REN21
RENEWABLES NOW

RENEWABLES 2023
GLOBAL STATUS REPORT

2023
COLLECTION

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FOREWORD

The fourth module of the *Renewables 2023 Global Status Report (GSR) Collection* explores the wide range of benefits that renewable energy can offer beyond the supply of energy. From the job creation opportunities that breathe life into local economies, to building up local supply chains that foster a participatory society, the evidence in the report illustrates how energy, economic growth and social progress are not competing forces. When renewables are anchored in a systems approach, they can contribute to prosperous, healthy, and sustainable economies and societies.

Despite the transformative potential of a renewables-based economy, investments in renewable energy continue to pale in comparison to those in fossil fuels. The persistence of large fossil fuel subsidies casts a shadow over the progress in renewables to-date. It is a perplexing paradox – a tale of immense potential shackled by inertia and a reluctance to let go of the familiar.

The *Economic & Social Value Creation* module of the GSR 2023 is another collaborative effort capturing the perspectives and insights from the full range of sectors and stakeholders in the renewable energy sector. I want to thank the REN21 team, the authors, special advisors and contributors who have given their expertise and time for this module. Their input makes REN21's knowledge products an undisputable and neutral source of crowd-sourced information and data.

I hope that you will find in this module the evidence needed to challenge the current energy status quo. Together, we can build a system where renewable energy supports economic development and fosters social equity.

Rana Adib
Executive Director, REN21

REN21
RENEWABLES NOW

RENEWABLE ENERGY POLICY NETWORK FOR THE 21st CENTURY

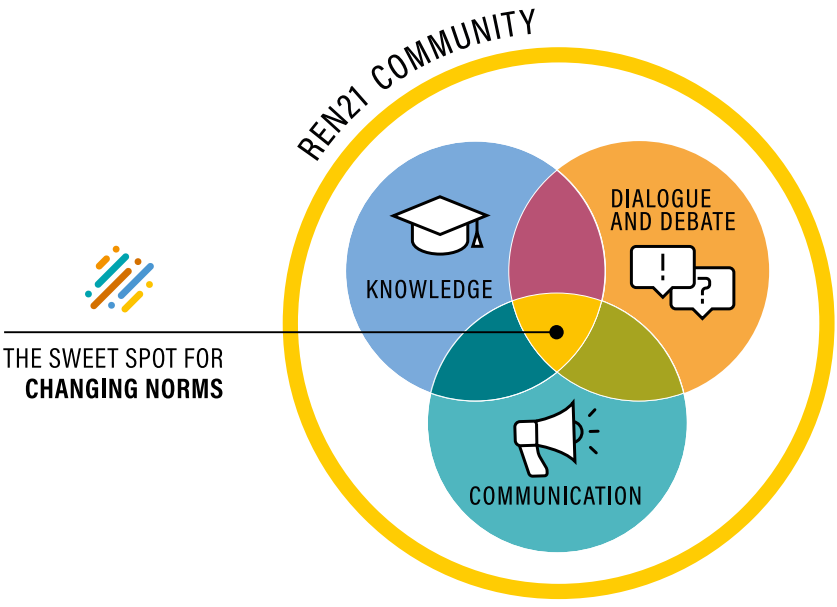
REN21 is the only global community of actors from science, governments, NGOs and industry **working collectively** to drive the rapid uptake of renewables – now!

REN21 works to build knowledge, shape dialogue and debate, and communicate these results to **inform decision makers** to strategically drive the deep transformations needed to make renewables the norm. We do this in close co-operation with the community, providing a platform for these stakeholders to engage and collaborate. REN21 also connects with non-energy players to grow the energy discourse, given the economic and social significance of energy.

The most successful organisms, such as an octopus, have a **decentralised intelligence** and "sensing" function. This increases responsiveness to a changing environment. REN21 incarnates this approach.

Our more than **4,000 community members** guide our co-operative work. They reflect the vast array of backgrounds and perspectives in society. As REN21's eyes and ears, they collect information, share intelligence and make the renewable voice heard.

REN21 takes all this information to better understand the current thinking around renewables and change norms. **Our publications** are probably the world's most comprehensive crowd-sourced reports on renewables. Each is a truly collaborative process of co-authoring, data collection and peer reviewing.



CROWD-SOURCED DATA AND KNOWLEDGE

REN21's data and knowledge collection method is built on a global multi-stakeholder community of experts. It is validated in a collaborative and transparent open peer-review process. It is made openly available to develop a shared language that shapes the sectoral, regional and global debate on the energy transition.

For more information, see the Methodological Notes section on data collection and validation.

RENEWABLES GLOBAL STATUS REPORT
2023 COLLECTION

Since 2005, REN21's *Renewables Global Status Report* (GSR) has spotlighted ongoing developments and emerging trends that shape the future of renewables. It is a collaborative effort involving hundreds of experts.

This year's edition (18th) has evolved in design and structure to reflect the fundamental changes in the global energy landscape. The new structure is in the form of a collection of five publications. In addition to presenting the trends in renewable energy supply, it also dives into the energy demand sectors, with dedicated modules on buildings, industry, transport and agriculture. It includes a publication on energy systems and infrastructure with renewables, as well as a publication on renewables for economic and social value creation, acknowledging the key role that energy plays across economies and societies. Collectively these five publications offer readers a systemic global overview of the current uptake of renewables.

This new structure makes the GSR a key tool in expanding the renewable energy discussion into key sectors and ecosystems, developing a shared language and driving a stronger integration of supply, demand, infrastructure, markets and investment.

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Reference Tables can be accessed through the GSR 2023 *Economic & Social Value Creation* Data Pack at
→ http://www.ren21.net/gsr2023-data-pack/esvc

For further details and access to the report, references and endnotes, visit **www.ren21.net/gsr-2023**

ECONOMIC & SOCIAL VALUE CREATION

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SNAPSHOTS

Comments and questions are welcome and can be sent to **gsr@ren21.net**.

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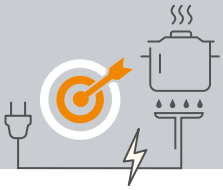
Note: Some individuals have contributed in more than one way to this report. To avoid listing contributors multiple times, they have been added to the group where they provided the most information. In most cases, the lead topical contributors also participated in the Global Status Report (GSR) review and validation process.

In 2022, an estimated **1.2 GW** of off-grid renewable energy capacity was added in developing countries, bringing the total to around 12.4 GW

Globally, **113** countries **do not have universal access to electricity**; meanwhile, **128** countries **lack universal access to clean cooking**



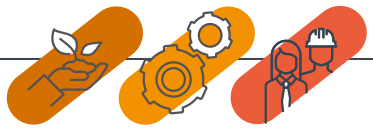
The number of people **without access to electricity** globally was expected to rise in 2022 for the first time in decades, by some **20 million**, to reach **774** million

Governments and the private sector are addressing the need to **expand and diversify the renewable energy workforce** by establishing specific policies, programmes and funds that address gender and energy access

Investment in off-grid renewable energy reached an **all-time high** in 2022, with most of it going to solar photovoltaic systems in Sub-Saharan Africa

RENEWABLES FOR ECONOMIC & SOCIAL VALUE CREATION

Module Overview | Policy | Investment | Market Developments



MODULE OVERVIEW

The global pandemic followed by supply and demand shocks forced governments and businesses alike to re-assess their supply chains. For the foreseeable future, they will face pressure to increase domestic production, grow local employment and reduce their risk exposure. Renewable energy offers solutions on two fronts, as it can reduce dependence on energy imports while also (with targeted policies and investment) developing local and regional supply chains for renewable technologies.

Deployment of renewable energy can provide enormous benefits for local populations and economies, creating value for both the natural environment and society. This is especially true when compared to fossil energy sources and the traditional use of biomass. Research on the impacts of renewables emphasises their multiple socio-economic benefits, far beyond their potential to mitigate climate change.[1] Deployment of renewables creates **employment** opportunities and contributes to growth in gross domestic product.[2] The energy transition is projected to result in a global net gain in employment, with more jobs created by ramping up renewable capacity than lost by phasing out fossil energy.[3]

Deployment of renewable technologies can enable countries to reduce energy imports and the negative impacts of volatile fossil fuel prices, thereby improving national and regional **energy security**.[4] By offering a decentralised energy supply, renewables can provide **electricity access** to rural areas far from the main power grid, helping to alleviate poverty and support low-income communities.

