

**Work towards net
zero in Asia Pacific**

The rise of the Green Collar
workforce in a just transition

June 2023



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The global struggle against climate change must be fought – and won – in Asia Pacific.

We have entered the period of consequences of inaction on climate change. Due to the increasing frequency alongside intensity of extreme weather and existing socioeconomic vulnerabilities, the Asia Pacific region is one of the world's most exposed regions to climate change. These two factors are causing immense suffering and vast damage to our communities, ecosystems and infrastructure without rapid decarbonisation, the losses will continue to mount.

The decisions Asia Pacific leaders make over the next decade will be felt across the world. But currently the collective climate commitments of Asia Pacific countries – and all countries globally – are falling short of what is needed to avert the worst impacts of climate change.

Through coordinated action, Asia Pacific countries can drive global efforts to turn the tide on the climate crisis and reap the benefits of global leadership. But we need the skills to drive the transition and harness Asia Pacific's unique position, ensuring people are equitably equipped, prepared and able to be resilient as we contend with the ongoing impacts of climate change while enabling the required economic transitions.

Harnessing the power of Asia Pacific workforce will be the difference between success and failure.

People, their ingenuity, hard work, and determination, will create the solutions needed to solve the world's most pressing climate challenges. Starting with decarbonisation, we must transform the underlying production systems of our economy, embracing circularity, biodiversity, artificial intelligence, robotics, digital manufacturing, and smart infrastructure.

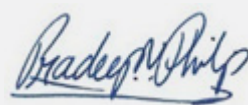
We have some of the world's brightest talent and we are starting to witness the rise of a Green Collar workforce. In fact, Deloitte estimates 80% of the skills needed for the zero-emissions transition in the short-to-medium term already exist in today's workforce.

However, over 40% of Asia Pacific workers are currently employed in industries that are under threat from climate change and the transition to net zero.

How governments act individually and collectively to support these workers to adapt, contribute and thrive as our economy transforms will be one of the biggest determinates of equality in the coming decades. No country can do it alone, but together it is possible to influence a just transition where the benefits far surpass the cost.

In this report we present our Green Collar workforce policy agenda to demonstrate how Asia Pacific governments can lead the way in tackling the climate crisis, while increasing the resilience of those most vulnerable and ensuring equitable employment outcomes.

If we get this right, we can turn devastating losses into extraordinary economic growth and create 180 million jobs along the way. We have a narrow window of time to secure a sustainable and prosperous future. With the world at stake, there is no time to waste.



Dr. Pradeep Philip
Lead Partner,
Deloitte Access Economics



Will Symons
Sustainability & Climate
Leader, Deloitte Asia Pacific

02

Executive summary





Climate inaction is the greatest threat to the Asia Pacific region, but a poorly planned transition could perpetuate inequalities and curb growth.

- **Asia Pacific has much to gain from investing in green innovation and decarbonisation, and the most to lose from inaction.**
- **Workers will be the foundation of the net zero transition. How leaders invest in the development and resiliency of their workforce will determine if the climate challenge is won or lost.**

Climate inaction is the greatest threat to the Asia Pacific region, but a poorly planned transition could perpetuate inequalities and curb growth.

Temperatures are rising twice as fast in Asia as anywhere else in the world¹. The increasing frequency of climate-related disasters is devastating ecosystems and communities and translating into painful commercial and economic losses.

Asia Pacific countries face the dual risk of being highly exposed to the physical impacts of climate change, and a high employment rate in industries that will face disruption from the low emissions transition. The Deloitte Economics Institute estimates that 43% of workers in the region are employed in vulnerable sectors such as agriculture, conventional energy, manufacturing, transportation, and construction.

China and India are expected to contribute around half of global economic growth this year with the rest of Asia Pacific contributing an additional fifth². However this growth means that the region is also the source of over half of global greenhouse gas emissions. Rapid decarbonisation in Asia Pacific is critical to tackling the climate crisis, but countries must strike a delicate balance to ensure the transition focuses on distribution and growth quality to ensure equitable outcomes for all regions and communities.

Transforming Asia Pacific economies to net zero is an unprecedented economic opportunity with the potential to create 180 million jobs.

Deloitte's Turning Point research showed that accelerated climate action can significantly boost GDP and drive phenomenal growth in Asia Pacific³. With abundant natural, human and technological capital, the region is uniquely positioned to build and scale the solutions needed to accelerate the global transition to net zero. Asia Pacific's strengths in industrial and digital technologies offer significant opportunities for leadership across the future of all low-carbon systems, including mobility, energy, manufacturing, food and land use. If Asia Pacific countries seize the decarbonisation opportunity, they could add \$47 trillion to the region's economies by 2070 and create 180 million jobs by 2050⁴.

A focus on green skills can chart the path to climate-resilient growth and shared prosperity.

Reaching net zero and averting the worst impacts of climate change will require a highly skilled workforce to drive the transition. Governments must partner with businesses, education, and training institutions to ensure that, as the transition unfolds, the right skills are available at the right time. Building this adaptive pipeline of green talent will require significant investment in education and training systems across the Asia Pacific region. Careful planning is needed to protect workers whose jobs are disrupted and support them to adapt, upskill or transition into higher-value employment pathways. Universal social protection systems and skills promotion will be critical components to facilitate a just transition, and protect people and economies from climate change.

A Green Collar workforce is emerging, but green skills policy readiness varies widely across Asia Pacific.

As Asia Pacific countries step up their decarbonisation commitments a new Green Collar workforce is emerging. The region has strong pools of science, technology, engineering and math (STEM) talent and is seeing significant employment growth in sectors like renewable energy. However, currently the collective climate commitments of the region need to catch up to what is necessary to limit climate change⁵. Similarly, green skills policy readiness varies widely, and some need to develop robust social protections and put just transition plans in place. In a region shaped by diverse levels of wealth and economic maturity, as well as varying levels of development and social progress, it is essential to recognise that every country has a different starting point and unique challenges. Overcoming these will require an unprecedented effort with radical collaboration across borders and industries.

Proactive public policy must step up to drive a prosperous and equitable future for all.

The Deloitte Economic Institute has developed a Green Collar workforce policy agenda to guide decision-makers on how to support industries and workers to adapt to a new economy. This report builds on how Asia Pacific leaders can lead the way by accelerating climate action, while ensuring equitable outcomes for all citizens. Throughout this report, we have included examples of ongoing green skills initiatives in our region to demonstrate the power of collective action to protect our planet and the prosperity of future generations.

Green Collar workforce policy agenda

1/

Set ambitious interim targets

Setting purposeful interim targets can stimulate investment and direct it to areas of the economy that will deliver strong and equitable growth. This supports industries, businesses and individuals to make effective investment decisions for a timely and coordinated transition.

2/

Design new industrial policy

As sectors transform, they will become increasingly interconnected and the decarbonisation of certain sectors – like power and hydrogen – will underpin the decarbonisation of others. Governments have an important role as ecosystem architects, co-ordinating efforts and attracting green talent to the biggest areas of opportunity.

3/

Create high-value jobs for transition pathways

A just transition must create decent work and viable, fulfilling job opportunities that contribute to meeting regional and global climate challenges. Policy settings must ensure employment pathways with better outcomes in terms of wage, working conditions and job security.

4/

Ensure an adaptive skills and education pipeline

Reaching net zero will require a dynamic approach to skills development, with policymakers collaborating with businesses, education and training providers to cultivate both the skills needed now – and in the future – to become low emissions.

