#Renewables4Climate

IRENA
International Renewable Energy Agency

RENEWABLE ENERGY BENEFITS: UNDERSTANDING THE SOCIO-ECONOMICS

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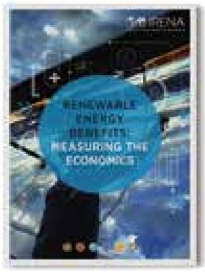
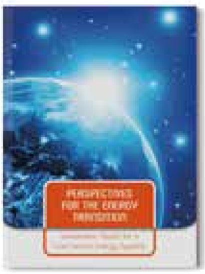


Sustainable energy solutions, including renewable energy, have sometimes suffered from the perception that they come with too many trade-offs, at the expense of overall socio-economic development. Undoubtedly, as governments around the world strive to put the 2015 Paris climate agreement into practice, they need to balance the urgency of the energy transition against numerous other considerations that affect people's welfare. Fortunately, renewable energy provides climate-safe solutions that also support a wide range of socio-economic benefits, including net job creation, health and greater social inclusiveness.

The International Renewable Energy Agency (IRENA) has analysed the socio-economic benefits of renewable energy since 2011. An initial focus on employment creation and skills was subsequently extended to cover aspects such as gross domestic product (GDP), broader measures of welfare, local economic value creation, improved livelihoods, gender and other benefits. The assessments include present-day global, regional[1] and selected national impacts, as well as projections to 2030 and 2050.

[1] *IRENA analyses the socio-economic benefits of achieving regional renewable energy targets in the Renewable Energy Market Analysis series on the GCC (IRENA, 2016a), Latin America (IRENA, 2017b) and South-East Asia (IRENA, 2018a forthcoming).*



Impacts on global GDP and welfare

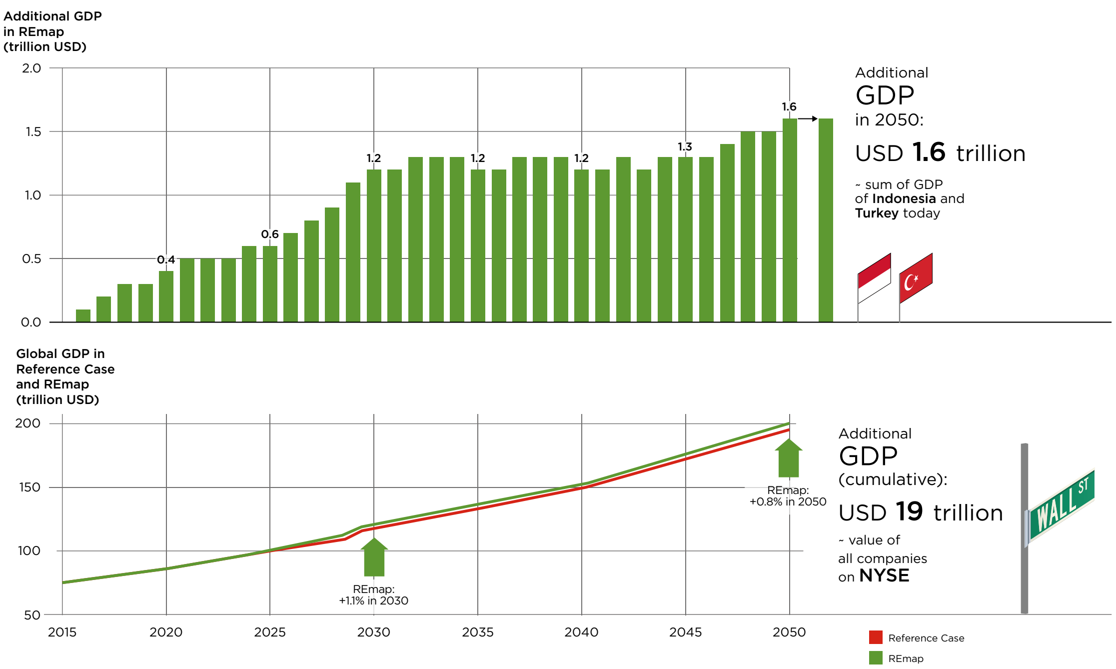
In addition to supporting climate stabilisation goals, a significant uptake of renewables and energy efficiency measures offers important macroeconomic benefits. In the analysis prepared under the German G20 Presidency, IRENA found that reducing global carbon dioxide emissions in line with the Paris Agreement would boost GDP by 0.8% in 2050, relative to a reference case (IRENA, 2017a). This translates into a cumulative gain of USD 19 trillion, roughly equivalent to the combined market capitalisation of all companies listed on the New York Stock Exchange (see Figure 1). The increase in economic activity is stimulated by the investment in renewables and energy efficiency as well as by enabling policies, including carbon pricing and the recycling of revenues from reduced income taxes.