Replacing fossil fuels with renewables brings considerable **health benefits**, including from reduced air and water pollution.[5] Distributed renewable energy solutions provide an alternative for healthcare facilities that lack a reliable (or any) power supply from the main grid. Worldwide, nearly 1 billion people in low and lower-middle income countries continue to be served by healthcare facilities with unreliable electricity supply or with no electricity access at all.[6] (→ *See Snapshot: Tanzania.*)

Renewables can play a key role in reducing **gender inequality**, for instance by creating jobs and entrepreneurial opportunities for women.[7] Renewable energy also contributes to the adaptive capacity and resilience to the impacts of climate change, by improving access to clean water and food, providing electricity for chilling and space cooling, and helping to improve communications and connectivity.[8]

As countries seek to increase their energy security and improve the economic and social value of deploying renewable energy, those with significant resources are increasingly looking to improve **local supply chains** for renewables. Some countries have banned exports of the unprocessed raw metals needed to manufacture renewables and related technologies (such as batteries), providing financial incentives for local manufacturing and assembly or imposing local content requirements in tenders for specific projects. Countries have different strategies and priorities on how to increase the social and economic local value associated with renewable energy deployment and investment.

The economic and social value potential of renewables is discussed in detail in the following sections, with a focus on employment, education and inclusion, the creation of local supply chains and energy access. In future years, this publication will develop a more comprehensive picture of the value proposition of renewable energy and explore themes such as inequality, energy poverty, research and development, and innovation.

SNAPSHOT

TANZANIA

Off-Grid Solar Photovoltaics for Health Care

Off-grid solar photovoltaic (PV) systems can be of vital importance for healthcare facilities that are not connected to the electric grid, as reliable and affordable electricity is needed to provide refrigeration for vaccination facilities and to power life-saving equipment. In Sub-Saharan Africa, only an estimated half of hospitals have reliable electricity supply; among the rest, around 68,350 healthcare facilities have access to unreliable electricity and at least 25,000 facilities have no electricity access.

Tanzania, where electricity access was below 40% in 2020, was able to provide access to 4.5 million people between 2017 and 2022, adding new connections for more than 1,600 healthcare facilities and 6,000 education facilities. Through its Rural Energy Master Plan, Tanzania aims to achieve universal access to modern energy services by 2030, with 75% of the electricity provided through the national grid and mini-grids and the remaining 25% through quality-verified off-grid solutions.

Around 10% of healthcare facilities in Tanzania's urban areas and 24% in rural areas reportedly had no access to electricity as of 2020. In 2022, with grant support from the Shine campaign, the Tanzania-based non-governmental organisation Elico Foundation was able to install and commission two solar PV microgrids with battery storage in Oltukai and Eluwai villages to power lab equipment, refrigerators and lighting for local health facilities, 24 hours a day. Together, these centres serve up to 6,000 patients a month.

Source: See endnote 6 for this module.

POLICY

Governments are increasingly adopting industrial, labour and cross-sectoral policies to increase the social and economic benefits of renewable energy deployment. They are taking steps to promote local value creation for renewable energy manufacturing and deployment through policies and targets, such as local content requirements in renewable power auctions, incentives for the consumption of locally produced technologies, gender and employment targets, and in some cases import bans on products and raw materials.[9]

Governments also are recognising the need for a skilled renewable energy workforce and are funding educational and reskilling programmes for workers in the fossil fuel industry whose jobs are gradually being lost. Additionally, there is growing recognition that poverty alleviation and economic growth are intricately linked to access to modern energy services and that renewables are the most efficient and affordable path to universal access.[10]

EMPLOYMENT

Expansion of renewable energy manufacturing and deployment – in response to national and regional policies and targets to tackle climate change and boost renewables – are expected to lead to substantial job growth in the sector in the coming years. In the United States, the Inflation Reduction Act of 2022 is expected to create nearly 5 million jobs in clean energy[i].[11] To ensure high-quality jobs, the Act aims to provide strong labour protections, for example by incentivising higher wages in clean energy jobs compared to similar jobs in other sectors.[12] In Canada, the clean energy sector is projected to grow nearly 50% by 2030 – to around 640,000 jobs – due to the country's climate law.[13]

In the European Union (EU), more ambitious renewable energy targets aimed at ending the region's dependence on Russian oil and gas are driving increased uptake of renewable technologies. Employment in the EU solar industry alone grew an estimated 30% in 2022, adding around 600,000 jobs.[14] Meeting the targets of the REPowerEU plan will require the creation of an estimated 3.5 million jobs between 2022 and 2030.[15]

The Association of Southeast Asian Nations (ASEAN), which has set a regional target of 35% renewables in total installed power capacity by 2025, projects an estimated 1.3 million additional jobs in renewables by that year, with more than half of the jobs in solar PV.[16] In India, the Council on Energy, Environment and Water estimates that the country's climate targets will lead to the creation of more than 3.4 million jobs in the wind and on-grid solar power sectors by 2030.[17]

In Africa, an estimated 462,000 new green jobs are expected to be created between 2017 and 2025 in South Africa alone, and Morocco's energy efficiency strategy, enacted in 2014, could create as many as 520,000 jobs by 2030.[18] In Nigeria, the Solar Power Strategy aims to support the creation of 250,000 jobs and to benefit up to 25 million people through the installation of 5 million solar home systems and mini-grids.[19]

An estimated
70%
of jobs in the oil and gas industry overlap with the skills needed for the energy transition.

RESKILLING POLICIES TO TRANSITION FROM FOSSIL FUELS TO RENEWABLES

In some economies or regions with historically strong economic activity and employment linked to the fossil fuel sector, the shift from fossil fuels to renewables represents both direct and indirect job losses. The loss of fossil fuel jobs is not necessarily linked in time or geography to the creation of renewable energy jobs[ii]. In parallel with the transition, some governments have established funds to provide fossil fuel workers with the skills needed for careers in the renewables sector.

To expand the renewable energy workforce and ensure a socially just response to the energy transition, governments are implementing programmes to **retrain individuals employed in the fossil fuel** sector and to train young people seeking careers in renewable energy industries. An estimated 70% of jobs in the oil and gas industry, representing 22 million workers in 2022, overlap with the skills needed for low-carbon jobs.[20] To tap this potential, some governments have established funds to provide the necessary financial resources.

In Europe, the EU has committed to skills development for renewable jobs as part of the Green Deal Industrial Plan.[21] Spain's Just Transition Strategy aims to support communities affected by the phase-out of coal by providing early retirement and voluntary redundancy for people affected by the closure of mines and by prioritising ex-miners in hiring processes for environmental conservation projects. These goals are mainstreamed into other public policies and plans, including the Annual Employment Policy Plans and school curricula.[22]

i Clean energy jobs in this context include the manufacturing and deployment of renewables, energy efficiency, hydrogen, storage, nuclear energy and grid modernisation.

ii The potential for new renewable energy job creation at the local level varies greatly depending on the technologies installed. Whereas wind energy requires a highly skilled workforce that often cannot be found locally, solar PV investments might more easily create local jobs because fewer specialised skills are needed.