5/

Target workforce policy to direct skills where they are needed

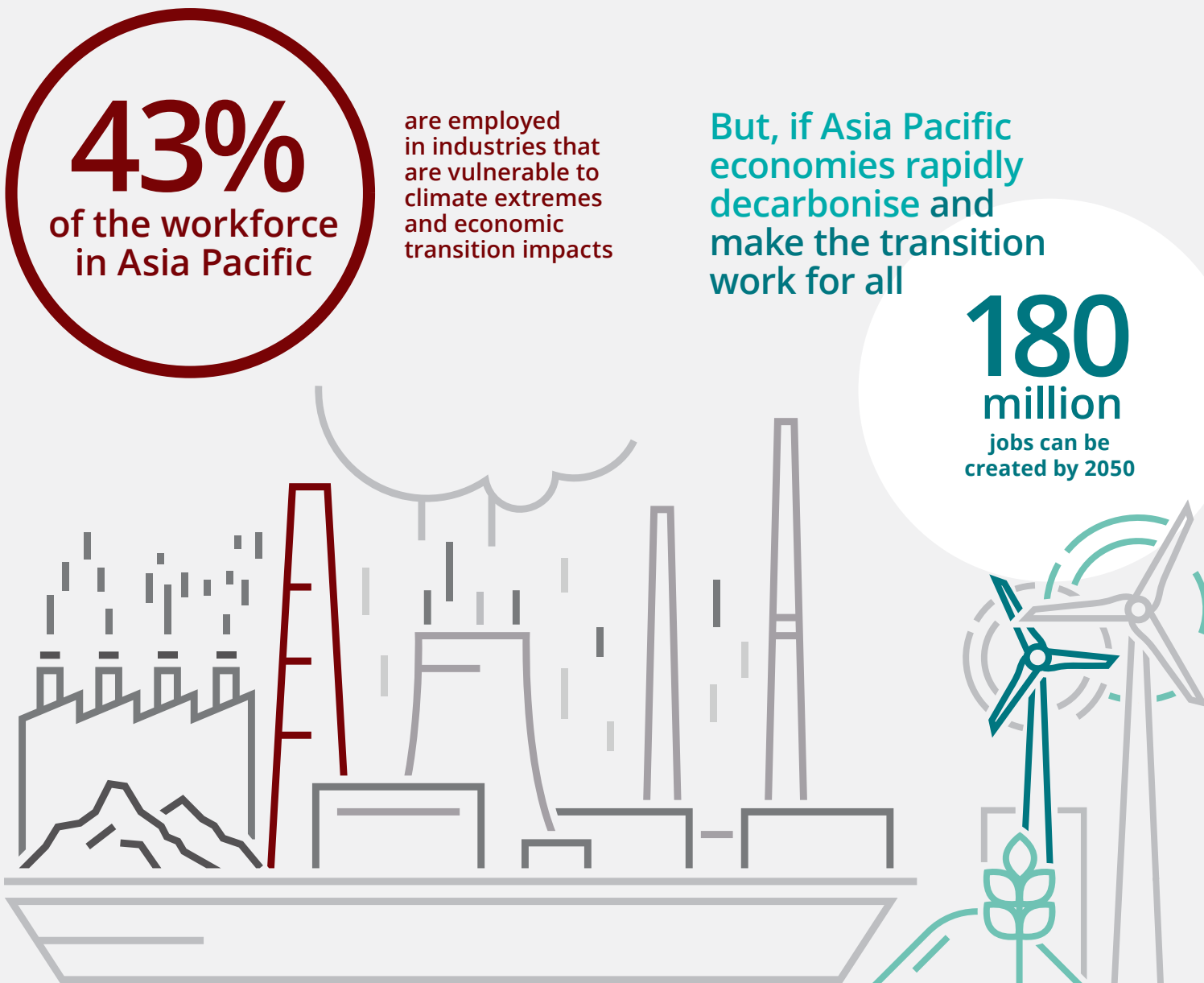
The unique labour markets of Asia Pacific require a differentiated public policy approach. Labour mobility policy will be critical to both driving equity and meeting demand in expanding sectors.

Definition:

Green skills – an umbrella term for the technical skills, knowledge, behaviours, and capabilities required to tackle environmental challenges and unlock new opportunities for growth. Our definition of environmental challenges extends beyond net zero ambitions to include nature and biodiversity, climate change and decarbonisation, and waste and pollution reduction.

Seizing Asia Pacific's opportunity for a better, greener future

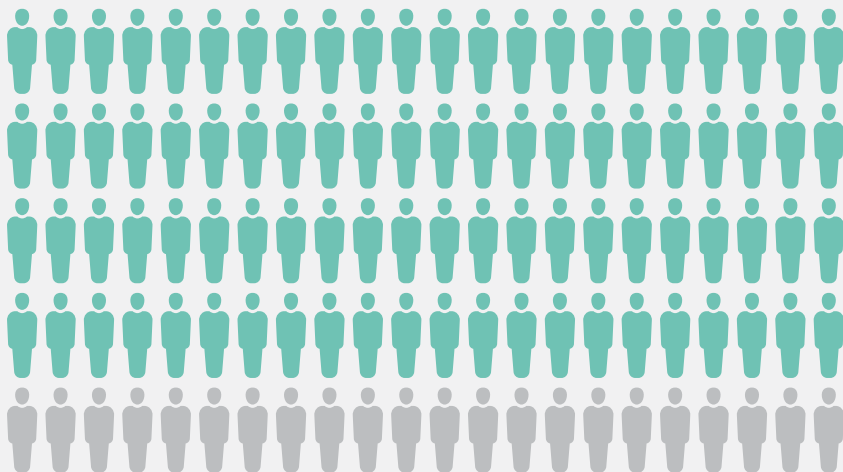
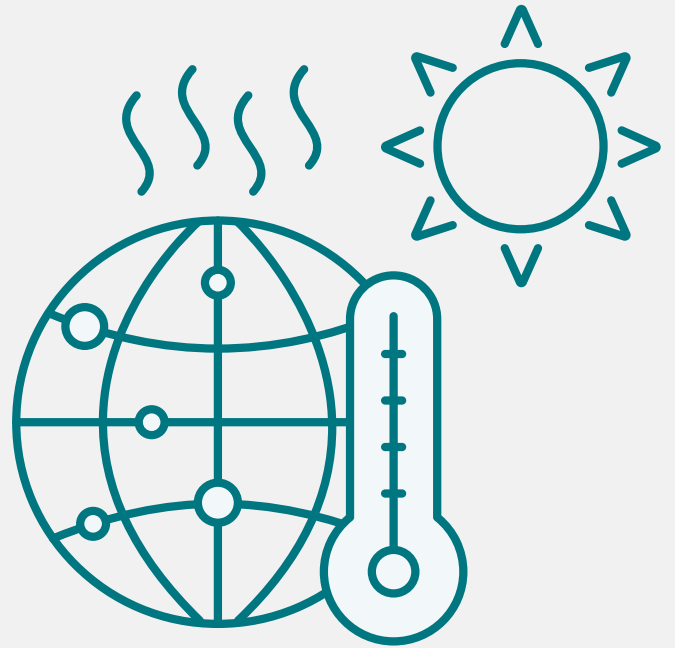
Figure 1: Asia Pacific's net zero opportunity



Asia Pacific leaders must support and empower disrupted workers to enable a just transition for its people and the planet.

Strong climate action could deliver

\$47 trillion to Asia Pacific economies by 2070⁶



Workers will be the foundation of the climate led transformation

80%

of the skills required to achieve net zero emissions by 2050 already exist.

03

Asia Pacific's workforce vulnerability





43%

of the Asia Pacific workforce are in vulnerable industries

Figure 2: Share of vulnerable workforce across Asia Pacific

INDIA

43%

of workforce vulnerable

The SCGJ expects the clean energy shift in India to create over **30 million jobs by 2047**.

ASEAN

38%

of workforce vulnerable

Almost two-thirds of the world's renewable energy jobs are in Asia, with China alone accounting for **42% of the global total in 2022**.

AUSTRALIA

26%

of workforce vulnerable

Ambitious targets to generate most electricity from renewable sources by **2030 will see an influx in skills and jobs for construction, maintenance and operation of renewable power**.



CHINA

48% of workforce vulnerable

Almost two-thirds of the world's renewable energy jobs are in Asia, with China alone accounting for **42% of the global total in 2022.**

SOUTH KOREA

36% of workforce vulnerable

The country has launched several initiatives to promote green skills development, including the Green New Deal, which aims to **create new jobs in the areas of renewable energy, energy efficiency, and green transport.**

JAPAN

31% of workforce vulnerable

Japan has set a target to achieve **net zero emissions by 2050** and is investing in renewable energy sources, including wind, solar, and hydrogen.

The country has launched several initiatives to promote green skills development, including the Green Growth Strategy, which aims to create new jobs in the areas of renewable energy and energy efficiency.

OCEANIA

24% of workforce vulnerable

Oceania (excluding Australia) such as New Zealand, Fiji, Papua New Guinea and other Pacific Islands face **an average of 24% workforce vulnerability.**

Asia Pacific has experienced rapid growth over the past decades, but these hard-earned gains in prosperity risk being eroded by climate change. If the world fails to rapidly decarbonise by 2050, productivity will decline, investment and innovation will slow and social progress will slip⁷.