However, indicators such as GDP alone do not capture the full spectrum of human welfare gains. A fuller accounting of benefits includes dimensions such as employment, health, education, reduced greenhouse gas emissions and changes in material consumption (see Figure 2).

Most immediately, welfare gains are the result of reduced negative externalities such as pressure on ecosystems (less mining of coal and less drilling for oil and gas) and impacts on human health (lower exposure to air and water pollutants stemming from fossil-fuel use). In addition, there are positive social impacts in the form of employment and income gains.

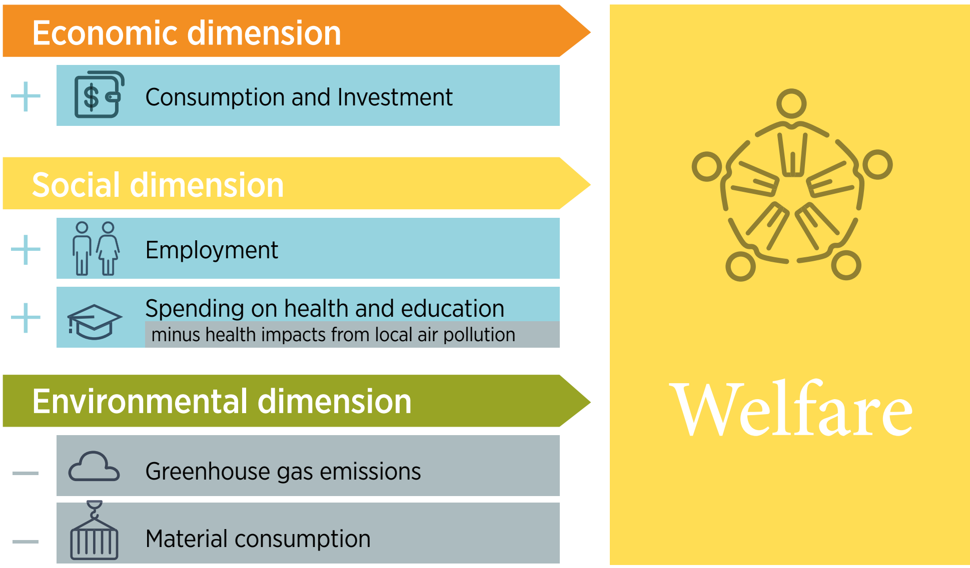
Increasingly, the deployment of renewable energy is recognised as a tremendous opportunity that helps to diversify a country's skill base, boost its industrial development and support societies' broad developmental priorities. According to IRENA estimates, the expected increase in human welfare from the deployment of renewables is close to 4%, far exceeding the 0.8% rate of improvement in GDP. Savings from reduced health and environmental externalities, which are not fully reflected in conventional economic accounting systems, far offset the costs of the energy transition.

Figure 1 Projected increase in global GDP to 2050



Source: IRENA, 2017a.

Figure 2 Welfare improvements – key dimensions



Source: IRENA, 2017a.

Because employment is essential for wage generation and thus for the well-being of individuals and their families, the creation and retention of jobs is of critical importance in any measure of socio-economic development. Wage and salary income – especially from well-paying jobs – permits people to make the purchases that translate into stable demand for goods and services, contributing to healthy local and national economies. The measure of employment thus goes far beyond direct jobs in the renewable energy sector and indirect jobs in the supply chain, also encompassing so-called induced jobs in the wider economy.

Growth in renewable energy jobs

IRENA's *Renewable Energy and Jobs – Annual Review* undertakes yearly estimates of global employment in the sector since 2013 The 2017 edition concludes that direct and indirect renewable energy employment has expanded to 8.3 million people worldwide. In addition, there are an estimated 1.5 million jobs in large hydropower (direct only), for a combined total of 9.8 million jobs. Large hydropower jobs have seen a decline in recent years, reflecting a slower pace of new installations and a rise in labour productivity (IRENA, 2017c, 2016c, 2015, 2014, 2013).

