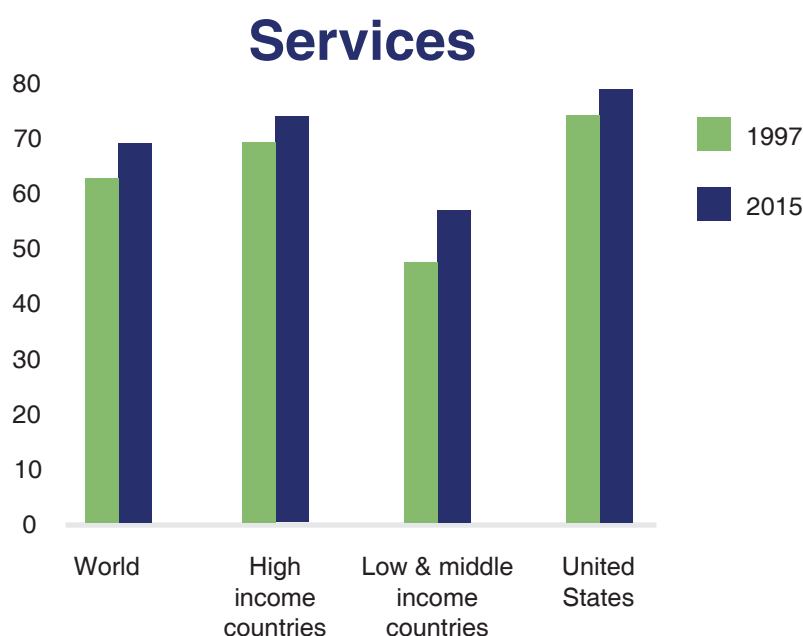
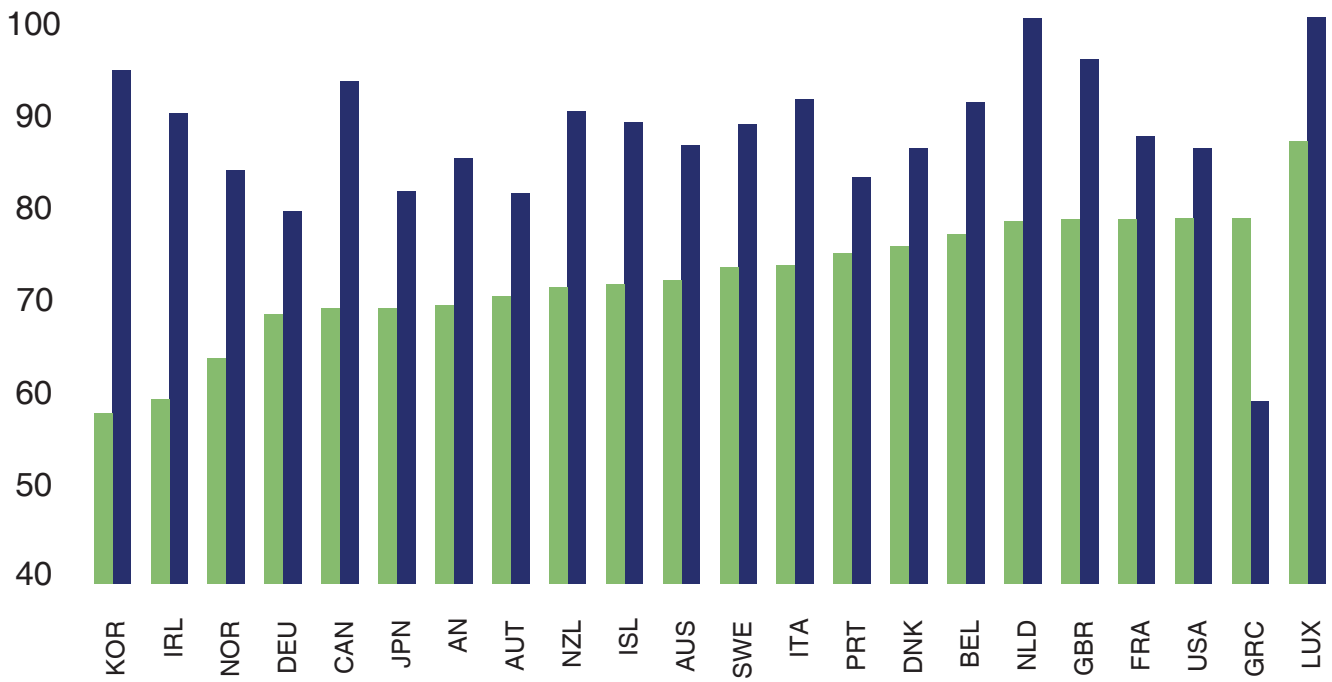
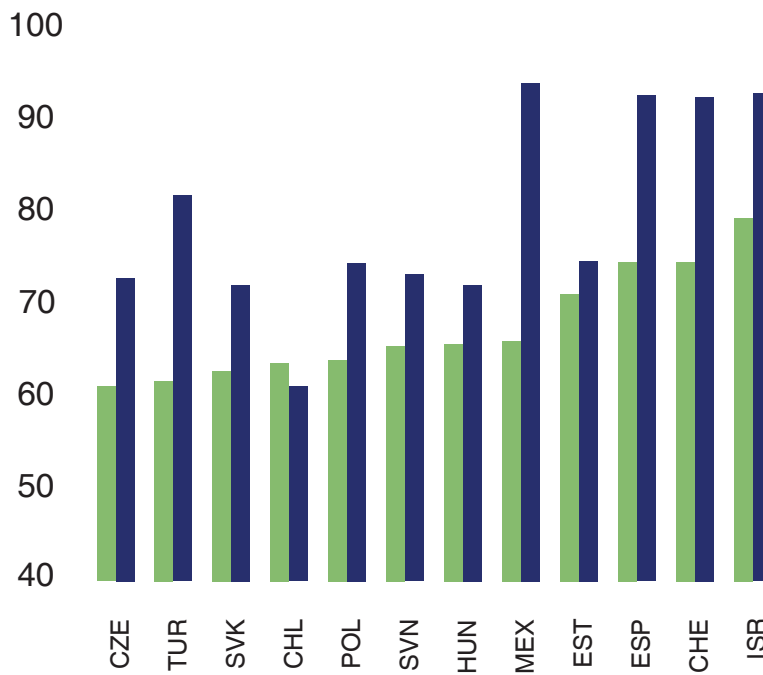


