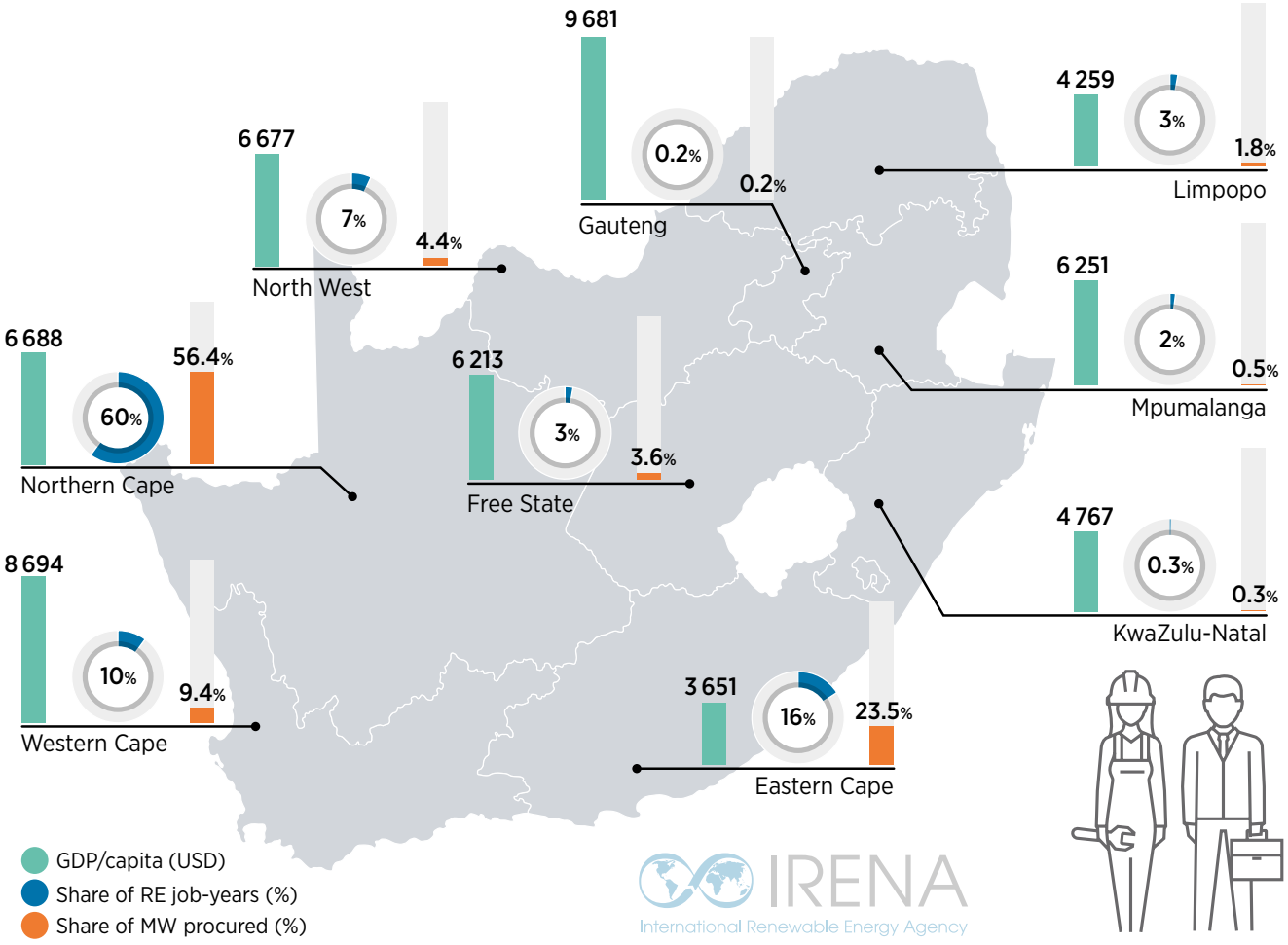
FIGURE 12. **RENEWABLE ENERGY DEPLOYMENT AND JOB CREATION IN SOUTH AFRICA'S PROVINCES, AS OF SEPTEMBER 2019**



Source: IPPPP, 2020.

Disclaimer: Boundaries and names shown on this map do not imply any endorsement or acceptance by IRENA.