With dense urban populations, extensive coastlines, low-lying territories and small island states, the Asia Pacific region is highly susceptible to extreme weather events, sea level rises and global warming along with existing socio-economic vulnerabilities.

These factors are already impacting workers and their employers today; in Deloitte's CxO Sustainability research, 44% of Asia Pacific business leaders reported that their employees are facing physical health challenges due to climate change and 45% are experiencing disruption to their operations from climate-related disasters and weather events⁸.

Meanwhile, the region's high share of emissions-intensive industries means millions of workers and their communities depend on activities that will need to be replaced by zero-emission alternatives.

Deloitte Economic Institute's Job Vulnerability Index found that Asia Pacific regions have the highest job vulnerability in the world. This ranges from around a quarter of the workforce in advanced economies like Australia, New Zealand and Singapore, to over 40% of the workforce in emissions-intensive economies like China and India.

The Deloitte Job Vulnerability Index

The Deloitte Vulnerability Index identifies employed workers who are the most vulnerable to the physical impacts of climate damage and the economic transition to net zero. Using 2021 employment data, the Index identifies the following five industries as the most vulnerable: agriculture, conventional energy, heavy industry and manufacturing, transport, and construction.

A country or region's vulnerability is determined by the share of workers in these industries relative to total employment.

Note that the Job Vulnerability Index is not a measure of job losses. Rather it indicates relative 'job vulnerability' based on how much a region stands to lose (economically and socially) if businesses and governments do not mitigate both climate change impacts and the costs from the economic transition to net zero.

The technical appendix provides additional detail on our methodology.



04

The rise of the Green Collar workforce in Asia Pacific





As Asia Pacific countries step up their decarbonisation commitments, a new Green Collar workforce is emerging. Reaching net zero in less than 50 years will take nothing short of an industrial revolution; new types of work are required to achieve this.

These occupations will fill the demand in transitioning and will create entirely new industries. The renewable energy transition, for example, is causing a green jobs boom in Asia Pacific. Almost two-thirds of the world's renewable energy jobs are in the region, with China alone accounting for 42% of the global total in 2022⁹.

A Green Collar worker can be an office worker or a manual labourer in any industry or location – what matters is how their skills, knowledge, behaviours and capabilities contribute to tackling environmental challenges and unlocking new opportunities for growth.



80%

of the skills required in new and transformed net zero jobs in the short-to-medium term are used in the current workforce

The Deloitte Economics Institute defines the Green Collar Workforce in five categories:

Figure 3: Categories that make the Green Collar workforce

Old economy at risk

Blue + white collar existing skills

Two categories represent types of work that are more exposed to the risks of unmanaged costs from the economic transition to net zero and the impacts of climate change.



Emissions-intensive jobs

High job vulnerability to unplanned transition



Climate-reliant jobs

High exposure to physical climate changes

New economy emerging

Blue + white + Green Collar (existing and new) skills

Three out of the five categories represent the types of work that will significantly benefit from the global changes brought on by decarbonisation.



Growing-demand jobs

Increase in demand for jobs with these skills



Transformed jobs

Existing jobs where the requirements are expected to change



New net zero jobs

New jobs that will emerge and become prominent

Emissions-intensive jobs

Workers in emissions-intensive industries will likely face significant disruption due to changes in demand and technology. For some workers this may mean job loss and retraining, while others may be able to access new pathways in other industries (e.g. engineers, electricians, administrative and managerial workers). These workers could also find employment within their existing industry as it restructures (e.g. mining minerals required to produce batteries or carbon farming).

As many countries in Asia Pacific have significant employment in labour and emissions-intensive industries, the workforce impacts of climate-led transformation could be severe without careful and coordinated planning. For example, almost 90% of the coal supply workforce and half of the Internal Combustion Engine (ICE) vehicle manufacturing workforce are based in Asia Pacific¹⁰.



Emissions-intensive jobs are directly related to an emissions-intensive activity or industrial process. As global energy grids and the production of goods shift away from fossil fuels and high-emitting industrial processes, it is expected that demand for labor in these jobs will decline as technology and industries change.

Climate-reliant jobs

Reaching net zero by 2050 will avert the worst impacts of climate change. However, in the coming decades, global warming will still drive productivity losses and physical damage to both ecosystems and infrastructure. Extreme heat in the Asia Pacific region is already leading to physical health and safety risks for workers, consequently impacting their ability to work productively. Meanwhile, climate damages also impact natural capital, such as natural resources, land and ecosystems that economies depend upon.

The latest Asia Pacific Riskscape report warns that under all climate change scenarios, the region will be most affected by heavy precipitation, drought, heatwaves and high winds with intensifying tropical cyclones¹¹. With high proportions of workers in industrial and agricultural jobs, this has major labour productivity implications. In ASEAN, for example, around a third of workers are employed in agriculture, increasing up to 45% in Lao People's Democratic Republic and Myanmar¹².

Minimising job disruption for climate-reliant jobs through investment in climate adaptation and accelerating the transition to net zero will be critical for Asia Pacific economies.



Climate-reliant jobs are those directly related to activities that rely on the environment and are more exposed to climate extremes.

Growing demand jobs

Just as the transition to net zero will cause disruption to some workers, it will also positively impact jobs growth in many areas of the economy. For example, the renewable energy and critical minerals mining sectors are experiencing exponential growth in demand, as all industries pursue electrification in the global push to net zero.

With an abundant natural, human and technological capital, the Asia Pacific region is uniquely positioned to capitalise on these growth opportunities and create jobs. For example, the region has massive renewable energy potential, and access to the critical resources and minerals that will be in high demand during the transition.

Good examples of this are China and Australia who have significant reserves of lithium, zinc, copper, nickel and cobalt.

There is also a pertinent need for skilled resources in nature and biodiversity, ensuring that extraction is doing no harm and communities and indigenous people are at the centre of decision making and benefits distribution.

Many growing demand jobs already exist in the economy, such as project managers, some engineers, labourers, scientific services, and trade workers.



Growing-demand jobs support general development across the economy and will be a key input to the emergence and expansion of low-emissions sectors. Demand for these jobs will increase under the transition period, but the skills and tasks of the role will not dramatically change.

Transformed jobs

Just as types of work are changing, so too are the skills required to perform in a net zero workforce. Jobs that are tied to emissions-intensive activities will need workers to develop new skills as decarbonisation affects how these jobs are performed.

Asia Pacific economies have high employment in the five most vulnerable sectors: agriculture, conventional energy, heavy industry and manufacturing, transport and construction. Government, industry, and education providers will need to work closely to ensure all workers in these industries have access to reskilling and upskilling opportunities.

The building and construction sectors, for example, will experience significant transformation under the transition to net zero. Professionals in these sectors will need to develop new skills in building for energy efficiency, low embodied carbon, and climate resilience. This is particularly important in Asia Pacific, where urban populations are expected to grow to 3.3 billion by 2050, adding further demand for buildings¹³. Decarbonising hard-to-abate sectors, such as steel and cement, will be critical to enabling sustainable urban growth. However, current shortages in skills such as engineering, metallurgy, and IT are holding back progress¹⁴.



Transformed jobs are existing jobs where the work and worker requirements are expected to change as the global economy transitions toward net zero.

New net zero jobs

While the tasks of transformed jobs change, there are some roles that change so significantly that a new net zero job emerges. For example, many new jobs are emerging as the renewable hydrogen industry expands, ranging from specialist research and development (R&D) directors to fuel cell engineers, hydrogen plant operations managers, hazardous materials management specialists, and hydrogen fuel transporters. Many of these jobs will be high-paying and require specialist skills, training and education. Scientists, engineers and trade technicians, in particular, will be in high demand.

Many Asia Pacific governments are investing heavily in renewable hydrogen. China, India and Australia are targeting global leadership in hydrogen production and exports, while Japan and South Korea are leading in the research and use of green hydrogen.

Analysts predict that combining these complementary strengths could support Asia Pacific to become a hydrogen superpower, and catalyse the decarbonisation of the region's most hard-to-abate industries, such as shipping, freight, chemicals, cement, iron and steel manufacturing¹⁵.