In 2022, Scotland created the Transition Training Fund to retrain oil and gas workers for the renewable energy sector (especially wind power).[23] The Czech government's RE:START programme committed USD 3.15 billion to coal regions from 2017 to 2030 to spur economic development and mitigate the impact of dwindling coal jobs.[24] In addition, the Association of European Renewable Energy Research Centres (EUREC), together with several universities and institutions, have developed the European Master in Renewable Energy as a key certification option.[25]

In 2023, Australia announced plans to establish a Net Zero Authority to support coal-dependent communities, providing additional funding through the creation of an AUD 400 million (USD 272 million) Industrial Transformation Stream that includes skills development.[26] In the United States, the state of Colorado has committed USD 15 million to support coal-dependent workers and communities, with USD 7 million directly funding worker training programmes.[27]

China's 13th Five-Year Plan (2016-2020) has a special USD 15 billion industrial fund to support displaced coal workers, including their resettlement and retraining.[28] In Nigeria, the Micro Grid Academy was opened in Sub-Saharan Africa in 2018, primarily to train young people to work in the field of decentralised renewables.[29]

RENEWABLE JOBS FOR GREATER INCLUSION

Many governments are addressing the need to **increase and diversify the renewable energy workforce**, such as by offering programmes to train women, Indigenous Peoples and other marginalised groups. The Canadian Science and Technology Internship Program, adopted in 2017 and aimed at creating inclusive green jobs (including in renewables) for youth, has seen an increase in Indigenous employment.[30] Some governments (such as in the EU and the United Kingdom) are working with industry and educational institutions to attract more students to fields in science, technology, engineering, and mathematics, with the ultimate goal of training a renewable energy workforce.[31]

Although most energy policy remains gender-blind, around 10 countries globally have integrated gender considerations into their national energy plans.[32] In 2019, Kenya became the first country to enact a National Gender and Energy Policy.[33] In 2022, Australia adopted the Growing Our Clean Energy Workforce package aimed at fostering women's employment in renewable energy jobs, and the state of Victoria is subsidising 50% of the cost of new female apprenticeships.[34] In Chile, the government-initiated Energia+Mujer programme is targeted at increasing women's participation in renewables.[35]

In addition to national policies, some renewable energy companies are leading by example and establishing equality and diversity programmes aimed at ensuring a more inclusive workforce.[36] (→ *See Snapshot: United States.*) However, a recent survey found that only 26% of assessed solar companies had strategies to diversify their workforce, while 31% were making efforts to hire more women and 8% were seeking to broaden LGBTIQA+ employment.[37] Several international organisations are developing tools and platforms related to gender and employment in the energy sector. In 2022, the International Energy Agency launched a gender and energy portal to reveal gender gaps, and the World Bank expanded its Regulatory Indicators for Sustainable Energy (RISE) to include gender-specific data.[38]

LOCAL SUPPLY CHAINS

With recent supply chain disruptions and the emergence of renewables as a preferred sector for industrialisation and re-industrialisation, governments are taking concrete policy actions to promote local value chains for renewable energy deployment and manufacturing. Most such policies are aimed at prioritising local content and range from local content requirements in renewable power auctions to import bans on products and raw materials.[39] Regulations governing the use of locally produced materials are in place in more than 20 countries, including 7 advanced economies.[40]

Around
10 countries
globally have integrated gender considerations into their national energy plans.

SNAPSHOT

UNITED STATES

Diversity and Equity in the Offshore Wind Power Workforce

A number of new collective bargaining agreements between contractors and unions – known as project labour agreements (PLAs) – related to renewables have been adopted by key actors in the US offshore wind power industry. In 2022, Ørsted, one of the world's largest offshore wind energy developers, entered into a National Offshore Wind Agreement with US building trades unions, in part to diversify the company's renewable energy workforce and to incorporate social and equity considerations into its work and hiring. The agreement sets a standard for wages, local training programmes, and workplace health and safety. In addition, Work Equity Committees are established for each project to prioritise hiring women, people of colour, local environmental justice communities and gender non-conforming people.

Other companies that have entered into or are negotiating PLAs include Dominion Energy, Vineyard Wind and Mayflower Wind. Vineyard Wind´s PLA includes hiring targets for women and people of colour, while Mayflower Wind is committed to hiring a diverse workforce and paying prevailing wages.

Source: See endnote 36 for this module.

In the United States, the Inflation Reduction Act provides tax credits for domestic production of offshore wind turbine components, electric vehicles and battery components. In 2022, the US Department of Energy announced investment grants totalling USD 52 million for 19 solar PV manufacturing projects in 12 states.[41] In addition, the United States applies import duties on solar PV modules and cells from most countries, whether to strengthen domestic manufacturing capacity or in response to human rights issues in some exporting countries.[42]

In Australia, the parliament approved plans in March 2023 to establish an AUD 15 billion (USD 10 billion) national reconstruction fund to support domestic manufacturing of solar panels, batteries and hydrogen electrolysers.[43] In Brazil, developers are eligible for low-cost financing from the country's development bank only if they use local equipment.[44] Jordan has a requirement for up to 35% local content in solar PV projects, which can be fulfilled by procuring the necessary value of the project through local contractors even if the products and services are being imported.[45]

Between 2020 and 2023, India's manufacturing capacity for solar cells and modules grew sharply in response to a combination of import restrictions and production-based incentive schemes for solar PV.[46] In September 2022, India approved a roughly USD 3 billion incentive package for manufacturing high-efficiency solar panels and imposed a basic customs duty on imports of solar PV cells and modules starting in April 2023.[47] In Kenya, as of January 2022, mini-grids that sell power to surrounding communities have received an extra 50% tax credit as part of reforms to the country's Finance Act.[48]

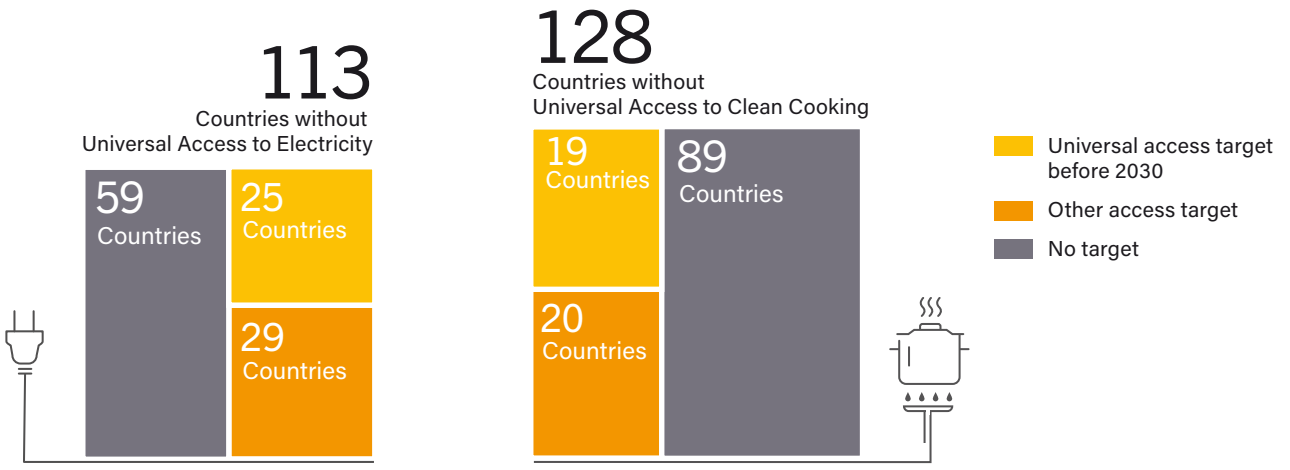
Several countries have introduced export bans on strategic renewable energy products, hoping to secure or strengthen their position in the global market. In 2022, countries that introduced export bans on unprocessed raw materials needed for the energy transition included the Democratic Republic of the Congo (DRC) (for lithium and cobalt), Indonesia (for nickel and bauxite) and Zimbabwe (for lithium and cobalt).[49] In early 2023, China banned the export of several core solar panel components, such as large silicon and black silicon, in the hope of maintaining its market leadership.[50] China dominates the solar PV supply chain by manufacturing most of the world's polysilicon, solar wafers and cells.

DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

In 2022, despite the numerous social, economic, and geopolitical challenges, investment in renewables reached a record high of USD 495.42 billion.[51] The installed capacity of distributed renewables for electricity access (DREA) also achieved record levels, with sales of solar PV products growing 24% and installed off-grid capacity growing 11% in 2022.[52] Even so, the number of people worldwide lacking access to electricity was projected to increase by 20 million during the year.[53]

Between 2010 and 2020, 45 countries achieved universal **access to electricity**.[54] However, 113 countries still lacked universal electricity access as of the end of 2022.[55] (→ *See Figure 1.*) Of these countries without access, 25 had set targets to achieve universal access to electricity by or before 2030, and another 29 had set targets to improve access; meanwhile, 59 countries remained without electricity access targets.[56]

FIGURE 1.
Countries Without Universal Access to Electricity and Clean Cooking, and Status of Targets, as of End-2022



Source: See endnote 55 for this module.