The deployment of renewables is still relatively limited in most countries of Sub-Saharan Africa. But as noted elsewhere in this report, some countries are making progress in improving energy access. Kenya's DRE sector has created an estimated 10 000 direct formal jobs and 15 000 informal jobs. Formal DRE employment in Nigeria is estimated at about 4 000, with another 9 000 informal ones (Power for All, 2019).

BEYOND THE NUMBERS

- In our societies, a job is how the vast majority of working people secure an income for themselves and their families. Beyond ensuring an adequate number of jobs, labour representation is often essential to ensuring good jobs that will provide an adequate wage or salary (see Box 3) in a safe and productive workplace.
- Jobs build experience, hone skills and can provide a path to self-fulfilment by way of a worker's pride in performing a task well or in helping a community or country accomplish an important objective, such as creating a clean energy system.
- Jobs in renewable energy are important beyond the energy sector: incomes spent on food or consumer goods and services stimulate many different industries in local, national and global economies.
- Available evidence suggests that renewable energy employs more people than do fossil fuels. An input-output analysis (Garrett-Peltier, 2017) performed to evaluate public and private energy investment found that, on average, spending USD 1 million on renewables creates 7.49 FTE jobs, almost triple the 2.65 FTE jobs in fossil fuels.
- Learning curves, economies of scale and new technologies such as drones and artificial intelligence will shape the labour intensity of renewables in years to come (see Box 4). The dynamics will probably differ somewhat in the agricultural supply chains for bioenergy, where informal employment is often the norm in developing countries.

BOX 3. WAGES IN CLEAN ENERGY

Information on pay in the renewables sector is fragmented. In part, this is because renewables stretch across agriculture, construction, manufacturing, commerce and many kinds of services. Renewables-related positions are found in the formal and informal economies. Detailed assessments are needed in each country.

A US study (Muro *et al.*, 2019) found that hourly wages in clean energy production, at USD 28.41 in 2016, far surpass average wages of USD 23.86 across the whole economy (energy efficiency jobs averaged USD 25.90). Among the lowest decile of earners, who earn only slightly above USD 9 per hour, the clean energy bonus can run up to USD 7. However, workers in the fossil fuel sector often seem to earn more than those in renewable energy (Saha and Jaeger, 2020).

BOX 4. SOLAR PV: NEW TECHNOLOGIES, APPROACHES AND LABOUR INTENSITY

While module manufacturers are continuing to automate production processes, new technologies like drones and aerial thermography, automated module washing and robotic vegetation management have implications for employment in operations (Liu and Garcia da Fonseca, 2020). For example, it takes a technician on average about 10 hours to inspect 1 megawatt (MW) of solar modules, but drones could reduce this to an estimated 15-18 minutes/MW, a pace 38 times faster. Thermal imaging and digital technologies may be increasingly used for early detection of equipment faults. (To date, the wind industry is outpacing solar farm operators in adoption of these technologies.)

Other technologies – such as automated washing of modules and robots tending to ground-level vegetation at solar farms – are less common but influence the need for lower-skilled labour. While the promise of cost savings, greater inspection accuracy and enhanced flexibility is a major driver of remote technologies, the COVID-19 pandemic may further prompt greater use to reduce risks to operating and maintenance personnel (Liu and Garcia da Fonseca, 2020).

A low-impact approach known as agrivoltaics embodies a very different cost-benefit rationale. It avoids removing vegetation in favour of growing crops under the shade of solar panels, which can reduce water needs and raise yields, while potentially boosting energy production (ground shading provided by crops or vegetation can cool the solar panels, avoiding the higher temperatures that can reduce the efficiency of PV cells). Such a nexus offers cost savings and added benefits, including job creation not only in energy production but also in agriculture (NREL, 2019).

IN FOCUS: EDUCATION AND TRAINING

As the renewable energy workforce continues to expand, education and training along with reskilling and upskilling rises in importance. Policies and programmes centre on vocational training, curricula, teacher training, information and communications technology (ICT), public-private partnerships, and recruitment of under-represented groups such as women.

CURRICULA AT ALL EDUCATION LEVELS, AND TEACHER TRAINING

Renewable energy can be better integrated into national curricula – not only in science and technology but also in social studies – for students in primary, secondary and tertiary education and at technical and vocational institutions. Teaching students well at all levels requires that teachers and trainers have a good knowledge of the sector. Industry leaders can play a major role in imparting that knowledge – and thus in educating the workforce of the future.