The energy sector as a whole is traditionally male-dominated. Findings from an IRENA survey (IRENA, 2016c) suggest that **women** at present represent on average **35% of the labour force** in the modern renewable energy sector – a share higher than in the conventional energy sector. An additional online survey conducted with partners at Bloomberg New Energy Finance and the Clean Energy Business Council (BNEF, CEBC and IRENA, 2017) focused on the Middle East and North Africa region. It confirmed findings from other parts of the world that women continue to face challenges due to a range of attitudinal and structural factors. These include a lack of background in the STEM (science, technology, engineering and mathematics) fields, dated perceptions of gender roles, discrimination in pay and the glass ceiling for managerial positions. Redressing the situation will require a number of initiatives, including offering greater flexibility in the workplace, policies to facilitate child raising, and greater support for women through mentorship and training.

Women in renewables still face workplace challenges due to entrenched attitudes and structural factors

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Renewable energy employment in selected countries

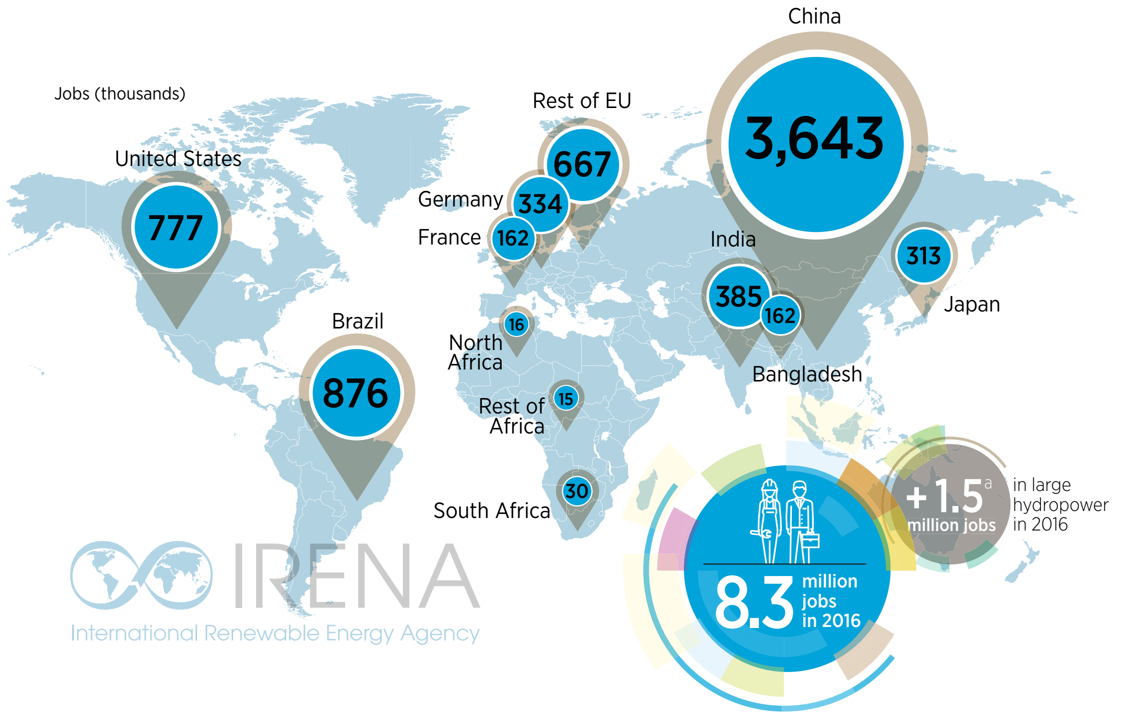
China, Brazil and the US are leading employers in the renewable energy sector (see Figure 3). Recent years have seen a considerable shift towards **Asian countries**, whose share of global renewable energy employment rose from 50% in 2013 to 62% in 2016. This shift is the result of two factors. Strong deployment policies have led to the emergence of dynamic domestic markets, and industrial policies have supported the growth of globally competitive manufacturing facilities, especially in the solar photovoltaics (PV) industry.

