



Skills Development and Inclusivity for Clean Energy Transitions

International
Energy Agency

A photograph of a solar farm under a clear blue sky. In the foreground, two workers wearing white hard hats and high-visibility orange safety vests over dark work clothes are walking. The man on the left is gesturing with his right hand towards the solar panels. The woman on the right is smiling. The solar panels are mounted on metal racks and extend into the distance. The ground is dry and brownish.

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Abstract

Ongoing energy transitions and decarbonisation efforts are poised to bring profound shifts in the sector's employment, including massive new opportunities for job creation in clean energy. At the same time, traditional energy sectors will experience declining job opportunities. In most cases, this will require the development of both new programmes of education, certification and vocational training along with targeted upskilling or reskilling programmes for the existing workforce. Several governments, companies and industry organisations, among other stakeholders, are already developing robust educational and skills training programmes to meet the challenges of the workforce transition. Therefore, a review of existing skills and training programmes can provide valuable insights for others embarking on their own energy transitions. This report compiles a collection of case studies from around that world that showcase programmes designed to address skills development of workforces for energy transitions.

Foreword

Today, the commitment to addressing climate change has never been higher, as a chorus of diverse countries announces net zero pledges. It is clear that the solutions to today's energy security concerns lie in clean energy technologies that can reduce vulnerability to fuel price shocks.

As the transitioning energy system reduces its reliance on traditional hydrocarbons and increases its reliance on clean fuels and technologies, the energy labour workforce will face both new opportunities and challenges. The opportunities will come from new investments in clean energy sectors that will create tens of millions of new jobs in all parts of the world. The challenges will come from disruptions to workforces in fossil fuel sectors and ensuring a proper alignment of skills with new jobs to capitalise on the clean energy opportunity.

Countries will be embarking on their energy transitions from different starting positions, highlighting the importance of net zero pathways being fair and inclusive, leaving no one behind. It is for this reason that in January 2021, I convened the Global Commission on People-Centred Clean Energy Transitions, bringing together 30 government leaders, ministers and prominent thinkers. The Commission produced 12 actionable recommendations that draw on best practices from around the world and include actions that will enable energy transitions that maximise benefits for all people.

A critical component of people-centred energy transitions will to be to create quality jobs while at the same time reskilling and training the world's existing energy workforce. This theme was a pillar of the Global Commission's recommendations and is now a major focus for the IEA.

The Clean Energy Ministerial "Empowering People Initiative: Skills and Inclusivity for a Just Clean Energy Transition" adds a further dimension to these efforts with its a focus on empowering people and promoting just and equitable transitions. This collaborative report of the IEA and CEM EPI advances the initiative's work by offering real-world examples and lessons from programmes around the world that seek to prepare workers to meet the energy workforce demands of tomorrow.

I hope this compilation of case studies provides valuable insights to governments, companies, workers and organisations in their efforts to train employees and manage a smooth energy transition for the workforce.

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Acknowledgements, contributors and credits

This report is part of the work of the Clean Energy Ministerial's (CEM) "Empowering People Initiative: Skills and Inclusivity for a Just Clean Energy Transition" (EPI). The EPI seeks to highlight the socio-economic elements of energy transitions as they related to advancing skills, inclusivity and workforce development, with a goal to empower people and promote just and equitable transitions.

The report builds off the IEA Global Commission on People-Centred Clean Energy Transitions, which issued 12 actionable recommendations addressing key issues of people-centred clean energy transitions, underpinned by a review of over 150 case studies.

The introduction and executive summary draw information and insights from the IEA World Energy Employment report, with a special thanks to its lead authors, Daniel Wetzels and Olivia Chen. Their analysis provides a comprehensive data baseline on the global energy workforce that will help inform skills training and worker transition programmes. Likewise, the country profiles in the report are based on a compilation of programmes and publications in place around the world, so we thank all governments, companies and organisations for providing us their project descriptions.

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Executive summary

Clean energy transitions will reshape the workforces of today and tomorrow

The clean energy transition is ushering in a new era of job creation stimulus around the world. The energy sector today is a major source of global employment, and an outsized contributor in many regions. To maximise benefits from these changes, both current and future workers will need to be equipped with the requisite skills that the new energy economy demands. Programmes undertaken today to educate, train and certify workers in anticipation of these changes will be instrumental to capitalising on this opportunity.

Under a net zero emissions pathway, the transition could create 14 million new jobs related to clean energy technologies, shift around 5 million workers from fossil fuels, and require additional skills and training for an estimated 30 million employees, according to the IEA's landmark report, [Net Zero by 2050](#).

Changes already underway are behind a significant shift in the global energy labour market, with a little over half of the workforce now employed in the clean energy sector. This trend will only grow more pronounced as demand for skilled clean energy workers accelerates, with opportunities across a wide range of industries, including the power sector, electric vehicle manufacturing, technology development as well as end uses such as energy efficiency.

Training, upskilling and reskilling programmes are essential to support workers during energy transitions

Today's energy workforce is more skilled than global averages, and emerging clean energy industries will require an even higher share of skilled employees. In many cases, this will necessitate the development of completely new programmes of education, certification and vocational training. Equally, targeted upskilling or reskilling training programmes for the existing workforce will be critical.

Many traditional energy sectors – notably coal – are already experiencing major workforce changes, both through greater degrees of automation as well as global fuel mix trends. Though coal is on the front lines of changes today, in coming years, many other sectors will also undergo more significant employment shifts, including oil and gas, heavy industry and road transport. During the transition, maintaining sufficient capacity of skilled workers in these sectors is of strategic importance. Devising the right long-term transition plan can ameliorate these risks. Many of these workers also have energy sector-specific skills that will be needed

in clean energy sectors, and capitalising on these skills can help traditional energy firms diversify their portfolio to clean energy technologies.

For energy transitions to be truly people-centred, the diversity of the workforce must be a paramount consideration in policy and programme design for training and skills development. Women, in particular, are strongly underrepresented in the energy labour force, including in clean energy sectors. Equally, historically, minorities are also under-represented within the energy workforce. This presents an important moment for course-correction to ensure that the new energy workforce is more inclusive, gender-balanced, and enabling of equal opportunity compared to the energy sector of today. A number of initiatives are already underway around the world to support this outcome, targeting education and skills training programmes to specific groups, notably women, youth and marginalised communities.

Existing programmes can provide guidance on how to prepare workers for future clean energy jobs

A review of skills and training programmes that are already underway can provide a valuable blueprint for others embarking on their transitions. Several governments, companies and industry organisations, among other stakeholders, have developed comprehensive educational and skills training programmes to meet the challenges of the workforce transition, but much more needs to be done.

As part of such an effort, this report compiles a collection of case studies from around that world that highlight programmes designed to address skills development of workforces for energy transitions.

The report highlights a broad set of programmes that demonstrate the diversity of local circumstances that will inform successful policy outcomes. The case studies cover workforce planning and skills development programmes under five broad categories: 1) clean energy skills training; 2) reskilling for coal workers; 3) retraining of workers in the oil and gas and auto sectors; 4) academic and corporate programmes; and 5) targeted skills programmes for youth, women and marginalised communities.

The examples allow us to draw important lessons based on proven success in the real world. For instance, workforce mapping exercises provide a much clearer picture of energy employment in given countries or regions that can lead to better targeted policies and measures. Moreover, collaborative approaches between government, industry and workers have shown to produce stronger results. Importantly, though sufficient budgetary outlays are a critical element to putting in place effective training programmes, successful outcomes are by no means limited to national governments, as ample achievements are apparent at the sub-national, company, and grassroots levels.

Introduction

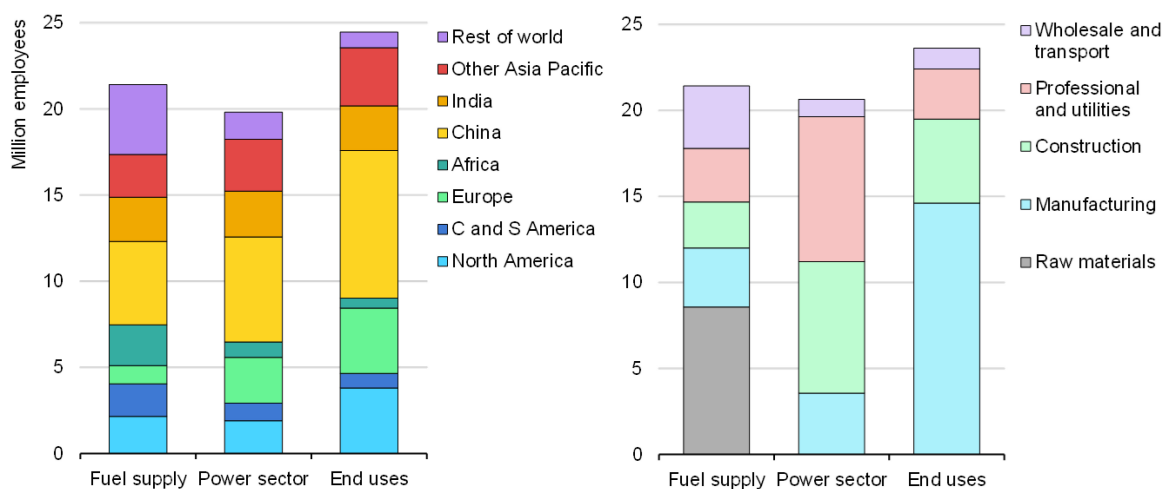
Overview

The level of commitment to fight climate change has never been higher than it is today. Countries currently accounting for over [70% of global emissions](#) have pledged net zero emissions targets by around mid-century. Stepped-up efforts to address climate change will entail a paradigm shift in economies around the world, and especially for the energy sector. These energy transitions will not only directly impact the daily lives of people in terms of how they produce and consume energy, but will also result in major changes to employment in the energy sector. To navigate the workforce evolutions on the horizon, decision makers need better visibility into energy employment today and the requirements of tomorrow.

To that end, the IEA's just-released [World Energy Employment](#) report is the first comprehensive data assessment and analysis of the global energy workforce that provides a baseline for policymakers, companies and other stakeholders to help plan for education and training needs. It finds that the energy sector in total employs over 65 million people, which equates to around 2% of global employment in 2019. This includes workers in fuel supply, the power sector, and end-use sectors, energy efficiency and vehicle manufacturing.

The overall employment numbers belie an even more complex situation on the ground, where the skillsets of individual workers can vary immensely based on industry, job function and region. So even though clean energy sectors are set to grow rapidly over the next decade, companies may face a lack of skilled workers that match the skillsets needed for a project in the region it is located. In some cases, this requires the development of completely new programmes of education, certification and vocational training, while in other cases, it means targeted upskilling or reskilling for the existing workforce.

Energy employment by region and economic sector, 2019



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Notes: C and S America = Central and South America.

Source: IEA (2022), [World Energy Employment](#).

Workers in traditional energy sectors will need to be trained with new skills for the future

The energy workforce of today represents a relatively skilled set of workers but clean energy industries require an even higher share of skilled employees. Emerging technologies currently account for only a fraction of the energy workforce but are poised for exponential growth in the coming decades.

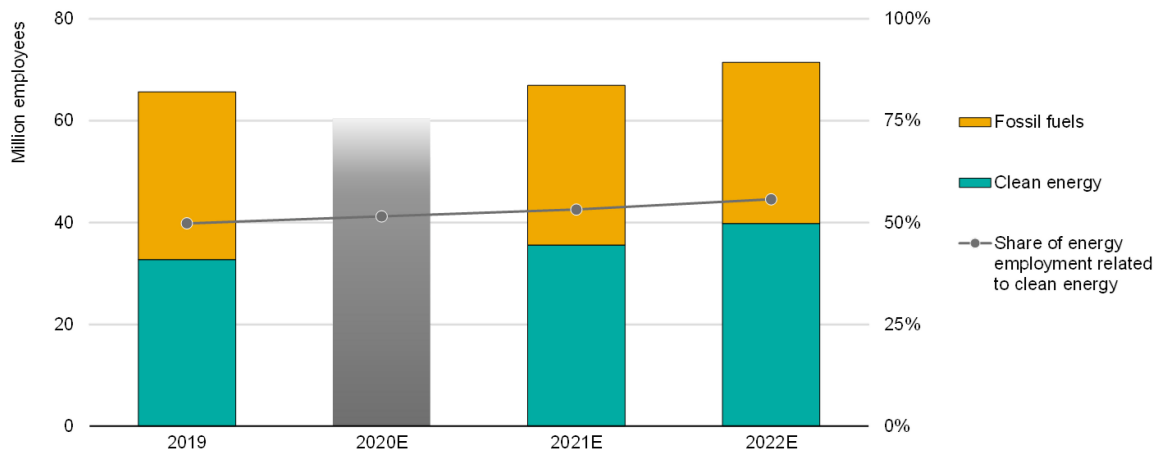
It is equally important to ensure that workers in traditional energy sectors facing decline as a result of energy transitions are equipped to find new employment in other sectors. Many of these sectors are now experiencing major workforce changes that require accelerated efforts to support employees, including through reskilling and upskilling initiatives.

In particular, the coal sector is already undergoing a rapid decline in many areas, prompting governments and companies to develop plans for a just transition for coal workers. Some governments, such as South Africa and Spain, have begun to undertake detailed assessments of their coal workforces as a first step toward understanding the specific characteristics of existing labour pools. Building off these studies, several governments have led social dialogues with industry and labour to develop joint strategies and action plans for transitioning away from coal, including skills training programmes for other sectors.

Over time, these changes will also get underway on a larger scale in other sectors, including oil and gas, heavy industry and road transport, among others. Reskilling

of automobile workers would enable a shift to the production of electric vehicles while oil and gas workers could find employment in the hydrogen sector, for example.

Energy employment in fossil fuel and clean energy sectors, 2019-2022



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Notes: Clean energy employment includes workers in bioenergy supply, nuclear and renewables for power generation, grids and storage, electric vehicles manufacturing, and energy efficiency. Estimates are modelled for 2020 to 2022 based on latest IEA energy balances and investment data, under the assumption that labour intensity and the job creation potential of new investment remain constant across years. The lockdowns associated with the Covid-19 pandemic made 2020 employment difficult to assess. Accordingly, 2020 estimates are indicative.

Source: IEA (2022), [World Energy Employment](#).