Figure 9 – Services Sector GDP (percent). The world bank classification of services sector includes value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Source: (Buckley & Majumdar, 2018), data from the World Bank national accounts data, OECD national accounts data files, 2017, <https://data.worldbank.org/indicator/>.

OECD Member Nations



High Income



Middle Income

■ Percent of value added in service
 ■ Percent of total employment in service

Figure 10 – Services sector GDP and employment in OECD countries. Source: (Buckley & Majumdar, 2018), data from the OECD database, 2017

8.2 COVID19's Impact on Green Jobs

The Radical Economic Shift Across Industries (Brown and Green)

Prioritising economic restructuring is crucial in many countries, as there is a need to balance safeguarding the public healthcare system and reviving the post-lock down economy. There is a need to evaluate adopting different measure for different economies.

For G20 economies, moving away from a business as usual approach and transitioning to greening the economy can have multiple benefits. It can create the structural economic shift using government stimulus packages to promote sustainable businesses throughout the private sector, eliminate fossil-fuel subsidies, price GHG emissions, raise public awareness on greening the environment, and promote behavioural change to support sustainable consumption. Developed economies can cushion the change and adopt a long-term commitment to achieve their net-zero commitments, building a low carbon resilient economy. According to the IMF World Economic Outlook, the global economy is projected to contract by 3% in 2020, but then grow by 5.8% in 2021 when economies normalise business activities through policy measures.