Although steady progress has been made in urban electrification worldwide, significant challenges remain for energy access in rural areas.[57] Renewable energy systems, particularly off-grid solutions, are generally considered the least-cost solution for electrifying the "last mile", or unserved populations in rural communities.[58] This is reflected in the widespread adoption of renewable energy targets for rural electrification.[59] As of May 2022, 34 countries had adopted such targets, mostly for off-grid solar PV.[60]

Strong quality standards play a key role in improving the affordability and reliability of decentralised renewables and supporting market development.[61] In 2021, quality standards for solar kits, developed by the World Bank's Lighting Global programme, became an official technical specification of the International Electrotechnical Commission (IEC) standards.[62] By 2022, six countries (Ethiopia, Senegal, Sierra Leone, Uganda, Zambia and Zimbabwe) had fully adopted the IEC standards, while three countries (the DRC, Papua New Guinea and Tanzania) were in the process of doing so.[63] Also in 2022, India published the Policy Framework for Decentralized Renewable Energy (DRE) Livelihood Applications, which established quality control standards and a strong monitoring framework (among other interventions) to support the adoption of new solar appliances.[64]

As temperatures rise in many regions, more countries are facing the need for chilling and space **cooling** solutions. As of 2022, 5 billion people were living in regions with significant space cooling needs, most of whom did not have access to the necessary means to meet those needs.[65] Space cooling is one of the fastest growing sources of electricity demand.[66] To meet this demand, more governments are creating National Cooling Action Plans (NCAPs), with 30 NCAPs at varying stages of development as of 2022.[67]

Interventions to improve energy access also include improving the non-electricity energy needs of households, especially for **cooking**. As of 2022, as many as 128 countries lacked universal access to clean cooking (more than lacked universal access to electricity).[68] (→ *See Figure 1.*) Of these countries, only 19 had official targets to provide universal access to clean cooking by 2030, while another 20 had less ambitious targets.[69] A total of 89 countries were without any targets for access to clean cooking.[70] While some countries are on track to increase access, others have struggled to achieve their objectives.[71]

The number of people without access to electricity was projected to increase by **20 million** in 2022.

Improving access to clean energy has clear gender implications.[72] (→ *See Snapshot: Haiti.*) Women are typically more exposed than men to the adverse health effects of cooking with traditional and polluting fuels (such as traditional uses of biomass, dung and kerosene), which are often the only affordable energy sources for the poorest households in developing countries.[73] Worldwide, nearly 4 million people die each year from diseases attributable to household air pollution.[74] Replacing wood and charcoal stoves with modern renewables in Sub-Saharan Africa could prevent an estimated 463,000 deaths annually and save USD 66 billion in health-care costs.[75]

Implementing policies for cleaner cooking options can lead to better health and more time for other activities, such as learning, leisure and development of small businesses.[76] Studies have shown that energy access increases the likelihood of women finding jobs by 9% to 23%.[77]

SNAPSHOT

HAITI

Solar Microgrids Empowering Women in Rural Communities

EarthSpark International, a US-based organisation that develops business models to overcome energy poverty worldwide, is applying a gender perspective in its efforts to provide solar PV systems in Haiti, where access to electricity is very limited. The organisation operates two smart microgrids in Les Anglais and Tiburon, providing 24-hour electricity generated mainly by solar PV systems combined with battery storage. The Tiburon microgrid, launched in 2019, operates with 100% solar energy and on-site battery storage, serving around 2,000 people.

Haiti has the lowest electrification rate in Latin America and the Caribbean, with as much as half of the population living without electricity. In rural areas, electrification rates are even lower, below 15%, and the population subsists using kerosene, candles and charcoal. These low-quality energy resources are not only expensive – costing households up to USD 20 a month – but also inefficient and harmful to human health and the environment.

Since energy affects men and women differently, gender-differentiated needs and priorities should be considered in energy access. In particular, given the small number of end-users of mini-grids, each consumer has a significant impact on the economically viable operation of the system. EarthSpark's "feminist electrification" strategy seeks to integrate the needs and requirements of women. In rural Haiti, where local women are often under-represented in decision making, the organisation works with women's co-operatives and committees to involve women in infrastructure planning. EarthSpark also trains and employs local women in home electrical installations, supports female entrepreneurs and has helped introduce new productive uses of solar energy for agricultural processes, such as electric corn mills, corn threshers and fryers.

With USD 9.9 million in financing from the Green Climate Fund and other grants, EarthSpark plans to expand to 24 solar microgrids over a five-year period, supported by a strategy that identifies and responds to the specific needs of women in energy systems. Such gender-sensitive energy programmes that consider the differentiated dimensions of energy access help to increase productivity, job opportunities and local resilience. At the same time, integrating women's needs and requirements in mini-grid operations can improve the viability of rural electrification business models.

Source: See endnote 72 for this module.

INVESTMENT AND FINANCE

LOCAL SUPPLY CHAINS

Trends in renewable energy spending indicate a widening gap between advanced economies and the developing world. Although emerging and developing economies account for two-thirds of the world's population, they represent only one-fifth of global investment in renewables and one-tenth of global financial wealth.[78] Annual investment across all areas of the energy sector in emerging and developing countries has fallen by around 20% since 2016, and these markets face debt and equity costs that are up to seven times higher than in the United States or Europe.[79]

Among developed country advancements, developers in the United States can take advantage of investment credits and tax breaks under the Inflation Reduction Act that are worth up to 30% of the total project cost.[80] More than USD 70 billion in investment in clean technology manufacturing was announced between the Act's passage in August 2022 and late May 2023.[81] In Canada, the 2023 budget proposes a tax credit of 30% of the cost of any investment in new clean technology manufacturing.[82]

Also in 2023, the Africa Renewable Energy Manufacturing Initiative (AREMI) was launched with the aim of scaling up renewable energy manufacturing capabilities in Africa. The initiative aims to unlock up to USD 850 million in investments to advance a renewable energy manufacturing ecosystem across the continent.[83] The European Investment Bank agreed to invest USD 544 million in Namibia for the development of local mining and renewable hydrogen value chains, while modernising industrial capacities and driving socio-economic development in the country.[84]

In Asia, the Export-Import Bank of Korea announced an investment of USD 5 billion in loans and guarantees to advance domestic battery manufacturing.[85] In Japan, the Green Transformation initiative will direct up to USD 1.8 billion in subsidies for battery manufacturing.[86] Australia's National Reconstruction Fund, adopted in March 2023, will dedicate up to USD 2 billion to domestic manufacturing of solar PV, batteries, wind components and electrolysers.[87]

DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

The economic and social benefits of renewable energy are most apparent in the field of distributed renewables for energy access. DREA systems, which operate outside of a centralised electricity grid, provide basic services such as lighting and mobile charging that can have transformative effects on off-grid communities, breaking their dependence on costly fossil fuels and enhancing their social, environmental and financial resilience.[88] DREA is key in most regions to advancing progress towards Sustainable Development Goal 7 on clean energy.[89] Off-grid solar technologies are expected to be the least-cost solution for 41% of new household connections between 2020 and 2030.[90]

Cumulative investment in mini-grids for energy access rose from around USD 13 billion in 2018 to USD 16 billion in 2021.[91] In some countries, however, the higher costs of mini-grid components, linked with currency depreciation, have made investments in DREA projects less appealing to investors.