With strong pools of technical and engineering talent, Asia Pacific is well placed to build a skilled hydrogen workforce, but significant investment in training and education will be required. The Australian state of Queensland, for example, has already invested \$50 million AUD in training infrastructure to support the growth of renewable hydrogen¹⁶.



New net zero jobs are new jobs that will emerge and become prominent as new technology and processes are adopted during the transition to net zero.

Today's workers have the foundation to safeguard the workforce from disruption and seize the economic opportunity of an active transition to net zero, there is a need to think beyond just types of work and about the specific skills of workers. The Deloitte Economics Institute has found that 80% of the skills required in the short to medium term to achieve net zero emissions by 2050 already exist.

This means most current workers will likely need to upskill rather than completely retrain to remain in their current job or get a new job due to decarbonisation.

Skills offer a passport into new work, but pathways are not always immediate or easy for workers. Policymakers, businesses and the education and training sector must work together to facilitate employment pathways and ensure that no workers are left behind.

For example, the reality is that high emissions jobs aren't likely to be in the same locations as low-carbon jobs. This is an important policy issue that will need to be addressed, we cannot assume frictionless labour mobility.

05

Securing a just transition





What is a just transition and why is it important?

The International Labour Organization (ILO) defines a just transition as greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind.

This involves maximising the social and economic opportunities of climate action, while minimising and carefully managing any challenges – including through effective social dialogue among all groups impacted, and respect for fundamental labour principles and rights¹⁷. A just transition will also help minimise the negative impacts and social unrest that would come from high unemployment through the transition.

People, their work and their livelihoods, will be at the centre of the transition and countries will be judged on how growth is distributed.

Reaching net zero by 2050 will only be achieved through the hard graft, skills and ingenuity of the workforce. We need all hands on deck. The IPCC's Shared Socioeconomic Pathways (SSP) show that the only way to meet the goals set in the Paris Agreement, is through a just and inclusive transition¹⁸.

Deloitte sees workers and their skills as the driver of change, rather than the consequence. Supporting potentially displaced workers with retraining and reskilling opportunities and viable employment pathways will be key to driving the economic transition. As will building a new talent pipeline with the right skills for emerging areas of opportunity.

“There is no climate change transition if it is not a just one.”

Antonia Gawel
Head of Climate Change at the
World Economic Forum



How can we make the transition work for all?

The World Economic Forum warns that policy, investment choices and business practices will determine whether workers, companies and economies will thrive or be stranded in the zero emissions transition¹⁹. A focus on skills will be critical to enable workers to drive a just transition.

No country can achieve this alone. Collaboration between regions, governments, businesses, workers and communities is what will build a sustainable economy. It will also demand the developed world to support developing countries with practical and financial support.

Policymakers must lead the way by actively planning for equity and positive employment outcomes on a coordinated path to net zero with input from workers and employers. Together with businesses, local governments must develop the green skills pipeline of the future, while putting workers and the communities at the heart of transition plans.

Finding out what these skills are and where gaps may exist is crucial to enable public policy to support a successful workforce transformation. In this way, skills and training – whether formal or informal, tertiary level or an apprenticeship – are often considered to be an output of economic activity. That is, the skills and training that workers need are a function of what the 'market' and broader economy demands. Increasingly though, economic growth policy can use skills and training as an input into creating and shaping economic growth trajectories²⁰.

However, Deloitte research has shown that many businesses in Asia Pacific are missing opportunities to play their part in the just transition and only 34% of executives believe global governments are very serious about addressing climate change²¹. For example, just 57% of business leaders consider ensuring a just transition as extremely important to their sustainability agenda, and only 27% believe their company can play a role in skills training to help developing countries manage the transition to a low-carbon economy^{22,23}.

Nevertheless, many private and public sector collaborations are delivering impactful solutions to empower workers in Asia Pacific with the skills needed to adapt to climate change and access the green job opportunities climate action brings. Some of these solutions can be relatively simple but can have an enormous impact, while other multinational initiatives involve complex interactions between countries, financial institutions and multilateral development banks.

To inspire action and collaboration, we've included multiple examples of the green skills initiatives already underway in the region.

"There is strength in individual acts, but unparalleled power in collective action".

David Hill
CEO Deloitte Asia Pacific

Case Study

Indonesia's Just Economic Transition Partnership (JETP)

Indonesia is the fourth most populous country in the world and one of the largest consumers and exporters of coal. Currently, around 60% of the country's electricity comes from a young fleet of coal-fired plants, which could continue to operate and pollute for decades without mitigation²⁴.

In November 2022, during the G20 summit in Bali, Indonesia announced a Just Economic Transition Partnership (JETP) with international partners to accelerate its transition from coal to clean energy. The partnership is a long-term agreement between Indonesia and the International Partners Group (IPG), co-led by the US and Japan, and supported by Canada, Denmark, the European Union, France, Germany, Italy, Norway, and the United Kingdom.

Under the partnership, Indonesia will receive an initial US\$20 billion over the next 3-5 years. This funding aims to help Indonesia to reach peak power sector emissions by 2030 and bring forward its net zero emissions goal by ten years to 2050. Half of the financing will come from public sector pledges and half will be mobilised from private sector financial institutions²⁵.

While accelerating Indonesia's energy transition, the JETP model aims to boost the development of Indonesia's emerging green economy and support communities that are vulnerable to the effects of energy transitions²⁶. The JETP has set a target of generating 34% of Indonesia's power generation from renewable energy by 2030. Ensuring coal workers can transition into the renewable energy market without compromising their livelihoods will be important, as will be training a new generation of workers with the right skills to access opportunities in the clean energy rollout. Particular emphasis will be required to enable women to participate equitably in the transition. According to the Ministry of Women Empowerment and Child Protection, less than 1% of women participate in the electricity and gas labour force²⁷.

Clearly the success of this JETP will lie in its implementation. However, the agreement is a landmark deal and a promising example of the power of global collaboration to accelerate just energy transitions in developing countries. Vietnam has since also agreed a JETP deal and the IPG is also negotiating with India and Senegal.

06

How Asia Pacific governments can lead the workforce transition





The past few years have seen a promising wave of climate pledges and policies from countries across the region. Governments have made varying levels of commitments to reach net zero and phase out coal, and many are pursuing ambitious renewable energy targets. Australia, for example, which has the highest coal power emissions per capita amongst the world's major economies, has pledged to reach net zero by 2050 and produce 82% of its electricity from clean sources by 2030²⁸.

Meanwhile, China and India, the world's first and third largest CO₂ emitters, have pledged to reach net zero by 2060 and 2070 respectively and are driving massive growth in the renewable energy sector.

Bold, decisive targets and proactive policy will be instrumental in the fight against climate change. Green initiatives require significant investment from the private sector and a robust regulatory environment, supported by other compliance mechanisms, can increase business and investor confidence. Recent research by Deloitte found that fast-changing regulatory environments drove 78% of Australian and 72% of Chinese businesses to accelerate climate action in 2022²⁹.

However, this positive momentum only partially reflects the reality across much of the region where reliance on fossil fuels and conflicting development priorities are a significant barrier to progress. One recent study warned that collectively the current Nationally Determined Contribution (NDC – a climate action plan to cut emissions and adapt to climate impacts) commitments of all 49 Asia Pacific geographies will result in a 16% increase in greenhouse gas emissions from 2010 levels to 2030, rather than the 45% reductions required by the Paris Climate Agreement³⁰.

Ensuring every region can rise to the climate challenge and build an equitable path to climate-resilient growth, will require a step-change in ambition and urgent collective action from developed and developing countries.



A focus on green skills can chart the path to climate-resilient growth and shared prosperity

If Asia Pacific governments coordinate an active and rapid transition to net zero, all regions can have higher growth and 180 million jobs could be created by 2050.

Investing in skills to support industries to decarbonise and workers to adapt must be a priority. Asia Pacific governments face the dual challenge of ensuring there is enough green talent to drive the transition, while also ensuring that large numbers of disrupted workers in primary and emissions-intensive industries are not left behind. Historically skills policy has typically found skills gaps and then considered how to fill them. Reaching net zero will require a much more dynamic approach, with policymakers collaborating with businesses, education and training providers to cultivate both the skills needed now and, in the future, to achieve zero-emissions.

