IRENA QUARTERLY
Q2 2018

OFF-GRID ENERGY ACCESS ATTAINS NEW HEIGHTS

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New estimates show rapid growth in the numbers of people using off-grid solar and other renewable power.

About 115 million people worldwide currently rely on the very basic energy services provided by solar lights, while another 25 million obtain a higher level of renewable energy services through solar home systems or connection to a solar mini-grid. In addition to solar power, over 6 million people are currently connected to hydropower mini-grids, while another 300 000 people use biogas power.

Almost all the growth in off-grid power use has occurred in the last five years

The supply of electricity from mini-grids and small solar devices, such as solar home systems and solar lights is growing especially fast. This part of the energy sector, including power generation from these sources, is often missing from official energy statistics. But evidence of their growing importance can be seen in solar panel import statistics and development project databases.

During 2017, the International Renewable Energy Agency (IRENA) collected detailed data about off-grid power developments to determine global off-grid capacity. Data sources included biannual market surveys from the Global Off-Grid Lighting Association, the *OECD-DAC* development project database, national and regional power plant databases, off-grid data gathered via IRENA questionnaires, and information obtained from organisations such as REN21 and the Alliance for Rural Electrification.

Sources included market surveys, national and regional data, and off-grid data gathered via questionnaires

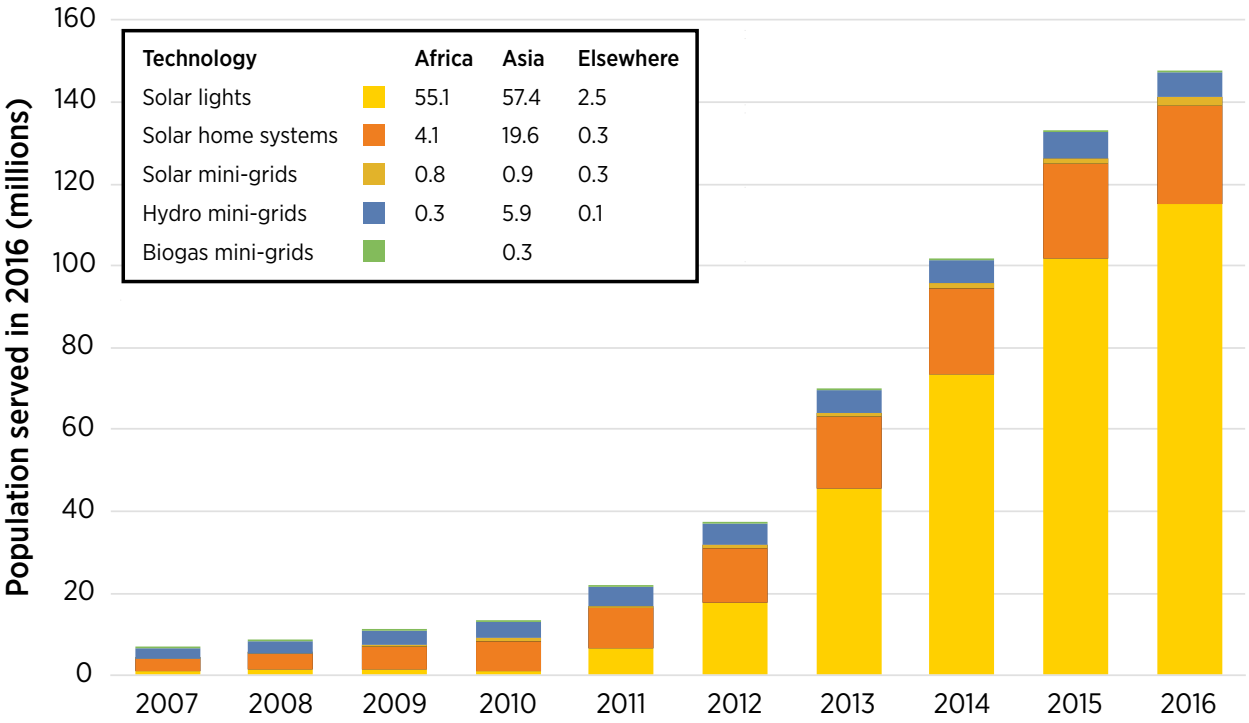
Sample data collected from these sources included information about 180 000 off-grid solar power plants and 650 records of annual sales of solar devices around the world. Together, these accounted for almost half of the off-grid solar photovoltaic capacity currently estimated by IRENA, based on import statistics. In addition, the exercise also obtained information about 40 000 off-grid hydropower plants and 100 off-grid biogas power plants, as well as records of the construction of almost 42 million biogas digesters reaching as far back as the 1980s.