Solar PV products dominate the market for off-grid renewable energy solutions, accounting for 92% of overall investments between 2010 and 2021, with solar home systems being the most-funded technology.[92] Investment in off-grid solar PV solutions increased 63% in 2022 to reach an all-time high of USD 746 million.[93] Cumulatively, the off-grid solar sector has attracted around USD 3.1 billion; however, an additional USD 23.3 billion in investment is required to achieve basic universal access to electricity.[94] While the off-grid solar sector showed strong investment growth in 2022, the number of companies investing in the sector declined, with just a handful of prominent companies driving the overall increase in investment (such as Sun King, with USD 330 million in investment).[95]

Sub-Saharan Africa remains the primary destination for off-grid investment, attracting USD 2.2 billion between 2010 and 2021, or around 70% of the worldwide total.[96]

PROJECT FINANCING

Because many mini-grid and off-grid renewable energy projects in developing countries are not yet commercially viable, there remains a prevalent need for grants and funding schemes. The main actors in financing energy access globally are the United Nations Development Programme, the Green Climate Fund (GCF) and the World Bank, with billions of dollars in pledged projects. Although the GCF focuses mainly on climate adaptation projects, its Energy Generation and Access programme comprises 61 projects with total financing of USD 3 billion.[97]

In November 2022, the World Bank announced a new initiative to promote private investment in distributed renewables, calling for joint action by governments, private investors and development agencies to accelerate the pace of electrification in Sub-Saharan Africa.[98] The World Bank has an active portfolio of USD 2.7 billion for DREA, targeting electrification for around 40 million people.[99] In 2022, seven donor agencies provided total grant funding of USD 11 million for off-grid solar projects.[100] The Rwandan government's results-based financing approach, known as "RBF Window 5", launched a subsidy for low-income households in off-grid areas in 2020, which reduces the price of a solar home system by 45-90%; by April 2023, the programme had connected some 281,139 off-grid households.[101]

BUSINESS MODELS AND FINANCE MODALITIES

The emergence of distributed renewable energy has turned electricity users into "prosumers" who not only consume electricity but also produce, store and supply it back to the grid, empowering them to actively participate in electricity markets. This creates a variety of challenges for transmission and distribution system operators, requiring associated investments to make network balancing services more flexible. However, this also represents an opportunity to introduce innovative business models that can foster further deployment of renewable energy projects.[102] (→ *See Snapshot: Germany.*)

During 2010-2021, Sub-Saharan Africa attracted

USD 2.2 billion

of off-grid investment or 70% of the worldwide total.

SNAPSHOT
GERMANY

The Community Benefits of Wind Farms, Beyond Electricity

Mörsdorf, a village around 100 kilometres west of Frankfurt in Germany, has become a successful tourist attraction in recent years. This would not have been possible without the long-term income that community renewable energy projects bring to the village. Hundreds of thousands of people come every year to see and walk over a bridge suspended almost 100 metres above ground. The bridge was constructed for EUR 1.2 million (USD 1.3 million), and visitors can gain insights into wind energy and the development of the project that powers the village.

Mörsdorf produces three times more electricity than it consumes (exclusively from renewables, mainly wind power and solar PV). In 2021, the plant produced 337% more than the electricity demand of the village. Although the wind farms are owned by external companies, they are installed on municipal land, bringing in EUR 7.8 million (USD 8.3 million) annually from rents and taxes.

Source: See endnote 102 for this module.

Aggregation of distributed renewable energy enables smaller producers to access wider electricity markets. With the help of aggregators, these producers can combine their individual distributed projects to attain a similar capacity to that of a conventional power plant and sell that electricity in the wholesale market. Such ancillary services are important to ensure the stability of the power network and thus contribute to the system's flexibility, enabling smoother integration of distributed renewables.

Peer-to-peer energy trading creates a platform for distributed renewable energy producers that facilitates peer-to-peer transactions. This enables prosumers to sell their electricity to local consumers, creating additional revenue and increasing resilience due to a long-term income stream. For example, a school with a solar PV solution can sell its excess electricity to local consumers during weekends and summer holidays.

The **pay-as-you-go** (PAYGo) model replaces fixed regular payments with payments for the direct use of a service, often combined with a package of appliances associated with electricity supply. PAYGo models encourage controlled energy use and increase agency over one's energy spending. The model favours deployment of distributed renewables, as payments can be made in smaller amounts and in off-grid areas. Dominant companies in the off-grid solar field and their offerings include the following:

- M-KOPA, which operates in East Africa, uses a PAYGo approach to offer three sizes of solar home systems and solar fridges for small businesses, as well as smartphones. For customers who have made reliable payments on a PAYGo product, the company also offers services such as clean biomass cookstoves, entertainment packages, and financial services such as cash loans and hospital packages.[103]
- Green Planet / Sun King is primarily a retail and maintenance company that manufactures solar home systems and also offers appliances. Its service centres are based in India, but the company is looking for distributors in Africa.[104]
- Zola offers a hardware solution with modular and versatile solar power, storage and inverter packages at several scales. In addition, it offers a software solution that generates data for both the customer and the distributor to monitor the fleet of operational devices. The company is looking for distributors in Africa.[105]
- d.light uses its PAYGo Atlas platform to enable customer management and payment processing for a range of smart solar appliances connected to the platform. It also provides access to mobile phones, which host the mobile payment solution and can be recharged through the solar appliances. The company relies on distribution partners that operate local sales networks.[106]

Community-owned projects enable a community to own a distributed renewable energy project in its vicinity, decreasing capital costs per person and avoiding the need for an external investor. This creates local value for the community with an additional revenue stream, as excessive electricity can be sold to the grid.

Energy communities are citizen-driven groups that organise collectively owned renewable energy projects. They offer a variety of benefits such as lowering energy bills for households, increasing energy efficiency and creating local job opportunities.[107] Energy communities enable citizens to directly participate in the energy transition and to benefit from the energy savings, increasing overall community engagement and societal support of renewable energy projects.

Energy communities can take the form of a legal entity such as a co-operative, association or non-governmental organisation. Some governments have sought to update energy regulation to allow for their future development. The Australian government, as part of its 2022 Climate Change Law, committed AUD 102.2 million (USD 70 million) to the Community Solar Banks Initiative.[108]

In 2023, the US Department of Agriculture announced USD 9.7 billion for rural co-operatives to create renewable energy, zero-emission and carbon capture systems through the Empowering Rural America programme.[109] In 2022, California enacted legislation authorising regulators to define a new community programme for the state.[110] By year's end, 13 US states had programmes to support community solar projects.[111] The US National Community Solar Partnership issued a roadmap for reaching 5 million community solar households by 2025.[112]

As of end-2022,

13 US states

had programmes to support community solar projects.

MARKET DEVELOPMENTS

EMPLOYMENT

In 2021, renewable energy employment increased to reach a record high of 12.7 million jobs.[113] (→ *See Figure 2.*) The solar PV industry remains the largest employer in the sector with 4.3 million jobs, followed by bioenergy with 3.4 million jobs in 2021 (down from 3.5 million in 2020).[114] Between 2020 and 2021, the number of jobs in hydropower increased from 2.2 million to 2.4 million, and wind energy jobs increased from 1.25 million to 1.4 million.[115] Employment in solar heating and cooling totalled 0.77 million and in "other" technologies totalled 0.43 million.[116]