Policymakers must ensure skilling pathways and social protections are available to these workers, so they can adapt, contribute and thrive during the transition.

One recent report by the International Trade Union Confederation (ITUC) found that while green jobs in developing countries can provide routes out of poverty, many are informal, poorly paid and do not offer safe working conditions, benefits or opportunities for advancement³¹.

However, the net zero transition also offers many high-value opportunities for workers with green skills and expertise in Asia Pacific. As a leader in many of the technologies needed to decarbonise, including digital technologies such as cloud, artificial intelligence and data analytics, Asia Pacific has a head start with strong pools of STEM talent. The region is also leading in climate research and development, and filed the most environment-related technology patents in 2019³².

Policymakers must prioritise building highly skilled green talent pipelines and develop skills pathways into the highest-value opportunities.



Green skills policy readiness varies widely across Asia Pacific

Governments across Asia Pacific are recognising the importance of green skills to drive sustainable growth. However, as reflected in their interim NDC many governments need help to translate long-term policy ambitions into near-term action.

In a region shaped by diverse levels of wealth and economic maturity, governments are clearly working at different paces and with different competing priorities, including varying degrees of climate impact and adaptation requirements.

Developed and developing countries may be in the same storm, but they are not in the same boat.

A 2021 regional analysis of green jobs policy frameworks in Southeast Asia, for example, found wide variation in policy readiness across ASEAN countries (see figure 3). While most ASEAN states are broadly making good progress establishing the green agenda and developing sector-specific strategies, most policies fall short on addressing just transition plans, including labour rights, social dialogue and social protection³³.

Figure 4: Green jobs policy readiness in ASEAN countries

Policy area	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Development policies establish the green agenda	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant
Industrial and sector policies for greening	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant	Significant
Enterprise policies and initiatives for greening	Significant	Some	Significant	Some	Significant	Significant	Significant	Significant	Some	Some
Skills development for green skills	Some	Some	Some	Some	Significant	Limited	Significant	Significant	Some	Some
Active labour market for greening	Limited	Limited	Limited	Some	Significant	Limited	Significant	Significant	Limited	Significant
OSH for climate change issues	Limited	Some	Limited	Some	Significant	Limited	Significant	Significant	Limited	Significant
Social protection	Some	Some	Some	Some	Some	Some	Some	Significant	Significant	Significant
Cross-cutting issues – labour rights, standards and social dialogue processes in greening	Limited	Some	Some	Some	Some	Some	Significant	Significant	Some	Significant

Significant policy elements in place
 Some policy elements in place
 Limited/No policy elements in place

Source: International Labour Organization, Regional Study on Green Jobs Policy Readiness in ASEAN, 2021

07

The Green Collar workforce policy agenda





Social protections for those experiencing work-related disruption, displacement and loss

Public policy must step up to protect vulnerable industries, communities and workers through a proactive and coordinated net zero transition.

To guide decision-makers on how to support industries to harness the full potential of the workforce through a just transition, the Deloitte Economics Institute has developed a Green Collar workforce policy framework. Throughout this section, we have highlighted specific opportunities for governments in Asia Pacific and included examples of where countries are leading the way.

Figure 5: Policy agenda for a Green Collar workforce

Ambitious decarbonisation targets



...aligned with the latest climate science and investments in rapid decarbonisation

Strategic industrial policy



...targets traditional strengths and new areas of economic growth

High-value job creation



...establishes secure career pathways for workers and graduates

Adaptive education and skills system



...produces a skills pipeline that aligns to industry demands for transition

Active skills reallocation



...labor mobility policies direct skills to where they are needed

Source: Deloitte (2022) *Work towards net zero | The rise of the Green Collar workforce in a just transition*, figure 17 page 76



1/

Set ambitious interim targets

Governments globally have a role in stimulating and directing investment to areas of the economy where it will deliver strong and equitable growth.

Vital interim targets for emissions reduction and renewable energy generation provide markets with a clear direction of travel. This guides industries, businesses and individuals to make effective investment decisions for a timely and coordinated transition. Getting the timing of emissions reduction right is critical to an active transition that will minimise overall costs and leave workers better off.

For example, under the Just Energy Transition Partnership to accelerate Indonesia's transition away from coal, international investors have set significant interim and long-term targets for the country to reduce GHG emissions, accelerate renewable energy deployment and support impacted communities³⁴.

Case Study

Strengthening innovation and creating quality green jobs through Singapore's 2025 Industry Transformation Maps

Under a \$4.5 billion (SGD) Industry Transformation Programme, Singapore is creating refreshed roadmaps for 23 economic sectors to support them in meeting the needs of the future economy³⁵. These roadmaps aim to promote innovation, skills, productivity and internationalisation. Each Industry Transformation Map (ITM) is co-created by the Government, industry's stakeholders and unions, in partnership with companies, schools and higher education institutions.

Manufacturing makes up the largest component of Singapore's economy. It represented 22% of the GDP in 2021 and employs almost 13% of the population³⁶. In October 2022, the Government launched refreshed ITMs for five sectors in its advanced manufacturing and trade cluster: electronics, precision engineering, energy and chemicals, aerospace and logistics. Singapore is targeting 50% value-added growth from 2020 to 2023 by focusing on investment in innovation, sustainability, training and talent.

Recognising that manufacturing will be reshaped by decarbonisation and sustainability goals, as well as the maturation of Industry 4.0 technologies, Singapore is seeking to boost quality job creation and ensure workers have the technology and sustainability skills needed to take on roles in emerging areas of opportunity. These include additive manufacturing and robotics, artificial intelligence, digitalisation and process engineering for sustainable products³⁷.

In January 2023, Singapore launched its Environmental Services Industry ITM 2025. To advance Singapore's green growth agenda, the ITM seeks to harness sustainable opportunities and build capabilities in areas such as material circularity and decarbonised waste solutions³⁸. The aim is to boost innovation and technology adoption, while improving productivity and creating quality job opportunities for Singaporeans.

2/

Design new industrial policy

Accelerating to net zero and tackling the world's toughest challenges will require unprecedented levels of collaboration across emerging economic systems. As sectors transform, they will become increasingly intertwined and the decarbonisation of certain sectors – like power and hydrogen – will underpin the decarbonisation of others.

A systems approach to decarbonisation recognises that existing industries will be rebuilt as complex, interconnected emissions-free systems, such as energy, mobility, manufacturing, food and land use. An electrified vehicle fleet, for example, is only sustainable if it is fuelled with renewable energy and manufactured using circular, low-waste processes using sustainably extracted raw materials³⁹.

Figure 5: The building blocks of the low-carbon economy



Source: Deloitte (2021) Leading in a low-carbon future | A "system of systems" approach to addressing climate change low-carbon future – Deloitte Insights

Governments have an important role as ecosystem architects from an industrial policy perspective: bringing together networks of public sector agencies, businesses, academics and non-governmental organisations (NGOs) to build and scale solutions. These systems-wide transformations will have most significant workforce and industrial policy implications: skilled workers must be attracted to the most significant areas of opportunity. In contrast workers in declining industries must be protected and redirected to growth areas.

Asia Pacific's strengths in manufacturing and digital technologies offer significant opportunities for leadership across all low-carbon future systems. For example, the region has strong potential to disrupt future mobility models through its markets of scale and innovation in EVs, autonomous vehicles, connected cars and shared transport models.

Case study

Partnering with industry to accelerate green manufacturing growth and skills development in Karnataka, India

As part of its 'Make in India' and 'Atmanirbhar Bharat Abhiyan' campaigns, India aims to increase its self-reliance and accelerate manufacturing growth to transform the country into a global design and manufacturing export hub. The southwest region of Karnataka is a leader in India's technology sector and its capital city, Bengaluru, is often referred to as the 'Silicon Valley of India'.

The Government of Karnataka seeks to promote emerging technology clusters across the state and is collaborating with industry to build a future-ready skilled workforce. So far it has launched several initiatives to modernise Industrial Training Centres (ITIs), create Centres of Excellence and support local start-ups with global industry partners^{40,41,42}.

One particular focus area for Karnataka is future mobility solutions and it is seeking to become the preferred destination for electric vehicle (EV) manufacturing. In 2022, a Japanese automotive manufacturer signed a memorandum of understanding with Karnataka to invest in localising the supply chain for EVs, with the aspiration to make India 'the manufacturing hub for cleaner technologies'. The automotive manufacturer will focus on upscaling skills through training and supporting local community development⁴³.