The data was processed to account for such factors as the durability of solar systems and the different end-uses of power plants. An important part of this was to convert reported connection or use statistics into a standard measure of the number of people served by each type of plant. This was done to avoid over-estimation – when, for example, a report says that a village has been electrified, but only some residents are actually connected to the power supply.

Almost all of the growth in the use of off-grid power has occurred in the last five years (see figure). It has been largely driven by the increased availability and affordability of small solar devices, such as solar lights and lighting kits. These devices only provide lighting and low-power charging (e.g. for mobile phones) and do not provide a comprehensive range of energy services. However, only about 10% of the population served in Africa obtains the higher level of services associated with solar home systems and mini-grids, whereas in Asia the share is over 30%.

To learn more, see the IRENA publication:
Renewable Capacity Statistics 2018

Off-grid renewable energy users worldwide



Technology	Africa	Asia	Elsewhere
Solar lights	55.1	57.4	2.5
Solar home systems	4.1	19.6	0.3
Solar mini-grids	0.8	0.9	0.3
Hydro mini-grids	0.3	5.9	0.1
Biogas mini-grids		0.3	

Auctions drive rise of solar PV in sub-Saharan Africa

Renewable energy investment levels in low- and middle-income countries surpassed those of high-income countries for the first time three years ago. This important global shift could also be seen at the regional level in sub-Saharan Africa, thanks partly to the Republic of South Africa's successful auction programme. A series of auctions to procure solar and wind power allowed South Africa to join the top ten countries investing in renewables in 2015. Its investment reached USD 4.5 billion, more than three times the level in the previous year.

Worldwide, auctions are now growing faster than other well-known renewable energy policy mechanisms, such as feed-in tariffs or feed-in premiums. This is mainly motivated by interest in auctions as a competitive mechanism for price determination, combined with growing market interest in renewable energy technologies. South Africa's latest auction results have made solar photovoltaic (PV) and wind power cheaper than the average cost of power supply from the national utility and the cost of new coal-fired power stations.

Largely based on South Africa's success, auctions have emerged as the preferred tool to procure electricity and set renewable energy prices in sub-Saharan Africa. Between 2012 and 2016, installed solar PV generation capacity increased by a factor of ten across the region. Ghana, Mauritius, Uganda and Zambia have also run renewable energy auctions, while at least 15 more sub-Saharan African countries are developing such programmes.

Price outcomes for solar PV in these countries have been in line with, or even significantly below, global average prices. Like elsewhere, such results reflect growing technology maturity and falling technology costs, which are making renewables increasingly competitive with conventional generation technologies.

Auctions have emerged as the preferred tool to procure electricity and set renewable energy prices

Yet as experience shows, auctions need to be independently managed and transparent. They should be associated with well-designed power purchase agreements and other contracts. They should also be closely linked to wider national development policies. Socio-economic and environmental considerations, as well as the need to boost power supply, are valid reasons to hold renewable energy auctions.

Ugandan and Zambian auction schemes, like the latest South African scheme, ensure that site locations for power generation sufficiently reflect transmission needs and environmental factors.

For further insights on auction design, see:
Renewable Energy Auctions: Cases from sub-Saharan Africa

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Change is needed. Will the world act?