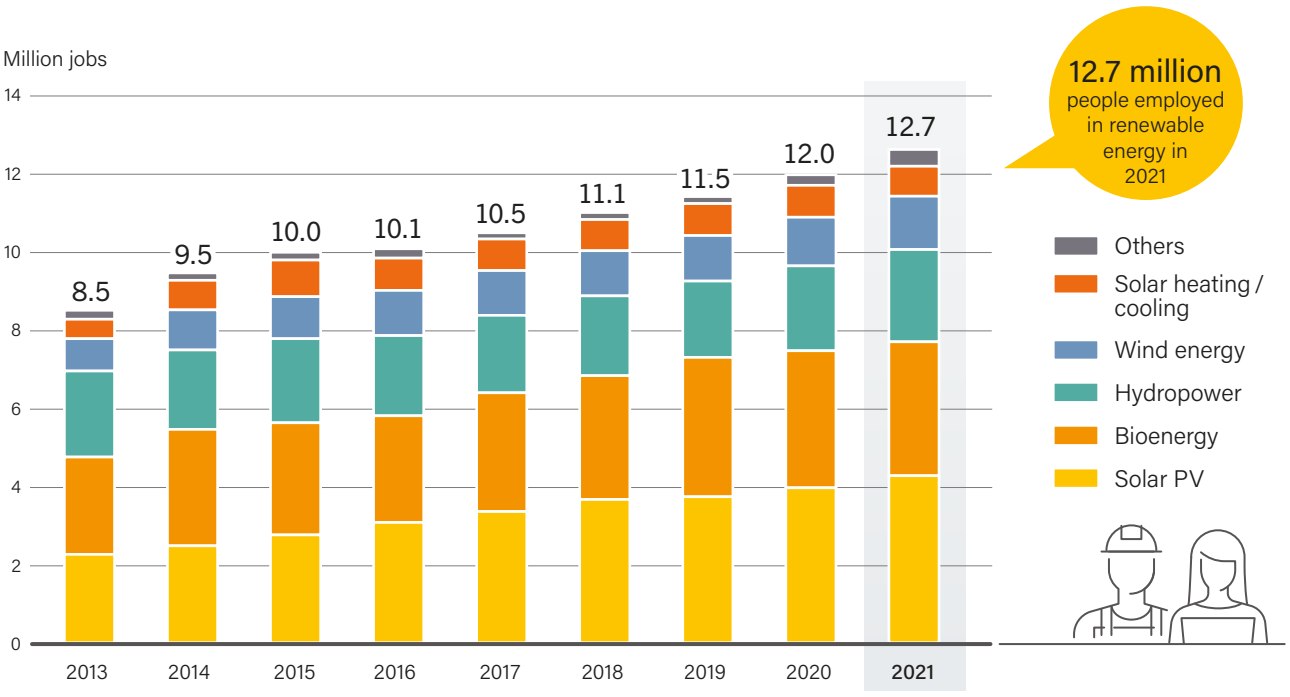
By region, Asia accounted for around two-thirds of all renewable energy jobs in 2021, while the Americas represented 21% and Europe 12%.[117] China was the largest renewable energy employer worldwide with 5.36 million jobs (42% of the global total).[118] Most of the jobs in the solar PV industry, around 3.39 million or 79%, were in Asia.[119] (→ *See Figure 3.*) China alone employed around 2.7 million people, representing 63% of the solar PV jobs in 2021.[120]

For bioenergy, the Americas accounted for 43% of the global workforce, closely followed by Asia with 39%, while Europe represented only 17%.[121] Around 70% of the jobs in hydropower were in Asia, with the remainder in the Americas (18%), Europe (7%) and the rest of the world (4.5%).[122] Asia had most of the wind energy employment, at almost 60% (China alone accounted for 47% of the total), followed by Europe at 25%, the Americas at 16%, and Africa and Oceania at 2%.[123] Solar heating and cooling jobs were concentrated in Asia, mainly in China with 636,000 jobs (82% of the total in 2021), down from an estimated 670,000 jobs in 2020.[124]

Women accounted for one-third (32%) of the renewable energy workforce overall in 2021, and the share of female employees in the solar industry is above average, at 40%.[125] However, most women in solar PV work in administration (58%), and across the energy sector the salaries of female workers remain 20% lower than those of men in equivalent positions.[126]

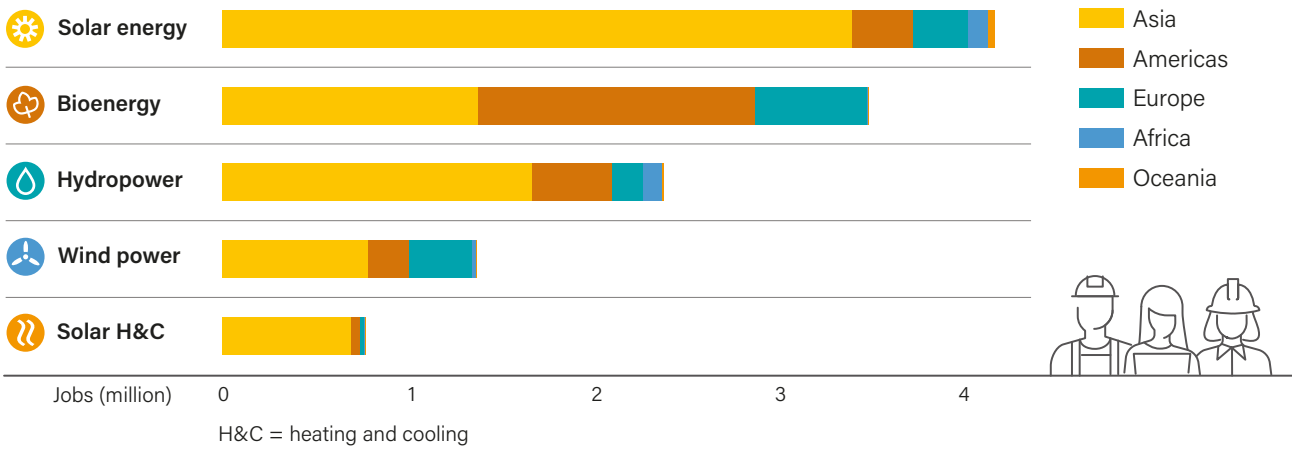
Although the COVID-19 pandemic led to a decline in employment in distributed renewable energy, the sector recovered quickly and in some countries exceeded pre-pandemic employment levels by 2021.[127] Of the estimated more than 500,000 direct jobs in distributed renewables worldwide, most are in African countries (374,000 jobs), followed by India (80,000).[128] In Nigeria, the estimated 50,000 jobs in distributed renewables are nearly equivalent to the estimated 65,000 jobs in the oil and gas industry.[129]

FIGURE 2.
Global Renewable Energy Employment, by Technology, 2013-2021



Source: See endnote 113 for this module.

FIGURE 3.
Global Renewable Energy Employment, by Technology and Region, 2021



Source: See endnote 119 for this module.

LOCAL SUPPLY CHAINS

Global clean energy manufacturing capacity showed strong growth in 2022, with robust expansion in batteries (72%), solar PV (39%), electrolysers (26%) and heat pumps (13%).[130] Wind manufacturing capacity grew much more modestly at around 2%.[131]

The diversification of renewable energy supply chains can **minimise geopolitical risks.**

Solar PV global manufacturing capacity rose nearly 40% to around 640 gigawatts (GW), with 90% of the growth taking place in China.[132] China is home to nearly 80% of the total manufacturing capacity, with Vietnam and India accounting for 5% and 3%, respectively.[133] India's solar PV manufacturing capacity more than doubled from 18 GW in March 2022 to 38 GW in March 2023.[134]

Diversification of supply chains is occurring as more countries opt to participate in the global renewable energy supply chain. Maxeom, a Mexico-based solar PV manufacturer, has completed the expansion of its solar PV module plant in Baja California, reaching a combined 2.5 GW with a workforce of around 2,000 people.[135] In June 2023, Germany announced a proposal for 10 GW of solar factories with a requirement to reduce the carbon footprint of the manufacturing process as manufacturers need to demonstrate a carbon dioxide (CO_2) footprint below 18 grams per kilowatt-hour.[136]

Battery manufacturing throughput totalled 340 gigawatt-hours (GWh) in 2021, and in 2022 this figure nearly doubled to reach 660 GWh.[137] Around 80% of the 2022 additions in manufacturing capacity were in China, with just over 10% in Europe and just under 10% in the United States.[138] France's first electric vehicle battery gigafactory was expected to start operation in summer 2023, creating an estimated 2,000 jobs as the country aims to become self-sufficient in vehicle battery production by 2027.[139]

Wind manufacturing capacity was around 100 GW in 2022, with China accounting for more than 60% of this capacity globally, followed by the EU (just under 15%) and the United States (10%).[140] Following years of expansion, the supply chain for the US domestic wind industry contracted in 2021.[141] However, the effect of the Inflation Reduction Act in 2022 was immediate, enabling the industry to begin to stabilise. Two GE subsidiaries announced plans to manufacture offshore wind parts in coastal New York, and at least six other companies are developing or expanding wind facilities around the country.[142]

For heat pumps, the global manufacturing capacity is just under 120 GW, with around 35% located in China, 25% in the United States and just under 20% in the EU.[143] Virtually all of the project announcements for heat pumps manufacturing are situated in Europe.