Skills training programmes should ensure inclusion for all members of society

For energy transitions to be truly people-centred, the diversity of the energy workforce must be a paramount consideration in policy and programme design for training and skills development. Women, in particular, are heavily under-represented in the energy labour force.

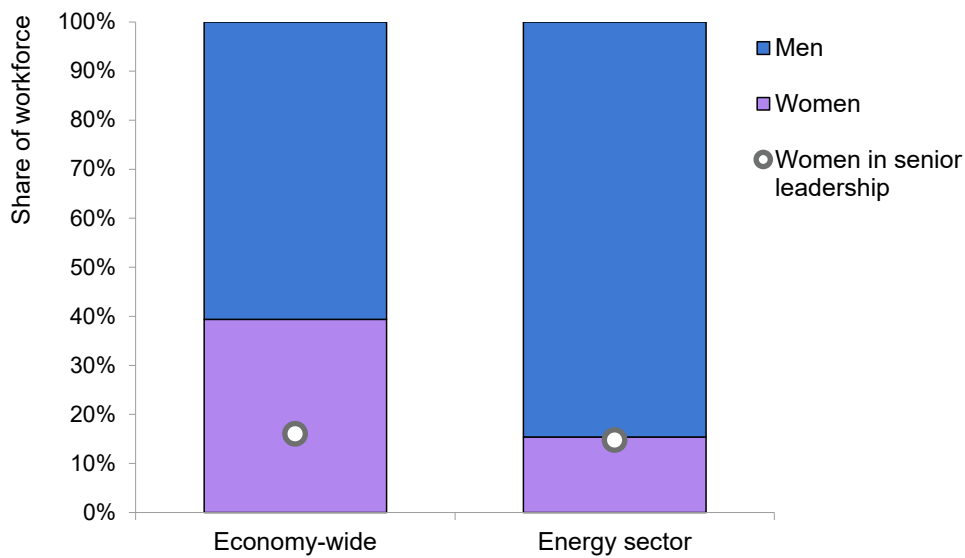
This marks a decisive wake-up call for course-correction to ensure that the future energy workforce is more inclusive, gender-balanced, and enabling of equal-opportunity compared to the energy sector of today. A number of initiatives are already underway around the world to support this outcome, which target education and skills training programmes to specific groups, notably women, youth and marginalised communities.

Importantly, many of the massive post-pandemic economic recovery plans that are now being implemented around the world could have a transformative impact on increasing equality and diversity in the energy workforce. Many of the programmes prioritise skills training for women, Indigenous populations or other marginalised groups. For instance, as part of the EU's recovery plan, 22 member

countries have focused on gender equality and inclusiveness in their national recovery and resilience plans.

Elsewhere, Canada has implemented programmes to increase clean energy opportunities for under-represented groups, including women, youth and Indigenous peoples. Beyond government programmes, several non-profit groups and industry collaborations have put in place innovative programmes designed to ensure that the clean energy workforce is more inclusive than the traditional energy sector.

Workforce by gender, economy wide and in energy, 2019



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Notes: Employment shares are from ILO, covering 48 countries for the energy sector. Senior management shares are global IEA calculations based on the Refinitiv PermID database.

Sources: IEA (2022), [World Energy Employment; Gender and Energy Data Explorer](#).

Clean energy skills training

Delivering a qualified workforce for a low-carbon economy

Millions of new jobs in clean energy sectors will create a once-in-a-generation opportunity for employment growth across the world. The overriding concern for government officials, policy makers and companies is the lack of a sufficiently skilled workforce to undertake the scale of new projects required for a low-carbon economy. Future growth in clean energy industries is closely correlated with the simultaneous development of a qualified workforce to implement projects.

Many governments are investigating the development of training, reskilling and educational programmes in anticipation of the upcoming changes. The most advanced programmes align energy, industrial, labour and education policies to jointly develop a strategy for energy transitions. Countries that are still in the early stages of their energy transitions have also benefited from capacity building and knowledge exchange with other countries that have longer experiences building out clean energy sectors. Moreover, clean energy skills training programmes are by no means limited to national governments, with subnational initiatives also offering useful examples of successful outcomes for workers. The following case studies highlight such examples.

Canadian energy advisor recruitment, training and mentorship programme

To support new programmes for the transition to a low-carbon economy, the government of Canada is taking steps to offer skills and training in various areas of clean energy sectors. Natural Resources Canada is leading the recruitment and training of EnerGuide energy advisors to meet increased demand for home retrofits following the launch in May 2021 of the [Canada Greener Homes Initiatives](#). The programme aims to help 700 000 homeowners upgrade energy efficiency on their properties. The initiative offers grants of up to CAD 5 000 for eligible home retrofits, a maximum CAD 600 toward the cost of EnerGuide evaluations, and from CAD 5 000 to 40 000 in interest-free loans to undertake major renovations that increase energy efficiency. To ensure that planned upgrades improve energy efficiency and homeowners know about their options, a trained advisor is required to conduct a pre-retrofit and post-retrofit EnerGuide home energy evaluation. As such, energy advisors are a critical component of the initiative.

To complement the Greener Homes Initiatives, the government launched the [Energy Advisor \(EA\) Recruitment, Training and Mentorship](#) campaign that includes a special focus on increasing the diversity and representation of the existing energy advisor workforce, particularly for Indigenous peoples. It will provide CAD 10 million over five years to support innovative projects and attract experienced partners, with at least 10% of this funding directed towards Indigenous governments. The focus will include projects targeting underserved areas of the country, such as in the northern region as well as rural and Indigenous communities more broadly. It also prioritises projects for under-represented groups, which include women, Indigenous peoples, persons with disabilities, racialised individuals and individuals who identify as LGBTQ+. The programme aims to partner with organisations across the country to provide practical hands-on training and mentorship opportunities as well as help prepare candidates, including those from under-represented groups, to pass the exams required to become energy advisors.

The programme is divided into five project categories with specific criteria. To be eligible for funding in the first round of bidding, the project proposals were required to support at least one of the following categories: training, mentorship, recruitment, upskilling and professional development, and accessibility of EnerGuide evaluations.

The first call for proposals closed on 8 July 2021, with a total of CAD 9.1 million allocated to 18 organisations that will help recruit, train and mentor 850 new energy advisors across Canada and upskill 110 existing ones. It is part of a larger five-year plan to train an additional 2 000 energy advisors.

The first round of funding awarded includes CAD 1.15 million to SaskPower in Saskatchewan, CAD 675 000 to NorQuest College in Alberta, CAD 624 000 to the Government of Yukon, and CAD 227 000 to EnviroCentre in Ontario.

As part of the government's commitment to support Indigenous communities, five out of 17 projects awarded (around CAD 4.4 million) will organise, train, recruit and mentor rural and Indigenous peoples across Canada. For example, the [Indigenous Clean Energy \(ICE\) Social Enterprise](#) project will recruit, train and mentor 15 Indigenous Champions from across Canada to become registered EAs. Elsewhere, the Temiskaming Native Women's Support Group project will also recruit, train and mentor Indigenous women in Northern Ontario to become registered EAs. At the same time the programme will also provide support to address existing barriers such as travel, childcare, and stipends as well be informed and supports the goals of the trainees. Equally, their project will include a training programme for industry partners on mentoring and providing safe and supportive work environments for Indigenous women.

Another, separate, government initiative is funding the development of the [DiscoverEE Hub](#), which is an online portal to help Canadians join the energy efficiency industry and become energy advisors. The hub was designed and is operated in partnership with Efficiency Canada.

India's Skill Council for Green Jobs

India's ambitious renewable energy target of 450 GW by 2030 is expected to create a surge of investments in the sector, representing an important opportunity for job creation. Based on the Indian government's pledge under the Paris Agreement to scale up renewables, it is estimated that net employment (measured in full-time employees) will increase by an additional 30% by 2030. And the International Labour Organization (ILO) forecasts that India's shift to a green economy could add 3 million jobs in the renewables sector alone by 2030. Given the scale of the commitment, the government is attempting to move early to develop training, skills and educational programmes, as well as reskilling and upskilling initiatives.

The [Skill Council for Green Jobs](#) (SCGJ) was established in October 2015 under the aegis of the government of India's Ministry of Skill Development and Entrepreneurship, to address skilled manpower requirements for emerging climate resilient technologies and India's commitments under the UNFCCC. The programme is backed by the Ministry of New and Renewable Energy and Confederation of Indian Industry. SCGJ was set up as a non-profit, independent, industry-led organisation with a mandate to identify skilling needs in green jobs sectors and to design and implement a wide range of capacity building and skilling programmes to meet these requirements.

SCGJ's activities are linked to some of the key clean energy and industrial schemes and missions of the government of India, including the National Solar Mission, Make in India, Atmanirbhar Bharat, Swach Bharat Mission, and has been closely interacting with central ministries, including the Ministry of New and Renewable Energy, Ministry of Environment Forest and Climate Change, Ministry of Housing and Urban Affairs and Ministry of Jal Shakti, in addition to skill missions in various states. In line with the National Education Policy 2020 of India, SCGJ is now also working towards introducing green jobs vocational education in schools, universities and engineering institutions.

SCGJ's key activities encompass all stages of [training, design and delivery](#), and include:

- performing skills gap analysis
- occupational mapping
- development of qualification packs based on industry requirements

- affiliating with suitable training partners and assessment agencies
- training for trainers and assessors
- training and certification of candidates in various subsectors
- creation of centres of excellence
- improving industry linkages in all sub-sectors
- undertaking consultancy assignments
- implementing externally sponsored projects.

SCGJ has a focus on three work streams – renewable energy; environment, forestry and climate change; and sustainable development – which covers the entire gamut of “green businesses” in the country.

SCGJ has so far developed 44 nationally-approved qualifications across various sub-domains (e.g. renewable energy, waste management, etc.), along with supplementing coursework and content. It has a network of over 406 affiliated institutions/centres along with over 4 000 trainers and assessors countrywide across green business domains. To-date, SCGJ through its partners have trained over 500 000 candidates, including over 100 000 in solar and other renewable energy domains. In addition, SCGJ has developed an e-learning management system through which over 4 000 candidates have received virtual training.

For example, with support from the International Solar Alliance, SCGJ has undertaken training of over 1 300 stakeholders from 82 ISA member countries across various aspects of solar energy. In addition, SCGJ implemented a range of corporate social responsibility supported projects, including on Simultaneous Intervention of Renewable Energy Systems and Skilling for Smart Model Villages, a [project](#) adopted by the president of India to create ‘smart villages’ in the state of Haryana through expanded access to clean energy and skilling. Moreover, under a [project](#) with IT company HCL, SCGJ has designed and developed training modules and implemented trainings on solid waste management best practices, health and hygiene, and communications skills, to over 4 000 field staff of the Noida Authority.

To understand current and future employment of the country’s clean energy sector, SCGJ is also implementing a comprehensive mapping of the green jobs landscape in India, supported by JP Morgan Chase. As part of workforce mapping exercises, SCGJ has partnered with the Council on Energy, Environment and Water and Natural Resources Defense Council to undertake an annual review of jobs and skilling in the Indian solar and wind energy industry.

SCGJ’s industry-led skilling programmes are designed to include advanced technological interventions that are harmonised with industry standards and

requirements. As part of these efforts, SCGJ partners with key national institutions and industry to leverage their expertise and strengths in various subsectors. SCGJ's [vision to 2047](#) sees the shift to clean energy resulting in [30-35 million additional jobs](#) created across a number of sectors by the end of the period, with over 10 million skills trainings and job facilitations undertaken. The sectors deemed to have the highest potential for job creation include green hydrogen, energy storage, hybrid renewable systems, biomass/biofuels, EV charging, pollution control, e-waste management, and decarbonisation of energy intensive industries. By 2030, SCGJ aims to facilitate training one million candidates in clean energy and green technologies and two million via virtual or blended upskilling and reskilling training across all sectors, establish 20 centres of excellence along with 750 affiliated training centres, and certify 7 500 trainers across the country.

South Africa's REI4P and SARETEC

South Africa introduced in 2011 the Renewable Energy Independent Power Producer Procurement Programme ([REI4P](#)) to stimulate private investment through competitive tenders in wind, biomass, small hydro and other technologies. To date, it has resulted in over 6 GW of new renewables generation capacity, mainly wind and solar. It is estimated that the REI4P has created over 18 000 jobs in manufacturing, installation and maintenance. Though construction jobs are usually temporary, the programme also includes requirements for [local content](#) that are designed to promote local manufacturing of renewable energy components and support skills development for workers over time. Companies have a contractual obligation to support local socioeconomic outcomes over the lifetime of a project (around 20 years), including for education and skills development.

Projects are required to demonstrate 40% South African ownership, which enables knowledge sharing between local developers and foreign operators. In particular, a number of foreign project developers sent a wide array of staff to work in South Africa to cover areas such as negotiations and contract agreements, construction, supply chain development, financing and legal services. Given the limited presence of these specialised skills in South Africa, the implementation of projects led to sizeable levels of knowledge sharing with local firms in the legal, banking, engineering and advisory fields.

Subsequently, in 2015, the government launched the South African Renewable Energy Technology Centre (SARETEC) to develop local green skills in response to the demand created by REI4P. [SARETEC](#) was established at the Cape Peninsula University of Technology, Bellville campus in Cape Town. The institution offers specialised and accredited training for the renewable energy industry. In particular, its courses are designed to address the skills needs

stemming from the REI4P, especially as they relate to the long-term operation and maintenance of projects. A slowdown in the REI4P policy implementation has impeded some progress in recent years, however.

EU Skills Agenda

The European Union has placed a strong emphasis on a green and digital transformation of its economies, including directing sizeable Covid-19 economic recovery into these areas. The lack of basic digital skills is currently limiting EU countries' ability to capitalise on emerging opportunities in the clean energy sector. As a result, the European Union is planning for a major [skills revolution](#) in both the green and digital spaces. Within ten years, nine out of ten jobs will require digital skills but only around 44% of Europeans are estimated to have basic digital skills and only one in five have digital skills above that level, according to the World Economic Forum. Based on current workforce projections, this implies a skills gap of 1.67 million unfilled jobs in the information communications technology field by 2025.