In April 2020, the IMF fiscal monitor (Battersby et al., 2020) measured the total global fiscal support being deployed to help businesses and residents restart economies to be \$9 trillion. The group of G20 countries (advanced and emerging countries) have valued their fiscal support measures at \$8 trillion. It is expected that there will be a further increase in spending. However, very little of the fiscal spending is aimed towards greening the economy. The United Nations has called for “build back better” measures (United Nations, 2020, p. 13-22), to encourage green investments. A combination of short- and long-term recovery plans to revive the economy (Barbier, 2020) can tackle the challenges of unemployment and inequality which has been witnessed since the pandemic. Past learnings from the 2009-09 financial recession indicate that realising economic recovery whilst transitioning to a low carbon economy will require long-term (5-10 years)

commitments. Hepburn et al., (2020) have identified several high-priority policies, which can simultaneously help revive the economy and meet national climate change targets. These are constructing green cities and infrastructure, energy efficiency building retrofits, research and development for low carbon solutions, and investing in education and training.

Policy for Economic Recovery – a Green Recovery or BAU (Business as Usual)

In their report on “How a post-pandemic stimulus can both create jobs and help the climate”, McKinsey & Company undertook a low-carbon stimulus analysis across four European countries. Their analysis suggests that mobilizing 75 - 150 billion euros capital could generate 3 million new jobs and reduce CO₂ emissions by 15 - 30 percent. A balanced stimulus package can achieve growth whilst maintaining environmental goals. While developing stimulus packages, policymakers will have to balance socioeconomic impact, climate impact, and financial feasibility in order to adopt a long-term development plan to ensure jobs, economic growth, and a sustainable low-carbon economy. For example, several EU countries and businesses have supported the European Green Deal as an economic recovery plan, which also addresses the challenges of climate change (Engel et al., 2020).



8.3 Opportunities

Investing in structural transformation, including the transportation sector, has the potential to create green jobs and build an equal and inclusive society. A recent study by the ILO and UNECE examined the implication of four public transport scenarios for 60 countries across the UNECE member states, showing the potential to create up to 15 million new jobs worldwide. The four scenarios are shown in Figure 11 (ILO and UNECE, 2020).

To enable employment opportunities for green and decent jobs, comprehensive sets of policies need to be implemented including skill development, promoting sustainability through public transport electrification and greening, and creating alternate mobility options (cycling, hyperloop transport, etc.). Social dialogue with industry and the public to foster adoption is crucial to the successful implementation of such policies.