China remains the single largest employer with 3.6 million renewable energy jobs. In **India**, record deployment of solar and wind capacities has been driven by both national- and state-level policy instruments. Solar photovoltaic (PV) panel and module manufacturing is also taking off in **South_East Asian countries**, such as **Malaysia**. Others in the region, particularly Indonesia, Malaysia, Thailand and the Philippines, have been adding jobs in the biofuels sector.

Brazil has the largest number of biofuels jobs of any country, but mechanisation of sugarcane harvesting is limiting the growth of employment. In all of Latin America, around 2 million people are working in the renewable energy sector, with biofuels in the lead, followed by hydropower and by fast-growing wind industries in Brazil and Uruguay.

In the **US**, employment growth is driven primarily by wind and solar. Both industries benefit from multi-year extensions of federal investment and production tax credits, along with state-level net metering and renewable portfolio standards.

Figure 3 Renewable energy employment in selected countries, 2016



Source: IRENA, 2017c.

Several member states of the **European Union (EU)** were among renewable energy's early twenty-first century pioneers. However, competitive pressures and adverse policy changes, especially since 2008, have led to significant job losses in solar PV, while Europe's wind industry continues to be a global leader.

In other parts of the world, available information on employment remains limited. In **Africa**, IRENA estimates a conservative 62 000 jobs. South Africa, due to its successful auctions, is the largest employer, with Egypt, Kenya and Morocco making significant strides. Expanding energy access will help boost employment numbers.

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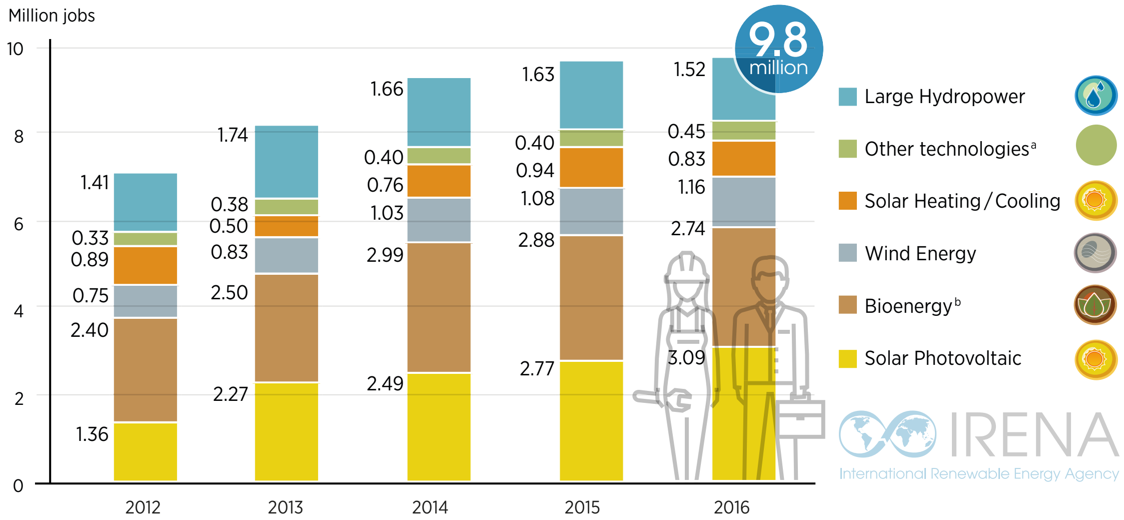
Employment and occupations by technology

At 3.1 million jobs, **solar PV employment** grew by 12% in 2016 and has more than tripled since 2011 (see Figure 4). The industry is followed by the liquid biofuels sector (growing at a slower rate of 3% to 1.7 million jobs), and by the wind industry, growing by 7% to 1.2 million jobs.