The [European Green Deal](#) targets are projected to create 2.5 million new jobs in the European Union by 2030, driving employment growth of 1.2%, both directly in clean energy sectors as well as in supporting industries. Therefore, the European Union has made upskilling a priority for its just transition. The [European Pillar of Social Rights Action Plan](#) has a headline target that states at least 60% of adults will participate in a learning experience over a year by 2030 (compared to 37% in 2016).

The [EU Skills Agenda](#) also includes ambitious targets to upskill and reskill 120 million adults annually, which means 30% of low-qualified adults would be participating in learning at least once a year, or around 14 million every year, and that the number of adults with basic digital skills would increase by a third. As part of these efforts, the European Union has earmarked sizeable funds to support worker training. While the European Social Fund Plus (ESF+), which is dedicated to improving employment opportunities in the European Union, remains the main source of financing, national recovery and resilience funding plans also include reskilling and upskilling activities. Moreover, the European Union has set up a EUR 19.3 billion Just Transition Fund, aimed at mitigating socio-economic impacts stemming from energy transitions, which is also expected to support skills training. Furthermore, the national Recovery & Resilience plans of EU member states must include a chapter on skills in order to release funding from the Recovery & Resilience Facility.

Technical transformation to promote the energy transition in Panama

The government of Panama is prioritising energy security and the diversification of the energy mix in its transition to a low-carbon economy, with a focus on promoting renewables, efficiency and electro mobility. By 2024, Panama's Energy Transition Agenda (ATE) plans to reach 4.3% of distributed generation (DG) installed capacity, up from 1% today, and to reach 1 700 MW installed DG capacity in 2030. It also plans to increase electro mobility penetration to 10% in 2024.

Achieving these goals is predicated on creating 15 687 net additional clean energy jobs by 2024, which would lead to a 0.4% reduction in the overall unemployment rate. Of the total additional jobs created, 15.9% would be direct employment in the energy sector and the remaining 84.1% would be indirect jobs, distributed throughout the economy.

Reaching decarbonisation targets and realising the green job creation potential will require skills training for technicians who can work in these new sectors. The private sector in Panama – in particular the Association of Car Dealers of Panama, the Panamanian Chamber of Solar Energy (CAPES) and the Panamanian Society of Engineers and Architects – has expressed concern about the lack of technical capacity in the country. Vehicle importers are expected to meet a goal of 25%-40% private vehicle sales to be EVs in 2030, but have identified a risk that the country will not have enough personnel to maintain them. Moreover, a lack of local capacity will make it difficult to increase the infrastructure of charging stations at the required pace. Similarly, CAPES identifies a key aspect for distributed generation growth is the training and retraining of electrical technicians who can guarantee the installations, thus providing security for the development and growth of the technology. It is estimated that the installation of DG can create up to 3 000 jobs by 2030, with 450 permanent jobs. However, many municipalities do not have sufficiently trained personnel with knowledge of DG, so it is necessary to hold technology training seminars, evaluate technical and university curricula related to distributed energy, develop programmes to instruct trainers, and create new DG training programmes.

In response, the National Energy Secretariat (SNE) of Panama, with the technical cooperation of the Inter-American Development Bank, is embarking on a [training programme](#) for clean energy in 2022, in particular for electro mobility and distributed generation. The programme, launched in collaboration with the country's two main educational institutions and the private sector, will be implemented through an itinerant mobile classroom to promote the country's energy transition with the participation of the private sector. The programme will be focused on retraining mechanics and technicians from traditional energy sector

areas in new capacities on electro mobility and distributed generation, especially for maintenance of EVs, distributed energy installation and EV charging stations. Both training programmes (for EV mechanics and DG and EV charging technicians) are based on a preliminary survey, carried out with the private sector, to identify potential beneficiaries, as well as to estimate the current and projected demand for professionals by the private sector. The survey also allows for the adjustment in format, schedule and content of the training programmes to better align with the needs of the workers to improve learning and limit drop-outs.

Specifically, the training programme will be led by SNE and developed in coordination with the country's two main educational institutions and the private sector, covering: (i) retraining of vehicle mechanics to be qualified to maintain EVs and (ii) training of technicians in energy auditing, distributed generation installation, and installation of charging stations for EVs. The training programme will use virtual classes, and a mobile classroom that can travel to various cities and communities to teach the practical parts of the technical courses. This virtual format will be designed based on lessons learned from the Solar Bus Program, where a mobile classroom was used for the Termosolar Panama project that teaches a course on the installation and maintenance of solar water heater systems, developed by the National Institute for Professional Training and Training for Human Development (INADEH).

For the selection of candidates, prioritisation for elderly and unemployed technicians is included as well as for current workers in the fossil fuel sector. Consistent with the government's objective of mainstreaming gender equality in the energy sector, these programmes will also have an expanded diversity approach, to help close the existing employment gap, training both women and people with disabilities.

To achieve sustainability and scaling-up of the training programme, work will also be undertaken with public education and training institutions. The training programme will be developed with INADEH, together with the Superior Technical Institute (ITSE). This will allow the programme to reach a larger group of participants, without imposing logistical costs on beneficiaries. Toward this end, a curriculum will be prepared for each of the trainings and teachers who will be trained first, with the aim that the programme can continue to be taught by both institutions even after the financing of the technical cooperation ends.

The training activities will be developed based on four components: 1) design of a re-training programme for mechanics and vehicle technicians, with the objective to provide them with the necessary skills to maintain and repair EVs; 2) design of a training programme for technicians in energy auditing, installation of DG and installation of charging stations for EVs; 3) pilot implementation of the training

programme in at least four locations through virtual classrooms and the mobile classroom; and 4) monitoring and evaluation to support the administration on technical cooperation.

Morocco's Institute of Renewable Energy and Energy Efficiency Training Jobs

The government of Morocco has for over a decade embarked on a strategy to limit GHG emissions and increase the role of renewables in its energy mix. The government's target is to reduce emissions by 42% by 2030 (17% unconditional, 25% conditional on international financing). To underpin the target, the government has a number of strategy documents, including the green plan and national energy strategy, which aims to reach 52% installed renewables generation capacity in electricity by 2030. This is expected to lead to the creation of over 50 000 new jobs in the clean energy sector. To support these ambitions, the government has undertaken a programme to train workers for jobs in the renewable energy sector.

The government launched the [Institute of Renewable Energy and Energy Efficiency Training Jobs](#) (IFMEREE) in 2011 to educate and train technicians, operators and executives for jobs in renewable energy and energy efficiency, with a focus on maintenance and operation of wind and solar installations.

The programme is based on an agreement signed between the government and professionals in the renewable energy and energy efficiency sectors to build three vocational training institutes in Oujda, Tangier and Ouarzazate, with an aim to eventually train [1 000 workers](#) each year. In addition to initial courses for technicians specialising in renewables and efficiency, the programme also offers continuous training to employees at companies in the three cities and participates in research work and offer technical advice and assistance.

IFMEREE offers specialised diplomas for training in five areas: energy efficiency in buildings, wind systems, solar PV systems, solar thermal systems, and biogas. Admission to the specialised technician courses is based on a competitive examination. IFMEREE provides an estimated 10 000 training hours per year.

The Oujda facility was the first of the three campuses to open, in 2015, and consists of 10 classrooms, two workshop areas for practical work, and one open-air workshop that houses a biodigester for the biogas training course. It has an eventual planned intake capacity of 250 students at a time, with a possibility for expansion over time.

IFMEREE also provides [continuing education](#) and training services for employees of companies in the renewables sector. Areas for continuing training include for

the installation and maintenance of solar pumping systems, energy audits, basic safety for wind energy, and installation and maintenance of solar pumping systems.

The [initial investment cost](#) was MDH 95 (EUR 9 million) per institute, or MDH 285 MDH (EUR 27 million) in total, with significant financial support coming from the European Union (EUR 10 million as a donation), the French Development Agency (EUR 10 million as a loan) and the Germany cooperation agency GIZ (EUR 2 million for equipment and teacher training). The remainder comes from the state budget.

Energy Academy in Germany and Jordan

In Jordan, the 2017 National Green Growth Plan for Jordan established a framework for increasing the role of renewable energy and energy efficiency in the country. The plan also targeted new job creation in the renewables sector to help address the country's employment challenges, as a counterpart to the country's [Vision 2025](#) strategy that targeted a reduction in unemployment from 13% to 8-9.2% by 2025.

At the same time, building off a high-level energy dialogue between Jordan and Germany in 2016, the governments upgraded to an Energy Partnership in 2019. Under the partnership the two countries agreed to set up the German [Energy Academy in Jordan](#). The training facility leverages German experience in building clean energy systems, with an aim to upskill and reskill technicians in clean energy technology areas such as renewable energy, energy efficiency, smart grids and digitalisation. The academy aligns with Jordan's vision of becoming a regional energy hub and expects to support capacity building for an energy transition that creates jobs and stimulates economic growth and development.

The academy brings together expertise from two of Jordan's largest universities, professional skills training organisations in Germany, as well as representatives from the Jordanian and German renewable energy industries. It offers certificates that are accredited by international institutions such as the German Foreign Chamber of Industry and the German- Arab Chamber of Industry and Commerce in Cairo. In the future, the countries plan to launch the academy's format on a larger scale to include other countries in the Middle East and North Africa region.

Philippines' Green Jobs Act of 2016

The [Philippines' Green Jobs Act of 2016](#) was a major piece of legislation designed to create and maintain jobs in the emerging green economy. It identifies skills needs, develops training programmes, and trains and certifies workers for jobs in a range of industries related to sustainable development and the transition to a

green economy. It offers [financial support](#) for the creation of green jobs, including generous tax deductions for skills training programmes.

The Act lays out a cross-agency effort to implement its goals. The Department of Labor and Employment (DOLE) was tasked with developing a National Green Jobs Human Resource Development Plan on the development and deployment of the public and private sector labour forces. The plan includes programmes and projects related to basic and higher education as well as technical-vocational training.

The DOLE, together with the Philippine Statistics Agency, maintains a database of green jobs as well as a list of companies that are expected to create new clean energy jobs in support of skills training assessments and certifications. The Department of Finance administers financial incentives (including new tax incentives introduced in the law) to qualified people and businesses engaged in registered activities.

Several education departments and authorities oversee development and implantation of curricula and certifications for skills needed for a clean energy transition, while the Department of Trade and Industry established a special business facilitation programme for people and businesses that create green jobs. Other governmental departments also ensure mainstreaming of green jobs in sectoral development plans, such as transport, sustainable tourism and green buildings.

Austria's Environmental Foundation

As part of its efforts to reduce GHG emissions and reduce its dependency on Russian oil and gas imports, Austria's government has prioritised rapid expansion of wind, solar, hydropower and biomass. The Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology, along with the Ministry of Labor and social partners, started the [Environmental Foundation](#) as a joint project to train at least 1 000 workers in the field of environmental and climate protection within three years.

The government foresees significant job creation potential in the clean energy sector, including for specialists to install PV panels, construct wind turbines and switch to modern heating systems. However, job seekers do not always have the required qualifications to perform these jobs, raising the need for training. The foundation works in conjunction with training providers and considers regional and industry factors. The project will notably focus on unemployed people who do not have sufficient qualifications to otherwise find jobs. The programme will also place special emphasis on training and jobs for women, older people and those struggling with long-term unemployment. The foundation began operations in April 2022, closely aligning its work with the Austrian Public Employment Service.

It has a total cost of EUR 17.5 million, of which EUR 10 million will come from the government's labour budget and EUR 7.5 million will be supplied by companies. The educational foundation follows the 2021 [Job.ReAct](#) pilot programme in Austria, which offered jobs in ecological and sustainable sectors to unemployed people, co-funded by the European Union's European Social Fund.

Barbados National Energy Policy 2017-2037

The [Barbados National Energy Policy](#) (BNEP) 2017-2037 outlines plans to shift the country's economy away from fossil fuel dependence toward one based mainly on renewables. The headline goals specified in the strategy include fostering local entrepreneurship, education and capacity building. To this end, one of the 16 objectives of the policy focuses on training local employees with qualifications and skills relating to renewable energy production and management. The policy also aims to develop standards of qualification for jobs in the renewables sector, increase collaboration between educational institutions and the energy sector toward establishing degree and vocational programmes, developing renewable energy syllabuses in tertiary institutions, and internship and scholarship opportunities. As part of this, the government established a working group comprised of members of educational institutions and the energy sector to ensure ongoing relevance of the education system amid energy transitions. It also mobilises funding for training and development and establishes a system of knowledge sharing on energy skills among local educational and vocational institutions and international institutions.

Vocational training in the sector of renewable energies and energy efficiency in Côte d'Ivoire

[According to GIZ](#), The government of Côte d'Ivoire plans to rapidly increase its electricity generation capacity by 2030, including by expanding the share of renewables to 42%, including 16% from non-hydro sources. Given that the current share of renewables in the power mix is less than 1%, the industry is expected to see significant growth, which will bring sizeable new job opportunities. Jobs in the solar power and biomass sectors are projected to grow by around 8 000 to 13 000 people by 2030 (compared to around 970 today). To take advantage of this opportunity, the government has plans to support young people entering the labour market, including by developing vocational training programmes in collaboration with the private sector.

However, the renewables sector in Côte d'Ivoire has yet to develop more capacity and attract more funding for small and medium-sized enterprises. Moreover, teaching staff at public schools and universities would benefit from additional learning opportunities, and women are currently under-represented in technical training courses. In response, as part of the reform partnership between the

government of Côte d'Ivoire and the German Federal Ministry for Economic Cooperation and Development (BMZ) within the G20 Compact with Africa initiative, a project was launched to increase local technical expertise and management skills in renewable energy and energy efficiency sectors. The project, spanning 2019-2022, was undertaken in cooperation with the Ministry of Technical and Vocational Training and Apprenticeship, the Ministry of Higher Education, the Ministry of Energy and the Ministry of Environment. The project bolsters the capabilities of teachers at vocational schools and universities, to allow them to support larger-scale dissemination of practical skills. It also advises vocational schools and universities on organisational areas that align training programmes with market needs. In addition, the programme facilitates dialogue and networking between the private sector and training organisations. Lastly, to foster market development, it promotes energy audits that can stimulate new projects and improves the capacities of banks to assess energy projects. As of May 2021, three cross-sectoral formats were established, and in 2020 45 companies had liaised with training institutions, while 37 teachers have received training in solar PV, energy efficiency and supporting skills. The project supports three public vocational training facilities in developing their offerings, while renewable energy and energy efficiency are being steadily integrated into the training curricula for jobs in the industrial and construction sectors. Around 400 workers, including 69 women, have received training.