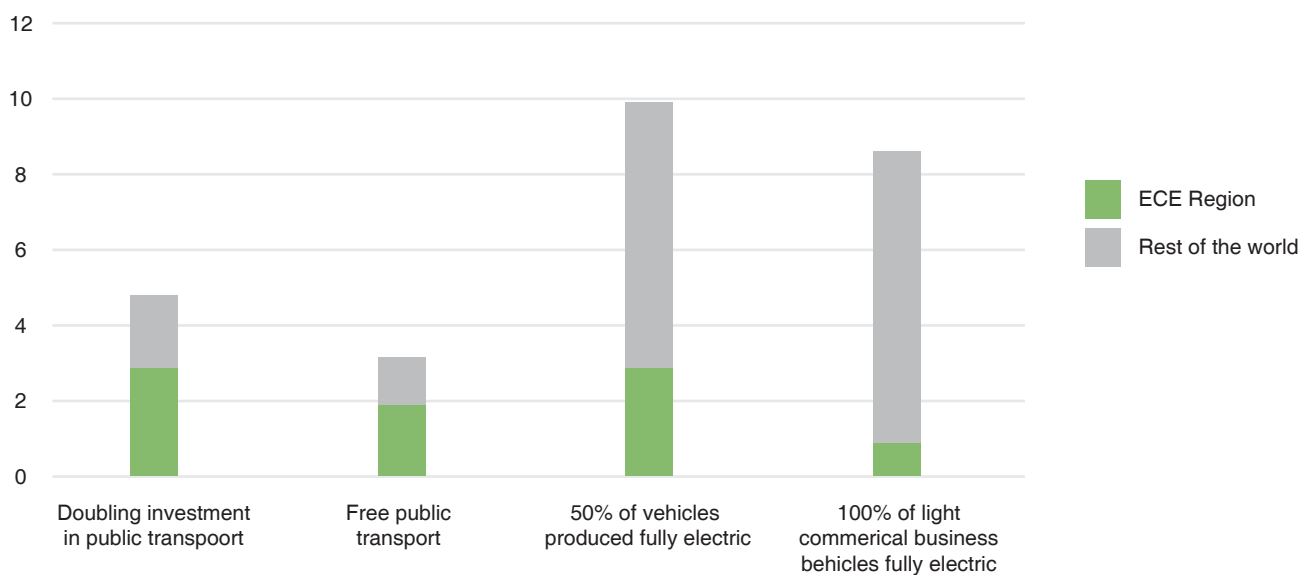


Figure 11 - Net job creation (in millions) in the whole economy under each of the scenarios modelled in the study *Jobs in green and healthy transport: Making the green shift*. Source:(ILO and UNECE, 2020)

Digital technologies have played a crucial role during the pandemic, not only helping people overcome isolation during lockdown, but also in promoting opportunities for businesses, enterprises, and education to remain connected. Innovative platforms contributed significantly to the development of resilience measures to protect vulnerable populations using data and artificial intelligence (United Nations, 2020, p. 6). Healthcare systems benefitted from mitigation measures which included features to increased awareness among the population and supported effective social contact avoidance. The government and the education system benefitted immensely by remaining connected with the pupils

and population. Contact tracing applications have provided support to contain the spread of COVID-19 amongst the population. Several new ecommerce opportunities are being created daily, but to be able to offer equal opportunity to all citizens, there is a need for investment in this sector to ensure progress. Information and Communication Technology (ICT) is a natural choice for creating green jobs, and is an enabler for job transition, creating healthy, safer, and decent employment opportunities. However, it is also important that this sector develops in a sustainable way that reduces both the requirement for natural resources (e.g. rare minerals) and energy (e.g. for cooling data centres).

9. Conclusion

With effective planning and policy strategy, green jobs can create decent living and work opportunities that contribute to the wellbeing of people, in turn raising the productivity and prosperity of future green economies. The concept of decent work in green jobs can provide the means for people to afford at least a basic standard of living in a healthy and socially inclusive environment. Creating productive and skilled human resource capital helps society generate sustained wealth by building a progressive low-carbon economy, whilst protecting ecological resources. The creation of green jobs may also constitute a key element of how reflecting low carbon transition actions within recovery planning from the economic downturn associated with the Covid-19 pandemic can make the latter more sustainable over the long term.

As discussed widely in this report, transitioning to improve the energy, emissions, and resource efficiency of economies can open new job opportunities while moving towards a lowcarbon economy. While the renewables sector is expected to see the largest relative growth, the greatest absolute job growth may be seen in supporting sectors such as construction, manufacturing and certain mining industries. Although the net impact on employment from transitioning to a low or zero carbon global economy is expected to be positive, it is likely that some sectors such as petroleum refining and extraction may experience contraction and associated job losses.

As has been highlighted at numerous points in this report, if the transition is not planned and designed effectively the phasing out of carbon-intensive sectors could potentially destroy jobs and livelihoods for many workers and may have a significant negative impact on employment in certain countries. Providing particularly older workers and those with limited geographical mobility with training / retraining and new or adaptive skills is not an easy feat. We note as a key conclusion that effective planning for a 'Just Transition' and, where possible, evolution rather than revolution in how people live, work, and do business, is essential.