Case study

Accelerating talent development through China's New Energy Vehicle Plan⁴⁴

With policy support from the government, China's new energy vehicle industry has been booming since 2020. In 2022, China sold 5.67 million electric vehicles and plug-in hybrid electric vehicles⁴⁵.

In October 2020, the State Council of the People's Republic of China released the New Energy Vehicle Industrial Development Plan for 2021 to 2035. Plan 2021-2025 sets out the vision of forming a globally competitive new energy vehicle (NEV) industry and transitioning China to an energy-efficient and low-carbon society. It sets five strategic tasks for China's NEV industry for the next 15 years, including improving capacity for technology innovation and building a NEV industry ecosystem. In the past, China has focused mainly on automobile production, but this new ecosystem approach will promote integration and growth across the automobile, energy, transportation and information and communications industries.

Innovation, collaboration and talent development are vital enablers. The plan highlights the role of corporate champions, key national laboratories and manufacturing innovation centres to advance R&D in key technologies. It also advocates for innovation incubation centres and industrial associations to drive technology transfer and talent cultivation across industries – particularly in the fields of battery technology and intelligent/connected technologies.

3/ Create high-value jobs for transition pathways

A just workforce transition is not just about job creation. It is about ensuring decent work and viable, fulfilling job opportunities that contribute to meeting regional and global climate challenges.

The renewable energy transition, for example, is causing a green jobs boom in Asia Pacific. However, the International Energy Agency (IEA) has warned that many clean energy jobs in developing markets are still informal and lack labour protections and union representation⁴⁶. Policy settings must ensure employment pathways with better outcomes regarding wage, working conditions and job security.

Case study

Green Collar skills and jobs in the Philippines

The Philippines is highly exposed to the impacts of climate change. Recognising its vulnerability, the Philippines has embarked on an extensive development and realignment of national policies over the past decade to link the country's sustainable development with green industrialisation. While challenges remain, the Philippines recognized that the structural shifts associated with climate change were an opportunity for economic value-adding and job creation. Policy foundations underpinning the focus on green skills and jobs include the following:

- Nationally determined contributions – the Philippines has particularly ambitious plans under the Paris Agreement compatible with keeping global warming below 2°C.
- The Philippine Development Plan – the plan takes a long-term approach to promoting green jobs and links it to the country's sustainable development.
- The Green Jobs Act of 2016 – the Act provides a legal framework designed to generate and sustain the transition to a green economy and incentivise the creation of green jobs.

When the initial research around green jobs was conducted in 2010, there were no apparent skill shortages. But the Philippines anticipated the importance of a skilled and capable workforce in enabling the shift in industrial, agricultural, and services sectors and in protecting communities from climate change risks. Under the Green Jobs Act, the Department of Labor and Employment was responsible for the development of a National Green Jobs Human Resource Development (HRD) Plan. This sought to identify skills and skill gaps, develop training programs, and upskill workers for jobs in green industries. The plan integrates with the ILO's 'Just Transition' policy guidelines to provide decent work for all and has involved extensive consultation and social dialogue with workers and employer.

The Department took a sector approach. Priority was given to developing green jobs in agriculture, fishery and forestry, manufacturing, transportation, tourism, waste management, energy, and construction. To understand how green jobs may grow and evolve, profiling of these sectors was conducted. The research also identified jobs that will be displaced, created, and transformed in the transition. This research underpinned a modernisation of the higher education and technical vocational education and training (TVET) programs to support the skill needs of the green economy. This included greening the general curriculum by adding specific green competencies into existing qualifications (for example, the design, installation, and servicing requirements for solar-power systems in the construction sector or integrated pest management in agriculture). A Green Technology Center was established for the development of more specific green skills through green skills training courses catering to the needs of emerging green jobs. The Green Jobs Act also supports green growth through incentives. This includes tax deductions for business expenses for skills training and research and development, as well as tax-free importation of capital, which supports the growth of green businesses and the creation of green jobs.

4/

Ensure an adaptive skills and education pipeline

Training and education will underpin Asia Pacific's transition to net zero. If the right skills are not developed, economies will experience higher costs in mitigation, adaptation and transition over the long term.

Governments will need to partner with businesses, education and training institutions to ensure that, as the transition unfolds, the right skills are available at the right time and in the right places. This will require a major reform of education and training systems in line with each country's climate goals. This includes developing new courses and curriculums, upscaling existing courses for in-demand jobs and creating new modes of delivery, such as on-the-job training, apprenticeships and online education.

Micro-credentials are one vital tool to enable professionals to upskill flexibly, while digital training can help enable affordable access at scale. This could mean taking a series of courses or workshops led by a university on a specific skill, such as sustainable materials management or sustainable finance, or it could mean more practical climate adaptation advice for workers on the frontline, such as farmers.

The Government of Odisha in India, for example, has developed a free mobile phone advisory service called '*Ama Krushi*' (Farmer's Friend) for farmers in the region to receive tailored advice on how to adapt and optimise their farms to be more productive and resilient to climate change⁴⁷.

The ILO warns that most countries have not developed a systematic approach to incorporating skills for green jobs into their technical and vocational education and training systems⁴⁸. However, we are seeing some positive examples of reform in Asia Pacific. South Korea, for instance, has prioritised the growth of green and digital talent in its Korea New Deal national transformation strategy. This included plans to train 20,000 individuals in green-integrated fields, create specialised graduate schools in climate change and green engineering, and provide specific training in the environmental industry⁴⁹.

Case study

India's Green Skills Council

Since 2015, India's Skill Council for Green Jobs (SCGJ) has been leading collaborative skills and entrepreneurial development initiatives to support India's green agenda. Set up under the aegis of the Ministry of Skill Development and Entrepreneurship, the SCGJ is a not-for-profit, autonomous and industry-led organisation.

The SCGJ promotes skills development in line with evolving industry requirements across three core workstreams: 'renewable energy', 'environment, forest and climate change', and 'sustainable development'. It sees particularly high potential across seven areas: renewable energy generation, battery energy storage systems, green hydrogen, circular economy, green buildings, EV charging and clean transport and green manufacturing⁵⁰.

So far, the SCGJ has undertaken nine skills gap studies and has developed 50 nationally-approved qualifications⁵¹. It is currently leading a funded in-depth analysis to map the green jobs landscape in India and advance opportunities, particularly for disadvantaged populations.

The SCGJ expects the clean energy shift in India to create over 30 million jobs by 2047. India has ambitious targets to raise its clean energy capacity to 500 GW by 2030, while meeting 50% of its energy demand from renewable sources and cutting its carbon emissions by a billion tonnes by the same year. Between 2021 and 2022, the number of employees in the solar and wind energy sectors increased by 47%⁵².

In FY22 the SCGJ trained 100,000 people in the renewable energy sector, focusing on installation, operations and maintenance roles. By 2030, the SCGJ aims to train one million candidates in clean energy and green technologies, and two million via virtual or blended upskilling and reskilling training across all sectors. It plans to establish 20 centres of excellence, along with 750 affiliated training centres, and certify 7,500 trainers nationwide. The SCGJ is also incorporating vocational education across green business sectors in schools, universities, and other institutions of higher learning in line with India's National Education Policy 2020⁵³.

Case study

Fast-tracking training for Australia's energy transformation

Australia has ambitious targets to generate 82% of electricity from renewable sources by 2030. Around 20,000 to 25,000 new jobs are predicted to be created in the construction, maintenance and operation of renewable power⁵⁴.

To provide a skilled pipeline of workers, the Victorian Government opened Australia's first renewable energy training tower at Federation University in March 2022. The tower was developed in partnership with the renewable energy companies Vestas, Acciona Energia, GPG and Tilt Renewables and is the first stage of the Asia Pacific Renewable Energy Training Centre (APRETC).

The Federation training centre is expected to train over 600 people a year. In 2023, following an agreement with Germany's BZEE Network, Federation will offer the globally recognised post-trade turbine technician training course. The six month course is designed for electricians, mechanical fitters and automotive technicians and will include an internship with wind turbine manufacturers and service organisations, covering electrical, mechanical, and hydraulic systems training⁵⁵.

Stage two of the APRETC is underway and will include classroom, workshop and training equipment to deliver specialised training courses, such as for blade repair technicians.