Spain's Empleaverde Program

The [Empleaverde Program](#) of Spain's Ministry for the Ecological Transition and Demographic Challenge (MITECO) is run by the Biodiversity Foundation to "promote and improve employment, entrepreneurship and the environment". The programme is co-financed by the European Social Fund under the Employment, Training and Education Operational Programme 2014-2020. It aims to leverage environmental opportunities to create good jobs and competitive companies by better aligning employment and environmental policy. The Biodiversity Foundation issues calls for grants as well as undertakes its own projects.

Over the 2014-2020 period, the Empleaverde Program co-financed 288 projects in a range of environmental sectors, including the circular economy, renovation and sustainable buildings, eco-innovation, entrepreneurship, and ecological products, among others. The programme improved the employability of 2 783 people, while an additional 2 000 received support to create or improve a company. The Empleaverde Program might continue its work over the 2021-2027 period (currently under negotiation), focusing its activities on training for the green transition, targeting unemployed workers and entrepreneurs. Most recently, the Biodiversity Foundation issued two calls for grants in April 2022, one of which will be for projects that provide training, advice and support for job placement, while the other seeks to promote the hiring of unemployed people. Under the latest

programme, MITECO will award EUR 7.5 million to 66 projects that support jobs in environmental sectors and promote training programmes in areas such as agricultural sustainability, forest management, the just and ecological transition or sustainable fashion. The projects are expected to train over 7 000 people.

Barcelona Energy Advice Points

In an example of local governments offering clean energy skills programmes, the city of Barcelona launched the [Energy Advice Points](#) (EAP) initiative to address energy poverty through building retrofits and job training. The project was established with the goal of upgrading the energy efficiency of homes in Barcelona, with a focus on the most vulnerable households. The training aspect of the programme builds off the [Energia la Justa](#) initiative, which trained 100 unemployed people citizens and gave them jobs as energy advisors for six months to help 3 000 households in energy poverty implement energy efficiency improvements in their homes and lower energy bills. The EAP assembles a team of 40 people, spread across 11 points in the city with the goal of achieving energy efficiency improvements of homes, increasing the employability of vulnerable people, and empowering citizens. In addition, the EAP hires 20 unemployed people (over the age of 45) every eight months and integrates them into the group of energy advisors, to create a team of 60. By October 2019, the EAP had trained 80 people for work as energy advisors. Notably, the programme helps unemployed people get the training, professional qualifications and experience to gain employment as energy consultants elsewhere at the end of their training. In 2020, [80% of participants](#) found work after completing the programme, a significant jump from previous year (37% 2019 and 28% in 2018).

US DOE lithium-battery workforce initiative

As the energy transition brings about surging demand for critical minerals, employment needs in the sector are also poised to grow. In particular, the lithium battery supply chain will underpin growth in an array of clean energy technologies from electric vehicles to energy storage to support wind and solar power. Several recent reports commissioned by the Biden administration have underscored the need for the United States to develop and sustain a robust workforce for the domestic battery supply chain and for the entire transition to clean energy. As part of the President's 100-Day Supply Chain Review for the Energy Sector Industrial Base, the US Department of Energy (DOE) recently released "[America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition](#)".

In 2021, the National Blueprint for Lithium Batteries 2021-2030 published by the Federal Consortium for Advanced Batteries recommended the creation of a secure battery materials and technology supply chain by 2030. In response, the DOE, along with the US Department of Labor and the AFL-CIO, in March 2022

launched the [Lithium-Battery Workforce Initiative](#) to support lithium battery production. The USD 5 million investment will support five pilot training programmes in the energy and automotive sectors as well as promote workforce partnerships between industry and labour along the domestic lithium battery supply chain. The pilot programmes will include manufacturing companies, labour organisation and training providers toward the development of a national workforce strategy, and will analyse job tasks and worker competencies in lithium battery production. The analysis will inform the development of industry-approved credentials and support worker training programmes for the entire supply chain. The workforce initiative supplements other efforts, such as USD 3 billion allocated under the Bipartisan Infrastructure Law for projects that boost domestic battery production and recycling.

Skills training for coal workers

Reskilling and upskilling programmes for the transition away from coal

As the most GHG-intensive fuel, coal will be among the first sectors impacted by the ongoing energy transitions. Already, driven by market conditions and emissions reduction policies, many countries have seen sharp declines in their coal sectors. Since 2010, an average of [25 GW](#) of coal plant capacity have retired globally, mostly concentrated in Europe and North America. The pathway to net zero emissions will mean even more precipitous declines in coal usage. The IEA projects that [90 GW](#) of annual average coal plant retirements will be needed to meet NZE requirements. As a large employment and economic sector in many regions, retraining and regional revitalisation programmes are essential to reduce the social impact of job losses at the local level and to enable workers and communities to find alternative livelihoods.

Based on [IEA analysis](#), the coal sector – which is relatively labour-intensive – employs around 6.3 million workers, heavily concentrated in the Asia Pacific region, where the bulk of today's coal production takes place. The jobs are predominately in mining, but also include the transport, washing and processing of coal, as well as the manufacturing of specialised mining and conveying equipment. Meanwhile, coal power employs two million people globally, mainly of whom are informal workers, with a heavy concentration in emerging and developing economies in Asia.

Over the past decade, coal mining in North America and Europe has fallen considerably and further declines are inevitable. As a result, governments in these countries, from Spain to Canada and the United States, have already put in place strategies to manage the transition for workers away from coal mining into areas such as rehabilitation for new clean energy facilities. Such strategies require close collaboration with labour and industry, as well as financial resources to offer retraining and reskilling programmes for coal sector workers.

For large emerging markets, such as India and South Africa, which still have sizeable coal sectors that employ a large number of workers, the task is still more challenging. Nonetheless, actions taken today can prepare workers for a longer-term transition away from coal, including through social dialogue between governments, companies and unions, as well as detailed workforce and skills assessments that can inform future strategies and policies. A number of countries

around the world have begun to undertake these processes and offer good examples to ensure a smooth transition pathway for coal workers.

Spain's Just Transition Strategy

Spain's Strategic Framework for Energy and Climate, released in 2019, was built on three pillars, one of which is the [Just Transition Strategy](#). Spain views the energy transition as an engine for quality job creation, especially given that the country's unemployment rate hovers around 15%, with the highest share of temporary workers in the European Union. The Spanish government estimates that between 253 000 and 348 000 jobs will be created in the next decade as part of the energy transition, mainly in manufacturing and construction, with an overall reduction in the unemployment rate of between 1.1% and 1.6%. It also anticipates that the energy transition can bring about the economic revitalisation of sparsely populated areas based on the creation of green jobs.

However, in order to achieve these results, the government recognises the need to support the transition of workers in coal-dependent regions to new opportunities. The Just Transition Strategy, therefore, distinguishes green vocational training as an important element, including retraining of workers in vulnerable sectors or those undergoing restructuring. Already, between 2018 and 2020, Spain shut down 5.4 GW of installed coal capacity, with an additional 3 GW slated for closure in 2022 (relative to 10 GW of capacity from 15 coal plants in 2018). As such, the strategy identifies territories with maximum short-term vulnerabilities and proposes an Urgent Action Plan for Coal Regions and Power Plants to address them.

For coal power plants, the job losses from plant closures are not necessarily immediate as dismantling and decommissioning activities can result in job retention and even job creation. Nonetheless, these jobs are temporary and may require specialised skills that the existing labour force does not have. However, in Spain, the companies that close coal-fired power units are often the same as those that open new power plants, increasing opportunities to relocate staff.

A key tool under the strategy for supporting coal phase-outs are regional [Just Transition Agreements for Coal Power Plants](#) between the government, workers, companies that own coal power plants and workers (represented by trade unions). The agreement notes that the closure of coal-fired plants could result in both direct and indirect jobs in repair and maintenance services, as well as jobs in coal transportation and other associated services. In April 2020, Endesa, Iberdrola and Naturgy, operators of the plants in the process of being closed down, signed a Just Transition Agreement to protect 2 300 workers at 12 plants (7.8 GW). In March 2021, EDP joined the agreement, bringing the total to 3 000 workers at 15 plants (10 GW).

The agreement commits the national government (Ministry for Ecological Transition and Ministry of Labour and Social Economy) to collaborate with the Spanish National Employment Service to offer comprehensive support to workers in impacted areas by providing them with vocational training and employment services. Such support will be included in each Just Transition Agreement. This includes implementing a special register under the Just Transition Institute for affected workers to track requalification and job support, in coordination with State and/or Autonomous Communities. The plan includes vocational training and employability support for workers in affected areas, by means of an agreement between the State Public Employment Service and the Just Transition Institute, funded by the latter. It also calls for a study on the profiles of jobs, labour skills and capabilities that will be needed to ensure career development and the integration of job seekers, including analysis of professions at risk of declining demand in the short term, skills needed for future professions and measures needed to bridge the gap.

For companies that own coal plants, the agreement calls for maintaining employment through relocation plans for direct workers and ancillary companies' workers, giving them priority to new, immediate jobs in restoration and decommissioning activities. As part of this, the companies commit to upskilling and reskilling programmes for workers to support them in these efforts. Priority in decommissioning and restoration tenders will be given to companies that employ ancillary company workers in the local area. Coal plant owners also commit to facilitate compliance and monitoring of their commitments under the agreement.

Meanwhile, unions have a responsibility to monitor compliance under the arrangement as part of the Committee for Monitoring the Agreement, which includes representatives from the government, unions and companies. The committee meets to evaluate implementation progress every six months.

As an example of the Just Transition Agreements working in practice, Endesa in January 2022 announced training courses that will begin in February 2023 as part of the company's [Futur-e plan](#), in an effort to support local jobs as part of the process of dismantling its coal plant in Carboneras and the installation of renewables facilities. The training programme is part of a cooperation agreement signed by Endesa, the Andalusian Employment Service and Carboneras town council. Endesa has devoted over EUR 150 000 for the training courses in Carboneras that will benefit 500 people. Priority is given to those registered as job seekers under the Just Transition Employment Exchange in Carboneras, followed by jobseekers registered in the same registry of the province of Almeria. The company is planning to build over 1 200 MW of renewable generation in Almeria, which could offer job opportunities for workers from the Carboneras plant.

iForest local skills assessment of coal sector in India

The International Forum for Environment, Sustainability & Technology (iFOREST), an independent non-profit environmental organisation based in New Delhi, India, released a [landmark report](#) on planning a just transition in the country's largest coal and power district, Korba. In the early stages of planning a people-centred energy transition, it is necessary to gather data on employment and skills among the working population at the local level as a first step toward planning for employment redeployment and skills training needs. The government of India's target to reach net zero emissions by 2070 and undertake a massive buildout of renewable energy capacity (500 GW by 2030) will require a phase out of coal production and consumption in the country in the coming decades, with a peaking of demand needed in ten years.

Korba is not only the top coal producing region in India, but it is also one of the poorest, highlighting the acute dependence of people there on the coal economy. As part of the comprehensive study, iForest assessed the jobs dependency on the coal sector in Korba, finding that one in five workers is employed in the coal sector (coal mines, coal washeries, coal transport, power plants and fly ash brick units), either formally or informally. In the absence of official data on coal dependency, the study surveyed 600 households in Korba district to determine dependence on coal and to profile the workforce dependent on coal mining, coal-fired power plants and other related industries. It was estimated that at least 87 558 workers are employed formally or informally by the coal industry and power plants in Korba. The worker profile showed that 44% of the coal workforce were formal workers, employed by public sector coal mining company South Eastern Coalfields Limited and through private contractors in occupations such as machine operators, technicians and accountants. The remaining 56% were informal workers, often engaged through sub-contractors, in activities such as moving equipment, helping in loading and unloading and civil works in company-run facilities. The study also highlighted that the largest informal workforce is in the coal transport sector, particularly road transport, where nearly all workers are informal. The report noted that impacted informal mining workers will require skills training for new jobs, while for formal mining workers reskilling is needed for younger employees oriented toward Coal India's shifting portfolio. For coal power plants, informal workers will require vocational training for new skills to find work elsewhere, with aluminium and steel plants noted as industries presenting opportunities. For drivers in coal transport and informal fly ash brick workers, who often have limited skill sets, new skills training will likely be needed. The report also identifies the need for investments in education to prepare the younger generation for jobs in other areas.

South Africa Sector Jobs Resilience Plans

South Africa has undertaken early national engagement on a just transition for its coal industry in a context where coal accounts for [73% of the country's energy supply](#) and about [1.5% of formal employment](#). In 2017, the Department of Environment, Forestry and Fisheries and the Department of Trade, Industry and Competition (formerly Economic Development Department) [commissioned](#) Trade & Industrial Policy Strategies to carry out a National Employment Vulnerability Assessment (NEVA) to evaluate the impacts that climate change would have on companies, workers and communities along the value chain in the following sectors: coal, metals, petroleum-based transport, agriculture and tourism.

The [2019 NEVA](#) found that South Africa's coal mining sector, which is highly concentrated among a few companies, employed around 89 000 workers in 2018 and accounted for 20% of mining jobs in the country. That same year, state-owned utility Eskom employed 50 000 workers, while petrochemical company Sasol had 26 000 workers in South Africa. The NEVA identified four main risk factors for the country's coal value chain, including longer-term risks from abroad that importers reduce demand for South African coal and global efforts to cut coal consumption mount as well as domestic risks that consumers lower their demand for coal-fired electricity due to an expansion of renewables and efficiency and policies for lower carbon intensity from electricity generation.

To complement the NEVA, the country's National Climate Change Response White Paper requires the development of Sector Jobs Resilience Plans (SJRP) for each value chain. The SJRPs aim to assess opportunities to transition these sectors to green jobs and industries and to protect vulnerable groups that will be impacted by the changes.

[For coal](#), the SJRP estimated in 2020 that value chain employment is more than 120 000 workers, out of which 80 000 work in coal mining, the largest employment sector. The power generation sector (Eskom) accounts for 12 000 jobs, the petrochemicals sector (Sasol) for 26 000, and small coal truckers for 2 000 jobs. 15% of the workers in the coal value chain are women.