As the global economy transitions to align with emissions reduction targets, it is important that the supply chain implications within and across countries is considered. Greening of the entire supply chain can be challenging, especially for production processes based in the least developed or developing countries. Public and policy awareness is well developed in terms of understanding the full carbon footprint of consumption choices, and, increasingly of the social responsibility associated with corporate procurement decisions. However, we note that not only are carbon footprints difficult to quantify, but recognition and understanding is lacking in terms of the full supply chain implications in terms of environmental and worker impacts/conditions.

The transition to low-carbon economies and green jobs must be set in the context of the ongoing digital revolution impacting and increasing productivity in all sectors of all economies around the world. This provides a very pertinent example of why climate, energy, and environmental policy design and delivery must integrate with the wider public policy framework, in which digital skills and capacity sit at the heart of many countries' industrial and wider economic strategies.



10. Recommendations

Delivering a Just Transition

- Effective planning for a transition and, where possible, evolution rather than revolution in how people live, work, and do business, is essential. During this transition phase, a support structure, such as financial incentives, can cushion the income loss and help orient existing skills with necessary green skills.
- Policymakers should consider the extent to which evolutionary transitions can be supported and incentivised to build on the existing strengths of a country's industrial landscape.
- There is a need for policymakers and industries to explore, identify and leverage transferable skills, capacity and infrastructure that exist in brown sectors, and which can play a role in effectively developing required green sector, potentially with a transitional or sustainable role for a wider portfolio of activity across a range of existing and new areas.

Integrating Environmental, Economic, and Decent Work Objectives

- A regulatory framework that will enable effective and efficient integration of decent work with environmental and economic objectives is essential for countries to meet both the UN's Sustainable Development Goals and emission reduction pathways aligned with limiting global temperature rise to 1.5°C.
- Local, regional, national and supranational government bodies need to actively engage with private and third sector actors to design policy frameworks that forge consensus to develop mechanisms to meet national economic and environmental goals while delivering decent jobs.
- At the industry level, social dialogue between local authorities, trade unions, and educational institutions (research and training) regarding forecast skill needs / gaps, and employment challenges will help with the implementation of regulatory measures and monitoring policies.

Enabling Skills Transfer and Capacity Building

- There is an urgent need for the development of coordinating bodies with prime responsibility in anticipating the skills required for developing new green economic activities – especially in developing countries.
- Cooperation and coordination between, political actors, institutions, industries, employees, and educational institutions is required to identify and coordinate lifelong learning and skill-building activities.
- Support structures, such as financial incentives, should be used to support reskilling.
- Encouraging short - and long-term technology transfer between nations and sectors is crucial – especially for developing countries.

Increasing Business and Investor Confidence

- There is a need for stable supporting policy and regulatory environments that gives companies and investors' confidence in the transition.
- To build robust, resilient, and sustainable economies, a greater coherence and multi-sectoral engagement in a wider public policy framework are required to instil confidence in businesses to invest in creating green jobs.
- The availability of more comprehensive data could also be important to investors. Separate accounting metrics or indicators to show green job employment levels will help society transition more smoothly to a green economy.

The Need for Improved Data on Green Jobs

- A standard methodology to assess green jobs needs to be developed and adopted by all nations
- There is a need to assess the actual new (additional) green jobs created, and calculating / reporting total or employment impacts will either not account for or potentially mask gross job losses or transfers due to the transition.
- Accounts of net employment data derived from considering gross new green jobs minus any job losses / transfers in shifting from brown to green jobs are required to measure the real nature of evolution in green job creation.

Increasing Consumer Demand for Low Carbon Products and Practice

- Policy makers should work to influence, incentivise, and support consumer choice and demand for higher environmental protection. This can further create an enabling landscape for a shift in the nature and type of economic transitions underpinning how people live and do business. However, it must be accompanied by multi-lateral action and cooperation in enabling the emergence of effectively functioning markets for green goods and services.
- There is a need to create social awareness on promoting the uptake of green or recycled products.