The chronic shortage of skilled workers in the area of expanding access to modern forms of energy could constitute a major barrier to the deployment of renewables. Installations undertaken by unskilled workers can result in performance issues and a negative perception of renewable technologies. Training initiatives are critical to forestall such outcomes and instead translate potential benefits into reality.

INITIATIVES: TRAINING

Solar PV companies BBOXX and M-KOPA have created training programmes for their employees (BBOXX, 2014; Maritz Africa, 2015). Schneider Electric's 2025 objective is to impart energy skills to a million people in countries where access to energy is limited. The company has opened training centres in South Africa and other African countries as part of its Access to Energy Solutions programme (Schneider Electric, n.d.).

TECHNOLOGY-ENHANCED LEARNING

Innovations in the use of ICT can play an important role in the delivery of education and training related to renewable energy. Models and simulations can be used to build learners' technical skills, and flexible delivery of online content can improve access for learners. Learning-management systems can be applied to deliver personalised learning content that takes into account the different starting points of learners. ICT can also be used to increase collaboration between industry and technical and vocational education and training (TVET) institutions, thus allowing experts to contribute to the curriculum as well as deliver instruction digitally.

Technology-based learning, however, can result in greater inequality in areas where low-income communities lack access to the requisite equipment and infrastructure.

INITIATIVES: ONLINE COURSES

The Online Lifelong Education Institute (OLEI) at the Korea University of Technology and Education offers simulated learning in a virtual training environment (Yian and Park, 2018). Funded by the Korean government, OLEI offers over 200 free online courses in a range of fields that include renewable energy technologies. Three types of training are offered: components (using 3D modelling to take apart and assemble equipment), scenarios (following prescribed procedures to learn about operating equipment) and equipment practices (practicing controlling the equipment in different environments).

PUBLIC-PRIVATE PARTNERSHIPS

Engaging the private sector is crucial for meeting sectoral labour requirements, promoting national skill standards, providing on-the-job training and improving the quality of training overall. Public-private partnerships can play an especially important role in TVET. The private sector can contribute to skill delivery in several ways, including course delivery, work-based learning and apprenticeships, and transfers of knowledge and equipment.

The private sector is playing an increasingly significant role in the financing of TVET programmes. Dunbar (2013) discusses the need to move away from the traditional fragmented model of training markets, which are financed primarily through fees, toward a more integrated market that incorporates a range of funding mechanisms, including payroll-based training levies, tax incentives, scholarships and donations, vouchers and student loans.

INITIATIVES: SKILLS COUNCILS

India's National Skill Development Corporation (NSDC, 2020) seeks to close the skill gap by providing funding and support services to organisations and enterprises providing skill-based training. To achieve the government's objective of skilling and upskilling 150 million people, NSDC formed 37 sector skill councils bringing together industry, labour and academia.

The Skill Council for Green Jobs and the Power Sector Skill Council, for example, identify sectoral requirements, determine standards and qualifications, and train trainers. The Skill Council for Green Jobs has established over 350 training centres in seven states, training more than 25 000 certified solar PV installers and engineers and 160 installers of improved cookstoves (SCGJ, 2018).