The coal sector is highly localised in the Mpumalanga province, which houses most of the country's coal mines, including Eskom power stations and Sasol's coal-to-liquids plants. In particular, four districts in Mpumalanga supply nearly all of the country's coal.

The SJRP notes that workers in the coal value chain have better-than-average compensation and benefits compared to other formal workers, despite lower levels of education. In coal mining and heavy chemicals, the median monthly salary was ZAR 10 000 and in the electricity sector, around ZAR 15 000. This compares with the median salary for other formal workers of a little over ZAR 5 000. Moreover, in

2017, around 80% of workers in the coal value chain had retirement funds relative to less than 60% for other formal workers.

However, education levels among coal miners lagged behind formal workers in other sectors. The coal labour force with matriculation or less stood at 80% in 2017, compared to 74% in other sectors. In addition, union membership was over 70% for coal miners, 67% for electricity workers and 45% for basic chemical workers. This compares with only 35% in the formal economy as a whole.

The SJRP framework, in addition to estimating the scale of displacement expected in a region, also offers recommendations for adjustment. It notes various areas for diversification, including in the renewable energy value chain through skills development, including in the maintenance and repair of renewable generation equipment, and the manufacture of renewables generation components and related services. Another area for diversification is beneficiation of coal waste products, which would require skills training and education to transition workers from coal mining and power plants, preceded by a thorough assessment of the potential for ash beneficiation. Lastly, the framework also identifies mine rehabilitation and repurposing as a diversification option.

The SJRP framework notes that aggregated employment adjustment plans for all of Mpumalanga will not be effective as each local municipality has unique economic drivers, labour markets and infrastructure. Along these lines, the strategy highlights effective labour market strategies will require a comprehensive profile of affected miners, specifically a survey of mining firms, to get an accurate profile of miners' age, background and skillset. It, therefore, calls for a study into the skills, experience, age and long-term career plans of workers that will be displaced by the sector's slowdown in next ten years, funded by the Mining Qualifications Authority or the National Skills Fund. Such analysis could determine, for instance, if the age profile of workers warrants retraining and reskilling for younger workers or possible early retirement packages for older workers.

EU RES-SKILL project

The [RES-SKILL](#) project has an objective to strengthen vocational education and training (VET) for coal workers to secure jobs in the renewable energy space. According to the initiative, the European Union's carbon agenda will displace around 76 000 jobs in coal mines and coal power plants by 2025 and 154 000 jobs by 2030. However, growth in renewable energy will create new jobs in the energy sector. The programme notes a similar skillset between coal workers and those in the renewables sector. For example, some skills of coal workers, such as experience in hazardous environments as well as employment of manual and sophisticated technologies, are applicable in the solar photovoltaic (PV) and wind

industries, especially for solar PV installers and technicians as well as for wind-farm and wind turbine operators. In this regard, coal workers can more quickly transfer their skills, bypassing lengthy training of around two years for VET courses; instead, they might only need a short course or on-the-job training.

The project employs a [three-step methodology](#): 1) identifying the main occupation profiles in the coal industry and renewables sector, 2) documentation of skills in the coal industry and renewables sector, and 3) development of transition profiles based on skills matching. As part of this initiative, the RES-SKILL project develops a tailored curriculum and training content to support the integration of coal workers in renewables jobs, supports VET providers integrate RES-SKILL materials into their offerings, and improves coordination between VET providers and employers to identify opportunities that facilitate coal workers transition to the renewables sector.

In particular, the project identifies synergies and misalignments on skills between the job descriptions of coal and renewables sector workers to better target training. It also creates tailored teaching materials that are offered as open education resources (so far in six languages) as well as develops self-assessment tools and skills portfolios to tailor retraining efforts. The project also develops resources to set up Joint Competence Centres to reorient the careers of coal workers. Target groups of the project include: VET providers; coal industry workers (especially low-skilled workers); companies, social partners, and worker associations; and VET authorities and career advisory organisations (including regional development agencies that oversee training programmes). The project is co-funded by the EU Erasmus+ Programme.

Romanian Wind Energy Association training schools in coal regions

Building on the success of the [Renewable Energy School of Skills](#) (RESS) in Constanța, which trained over 5 000 wind energy technicians in Romania, the Romanian Wind Energy Association (RWEA) is developing a professional training academy in a former coal region. The academy will be based in the Jiu Valley, a former coal mining area with a previously strong economy that has been afflicted in recent years by mine closures that have resulted in stress on local communities and prompted nearly half of the region's population to leave for better opportunities elsewhere.

With wind energy installations on the rise in Romania, the industry offers an attractive opportunity for new jobs. The academy will leverage the RESS programme to reskill coal miners for jobs in the wind energy sector. Among the courses offered by RESS are wind turbine blade repair, PV panel installation, safety and other specialised trainings. RWEA's [Valea Jiului Academy](#) will be

supported by its member companies, such as Monsson and CEZ Group, and plans to access funding from the EU Platform for Coal Regions in Transition. The intention of the academy is to retrain up to 800 coal miners as technicians in the renewable energy and energy distribution fields annually, for a total of 8 000 technicians over the ten years of the project. The certifications awarded through the courses will provide technicians with employment opportunities in installation, operation and maintenance of renewable energy and grid projects both in Romania and abroad.

US POWER initiative

In 2015, the Obama administration launched the Partnerships for Opportunity and Workforce and Economic Revitalization Initiative (POWER) to direct federal assistance to communities and regions facing job losses related to the energy transition in mining, coal power plants and coal supply chain industries.

POWER is a multi-agency effort to support federal economic and workforce development programmes to assist communities facing downturns in the coal mining and power sectors. The [POWER funds](#) can be used by regions to diversify economies, create new jobs, attract new investments that create jobs, and provide workforce services and skills training that lead to industry-recognised credentials for high-quality jobs.

The Power Initiative's funding is provided by the US Congress. Upon its launch, the [POWER Initiative](#) was spearheaded by the Economic Development Administration, with sizeable funding coming from the Appalachian Regional Commission (ARC), Small Business Administration and Department of Labor. Since the Trump Administration, the ARC retained sole oversight over the programme. The [ARC](#) is an economic development agency of the federal government and 13 state governments working in 423 counties (accounting for 26 million people) in the 13 Appalachian states with a mission to "build community capacity and strengthen economic growth in Appalachia".

Under the POWER Initiative, the [ARC awards](#) implementation grants of up to USD 1.5 million, technical assistance grants of up to USD 50 000, and broadband deployment grants of up to USD 2.5 million. The programme awards funding through a competitive bidding process each year.

POWER [investment priorities](#) areas include: building a competitive workforce, fostering entrepreneurial activities, developing industry clusters in communities, and broadband.

Within the workforce development area, training projects are expected to focus on the upward mobility for participants through upskilling, retooling and establishing distinct career pathways. Workforce projects should also strive increase labour

participation rates by targeting both underemployed workers as well as by recruiting and training people who have left the workforce. [Since 2015](#), under the POWER Initiative, ARC has invested over USD 319.3 million in 395 projects in 358 coal-dependent counties throughout the Appalachian region. Those investments are expected to create or retain over 36 600 jobs, leverage more than USD 1.5 billion in private investment into the region and groom nearly 14 300 workers and students for opportunities in entrepreneurship, broadband development, tourism and other sectors.

For example, [ARC in 2021](#) offered several grants to revitalize economic and job opportunities in the Appalachian region. Among other funds, it granted USD 1.5 million to Coalfield Development Corporation in Wayne, West Virginia for the Appalachia FORWARD (Freight Opportunities Reducing Waste and Revitalizing Development) project. The funds will be used to offer technical assistance to entrepreneurs and social organisations in the transport and recycling sectors. The programme will also train and hire people in sustainable recycling and reuse of materials, as well as perform research on sustainable upcycling and repair business models. The grant is expected to create 50 new jobs, six new business and upskill 300 workers.

Also in 2021, [ARC awarded](#) a grant to Frostburg State University in Frostburg, Maryland to implement Phase II of the Western Maryland Advanced Technology Center Development Project at Frostburg State University Innovation Park. The facility aims to support the growth of new industries that can play a key role in the region's revitalisation and create new jobs, including information technology, renewable and resilient energy, green construction materials manufacturing, environmental hazard removal, and biotech laboratory testing and analysis. Located in a designated Opportunity Zone, the facility plans to offer training and education in new technologies to residents in three surrounding counties. The project is projected to create 18 new businesses and 125 jobs, retain 230 jobs, provide 40 existing businesses access to skilled workers, and stimulate an additional USD 2.5 million in private investment in the region.

ARC's largest grant package to date under POWER was for USD 52 million in 2021, followed by the announcement of an additional USD 21 million in grants in 2022. The 2022 grants will go to 21 projects impacting 211 countries.

Greece's just transition strategy for lignite workers

As part of [Greece's energy transition](#), the government announced a phase out of lignite by 2028. The transition will require decommissioning of lignite power plants and mines, which will create economic and employment disruptions in lignite-producing areas, especially in Western Macedonia, where 80% of the country's lignite is produced. To help manage an efficient transition for impacted regions

and communities, Greece created a Fair Transition Fund in 2018, which will support the diversification of local economies and job creation in lignite dependent areas. The fund is financed by 6% of revenues from auctions of allowances under the EU Emissions Trading System, amounting to around EUR 20 million annually. For both the Dytiki Makedonia and Peloponnesus coal-mining regions, Greece participates in the Initiative for coal regions in transition that offers technical assistance and capacity building toward the development of inclusive transition strategies and roadmaps.

In 2020, Greece submitted a detailed plan for managing a just transition for its coal regions to the European Commission, supported by the World Bank and the EC's Directorate-General for Structural Reform Support. The [roadmap](#) included findings from a comprehensive, multi-disciplinary research project that examined key topics for a transition away from lignite in Western Macedonia. The proposed transition strategies identified in the plan include, among others, an alternative energy transition pathway that leverages the energy-related skills and social identity of the region as well as a digital regional transition approach that would expand science, technology, engineering and math (STEM) and robotics education in public schools. Given the exceedingly high unemployment rates in Western Macedonia, the roadmap calls for an employment strategy that considers the broader picture, providing employment opportunities, training and retraining for youth, the long-term-unemployed, as well as individuals affected directly and indirectly by the transition out of coal. The workforce assessment found that, as of June 2020, around 5 200 workers were directly impacted by the lignite phase out. After 2023, workers in the sector will mainly comprise mine technicians, with a smaller number of engineers and administrative and support staff. A large number of temporary workers would also be negatively affected. According to estimates by the Institute for Economic and Industrial Research (IOBE), the Greek coal (lignite) regions will suffer a loss of EUR 1.3 billion in their GVA by 2029 compared to 2019. As regards job creation, IOBE estimates that coal regions will cumulatively lose around 14 000 jobs by 2029 compared to 2019.

Under Greece's 2021 Recovery and Resilience Plan, the government [announced measures](#) to improve green skills through training programmes in resource efficiency, low-carbon industry, climate reliance and managing natural assets. The Plan also includes investment to rehabilitate industrial land and creates the basis for further developing low carbon investment. The measures aim to ensure a just transition in view of the phasing out of lignite, notably in Western Macedonia and Central Peloponnesus. In the framework of the Just Transition Fund (JTF) programme and plans adopted in June 2022, Greece will mobilise a total investment of EUR 1.63 billion to alleviate the impact of the energy and climate transition on the local economy and society in the territories most affected. The programme will support decarbonisation in Western Macedonia and Peloponnesus as well as the phasing out of fossil fuel power stations in the islands

of North-South Aegean and Crete. Support from the JTF programme will foster the diversification and modernisation of the economy through creating new jobs as well as through upskilling and reskilling people affected by the transition. This includes training and retraining in digital skills and cutting-edge technologies, with a focus on vocational training and human resource certification actions and job-search assistance.

China's coal and steel capacity cuts and worker re-employment

In early 2016, China's government urged coal and steel companies to cut excess capacity, in part to track lower demand driven by slowing economic growth and environmental regulations. However, mindful of the job losses that would result from capacity closures, the government prioritised redeployment of workers, including through professional training. Based on China's 13th Five Year Plan (2016-2020), the Ministry of Finance in 2016 set up the [Industrial Special Fund](#) to disburse CNY 100 billion (EUR 14 billion) toward relocating displaced workers in the coal and steel sectors.

As part of these efforts, China's State Council pledged [CNY 10 billion](#) (EUR 1.4 billion) for the training of workers. The government also worked with coal companies to explore new business opportunities that would create jobs for the existing workforce. Shanxi Province in northern China is the country's largest coal-producing region and the sector is a major source of employment, making it particularly vulnerable to coal and steel closures. Therefore, the regional Shanxi government also pledged [CNY 2.2 billion](#) (EUR 0.3 billion) to support job transfers, retraining, early retirement and the creation of public service jobs. The Shanxi Coking Coal Group set up an [innovation centre](#) in June 2016 that helped support the creation of 26 businesses, 70% of which were started by the company's employees. Workers were assisted in finding new jobs in other departments within their factories or at different facilities in the area, while employees in their 40s and 50s could receive extra training to find new jobs (or retire early under certain circumstances). An [estimated](#) 31 600 workers in Shanxi province were successfully re-employed, representing 99.8% of the workforce that was made redundant from coal and steel capacity reductions. Across China, in 28 provinces, the Ministry of Human Resources and Social Security estimates that more than 726 000 workers from 1 905 companies in the steel and coal sectors found new employment in 2016.

Skills training for workers in other traditional energy sectors

Reskilling and upskilling programmes for workers in oil, gas and auto sectors

Following coal, other fossil fuel sectors will also face declines over time should countries be successful in bringing down their emissions in line with net zero ambitions. This decline will expose oil and gas workers, communities and local economies to market volatility and employment disruption. According to the [World Energy Employment](#) report, oil supply has the highest employment among fossil fuels, with nearly 8 million workers in 2019. Of these, 5 million are employed in extraction and production, and 1.4 million each in transport and refineries. Geographically, almost 20% of oil supply jobs are found in the Middle East, while around 15% are in North America and another 15% in Africa. Refining sector jobs are predominantly in the Asia Pacific region. On top of this, oil and gas power employment accounts for an additional 1.4 workers.