Case study

Charting the course for carbon neutrality through higher education reform in China

In April 2022, China's Ministry of Education announced its plan to strengthen talent development in higher education for 'carbon peaking and carbon neutrality'⁵⁶. To encourage colleges and universities to accelerate and expand education in these fields, the plan focused on the following aspects:

- 1. Accelerating the creation of disciplines** related to carbon finance, carbon management, carbon market, energy storage, hydrogen energy, and carbon capture, utilisation and storage technology.
- 2. Establishing national laboratories and technology innovation centres** for peaking carbon emissions and achieving carbon neutralization, and further promoting technical exchanges and cooperation between Chinese and international universities.
- 3. Focusing on the clean and efficient development of primary energy** and efficient conversion of secondary energy, expanding the scale of professional personnel training, and promoting the transformation and upgrading of traditional industries.

Following the Ministry of Education's announcement, many universities have taken action. In July 2022, the School of Applied Economics of Renmin University of China successfully approved the master's degree in carbon economy. In June, Fujian Agriculture and Forestry University established its Carbon Neutral Research Institute and Shandong University of Petrochemical Engineering established its Carbon Neutral Modern Industry College. In March, Peking University's Institute of Carbon Neutrality was officially established. To date, China has established 21 undergraduate programs related to 'peaking carbon emission' and 'carbon neutrality', and a total of 42 colleges to train talents for carbon neutrality.

5/ Target workforce policy to direct skills where they are needed

The dynamic transition to net zero will require a public policy approach as differentiated and diverse as the people who make up the unique labour markets of Asia Pacific.

Where Asia Pacific regions are highly exposed to climate risks and the transition away from emissions-intensive industries, national and local governments will need to strike a delicate balance between decarbonisation and growth. Careful timing and planning will be vital to protect workers and redirect them to the areas of the economy where they can add the most value.

A portfolio approach to policy for the Green Collar workforce in Asia Pacific will require decision-makers to ensure that policy supports:

- **Workers with high exposure** – e.g. upskilling or facilitating new employment pathways for workers in climate-reliant or emissions-intensive jobs.
- **Workers with transitioning skills** – e.g. upskilling or reskilling workers in roles or industries that are set to transform through the zero emissions transition.
- **Workers who are underutilised or underrepresented** – such as women, youth, migrants, indigenous peoples and people with disabilities.

Labour mobility policy will be critical to both driving equity and meeting demand in expanding sectors, such as green hydrogen, ecology and biodiversity and the circular economy. Leading governments are working proactively to increase the participation of underrepresented groups, such as women and indigenous people to leverage the knowledge and cultural wisdom to drive holistic climate solutions.

"Indigenous people, local communities, young people, women and girls, should be leaders of climate action and not victims of climate policies."

Archana Soreng

United Nations Secretary General's
Youth Advisory Group on Climate Change

Case study

Building the hydrogen workforce of the future in Queensland, Australia

With significant renewable energy resources, high-quality infrastructure and export-ready ports, Queensland has the potential to be a significant producer of renewable hydrogen. The Queensland Government aims to be at the forefront of renewable hydrogen production and become the global supplier of choice for green hydrogen⁵⁷.

The strategy sets out a detailed map of the skills requirements and training pathways across the hydrogen value chain. Many of the skills required already exist in Queensland's local workforce, such as engineers, technicians, and specialists in the liquefied natural gas industry. But other new skills, such as hydrogen-specific safety training will need to be taught.

Across Queensland more than \$50 million AUD is being invested in infrastructure to support training in renewables and hydrogen. This includes a Hydrogen Training Centre of Excellence in Beenleigh, which will upskill existing tradespeople and provide apprentices with the skills needed to work safely with hydrogen. The funding will cover further training centres, including facilities at Gladstone High School to prepare students for future jobs in the hydrogen industry.

The Australian Government has also pledged \$69.2 million AUD for the development of the Central Queensland Hydrogen Hub in Stanwell. Intended to position the region as a global leader in renewable hydrogen, the Hub will place a strong emphasis on skills development and community education through collaboration with schools, universities and industry bodies⁵⁸.

Case study

Creating shared prosperity through circular economy in Auckland, New Zealand

Currently the global economy is only 7.2% circular. This means that more than 90% of materials are either wasted, lost or unable to be reused for many years. To bring human activity back within the safe limits of the planet, Deloitte estimates that we need to reduce global material extraction and consumption by one-third⁵⁹.

Auckland is one city looking at circular, regenerative solutions and has committed to becoming a zero waste-to-landfill city by 2040. Equity and inclusion are central to the city's commitment, in particular building economic resilience and growth opportunities for Māori and Pasifika businesses in South and West Auckland.

Each year Auckland throws away up to \$73 million worth of materials that could be recycled. Addressing the problem, will require a radical rethink to accelerate the shift from waste management to resource recovery. Building a skilled workforce will be critical to growing the circular economy at pace. As part of the three-point plan to catalyse an inclusive transition, Auckland Council is investing in improving workforce capabilities, providing support to regenerative economy businesses, and boosting research and development.

So far, the initiative has invested in curriculum development, training and accreditations in new skills, including New Zealand's first deconstruction micro-credential. The city is developing demand-led employment programs and training with stackable qualifications, including technology and knowledge economy roles. Creating a platform for innovation is crucial and the council is targeting support for regenerative economy businesses, particularly those owned by Māori, women, Pasifika peoples, refugees, lone parents, young people, LGBTQI, and social/community-led enterprises⁶⁰.



08

Technical appendix





Modeling climate change and net zero transition impacts

To quantify its conclusions, the Deloitte Economics Institute modeled the economic impacts of a changing climate on long-term economic growth using the following process:

1. The model projects economic output (as measured by GDP) with emissions reflecting a combined Shared Socioeconomic Pathway (SSP)–Representative Concentration Pathway (RCP) scenario, SSP2-36.0, to the year 2100.⁸ The socioeconomic pathway, SSP2, is the “middle of the road” among five broad narratives of future socioeconomic development that are conventional in climate change modeling. The climate scenario, RCP6.0, is an emissions pathway without significant additional mitigation efforts (a baseline scenario). This results in a projected emissions-intensive global economy.
2. Increased atmospheric GHGs cause average global surface temperatures to continue rising above pre-industrial levels.⁹ In the SSP2-6.0 baseline scenario, global average temperatures increase more than 3°C above pre-industrial levels by the end of the century according to the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC).¹⁰ (Note that present-day temperatures have already risen more than 1°C above pre-industrial levels.)
3. Warming causes the climate to change and results in physical damage to the factors of production. Deloitte’s model includes six types of economic damage, regionalised to the climate, industry, and workforce structure of each defined geography across Asia Pacific, Europe, and the Americas. These damages capture the trend or chronic impacts of global mean surface temperature increases. The approach does not explicitly model individual acute economic shocks driven by extreme climate events, such as natural disasters, although these are implicitly captured in an increasing trend of climate change damage.
4. The damage to the factors of production is distributed across the economy, impacting GDP. Any change in emissions (and, correspondingly, temperatures) over time results in a change to these impacts and their interactions. The economy impacts the climate, and the climate impacts the economy.

5. The key variables of time, global average temperatures, and the nature of economic output across industry structures combine to offer alternative baseline views of economic growth. Specific scenario analysis is then conducted, referencing a baseline that includes climate change damage. Scenarios could also include policy actions that either reduce or increase emissions and global average temperatures relative to the current SSP2-6.0 baseline view.
6. There are two net zero transition scenarios developed and applied in reference to the baseline in this report. The first reflects a similar scenario to the *Turning point* series where the world rapidly accelerates to mitigate climate change and coordinates to transition economies away from emissions-intensive activity and processes. This first scenario limits global average warming to well below 2°C by mid-century and accounts for elements of an equitable transition via the role of government and businesses to transition in an orderly manner. The second scenario follows a similar narrative and global average warming outcome but does not include an orderly, planned, or equitable transition via the role of governments and businesses to mitigate disruption and minimize transition costs.






This modeling framework involves significant research on climate and economic impacts across Asia Pacific, Europe, and the Americas, which are used as inputs for Deloitte's D.Climate model (refer to the technical appendices for those regional reports at deloitte.com/global-turningpoint).