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Renewable energy needs to be scaled up at least six times faster for the world to start meeting the climate goals set out in the Paris Agreement. However, emission trends are not yet on track.

Today's policies, including Nationally Determined Contributions under the 2015 climate deal, fall far short of what is needed to limit global warming to "well below 2°C", compared to pre-industrial levels.

Currently, the world is set to exhaust its energy-related "carbon budget" in under 20 years. Fossil fuels, such as oil, natural gas and coal, look likely to dominate the energy mix for decades to come. To avert catastrophic climate change, the fossil-powered system built-up over several hundred years has to give way in a matter of decades to a system based mainly on renewables, coupled with significantly higher energy efficiency. Policy makers face the challenge of making this transformation happen fast enough.

Clearly, the world needs to plan more investment in low-carbon technologies. Cumulative investment in the energy system between 2015 and 2050 must increase around 30%, from USD 93 trillion under current and planned policies to USD 120 trillion with renewables and energy efficiency being scaled up faster, according to the latest assessment from IRENA.

Fortunately, such a transformation can create a world that is more prosperous and inclusive.

The cumulative gain in gross domestic product from faster adoption of renewables until 2050, compared to current policies, would amount to USD 52 trillion. The transition would cost far less than the savings gained from reduced pollution and environmental damage. Additional health- and environment-related savings could average USD 6 trillion annually by 2050 – more than three times the additional energy system costs resulting from decarbonisation in the same year.

The shift to renewables, moreover, would create 11 million additional jobs in the energy sector and boost overall welfare by an estimated 15%.

Renewables, in combination with improving energy efficiency, form the basis of any viable climate solution. The total share of renewable energy must rise from around 15% of total primary energy supply to around two-thirds by 2050. The share of renewable energy in the power sector will need to increase to 85%.

The energy intensity of the global economy, meanwhile, has to fall by about two-thirds, lowering total primary energy supply in 2050 to slightly less than 2015 levels. Improving energy efficiency makes this achievable, even with significant population growth.

For more, see: **Global Energy Transformation: A Roadmap to 2050**

Areas for action:

While the envisaged energy transformation is technically feasible and economically beneficial, it will not happen by itself.

IRENA has identified six focus areas where policy and decision makers need to act:

- Tap into the strong synergies between energy efficiency and renewable energy.
- Plan a power sector for which renewables provide a high share of the energy.
- Increase use of electricity in transport, building and industry.
- Foster system-wide innovation.
- Align socio-economic structures and investment with the transition.


Photograph: Shutterstock

Pakistan turns to renewables to boost power generation and energy access

Pakistan has abundant renewable energy resources that can be utilised to further its power generation and other energy needs. While hydropower has traditionally been the most prominent source of renewable energy, existing installed capacity remains far below the country's economically and technically viable 60 gigawatt (GW) potential. This includes significant potential to develop small-scale run-of-river hydropower.

Today, the primary energy mix relies largely on natural gas. But it also includes oil, coal and nuclear energy. Pakistan has little capacity to expand domestic gas production, and increasing demand has inevitably been met by imports. The share of oil in total primary energy supply has risen consistently since 2006, reaching 36% by 2016.

Nearly one-third of the country's oil demand is met by imports, making Pakistan vulnerable to global oil price volatility. The government has responded with a coherent strategy for the sector, aiming to establish enough reliable electricity supply to match today's demand.