The skills of oil and gas workers can be transferable to other energy sectors. For instance, petroleum engineering skills are pertinent to geothermal activities, while chemical engineering skills used in oil refineries are applicable to the production of clean fuels and hydrogen. The offshore petroleum sector's skills are relevant for offshore wind, carbon capture and storage, and hydrogen. Meanwhile, oil and gas power plant operators, turbine manufacturers and construction workers can apply their skills to clean energy power plants, as well as upgraded technologies to use hydrogen and other innovative clean fuels in the future.

Beyond oil and gas, the automotive sector is also poised for a major shake-up as emissions reduction policies increase the uptake of electric vehicles over traditional combustion models. The IEA's World Energy Employment report estimates 13.6 million people were employed in road vehicle manufacturing in 2019, accounting for around 2.5% of total global manufacturing jobs. Given that electric vehicles have fewer components and simpler assemblies, EV manufacturing could have a lower labour intensity compared to internal combustion engine (ICE) vehicles. However, when considering the full value chain of production, including batteries and electric charging infrastructure, EVs could have a comparable labour intensity to conventional vehicles. Still, automobile workers will require support to shift their skillsets from the production of ICE vehicles to EVs, with appropriate consideration to wages and worker displacement.

Such large-scale redeployment of workers across major industries requires detailed assessments of workforces and skills needs as well as reskilling and upskilling programmes for current workers for jobs in higher growth sectors. Several governments have put in place such initiatives in anticipation of the upcoming changes.

French fund to retrain foundry workers in the auto sector

As part of an updated action plan to support changes in the automobile sector announced in May 2020, France launched a [EUR 50 million fund](#) in April 2021 to retrain foundry factory workers as it shifts its internal combustion-based automotive industry toward the production of electric vehicles. The French government will [contribute](#) EUR 30 million and car manufacturers Renault and Stellantis will contribute EUR 20 million. France currently has 355 foundry factories employing about 30 000 workers, with half of them linked to the automotive industry. A prospective study by the French metallurgy observatory on jobs and skills in the automotive sector will be complemented by an analysis of the skills gaps between declining jobs and new jobs, in order to offer tailored training to employees who may suffer job losses, with a specific focus on regional and local employment workforce dynamics. The support measures are planned until 2023, and will be implemented by France's unemployment agency, Pôle emploi. As [part of the broader plan](#) for employment in the sector, the government also proposed the establishment of four new campuses for automotive skills.

UK Green Jobs Taskforce and North Sea Transition Deal

As part of the UK government's climate strategy and green recovery efforts from Covid-19, the government in 2020 set up the [Green Jobs Task force](#), comprised of 17 experts from industry, academia, labour unions, and the education and skills sector. The group undertook a study over the period from November 2020 to July 2021. The task force is part of the government's [Ten Point Plan for a Green Industrial Revolution](#), launched by the Prime Minister in November 2020. The plan directs GBP 12 billion in government funding, covering the energy, transport and industry sectors, to support a green recovery and support job creation. Specifically, the plan is expected to support the creation of up to 250 000 green jobs – including engineers, fitters, construction workers among many others – by 2030. Sectors for new investment include offshore wind, hydrogen, advanced nuclear, zero emissions vehicles, green buildings and CCUS.

The strategy builds off the [Lifetime Skills Guarantee](#), announced by the government in September 2020, which aims to better align the post-16 education system with company needs in order to set up workers to meet the skills gaps of today and the future, in sectors such as construction, digital, clean energy and

manufacturing. In early 2021, the programme launched almost 400 qualifications that are fully-funded for any adult who has not already achieved a Level 3 qualification.

The 15 final recommendations of the Green Jobs Task Force – divided along three themes of the ‘green jobs lifecycle’ – are meant to support the government’s ambition for two million green jobs in the United Kingdom by 2030 and help establish the workforce pathway to net zero emissions by 2050. It notes research commissioned by the Climate Change Commission that found that overall the United Kingdom’s transition to net zero emissions will increase GDP by around 2-3%, and create about 300 000 additional jobs by 2050. The green jobs lifecycle is defined as employment in an activity that either directly or indirectly contributes to the United Kingdom’s net zero emissions target and mitigates climate risks, and therefore covers a broad range of economic sectors. It builds upon reforms to the skills system established under the government’s [Skills for Jobs White Paper](#) that introduced new T Levels technical qualifications, flexible apprenticeships, Skills Bootcamps and occupational traineeships.

The [task force’s report](#) notes that one in five jobs in the United Kingdom (6.3 million workers) will require skills that may see increased demand (10% of UK jobs) or reduced demand (approximately 10%) as a result of the net zero transition. The report also includes estimates of job creation potential in various clean energy sectors (such as offshore wind and buildings retrofits) as well as jobs and skills shifts in sectors experiencing significant transformation (such as automotive).

For example, on a sectoral basis, the offshore wind sector is poised for major growth. Based on industry estimates, the sector could employ 40 000 directly and an additional 30 000 through the supply chain, relative to around 26 000 today. These jobs will be concentrated in construction, installation, operations and maintenance, requiring technicians and engineers, in particular. Nonetheless, a broad set of skills is needed for ongoing sectoral development, including asset management, project management, engineering and technical skills, science, advanced first aid and rescue, and offshore-specific skills. A number of these skills are particularly well-suited for current oil and gas sector workers. Similarly, some of the skills gaps in CCUS and hydrogen could be met with the current oil and gas workforce, such as pipe fitters and designers, leak test technicians, and offshore barge operators.

The United Kingdom’s offshore oil and gas sector, notably, has been an important pillar of the country’s economy and energy security for many decades, and will face significant change on the path to net zero. It is estimated that the sector supports around 260 000 jobs, including 147 000 direct and supply chain jobs.

Already, between 2014 and 2017, the UK oil and gas sector lost over 70 000 direct and supply chain. Another 80 000 workers are predicted to lose their jobs in the sector between 2018 and 2035.

However, over 90% of the United Kingdom's oil and gas workforce have medium to high skills transferability so can be suitable to work in other energy sectors, including decommissioning and subsea network projects, offshore wind, CCUS and hydrogen.

The offshore oil and gas industry has supported the United Kingdom's target to reach net zero emissions by 2050 based on the sector's [Roadmap 2035](#). This includes a focus on [developing people and skills](#) with a commitment to a diverse workforce with transferable skills and to support 130 000 jobs across the energy sector. It also commits the industry to becoming a global leader in carbon management through by fostering knowledge, skills, innovation and capabilities. Key actions will include upskilling workers on the UK Continental Shelf, developing of a plan for a more flexible, multi-skilled and technology-enabled workforce, and ensuring diversity that reflects broader society.

As part of the government's climate change strategy, it also reached an [agreement](#) with the North Sea oil and gas industry to manage the economic transition and transformation of the region. The North Sea Transition Deal includes public and private investments of up to GBP 14-16 billion by 2030 in clean energy technologies, a voluntary commitment by the sector to source 50% local content for energy transition projects by 2030, and support for up to 40 000 direct and indirect jobs as part of efforts to decarbonise offshore oil and gas production.

The commitment to employment will include reskilling of the existing oil and gas workforce. Technologies that will be promoted based on existing skills, infrastructure and expertise in the North Sea include CCUS, hydrogen and offshore wind. The agreement notes that sectors such as offshore renewables, CCUS and hydrogen will rely heavily on a number of skillsets that match the profile of current oil and gas workers, such as geologists, project managers, different types of engineers, and fabricators. As such, the sector will aim to align with initiatives on workforce transition, skills, diversity and inclusion under other Sector Deals (such as the Offshore Wind Sector Deal), where synergies can be found.

However, a deeper understanding of the future skills profile of the CCUS and hydrogen sectors will also be needed. Toward this end, the [Energy Skills Alliance](#) has spearheaded work on detailed mapping the energy sectors' current capabilities and future needs through its Future Energy Skills Demand and Supply workstream.

US hydrogen workforce development programmes

The US Department of Energy (DOE) launched two new efforts in 2020 targeting workforce development, training and STEM education. The [Hydrogen Education for a Decarbonized Economy](#) (H2EDGE) aims to develop and grow the emerging industry workforce to advance hydrogen technologies and end-use applications through regional hubs. The programme seeks to improve workforce readiness through training and education, including by developing materials and offering professional training courses and developing university curriculum content. It also plans to collaborate with industry and university partners to develop certifications, credentials, qualifications and standards for training and education. In September 2020, the DOE awarded a USD 2 million contract under the initiative to a consortium of research organisations, including the Electric Power Research Institute (EPRI), the Gas Technology Institute (GTI), Oregon State University, Purdue University and the University of Delaware. Primary funding for the [project](#) comes from DOE's Office of Energy Efficiency and Renewable Energy's Hydrogen and Fuel Cell Technologies Office (HFTO), with supplemental support from the Low-Carbon Resources Initiative, jointly led by EPRI and GTI, along with participating universities.

H2EDGE is both focused on developing a newly trained workforce and on helping the current labour force transition into jobs in the hydrogen sector through increased industry coordination and workforce planning efforts. H2EDGE is part of the broader workforce development project, GridEd, that now includes hydrogen to the technical programme that covers power systems, distributed resources and digital systems. The programme will address hydrogen workforce development skills in four technical areas: production, delivery, storage and use. DOE's HFTO in June 2020 also announced [USD 20 million](#) in funding to the University of Tennessee to support workforce development in new energy technology areas (including hydrogen and fuel cells), in partnership with Oak Ridge National Laboratory and Oak Ridge Institute. The five-year, interdisciplinary programme will focus on research and development in emerging technical fields, such as energy system resilience.

Spain auto sector transition plan

The Spanish government in June 2020 announced a EUR 3.75 billion [package](#) to aid the ailing auto sector and to support the production and sale of cleaner cars under the Plan to Boost the Value Chain of the Automotive Industry towards Sustainable and Connected Mobility. In addition to payments to consumers for giving up old cars and buying new, lower-emissions vehicles, the package also offers EUR 2.6 billion in low-interest loans and loan guarantees to car companies to modernise factories and upgrade fleets. As part of the package, the government also directed EUR 95 million to worker training programmes to adapt the existing

workforce to new labour demands. The Spanish auto sector is estimated to account for around 10% of GDP and support 650 000 direct jobs and up to 2 million indirect jobs. As such, the government will [implement a plan](#) to retrain and update the qualifications of auto sector workers. In addition, the government will enact a campaign on accreditation of professional skills acquired through auto sector employment; a training plan for new technologies, digitisation and sustainable transport; and comprehensive training plans for management skills, digitalisation and innovation platforms in the auto sector. Following up on the introduction of the plan, in July 2021, the government announced approval of the [Strategic Project](#) for the Recovery and Economic Transformation (PERTE) of Electric and Connected Vehicles, which will mobilise EUR 24 billion of investment, including EUR 3.4 billion of public investment.

Corporate and academic programmes

Developing a new talent pool for clean energy

Beyond governments, companies and educational institutions have also begun to put in place programmes to prepare for the upcoming skills revolution that clean energy transitions will bring. For companies, the existing workforce can present a unique opportunity to develop a new pool of talent in emerging areas of low-carbon sectors. Ensuring a just transition for current workers will require assessments of future skills needs against current ones, as well as programmes to offer skills development. In particular, oil and gas workers already have many skills that can be redeployed in emerging energy innovation areas, such as CCUS and hydrogen.

Among other sectors, the automotive sector will also face major transformation as more and more governments put in place targets to phase out sales of internal combustion engines in favour of electric vehicles. As such, retraining existing workforces in software engineering skills, for example, can help manage the transition. Over time, clean energy transitions will extend employment changes to a number of other sectors, including heavy industry. Companies that plan for the shifts early and prepare their workforces accordingly will be better positioned for the upcoming changes.

Education and research institutes also have an important role to play in devising curricula and offering courses that provide people with employable skills in the clean energy economy. Several initiatives, including partnerships between companies, universities and research centres, offer good examples of such efforts.

BP's strategy for a just energy transition

A key area of BP's sustainability strategy, in addition to achieving net zero emissions by 2050, is to improve people's lives. Of the five aims in this area, [Aim 12](#) focuses on supporting a just energy transition that delivers decent work, quality jobs and supports the livelihoods of local communities.

[Activities](#) in support of this aim include initiatives to help the BP workforce build skills for the future energy system, including in low carbon and renewables. This includes using skills forecasting and capability plans to inform recruitment and

development decisions and building career pathways and development offers to support employees who are interested in moving into new areas of the business.

BP's plans under Aim 12 also include a focus on education and employability activities, working with partners to help people develop transferable skills for jobs in clean energy and elsewhere, with a focus on disadvantaged and under-represented communities. For example, [BP and EnBW have committed over GBP 1 million](#) over five years to X-Academy in Scotland, to finance the reskilling of current oil and gas professionals as well as the creation of new entry-level roles related to the energy transition.

BP continues to develop its approach and strategy, and actively engages and collaborates with others in local just transition processes, including in Aberdeen, and in global initiatives such as the Council for Inclusive Capitalism's Just Energy Transition Framework. BP also participates in the UK government's Green Jobs Taskforce, and is currently developing 2025 and 2030 metrics and targets for its just transition initiatives.

Volkswagen electro mobility training programmes

As Volkswagen looks to transform its vehicle fleet to electric vehicles in the coming decades, the company has taken steps to enable its employees to develop the requisite skills for jobs using new production methods. The shift to electric cars will be especially important for Germany, given that an estimated [5% of all jobs](#) in the country are directly (830 000 workers) or indirectly (1.3 million workers) linked to the automotive industry.

Volkswagen commissioned the [Fraunhofer Institute](#) for Organization and Industrial Engineering IAO in Stuttgart to undertake a study on workforce changes that e-mobility and digitalisation will bring about for the company. The study, *Employment at Volkswagen in 2030*, was based on interviews with 60 experts from all of the company's business lines as well as analysis of over 30 employee groups. Overall, the analysis found that workforce disruptions can be managed smoothly if the right measures are introduced at an early stage to transition the qualifications of employees. In fact, the study found that employment disruptions would be lower than the 35-62% losses predicted by previous studies across the German automotive industry by 2030. The study considered employment losses from the switch to electromobility both in terms of vehicle production and component production, with greater impacts predicted in the component segment as the electric powertrain requires less manpower compared to conventional powertrains. Some of the employment losses could be offset by new areas of knowledge, such as the development and production of battery cells. On

digitalisation, the study finds that job creation can be achieved in the medium term, though should be supported by sufficient resources given the complexity of implementation.