EDUCATING GIRLS AND WOMEN

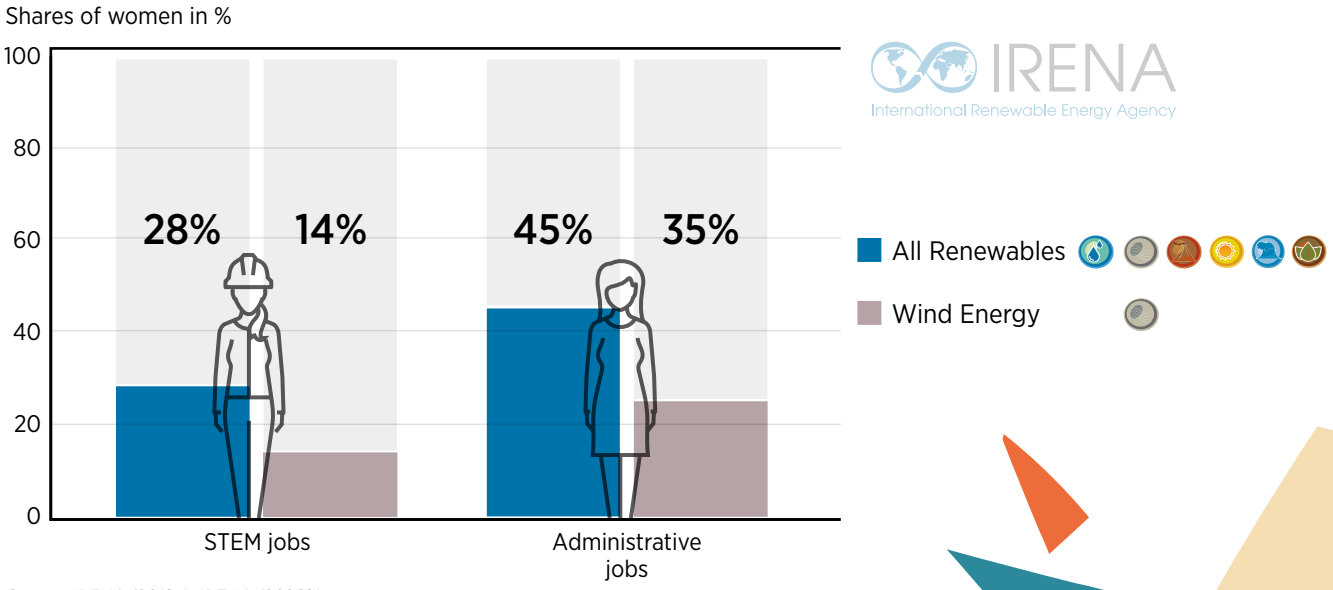
In the renewable energy sector, women's participation in science, technology, engineering and mathematics (STEM) jobs is far lower than in administrative jobs (28% versus 45%) (IRENA, 2019a). The difference is more pronounced in the wind energy sector, where women account for only 14% of the STEM total, compared to 45% in administrative jobs (see Figure 13) (IRENA, 2020d).

Strategies to increase the representation of women in the renewable energy sector often focus on workplace accommodations, mentorship and professional development. These approaches reach only the small number of women who have already made a conscious career path decision. Influencing the choices girls make earlier in life, when aspirations and affinities are still being discovered, can help increase the number of women in the renewable energy sector specifically, as well as in STEM fields more broadly.

Early career choices are often shaped by gendered cultural norms and perceptions (IRENA, 2019a). Even where no direct structural constraints limit career choices, gendered cultural norms have been shown to influence girls' self-understanding and interests – and in turn their future career trajectories. Such norms can result in the categorisation of occupations as masculine and feminine, biased self-assessments of personal abilities, a perception of the engineering profession as a male bastion, unwelcoming classrooms and institutions, and gender segregation of workplace environments.

In the decentralised renewable energy industry, there are plenty of opportunities for women's engagement along multiple segments of the value chain. Yet women also face challenges owing to insufficient skills and training opportunities (IRENA, 2019a).

FIGURE 13: **WOMEN'S SHARE OF STEM AND ADMINISTRATIVE JOBS, ALL RENEWABLES AND WIND POWER**



Source: IRENA (2019a); IRENA (2020b).

STEM = science, technology, engineering and mathematics.

INITIATIVES: EMPOWERING YOUNG WOMEN

The Green Girl Project is a social enterprise that has reached over 6 000 young people by empowering young women to become facilitators of sustainable practices that build peaceful and economically viable communities in Africa (Green Girl Project, n.d.). Greenlight for Girls, for example, is an initiative to encourage girls of all ages and backgrounds in science, math, engineering and technology (Greenlight for Girls, n.d.).

To satisfy its growing needs for skills, the renewable energy industry will have to engage and retain more girls from early ages. Initiatives all over the world help boost girls' interest in subjects typically regarded as less "female oriented". But to achieve greater gender equality, it is crucial that education and training scholarships and mentorship opportunities be available to girls.

RESKILLING AND UPSKILLING

Governments and the private sector can take steps to reskill and upskill parts of the existing energy workforce, allowing fossil fuel workers to take on new roles in renewables (IRENA, 2020c). For instance, this is the purpose of a GBP 12 million (USD 12 million) Transition Training Fund set up by the Scottish government for oil and gas workers at risk of redundancy (Skills Development Scotland, 2019).

Assessing the skills relevant to renewable energy and ascertaining which are transferable from fossil fuel industries allows an estimate of how many workers could, in principle, make a lateral move between the two sectors. IRENA's *Leveraging Local Capacity* series (IRENA, 2017a, 2017b, 2018) assesses the requirements for selected technologies and synergies between industries such as offshore oil and gas and offshore wind.