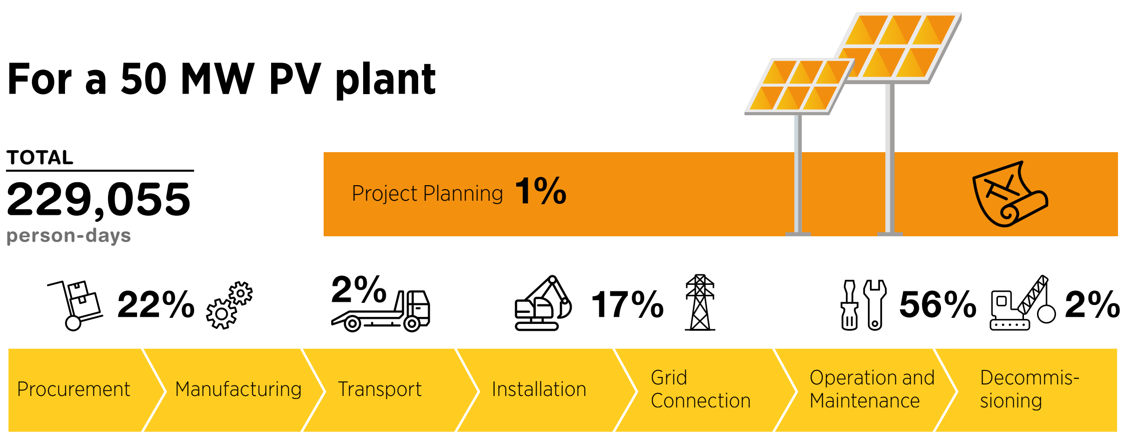
IRENA's *Leveraging Local Capacity for Solar PV* (IRENA, 2017d) analysed the occupational patterns and skills needs of a typical **50 megawatt (MW) solar PV project**. In total, some 230 000 person days are needed along the value chain (see Figure 5). Operations and maintenance account for 56%, manufacturing for 22%, and construction and installation for 17%. Construction workers (35 500 person days) and factory workers and technicians (32 000 person days) are among the most prominent occupations. Many of the occupations that can be filled locally – especially in construction – do not require highly renewables-specific skills and thus offer convenient entry points for employment.

Figure 4 Growth in global renewable energy employment by technology, 2012-2016



Source: IRENA, 2017b.

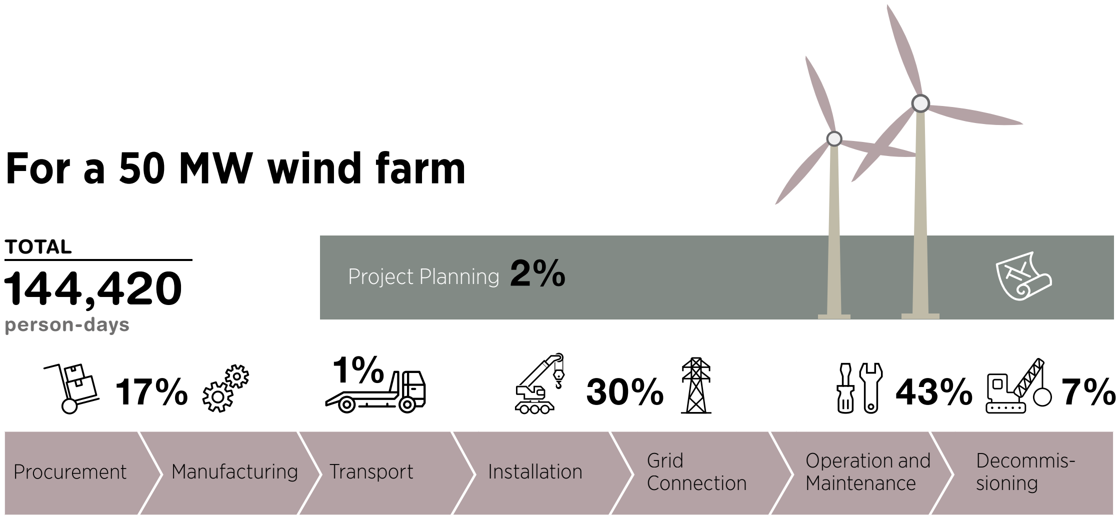
Figure 5 Employment impacts in the solar PV value chain



Source: IRENA, 2017c.

In the **wind power** industry, a strong pace of new installations – particularly in China, the US and Germany – resulted in a 7% increase in global employment to reach 1.2 million jobs. IRENA's *Leveraging Local Capacity for Onshore Wind* (IRENA, 2017e) found that a typical 50 MW project requires a total of 144 000 person days, with operations and maintenance representing 43%, construction and installation 30%, and manufacturing 17% (see Figure 6). Construction workers (26 600 person days) are the single largest occupational contingent, followed by factory workers (close to 12 500 person days).

Figure 6 Employment impacts in the onshore wind value chain



Source: IRENA, 2017d.