In an effort to manage the workforce transition, in 2019 Volkswagen set up its “[Faculty 73](#)” training programme for software developers to work in the auto sector. Under the two-year programme, students receive advanced IT education that includes rigorous programming training and project assignments toward becoming a Junior Software Developer. Upon successful conclusion, the company offers students a permanent position at the company. For participants who do not have a professional qualification, the programme offers an additional four months of vocational training followed by a Chamber of Industry and Commerce examination.

In the first year of the [programme](#), students receive basic training customised to their existing level of knowledge. In the second year, students are taught more detailed, practical programming, including several programming languages. The training is tailored toward the company’s needs based on which division the students will eventually work.

The programme, which was developed by the Volkswagen Academy, is held at the Volkswagen MobileLifeCampus, close to the company’s Wolfsburg factory in Germany. In the first year of launching, most of the students already worked for the company, though half of applicants were external, many from the Lower Saxony region.

In addition, at its [Zwickau plant](#) in Germany, which Volkswagen fully converted into the production of electric cars in 2019, the company undertook a massive requalification and training programme for its 7 700 employees over the period 2019-2021. Among them, 3 000 employees received basic e-mobility skills under a two-day training directed at assembly workers, while 3 500 employees received product training courses covering topics such as operating concepts, test procedures and driver assistance systems. An additional 160 employees received “high-voltage training” over 18 weeks that concluded in certifications for electrical specialists in various fields . Meanwhile, 1 400 employees received high-voltage awareness training and 60 employees undertook courses over 24 months to become technical electric specialists.

The programme is being implemented in close cooperation with the Volkswagen Training Institute. In order to prepare for the programme, training staff expanded their capabilities, especially with respect to high-voltage technology. And the company made large investments into training technologies and virtual reality simulations, in cooperation with around 90 training partners, including companies such as Siemens and Kuka as well as renowned higher education institutions. Around 1 000 internal and 1 600 external trainer days were planned.

In total, Volkswagen invested EUR 1.2 billion to repurpose the Zwickau facility as an e-mobility plant. [To date](#), Volkswagen has converted its Zwickau and Emden plants for the production of electric vehicles, with the new Trinity plant located near its massive Wolfsburg facility planned next. Retraining workers for the shift to e-mobility is one of the central elements of these transformation plans, which the company developed in collaboration with the Works Council.

Brunel hydrogen course to retrain oil and gas workers

The Netherlands-based energy recruitment company Brunel, along with the Groningen-based business school, The Energy Delta Institute, launched a [degree for oil and gas workers](#) to retrain them for jobs in the hydrogen sector. Brunel launched the degree after receiving the results of a survey it undertook with oilandgasjobsearch.com, which showed a third of oil and gas workers were looking for new jobs in the renewables industry. The European Union will invest EUR 250 billion (of which EUR 4.5 billion is planned in the Netherlands) into hydrogen production, which will generate strong demand for hydrogen specialists in coming years. The course will be a fully accredited postgraduate degree covering the fundamentals of hydrogen production, usage (mobility, industry and built environment) and the full value chain, as well as policies, regulatory and legal issues. It will be the first such programme in the world. It is planned as a part-time course, once a week for nine months, with 25 available spots for Brunel's clients with more than five years in engineering and legal roles. After the pilot phase, Brunel plans to launch additional international programmes.

Australia's renewable energy training tower

As one of the world's largest coal and natural gas producers, the global energy transition will have major impacts on Australia's traditional workforce. [By some estimates](#), the country will lose around 10 000 jobs in coal mines and at power plants by 2036. At the same time, Australia's renewables sector has experienced significant growth in recent years, a trend that is expected to accelerate in coming years, which will present sizeable new job opportunities. Around 20 000 to 25 000 new jobs are predicted to be created in the country in the construction, maintenance and operation of renewable power. To avoid a labour shortage in the renewables sector, investments in skills training will be required. In response, wind energy company Vestas in 2022 opened the first renewable energy training tower at Federation University in Ballarat, Victoria. The tower is the first stage of the [Asia Pacific Renewable Energy Training Centre](#) (APRETC). Vestas, along with energy companies ACCIONA Energia, GPG and Tilt Renewables, invested AUD 1.8 million in APRETC, leveraging an AUD 50 000 investment by the government of Victoria. The opening of the tower will allow Federation University to begin offering Global Wind Organisation Standard Basic Safety Training and

Basic Refresher Training this year. Over time, Federation expects to train more than 600 people annually, supplying the wind energy sector with a steady stream of qualified workers. In addition, by 2023, following an agreement with Germany's BZEE Network, Federation will also offer the globally recognised post-trade turbine technician training course. The course is designed as a six-month intensive programme for electricians, mechanical fitters and automotive technicians and will include an internship with wind turbine manufacturers and service organisations that provides training on electrical, mechanical and hydraulic systems. Phase 2 of APRETC is currently in the planning stages, and is expected to offer specialised courses, such as for blade repair technicians, based on a new classroom, workshop and training equipment.

European Master in Renewable Energy

The [European Master in Renewable Energy](#) was developed by the European Renewable Energy Research Centres (EUREC) and a consortium of nine universities to train people for skills in renewable energy fields. Created in 2002, this master's degree is intended to meet the job market's growing demand for renewable energy expertise, and is accessible to graduate students from scientific disciplines or with relevant work experience. The course is divided into three sections: in the first semester, students learn the foundations of key renewable energy technologies; in the second semester, they choose a technology for specialisation at a separate university; and during the final session, students undertake a six-month practical training or research project. Universities offer different specialisations, such as in photovoltaics, wind energy, grid integration, solar thermal and associated renewable storage, ocean energy, and sustainable fuel systems for mobility. Each university can admit around 8 to 15 students. For the academic year 2019-2020, 59 students participated in the programme. For Academic Year 2022-2023, the course fee is EUR 8 000 for EU students and EUR 13 000 for non-EU students.

Targeted programmes for inclusiveness

Clean energy skills training programmes targeting women, youth and marginalised communities

For energy transitions to be truly people-centred, the diversity of the energy workforce must be a paramount consideration in policy and programme design for workforce training and skills development. Women, in particular, are strongly under-represented in the energy labour force. [According to IEA data on gender diversity](#), though they make up 39% of the overall labour force, women account for only 16% of conventional energy sector employment, and less than 14% of senior management roles in the energy sector. Moreover, women's employment in clean energy sectors is not markedly higher than that in fossil fuel industries, though there are some signs of change at clean energy start-ups.

Depending on the region, other minority groups may be under represented in the energy labour force as well. Understanding better the demographics of workers within energy is an important first step. Energy policies can consider these dynamics and include provisions to ameliorate underrepresentation.

It is equally important to ensure that today's young people are offered job opportunities in the energy sector of the future. The massive job creation potential of clean energy sectors hold tremendous opportunities for youth, but need to align with education and training programmes that young people receive to ensure they can benefit from these opportunities. Improving access to education and skills training in clean energy technical areas for youth and all under-represented groups can create an opportunity to make the energy workforce in the coming decades better balanced and supportive of equal opportunities to all members of society.

Student Energy Solutions Movement

Student Energy is a Canada-based, youth-led organisation that aims to empower the next generation of leaders to drive energy and climate transitions. It works with a network of 50 000 young people from over 120 countries to build sustainable energy knowledge, skills and networks, in cooperation with governments, companies and organisations. Within the platform, the [Student Energy Solutions](#)

[Movement](#) plans to support 100 000 young people in building the technical and soft skills training needed to work in the growing clean energy sector by 2030. The initiative plans to raise USD 150 million by 2030 to provide young people from around the world with access to small-scale funding and education, training and mentorship so they can implement clean energy projects in their communities. There are several projects in Student Energy's portfolio that utilise proven coaching and mentorship models to provide skills training to young people around the world. For entry-level, community-building experiences, they offer Student Energy Chapters and Fellows. These programmes enable young people to realise how they can be part of building the clean energy future and gives them tools to engage their communities. For more directed programming, Career Training offers a four-month training programme that prepares young people for jobs in clean energy policy, finance, project management and data analysis. For those interested in project development and entrepreneurship, they offer Student Energy Start-Ups, under which young people are supported in completing a small-to-medium scale energy project and learning the skills necessary to start their own business. The Solutions Movement enables these programmes to engage and train youth at the scale and speed required to fill demand for people who will implement the clean energy transition.

Cooperative Training at Coal Sites in North Rhine-Westphalia

The [Cooperative Training at Coal Sites](#) programme has been run by the Ministry for Labour, Health and Social Affairs of the State of North-Rhine Westphalia in Germany since 2008. The aim of the training programme is to support the employment of youth in German coal mining regions. It provides young people in the region with the skills needed to find a company apprenticeship or training opportunity. It encourages companies to invest internally to provide jobs to young people as well as fosters cooperation between training providers, local employment authorities and local companies to jointly offer initial training to young people. [Specifically](#), state-owned company GIB (German Assessment Institution) supports the state government of North Rhine-Westphalia by facilitating cooperation between training providers and small and medium-sized enterprises. Meanwhile, young people are given an external training, after which they can be taken on for a second year of apprenticeship under a company programme. In doing so, the programme especially targets young people experiencing difficulties securing a training position upon completion of school. The programme has received EUR 500 000 per year from the state government of North Rhine-Westphalia, co-financed by the European Social Fund. Since September 2016, up to 20 young people per year have undertaken out-of-school training under the programme, in preparation for in-company training. The programme was

implemented in four cities by local educational institutions, in close cooperation with local companies and the state's employment agency.

Brazil's RevoluSolar project

[RevoluSolar](#) is a Brazilian non-profit organisation, founded in 2015, that helps improve livelihoods in low-income communities by providing solar energy. The group's work is focused on the low-income communities of Babilônia and Chapéu Mangueira in Rio de Janeiro. People living in favelas have historically been marginalised from access to essential public services such as energy, though they represent one-quarter of Rio de Janeiro's population. As such, the programme originated as a strategy to combine poverty eradication efforts in the favelas of the city with the promotion of solar energy as a more affordable, sustainable and community-based development solution.

Since 2012, the Brazilian government has allowed decentralised models for energy generation and since October 2015 has also started to allow the cooperative model for distributed and grid-connected energy. These have bolstered investment in small-scale solar generation in the country. The first solar cooperative of RevoluSolar was effectively created in 2021. The organisation is financed through institutional investors and rents from the solar beneficiaries.

The project supports three programmes, carried out by a team of 15 contractors and 50 volunteers. The programme refers to its working methodology as the "[Solar Cycle](#)", which means that facilities are built, operated and maintained by professionals trained by RevoluSolar. Moreover, the training is combined with children's education and promotes the involvement of local community members in all stages of a project.

The [Sustainable Energy Program](#) installs solar PV energy systems to lower energy bills, empower consumers and promote community sustainability. According to project developers, the technical power generated is sufficient to meet and exceed local energy demand. [In 2020](#), total installed solar generation capacity was 26 kilowatt peak power (kWp) and actual generation was about 35 000 kWh/year. This was enough production to cover the needs of the 36 sponsoring families of the project. [In the last quarter of 2021](#), RevoluSolar had four solar plants, cumulating in installed capacity of 38 kWp and production of about 23 000 kWh. The estimated annual savings for families was about BRL 8 000 (EUR 1 448).

In parallel, RevoluSolar partnered with [Circo Crescer & Viver](#), a local circus, to launch the Solar Project, whose objective is to drive a socially fair and inclusive energy transition movement in the Rio region by 2030. The project marks RevoluSolar's first undertaking outside its main focus areas of Babilônia and Chapéu Mangueira. Not only did the initiative help lower energy bills for the circus, but it also served as an environmental education tool for children and youth as

well as helped make the learning process in technical courses more tangible. 17 residents of low-income communities around the circus will be initially trained in 2022 as electricians and solar installation assistants, with the possibility of advancing in the training programme to become professional electrical installers in the future. The City Hall of Rio de Janeiro's Municipal Environment Department is a partner in the project.

RevoluSolar's [Professional Training Program](#) provides vocational training for solar installers and electricians. Given that residents of favelas are mainly self-employed or underemployed, the programme equips residents with skills to compete for jobs in the electricity and solar industries at a time when the sector is poised for strong growth in the country. The programme supports community participants to install and maintain systems over a period of around 25 years. A portion of the training classes are offered in the community, while another is undertaken through partner technical schools, and others are offered virtually. [As of 2020](#), RevoluSolar had trained 31 residents as electricians and solar installers. In 2021, the project has hired 81 residents and trained 10 of them, generating local income for the year of BRL 59 000 (EUR 10 700).

Lastly, the [Education and Culture Program](#) raises environmental and ecological awareness in local children and teenagers, to prepare the next generation of community members to advance sustainable development. The programme offers continuing education classes for children and youth based on a local team of four teachers and one contracted coordinator, residents of the communities, and a team of volunteers and partnerships. It works on six themes related to sustainability: energy, agro-ecology, solid waste, water, climate change and biodiversity. The programme offers biweekly classes, and includes trips to sustainability-related sites inside and outside the operating favelas.

For the year 2021, the workshops were attended by 400 children and teenagers. In 2022, about 200 children and adolescents from the Circus programme will also benefit from these awareness classes. Simultaneously, during 2021, RevoluSolar offered courses on the topic of systematisation of information and fieldwork metrics. This course had 60 students, attending 80 classes for a total of 160 hours. About 20% of the students dropped out, though the overall satisfaction of the graduating students was around 87%. The programme cost about BRL 461 (EUR 83) per student, thus averaging BRL 6 (EUR 1.09) per student per activity.

Chile's "Energia+Mujer" programme

The Chilean government launched a public-private partnership in 2018 to develop a strategy to promote greater participation of women in the country's clean energy transition. The programme "[Energia + Mujer](#)" began implementation by Chile's

Ministry for Energy in 2020 and runs until 2030. To date, it [unites](#) more than 70 companies, associations and institutions involved in the energy sector to tackle gender inequality for more than 26 000 workers.

The partnership has been conceived as a [multi-decade project](#), covering the period 2016-2031 and beyond. It started with an awareness campaign and diagnostic period (2016-2018), leading to the development of a plan in 2019 and implementation over 2020-2022. This is followed by the establishment of measurement and metrics over 2022-2026 and monitoring of progress over 2027-2030. From 2031 onwards, the programme will be focused on continuous improvement.