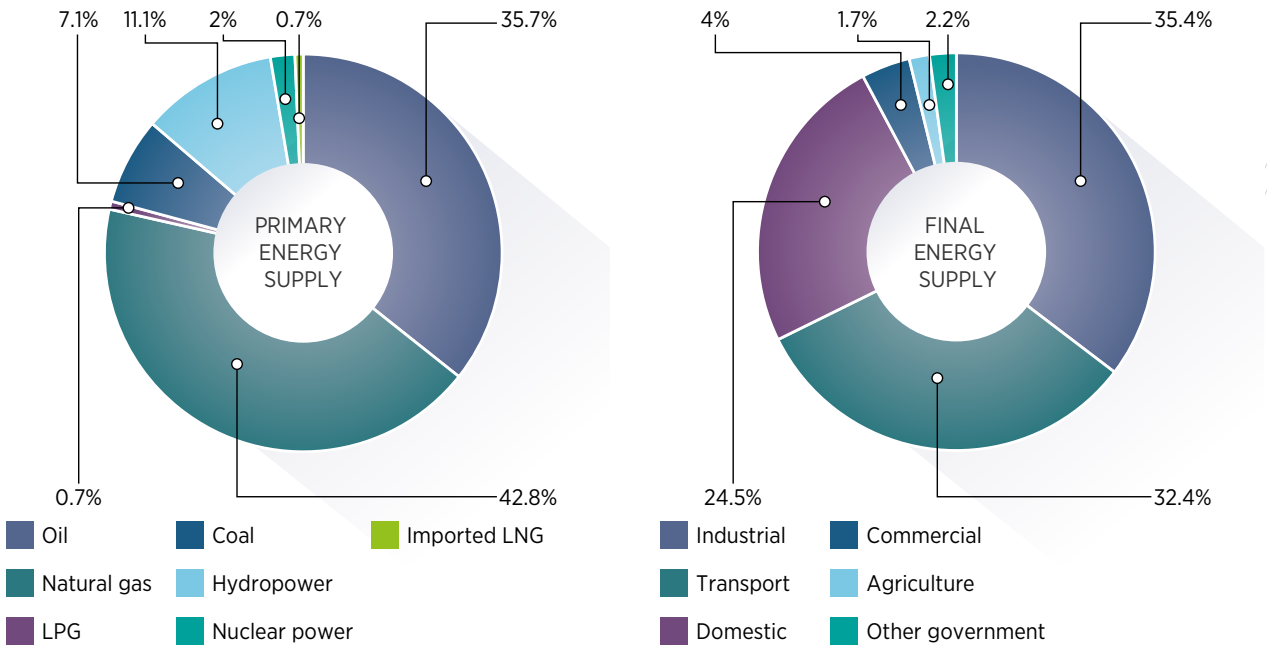
Pakistan, like other Asian countries, must keep its economy growing and meet the needs of a steadily growing population. Yet inadequate investment in power generation infrastructure, together with energy demand rising about 5% annually, could mean a return to power outages.

The federal government response has been to pursue low-carbon energy options, to bolster energy security and access, and to spur sustainable economic growth.

Pakistan, furthermore, has responded positively to the global call to tackle climate change, ratifying the Paris Agreement in 2016. Renewable energy technologies, in this context, have come to the fore in national planning and policy-making.

> The government has produced a strategy to establish reliable electricity supply

Pakistan's primary and final energy supply by source, 2015



Source: Hydrocarbon Development Institute of Pakistan (2016)

LPG = liquefied petroleum gas
LNG = liquefied natural gas

Pakistan introduced a comprehensive renewable energy policy in 2006, making private sector investment in the sector commercially viable. Over 1 200 megawatts (MW) of renewable energy capacity has been added as a result. Nevertheless, remaining technical, economic and implementation barriers inhibit further growth of the sector.

More than half of the population still resides in rural areas and relies on traditional biomass use, such as collecting and burning firewood. Only half of the country's rural people have access to electricity, leaving the other half highly exposed to indoor pollution from smoke.

Several provincial governments have introduced promising rural renewable energy initiatives. The federal government is also looking to boost off-grid renewables.

Plans to boost renewable energy supply form a key part of Pakistan's sustainable development agenda. The installed capacity of alternative and renewable energy sources in the power sector has already risen from 0.2% in 2013 to 5.2% of total installed capacity in 2018. Ongoing policy reforms, regulatory transformations, infrastructure development and investment incentives aim to ensure clean, cheap and continuous supply that includes a steadily growing share of renewable energy.