DISTRIBUTED RENEWABLES FOR ENERGY ACCESS

Electricity access worldwide changed little between 2019 and 2021, with an estimated 754 million people lacking access to electricity.[144] The impacts of the COVID-19 pandemic slowed progress towards the goals of universal access to clean cooking and electricity by 2030. In 2020, the number of people in Sub-Saharan Africa without electricity access increased for the first time since 2013, as many households were unable to pay their energy bills due to the impacts of the pandemic.[145]

Preliminary data suggest that in 2022, for the first time in decades, the number of people without access to electricity globally was expected to rise by 20 million to reach 774 million, reflecting the impacts of the pandemic compounded by high energy prices.[146] The rise was expected to occur mainly in Sub-Saharan Africa, home to around 80% of the people who lack access.[147] The African countries with the lowest shares of the population having access to electricity are South Sudan (7%), Chad (11%) and Burundi (12%).[148] Globally, the countries where the most people lack access to electricity remain Nigeria, the DRC and Ethiopia, where in total more than 230 million people are without access.[149]

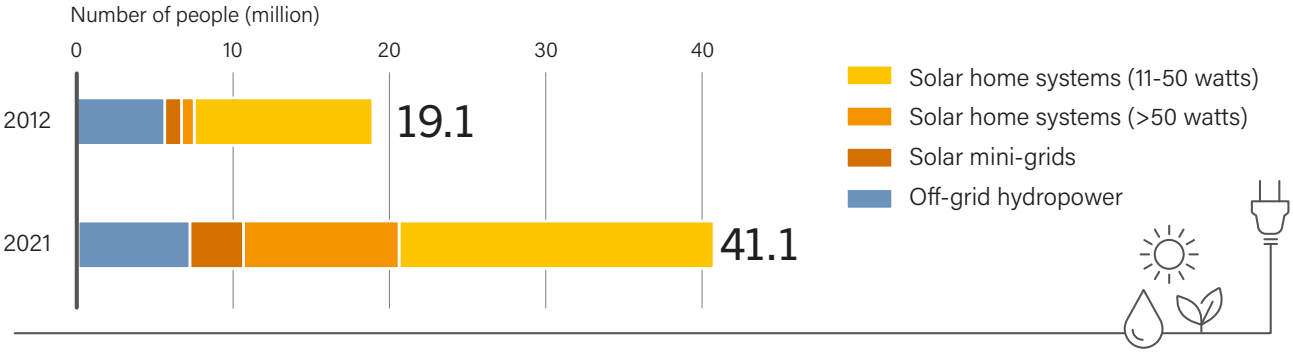
In 2022, 1.2 GW of renewable energy stand-alone systems (including renewable-based mini-grids and off-grid solutions) were added globally, for a total of around 12.4 GW.[150] Off-grid solar PV capacity grew by nearly 0.5 GW, with most of the increase occurring in Asia (nearly 0.4 GW) and Africa (less than 0.1 GW).[151]

Decentralised renewables are the fastest way to scale up electricity access and are also more inclusive.[152] The number of people gaining access to electricity through off-grid renewable-based systems[i] more than doubled from 19 million in 2012 to 41 million in 2021.[153] (→ *See Figure 4.*)

As of 2022, an estimated 48 million people globally were connected to around 21,500 **mini-grids**, for a combined capacity of 7,224 megawatts (MW).[154] Around half of the installed mini-grids are powered by solar energy, followed by hydropower (35%) and fossil fuels (10%).[155] South Asia accounts for 9,600 systems with a total capacity of 407 MW, East Asia and the Pacific for 7,200 systems with a total capacity of 1,530 MW, and Africa for 3,100 systems with a total capacity of 1,960 MW.[156] (→ *See Snapshot: Africa.*) By country, most mini-grid projects are in India (18,900), Nigeria (2,700), Tanzania (1,500) and Senegal (1,200).[157] Another

i Including solar home systems and mini-grids based on solar, hydropower and biogas.

FIGURE 4.
Population with Access to Electricity Through Off-Grid Renewable Energy Systems, 2012 and 2021



Source: See endnote 153 for this module.

SNAPSHOT

AFRICA

Africa Minigrids Program – The UN Development Programme's Energy Access Project

The Africa Minigrids Program (AMP) aims to improve access to clean electricity by reducing the cost and increasing the economic viability of renewable energy mini-grids. The AMP was officially launched at the 2022 United Nations Climate Conference in Egypt and is expected to run until 2027. Funded primarily by the Global Environment Facility, the project is being implemented by the United Nations Development Programme (UNDP) in collaboration with RMI and the African Development Bank.

Active in 21 African countries, the AMP seeks to adapt its implementation strategy to the specifics of the energy sector in each country. The programme strives to foster business model innovation, for example by supporting the digitalisation of mini-grids with innovative models such as pay-as-you-go. The AMP aims to unlock socio-economic benefits for vulnerable communities and to increase resilience to climate change by providing access to clean electricity.

Source: See endnote 156 for this module.

29,400 mini grids are in planning stages, for a total of 2,657 MW, with a potential to connect more than 35 million people, mainly in Africa (9,000 projects) and South Asia (19,000 projects).[158] Solar PV accounts for 99% of all planned projects.[159] Achieving universal access to electricity will require more than 217,000 new mini-grids by 2030, at a cumulative investment cost of nearly USD 127 billion.[160]

Electrification in Sub-Saharan Africa has been based largely on **off-grid solar PV products**. However, the high price environment, with rising inflation rates, has pushed up the cost of components for off-grid systems. In 2022, the costs of both solar and hybrid mini-grids increased by at least 20% on average compared to pre-pandemic levels.[161] Even so, sales of off-grid solar products have continued to grow. In 2022, the number of off-grid solar products sold globally increased by around 2.1 million to some 9.5 million units, of which 6 million were cash-only products[i] and 3.5 million were sold on a pay-as-you-go (PAYGo) basis[ii].[162] (→ *See Figure 5.*)

As in 2021, most sales in 2022 were in Sub-Saharan Africa, which recorded 3.5 million cash-only sales and 3.2 million PAYGo sales (60% and 91% of the respective totals).[163] However, these technologies offer a relatively low level of overall electricity access, since 82% of sales were for portable lanterns and small devices (0-10 watts-peak) and only 18% for solar home systems (above 11 watts-peak).[164]