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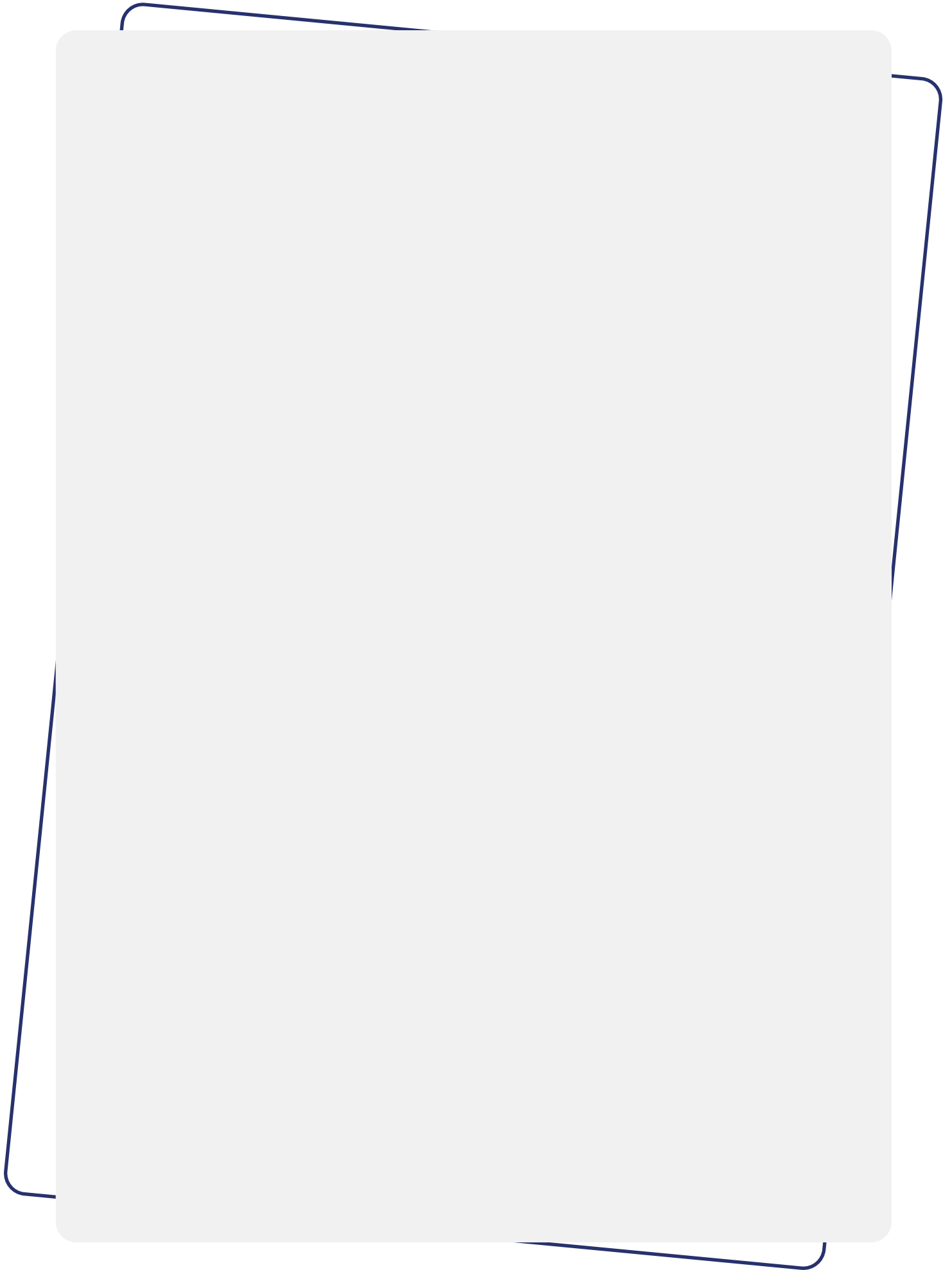