Occupational patterns and skills

As IRENA's Leveraging Local Capacity reports (IRENA, 2017d, 2017e) indicate, the renewable energy sector encompasses a broad range of occupations and skills requirements. Filling some of these positions can be a challenge. Indications are that skills gaps already exist and could grow as the sector continues to expand (IRENA, 2013). Unalleviated, this could hinder the smooth transition towards a cleaner energy economy, contributing to project delays or even cancellations, cost overruns and faulty installations, which could reduce acceptance of renewables.

In this context, better co-ordination of approaches and policies between the industry and the education sector, including the integration of renewables modules into training classes, is essential. Adequate public financing for renewable energy education and training also carries great importance.

To a certain extent, the renewable energy sector can draw on skilled personnel from other industries, such as semiconductors, electrical equipment, shipbuilding and glass manufacturing. The German experience suggests that former shipyard workers can apply their know-how to building bases and towers for offshore wind farms (Fornahl *et al.*, 2012; Hülsen, 2012).

The renewable energy sector can draw on skilled personnel from other industries

Some skill sets in fossil-fuel industries are transferable and adaptable to the renewable energy sector. Workers from the offshore oil and gas sector possess valuable expertise for offshore wind projects (CBI, 2012). Drilling experts from the petroleum sector can be employed in geothermal development. Further, the skills of electrical engineers, electrical technicians, electricians and information technology specialists employed in operating fossil-fuel power stations can be adapted to operating renewable power plants (EC and ILO, 2011). In the US context, research has found complementarities in occupational patterns and skill sets in the coal and solar industries (Louie and Pearce, 2016).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Net job effects and fossil-fuel job loss

As the energy transition accelerates, growth in renewable energy employment appears set to remain strong. IRENA's analysis finds that the sector could employ around 25 million people worldwide by 2050 (IRENA, 2017a). New job creation in renewables and energy efficiency would more than offset the job losses in the conventional energy sector. In fact, net energy sector employment would be higher by 6 million additional workers in 2050 compared to the reference case – the result of shifting investment patterns and differentials in labour intensities.

In recent years, the renewable energy sector has continued to create jobs, whereas the conventional energy sector has struggled to retain them. In the US, the solar PV sector added workers almost 17 times as fast as the overall economy during 2016 (Solar Foundation, 2017).

Rising automation, overcapacities, industry consolidation and shifts towards cleaner energy are resulting in job losses in the fossil-fuel sector. China is preparing for the layoff of 1.3 million coal miners (Yan, 2016); India's largest coal company has shed 36% of its workers since 2002/03 (Statista, 2017); and the coal industry workforce in Europe and North America has been shrinking for many years. The global oil and gas industry is also confronting job losses due to low oil prices and oversupply, with at least 440 000 people laid off in 2015 and 2016 (Jones, 2017).

Localising the value chain and ensuring community benefits

A number of countries have pursued policies to localise portions of the renewable energy value chain and thus to boost the domestic share of employment generation (Kuntze and Moerenhout, 2013). Local content policies typically require that a specified portion of a renewable energy project be sourced from domestic suppliers. To be successful, domestic content policies need to be part of a broader industrial policy to develop viable supply chains and supporting infrastructure; be linked to training and skill-building efforts; and be sufficiently attuned to technology trends and market dynamics.

Manufacturing of renewable energy equipment is concentrated in a limited number of countries. But the IRENA study on *The Socio-economic Benefits of Solar and Wind Energy* (IRENA and CEM, 2014) shows that in other parts of the value chain, more than half of jobs can be localised, in part by leveraging existing industries. Policy mechanisms are key to maximising the various socio-economic benefits of renewable energy development.

Localisation of the value chain is, to some extent, a precondition of generating community benefits – ensuring that a certain percentage of revenue streams flows to areas that host wind and solar farms or that are involved in providing inputs to the sector. But there are other ways to generate community benefits as well. An example is monetary payments to farmers on whose fields wind turbines are erected. For instance, US wind farms annually pay USD 222 million to rural land owners; more than 70% of this sum went to low-income counties (AWEA, 2016).

Experience in countries as diverse as Kenya (Waruru, 2016) and Mexico (Wood, Lorzano Medecigo and Romero-Hernandez, 2012) underlines the importance of awareness raising and prior consultation with host communities. In addition to providing local economic stimulus, tangible benefits that may be offered by a renewable energy project developer include the building of schools, clinics and roads; the drilling of water boreholes; and the provision of agricultural extension services.