For more on the country's challenges and opportunities, see: **Renewables Readiness Assessment: Pakistan**


Photograph: Shutterstock

Finnish forests brimming with bioenergy

A key challenge for bioenergy production from forest biomass is sourcing. Feedstock is needed consistently, in sufficient quantity, in one place, to allow efficient conversion to heat and electricity at an industrial scale.

A new bioproduct mill in central Finland has overcome the sourcing challenge, making use of a range of residues from surrounding woodlands.

The Äänekoski bioproduct mill uses such wood residues to power its own operations; to supply electricity to the Nordic power market and district heat for the nearby town; to make standard products like pulp and turpentine; and to turn out high-value products like textiles, composites, fertilisers, and liquid biofuels.

In another case, a multi-fuel combined heat and power plant in southern Finland operates with 96% efficiency due to a flue gas condenser, which enables the plant to capture energy from moist fuel that would otherwise be wasted. A combined heat and power plant in eastern Finland produces pyrolysis oil from forest residues and sawdust, using a fluidised bed boiler to provide heat for pyrolysis and left-over gases to generate additional heat and power.

Other countries with abundant forests have also started realising they possess a staggering amount of renewable energy potential. Interest in forest biomass as a renewable energy source is rapidly growing, generating higher demand for biomass production from forest systems. Yet such countries often struggle with how to exploit this bioenergy reserve sustainably.

Finland's vast forest resources feed renewable-based industrial output, energy supply, economic growth and social well-being.

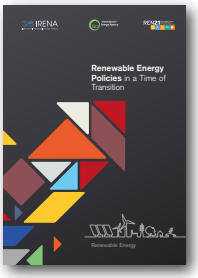
The annual growth of the forests in the northern European country has nearly doubled since the 1950s, and so has the amount of wood that can be sustainably extracted from those forests. Less than half of the country's roundwood harvest is used for heat and power. Meanwhile, unextracted forest growth and durable wood products continue to store carbon for years or decades.

Of the wood extracted, roughly half is used for products like lumber for buildings and pulp for paper, while the other half is used for energy in highly efficient district heating systems and combined heat and power plants. Most of these combust wood directly, but the most modern district heating systems use fluidised bed technology to gasify a wider range of forest residues.

For more, see: **Bioenergy from Finnish Forests: Sustainable, efficient, modern use of wood**

Photograph: Shutterstock

Recent publications

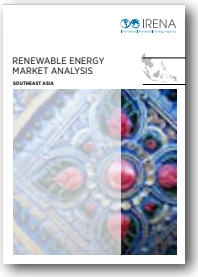


Renewable Energy Policies in a Time of Transition

This report, prepared jointly by IRENA, the IEA and REN21, identifies key barriers and highlights policy options to boost renewable energy deployment. It reviews current policies and targets worldwide, providing a comprehensive overview of policy measures to address challenges for renewables.

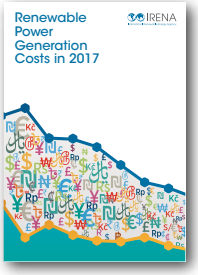
Renewable Energy Prospects for the European Union

The latest regional REmap study, prepared in co-operation with the European Commission, identifies cost-effective renewable energy options for all EU Member States, spanning a wide range of sectors and technologies.



Renewable Energy Market Analysis: Southeast Asia

Energy consumption in Southeast Asia has doubled in just over two decades. This regional market analysis examines the challenges of economic and population growth, the need to boost energy supply, and growing environmental and energy security concerns.



Renewable Power Generation Costs in 2017

Renewable energy has emerged as an increasingly competitive way to meet new power generation needs. This comprehensive cost report highlights the latest trends for each of the main renewable power technologies, based on the latest cost and auction price data from projects around the world.

www.irena.org/publications

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

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