The [diagnostic](#) allowed for the identification of trends in the energy sector. It found that women only represented 23% of the energy sector's workforce and earned on average 24% less than men. This gender pay gap was mostly reported in managers and administrative positions. Women only accounted for 18% of company board members, 10% of CEOs and 18% of managers. The majority of women in the energy sector were filling administrative positions, whereas men were mostly engineers and analysts. From the survey, only 17% of companies were offering leadership training with specific support for women and 10% specific qualification programmes for management and high-level positions. About two-thirds of companies were unaware of this pay gap. It was also reported that 65% of companies did not encourage men to take parental leave and 73% did not offer flexible working hours.

The “Energia + Mujer” programme was thus constructed from these findings. Following the analysis, all stakeholders agreed to voluntarily and gradually implement a public-private plan, consisting of ten objectives, 14 measures and 40 specific actions.

At the time of the signing of the Manfesto for Equity (2019), the initiative comprised 31 companies and 21 industry associations and institutions, representing 25 000 workers. Companies have committed to reducing the barriers women face in pursuing a career in the energy sector by revising their recruitment, selection and promotion processes, setting gender equity targets, and providing training workshops to staff in order to raise awareness about gender inequality and violence, and to find solutions to better include women in the clean energy sector. For example, one of the pillars is focused on increasing participation of women in the energy sector by supporting the training of women in professional technical skills in the energy sector. Nonetheless, the signatories are free to change the actions to fit to their own context.

Under the programme's second year of implementation (2021), the commitments of the 67 participants were systematised for consistency of measurement. In total,

717 specific actions were carried out across the ten objectives, bringing the total actions over 2020-2021 to more than 1 500 activities carried out by organisations.

The Ministry of Energy reports results for the programme through [annual reports](#). These are intended to be yearly accountability checks, sharing best practices and results. Based on the 2021-2022 yearbook, about 50% of involved businesses and organisations have introduced a paid primary career's leave (+3% increase from previous year). The number of women CEOs is also increasing (+1.2%), with women being more present on boards (+1.3%). Women now account for about 40% of all managers. Gender pay gaps have also fallen by 0.7%, which still leaves a salary difference of USD 25 534. The energy sector is intended to serve as a flagship for the rest of the economy to follow.

In July 2022 the first Gender and Human Rights Office of the Ministry of Energy was created, a specialised team that will not only monitor the public-private plan, but will also promote the gender goals in the National Energy Policy (in its updated 2022 version). The most ambitious targets are to achieve: 1) parity in remuneration and senior positions by 2040; 2) gender equity policies in 100% of medium and large energy companies by 2030; and 3) increase women's participation in clean energy and other relevant subsectors to 30%, including through training 18 000 people and certifying 9 000 women by 2030.

Nepal's Girls4rurals initiative

The "[Girls4rurals](#)" initiative was launched in 2018 by the social enterprise group Rural Development Initiative and its implementing partner, Himalayan Innovations, to bring together young girls to build cleaner and greener communities. The initiative trains young Himalayan girls on adaptation of renewable energy technology, notably by working as distributors of solar PV systems for transforming rural lives. Girls4rurals uses a digital platform to connect Nepalese girls who live in rural communities, enabling knowledge exchange and experience on skills and ways of living.

Local, bottom-up education, training and women's empowerment are crucial factors in providing the skills necessary for jobs in the clean energy economy, focusing on climate action. The group's actions are focused on three primary objectives: increasing awareness on renewable energy and climate activism, allowing market development for renewable energy products and creating an environmental impact through young girls. Girls4rural is currently running a programme teaching teenagers about the benefits of renewable energies on their health, so youth can become impactful advocates for their communities. Another programme focuses on Green Entrepreneurship by teaching women tailors to transform their manual sewing machines into automatic ones, and to maintain them; 6 000 Nepalese tailors are beneficiaries of this programme. The initiative

also runs a programme on promoting induction stoves in rural areas, including training on the use of induction stoves, which save rural women from respiratory health problems and are important for young girls to promote as part of good practice of adapting renewable energy uses for families.

WePOWER Network in South Asia

[WePOWER Network](#) is a women's network dedicated to professionals in South Asia's energy and power sectors and to students in Science, Technology, Engineering and Mathematics (STEM) education. The programme notes that the total share of women in South Asian power utilities ranges from 3% to 25%, and the share of women engineering/technical employees is even lower – less than 1% to 21%. Therefore, WePOWER, launched in 2019, undertakes gender activities to narrow the gap in women employed in the energy sector and STEM education. The initiative's work is based around [five pillars](#): STEM education, recruitment, professional development, retention, and policy and institutional change. Activities include study tours and field visits, STEM outreach workshops, training seminars, mentorships and development of women friendly facilities, all designed around women empowerment. The partners of the network are East Asian businesses and organisations linked to the energy and power sector. [In 2021](#), the network managed to reach over 13 400 women participants through 628 activities with the help of 28 partners. For 2022, WePOWER's partners plan to set more ambitious [targets](#) to implement over 900 activities that reach more than 19 000 women and girls in South Asia. The World Bank's South Asia Gender and Energy Facility serves as the Interim-Secretariat of the WePOWER Network, with the support of the Asian Development Bank, the World Bank's Energy Sector Management Assistance Program and Australian Aid.

RES4Africa Micro-Grid Academy

The [RES4Africa Foundation](#) was launched in 2012 to support just transitions in Africa's energy sector toward achieving the SDG7 goal to ensure affordable, reliable, sustainable and modern energy for all. The role of the foundation is to provide a supportive environment for clean energy technology investments in Africa. The executive committee of the foundation is comprised of CEO's and directors from Enel Green Power, Siemens, Gamesa, Schneider Electric and PwC, among others. The main focus areas are: 1) building dialogue between public and private actors in Europe and Africa; 2) sharing experiences within the clean energy technology industry to allow a sustainable transition of Africa's electricity sector; 3) creating a cooperation platform that unites experts in the energy industry, development community and energy stakeholders in Europe and Africa; and 4) supporting African stakeholder's needs in the clean energy space.

Overall, the foundation has developed more than 100 partnerships across the globe, trained 1 400 people in 30 countries, and published more than 70 studies, reports and papers.

As part of the foundation's work, the [Micro Grid Academy](#) (MGA), launched in 2018, is a vocational capacity-building programme in Sub-Saharan Africa. The MGA aims to create a skilled workforce to deploy decentralised renewable energy solutions in the East Africa region and beyond, thereby improving energy access in rural communities while fostering local enterprise development and job creation. The MGA has a particular focus on training young people, given that 75% of the continent's population is currently under the age of 35. The MGA's programme is based on three elements: education, innovation and impact/empowerment.

Under its education category, the MGA's goal is to provide theoretical and practical technical skills to up to 200 people per year in occupations ranging from technicians, project managers, developers, engineers and academic students. To-date, around 1 550 people have been trained, and 24 training editions have been implemented on-field in the East African Community, Ethiopia, the Democratic Republic of Congo, Mozambique and Zambia, as well as an online course with eth involvement of more than 40 African countries.

The innovation pillar of the MGA annually awards three innovative youth projects with EUR 5 000 and supports winners with mentorship and visibility, in collaboration with the European Investment Bank. The winner of the 2021 edition submitted the idea of a platform consisting of a network of solar-powered cold storage solutions, deployed in food aggregation centres (farm clusters, open markets or food warehouses). This aims to enhance food security while providing sustainable jobs to locals in installation and maintenance.

The impact and empowerment pillar includes an alumni community of local professionals that foster peer-to-peer experiences and knowledge, with a focus on job opportunities, soft and business skills, and entrepreneurship issues to support youth access to the local job market. The effort also includes partnerships with women- and youth-led associations to increase the participation of women and youth in the renewables sector.

RES4Africa has additional training programmes, including the [Advanced Training Course](#) (ATC). The ATC, which takes place both online and in-person in Milan, in collaboration with Bocconi University and Politecnico di Milano, is a two-week capacity-building course dedicated to managerial expertise that covers technical, regulatory, financial, and sustainability issues for renewable energy. The course includes an overview of the state of renewables development in Africa, reinforces capacities in the development and implementation of renewables programmes, introduces ways to boost investments and overcome barriers, as well as stresses the importance of inclusive and sustainable development. In 2021, the classes ran

from November to April, with one weekly lesson. The ATC has trained 570 managers since its inception in 2014 from several African countries.

In parallel to its capacity building training, the RES4Africa Foundation also holds events designed to raise awareness on topics related to education. In June 2022, RES4Africa held an event on [Youth Empowerment for driving African energy transition](#), in collaboration with PwC Italy. The events focus on the educational challenges encountered by African youth and identify the best ways to support them through existing programmes.

Canada's Science and Technology Internship Program - Green Jobs

Canada's Department of Natural Resources through the [Science and Technology Internship Program](#) (STIP – Green Jobs) is supporting the clean energy transition through inclusive and sustainable job creation for youth (ages 15 to 30). STIP – Green Jobs, partner of Canada's [Youth Employment and Skills Strategy](#) since 1997, offers funding to qualified employers throughout Canada and provides youth with the work experience and training needed to launch successful careers in the natural resources sector (clean energy, forest, mining and minerals, and earth sciences). Since 2017, STIP – Green Jobs has committed to incorporating equity, diversity and inclusion into all aspects of the programme to better serve youth experiencing barriers based on feedback from youth, employers and delivery partners. Actions include setting targets and aims for participation of youth from employment equity groups (women, Indigenous peoples, persons living with disabilities, and members of visible minority communities), removing barriers such as the post-secondary education requirement, and expanding the delivery by working with smaller, regionally-focused and Indigenous-focused organisations.

Over the past five years, the programme created over 4 000 green jobs for youth across Canada. Typically, 80% of youth successfully transitioned into full-time employment and over 85% of youth jobs were in the clean technology sector. At least 60% of youth participants identified as belonging to one or more employment equity groups, while Indigenous and northern youth participation increased from 6% in 2018 to 22% in 2021.

In addition to the programme changes, STIP also ran a pilot project in 2020 to work with Indigenous focused organisations to better understand the employment and training needs of Indigenous youth, the important cultural aspects that could be included in the programme design, and how NRCan's intake process for delivery partners could be adjusted to include smaller and more Indigenous-led organisations. Through this pilot, STIP had the opportunity to work with and learn from the [Indigenous Clean Energy](#) (ICE) Network through the development of their [Generation Power Program](#), a holistic and culturally focused training programme.

In the first year, the curriculum was designed with and for youth and employers. In the second year, ICE implemented Generation Power and successfully created over 40 internship and training opportunities for Indigenous youth in the clean energy sector.

Growing our Clean Energy Workforce initiative in Victoria, Australia

In March 2022, the government of Victoria in Australia announced the AUD 11 million [Growing our Clean Energy Workforce package](#), which includes subsidised apprenticeships, professional mentoring and access to ongoing education for women in the clean energy space. The state found that women are under-represented in the solar industry by a wide margin, accounting for less than 1% of electricians, plumbers, air conditioning and refrigeration mechanics, solar designers and installers, and licensed electrical inspectors. Therefore, the aim of the Growing our Clean Energy Workforce initiative is to increase the number of women working in the renewables energy industry. In particular, the Victorian government will subsidise 50% of the cost of new apprenticeships to support more women entering the industry and provide apprentices a stipend for tools as well as incentive payments every six months. The programme will be managed by two training organisations: Ai Group Apprentice Training Centre and Apprenticeships Group Australia. In addition, the government will also offer free or low-cost training by professional organisations to women currently working in related energy industries, to allow them to upskill and transition to jobs in the renewables industry. As part of the package, the industry organisation Tradeswomen Australia will offer targeted support for women already working in, or considering joining, the solar industry through online workshops, information sessions and professional mentoring opportunities. The skills package builds off the Solar Homes programme launched in 2018, which offers households rebates for the installation of solar panels, batteries, solar hot water, zero emissions vehicles and heating upgrades. The Solar Homes programme more broadly is estimated to have created 5 500 clean energy jobs in the state since its inception.

Canada's Clean Energy for Rural and Remote Communities programme

In Canada, there are over 200 communities that rely completely on diesel for heat and power. They often depend on small diesel-based micro-grids for their energy supply that are inefficient, vulnerable to outages, expensive to operate, and contribute to local pollution. The vast majority of diesel-reliant communities are Indigenous or have significant Indigenous populations. In 2018, Natural Resources Canada launched the eight-year CAD 220 million [Clean Energy for Rural and Remote Communities](#) (CERRC) programme to support community-

driven activities aimed at reducing diesel reliance for heat and power in rural, remote and Indigenous communities. The CERRC program operates through four distinct streams: 1) capacity building, 2) bioheat, 3) innovative demonstrations, and 4) deployment. The programme can provide communities with resources to fund capital projects and build the internal capacity needed to drive implementation of a diesel-reduction or renewable energy project.

As part of this effort, CERRC's Capacity Building stream has prioritised equity, diversity and inclusion within its programme design, implementation and project selection. CERRC has included specific requirements for applicants to demonstrate how they will encourage and integrate the greater participation of Indigenous women and youth in clean energy, as part of the project and project team itself. Further, the CERRC programme is supporting several projects that aim to support Indigenous women and youth to become future clean energy leaders within their communities. For example, the Centre for Indigenous Environmental Resources' project Shining Lights: Energy Literacy and Language in the Northwest Territories was designed to focus on increasing the energy literacy and empower participants to be able to support their community's energy planning goals. The project held a series of workshops during 2019-2020 that included participation of 60 Indigenous women and youth from 22 Northwest Territories communities.

In addition to the many capacity building projects the CERRC programme has funded, CERRC is funding Indigenous owned and led clean energy projects. These projects are expected to bring significant benefits and impacts for the communities. For example, the development of the community owned 2.35 MW solar project in Fort Chipewyan, Alberta was a unifying factor that brought three Indigenous communities together for the creation of Three Nations Energy (3NE). 3NE has since become the organisation that leads efforts on community energy planning, using solar in remote cabins, replacing diesel with biomass and sustainable food production. It is also a source of significant community pride and revenue generation. Overall, the CERRC programme has mobilized 115 renewable energy and capacity building projects involving more than 130 diesel-reliant communities. In 2021, the government of Canada announced an additional CAD 300 million over six years, starting in 2022, to continue to advance the work of the programme.

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