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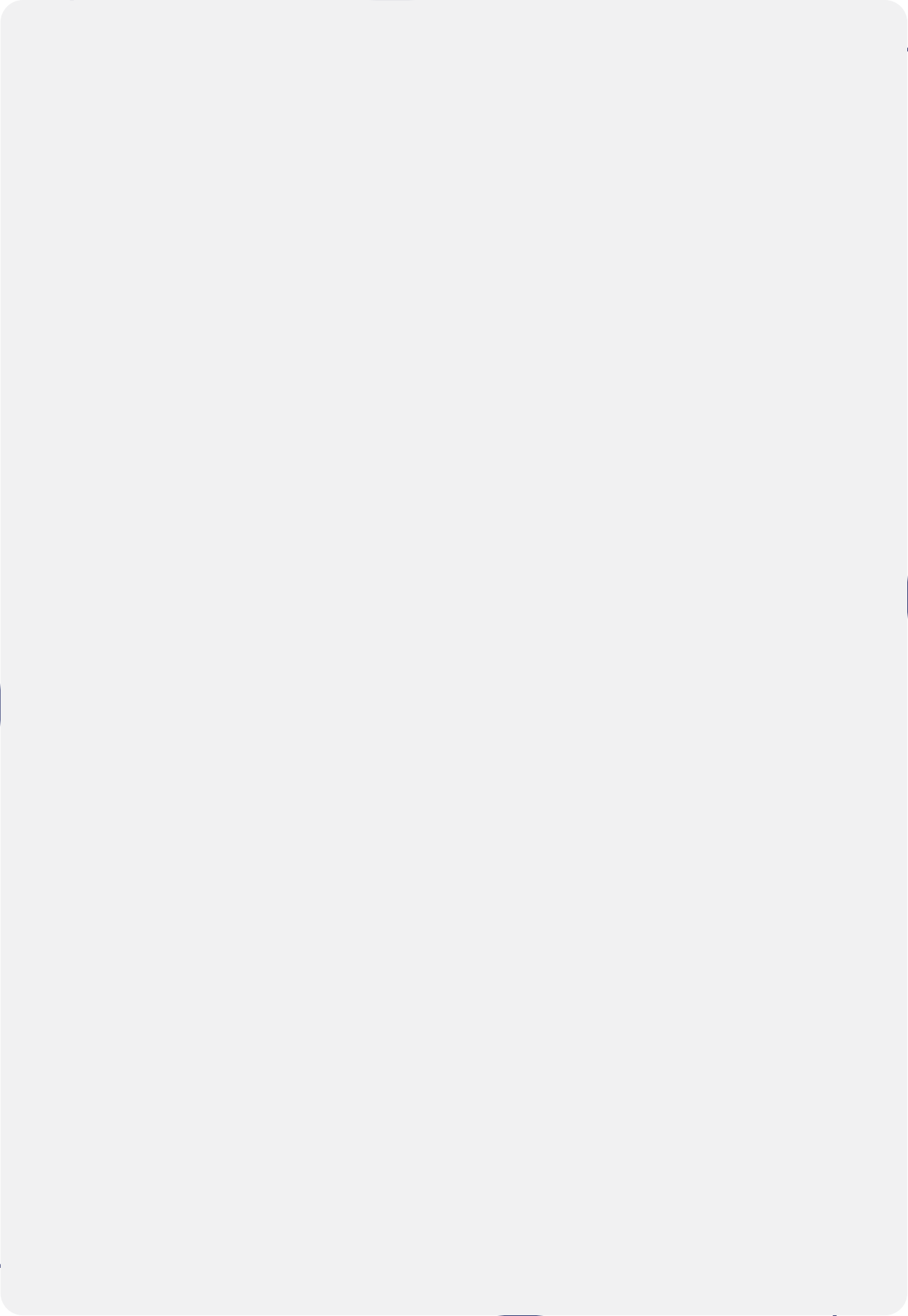
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