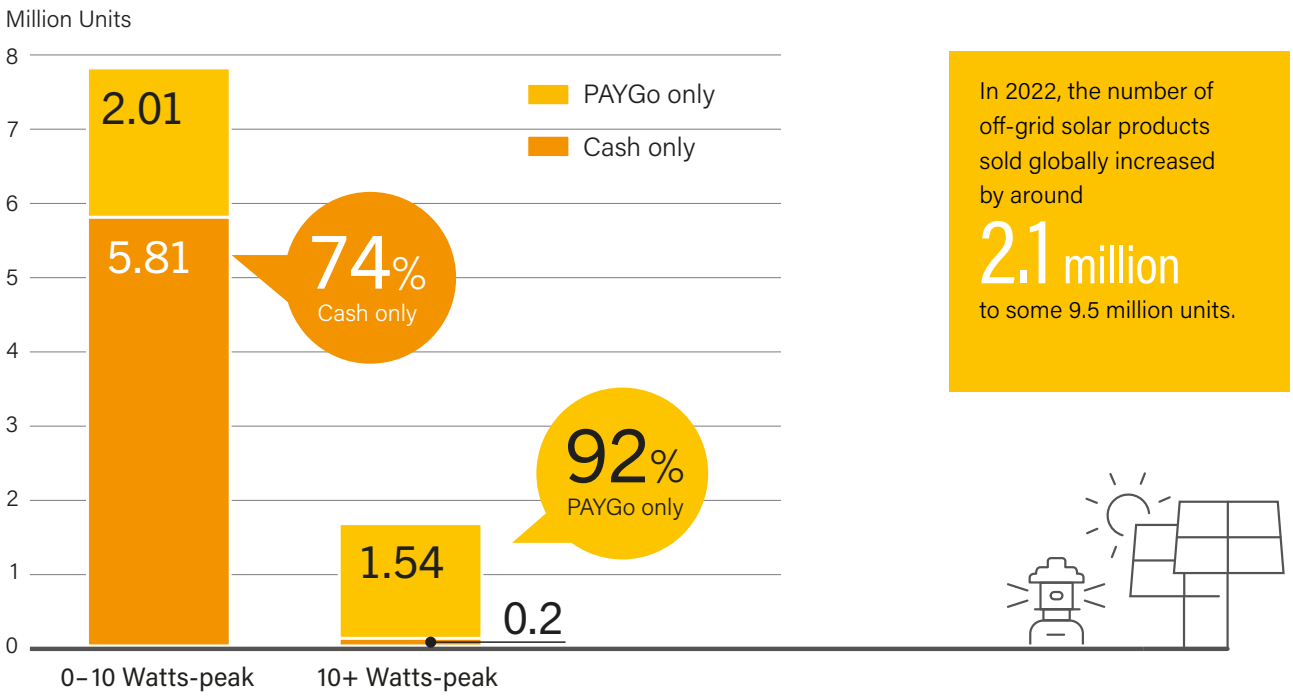
CLEAN COOKING

In 2021, 2.4 billion people lacked access to clean cooking worldwide, of whom 55% were in Asia and 45% in Africa.[165] Following the COVID-19 pandemic, the population without access to clean cooking was projected to grow as prices of liquefied petroleum gas (LPG) rose and as countries began to remove subsidy schemes for LPG and other fuels to reduce pressures on already tight state budgets.[166] Higher fuel prices have pushed some households to revert to using traditional (solid) biomass for cooking, including around 50 million people in the least-developed countries in Asia and Africa in 2020.[167]

Renewable energy can play an important role in providing access to clean cooking through solutions such as renewable-based electrification, solar thermal heat and modern bioenergy. In 2022, investment in clean cooking reached a record USD 200 million, although the sector remains heavily under-invested.[168] According to a recent report, investment in clean cooking companies remains in the tens of millions of dollars, well below the USD 4.5 billion of annual investment needed for the clean cooking industry to reach billions of people that still depend on polluting fuels by 2030.[169] In 2020 (latest data available), 88% of the capital going to clean cooking companies was from the private sector.[170] Although grants have been a common source of funding for clean cooking companies, the number of companies receiving grants has declined greatly in the last few years.[171]

i Cash sales include a single transaction to a customer. This category also includes products purchased by governments or humanitarian organisations.
ii With PAYGo, customers pay for a product in instalments.

FIGURE 5.
Volume of Off-Grid Solar Products Sold, by Size and Type of Sale, 2022



Source: See endnote 162 for this module.

Mechanisms to spur investment in clean cooking have expanded in recent years. In 2022, five companies in West Africa (three of them promoting technologies such as biogas, ethanol and improved biomass stoves) were added to the Venture Catalyst programme of the Clean Cooking Alliance, launched in 2021.[172] The Modern Cooking Facility for Africa programme, financed by Sweden and managed by the Nordic Environment Finance Corporation (NEFCO), aims to bridge a critical gap between early-stage support, traditionally offered by challenge funds and (impact) equity, and the concessional/commercial debt needed for scaling in Sub-Saharan African countries. In 2022, the first round included support to cooking service providers of electric, solar thermal, biogas and bioethanol stoves.[173]

Innovation in the clean cooking sector includes the introduction of metering technology in biogas, electric, and gasifier pellet stoves, which can play a potential role in the verification of carbon programmes and results-based financing programmes.[174] In 2021, the voluntary carbon offset programme Gold Standard approved a new methodology for certifying CO_2 emissions from modern cooking appliances, allowing verification using metered devices.[175] In 2022, the Clean Development Mechanism approved a proposal by Inclusive Energy to monitor and report carbon abatement in biogas digesters. The approval means that remote metering solutions can be used by Gold Standard and the United Nations Framework Convention on Climate Change to monitor and report carbon abatement.[176] Other tools for digital monitoring of household biogas cooking projects are being developed to demonstrate their use in cost savings, revenue gains and increased value for carbon offset projects.[177]

The growing use of PAYGo business models in the clean cooking sector has been reinforced by the development of metering technologies that allow real-time tracking of the fuel used, including electricity, (bio)ethanol and biogas. The Angaza software platform, which supports more than 200 distribution partners in over 50 countries, has integrated its PAYGo technology into more than 50 devices, including electric cook stoves and biodigesters; PAYGo cookstove sales registered on the platform have reportedly increased at a compound annual growth rate of more than 140% since 2017.[178]

Product diversification across fuel types continues to be a relevant strategy in the sector. For example, BURN Manufacturing, a charcoal stove manufacturer, has launched electric pressure cookers for grid-connected consumers in Kenya, and ATEC International, originally a biodigester company operating in Bangladesh and Cambodia, has begun offering magnetic induction cookers to grid-connected consumers.[179] Bundling and diversifying represent a valuable opportunity for cooking enterprises to capitalise on existing distribution networks, reducing customer acquisition costs, potentially increasing revenues and spreading risk among multiple business lines.[180]

Biogas could facilitate transitions to clean fuels in rural areas, but support is needed to cover the high upfront cost of biodigesters, the availability of sufficient feedstock, and training on use and maintenance.[181] A major recent development has been the entry of companies selling prefabricated modular biodigesters in African markets.[182] For instance, Sistema.Bio has sold more than 14,000 biodigesters, offering finance, after-sale service and training.[183] In 2019, the company raised USD 12 million in venture capital, followed in 2020 by a EUR 387,000 (USD 413,119) grant from EEP Africa.[184] In 2022, Sistema.Bio closed more than USD 15 million in financing to scale climate-smart clean energy technology.[185] More than 27,000 household biodigesters were installed in 2021 in selected countries in Asia and Africa, providing biogas for clean cooking and bio-slurry as organic fertiliser for agriculture.[186] In 2021, the installation rate rose 10% compared to 2020 and 7% compared to 2019 (pre-COVID).[187]

In 2022, Rwanda signed an agreement with KOKO network to establish a USD 25 million renewable cooking fuel utility, including setting up a network of bioethanol cooking fuel vending machines.[188] Households use a modern two-burner bioethanol KOKO Cooker with a smart KOKO Canister that enables access to a network of high-tech "KOKO Point" fuel ATMs, which are refilled by a fleet of Smart MicroTankers.[189]

CHALLENGES AND OPPORTUNITIES

CHALLENGES

- Although emerging and developing economies account for two-thirds of the world's population, they represent only one-fifth of global investment in renewables and one-tenth of global financial wealth.
- Women are still underrepresented in the renewable energy workforce with less than a third of total employment.
- For the first time in decades, the number of people without access to electricity is rising and more than half of the countries without universal access to electricity or clean cooking do not have targets to achieve this.
- Annual investment across all areas of the energy sector in emerging and developing countries has fallen by around 20% since 2016, due to the rising cost of debt and equity.

OPPORTUNITIES

- Countries are taking concrete steps to improve local supply chains for renewables to maximise the economic and social value from renewable energy. Regulations governing the use of locally produced materials are in place in more than 20 countries, including 7 advanced economies.
- Renewables are the most efficient and affordable way to achieve universal access to energy. The number of people gaining access to electricity through off-grid renewable-based systems more than doubled from 19 million in 2012 to 41 million in 2021.
- The energy transition is projected to result in a global net gain in employment, with more jobs created by ramping up renewable capacity than lost by phasing out fossil fuels. An estimated 70% of jobs in the oil and gas industry overlap with the skills needed for renewable energy jobs.
- Many governments are addressing the need to increase and diversify the renewable energy workforce, such as by offering programmes to train women, Indigenous Peoples and other marginalised groups.

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NOTES

ENDNOTES – RENEWABLES FOR ECONOMIC & SOCIAL VALUE CREATION

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