Job Vulnerability Index

The global workforce vulnerability index was informed from employment composition data from the D.Climate model and informed by various statisticians offices from relevant countries. The employment composition data reflects the full-time equivalent workers who are employed in an industry.

Consistent industries were used across regions using the Global Trade Analysis Project (GTAP) classification. The included industries capture all global economic activity. The industries identified as most 'vulnerable' to extreme temperatures and economic transition impacts were selected for the Index based on an assessment on how increased temperatures and a carbon price impact labor market dynamics. This was informed by research and assumptions in the D.Climate model undertaken in the Turning point series. The industries identified as most 'vulnerable' to physical climate damage and net zero transition risk are presented in Table A.1.

Table A.1: Sectors in the Job Vulnerability Index that are exposed to physical climate damage and net zero transition risk

Label	GTAP industry
 Agriculture	<ul style="list-style-type: none"> • Rice • Wheat • Other grains • Vegetables and fruit • Oil seeds • Sugar crops • Fibres crops • Other crops • Cattle • Other animal product • Raw milk • Wool • Fishing
 Conventional energy and mining	<ul style="list-style-type: none"> • Coal • Oil • Gas • Electricity generation from fossil fuels
 Heavy industry and manufacturing	<ul style="list-style-type: none"> • Petroleum and coke manufacturing • Chemical manufacturing • Mineral manufacturing • Metal manufacturing • Technology manufacturing (e.g., machinery and equipment) • Transport manufacturing • Other manufacturing
 Transport	<ul style="list-style-type: none"> • Land transport • Water transport • Air transport
 Construction	<ul style="list-style-type: none"> • Construction

Source: Deloitte Economics Institute; GTAP

Employment impacts of 'active transition assistance'

In the D.Climate model, **active transition assistance** reflects a view of government revenues, collected via a shadow emission price mechanism, being redistributed to represent policy actions that both deliver the emissions abatement and offset the costs of the abatement. This concept is applied in D.Climate to establish a better representation of economic impacts (costs) of the structural adjustment pathway economies will undergo as they decarbonise to net zero emissions.

D.Climate imposes a shadow price on emissions to deliver the emission reductions in line with the emissions constraint to net zero emissions by mid-century. In D.Climate, the shadow price is not the same as a legislated emissions tax, or a traded emissions price, but it is analogous in that it represents the projected 'economic price' at which a given reduction in emissions can be achieved.

The Deloitte Economics Institute views the shadow price mechanism to represent the various mix of actions, policies, investments, incentives, regulations, or penalties any government may impose to meet its stated emissions target – and the implied economic cost of these actions.

But despite it not being an explicit market-based mechanism imposed by government, there is a revenue stream collected by government as required by the model to solve. That is, where there is a price imposed, it creates a revenue stream a government must collect.

Transition assistance is a mechanism designed to be imposed in the D.Climate model to both:

- Offer a view to the government policies, actions, and investments that deliver abatement that drives the emission price (beyond the constraint); and
- Better reflect the structural adjustment costs in industries and regions as decarbonisation accelerates by offsetting them. That is, assuming government policies that deliver the transition will either account for a redistribution of transition costs in implementation or those transition costs will be offset elsewhere by other measures to secure economic growth and job creation.

Transition assistance is implemented as a 'shock' to the D.Climate model. A 'shock' refers to an imposed change in the model via alternative assumptions beyond what the model would automatically (endogenously) solve for. In this way, the shock represents a specific variable change, usually to create a difference in scenario outcomes and economic impacts in alignment with a scenario framing or narrative.

Transition assistance – or the revenue distribution – is typically researched, designed, and applied to industries that are neither emissions-intensive nor in high demand as an economy decarbonises. This means government effort does not disproportionately go toward emissions-intensive conventional energy or emerging clean energy, as both primarily respond to price and changing demand – and additional technological productivity parameters imposed in the model to reflect the assumed changing energy and technology mix.

For example, in an emissions-intensive region, transition assistance is targeted to diversify economic activity into areas such as construction, private-sector service industries, retail, and public services. This smooths the structural disruption to economies and their workforces, resulting in increased job creation earlier in the phases of decarbonisation.

Government investments are implemented through effective tax reductions and/or subsidies on capital and labor within targeted industries and are constrained at the national level by government revenue that is collected during transition. Investments are distributed across regions according to the relative costs incurred through transition.

Absent transition assistance, modeling results narrowly demonstrate the economic impacts of the shadow price as a 'blunter' instrument and the impacts of a changing energy and technology mix. Results also inherently assume there is no defined role for government in facilitating, coordinating, and delivering the transition outcomes of the economy. Where assumed, such results are not a fitting representation of the proposed policy mix and economic objectives of many current governments globally in relation to net zero targets. That is, jurisdictions have committed to delivering policy mixes (regulation, investments, incentives, penalties, etc.) that deliver stated abatement targets.

With its inclusion, transition assistance both reduces the aggregate economic costs of transition overtime to net zero and changes the cost-benefit profile at certain points in time. That is, the overall cost of transition is lower in terms of economic growth and job disruption, and the point at which the 'dividend' of transition occurs is earlier.

Green Collar workforce occupation definitions

There are no universal definitions for occupations that will be impacted by climate change and decarbonisation. For this research, the Deloitte Economics Institute used the O*NET developed green workforce categories as a starting point, refining the occupations within these categories to a global context.

O*NET: Definitions of 'green' jobs

- **Green increased demand;** the impact of green economy activities and technologies is an increase in the employment demand for an existing occupation. However, this impact does not entail significant changes in the work and worker requirements of the occupation. The work context may change, but the tasks themselves do not.
- **Green enhanced skills;** the impact of green economy activities and technologies results in a significant change to the work and worker requirements of an existing O*NET – Standard Occupational Classification occupation. This impact may or may not result in an increase in employment demand for the occupation. The essential purposes of the occupation remain the same, but tasks, skills, knowledge, and external elements, such as credentials, have been altered.
- **Green new and emerging;** the impact of green economy activities and technologies is sufficient to create the need for unique work and worker requirements, which results in the generation of a new occupation relative to the O*NET taxonomy. This new occupation could be entirely novel or 'born' from an existing occupation.

Source: O*NET Resource Center, Occupational Listings: Green New and Emerging Occupations

Separate categories were also added for occupations that were expected to be disrupted by the structural employment shifts of a net zero transition (occupation- and sector-based impacts) and the occupations that rely heavily on the climate for production (occupation- and sector-based impacts). This categorization is based on the Deloitte Economics Institute's labor market analysis and several studies using D.Climate and other occupational forecasting methodologies.

Although it is expected that all occupations will be affected in some way – either through the impacts of locked-in warming or the transition – the occupations discussed theoretically in the emissions-intensive and climate-reliant categories are those that are highly vulnerable to the structural employment shifts that will result from warming and transition impacts. It is expected that due to the nature of impacts in these categories, the proportion of emissions-intensive and climate-reliant jobs in an economy is somewhat reflected in a region's Job Vulnerability Index score.

In developing the green categories, O*NET investigated the impact of green economy activities and technologies on occupational requirements and the development of new and emerging occupations. It found that the transition to net zero will likely result in changes to work and worker requirements and the generation of unique work and worker requirements for green enhanced skills and green new and emerging occupations.

As a result of the research, a total of 1,369 green tasks were included in the O*NET Green Task File. The Green Task File includes the entire task lists for each of the 138 occupations that fit into green enhanced skills and green new and emerging occupation categories, which included both green and non-green tasks⁶¹.

The Deloitte Economics Institute leveraged this database, and our modeling of the timing of global occupation impacts in the transition to net zero, to estimate the proportion of existing skills that can be leveraged in the current workforce to facilitate the transition to net zero by 2050.

Deloitte Economics Institute

The pace and scale of global economic, social, environmental, and digital disruption is rapid, and we all now operate in a world we no longer readily recognize. This creates a need to understand how structural economic change will continue to impact economies and the businesses in them, and the livelihoods of our citizens.

In pursuit of economic prosperity, progressive organizations need future-focused, trusted advisors to help them navigate complexity and deliver positive impact. The Deloitte Economics Institute (the 'Institute')

combines foresight with sophisticated analysis to shape and unlock economic, environmental, financial, and social value. Connecting leading global insight and local knowledge with an independent perspective, the Institute illuminates future opportunities and drives progress.

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