Large-scale renewable energy projects are driven principally by national policy goals and industry interests, which do not always accord with the specific needs of local communities. To maximise socio-economic development opportunities and transformational change, policies and projects need to draw as much as possible on the local workforce, offer skills training programmes, and promote gender fairness and equality.

IRENA (2018b forthcoming) examines several case studies for evidence of such beneficial impacts. For example, the study points to Luderitz in Namibia, where the town council holds a 5% share in an adjacent wind farm and lease payments benefit the impoverished town's budget. Replicability is judged to be high, and a number of other town councils have indeed entered similar land lease arrangements with independent power producers.

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Expanding energy access

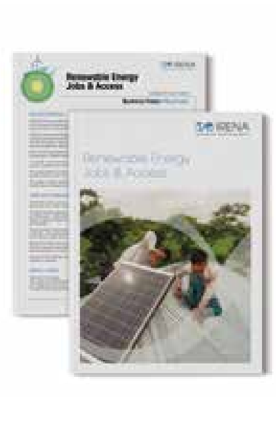
Renewable energy offers energy access in areas where grid extension is expensive or physically difficult. Access offers a range of socio-economic benefits, such as improved communications (mobile phone charging), which in turn facilitates economic transactions, assists in building rural markets and creates employment. Education and skills building are boosted by improved lighting in homes and schools. Also, energy access is important for improving health care (cold storage for medicines, use of medical equipment requiring electricity), and the use of clean renewables in place of highly polluting fuels reduces indoor air pollution (IRENA, 2012).

Sustaining the livelihoods of nearly 2.5 billion people, the agriculture sector is the single largest employer in the world. Increasing productivity and incomes in the agriculture sector is one of the most effective ways to fight poverty, stimulate socio-economic development and meet sustainable development goals. Energy is a vital input, but high cost, vulnerability to price fluctuations and lack of access to modern energy is coming at a tremendous cost – entrapping rural economies in poverty, contributing to food losses of nearly one-third of total produce and affecting food security. Access to affordable, secure and environmentally sustainable energy along different segments of the agri-food chain will be necessary to underpin future growth in the sector. Energy access will positively impact agricultural productivity, reduce losses, increase resilience to climate variability and eventually contribute to greater food security (IRENA, 2016d).

Benefits occur along the entire value chain, from food production (water pumping and irrigation) and the post-harvest stage (storage, drying, refrigeration) to agro-processing and retail (IRENA, 2016d).

Irrigation typically more than doubles agricultural yields compared with rain-fed farming. Replacing diesel-powered pumps enables considerable fuel savings, as India's experience shows: the deployment of 4 000 solar pumps led to savings of 2.4 million litres of diesel fuel (IRENA, 2016e).

Refrigeration and solar dryers can help prevent the spoilage of perishable foods. For agro-processing activities such as milling and grinding grains, replacing diesel generators with renewables permits considerable fuel and time savings. In Nepal, improved water mills saved around USD 750 per farmer per year for de-husking rice. Solar rice threshers in sub-Saharan Africa are six times as productive as manual threshers.



In food preparation, solar cookers, biogas and improved cook stoves reduce food and water contamination, factors that cause several hundred thousand deaths annually. Cleaner cook stoves and cooking fuels also minimise indoor air pollution, which kills almost 4.3 million people every year. Improved cooking technologies can result in reduced deforestation from fuelwood and charcoal production as well as reduced drudgery (in India, for example, average annual household savings on fuelwood collection is estimated at 660 hours). Country-level employment information is scarce in this context, but anecdotal evidence suggests significant potential for job creation (IRENA, 2012, 2013, 2014, 2016c, 2016d).

Renewables: The way forward

The multi-faceted socio-economic benefits of renewable energy have been gaining prominence as a key consideration for decision makers. The economy-wide impacts of the energy transition – employment, income generation, welfare improvements, gender balance and local industrial development – are becoming clearer.

In addition to the climate and environmental aspects of deploying renewable energy, maximising the social benefits is essential to ensure a just, timely and economically efficient transition. A just transition spreads the benefits of renewable energy broadly and enhances its overall acceptance in local communities and across societies.

To support an integrated approach to policy making related to renewables development, IRENA will continue to generate qualitative and quantitative evidence of the various benefits that can be generated and to analyse effective policies and appropriate business models.

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